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INDONESIA
IN A REFORMING WORLD ECONOMY:
Effects on Agriculture, Trade and the Environment

Kym Anderson, Randy Stringer, Erwidodo
and Tubagus Feridhanusetyawan (eds.)

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Acronyms

ACIAR	Aust. Centre for International Agricultural Research
AFTA	ASEAN Free Trade Area
AMS	Aggregate measure of support (to domestic agric.)
ANU	Australian National University
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BULOG	*Badan Urusan Logistik* (agency for centralised trading)
CASER	Centre for Agro-socioeconomic Research, Bogor
CEPT	Common effective preferential tariff
CIES	Centre for International Economic Studies, Adelaide
CSIS	Center for Strategic and International Studies, Jakarta
CV	Compensating variation in income (welfare measure)
ECOTECH	Economic and technical cooperation
EVSL	Early voluntary sectoral liberalisation
EU	European Union
GATT	General Agreement on Tariffs and Trade
GCE	Computable general equilibrium
GDP	Gross domestic product
GMO	Genetically modifies organism
GRP	Gross regional product
GTAP	Global Trade Analysis Project
IMF	International Monetary Fund
IRTS	Increasing returns to scale
KUD	*Kooperasi utama desa* (village cooperatives)
LDCs	Least-developed countries
MFA	Multifibre Arrangement
MFN	Most favoured nation
R&D	Research and development
RSPAS	Research School of Pacific and Asian Studies, ANU
TILF	Trade and investment liberalisation and facilitation
TRIPs	Trade-related intellectual property rights
US	United States (of America)
WTO	World Trade Organization

Preface

In the mid-1990s a joint research project was established between CASER (Bogor), CIES (Adelaide), CSIS (Jakarta) and RSPAS (at ANU, Canberra) to examine interactions between agriculture, trade and the environment in Indonesia. Funded by the Australian Centre for International Agricultural Research (ACIAR Project No. 9449), the specific objective of the project was to assess the production, consumption, trade, income distributional, regional, environmental, and welfare effects in Indonesia of structural and policy changes at home and abroad. Particular attention was to be paid to those structural and policy changes that could affect Indonesia's agricultural sector over the next 5-10 years. The implications of national and global economic growth, of regional and multilateral trade liberalisation initiatives, and of Indonesia's ongoing unilateral policy reforms were the initial focus of the study. However, with the onslaught of the financial crisis that began in the latter part of 1997, the project leaders added that issue to the research agenda.

The analysis draws on and adapts the global GTAP Model, which is a computable general equilibrium (CGE) model for the world economy within which there are sub-models for numerous individual economies including for Indonesia. The project began by also using a national CGE model for Indonesia, called INDOGEM, which was constructed in a previous ACIAR project by Ray Trewin and colleagues at the Australian National University (which in turn drew on a forestry-focused model developed by Philippa Dee of the Productivity Commission in Canberra). For the present project a more-detailed national economy-wide model was needed, however, if we were to get some idea of the regional and household income distributional and poverty consequences of policy changes. Hence ANU’s Peter Warr, with the help of some junior colleagues, created the so-called WAYANG model. This was based on the ORANI-G model for Australia developed by Peter Dixon and colleagues at Monash University’s Centre of Policy Studies, and uses GEMPACK software developed by Ken Pearson and colleagues (also at Monash). To all of those people we offer our thanks.

This volume brings together a subset of papers that have used those two CGE models as part of ACIAR Project 9449. Chapters 2 to 6 draw on various versions of the GTAP model, while Chapters 7 to 10 involve applications of various versions of the WAYANG model. Two technical appendices complete the book, one on each of those models. It is hoped that these applications will tempt other Indonesian economists to make use of these models for analysing other growth and policy reform issues in the years ahead. To encourage that, the WAYANG model has been documented by Glyn Wittwer and is available as Working Paper 99.10 "WAYANG: A General Equilibrium Model Adapted for the Indonesian Economy". The paper and the full model are freely downloadable from the CIES website, along with electronic copies of all the other main ACIAR project working papers, at www.adelaide.edu.au/CIES/indlist.htm

The project leaders are very grateful to all the participants in the project for their many and varied contributions. In addition to the modellers mentioned above they include Alan Powell of Monash University who served as a modelling mentor throughout the project; post-graduate students who contributed papers to the project even though their scholarships were not funded by ACIAR (particularly Adelaide's PhD student Anna Strutt and M.Ec. student Johanna Croser, each of whom have chapters in this volume); numerous support staff at CIES, CASER and CSIS who administered the project, organised workshops, published the working papers and periodic Newsletter, etc. (especially Adelaide's CIES Executive Assistants Zoe Ratcliffe, Jane Russell and Wendy Zweck and its School of Economics Administrators Kerry Braini and Silvia Schwarz); Peta Anderson, Jane Russell and Wendy Zweck who did the copy editing and typesetting of this volume; and ACIAR Program Managers Padma Lal and Ray Trewin who ensured the necessary funds kept flowing our way.

The Editors
December 2002

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1

Introduction

BY RANDY STRINGER, ERWIDODO, TUBAGUS FERIDHANUSETYAWAN AND KYM ANDERSON

For the quarter-century prior to the financial crisis of late 1997, Indonesia's economic performance had been, along with that of other East Asian countries, one of the best in the world. During those years Indonesia's real GDP grew at an average rate of more than 6 percent per year, inflation averaged less than 10 percent, and the incidence of poverty fell from three-fifths to one-seventh of the population. Significant structural changes accompanied that rapid economic growth, the nature of which raised important questions about its impact, together with that of Indonesia's agricultural, industrial, trade and environmental policies, on the sustainability of the country's development.

Up to 1997 all the forward-looking analyses aimed at understanding how to best address these structural changes had assumed the economy would continue growing at a strong pace into the future. The dramatic withdrawal of financial capital from Indonesia and the crash in the value of its currency from late 1997 meant that all these previous analyses needed to be revised. Also, the domestic policy emphasis shifted temporarily to emphasise basic concerns over unemployment, hunger and poverty, leaving concerns over the environment to richer countries' citizens.

Lots of important new questions emerged. How much difference would a few years of GDP decline in Indonesia make to projections of the structure of production, employment and trade? Might there be a re-agriculturalisation of the economy? How would the crisis alter the expected effects on Indonesia of implementation of the

WTO's Uruguay Round agreements, and hence on attitudes towards the efficacy of trade and other economic policy reforms? What would be the short and long term implications of the economic crisis on food security? How would the rupiah's devaluation impact on factor prices and food production? How would rural communities cope with thousands of urban unemployed returning to the countryside in search for jobs and food? Would trade reform at home or abroad reduce or add to the country's woes?

The chapters in this volume address these and related questions associated with the post-1997 financial crisis, as well as questions about the environmental consequences of a return to economic growth. They do so using two different economy-wide models, one national and the other global. A global model that provides a system-wide perspective is essential for assessing the impact on Indonesia of major economic shocks abroad, such as the implementation of WTO agreements, APEC or ASEAN initiatives, or ongoing reforms in former centrally planned economies. The national model complements that global one as it is able to provide more details of regional and household effects within Indonesia, including their impacts on poverty.

The next five chapters make use of the global, economy-wide model known as GTAP. The subsequent four chapters use WAYANG, which a general equilibrium model of the Indonesian economy named after the Indonesian puppet theatre. WAYANG was specifically developed for this project, but it has been fully documented and is freely available on the internet so as to encourage its continuing use.

A shared objective of all the studies reported here is to assess the efficiency, distributional, and welfare effects of structural and policy changes at home and abroad that affect Indonesia's agricultural production and trade in the course of its economic growth and response to the economic crisis.

The chapters also share a common focus on agriculture. The agricultural sector is a key component of the Indonesian economy, accounting for large shares of GDP, government budgeting, employment, consumption and trade. In addition, two chapters

(Chapters 4 and 5) assess the environmental impacts on Indonesia of economic growth and trade policy reforms.

Policies affecting agriculture have significant impacts on the overall economy. Moreover, there are major linkages between Indonesian agriculture and environmental resources such as soils, forests and water, and between individual sector policies and the use of primary factors and intermediate inputs. Hence the most appropriate tool for such analysis is computable general equilibrium (CGE) modeling that is able to capture the intersectoral effects of growth and policy reform.

In Chapter 2, Strutt and Anderson use the GTAP model to examine how much difference a few years of GDP decline in Indonesia and other East Asian economies make to projections of structural change in Indonesia. In particular, they ask how the crisis alters the expected effects on Indonesia of implementation of the Uruguay Round, and hence attitudes towards the efficacy of that and subsequent trade policy reforms. The chapter begins by modelling the effect of the growth interruption on the economy in 2005 without and then with Uruguay Round implementation. Next, two alternative possible trade policy responses to the crisis are simulated: either Indonesia chooses to slow its trade reform program, or it chooses to liberalise its markets even further than it is currently committed to under the Uruguay Round.

The results show that both the growth interruption and the choice of policy response could have substantial effects on sectoral growth rates and hence structural change. Specifically, there could be a re-agriculturalisation of the economy. With the declining relative importance of the agricultural sector being temporarily reversed by the crisis, and with workers returning from urban areas to their family's village, the study suggests it is more important now than ever to examine ways to boost rural development. Trade and other policy choices are shown also to impact substantially on the level and sectoral distribution of output, wages, etc. The final section draws out some trade and sectoral policy implications of the findings.

In Chapter 3, Feridhanusetyawan, Pangestu, and Erwidodo use the GTAP model to measure the impacts of various regional trade liberalisation proposals on the economies in the Asia Pacific region including Indonesia. The objective of this chapter is to examine the potential gains or losses and to predict the changing trade patterns and resource reallocations that are expected to result from these liberalisations. The study focuses on Indonesia even though the model treats Indonesia as part of an interdependent world economy. Among the liberalisation scenarios considered are the combination of Uruguay Round, APEC and AFTA trade reforms.

The authors find that among the existing liberalisation commitments in the Asia Pacific region, the implementation of the two major commitments, namely the Uruguay Round and APEC, would greatly benefit Indonesia. AFTA, on the other hand, is expected to contribute little to economic welfare for Indonesia. The explanation is that AFTA creates but also diverts trade of ASEAN countries (which trade mostly with non-ASEAN countries). The authors conclude that Indonesia would be better to focus its attention on pursuing more open and non-discriminatory trade liberalisation through APEC or the new Doha Development Round of the WTO.

Strutt extends the GTAP model in Chapter 4 to include the effects of land degradation for the Indonesian economy. Soil erosion is one of the more significant environmental problems caused by agricultural production in Indonesia. This chapter simulates the off-site environmental damage and on-site productivity impacts of soil erosion, along with the standard intersectoral and interregional economic effects of trade liberalisation. It then analyses the welfare implications of trade policy changes where soil erosion occurs and land productivity is reduced.

The inclusion of erosion and land degradation in GTAP enables a fuller welfare analysis of the effects of economic policy changes. An important finding of this chapter is that with Uruguay Round trade liberalisation, the level of production and soil erosion rises in the coarse grain sector but falls in the non-grain crops and forestry sectors. Net land productivity changes appear to be positive, since a reduction in land use in the large non-grain crops sector would improve land productivity. Results for the non-marketed off-site effects of erosion, however, suggest that there may be a small increase in soil erosion in Indonesia with trade liberalisation. This is due to increased land use in the relatively erosive coarse grain sector. Even so, relative to the projected gain from trade liberalisation, the cost of damage caused by increased erosion appears low. Chapter 4 also attempts to make explicit some of the trade-offs between income growth (from trade reform) and environmental damage from land degradation. The results suggest that the economic welfare benefits offered by trade reform far outweigh the small overall impact on soil erosion in Indonesia. This does not imply that land degradation is not a significant problem for Indonesia, but it does suggest that Uruguay Round implementation is not likely to significantly worsen the problem, at least at an aggregate level. The most serious effects of land degradation are often location-specific (for which local studies, along with ongoing efforts to ensure domestic resource policies are environmentally sustainable, will be important whether or not there is further trade reform).

The GTAP model is modified even more in Chapter 5 with the addition of an environmental module to capture effects on air and water. In that chapter Strutt and Anderson provide estimates that make it easier to assess whether the standard gains from trade reform are sufficient to outweigh any loss in welfare due to added environmental damage that might accompany trade liberalisation. One aim of this empirical study is to foreshadow any need for environmental policy changes to accompany such reforms. With an environmental module attached to the Indonesian part of the GTAP model, it is able to project the world economy to 2010 and 2020 without and with trade reforms. The effects of structural and policy-induced changes in economic activity on air and water pollution in Indonesia are then measured. The results are able to apportion the contributions of changes in the aggregate level and composition of output, and in production techniques, to changes in environmental indicators.

This case study first looks at the effect of economic growth at home and abroad without any policy changes. It suggests that if Indonesia's present environmental policies remain unchanged, projected economic growth and structural changes over the next two decades would add to environmental degradation and resource depletion in the country. Strutt and Anderson stress that this conclusion is not an argument against economic growth. Rather, it is an argument for introducing and strengthening the enforcement of environmental and resource policies to internalise some of the externalities associated with output and consumption expansion. When optimal environmental (and other) policies are in place and are continually adapted to remain optimal over time, economic growth enhances social welfare. There may be more environmental degradation or further resource depletion, but at least those changes would be optimal from that society's viewpoint, given the actual or opportunity cost of avoidance or abatement.

Likewise, trade reform can contribute to environmental damage and resource depletion, but again that will not be nationally welfare-reducing so long as optimal environmental (and other) policies are always in place. The Indonesia case study in Chapter 5 suggests that trade policy reforms slated for the next two decades would improve the environment in some cases (at least with respect to air and water pollution) and could reduce the depletion of natural resources. Even in the worst cases, trade reforms would add only very slightly to environmental degradation and resource depletion even without toughening the enforcement of existing environmental and resource regulations or adding new ones. The increases in pollution, where they occur, are driven primarily by a small number of sectors. Thus they could be targeted with environmental policies to help reduce emissions. The economic gains from trade reforms and the scope for adopting well-targeted environmental and resource policies to reduce any serious damage are such that social welfare almost certainly is going to be improved by these liberalisations.

In the final study in this volume to use GTAP, Anderson, Erwidodo, Feridhanusetyawan and Strutt explore empirically in Chapter 6 the scope for further gains to Indonesia from liberalising agricultural markets in OECD countries. In addition, the chapter examines what is likely to be included in the next agricultural negotiations. It asks if the likelihood of the next WTO round delivering siseable agricultural protection cuts and benefiting the world's poor (the vast majority of whom are developing country producers) would be significantly greater if negotiations include protection cuts for other sectors. It also explores new issues on the WTO's agenda. Finally, the study assesses whether rule-making efforts to accommodate new issues should be de-linked from the agricultural negotiations on border measures, rather than simply included under the three headings used in the Uruguay Round Agreement on Agriculture (import market access, export subsidies, and domestic support).

The authors of Chapter 6 conclude that traditional agricultural market access liberalisation should continue to be the key priority issue for developing countries such as Indonesia. However, attention should focus also on reducing protection granted to manufacturing and services industries in developing countries themselves, as protection in those sectors bestows a significant anti-agricultural bias in many low- and middle-income economies, making it more difficult for them to benefit from the agricultural trade reform of OECD countries. As far as the multilateral agricultural agenda is concerned, the focus should be on further reducing agricultural protection, particularly in industrialised countries, so as to give developing country farmers better access to export markets. Chapter 6 also argues that care should be taken not to overload international trade agreements with too many new trade-related issues.

The WAYANG model of the Indonesian economy is developed in Chapter 7 by Warr and Thapa, who use it to run a series of simulations motivated by the post-1997 economic crisis. In particular, they address policy issues associated with the affordability of food for the poorest people, reflected in the special government measures targeting additional food subsidies, especially for rice, to the poorest households. In special market operations, rice is sold at prices equivalent to around 50 to 60 percent of normal market prices. As the depreciation of the rupiah continued during 1998, the subsidies grew and the gap between international prices and domestic rice prices increased. The level of rice imports also increased substantially.

Warr and Thapa find that the consumption subsidy on rice has effects on different consumers that are not identical to those that would be predicted on the basis of the share of rice in the total expenditure of these households. This is because household incomes are affected by the factor market consequences of the subsidies. In so far as domestic producer prices of rice are increased by consumption subsidies, the production factors used intensively in rice production enjoy increased returns. Households who own these factors therefore tend to benefit. The way factor markets respond depends on labour market conditions as well as how other factor markets evolve in the post-crisis environment. The authors point out that subsidies have to be paid for. The manner in which the government's outlay for the subsidies is met therefore also will influence the distributional consequences across households.

In Chapter 8, Bahri, Kustiari and Wittwer make use of the WAYANG model to help understand the ways in which nonrice food crops (maize, soybean and cassava) are affected by the financial crisis as well as by changes in research, development and infrastructure investments. The concern in this chapter relates to post-crisis policy changes involving greater regional autonomy, leading to decentralisation of development activities. The government's intent is to allow individual provinces to manage their own agricultural development programs.

Chapter 8 provides detailed background on secondary crop development in Indonesia and then models an all-input productivity increase for maize, soybeans and cassava. Output gains depend on both the assumed magnitude of productivity growth arising from a partial redirection of funds, but also on the ability of individual industries to export. Household income impacts are also analysed. Specifically, the modeling scenario results in all households gaining from productivity growth in secondary crops. The chapter's conclusions suggest that Indonesia would gain from a reallocation of research and development funding towards maize, soybeans and cassava.

In chapter 9 Erwidodo, Wittwer and Stringer examine how agriculture can contribute to overcoming the negative consequences of the crisis in the medium term. WAYANG is used to model the consequences of a real devaluation, productivity declines, and a loss of the country's endowment of some productive factors. The scenarios presented assume a degree of adjustment within the Indonesian economy. For example, the Indonesian government responded to the crisis by liberalising markets and by removing legislative restrictions on agricultural land use.

In the real devaluation scenario, WAYANG is used to predict which industries might win and which might lose from the real devaluation. A number of influences are considered to assess the magnitude of the gain or loss to a particular industry from a real devaluation. They include the export intensity of sales of the industry's output, the import intensity of production, overall cost changes, the fate of other industries intensive in purchases of the output of this industry, and the proportion of household sales in total sales. Among the results, the authors find that that real consumption declines by 14 percent for high income urban households and by 21 percent for rural households in agriculture with more than 1 hectare of land. As expected, export-oriented crops increase output in response to the devaluation, but the model highlights additional sources of growth for certain commodities. And any commodity reliant on households for a large proportion of sales suffers a substantial negative local market contribution, due to the negative effect of declining household expenditure.

In the final chapter, the WAYANG model's regional and household disaggregations are exploited further by Croser to provide more insights into the impacts of trade liberalisation on income distribution and on poverty. Of course trade measures are unlikely to be first-best instruments for achieving income distributional goals, but if it can be shown that trade reform is pro-poor, then that provides yet another reason to reduce trade barriers. And indeed Croser's results do suggest that removing Indonesia's trade barriers would reduce poverty and improve the welfare of the poorest households. But the results also suggest richer households would benefit more, so the gap between the rich and poor would widen within the country even though the poor would be better off in absolute terms. The poverty reduction effect of trade reform is even stronger when perfect competition is replaced by the more-realistic assumption of increasing returns to scale and imperfect competition.

The volume concludes with appendices that provide some details of the two economy-wide models exploited in these studies: the WAYANG national model, summarised by Wittwer, and the GTAP global model, summarised by Strutt. It is hoped that by providing those details, other analysts will be inspired to put these models to work in analysing new development and policy issues as they arise in Indonesia or other developing countries.

2

Effects of growth, its interruption, and the Uruguay Round on Indonesian agriculture

ANNA STRUTT AND KYM ANDERSON

All of the forward-looking analyses of East Asia's economies of the decade or so to mid-1997 had been premised on the assumption that rapid national output and trade growth would continue. The dramatic withdrawal of financial capital from the region and the crash in the value of local currencies from late 1997 meant that such analyses needed to be revised. How much difference would a few years of GDP decline in Indonesia and other East Asian economies make to projections of structural change in Indonesia, for example? Might we even see a re-agriculturalisation of the economy? In particular, how will the crisis alter the expected effects on Indonesia of implementation of the Uruguay Round, and hence attitudes towards the efficacy of that and other economic policy reforms?

To help answer these questions, this chapter uses a global, economy-wide model known as GTAP (Hertel 1997). That model was used recently to project the implications of economic growth and Uruguay Round trade policy reform at home and abroad for the structure of Indonesia's economy over the period to 2005 (Anderson and Pangestu 1998). We extend that work to consider the impact of an interruption to growth due to the current economic and financial crisis. We begin by modelling the effect of the growth interruption on the economy in 2005 without and then with Uruguay Round implementation. We then simulate two alternative possible trade policy responses to the crisis: either that Indonesia chooses to slow its trade reform program, or that it chooses to liberalise its markets even further than it is currently committed to under the Uruguay Round.

Results show that both the growth interruption and the choice of policy response could have substantial effects on sectoral growth rates and hence structural change. Specifically, there could be a re-agriculturalisation of the economy. Trade and other policy choices are also shown to impact substantially on the level and sectoral distribution of output, wages, etc. The final section of this chapter draws out some trade and sectoral policy implications of the findings.

Projecting structural change to 2005

Economic development and on-going policy reforms in Indonesia and other countries of the world will change substantially the level, composition, and location of production and consumption during the next decade or so. As in Anderson et al. (1997) and Anderson and Pangestu (1998), we project global economic growth and structural changes from the GTAP model's base period of 1992 to 2005.[1] This is done initially using 1997 World Bank GDP, labour force, investment and population projections, together with the GTAP Version 3 data base and model. That GTAP data base divides the world economy into 37 sectors and 30 countries or country groups, but for the present analysis it is aggregated to 23 product groups and to five regions: Indonesia, other developing APEC economies, the rest of the world's developing and transition economies, high-income APEC economies, and the other-high income countries (Western Europe).

To project future changes in the global economy, we present two alternative baseline scenarios, the first reflecting similar assumptions to those used by Anderson and Pangestu (1998), the second taking into account the possible impact of the current economic crisis in Indonesia and some of the other East Asian countries.

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[1] See Strutt (1998, Ch. 4) for details. The GTAP model does not include financial markets explicitly, so the focus is just on real variables in goods, services and factor markets and on trade and sectoral policy responses. For an empirical modeling analysis of the East Asian crisis in which financial markets and macroeconomic policies are the central focus, see for example McKibbin and Martin (1998).

First baseline scenario, 1992-2005

For the first baseline scenario we adapt growth rates from Anderson et al. (1997) and Arndt et al. (1997). The upper half of Table 2.1 reports the assumed rates of growth in factors and real GDP (from which the implied rates of total factor productivity growth may be derived) for the period from 1992 to 2005. Exogenous projections of each region's endowments of physical capital, unskilled and skilled labour, and population are utilized. These are based on combinations of historical data and World Bank projections of the growth in population, labour force, real GDP and investment.

For Indonesia, the assumed rates of factor and GDP growth in this first baseline scenario are, as in Anderson and Pangestu (1998), close to government expectations prior to 1998 and in line with past trends. Growth rates from Table 2.1 are applied to GDP, physical capital, unskilled labour, skilled labour, and the population level to simulate the cumulative change in them for 1992-2005. This gives our first baseline scenario.

Second baseline scenario: 1992-2005 with interrupted growth

The second baseline assumes that the current financial crisis in Indonesia and other East Asian economies will have a significant dampening effect on economic growth for several years. For the historic period 1992-1997, the same growth rates are assumed as above in the first baseline scenario; and from 2000 to 2005 we assume that the economy recovers back to initial projected growth rates. In the three years 1998 to 2000, however, this scenario assumes that, for Indonesia, physical capital shrinks about 15 percent and that this leads to job layoffs such that the amount of skilled labour employed as such shrinks by a similar amount and that jobs for unskilled labour cease to grow during those three years. Hence GDP falls by nearly a quarter over that period. We also assume GDP and factor growth rates average zero in other East Asian developing economies during that period, as detailed in the lower half of Table 2.1 for this second baseline scenario.

Table 2.1: Projected cumulative [and annual][a] percentage changes in GDP and factor endowments assumed for various countries, 1992 to 2005

Region	*Real GDP*	*Physical capital*	*Unskilled labour*	*Skilled labour*	*Population*
First baseline scenario					
Indonesia	130	153	29	241	20
	[6.6]	[7.4]	[2.0]	[9.9]	[1.4]
Other APEC developing economies	121	179	18	103	14
	[6.3]	[8.2]	[1.3]	[5.6]	[1.0]
Other developing and transition economies	49	41	29	961	28
	[3.1]	[2.7]	[2.0]	[5.3]	[1.9]
APEC high-income economies	45	67	11	93	11
	[2.9]	[4.0]	[0.8]	[5.2]	[0.8]
Other high-income economies	38	36	1	218	3
	[2.5]	[2.4]	[0.1]	[9.3]	[0.2]
Second baseline scenario					
Indonesia	48	75	22	120	20
	[6.6]	[7.4]	[2.0]	[9.9]	[1.4]
	(-8)	(-5)	(0)	(-5)	(1.4)
Other APEC developing economies	84	120	14	72	14
	[6.3]	[8.2]	[1.3]	[5.6]	[1.0]
	(0)	(0)	(0)	(0)	(1.0)
Other developing and transition economies	49	41	29	961	28
	[3.1]	[2.7]	[2.0]	[5.3]	[1.9]
APEC high-income economies	45	67	11	93	11
	[2.9]	[4.0]	[0.8]	[5.2]	[0.8]
Other high-income economies	38	36	1	218	3
	[2.5]	[2.4]	[0.1]	[9.3]	[0.2]

[a] Numbers in square brackets refer to the total 1992-2005 annual growth rates in the first scenario; in the second scenario they refer to all but the 1998-2000 period, when the annual rates of growth in curved brackets apply.

Source: Author's calculations from Anderson et al. (1997) and Arndt et al. (1997).

Even with what might be viewed as a relatively conservative modification to Indonesia's growth rates (given that GDP in 1998 is expected to be down 15 percent in 1998), the 22 percent decline in GDP between 1998 and 2000 has a large projected impact on total cumulative GDP growth in Indonesia over the full period 1992-2005. Cumulative growth is reduced from 130 percent in the first baseline scenario to 48 percent in our second slower-growth baseline. This is because the growth from the first five years is almost completely wiped out by the negative growth assumed for Indonesia in the three years 1998-2000. Although the economy is assumed to resume rapid growth after 2000, it is from a much lower base than it would otherwise have been.

The changing structure of the global economy

The structural changes projected for 1992-2005 have implications for the shape of the world economy as economies and their factor endowments grow at different rates. The structural change projections in our first scenario will also cause large relative shifts in production in the Indonesian economy. These effects are less in our second, slower growth scenario, however.

Table 2.2 shows the changes in world output projected to 2005 in both the initial (2005) and the interrupted growth (2005ig) scenarios. The size of the world economy in the initial scenario is projected to increase by 43 percent between 1992 and 2005, but only by 40 percent in the Asian slowdown scenario. Under the initial scenario, the developing East Asian countries gain considerably in significance. Developing APEC economies including Indonesia were projected to increase their contribution to world output by around 55 percent before the crisis hit. However, in the second scenario where the crisis is taken into account, Indonesia increases its contribution to world output by only 7 percent and other APEC developing countries by only 33 percent.

The changing structure of the Indonesian economy, 1992 to 2005

All sectors in Indonesia can be expected to increase output between 1992 and 2005, even when growth is interrupted, according to the first two columns of Table 2.3. However, projected changes in the structure of production in Indonesia depend on the growth assumptions made. The on-going reduction in the importance of the agricultural and other natural resource based sectors is set to continue. This is shown by the numbers in parentheses in Table 2.3, which indicate the changing contribution to the composition of Indonesia's GDP. Even without the Uruguay Round being implemented, the projected contribution to GDP of each agricultural/natural resource industry would fall between 1992 to 2005, but each falls much less in the interrupted growth scenario (compare the parenthetic numbers in columns 1 and 2). That is, the economy does not move as much towards manufacturing and service sectors when growth slows. Sectors that significantly increase their contribution to GDP, though again less so in the interrupted growth scenario, include other unskilled labour-intensive manufactures such as textiles and clothing.

Table 2.2: Changing structure of global GDP, 1992, 2005 and 2005ig

(1992 US$ and percent)

	1992		**2005**		**2005ig**	
	GDP (US$b)	***% of world GDP***	***GDP (US$b)***	***% of world GDP***	***GDP (US$b)***	***% of world GDP***
Indonesia	128	0.55	287	0.86	192	0.59
Other APEC developing economies	1291	5.5	2831	8.5	2372	7.3
Other developing and transition economies	3103	13.3	4484	13.5	4464	13.7
APEC high-income economies	10828	46.5	15299	46.1	15261	46.9
Other high-income economies	7950	34.1	10319	31.1	10288	31.6
TOTAL	**23301**	**100**	**33220**	**100**	**32577**	**100**

Source: Authors' model results.

Table 2.3: Percentage changes in sectoral output (and cumulative changes in the compositional share of total GDP output) in Indonesia, 1992-2005, 1992-2005ig with and without Uruguay Round trade liberalisation

Sector	1992- 2005		1992-2005ig		Uruguay Round including Indonesia	Uruguay Round excluding Indonesia
Paddy Rice	59	(-31)	26	(-15)	-0.9	-1.1
Coarse grains	18	(-49)	9	(-26)	4.6	5.5
Non-grain crops	39	(-39)	13	(-24)	-3.5	1.1
Livestock	75	(-24)	29	(-13)	-0.3	-0.7
Forestry	69	(-26)	26	(-14)	-2.6	3.7
Fisheries	57	(-32)	13	(-23)	1.2	3.2
Coal	74	(-24)	36	(-8)	-8.2	4.3
Oil	73	(-25)	27	(-14)	-3.5	1.5
Gas	65	(-28)	25	(-16)	-3.6	1.5
Other minerals	78	(-23)	28	(-13)	-5.5	1.9
Food processing	58	(-31)	26	(-15)	-1.0	-1.1
Textile products	249	(52)	90	(29)	49.2	-30.4
Wood products	54	(-33)	20	(-19)	-5.2	5.7
Paper	186	(25)	65	(12)	-4.8	4.1
Petroleum and coal	149	(8)	50	(2)	0.4	-0.5
Chemicals, rubber & plastics	165	(15)	58	(7)	0.8	4.7
Nonmetallic minerals	159	(13)	63	(11)	-5.1	5.0
Other manufactured products	203	(32)	61	(9)	-13.3	8.2
Electricity, water and gas	158	(12)	54	(4)	1.9	-1.0
Construction	142	(5)	66	(12)	0.5	-0.6
Trade and transport	180	(22)	62	(10)	-1.6	1.3
Other services, private	173	(19)	58	(7)	-1.3	0.3
Other services, government	239	(48)	93	(31)	-0.4	0.0

Source: Authors' model results.

Table 2.4 summarises these changes in sectoral GDP shares. Note in particular that interrupted growth pushes projected shares of GDP in 2005 roughly half-way back to its 1992 level in the case of agriculture and food processing, compared with what would have been had the high economic growth rate of the past quarter century continued. The main reason for the differences between the two scenarios is given by Rybczynski (1955): in a comparative static situation, when the endowment of a subset of inter-sectorally mobile factors is reduced, the sectors using those factors relatively intensely will tend to shrink and other sectors expand, ceteris paribus. Since non-primary sectors use physical capital relatively intensely, and that factor is now relatively scarcer because of the crisis, the primary sectors' shares of GDP are higher and others are lower in the interrupted growth scenario (compare rows 2 and 3 of Table 2.4).[2] Real wages of unskilled workers are projected by our model to be in 2005 only 13 percent above those in 1992 in the interrupted growth scenario, compared with 51 percent above had high growth continued.

The effect of slower growth on the projected composition of exports is shown in Table 2.5. Agriculture and food's share of exports was expected to shrink dramatically over the 13-year projection period to 2005 as the light manufactures' share continued to grow, in line with past trends (c.f. the historical changes over two previous 13-year periods at the top of Table 2.5). But now with this interruption to economic growth, those changes are expected to be less.

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[2] The above results are not very sensitive to changes in factor intensities: boosting the share of value added by unskilled labour (and lowering capital's share) in those manufacturing sub-sectors the use that factor relatively intensely changes the effect of the growth slowdown on GDP shares by only a small fraction of one percent. The slump in petroleum prices in international markets in the latter 1990s, which is expected to continue into the new millennium (World Bank 1998), may well add to the re-agriculturalisation of the economy. The standard booming-sector theory in reverse tells us that a drop in the price of Indonesia's exports of energy raw materials (which had comprised about one-third of export earnings) would shrink the mining and perhaps non-tradables sectors but expand other tradables sectors, including agriculture (Corden 1984, Warr 1986).

Table 2.4: Sectoral shares of Indonesia's GDP, actual 1992 and 2005 under various scenarios (%)

	Agriculture and food processing	Other primary	Textile, clothing and leather manufactures	Other manufactures	Services	TOTAL
Actual 1992	21.9	15.7	3.7	13.8	44.9	100
Projected 2005 if no UR:						
-- high growth	18.6	16.5	5.2	14.1	45.6	100
-- interrupted growth (ig)	20.4	17.1	4.5	13.5	44.5	100
Projected 2005 with UR:						
-- high growth	17.7	15.87	7.5	13.4	45.7	100
-- interrupted growth (ig)	19.5	16.3	6.9	12.7	44.6	100
Additional policy changes (imposed on interrupted growth (ig) scenario for 2005)						
-- Indonesia reneges on its UR obligations	20.5	17.9	3.1	14.1	44.4	100
-- Indonesia further reforms trade	19.2	16.2	7.4	12.4	44.8	100
-- Indonesia reforms agricultural domestic policy	20.0	16.1	6.7	12.6	44.6	100

Source: Authors' model results.

Table 2.5: Sectoral shares of Indonesia's merchandise exports, actual 1992 and 2005 under various scenarios (%)

	Agriculture and food processing	Other primary	Textile, clothing and leather manuf	Other manufactures	TOTAL
Actual 1966	59.7	29.1	0.0	11.2	100
Actual 1979	17.0	73.0	0.7	9.3	100
Actual 1992	11.1	35.9	20.1	32.9	100
Projected 2005 if no UR:					
-- high growth	2.6	29.6	35.4	32.4	100
-- interrupted growth (ig)	5.1	35.1	28.1	31.7	100
Projected 2005 with UR:					
-- high growth	2.3	23.3	50.2	24.2	100
-- interrupted growth (ig)	4.4	28.3	43.3	24.0	100
Additional policy changes (imposed on interrupted growth (ig)scenario for 2005)					
-- Indonesia reneges on its UR obligations	5.7	37.8	17.6	38.9	100
-- Indonesia further reforms trade	4.6	26.5	45.4	23.6	100
-- Indonesia reforms agricultural domestic policy	5.8	28.1	42.3	23.7	100

Source: GTAP 4 data base (CGTA 1998) and, for projections, authors' GTAP model results.

Table 2.6: Agriculture and food processing exports and imports, actual 1992 and 2005 under various scenarios

	Exports (X, US$m)	Imports (M, US$m)	Trade specialisation index (X-M)/(X+M)	Self-sufficiency (%)	'Revealed' compara-tive advantage index[a]
Actual 1966	468	58	0.78	na	2.37
Actual 1979	3265	1498	0.37	na	1.14
Actual 1992	3774	2409	0.22	101	1.18
Projected 2005 if no UR:					
-- high growth	1768	6979	-0.60	93	0.30
-- interrupted growth (ig)	2503	4434	-0.28	95	0.60
Projected 2005 with UR:					
-- high growth	1907	8283	-0.63	91	0.25
-- interrupted growth (ig)	2595	5369	-0.35	96	0.48
Additional policy changes (imposed on interrupted growth (ig) scenario for 2005)					
-- Indonesia reneges on its UR obligations	2671	4488	-0.25	96	0.60
-- Indonesia further reforms trade	2885	5920	-0.34	94	0.49
-- Indonesia reforms agricultural domestic policy	3426	4979	-0.18	96	0.63

[a] Share of this product group in Indonesia's exports relative to its share in the value of world merchandise exports.

Source: GTAP 4 data base (CGTA 1998) and, for projections, authors' GTAP model results.

Table 2.6 details these trade changes for agriculture and food processing: the growth interruption lowers imports of those products dramatically, but boosts exports of them. Hence the index of agricultural and food trade specialisation (net exports as a ratio of the sum of exports and imports in value terms), which had fallen from 0.9 in the mid-1960s and 0.4 in the late 1970s to 0.2 in the early

1990s, is projected to fall by 2005 just to -0.28 under interrupted growth compared with -0.6 under high growth (see column 3). It means self sufficiency in those products falls from 101 percent in 1992 to just 95 percent instead of 93 percent as projected under high growth (column 4). Likewise, the index of 'revealed' comparative advantage in this product group, which had fallen from 2.4 in the mid-1960s to 1.2 in the early 1990s, is projected to fall only to 0.6 by 2005 under interrupted growth compared with 0.3 under high growth (column 5 of Table 2.6).

Uruguay Round liberalisation

To help users model the global policy reforms agreed to in the Uruguay Round, which are being implemented over the ten years to 2005, Version 3 of the GTAP database provides post-Uruguay Round protection vectors which draw heavily on the work of the World Bank (Hertel 1997, Chs. 13, 14). Import tariff levels in the model are lowered, as are domestic agricultural supports and agricultural export subsidies; and MFA quotas which restrict textile and wearing apparel exports from low-cost suppliers to the industrialised markets, represented in GTAP as bilateral export tax equivalents in the exporting LDCs in the GTAP database (Hertel 1997, Chs. 3, 15), are reduced by the appropriate amount to simulate removal of MFA quotas.[1]

Trade reforms, such as the implementation of the Uruguay Round, offer important opportunities for the Indonesian and other economies as we move into the next century. However, for Indonesia these gains are being reduced somewhat because of the financial crisis. As measured by an equivalent variation in income, the reduction is estimated to be $296 million per year.

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[1] Following Anderson et al. (1997). The starting point is the level of textile quotas as at 1992, which is the base year for Version 3 of the GTAP model. We assume that China will be fully integrated into the WTO by 2005 and hence, in our Uruguay Round simulation, that China reduces tariffs in accordance with the offer made by China to WTO member countries in late 1994 (Bach et al. 1996). Christian Bach generously provided post-WTO membership rates for China for the full disaggregated GTAP data base. These tariff reductions may be conservative, as the offer was unacceptable to the WTO members at the time.

The biggest gains from the Round are expected to go to the textile and clothing sector which, with the lifting of 'voluntary' export restraints under the MFA reform, would have increased its GDP share from 5.2 to 7.5 percent. The proportional increase in the interrupted growth scenario is similar, but from a lower base of 4.5 to 6.9 percent (column 3 of Table 2.4). That means the GDP shares for primary sectors, including agriculture, are lowered by the Round, but from a higher base in the case of the interrupted growth scenario. Agriculture's share of GDP falls by almost 1 percentage point, as does that of 'other primary' sectors, in both scenarios (compare rows 2 and 3 with rows 4 and 5 in Table 2.4).

In terms of export shares, Table 2.5 shows the huge expected changes to the composition of exports of manufactures should Indonesia indeed receive the expanded access to US and EU textile and clothing markets that are promised in the Uruguay Round Agreement. With interrupted growth, however, there is less expansion of the textile sector and hence less to gain from that part of the Uruguay Round reform. The sector's share of merchandise exports is thus expected to rise from 20 to 43 percent rather than to 50 percent between 1992 and 2005.[2] Primary sector export shares would be larger in that case, with agriculture's being nearly twice as large (falling from 11 percent in 1992 to 4.4 instead of 2.3 percent in 2005). Self sufficiency in food and agricultural products (production as a percentage of domestic consumption at market prices), which was 101 percent for Indonesia in 1992, would have fallen to 91 percent by 2005 with continued high growth and implementation of the Uruguay Round. The growth interruption raises that projection for 2005 to 96 percent (column 4 of Table 2.6).

The impact of altering Indonesia's trade liberalisation

When an economic crisis of the magnitude of that which hit Indonesia in 1998 occurs, governments tend to alter trade and sectoral policies in one of two directions: either they become more inward looking and raise protectionist barriers in an attempt to slow

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[2] Or less of course should the US and EU not open up as fully as has been promised. Even so, the 43 percent from textiles and another 24 percent from other manufactures would still mean Indonesia's share of exports from all non-food manufactures in 2005 was no less than that of Thailand in the early 1990s.

job losses, or they accelerate their policy reform agenda in the hope of trading their way out of increased poverty. This section examines the effects of both of these policy scenarios, compared with the 2005 data base with interrupted growth and assuming the Uruguay Round has been fully implemented by the rest of the world.

What if Indonesia does not liberalise as agreed in the Uruguay Round?

If Indonesia does not meet its Uruguay Round commitments, important growth opportunities will be lost. In this scenario we assume that Indonesia does not reduce its own tariffs as promised under the Uruguay Round, but still receives MFN status in markets abroad where Uruguay Round liberalisations are assumed to continue. These projections suggest a further reduction of US$0.7 billion per year in real GDP for Indonesia when it does not liberalise along with other WTO members. Should the US and EU deny Indonesia expanded access to their markets for textiles and clothing in retaliation for it not opening up as promised, however, Indonesia's would be lower by $3.7 billion rather than just $0.7 billion. In terms of equivalent variation in income, economic welfare is projected to be US$3.5 billion less in this latter case.

The changes in output for each sector from full Uruguay Round implementation, shown in the third column of Table 2.3, can be compared with column 4 which show what happens if Indonesia does not implement its Uruguay Round commitments and thereby does not get improved access to world textile and clothing markets. Indonesia then moves more resources into other sectors such as other manufacturing, natural resource intensive sectors, trade and transport, and grains.[3] Clearly Indonesia will lose significantly if it does not meet its Uruguay Round obligations, especially if that causes it to lose market growth opportunities associated with MFA quota removal. The impact on sectoral GDP shares is clear from Table 2.4: the textiles etc. share falls from 7 to 3 percent, and the primary sector's share rises nearly three percentage points. Export shares change in a similar direction but the changes are much larger,

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[3] This is likely to have severe implications for environmental damage and air pollution as these sectors are significantly more damaging than the textile sector (Strutt and Anderson 2000).

with textiles' share at 18 instead of 43 percent and the primary sector's share at 44 instead of 33 percent (Table 2.5).

What if Indonesia liberalises further?

By way of contrast, in the final two simulations we again start from a post-Uruguay Round scenario (2005ig). We first examine the implications of a further 25 percent reduction in import tariffs by Indonesia over and above its Uruguay Round commitments. With this further liberalisation, Indonesia's real GDP increases by an additional 0.4 percent or US$74 billion per year. Light manufactures and services would gain a bit more, with textile and clothing output 7 percent higher while other manufacturing and the natural resource-intensive sectors tending to decrease output slightly with this further liberalisation. Total exports and imports for Indonesia increase by almost 7 percent, on top of the increase from Uruguay Round liberalisation. Agriculture's share of those exports is slightly higher than in the ig scenario along with textiles', at the expense of the other sectors' shares (Table 2.5). The greater volume of food imports means that self sufficiency in agriculture and food is slightly lower, at 94 instead of 96 percent (column 4 of Table 2.6).

Finally, what if Indonesia went even further down the reform path? For example, with agriculture likely to become relatively more important because of the crisis than it otherwise would be, the government might consider reducing farm productivity-reducing domestic production and marketing regulations so as to boost this potential engine of growth recovery. One important regulation that reputedly has inhibited growth in the estate crop sector is that the sector has been kept in the hands of para-statal agencies. Suppose privatization or other reforms there led to a boost in total factor productivity in the non-grain crop sector by 10 percent by 2005. Our results suggest that, compared with the interrupted growth scenario ig, this would boost real GDP by 0.6 percent and that sector's output and exports by 12 and almost 60 percent, respectively. It would raise agriculture's share of GDP by 0.8 percent, and its share of exports from 4.6 to 5.8 percent (bottom of Tables 4 and 5).

Conclusions

The large changes projected for the structure of the global economy between 1992 and 2005 will be moderated once the effects of the Asian slowdown are felt. There is a large adverse effect expected on cumulative real output in Indonesia over this period, and more so the slower the country recovers from the current crisis. Hence the urgent need to find ways to return the economy to rapid growth as soon as possible.

Trade reform, particularly multilateral trade liberalisation, enhances Indonesia's economic growth and development prospects. Even in our comparative static model, Uruguay Round liberalisation was projected to increase Indonesia's real GDP by approximately 1.4 percent. That projection has been lowered slightly by the growth interruption, and could be lowered further -- or raised -- depending on trade and other policies responses to the crisis. On the one hand, if Indonesia responds by not meeting its Uruguay Round tariff reduction commitments, that is projected to lower its GDP by another 0.5 percent per year. On the other hand, if Indonesia not only meets but is able to exceed its Uruguay Round commitments with an additional 25 percent reduction in its import tariff rates, GDP is projected to be higher by a further 0.4 percent per year. And as the final scenario above shows, that could be raised to a 1 percent boost if domestic de-regulation in agricultural markets were able to raise productivity in the non-grain crop sector by 10 percent.

With the declining relative importance of the agricultural sector being temporarily reversed by the crisis, and with workers returning from urban areas to their family's village, it is more important now than ever to examine ways to boost rural development. Great scope for doing that has been shown to exist in Indonesia (Tabor 1998), as in other areas of Asia (World Bank 1997). The extent to which the government is prepared to take up that challenge will provide a key indicator of the quality of its economic governance.

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3

Effects of AFTA and APEC trade policy reforms on Indonesian agriculture

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Indonesia is facing commitments to international trade liberalisation through the Uruguay Round, its participation in Asia Pacific Economic Cooperation (APEC), and its collaborative effort with other ASEAN economies to form an ASEAN Free Trade Area (AFTA). As part of the Uruguay Round commitment, Indonesia has been reducing its border tariffs, opening its markets, as well as reducing other domestic distortions especially in the agricultural sector.

As a member of APEC, Indonesia is determined to liberalise trade and investment in the Asia Pacific region. In the meeting in Bogor, Indonesia, in 1994, APEC economies set the long-term goal of free and open trade and investment in the Asia Pacific. The Bogor Declaration hopes to realize the goal in 2010 for developed economies and 2020 for developing economies. Furthermore, the Bogor meeting clarified the three pillars on which APEC would be based, namely, Trade and Investment Liberalisation and Facilitation (TILF); Economic and Technical Cooperation (ECOTECH); and Development Cooperation. Import tariffs have been cut unilaterally

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in APEC member economies, and further tariff cuts are expected so as to implement the Bogor goal.

While considerable industrial tariff reduction has been implemented in APEC, there has not been much discussion of agricultural liberalisation. This is different from the Uruguay Round which explicitly specifies reductions of import tariffs, domestic subsidies, and export subsidies on agricultural commodities. In APEC, the tariff reduction measure is generally based on the average level of tariff. This means that sectoral classifications become less relevant. It was only more recently that the sectoral approach to tariff reduction, the so called Early Voluntary Sectoral Liberalisation (EVSL), was set out in the Vancouver meeting in 1997. However, in the following year in Kuala Lumpur, there was a disagreement among APEC member economies on the liberalisation of some sensitive agricultural sectors. As a result, APEC had to submit its EVSL problems to the WTO for resolution. Clearly agriculture remains a sensitive sector within APEC.

As a member of Association of Southeast Asian Nations (ASEAN), Indonesia is also committed to form a free trade area in ASEAN (AFTA) in 2003. Different from the most-favoured-nation schemes in APEC and the Uruguay Round, AFTA is meant to create a discriminatory trading block in ASEAN. While in general the coverage of AFTA includes both the agricultural and non-agricultural sectors, the progress of agricultural trade liberalisation has been very slow. It remains to be seen whether AFTA can be fully implemented in 2003.

This chapter estimates the impacts of Uruguay Round, APEC and AFTA trade liberalisations on the economies in the Asia-Pacific region in general, as well as specifically on Indonesia, by using a quantitative economic model. The objective is to measure the potential gains or losses, and to predict the changing trade patterns and resource reallocation as a result of these liberalisation schemes. The focus is on Indonesia even though the model treats Indonesia as part of an interdependent world economy.

This study compares the impact of each scenario on welfare, output, and resource allocation in the Indonesian economy. It uses a global Computable General Equilibrium (CGE) model known as GTAP (see Appendix 2 of this volume) which allows us to trace the impact of trade liberalisation through flows of goods and services across sectors and countries. In a global CGE framework, the world economy is classified into several regions and sectors, where quantity and prices adjust to the changing supply and demand that form the equilibrium conditions in every market. Policy changes, such as a reduction in import tariffs, lead to changing equilibrium market conditions in every sector and region involved in the model. The GTAP model measures the impacts of these policy changes on prices and quantities, structural resource allocation, as well as welfare gains or losses.

The chapter is organised as follows. The first part discusses various forces of trade liberalisation that Indonesia is currently facing. This includes a discussion of the Uruguay Round, APEC and AFTA. The second part presents the modelling framework in a computable general equilibrium model, including the development of various scenarios to represent various schemes of trade liberalisation. The third part presents the results of the simulation and is followed by the conclusion.

Forces of trade liberalisation

Liberalising trade in agriculture through the Uruguay Round

The Uruguay Round has been the main driving force of agricultural sector liberalisation in the Asia Pacific during the past decade. Even though in terms of actual trade liberalisation the Uruguay Round Agreement on Agriculture seems to be limited, its achievement was quite significant. Other international trade agreements, many of which are more progressive than the Uruguay Round in terms of non-agricultural products, often fall short in terms of a push for more agricultural liberalisation. Hence, the success of the Uruguay Round in including agriculture in its agreement has become the primary source of efficiency gains from this reform. Prior to this agreement, trading economies could maintain inefficient and costly barriers since the sector was not regulated under GATT (now WTO) rules.

The Uruguay Round Agreement on Agriculture consisted of two parts: a set of general commitments on the new GATT rules on agriculture, and country schedules on the commitments of each participant on tariffs and other areas of obligations. These different areas include obligations to improve market access and reduce domestic support measures and export subsidies.

ASEAN Free Trade Area

In January 1992, intra-ASEAN economic co-operation received a major boost at the Fourth ASEAN Summit in Singapore with the agreement by ASEAN countries to achieve an ASEAN Free Trade Area (AFTA) within 15 years. Originally, fifteen commodity groups were chosen to be on the fast track.[1] For fast-track products with tariffs greater than 20 percent, tariffs were to be immediately reduced to 20 percent, and to 0-5 percent within 10 years; while for fast-track products with tariffs at 20 percent or below, tariffs were to be reduced to 0-5 percent within 7 years. To qualify for CEPT (Common Effective Preferential Tariff), goods must satisfy the ASEAN local content requirement of 40 percent. AFTA was a broader and much improved intra-ASEAN liberalisation program, but unprocessed agriculture products were initially excluded.

Various forces including the commitments under the Uruguay Round, progress in APEC and unilateral liberalisations have contributed to accelerating and deepening ASEAN cooperation. For example, the timetable by which all products in the CEPT will have tariff rates of not more than 0-5 percent was accelerated from 15 to 10 years, that is, by 2003. A number of products were also accelerated to the year 2000, by which time 88 percent of tariff lines were in the 0-5 percent tariff range. Also, the product coverage of CEPT was broadened to include unprocessed agriculture products, although they are further categorised into temporary exclusion and sensitive lists. Items in the sensitive list will be liberalised under a separate schedule, but they are expected to go beyond ASEAN's commitments in agriculture under the WTO. Based on tentative lists, it appears close to 70 percent will be on the inclusion list. The temporary exclusion list will also be phased into the inclusion list by

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[1] The fast track products are: vegetable oils, chemicals, fertilisers, rubber products, pulp and paper, wooden and rattan furniture, gems and jewellery products, cement, pharmaceuticals, plastics, leather products, textiles, ceramics and glass products, copper cathodes, and electronics.

2003. There has been agreement that the sensitive list should be kept at a minimum and currently it comprises around 10 percent of the tariff lines in unprocessed agriculture products.

Despite that accelerated progress, difficulties have been experienced in reaching an agreement on the agricultural items to be included in the temporary exclusion and sensitive lists, and the time limit by which all items are phased into the inclusion list. At the ASEAN summit in 1995 for example, Indonesia reintroduced 15 agriculture products to its sensitive list that had earlier been in the temporary exclusion list. The majority of these products are items which are coordinated by a state logistic agency (BULOG) and included rice, sugar, wheat flour, and soybean.

Indonesia's decision to postpone the liberalisation of these 15 food items dominated the 10th AFTA Council meeting in Jakarta in September 1996. Indonesia, supported by the Philippines, refused to accept a 2010 deadline for including rice and sugar into the CEPT scheme. In addition to the sensitive list, Indonesia created a new list called the "very sensitive list" and included the two food items in that list. Indonesia and the Philippines demanded that the 2010 deadline be pushed back by 10 years. On the other hand, Thailand insisted that all unprocessed agricultural commodities be phased in 1 January 2003 and be totally liberalised by 2010. By the end of the meeting it was agreed that the liberalisation of sensitive agricultural commodities will begin in January 2003 and end in 2010, but Indonesia and Philippines were allowed some flexibility. For example, Indonesia can maintain import tariffs on rice and sugar above 5 percent after 2010 and introduce safeguard measures at that time to protect domestic producers.

APEC

In 1993, leaders of the APEC economies met in Blake Island, Seattle, to discuss the progress of liberalisation in the Asia-Pacific area. This meeting became a milestone of the forum’s progress, since the meeting provided a vision of free trade and investment in the region. Even though APEC itself had been formed in 1989, it was not until 1993 that APEC formulated a clear picture of what it wanted to achieve. A year after the Seattle meeting, another meeting in Bogor, Indonesia, set the long term goal of free and open trade and investment in the Asia Pacific. With the Bogor Declaration, APEC economies hoped to realize this long term goal in 2010 for developed economies and 2020 for developing economies.

In the following year, APEC leaders meet at Osaka to formalise this vision, and in doing so, laid down the framework for liberalisation. This framework, known as the Osaka Action Agenda (OAA), included nine clearly defined principles for APEC. They are: (1) comprehensiveness; (2) WTO-consistency; (3) comparability; (4) non-discrimination; (5) transparency; (6) standstill; (7) simultaneous start, continuous process and differentiated timetables; (8) flexibility; and (9) cooperation. In 1996 these nine principles were further emphasised in Manila and, based on this framework, action plans were made. These action plans, known as Manila Action Plans for APEC (MAPA), served as a map towards the Bogor goal.

Basically, MAPA was a set of liberalisation initiatives conducted either unilaterally or collectively. Unilateral and voluntary liberalisation became to be known as Individual Action Plans (IAPs), while collective initiatives were called Collective Action Plans (CAPs). By promoting these initiatives, it was expected that greater benefits of liberalisation would be felt by APEC economies because of a widened scope. This widened scope was achieved by allowing APEC members to work, firstly, on the goal through the simultaneous efforts of their own action plans. But in addition, concerted actions by APEC economies would enhance its collective capacity to lead global liberalisation. Via MAPA, APEC members reinforced the trends of liberalisation by ensuring more transparent trade regimes through the IAPs and CAPs, reducing the cost of doing business, and strengthening economic and technical cooperation in the region.

Modelling trade liberalisation

International trade liberalisation in this chapter is modeled using the global computable general equilibrium model and database known as GTAP. Version 3 of the database is used here because its tariff rates represent the situation when the Uruguay Round and other regional arrangements were launched in the first half of the 1990s. To model the impact of trade liberalisation on Indonesia's agriculture in this global CGE model, the world economy is aggregated into 19 regions (in order to give a detailed coverage of the APEC members) and 12 commodity groups (four or them agricultural, three other primary sectors, four manufacturing sectors, and an aggregated services sector. Five different liberalisation scenarios are considered to capture the Uruguay Round, AFTA and APEC agreements plus two more with greater agricultural reform.

The first scenario simulates an international trade regime in which the Uruguay Round is the only available force of liberalisation. This serves as a benchmark for results from other simulations. Three different shocks are applied: domestic tax and/or subsidy reductions in the agricultural sectors by 20 percent in developed countries and 13 percent in developing countries; agricultural export subsidy reductions by 36 percent in developed countries and 24 percent in developing countries; and border tariff reductions, in both agricultural and non-agricultural commodities (as specified in the GTAP version 3 database).

The second and third scenarios simulate the additional impact of AFTA, in addition to that of the Uruguay Round, on the ASEAN economies. AFTA only deals with reductions of import tariffs, which apply only to intra-ASEAN trade. Its schedule for completing the tariff reductions in 2003 is clearly faster than APEC's 2010 and 2020 targets. In our AFTA scenario, border tariffs between ASEAN member economies are reduced to zero while tariffs between ASEAN and non-ASEAN economies are maintained at the level committed for the Uruguay Round. The only difference between the second and third scenarios is their treatment of the agricultural sectors: in the second scenario, the agricultural sectors are not liberalised beyond Uruguay Round commitments, while in the third scenario, the agricultural sectors are liberalised for intra-ASEAN trade. This allows us to indicate the importance of agricultural trade reforms.

The fourth and fifth scenarios are a combination of the Uruguay Round and APEC MFN liberalisations (of zero tariffs in 2010 for developed and in 2020 for developing APEC economies, with the additional assumption that the latter economies have tariffs of 5 percent in 2010). Similar to the second and third scenarios, in the fourth scenario the agricultural sectors are not liberalised by APEC economies whereas in the fifth scenario they are included in the liberalisation.

The results

Welfare

The results show that broader the country participation, the wider the sectoral coverage, and the greater the tariff reductions, the larger are the welfare benefits of trade liberalisation. The welfare gain for Indonesia as a result of participating in the Uruguay Round is estimated at about US$3.3 billion per year. The aggregate gain for the five large ASEAN countries is US$13.6 billion.

AFTA does not contribute much to the welfare gains over and above what has been achieved by the Uruguay Round, even for the ASEAN member economies who get an additional welfare gain of just US$270 million on top of the gains from the Uruguay Round. Indonesia would get an additional benefit of US$50 million from the implementation of AFTA in addition to the Uruguay Round.

The inclusion of the agricultural reform in AFTA slightly reduces the welfare gain for all ASEAN members compared with the previous scenario that excludes agriculture: trade diversion is outweighing trade creation. However, Indonesia is a gainer as it becomes a bigger agricultural exporter within ASEAN. The additional welfare gain for Indonesia as a result of including agriculture is about US$ 90 billion.

The additional benefit from implementing APEC in addition to the Uruguay Round is much larger than that from AFTA. For Indonesia the APEC liberalisation excluding agriculture would boost welfare by $530 million per year over and above the Uruguay Round benefits. If agriculture also is included in the APEC reform, Indonesia is no better off even though most other APEC economies are. The reason is that, unlike in the AFTA preferential scenario, Indonesia faces competition from other agricultural exporters within the APEC region when it involves MFN liberalisation.

Domestic Production

The results in Table 3.1 suggest that implementation of the Uruguay Round globally would reduce some primary production in

Indonesia but would boost its textile and clothing sector enormously (although China's recent accession to WTO is likely to dampen apparel growth somewhat) as well as expand slightly its output of other manufactures and services. Agricultural output is projected to decline further with AFTA if agricultural liberalisation is excluded. If agriculture is fully included in AFTA, on the other hand, Indonesia's grain output would boom as new market opportunities became available (preferentially) within ASEAN. Under APEC reform on top of the Uruguay Round, the final columns of Table 3.1 suggest that Indonesia's textile and clothing sector would grow less than without APEC reform, reflecting the model's projected growth in competition from China (which in fact is now happening anyway because of China's accession to WTO in December 2001). That slower expansion in textiles is offset by the slower contraction of mining under APEC. Notice too that the inclusion of agriculture in the APEC reform makes little difference to Indonesia. This is because agricultural comparative advantage is stronger in some other APEC economies, and so the farm expansion that is projected under AFTA does not show up when the agricultural reform takes the form of most-favoured-nation as under APEC.

Table 3.1: Impact of various trade liberalisations on sectoral outputs in Indonesia (percentage change)

Sectors	Uruguay Round (UR) *Scenario 1*	UR - AFTA, Excluding Agriculture *Scenario 2*	UR-AFTA, Including Agriculture *Scenario 3*	UR-APEC, Excluding Agriculture *Scenario 4*	UR-APEC, Including Agriculture *Scenario 5*	
						US$m[a]
Paddy rice	-0.8	-0.8	-1.2	-0.4	-0.7	***-51***
Grains	0.5	0.5	31.7	1.0	2.6	***22***
Nongrain crops	-0.3	-0.4	-1.2	0.0	0.1	***10***
Livestock	1.4	1.4	1.6	1.7	1.6	***52***
Forestry	-0.4	-0.6	-0.9	-0.8	-0.6	***-16***
Fishing	0.3	3.5	3.3	1.1	1.3	***49***
Processed food	0.2	0.2	-0.2	0.6	0.3	***77***
Petroleum, coal, chemicals	0.4	0.3	0.1	1.5	1.5	***339***
Other mining	-11.7	-12.1	-12.2	-9.2	-9.1	***-1580***
Textiles/clothing	46.6	47.0	46.4	33.8	33.2	***4016***
Other manuf.	0.6	0.3	-0.1	-0.4	-0.2	***-60***
Services	2.0	2.0	1.9	2.0	2.0	***1922***

[a] Change in value of sectoral output

Table 3.2: Impact of various trade liberalisations on sectoral exports in Indonesia (percentage change)

Sectors	Uruguay Round (UR) *Scenario 1*	UR - AFTA, Excluding Agriculture *Scenario 2*	UR-AFTA, Including Agriculture *Scenario 3*	UR-APEC, Excluding Agriculture *Scenario 4*	UR-APEC, Including Agriculture *Scenario 5*	*US$m[a]*
Paddy rice	-14.6	-14.8	-16.9	-6.7	145.1	***0***
Grains	41.8	42.1	1816.2	44.4	46.7	***9***
Non-grain crops	44.0	43.8	42.0	44.9	46.8	***976***
Livestock	32.2	32.2	49.6	33.5	30.4	***26***
Forestry	9.2	9.0	8.9	18.8	19.7	***8***
Fishing	0.2	10.8	10.5	1.9	2.5	***29***
Processed food	1.8	2.3	-0.1	-0.5	-2.6	***-41***
Petroleum, coal, chemicals	18.1	17.8	17.4	14.5	14.5	***563***
Other mining	-11.9	-12.3	-12.4	-9.7	-9.6	***-1061***
Textiles/clothing	86.2	86.9	86.3	67.6	66.8	***4014***
Other manuf.	34.0	33.5	33.0	24.0	24.3	***2177***
Services	2.6	2.5	2.2	3.8	3.9	***96***

Patterns of Trade

The impact of trade liberalisation on the changing patterns of exports and imports are more significant that those of outputs. Table 3.2 shows that with all trade liberalisation scenarios, Indonesia's exports increase in all sectors except Other mining, and substantially so on non-grain crops, textiles/clothing and other manufactures. Similarly, imports of all groups of commodities are expected to increase with trade liberalisation, as shown in Table 3.3.

Table 3.3: Impact of various trade liberalisations on sectoral imports in Indonesia (percentage change)

Sectors	Uruguay Round (UR) *Scenario 1*	UR-AFTA, Excluding Agriculture *Scenario 2*	UR-AFTA, Including Agriculture *Scenario 3*	UR-APEC, Excluding Agriculture *Scenario 4*	UR-APEC, Including Agriculture *Scenario 5*	*US$m[a]*
Paddy rice	18.3	18.6	20.0	19.0	6.4	***0***
Grains	2.9	3.0	12.3	4.2	-0.0	***-0***
Non-grain crops	87.8	88.1	90.2	88.8	90.7	***898***
Livestock	12.5	12.7	15.1	11.6	1.7	***1***
Forestry	66.0	66.4	66.4	46.8	46.7	***10***
Fishing	119.9	121.0	121.1	92.9	92.6	***16***
Processed food	31.5	31.8	33.8	19.6	21.1	***206***
Petroleum, coal, chemicals	18.1	18.2	18.2	11.4	11.3	***910***
Other mining	9.0	9.1	9.0	0.3	0.3	***4***
Textiles/clothing	111.8	112.8	112.5	94.6	94.5	***1475***
Other manuf.	24.4	24.5	24.5	18.2	18.2	***2541***
Services	6.2	6.4	6.6	7.5	7.5	***415***

Conclusion

The result of this study has, in some ways, confirmed results of prior studies (e.g., Anderson et. al., 1996) on trade liberalisation in the Asia Pacific region. The general point is that the deeper the tariff cuts and the wider the product and country coverage of trade liberalisation, the bigger the welfare gains. This increase in welfare results from more efficient resource allocation. Among the existing liberalisation commitments in the Asia Pacific region, the implementation of the two biggest commitments, namely the Uruguay Round and APEC, would greatly benefit Indonesia. AFTA, on the other hand, is expected to contribute little to welfare gain for Indonesia. The explanation is that AFTA creates a discriminatory trading block in ASEAN, where trade diversion is offsetting potential trade creation. This suggests ASEAN would be better off economically from pursuing more open and non-discriminatory trade liberalisation through APEC or the new round of the WTO.

Agricultural liberalisation through APEC is expected to create an additional welfare gain for most economies, even though its magnitude tends to be small and it varies between economies. Its impact on Indonesia is small except under AFTA, where it gets preferential access to other ASEAN markets.

Of course not every sector in the economy would benefit equally from trade liberalisation. In the Indonesian case, the biggest gain is expected to take place in the textile and garment sector, at the expense of the mining sector. Within the agricultural sector, resources tend to move away from paddy rice to grain crops and livestock.

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4

Trade liberalisation and soil degradation in Indonesia

ANNA STRUTT

This chapter extends the Global Trade Analysis Project (GTAP) model to include the effects of land degradation for the Indonesian economy. For Indonesia, soil erosion appears to be one of the most significant environmental problems caused by agricultural production. We simulate the off-site environmental damage and on-site productivity impacts of erosion, along with the standard intersectoral and interregional economic effects of trade liberalisation. We then analyse the welfare implications of trade policy changes where soil erosion occurs and land productivity is reduced.

Land degradation may have significant adverse effects, particularly in developing countries (Scherr and Yadav 1996; Rosegrant and Ringler 1997). For example, in countries such as Costa Rica, Malawi, Mali and Mexico, soil erosion is estimated to cause national economic losses of between 0.5 and 1.5 percent of annual GDP (World Bank 1992a). Countries with fragile tropical land are particularly problematic, and rural poverty in developing countries may force people with no other options to exploit available resources beyond their sustainable capacity (Pinstrup-Anderson and Pandya-Lorch 1994).

Indonesia also appears to suffer significant negative effects from land degradation, with World Bank estimates suggesting that soil erosion on Java costs the economy US$340-406 million per year in 1989 dollars (Magrath and Arens 1989). Of this, nearly 80 percent is due to declines in the productivity of agricultural land. The other 20 percent or so is due to off-site costs such as siltation of irrigation systems and the loss of reservoir capacity. The estimated cost of soil erosion for Java is approximately 0.4 percent of total GDP or 2 percent of agricultural GDP (Magrath and Arens 1989; World Bank 1994).[1] This is significant for a country that has achieved only a little over 2 percent average annual growth in agricultural production in recent times.[2]

We begin by explaining modifications made to the standard GTAP model and our modelling of off-site damage and on-site productivity effects for Indonesia. The second section of this chapter presents results for our Uruguay Round trade liberalisation simulation, including erosion effects. The final section offers conclusions and policy recommendations.

Modelling land degradation in Indonesia

The environmental links of agricultural production are two-way. Agricultural production affects environmental quality and environmental quality affects agricultural production. There are many interrelated variables and feedback effects, and measurement of even the major environmental effects is not easy. We aim to keep the task manageable by concentrating on developing environmental damage functions for land. These are used with a modified version of the GTAP model to examine external costs and the degradation of land caused by soil erosion in Indonesia.

As farmers increase their production, they tend to generate more erosion. The erosion damage can cause on-site productivity losses or off-site environmental damage. Farmers may respond to the on-site productivity effects (Barrett 1991), but are unlikely to take the non-marketed off-site impacts of their activities into account when they make decisions if there are no incentives to do so.

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[1] However Lindert (1996) finds that there is virtually no evidence of productivity loss over many decades of net soil degradation in Indonesia. It is possible that farmers respond to minimize the effects of erosion by increasing other inputs such as fertiliser.

[2] 1990-1996 as calculated from the agricultural production index provided in the FAO database (FAO 1997).

We modify the standard modelling of land in GTAP to enable land to shift between agriculture and forestry then we model both off-site environmental damage and on-site productivity effects. Our modifications involve minimal changes to the standard version of GTAP, while retaining the structure of the model and ensuring that the consistency of the benchmark data is preserved. We exploit available environmental data without introducing a large number of parameters for which no appropriate data exist.

(a) Transformation of land between sectors

There is no land allocation to forestry in Version 3 of GTAP. However, it appears likely that land does shift between the forestry and agricultural sectors (World Bank 1990, Southgate 1990).[3] We therefore adjust the standard database to allocate some returns to forestry land in Indonesia. Returns to land are based on 50 percent of value added; this is similar to the value added by land for most other agricultural sectors in GTAP.

GTAP models land as an imperfectly mobile factor of production with the mobility described by a constant elasticity of transformation (CET) function (Powell and Gruen 1968; Hertel and Tsigas 1997). The CET revenue function is analogous to the constant elasticity of substitution (CES) cost function, but with an Allen partial elasticity of substitution less than zero. This restricts mobility and enables productivity differences between land used in different farm sectors, with land measured in productivity units rather than hectares (Darwin et al. 1995). We retain the standard GTAP elasticity of transformation function with an elasticity of substitution of -1 for all land-using sectors, including forestry.

(b) Off-site environmental damage

For resources with no stock feedback effects, environmental degradation can be modelled either as a factor of production (López 1994), or as a joint product in output (Copeland 1994, Tobey and

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[3] There is some dispute about the extent to which agricultural extensification causes deforestation. But even if it is not the *major* cause (World Bank 1994), it is still likely to be significant (World Bank 1990 and Southgate 1990).

Reinert 1991). Off-site effects are modelled here as driven by the level of production inputs and technology in the environmentally degrading sector.

Assume there are *j* sectors, and that the amount of erosion in each sector (E_j) depends on the quantity of land used in that sector. Total land degradation (D) is defined as the sum of erosion across all sectors:

$$D = \sum_{i=1}^{n} E_i \qquad (1).$$

It follows that the proportional change in total erosion (d) can be expressed as:

$$d = \sum_{j=1}^{n} e_j \beta_j \qquad (2)$$

where

$$\beta_j = \frac{e_j}{\sum e_j} \quad \text{and} \quad \sum_j \beta_j = 1 .$$

The term e_j indicates the proportional change in erosion. This method of calculating environmental damage follows the innovative work of Coxhead and others (Coxhead and Shively 1995; Bandara and Coxhead 1995 and Coxhead 1996). When used with the GTAP model, it has the important advantage of only requiring estimates of β_j (the share of total erosion contributed by each sector in the benchmark year). All other data and parameters necessary to determine the change in erosion are available in the standard GTAP database. Large changes to the core model and database are therefore unnecessary.

For the non-marketed effects of off-site environmental externalities, we append damage functions to the standard GTAP model. We use these side-equations to calculate the change in total erosion and the resulting off-site damage caused by shifts in land use. Once we have estimated the change in erosion, we estimate the welfare costs of the non-marketed off-site effects.

Magrath and Arens (1989) estimate the annual off-site damage caused by erosion for *Java* to be in the range of US$25.6m to

US$91.2m.[4] However we need estimates of the total off-site erosion costs for *Indonesia* for 1992. Agricultural production is thought to be an important determinant of erosion. We use this as a proxy to scale up the costs of erosion from Java alone to the whole country. We derive estimates of the contribution of each region to production from a 1993 disaggregated social accounting matrix for Indonesia (Warr and Azis 1997, Table 7). Table 4.1 shows the relative contribution of Java (Region 1) to total agricultural crop and forestry production. The final row of Table 4.1 indicates that Java contributes approximately 50 percent to total agricultural crop and forestry

Table 4.1: Contribution of each region to agricultural production in Indonesia, by sector
(percent)

	Region 1[(a)]	Region 2[(b)]	Region 3[(c)]	National Total[(d)]
Paddy rice	63	14	25	100
Coarse-grains	57	18	26	100
Non-grain crops	53	26	20	100
Forestry	3	11	84	100
Total, agriculture and forestry	**49**	**20**	**31**	**100**

[(a)] DKI Jaya, West Java, DIY Yogyakarta, Central Java, East Java and Bali.

[(b)] DIY Aceh, North Sumatra, West Sumatra, Riau, Jambi, Bengkulu, South Sumatra, Lampung.

[(c)] West Nusa Tenggara, East Nusa Tenggrara, East Timor, West Kalimantan, Central Kalimantan, East Kalimantan, South Kalimantan, South Sulawesi, North Sulawesi, Central Sulawesi, Southeast Sulawesi, Maluku and Irian Jaya.

[(d)] May not quite sum to 100 due to rounding.

Source: Derived from Warr and Azis (1997, Table 7).

production in Indonesia. We therefore estimate the total off-site costs of erosion in Indonesia to be in the order of double the costs for Java alone. With inflation of almost 10 percent in 1990 and 1991 (McLeod 1997, p. 199), this places the off-site erosion costs for Indonesia in the range of US$62m to US$220m in 1992 dollars. It is hoped that this range provides some indication of the magnitude of

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[4] The off-site costs valued include the siltation of irrigation systems, the obstruction and dredging of ports, and reservoir siltation.

off-site erosion costs for Indonesia. Other factors such as the steepness of slopes, different soil types and high forestry production in regions other than Java may increase this estimate. However, the impact on reservoir siltation and irrigation systems is likely to be lower in the less populated areas outside Java, where there is lower emphasis on irrigated rice production.

We use the high estimate of US$220m per annum to value the cost of off-site erosion in Indonesia. This is partly a cautionary approach, but also the cost estimates may be understated since they do not include all of the potential costs of off-side damage, such as the cost of flooding and stream flow irregularities (Magrath and Arens 1989).[5]

(c) On-site adverse productivity effects

Although soil erosion does not appear to have a major impact on land productivity in countries such as the US, it may be a far greater problem for tropical countries such as Indonesia. For example, average erosion rates in the US are estimated at about 0.7 tons of soil/ha/yr. This compares with overall erosion rates in Java of around 6-12 tons/ha/yr on volcanic soils and much higher losses on limestone soils and agricultural land (World Bank 1990). The high erosion rates are mainly due to the level and intensity of tropical rainfall, and the loss of ground cover on steep terrain. It is therefore important to try to model these production feedback effects to capture the adverse impact of on-site soil erosion on land productivity in Indonesia.

We capture the effect of land degradation in our modified version of the GTAP model through use of a land quality shifter parameter, FB_f^j.[6] As land quality deteriorates due to erosion, additional units of land (and other primary factors) are required to sustain the same

[5] Studies for other regions have sometimes found the total off-site costs of erosion to be of much higher magnitude than on-site losses in production (Crosson 1986).

[6] This is very similar to an exogenous factor-specific technical change variable (though erosion and the associated FB_f^j could be determined endogenously within the model if suitable data were available).

level of output. Use of this feedback parameter mimics the deterioration in land quality and productivity when erosion occurs.

We can now derive sector *j*'s demand for primary factors in the presence of erosion. Three primary factors of production are identified in the GTAP Version 3 database: land, labour, and capital. These primary factors combine according to a CES production technology, which is used to describe substitution possibilities between units of primary factors in sector *j*. The resulting *effective* primary factor input for sector *j* is then combined with intermediate inputs to form the production capability of sector *j*.

Given the price of primary factor *f* in sector *j* (P_f^j), profit maximizing producers choose the least cost combination of primary factor inputs of type *f* (X_f^j) necessary to sustain a given level of production (Z^j). Producers minimize:

$$\sum_{f=1}^{3} \overline{P}_f^j X_f^j \qquad j = 1, \ldots, n \qquad (3)$$

subject to a CES production function

$$Z^j = A\left[\sum_{f=1}^{3} \delta_f \overline{X}_i^{-\rho}\right]^{-1/\rho} \qquad (4)$$

where

$$\overline{X}_f^j = \frac{X_f^j}{FB_f^j} \qquad (5)$$

$$\overline{P}_f^j = FB_f^j P_f^j \quad .$$

A and δ_f are positive parameters with $\sum_{f=1}^{3} \delta_f = 1$. ρ is a parameter greater than or equal to –1; as it approaches zero, it approaches a Cobb-Douglas form. $\overline{X}_f^j$ is the effective land input (Dixon et al. 1982, pp. 76-81 and 1992, pp. 125-6).

The Lagrangian function is:

$$L = \sum_{f=1}^{3} \overline{P}_f^j \overline{X}_f^j + \Lambda\left(Z^j - \underset{f=1,\ldots,3}{CES}\left(\overline{X}_f^j\right)\right)$$

where Λ is the Lagrange multiplier. The first order conditions for this cost minimization problem are:

$$\overline{P}_f^{\,j} = \Lambda A\left[\sum_{f=1}^{3}\delta_i \overline{X}_i^{\,-\rho}\right]^{-(1+\rho)/\rho} \delta_g \overline{X}_g^{\,-(1+\rho)}$$

and

$$L_\Lambda = Z^j - \underset{f=1,\ldots,3}{CES}\left(\overline{X}_f^{\,j}\right) = 0$$

i.e. $Z^j = A\left[\sum_{f=1}^{3}\delta_i \overline{X}_i^{\,-\rho}\right]^{-1/\rho}$

These conditions are solved to determine the primary factor demand equation which is expressed in linear percentage change form as (Dixon et al. 1992, p. 125):

$$\overline{x}_f^{\,j} = z^j - \sigma_f^j\left(\overline{p}_f^{\,j} - \sum_{f=1}^{3} S_f^j \overline{p}_f^{\,j}\right). \qquad (6)$$

Lower case letters are used to indicate the percentage change in the corresponding upper case variables. Applying the percentage change forms of the two equations in (5), we find the primary factor demand:

$$x_f^j = z^j + fb_f^j - \sigma_f^j\left(p_f^j - \sum_{f=1}^{3} S_f^j p_f^j\right) - \sigma_f^j\left(fb_f^j - \sum_{f=1}^{3} S_f^j fb_f^j\right) \qquad (7)$$

where

$$\sigma_f^j = \frac{1}{1-h_f^j}$$

$$S_f^j = \delta_k X_k^{-\rho} \Big/ \left(\textstyle\sum_i \delta_i X_i^{-\rho}\right)$$

and

x_f^j = demand for primary factor *f* by sector *j*

z^j = activity level in sector *j*

fb_f^j = primary factor *f*-augmenting feedback

σ_f^j = elasticity of substitution between primary factors in sector j

p_f^j = unit price or rental rate for primary factors used by sector j

S_f^j = share of primary factor costs in sector j accounted for by the cost of primary factor f.

Equation (7) relates each sector's demand for primary factors to the overall activity level in the sector, to the costs of different types of primary factors, and to the feedback variable. Equation (7) indicates that if land degradation causes a one percent increase in the land-specific feedback variable (fb_j^j), then the requirement of land by sector j increases by $\left(1-\sigma_1^j\left(1-S_f^j\right)\right)$ in order to sustain the given level of activity.[7] Such a reduction in the quality of land will also induce substitution away from land toward the other two primary factors (Dixon et al. 1982, p. 82).

The effects of the feedback variable outlined above necessitate some changes to the standard GTAP model and parameters. In the GTAP model, the equivalent of equation (7) appears as two types of equations. The first describes substitution among inputs within a nest. Its form follows directly from the CES form of the production function. The second type of equation is the composite price equation which determines the unit cost for the composite good produced by that branch (Hertel and Tsigas 1997). We adapt both of these equations to incorporate feedback effects. The decomposition equations appended to the standard model (Huff and Hertel 1996) are also changed to capture the impact of the feedback variable when decomposing welfare changes. This procedure for incorporating environmental damage more explicitly into the GTAP model could be generalised to include other forms of environmental damage, and also the situation where damage caused by one sector adversely affects other sectors.

For Indonesia, we assume that the adverse effects of on-site soil erosion cause a reduction in land productivity in some agricultural

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[7]Assuming that factor prices are constant.

sectors. Repetto et al. (1989) calculate average productivity losses to be 6.8 percent on erosion-sensitive crops such as maize and 4.3 percent on less sensitive crops such as cassava. We follow this work and assume that the grain sector exhibits a 6.8 percent reduction in land productivity. The non-grain crops sector includes staple and estate crops. We assume that 50 percent of the crops are erosion-sensitive, which leads to a 5.6 reduction in land productivity for the non-grain crop sector. No adverse productivity effects are assumed for other agricultural and forestry sectors.

Effects of Uruguay Round trade liberalisation

We model the effects of multilateral trade liberalisation using a general equilibrium model closure. This closure captures the changes in trade flows and the substitution in production and consumption that occurs between commodities. Prices, output levels and incomes are endogenous for all regions. Policy variables, factor endowment levels and technical change variables are exogenous. We aggregate the full 30 region, 37 sector Version 3 GTAP database to 6 regions and 17 sectors. The regional aggregation includes Indonesia, China, high income APEC economies, developing APEC economies, the other high income countries of Western Europe and the rest of the world's developing and transition economies. Tables 4.2 and 4.3 detail the regional and commodity aggregation. The model is implemented and solved using GEMPACK (Harrison and Pearson 1996).

A Uruguay Round-type trade liberalisation is simulated from the GTAP 1992 base. Cuts to tariff rates, agricultural export subsidies and elimination of the Multifibre Arrangement (MFA) quotas are needed to generate a credible post-Uruguay Round environment from the GTAP protection data (McDougall 1996). Using protection vectors that draw on extensive work by the World Bank (McDougall 1997), we lower tariffs to post-Uruguay Round levels. The export tax equivalents of MFA quotas are removed and agricultural export subsidies are also reduced. We assume that agricultural export subsidies are reduced by 36 percent in developed economies.

When protection is reduced, interregional and intersectoral shifts in economic activity affect welfare. Table 4.4 shows the projected effect of Uruguay Round trade liberalisation on welfare. Projected

Table 4.2: Regional aggregation in the GTAP model

Regional Aggregation	GTAP Aggregation
Indonesia	Indonesia
China	China
Industrialised APEC Economies	Australia
	New Zealand
	United States
	Canada
	Japan
	Hong Kong
	Singapore
	Taiwan
Developing APEC economies	Korea
	Thailand
	Malaysia
	Philippines
	Mexico
	Chile
Other high income countries of Western Europe	European Union-12
	EU-3 (Austria, Finland and Sweden)
	EFTA (Iceland, Norway, Switzerland)
Rest of the world's developing and transition economies	Argentina
	Brazil
	Rest of South America
	Central America and the Caribbean
	India
	Rest of South Asia (Bangladesh, Bhutan, Maldives, Nepal, Pakistan, Sri Lanka)
	Middle East and North Africa
	Sub Saharan Africa
	Central European Associates (Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia)
	Former Soviet Union
	Rest of World

Table 4.3: Commodity aggregation in the GTAP model

Aggregated Commodity	GTAP Commodity
Paddy Rice	Paddy rice
	Processed rice
Wheat	Wheat
Coarse grains	Coarse grains
Non-grain crops	Non grain crops
Livestock	Wool
	Other livestock
	Meat products
	Milk products
Forestry	Forestry
Fisheries	Fisheries
Coal, oil and gas	Coal
	Oil
	Gas
Other minerals	Other minerals
Food processing	Other food products
	Beverages and tobacco
Textiles	Textiles
	Wearing apparels
	Leather etc.
Wood and paper products	Lumber
	Pulp paper etc.
Petroleum and coal	Petroleum and coal
Chemicals, rubber and plastics	Chemicals rubbers and plastics
Non-metallic minerals	Non-metallic minerals
Other manufactured products	Primary ferrous metals
	Non-ferrous metals
	Fabricated metal products
	Transport industries
	Machinery and equipment
	Other manufacturing
Services	Electricity water and gas
	Construction
	Trade and transport
	Other services (private)
	Ownership of dwellings
	Other services (govt.)

changes in economic welfare, as measured by an equivalent variation in income, are shown in the first row. The welfare measures incorporate the effect of on-site environmental damage on land productivity. To prepare these results, we run a simulation with just the land productivity effects. Including land degradation in the model will affect the benchmark data, even with no policy changes. The difference between these results and the Uruguay Round simulation (including land productivity effects) allows us to isolate the results due to trade liberalisation, in the presence of land degradation.

Uruguay Round trade liberalisation is projected to increase welfare for Indonesia by US$1.02 billion p.a. The welfare effects can be decomposed into four components (see Table 4.4): allocative efficiency effects (Huff and Hertel 1996), terms of trade effects (McDougall 1993), on-site productivity effects and off-site environmental damage.[8] Allocative efficiency gains result when resources are reallocated into areas of more efficient production. As shown in the second row of Table 4.4, Indonesia experiences significant gains of US$833m in allocative efficiency. Of this gain, US$635m is due to improved allocative efficiency in the textile, leather and wearing apparel market when Indonesia reaps the benefits of MFA quota elimination. The contribution to welfare of changes in the terms of trade are reported to be US$180m in row 4. The inclusion of on-site productivity effects for changes in land use in Indonesia appears to cause a positive, albeit extremely small, change in welfare with trade reform. Row 4 of Table 4.4 shows that the productivity effects contribute 0.4 percent to the welfare gain from Uruguay Round liberalisation for Indonesia. This small positive contribution to welfare is driven by the reduction in production, and land degradation, in the large non-grain crop sector. Off-site environmental damage increases and leads to a small reduction in welfare of less than 0.15 percent. This effect is discussed further in the following section.

[8] The summation of these effects may not equal the total change in welfare reported due to marginal utility of income effects. The effects are small in this simulation and simply reflect the non-homothetic preferences assumed in the standard version of GTAP (Huff and Hertel 1996).

Table 4.4: Welfare effects of Uruguay Round liberalisation for Indonesia

	Change (US$m)
Total change in welfare	**1,018**
Allocative efficiency effects	832
Terms of trade effects	180
On-site productivity effects	4
Off-site productivity effects	-2

Source: Author's model results.

Change in erosion and off-site damage

Table 4.5 presents the assumptions used to calculate β_j, the share of total erosion contributed by each sector in the benchmark year. The first column shows estimates of area harvested in each agricultural sector in 1992 derived from FAO data (FAO 1997).

Table 4.5: Contribution from the agricultural and forestry sectors to erosion in Indonesia

	Area harvested (000 ha)	Erosion rate (t/ha/p.a.)	Quantity of erosion (million tonnes)
Paddy Rice	11,103	0	0
Grain	3,629	100	363
Non-grain staple crops	3,457	100	346
Non-grain estate crops	10,404	4	45
Forestry	1,136	80	91

Source: Author's calculations, drawing on FAO (1997), Magrath and Arens (1989), Duchin et al. (1993) and Repetto et al. (1989).

Area harvested for forestry is calculated from Duchin et al. (1993, p. 95).[9] Erosion rates for each sector are approximations that can be improved as further data becomes available and as the available sectoral disaggregation of the GTAP database improves. We estimate the average erosion rates shown in column 2 from more detailed information presented in Magrath and Arens (1989), Duchin et al. (1993) and Repetto et al. (1989). No erosion is assumed in the paddy rice sector. Apart from the short-term erosion that occurs during the establishment of new ricefields, soil erosion does not appear to be an important issue for irrigated rice production (Duchin et al. 1993, p. 63). Within the non-grain crop sector, estate crops have a significantly lower erosion rate since they are predominantly tree crops. Columns 1 and 2 multiplied together give an indication of the total erosion contributed by each sector.

To examine the off-site environmental damage of soil erosion in Indonesia, we analyse changes in land use. In particular, we examine the shift of land between crops with different rates of soil erosion. Table 4.6 reports the projected change in erosion following trade liberalisation. The first column shows the initial erosion share for each sector. These are the percentage shares in total erosion calculated from Table 4.5. The simulated change in land use is reported in column 3 of Table 4.6. The final column indicates the resulting aggregate change in erosion. Our simulation projects a 0.7 percent increase in aggregate erosion in Indonesia following Uruguay Round liberalisation. Although land use is reduced by almost one percent in both the non-grain crop and the forestry sectors, it increases by almost three percent in the coarse grains sector. The coarse grain sector is a relatively small sector, but it has a high rate of erosion which drives this result.

Given the existing off-site costs of erosion of US$220m we estimated above, the 0.7 percent increase in soil erosion projected here suggests an increase in off-site erosion costs of US$1.5m for Indonesia. Despite using a high estimate of off-site costs, this still represents less than 0.2 percent of the projected increase in welfare

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[9] Forestry output is 24 million cubic metres and average yield of production forest is 21.2 cubic metres/ha. If annual deforestation is used instead, the figure is very close, with 1.2 million hectares annually (World Resources Institute 1994, p. 307).

due to Uruguay Round trade liberalisation. Furthermore, the erosion increase may be overstated since the comparative statics ignore important long run effects and political benefits.[10]

Table 4.6: Change in soil erosion in Indonesia from Uruguay Round implementation

	Initial erosion share (%)	Change in land use (%)	Change in erosion (%)
Coarse grains	43	2.79	1.20
Non-grain crops	46	-0.93	-0.43
Forestry	11	-0.78	-0.09
Total	100	0	0.69

Source: Author's model results and Table 4.5, column 3.

Systematic sensitivity analysis

In a simulation such as that presented here, results often hinge crucially on the values of key exogenous inputs. When precise information is not available, as in the case of land productivity changes, it may be more appropriate to specify distributions rather than point estimates. Systematic sensitivity analysis (SSA) is an emerging technique that can incorporate information on distributions, as opposed to single point estimates, in computable general equilibrium models. Arndt (1996) developed the SSA technique from recent advances in the area of numerical integration and its application to economic problems (DeVuyst and Preckel 1997). The procedure automates solving the model as many times as is necessary (Arndt and Pearson 1996).

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[10] For example, as world incomes grow, there may be a global improvement in soil caused by the shift away from producing staples, especially staple grains (Lindert 1996). In addition, significant erosion problems are caused by poor households with high discount rates seeking to increase immediate food production by using cropping methods that result in high soil erosion levels from their rainfed lands (Barbier 1990). Increased incomes may reduce these problems. And as land tenure becomes more secure, farmers may guard the productive capacity of their land more carefully.

We conduct SSA analysis on the land productivity feedback parameters used in this chapter. Symmetric triangular distributions are assumed: for coarse grains a mean of -6.8 and a minimum value of -13.6 are used; for non-grain crops a mean of -5.55 and a minimum value of -11.1 are used. The welfare results appear fairly robust to the assumptions we make for the on-site productivity effects of soil erosion. For example, the mean of the equivalent variation in income from Uruguay Round implementation is US$1,018 million, and the standard deviation is US$130 million. Thus even with the possibility of relatively high land productivity losses, we do not expect to see much erosion of the substantial gains from Uruguay Round implementation.

Conclusions and policy implications

The inclusion of erosion and land degradation in a global trade model enables a fuller welfare analysis of the effects of economic policy changes. We find that with Uruguay Round trade liberalisation, the level of production and soil erosion rises in the coarse grain sector but falls in the non-grain crops and forestry sectors. Net land productivity changes appear to be positive, since a reduction in land use in the large non-grain crops sector should improve land productivity.

Results for the non-marketed off-site effects of erosion suggest that there may be a small increase in soil erosion in Indonesia with trade liberalisation. This is due to increased land use in the relatively erosive coarse grain sector. However, relative to the projected gain from trade liberalisation, the cost of damage caused by increased erosion appears very low (less than 0.2 percent of the welfare gain from trade liberalisation for Indonesia). Systematic sensitivity analysis of the key environmental parameters suggests these results are fairly robust to assumptions about land productivity losses.

This chapter attempts to make explicit some of the trade-offs between income growth (from trade reform) and environmental damage from land degradation. Given the data available, our results suggest that the benefits offered by trade reform far outweigh the very small overall impact on soil erosion in Indonesia. Of course this does not imply that land degradation is not a significant problem for Indonesia. We simply suggest that Uruguay Round implementation is not likely to significantly worsen the problem, at least at an aggregate level. The most serious effects of land degradation are often very location-specific, suggesting that local studies, along with ongoing efforts to ensure domestic policies are environmentally sustainable, will be important for Indonesia whether or not there is further trade reform.

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Will the Uruguay Round and APEC reforms harm air and water quality in Indonesia?

ANNA STRUTT AND KYM ANDERSON

Most-favoured-nation (MFN) trade liberalisations will always improve global economic welfare even in the presence of environmental externalities, provided optimal environmental policies are in place (Anderson and Blackhurst 1992; Corden 1997, Ch. 13). However, where national environmental standards differ markedly between countries and international environmental spillovers are significant, globally optimal environmental policies will differ from nationally optimal ones. That, plus the fact that in many (especially developing) countries the enforcement of environmental policies is often less than optimal even from a national viewpoint, raises in some people's minds (e.g., Chichilnisky 1994) the question of whether liberalising trade between rich and poor countries is desirable. To begin to assess whether the standard gains from trade are sufficient to outweigh any loss in welfare due to added environmental damage, and to foreshadow the need for environmental policy changes to accompany trade reforms, empirical studies of the resource depletion and environmental degradation effects of such reforms are needed.

This Chapter provides a methodology for doing that and illustrates it with a case study of Indonesia, a large newly industrialising country that is rich in natural resources and committed to taking part in major multilateral and regional trade liberalisations over the next two decades. The first section describes how a modified version of the global economy-wide model known as GTAP is used to project the world economy to 2010 and 2020 without and with those

Table 3.2: Impact of various trade liberalisations on sectoral exports in Indonesia (percentage change)

Sectors	Uruguay Round (UR) *Scenario 1*	UR - AFTA, Excluding Agriculture *Scenario 2*	UR-AFTA, Including Agriculture *Scenario 3*	UR-APEC, Excluding Agriculture *Scenario 4*	UR-APEC, Including Agriculture *Scenario 5*	*US$m[a]*
Paddy rice	-14.6	-14.8	-16.9	-6.7	145.1	***0***
Grains	41.8	42.1	1816.2	44.4	46.7	***9***
Non-grain crops	44.0	43.8	42.0	44.9	46.8	***976***
Livestock	32.2	32.2	49.6	33.5	30.4	***26***
Forestry	9.2	9.0	8.9	18.8	19.7	***8***
Fishing	0.2	10.8	10.5	1.9	2.5	***29***
Processed food	1.8	2.3	-0.1	-0.5	-2.6	***-41***
Petroleum, coal, chemicals	18.1	17.8	17.4	14.5	14.5	***563***
Other mining	-11.9	-12.3	-12.4	-9.7	-9.6	***-1061***
Textiles/clothing	86.2	86.9	86.3	67.6	66.8	***4014***
Other manuf.	34.0	33.5	33.0	24.0	24.3	***2177***
Services	2.6	2.5	2.2	3.8	3.9	***96***

Patterns of Trade

The impact of trade liberalisation on the changing patterns of exports and imports are more significant that those of outputs. Table 3.2 shows that with all trade liberalisation scenarios, Indonesia's exports increase in all sectors except Other mining, and substantially so on non-grain crops, textiles/clothing and other manufactures. Similarly, imports of all groups of commodities are expected to increase with trade liberalisation, as shown in Table 3.3.

For the present purpose of projecting the world economy to 2020 we use Version 3 of the GTAP database and model of national and international markets for all products and countries/regions of the world (see Hertel 1997). There are numerous advantages of using such a global, economy-wide CGE model even if, as with the GTAP model used here, it is comparative static in nature. The economy-wide approach makes explicit the assumed sources of economic growth that expand the demand for and supply of various products; it ensures countries can import only what they can pay for through exporting or borrowing; and it includes in the base scenario the inter-sectoral structural changes that normally accompany economic development. The advantage of using a global model rather than a national one, even though the primary focus of this Ch. is on results for Indonesia, is that the economic growth and structural and policy changes of other countries can be incorporated explicitly. This ensures that those changes abroad in combination with Indonesia's changes are used to generate new terms of trade for Indonesia. But it also allows the resource depleting effects of international events on Indonesia to be compared with those effects on other economies.

World Bank GDP, labor force, investment and population projections together with the Global Trade Analysis Project (GTAP) Version 3 database and model are used to generate market projections to the year 2020. The full GTAP model divides the world economy up into 37 sectors and 30 countries or country groups (including the 16 major APEC economies). In order to keep the present analysis and presentation of results tractable, however, the database is aggregated up to 23 product groups and to 4 other regions in addition to Indonesia.

The GTAP model is a standard comparative-static multi-region computable general equilibrium model of the Johansen type that began as the SALTER model developed by the Australian Government in the 1980s but has been hugely improved during the 1990s from its current home at Purdue University in the United States. The model, which is implemented and solved using GEMPACK (Harrison and Pearson 1996), is in use by over one hundred researchers in more than 30 countries on five continents.

Hence space is not used here to describe its myriad features and database.[2]

The model utilizes a representation of consumer demands which allows for differences in both the price and income responsiveness of demand in different regions depending upon both the level of development of the region and the particular consumption patterns observed in that region. In the simulations presented below, many of the East Asian economies are projected to continue to experience very rapid economic growth rates (assuming a reasonably rapid recovery from the present financial crisis), so that the income elasticities of demand play an important role in the model. Non-homothetic preferences are captured through use of a constant difference of elasticities (CDE) function (Hertel and Tsigas 1997). This lies between the commonly used constant elasticities of substitution (CES) function and fully flexible functional forms. Such a demand system enables non-homothetic demand to be calibrated to replicate a pre-specified vector of own-price and income elasticities of demand.

On the supply-side, differences in relative rates of factor accumulation interact with different sectoral factor intensities to drive changes in the sectoral composition of output. The GTAP production system used here distinguishes sectors by their intensities in five primary factors of production: land, other natural resources, unskilled labor, skilled labor, and physical capital. Thus in a region where physical capital is accumulating rapidly, relative to other factors, we expect the capital intensive sectors to expand at the expense of unskilled labor intensive sectors such as agriculture in East Asia. Producers are assumed to choose inputs that minimize production costs subject to separable, constant returns to scale technologies. Constant elasticity of substitution (CES) functions describe substitution possibilities between primary factors and market clearing conditions equate supply with demand for each factor of production. For intermediate inputs, the assumption of a Leontief function implies no substitution between different intermediates or between them and a composite primary factor.

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[2] See Hertel (1997, especially Chs. 2 and 3) and McDougall (1997) for detailed descriptions of the GTAP model and data base. Updated information is available at the following website: http://www.agecon.purdue.edu/gtap.

Land and other natural resources (minerals and energy raw materials) are assumed to be sector-specific in this study, except that some movement of land within agricultural sectors and between agriculture and forestry is allowed. It is assumed that 60 percent of value added by capital in each of the natural resource sectors is attributable to the specific factor (following Arndt *et al.* 1997). The single factor labour in GTAP is split into skilled and unskilled labour for this study, whereby the global GTAP database is adjusted using recent estimates of labour payments by skill level (Liu *et al.* 1997, p. 17).[3] A composite capital nest is created for human and physical capital, following Arndt *et al.* (1997).

The present Ch. follows the methodology used in Hertel *et al.* (1996) and Anderson and Pangestu (1998) but projects the world economy from 1992 not just to 2005 but to 2010 before looking at the long-run effects of Uruguay Round trade policy reforms to be implemented between now and 2005. It does the same from 2010 to 2020, to get a more realistic measure of the long-run effects of APEC reforms. We use a carefully constructed set of Uruguay Round shocks, to take into account the reality that actual reforms in Indonesia and elsewhere, particularly for farm products, will be much less than was earlier expected, thanks to 'dirty tariffication' (see Hathaway and Ingco 1996).

Table 5.1 reports the assumed rates of growth in factors and real GDP (from which the implied rates of total factor productivity growth may be derived) in the reference case for the periods from 1992 to 2010 and 2010 to 2020. Exogenous projections of each region's endowments of physical capital, unskilled and skilled labor, and population are utilized. These are based on combinations of historical data and World Bank projections of the growth in population, labor force, real GDP and investment.[4] It is clear from these estimates that

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[3] Version 4 of the GTAP data base includes this split between skilled and unskilled labour. It will also break out a natural resource input calibrated to the target elasticity of supply in resource-constrained sectors (McDougall, Elbehri, and Truong (1998).

[4] Growth rates for 1992-2010 are adapted from Anderson *et al.* (1997) and Arndt *et al.* (1997), while growth rates for 2010-2020 are adapted from the latest (at the time) estimates prepared by Christian Bach for the World Bank.

Table 5.1: Projected cumulative [and annual] percentage changes in GDP and factor endowments assumed for various countries, 1992 to 2020

(a) 1992-2010

Region	Real GDP	Physical capital	Unskilled labour	Skilled labour	Population
Indonesia	215	260	44	449	27
	[6.6]	[7.4]	[2.0]	[9.9]	[1.4]
Other APEC developing economies	202	312	26	167	19
	[6.3]	[8.2]	[1.3]	[5.6]	[1.0]
Other developing and transition economies	73	61	43	151	40
	[3.1]	[2.7]	[2.0]	[5.3]	[1.9]
APEC high-income economies	66	101	16	150	16
	[2.9]	[4.0]	[0.8]	[5.2]	[0.8]
Other high-income economies	55	53	1	394	3
	[2.5]	[2.4]	[0.1]	[9.3]	[0.2]

(b) 2010-2020

Region	Real GDP	Physical capital	Unskilled labour	Skilled labour	Population
Indonesia	95	135	17	77	14
	[6.9]	[8.9]	[1.6]	[5.9]	[1.3]
Other APEC developing economies	72	88	9	51	9
	[5.6]	[6.5]	[0.9]	[4.2]	[0.8]
Other developing and transition economies	49	46	29	62	18
	[4.1]	[3.9]	[2.6]	[5.0]	[1.7]
APEC high-income economies	27	47	3	53	7
	[2.5]	[3.9]	[0.3]	[4.3]	[0.7]
Other high-income economies	28	34	-4	79	0
	[2.5]	[3.0]	[-0.4]	[6.0]	[0.0]

Source: Strutt (1998, Ch.4) drawing on Anderson and Strutt (1996), Arndt *et al.* (1997) and, for 2010-2020, Bach (1997).

the structure of the world economy will change in a number of important ways in this base case, with the developing countries constituting a considerably larger share of the global economy by 2020. Furthermore, given the particularly high rates of savings and investment in East Asia, the capital-labor ratios of these economies are expected to increase, creating supply-side pressures for changes in the composition of output in these economies (Krueger 1977; Leamer 1987). The relatively high rates of accumulation of human capital in developing economies also are likely to contribute to pressures for structural change as developing countries upgrade the skill-intensity of their product mix. Taking all these things into account and starting with the 1992 baseline, the model generates projections of the world economy assuming no changes to existing trade and other policies. That base scenario is then compared with scenarios involving trade policy reforms.

For Indonesia, the assumed rates of factor and GDP growth are close to government expectations and are in line with past trends. Over the 13 years from 1980, for example, the population and labor force growth rates were a little higher than those being projected here for the 18 years to 2010 (1.7 and 2.3 percent historically compared with assumed rates of 1.4 and more than 2.0 in Table 5.1), while the rates of growth of physical capital and real GDP were a little lower than those projected here (7.1 and 5.8 percent historically compared with assumed rates of 7.4 and 6.6 in Table 5.1).

The model can be closed with either gross domestic product (GDP) or total factor productivity (TFP) as exogenous targets. Since projections for GDP are available, these are imposed on the model, while total factor productivity is endogenized. Empirical evidence suggests that agriculture has a higher total factor productivity growth rate than other sectors (see Martin and Mitra 1996). Therefore, the assumption made here is that agricultural productivity increases at a rate of 0.7 percent per annum higher than other sectors.

With these and myriad other assumptions including those incorporated in the GTAP model (see Hertel 1997), a projection of the world economy to 2010 is generated assuming no trade policy changes. Then the model is re-run several times: with the Uruguay Round being fully implemented; with China first excluded but then included in the WTO (the main difference being whether China is excluded or included in getting expanded access to US and EU textile and clothing markets -- see Anderson *et al.* 1997); and then with APEC liberalisation commitments also being implemented by 2020. The scenario for 2010 with the Uruguay Round fully implemented is the starting point from which to project the world economy to 2020. This too is done assuming no further trade policy changes as a base case, and that scenario is then compared with one in which the remaining trade barriers of APEC countries are removed. Indonesia's nominal rates of import protection for each sector at the beginning of each of these reform scenarios are shown in Appendix Table 5A.

How do all these changes affect the world economy? Even without the Uruguay Round being implemented, the real value of global output is projected to increase by 65 percent between 1992 and 2010, and then by a further 35 percent by between 2010 and 2020 after the Uruguay Round is implemented but without any APEC regional liberalisation. Developing countries are projected to gain enormously in significance, particularly developing APEC economies which are projected to more than double their share of world output, from 6 to 14 percent during the 1992-2020 period, and treble their share of world trade.

Indonesia in particular is projected to almost treble its contribution to world output (from 0.5 to 1.5 percent), to increase its real volume of output and trade more than six-fold over the projection period, and to change the sectoral shares of its GDP substantially. The latter are summarised in Table 5.2. It shows Indonesia's agricultural and other natural resource based sectors continuing to decline in relative importance as textiles and other light manufacturing industries grow. The grain sectors' share of GDP is projected to roughly halve by 2010, for example, and to fall by a further one-third or more in the subsequent decade (columns 5 and 6) – even though the absolute level of output keeps rising in these as in all other sectors (columns 3 and 4). Another example is that while the depletion of natural resources continues, forestry, fishing and mining outputs are projected to grow much less rapidly than aggregate national output.

Against these massive structural changes that traditionally accompany economic growth, the model's projected changes caused even by very large policy shocks are relatively modest. Table 5.3 shows, for example, how much additional impact by 2010 the Uruguay Round's implementation would have on the output of different sectors in Indonesia, both without and then with China included, and then how much extra impact the APEC reforms to 2020 would add. Since liberalisation is expected to raise GDP growth rates as well,[5] we also simulate the APEC reform assuming each APEC economy's annual GDP growth rate over the 20-year implementation period (2000 to 2020) is half a percentage point higher than in the base case, due to faster total factor productivity growth. The impact of these reforms would have to be judged as rather small in most sectors, relative to the large changes that normal economic growth is projected to generate (compare Tables 5.2 and 5.3). Nonetheless they bring substantial increases in Indonesia's economic welfare as traditionally measured even by comparative static models such as the one used here: the Uruguay Round with China included boosts real GDP for Indonesia by 1.4 percent (or 1.9 percent if China were to be excluded), and the APEC reform (to 2020) adds another 1.2 percent – even ignoring the likelihood that GDP growth would be accelerated by reform.

However, such welfare measures ignore changes in resource depletion and the environment as a consequence of the increased level and changed composition of Indonesia's output. Many environmental groups would claim that adverse resource depletion and environmental degradation effects of trade policy reform will be substantial, but very few empirical studies have sought to test that hypothesis. On environmental degradation, the following section suggests a way to examine how the changes in the aggregate level of output, the composition of that output and in the inputs and technologies used is likely to impact on air and water pollution levels. The Ch. then provides some empirical results for Indonesia's environment, followed by a discussion of results on resource depletion.

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[5] See, for example, the theoretical reasons presented in Grossman and Helpman (1991), and the rapidly growing empirical evidence presented by Baldwin (1992), Dollar (1992), Edwards (1992), Sachs and Warner (1995), Harrison (1996), and USITC (1997) and the references therein.

Table 5.2: Percentage changes in sectoral output levels and in sectoral shares of GDP due to economic growth, Indonesia, 1992-2010 and 2010-2020[a]

Sector	1992 output (US$b)	2010 output (US$b)	Change in real value of output, 1992-2010 (%)	Change in real value of output, 2010-2020 (%)	Change in sectoral share of GDP, 1992-2010 (%)	Change in sectoral share of GDP, 2010-2020 (%)
Paddy rice	7.5	14.1	87	35	-41	-31
Other grains	0.8	1.0	23	1	-61	-48
Non-grain crops	12.4	19.5	58	15	-50	-41
Livestock	3.2	6.9	113	36	-32	-30
Forestry	2.5	5.1	100	43	-36	-26
Fisheries	3.8	7.0	85	23	-41	-37
Coal	0.8	1.8	124	49	-29	-23
Oil	7.4	15.8	114	64	-32	-16
Gas	6.1	12.4	103	59	-36	-18
Other minerals	3.1	7.1	131	82	-27	-7
Food processing	24.0	44.7	87	34	-41	-31
Textiles, clothing, leather	14.1	77.4	449	177	74	42
Wood products	7.2	12.5	73	32	-45	-32
Paper products	2.7	11.7	331	132	37	19
Petroleum & coal products	5.3	18.8	253	121	12	13
Chemicals, rubber & plastics	9.4	35.8	282	120	21	13
Non-metallic mineral products	1.9	6.8	267	125	17	15
Other manufactured products	20.0	95.0	375	201	51	55
Electricity, water & gas	2.8	10.2	268	118	17	12
Construction	22.1	75.4	241	125	8	16
Trade & transport	25.0	101.0	304	120	28	13
Other private services	36.2	142.5	293	114	25	10
Other public services	8.6	46.9	447	61	74	-18
Total, all sectors	**227.0**	**769.5**	**215**	**95**		

[a] The projections for the period to 2010 maintain initial protection data, while those for the period 2010 to 2020 in columns 5 and 7 assume that the Uruguay Round, including China, has been fully implemented by 2010.

Source: GTAP V3 database and authors' model results.

Table 5.3: Percentage changes in sectoral output levels following Uruguay Round and APEC trade reforms, Indonesia, 2010 and 2020

	Uruguay Round (without China), 2010	Uruguay Round (with China), 2010	APEC liberal-isation, 2020	APEC liberal-isation, 2020 (with extra GDP growth of 0.5% pa in APEC economies)
Paddy rice	-0.6	-0.3	-1.6	5.9
Other grains	3.2	4.7	14.9	22.6
Non-grain crops	-5.1	-4.6	-13.4	-4.5
Livestock	-0.2	0.1	3.1	13.2
Forestry	-3.4	-1.1	-0.2	9.4
fisheries	-1.1	-0.7	-4.1	5.8
Coal	-12.1	-7.1	18.4	31.1
Oil	-5.4	-3.3	0.6	11.9
Gas	-5.4	-3.4	0.7	11.1
Other minerals	-8.1	-5.2	-1.6	8.3
Food processing	-0.6	-0.3	-1.7	5.8
Textiles, clothing, leather	61.9	38.5	-2.6	2.9
Wood products	-6.9	-2.4	1.2	11.5
Paper products	-7.8	-3.7	6.7	17.8
Petroleum & coal products	0.9	0.5	-2.1	7.0
Chemicals, rubber & plastics	1.1	2.5	9.2	20.8
Non-metallic mineral products	-7.5	-4.4	23.8	33.6
Other manufactured products	-19.6	-12.3	-1.9	7.4
Electricity, water & gas	2.5	1.5	1.1	10.7
Construction	0.5	-0.1	-1.5	5.9
Trade & transport	-2.4	-1.3	4.9	16.3
Other private services	-2.0	-1.4	1.3	12.1
Other public services	-0.6	-0.5	-1.0	9.3
Real GDP growth	**1.9**	**1.4**	**1.2**	**10.8**

Source: Authors' model results.

Adding an environmental module to the projections model

Accompanying economic growth and market reform are changes in the scale of output, in tastes, in the relative size of sectors, and in inputs and production technologies. These can all affect the level of pollution. How can we model these interacting forces and decompose the projected changes in environmental degradation to determine how they drive environmental change?

The model providing the projections of structural change and trade liberalisation presented above provides a starting point, to which needs to be added environmental side modules to analyse the implications of these economic changes for environmental degradation.[6] In this Ch. we use side modules to project environmental outcomes in Indonesia for water use, water pollution and air pollution. The data for the side modules are based on a comprehensive environmental input-output data set prepared by Duchin *et al.* (1993) using data collected in Indonesia for 1985 and 2020 by industry for various types of environmental degradation. The authors use a case study approach to project anticipated changes in technology to 2020. Twelve case studies generated data reflecting the views of experts assuming a continuation of current policies. Specialists such as chemical engineers, hydrologists, environmental scientists, energy experts and agricultural scientists were consulted on the technologies likely to be adopted in coming decades.[7] For water use there are data on the volume of water used and discharged by sector. Four measures of the water pollution content of the effluent are provided: biological oxygen demand

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[6] The approach of augmenting CGE models with environmental side models has been taken by a number of researchers. For example, Bandara and Coxhead (1995) look at soil erosion in a single country model. Perroni and Wigle (1997) use an innovative side model to analyse global externalities and abatement costs with GTAP. There have also been attempts to incorporate environmental equations and parameters more directly into a CGE model (for example, Xie 1996).

[7] Other scenarios are also presented where the government is assumed to place heavier emphasis on environmental protection and resource conservation. Since we do not explicitly model improved environmental policies here, only the scenario of current trends is used.

(BOD), chemical oxygen demand (COD), dissolved solids (DS), and suspended solids (SS). The available air pollutant indicators are carbon dioxide and oxides of sulphur and nitrogen.[8]

Based on the data from Duchin *et al.* (1993), we assemble a matrix of environmental coefficients to estimate the environmental impact per unit of economic activity in each sector for 1992, 2010 and 2020 by assuming trends in environmental parameters per unit of output are linear over the period 1985-2020. The GTAP 1992 benchmark database for Indonesia is calibrated to this 1992 matrix of total emissions to derive environmental damage coefficients per unit of GTAP sectoral output in that base year. The proportional changes in these environmental coefficients over time are then multiplied by the GTAP 1992 environmental coefficients to obtain GTAP environmental coefficients for 2010 and 2020. This approach captures the expected change in environmental coefficients in a consistent way that is used to augment GTAP analysis.

Three sources of environmental effects of policy changes are able to be identified: the change in the level of aggregate economic activity, the change in the contribution of each sector to output, and the change in production technology. This decomposition is useful for disentangling the causes of changes in environmental damage.[9] Define the total change in pollution (P) as the sum of the changes in pollution in each sector $\left(P_j\right)$:

$$P = \sum_{j=1}^{n} P_j \ .$$

The change in pollution in each sector *j* is the sum of the "aggregate activity" effect $\left(A_j^o\right)$, the "intersectoral composition" effect $\left(C_j^o\right)$, and the "technology" effect $\left(T_j\right)$:

$$P_j = A_j^o + C_j^o + T_j$$

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8 Pollution from final consumption by households is not included in the model, for want of data.

9 The decomposition developed here is in some ways similar to the "scale", "composition" and "technique" effects of income growth on the level of environmental emissions discussed by Dean (1996, 1999). Beghin *et al.* (1997, 1999) also discuss such a three-way decomposition.

In the aggregate activity effect, increased economic activity leads to increased demand for all goods and services and therefore increased emissions. The change in output due to the aggregate activity effect is the proportional change in aggregate real output in the economy (g) multiplied by the initial output in each sector (X_j). This gives the change in the scale of output in each sector with all sectors growing at the aggregate growth rate of the economy. The change in the scale of output in each sector is then multiplied by the initial environmental coefficient for each sector (E_j^o) to give the change in environmental emissions in each sector due to the aggregate activity effect:

$$A_j^o = X_j * g * E_j^o$$

The second effect is the intersectoral composition effect. Because some sectors are more polluting than others, changes in the composition of output will change pollution, even if aggregate output were to remain constant. The intersectoral effect is measured by allowing the composition of output to change while maintaining aggregate output at its initial level. Some sectors contract and others expand. This has some similarities with Dean's (1996) composition effect, where emissions decrease if income growth shifts preferences toward income elastic cleaner goods, but we model the general equilibrium-determined intersectoral effects. Both producers and consumers respond to the changed incentives, given their behavioural functions and the various constraints on the economy. Demand and supply of each commodity in each region of the world respond to changing relative prices, given the elasticities implicit for each sector. The change in sectoral output due to the intersectoral composition effect is found by multiplying the initial output in each sector by the difference between the proportional change in output in that sector (x_j) and the aggregate proportional change in output in the economy (g) to give the change in the relative size of each sector. This change in the contribution of each sector is multiplied by the initial environmental coefficient for each sector to give that sector's change in environmental emissions due to the intersectoral composition effect, C_j^0, where

$$C_j^o = X_j * (x_j - g) * E_j^o$$

Thirdly, there is the "technology" effect, which is modelled using Duchin *et al.*'s (1993) set of environmental parameters reflecting expert opinion on anticipated changes to production methods.[10] Changes in technology will change the amount of degradation caused by each unit of output in each sector. Total emissions with the new coefficients are compared to total emissions with the old environmental coefficients in place. The first square bracketed term of the following equation reflects the new environmental coefficient $\left(E_j^n\right)$ applied to both the aggregate activity and the intersectoral composition components of changes in output. The second square bracketed part of the equation reflects the idea that the initial output in each sector will also be produced using the new technology and will therefore contribute to a change in emissions.

$$T_j = \left[\left(A_j^n - A_j^o\right) + \left(C_j^n - C_j^o\right)\right] + \left[X_j * \left(E_j^n - E_j^o\right)\right]$$

where

$$A_j^n = X_j * g * E_j^n$$

and

$$C_j^n = X_j * (x_j - g) * E_j^n$$

However, for policy changes such as trade liberalisation where we start from the appropriate updated database, we assume that the new technology is in place and that the trade reform itself does not change the environmental damage coefficients.

Empirical projections of environmental impacts in Indonesia of structural and policy changes to 2020

Projected environmental effects due to growth and structural changes

This section uses the detailed environmental side modules to analyse some of the environmental implications of first the growth

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[10] For a discussion of other possible components of the technique effect, see Fredriksson (1999).

and structural changes projected for Indonesia and then the trade policy changes by 2010 and 2020.

Table 5.2 shows the 1992 and projected 2010 output levels for each sector, evaluated at 1992 prices, and the proportional changes in output due to structural changes associated with economic growth projected over that period, assuming no trade policy changes. Changes over the subsequent decade also are shown. With the large growth in the economy projected from 1992 to 2010 and 2010 to 2020, all sectors exhibit increased output levels in Indonesia but some expand much more than others. We use environmental side modules to estimate the effects of these changes in output on air and water pollution.

Air pollution

Atmospheric emission changes are estimated for carbon dioxide and oxides of sulphur and nitrogen. Table 5.4 lists the initial 1992 level and projected new levels of emissions for 2010 without the Uruguay Round or APEC being implemented, and 2020 after the Round's implementation but without APEC trade reform. Large increases are projected for all of these air pollutants. Since the Indonesian economy is projected to grow by 215 percent between 1992 and 2010 and a by further 95 percent by 2020, this finding is not surprising. Carbon emissions increase by 134 percent in the first projected period and by 56 percent for the decade to 2020. Sulphur oxides increase by 132 and 50 percent and nitrogen oxides increase by 162 and 65 percent.

The aggregate output effect increases each sector's output, while the technology and intersectoral composition effects may add to or dampen the impact of increased aggregate output on emissions. Table 5.5 decomposes these air pollution effects to give a more precise indication of the relative magnitudes of the aggregate activity, the intersectoral composition and the technology effects. The table suggests the aggregate activity effects are the main driving force behind the increase in projected emissions, but that the intersectoral composition effects of structural change adds to that effect for all air pollutants. This is because there is a relatively high increase in the contribution to output of high air polluting sectors such as the electricity, water and gas sector and the trade and transport sector. Sectors that are not very high air polluters, such as agricultural sectors, tend to decline in relative importance.

While the aggregate activity effect, and to a much lesser extent the intersectoral composition effect, increase air pollution during the period to 2020, many sectors' emissions of carbon and oxides of sulphur and nitrogen grow less rapidly than output because of improvements in energy efficiency. This is shown by the technique effect which is negative for all air pollutants in Table 5.5, reflecting the improved technologies expected to become available.

Water use and pollution

Table 5.6 presents water use and water pollution results, calculated for the various sectors using GTAP simulation results and a water use and pollution side module.[11] Manufacturing sectors face two offsetting trends in their use of water. Growth occurs in water-intensive sectors like pulp and paper, but new technologies for conserving water are expected to be adopted over time. Overall there is a significant increase in water uptake in the textiles, other manufacturing and pulp and paper sectors. Even by 2010 these more than double their water use, while household water use increases by almost 50 percent. However increases in water use are dwarfed by the savings in water uptake for paddy rice, which is the largest user of water in our model. That comes from the significantly improved efficiencies anticipated in irrigation delivery systems as well as from the changing intersectoral composition of output. As a consequence, total water withdrawals fall over the projection periods, by 4 percent to 2010 and by a further 36 percent by 2020. Between 1992 and 2010, we project water discharge to increase by 126 percent, with a further 29 percent increase by 2020 (column 2 of Table 5.5). The decomposition in Table 5.5 shows that the intersectoral composition effect augments the aggregate activity effect a little. The relative increases are in textiles, pulp and paper and other manufactures, which are all large producers of waste water. However, improved technologies dampen the effect of increases in water discharged.

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[11]Increases in household water use are taken from estimates in Duchin *et al.* (1993) and entered exogenously, assuming Indonesia's population increases to 263 million by 2020.

Table 5.4: Recent and projected levels of atmospheric emissions in base cases, Indonesia, 1992, 2010, and 2020[a] (kt)

	1992			*2010*			*2020*		
	carbon	*sulphur*	*nitrogen*	*Carbon*	*sulphur*	*nitrogen*	*carbon*	*sulphur*	*nitrogen*
Paddy rice	1	0.0	0.1	2	0.0	0.1	3	0.0	0.2
Other grains	16	0.0	0.9	20	0.0	1.1	21	0.0	1.2
Non-grain crops	241	0.3	14.0	378	0.5	22.0	415	0.5	24.2
Livestock	310	0.4	17.9	677	0.8	39.1	931	1.1	53.8
Forestry	246	0.3	14.4	485	0.6	28.3	682	0.8	39.8
Fisheries	531	0.6	31.1	882	1.1	51.6	1,014	1.2	59.3
Coal	853	25.2	5.8	956	28.2	6.5	589	17.4	4.0
Oil	4,463	53.4	31.1	9,187	109.9	64.0	14,244	170.3	99.2
Gas	4,096	0.8	39.2	6,129	1.2	58.7	7,549	1.5	72.3
Other minerals	409	11.1	1.5	650	17.6	2.4	837	22.7	3.1
Food processing	489	13.0	1.8	752	19.9	2.8	890	23.5	3.3
Textiles, clothing, leather	293	7.7	1.1	770	20.1	3.0	1,160	29.9	4.6
Wood products	481	12.9	1.8	880	23.6	3.2	1,167	31.3	4.2
Paper products	217	6.3	1.5	712	20.8	5.0	1,317	38.9	9.7
Petroleum & coal products	1,305	17.4	8.3	4,047	54.4	25.7	8,302	112.4	52.8
Chemicals, rubber & plastics	3,330	35.6	26.6	5,930	65.9	47.3	4,867	60.8	38.6
Non-metallic mineral products	894	25.6	5.4	2,503	73.0	16.8	4,448	131.9	32.5
Other manufactured products	880	23.0	3.4	1,997	52.0	7.8	2,074	53.5	8.2
Electricity, water & gas	7,843	168.2	102.8	18,045	347.1	241.6	26,637	434.2	366.8
Construction	10,547	69.2	37.9	25,007	164.1	89.9	42,587	279.5	153.1
Trade & transport	10,322	129.8	532.5	30,564	384.5	1,578.4	52,865	665.4	2733.0
Other private services	193	1.2	0.8	559	3.4	2.2	943	5.7	3.7
Other public services	709	4.1	2.8	2,882	16.8	11.4	3,724	21.6	14.8
Total, all sectors	**48,668**	**606**	**882**	**114,014**	**1,405**	**2,309**	**177,264**	**2,104**	**3,782**

[a] 2020 levels include Uruguay Round implementation. Source: Authors' model results

Table 5.5: Decomposition of changes in pollution as a consequence of economic growth and structural changes, Indonesia, 1992-2010 and 2010-2020

(a) 1992-2010

	Total pollution change[a]		Aggregate activity effect	Intersectoral composition effect	Technology effect
Carbon (kt)	65,346	**[134]**	**104,607**	**10,149**	**-49,409**
Sulphur (kt)	799	**[132]**	**1,302**	**214**	**-716**
Nitrogen (kt)	1,427	**[162]**	**1,897**	**392**	**-862**
Water in (bm^3)[b]	-12	**[-4]**	**685**	**-388**	**-309**
Water out (bm^3)	0.8	**[126]**	**1.3**	**0.7**	**-1**
BOD (kt)	81	**[52]**	**337**	**176**	**-433**
COD (kt)	341	**[64]**	**1,149**	**726**	**-1,534**
DS (kt)	-17	**[-46]**	**79**	**-47**	**-48**
SS (kt)	105	**[23]**	**1,002**	**638**	**-1,536**

(b) 2010-2020

	Total pollution change[a]		Aggregate activity effect	Intersectoral composition effect	Technology effect
Carbon (kt)	63,982	**[56]**	**107,244**	**16,904**	**-60,166**
Sulphur (kt)	707	**[50]**	**1,323**	**276**	**-893**
Nitrogen (kt)	1,495	**[65]**	**2,165**	**366**	**-1,035**
Water in (bm^3)[b]	-109	**[-36]**	**296**	**-167**	**-236**
Water out (bm^3)	0.4	**[29]**	**1.3**	**1.0**	**-2**
BOD (kt)	-13	**[-5]**	**223**	**146**	**-382**
COD (kt)	-2	**[-0]**	**822**	**587**	**-1412**
DS (kt)	-13	**[-65]**	**19**	**-12**	**-19.5**
SS (kt)	-211	**[-37]**	**545**	**474**	**-1231**

[a] Percentages changes from base case are shown in square parentheses.

[b] This does not include the change in household water use.

Source: Authors' model results.

The water pollution changes we model are biological oxygen demand (BOD), chemical oxygen demand (COD), dissolved solids (DS) and suspended solids (SS). These emissions are assumed to be determined by the quantity of waste water produced. Once we have calculated the proportional change in water output for each sector, we can estimate the change in water pollution by sector. Because of the aggregate activity effect, emissions of all water pollutants except for dissolved solids rise between 1992 and 2010 (Table 5.5(a)).

However, emissions rise by significantly less than the proportional increase in total output in Indonesia. This is mainly due to the improved technology assumed to be available in 2010. The intersectoral composition effect for all water pollutants, with the exception of dissolved solids, is positive due to the increased relative significance of the polluting industries. The composition effect in both projected periods moves production into the sectors we model as being the most important producers of water pollutants, particularly textiles, pulp, paper, and other manufactures. For dissolved solids, the composition effect is negative with the reduced significance of the food processing sector.

For the period to 2010, the assumed technology effect offsets over 80 percent of the aggregate activity and intersectoral effects for all water pollutants. And for the period to 2020, the technology effect is sufficiently strong to overturn the positive aggregate activity and intersectoral effects to give a net reduction in pollution for all water pollutants.

Projected environmental effects of Uruguay Round and APEC trade reforms

How much difference will it make to those environmental effects of economic growth to impose on Indonesia and others some trade reforms? The first two columns of Table 5.3 show the proportional change in output due to Uruguay Round liberalisation, first without and then with the inclusion of China as a WTO member. The second pair of columns show the projected sectoral changes in output due to APEC liberalisation. Leaving aside the final scenario in which economic growth is assumed to be boosted by APEC liberalisation (discussed separately below), some sectors reduce and other sectors (continued p.83)

Table 5.6: Recent and projected levels of water use and quality in the base cases, Indonesia, 1992, 2010, and 2020[a]

Base level for 1992	Water in (millionm^3)	Water out (million m^3)	BOD (kt)	COD (kt)	Dissolved solids (kt)	Suspended solids (kt)
Paddy rice	313,072	0	0	0	0	0
Livestock	8	0	0	0	0	0
Food processing	124	97	21	30	37	49
Textiles, clothing, leather	102	102	18	72	0	87
Paper products	217	97	64	217	0	70
Chemicals, rubber, plastics	5	4	0	0	0	0
Other manufactures	307	307	54	216	0	261
Households	10,704	0	0	0	0	0
Total, all sectors	324,538	608	157	534	37	466
2010	**Water in (million m^3)**	**Water out (million m^3)**	**BOD (kt)**	**COD (kt)**	**Dissolved solids (kt)**	**Suspended solids (kt)**
Paddy rice	300,439	0	0	0	0	0
Livestock	16	0	0	0	0	0
Food processing	132	104	12	17	20	24
Textiles, clothing, leather	278	278	32	127	0	129
Paper products	519	262	111	402	0	83
Chemicals, rubber, plastics	9	9	0	0	0	0
Other manufactures	720	720	82	329	0	334
Households	15,712	0	0	0	0	0
Total, all sectors	317,825	1,372	238	875	20	571
2020	**Water in (millionm^3)**	**Water out (million m^3)**	**BOD (kt)**	**COD (kt)**	**Dissolved solids (kt)**	**Suspended solids (kt**
Paddy rice	190,557	0	0	0	0	0
Livestock	21	0	0	0	0	0
Food processing	104	82	5	7	7	7
Textiles, clothing, leather	460	460	37	147	0	115
Paper products	645	390	115	449	0	37
Chemicals, rubber, plastics	11	10	0	0	0	0
Other manufactures	822	822	65	263	0	206
Households	18,494	0	0	0	0	0
Total, all sectors	211,114	1,764	223	866	7	365

[a] 2020 levels include Uruguay Round implementation.

Source: Authors' model results.

increase their output level because of trade reform, in contrast to the middle columns of Table 5.2 for structural change projections where all sectors increase their output. We therefore can expect the composition effects to be much stronger relative to the aggregate activity effects in these reform cases, in contrast to the growth and structural change scenarios discussed above.

The results in Table 5.3, coming from a global model, include the effects on output levels in Indonesia of changes in protection and relative prices in other regions. The sector that experiences the greatest proportional increase in Indonesia with Uruguay Round implementation is textiles and clothing, with a 60 percent boost to output anticipated if China is kept out of the WTO, or just under 40 percent if China is able to join (as indeed it did, in December 2001). With additional APEC liberalisation, the effects on the textile sector are much less pronounced because MFA quotas are assumed to have been already phased out as part of the Round's implementation. The sectors that tend to do well with APEC reform are instead the coal and non-metallic minerals -- sectors which Indonesia's own policies tend to discriminate against. The corn (coarse grains) sector also is projected to do well.

What do these output changes do to pollution levels? Again, we consider effects on first air and then water, recognising that emissions will increase in some sectors and fall in others in response to Uruguay Round and APEC trade reforms.

Air pollution

Table 5.7 indicates that a *reduction* in air pollution is projected for Indonesia under Uruguay Round liberalisation (including China), rather than the increase feared by environmentalists. The reduction from 2010 baseline levels is 0.6 percent for carbon and sulphur oxides and 1.0 percent for nitrogen oxides. The decomposition in Table 5.7 shows that the aggregate activity effect adds to air pollution but the change in the intersectoral composition of output reduces air pollution by more.

When the total change in emissions is examined by sector (Table 5.8), we find that the most significant reduction is contributed by the trade and transport sector. The output of textiles rises more than that in any other sector, but since it is starting from a relatively low base of air emissions, the increase in air pollutants from this sector is more than outweighed by reductions occurring in other sectors. If China is not included in the WTO and hence by assumption does not liberalise its trade, the reductions in Indonesia's air pollution almost double relative to the reductions shown in Table 5.7 when China is included. This is primarily because the Indonesian textile and clothing sector does not grow as much when China is included and hence that sector does not pull as many resources away from other more-polluting sectors. However, the greater carbon and other emissions in Indonesia are possibly more than offset by a reduction in emissions in China following its accession to WTO and thereby its assumed greater access to textile markets in the United States and the EU.[1]

With additional APEC trade liberalisation, air pollution is projected to increase but, as shown in Table 5.9, the increases are only between 2 and 4 percent. Moreover, a small number of sectors drive the results. For example, the trade and transport sector contributes over 45 percent of the increase in air pollution (unreported further decomposition of results in Table 5.9). This makes it relatively easy to target that pollution with environmental taxes to reduce the impact of trade reform on emissions, should that small increase be considered a problem. The key point to draw from these results, however, is that the air pollutive effects of even these major trade liberalisations is tiny (at less than 4 percent of the base level), and is especially small compared with the increases that will accompany normal economic growth and structural changes, as can be seen by the numbers in square parentheses in Tables 5.7 and 5.9.

Water use and pollution

Water withdrawals are reduced by both trade liberalisations. Table 5.7 shows a reduction in withdrawals of 0.3 percent with Uruguay Round implementation, while Table 5.9 shows that water withdrawals reduce by a further 1.6 percent with APEC

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[1] When China is excluded, the group of 'Other APEC developing economies' (which includes China) expand their output of textiles and clothing by only 8 percent following Uruguay Round implementation, whereas with China included, that sector expands 25 percent (Strutt 1998, Ch. 5).

liberalisation. These water use reductions are largely due to a reduction in paddy output.

Table 5.7: Decomposition of pollution effects from Uruguay Round trade reform (incl. in China), Indonesia, 2010
(percentage change from 2010 baseline level in curved parentheses, percent of the 1992-2010 absolute change in square parentheses)

	Total change	Aggregate activity	Intersectoral composition
Carbon (kt)	**-733**	1,585	-2,318
	(-0.6)	(1.4)	(-2.0)
	[-1.1]	[2.4]	[-3.5]
Sulphur (kt)	**-8**	20	-27
	(-0.6)	(1.4)	(-1.9)
	[-1.0]	[2.4]	[-3.4]
Nitrogen (kt)	**-22**	32	-54
	(-1.0)	(1.4)	(-2.3)
	[-1.5]	[2.2]	[-3.8]
Water in	**-0.8**	4	-5
(billion m^3)	**(-0.3)**	(1.4)	(-1.6)
	[-7]	[35]	[-42]
Water out	**0.01**	0.02	-0.01
(billion m^3)	**(0.6)**	(1.4)	(-0.8)
	[1.1]	[2.4]	[-1.3]
BOD (kt)	**-2.0**	3	-5
	(-0.9)	(1.4)	(-2.3)
	[-2.5]	[4.1]	[-6.6]
COD (kt)	**-6.5**	12	-19
	(-0.7)	(1.4)	(-2.1)
	[-1.9]	[3.6]	[-5.5]
DS (kt)	**-0.05**	0.3	-0.3
	(-0.3)	(1.4)	(-1.7)
	[-0.3]	[1.6]	[-2.0]
SS (kt)	**5.3**	8	-3
	(0.9)	(1.4)	(-0.5)
	[5.0]	[7.6]	[-2.5]

Source: Authors' model results.

Table 5.8: Sectoral decomposition of the total change in emissions due to Uruguay Round implementation, Indonesia, 2010

	Carbon (kt)	Sulphur (kt)	Nitrogen (kt)	Water in (bm³)	Water out (bm³)	BOD (kt)	COD (kt)	DS (kt)	SS (kt)
Paddy rice	-0.01	0.00	0.00	-0.78	0.00	0.00	0.00	0.00	0.00
Other grains	0.93	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Non-grain crops	-17.33	-0.02	-1.01	0.00	0.00	0.00	0.00	0.00	0.00
Livestock	0.95	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Forestry	-5.09	-0.01	-0.30	0.00	0.00	0.00	0.00	0.00	0.00
Fisheries	-6.35	-0.01	-0.37	0.00	0.00	0.00	0.00	0.00	0.00
Coal	-67.89	-2.00	-0.46	0.00	0.00	0.00	0.00	0.00	0.00
Oil	-301.33	-3.60	-2.10	0.00	0.00	0.00	0.00	0.00	0.00
Gas	-207.77	-0.04	-1.99	0.00	0.00	0.00	0.00	0.00	0.00
Other minerals	-33.86	-0.92	-0.13	0.00	0.00	0.00	0.00	0.00	0.00
Food processing	-2.03	-0.05	-0.01	0.00	0.00	-0.03	-0.05	-0.05	-0.07
Textiles, clothing, leather	296.17	7.71	1.15	0.11	0.11	12.20	48.81	0.00	49.57
Wood products	-21.47	-0.58	-0.08	0.00	0.00	0.00	0.00	0.00	0.00
Paper products	-26.13	-0.76	-0.18	-0.02	-0.01	-4.08	-14.74	0.00	-3.05
Petroleum & coal products	21.45	0.29	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Chemicals, rubber & plastics	150.03	1.67	1.20	0.00	0.00	0.00	0.00	0.00	0.00
Non-metallic mineral products	-108.88	-3.17	-0.73	0.00	0.00	0.00	0.00	0.00	0.00
Other manufactured products	-246.05	-6.40	-0.96	-0.09	-0.09	-10.14	-40.55	0.00	-41.18
Electricity, water & gas	276.08	5.31	3.70	0.00	0.00	0.00	0.00	0.00	0.00
Construction	-27.51	-0.18	-0.10	0.00	0.00	0.00	0.00	0.00	0.00
Trade & transport	-385.10	-4.84	-19.89	0.00	0.00	0.00	0.00	0.00	0.00
Other private services	-7.71	-0.05	-0.03	0.00	0.00	0.00	0.00	0.00	0.00
Other public services	-13.83	-0.08	-0.05	0.00	0.00	0.00	0.00	0.00	0.00
Total, all sectors	**-732.75**	**-7.74**	**-22.09**	**-0.78**	**0.01**	**-2.05**	**-6.53**	**-0.05**	**5.27**

Source: Authors' model result

Most water pollutants also decline with Uruguay Round implementation, as shown in Table 5.7. The declines are just under 1 percent for BOD, COD and dissolved solids, but there is an increase of just under 1 percent in suspended solids. For APEC liberalisation, Table 5.9 reports a 2.4 percent increase in BOD and COD but reductions in solids of between 1 and 2 percent. Thus as with air pollution, these results show that trade reform will at most add only a very small amount to water use and pollution, an amount that would not be discernible alongside the increased BOD and COD pollution associated with the general expansion of the economy over time.

Resource depletion

The impact of trade liberalisation on natural resource depletion can be crudely inferred from changes in primary production. In the case of the Uruguay Round, the first column of Table 5.10 shows that most primary production is reduced by that liberalisation. This suggests that less rather than more depletion of Indonesia's natural resources will take place because of the Uruguay Round reforms. Of course there are some offsetting changes in other economies, but the final column of Table 5.10 shows that in aggregate the changes to natural resource use from the Round will be tiny.

What if trade reform boosts economic growth?

The above simulations of trade reform are from a comparative static model and so do not include the impact that trade reform would have in boosting economic growth. Hence it understates the extent of pollution that might result. To get a feel of how large that bias might be, we re-ran the APEC liberalisation but assumed that APEC economies' GDPs would grow substantially faster (by half a percentage point per year over the 20-year implementation period to 2020) through a boost to their total factor productivity growth. The impact of APEC reform including that faster growth on the pollution results is shown in Table 5.11, based on the output effects summarised in the final column of Table 5.3. Not surprisingly, that change in assumption raises the effect of liberalisation on pollution.

Table 5.9: Decomposition of pollution effects in Indonesia under APEC liberalisation, 2020 (percent change from 2020 baseline level shown in curved parentheses, percent of the 1992-2020 absolute change is in square parentheses)

	Total change	Aggregate activity	Intersectoral composition
Carbon (kt)	**3,736**	2,124	1,612
	(2.1)	(1.2)	(0.9)
	[2.9]	[1.6]	[1.3]
Sulphur (kt)	**72**	25	47
	(3.4)	(1.2)	(2.2)
	[4.8]	[1.7]	[3.1]
Nitrogen (kt)	**144**	45	99
	(3.8)	(1.2)	(2.6)
	[4.9]	[1.6]	[3.4]
Water in	**-3.0**	2.3	-5.3
(billion m^3)	**(-1.6)**	(1.2)	(-2.8)
	[-2.5]	[1.9]	[-4.4]
Water out	**-0.002**	0.02	-0.02
(billion m^3)	**(-0.1)**	(1.2)	(-1.3)
	[-0.2]	[1.8]	[-1.9]
BOD (kt)	**5.4**	2.7	2.7
	(2.4)	(1.2)	(1.2)
	[7.9]	[3.9]	[4.0]
COD (kt)	**21.1**	10.4	10.8
	(2.4)	(1.2)	(1.2)
	[6.2]	[3.0]	[3.2]
DS (kt)	**-0.13**	0.09	-0.21
	(-1.8)	(1.2)	(-3.1)
	[-0.4]	[0.3]	[-0.7]
SS (kt)	**-4.5**	4.4	-8.9
	(-1.2)	(1.2)	(-2.4)
	[-4.2]	[4.1]	[-8.4]

Source: Authors' model results.

Table 5.10: Percentage changes in resource-sector output levels in various regions of the world following Uruguay Round trade reform (including China), 2010

	Indonesia	Other APEC developing economies	Other developing & transition economies	APEC high-income economies	Other high-income economies	Total world
Paddy rice	-0.3	2.9	-1.3	-1.0	-3.1	0.48
Non-grain crops	-4.6	4.3	-0.4	2.0	-2.9	0.59
Livestock	0.1	-1.4	-1.6	0.9	1.2	-0.06
Forestry	-1.1	-0.7	-0.1	-0.0	1.9	-0.03
Fisheries	-0.7	-7.4	0.1	-0.4	5.1	-0.21
Coal	-7.1	-0.6	0.2	-0.3	1.0	0.03
Oil	-3.3	-2.9	0.2	0.1	0.4	-0.04
Gas	-3.4	-1.4	0.1	0.5	0.1	0.06
Other minerals	-5.2	-5.0	-0.7	-1.4	1.9	-0.39

Source: Authors' model results.

Even so, the numbers are relatively small: air pollution is 12-15 percent greater and water pollution 6-12 percent greater, than would have been the case in 2020 (instead of no more than 4 percent as when we assume no growth effect of APEC reform). This amount is less than one fifth of the air pollution (and a somewhat larger fraction of the water pollution) that would result from the normal output expansions and structural changes that would take place without reform. Moreover, that extra pollution due to accelerated growth is accompanied by a much greater boost to economic welfare as conventionally measured than when we assume there is no growth effect of trade reform: Indonesia's GDP in 2020 is 10.8 percent higher in this growth-enhancing case, compared with only 1.2 percent higher in the earlier APEC reform case that assumed no growth effect. This provides considerable compensation for the extra pollution, allowing some of that extra income to be spent on pollution abatement.

Table 5.11: Decomposition of pollution effects in Indonesia under APEC liberalisation, with 0.5 percent p.a. extra GDP growth in APEC economies, 2020

(percentage change from 2020 baseline level shown in curved parentheses, percent of the 1992-2020 absolute change is in square parentheses)

	Total change	Aggregate activity	Intersectoral composition
Carbon (kt)	**21,142**	19,091	2,051
	(12)	(11)	(1)
	[16]	[15]	[2]
Sulphur (kt)	**283**	227	57
	(14)	(11)	(3)
	[19]	[15]	[4]
Nitrogen (kt)	**557**	407	149
	(15)	(11)	(4)
	[19]	[14]	[5]
Water in (billion m^3)	**11**	21	-9
	(6)	(11)	(-5)
	[9]	[17]	[-8]
Water out (billion m^3)	**0.15**	0.19	-0.04
	(9)	(11)	(-2)
	[13]	[16]	[-3]
BOD (kt)	**27**	24	3
	(12)	(11)	(1)
	[39]	[35]	[4]
COD (kt)	**104**	93	11
	(12)	(11)	(1)
	[31]	[28]	[3]
DS (kt)	**0.4**	0.8	-0.4
	(6)	(11)	(-5)
	[2]	[3]	[-1]
SS (kt)	**26**	39	-14
	(7)	(11)	(-4)
	[24]	[37]	[-13]

Source: Authors' model results.

What if we include the impact of East Asia's growth interruption?

Chapter two above discusses the impact of an interruption to East Asian economic growth in the late 1990s. Here we use the sectoral outputs generated in those projections to briefly discuss the environmental implications of the slowdown.[1]

The growth interruption has significant implications for the change in pollution projected from 1992-2005. Table 5.12 compares the effect on pollution of the standard projection to 2005 with the interrupted growth scenario (2005ig). As anticipated, the much smaller change in aggregate output with interrupted growth gives rise to much smaller environmental effects. Our assumption is that GDP growth rises by only 48 percent over the 13-year period compared with 130 percent when there is no interruption to growth. The large reduction in cumulative growth leads to the significantly reduced aggregate activity effects. Intersectoral composition effects

Also are smaller in magnitude since the Indonesian economy undergoes less structural transformation. With less production to take advantage of improved technology, the positive environmental impact of the technology effects are not as strong in the interrupted growth scenario. However, the dominant effect for most pollutants is the aggregate activity effect which does lead to less environmental damage in the interrupted growth scenario.

The slower cumulative growth also has implications for the environmental impact of the Uruguay Round. Table 5.13(a) shows the environmental impact of the Uruguay Round from the standard 2005 projection, while Table 5.13(b) is for the Uruguay Round from the interrupted growth projection. The relative magnitudes of the various pollution changes are similar and are still negative for most pollutants (for reasons discussed earlier). However the projections for the interrupted growth scenario are much smaller in absolute terms since the Uruguay Round implementation is now occurring from an assumed lower level of economic activity.

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[1] These projections are only to 2005, therefore results are not directly comparable with the 2010 Uruguay Round results reported earlier in this Chapter.

Table 5.12: Changes in pollution as a consequence of economic growth and structural changes, Indonesia (a) 1992-2005 and (b) interrupted growth scenario, 1992-2005ig

(a) 1992-2005	**Total pollution change**	**Aggregate activity effect**	**Intersectoral composition effect**	**Technology effect**
Carbon (kt)	**42,857**	63,040	4,897	-25,079
Sulphur (kt)	**533**	785	109	-360
Nitrogen (kt)	**926**	1,143	218	-435
Water in (bm^3)a	**9**	417	-210	-197
Water out (bm^3)	**0.5**	0.8	0.3	-0.6
BOD (kt)	**65**	203	83	-221
COD (kt)	**267**	692	345	-770
DS (kt)	**-11**	48	-26	-32
SS (kt)	**120**	604	299	-783
(b) 1992-2005ig	**Total pollution change**	**Aggregate activity**	**Intersectoral composition**	**Technology effect**
Carbon (kt)	**9,895**	23,142	2,398	-15.644
Sulphur (kt)	**105**	288	37	-220
Nitrogen (kt)	**217**	420	57	-259
Water in (bm^3)[a]	**-58**	160	-58	-160
Water out (bm^3)	**0.04**	0.29	0.82	-0.33
BOD (kt)	**-30**	75	22	-126
COD (kt)	**-85**	254	92	-431
DS (kt)	**-16**	17	-8	-25
SS (kt)	**-140**	222	74	-436

[a] This does not include the change in household water use.
Source: Authors' model results.

Conclusions and future research directions

If present environmental policies remain unchanged, projected economic growth and structural changes over the next two decades would, according to the above simulations, add to environmental degradation and resource depletion in Indonesia. This is not an argument against economic growth of course, but rather for the need to introduce or strengthen the enforcement of environmental and resource policies to internalize some of the externalities associated with output and consumption expansion. When optimal environmental (and other) policies are in place and are continually adapted to remain optimal over time, it follows that economic growth enhances social welfare. There may be more environmental degradation or further resource depletion, but at least those changes would be optimal from that society's viewpoint, given the actual or opportunity cost of avoidance or abatement. Likewise, trade reform can contribute to environmental damage and resource depletion, but again that will not be nationally welfare-reducing so long as optimal environmental (and other) policies are always in place.

A concern of some people, though, is that developing countries' environmental and resource policies may not be optimal even nationally, let alone from a global perspective, and that trade liberalisation with no change in those environmental and resource policies therefore could be bad for the environment. Hence the reason in the present empirical study for looking at trade reform without changing environmental and resource policies.[2]

This case study of Indonesia suggests that trade policy reforms slated for the next two decades in some cases would improve the environment (at least with respect to air and water pollution) and reduce the depletion of natural resources in that country and in the worst cases would add only very slightly to environmental degradation and resource depletion even without toughening the enforcement of existing environmental and resource regulations or adding new ones. The increases in pollution, where they occur, are driven primarily by a small number of sectors which could be targeted with policies to help ensure no increase in emissions. The economic gains from the trade reforms and the scope for adopting well-targeted environmental and resource policies to reduce any serious damage are such that social welfare almost certainly is going to be improved by these liberalisations.[3]

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[2] For more on modelling the responses of environmental policies to trade reforms (something which has not been attempted in the present study), see the recent paper on Mexican agriculture by Beghin *et al.* (1997).

[3] Furthermore, a related study which focuses on land degradation through soil erosion and associated off-site damage draws a similar conclusion (see Ch.

Table 5.13: Decomposition of pollution effects from Uruguay Round trade reform (including in China), Indonesia (a) 2005 and (b) 2005ig

(a) 2005	Total change	Aggregate activity	Intersectoral composition
Carbon (kt)	**-641**	1,266	-1,907
Sulphur (kt)	**-7**	16	-23
Nitrogen (kt)	**-20**	25	-45
Water in (b. m^3)	**-1.7**	4.5	-6.2
Water out (b. m^3)	**0.013**	0.016	-0.002
BOD (kt)	**-1.2**	3.1	-4.3
COD (kt)	**-2.9**	11.1	-13.9
DS (kt)	**-0.14**	0.36	-0.5
SS (kt)	**8.9**	8.1	0.8
(b) 2005ig	**Total change**	**Aggregate activity**	**Intersectoral composition**
Carbon (kt)	**-452**	803	-1,255
Sulphur (kt)	**-5**	10	-15
Nitrogen (kt)	**-12**	15	-27
Water in (b. m^3)	**-2.4**	3.5	-5.8
Water out (b. m^3)	**0.012**	0.008	-0.004
BOD (kt)	**-0.4**	1.7	-2.1
COD (kt)	**-0.02**	6.2	-6.2
DS (kt)	**-0.19**	0.28	-0.48
SS (kt)	**8.1**	4.4	3.6

Source: Authors' model results

4 above). That study incorporates feedback effects of that damage on land productivity and thereby is able to value the loss of production associated with that erosion. Again using GTAP to model the effects of implementing the Uruguay Round agreements, the study finds that the aggregate output expansion and shift in its composition does add slightly to soil erosion, but that the cost of the damage caused by that increased erosion is miniscule, amounting to less than 0.2 percent of the national economic welfare gain (as traditionally measured) from the Uruguay Round liberalisation. This is not inconsistent with the finding by Lindert (1996) that there is virtually no evidence over many decades of net soil degradation in Indonesia.

Our study uses environmental side modules to focus primarily on one country's resources and environment. We set up a framework or modelling and decomposing the major environmental impacts of growth and policy reform in as transparent a way as possible. The results presented indicate sectors of particular concern, given available environmental data and our choice of model.[4] Needless to say, caution should be used in interpreting the above results, particularly given the still poor quality of much environmental data. For example, there are sectors and types of environmental damage that are not adequately represented here[5] and considerable humility is needed, given the limits on our knowledge of many environmental parameters (Martin 1999). However, aggregate studies such as this can provide an overview of the anticipated trade-environment interactions. Such work will clearly be complemented by studies at the local level to examine issues or sectors of particular concern. Micro studies by multidisciplinary teams will be an important input to improving future national and global studies (Anderson and Strutt 1996).

Use of a global trade model means it is possible to make inferences about the effects of trade reform on the environment and resources in other countries as well. The natural resource impact of the Uruguay Round can be seen in Table 5.10 to be positive rather than negative in most regions. It is negative mainly in Western Europe ('Other high-income economies'), where resource policies are well developed and could easily be adapted to cope with any undesired increase in exploitation. And it happens that when environmental damage occurs in Indonesia because of the change in the composition of its output following trade reform, damage to the environment of other countries is often lessened. Consider, for example, what happens if China is given greater access to US and EU textile and clothing markets following its WTO accession. This

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[4] There are of course more sophisticated methods of projecting economic growth, using endogenous growth and incorporating imperfect competition and scale economies.

[5] For example, the most excessive pollutant in Indonesian rivers is faecal coliform which exceeds recommended standards by more than a thousandfold in some places (World Bank 1990, p. xxxi). We have not been able to include this in our present analysis. Nor have we accounted for the human health effects of pollution (as was done for Chile in Beghin et al. 1999).

may reduce Indonesia's capacity to expand exports of light manufactures and so keep resources in more-polluting activities in Indonesia -- but it may mean China moves away from some of its very pollutive coal-intensive heavy manufacturing, thereby potentially reducing not only local air pollution in China but also global warming. Those environmental effects for other countries and globally could be quantified by extending the environmental side modules developed here for Indonesia to the other countries and regions included in the GTAP model.

As improved environmental data become available, improved modelling of pollution across countries will be facilitated. For example, future versions of the GTAP database will have an upgraded energy component that will enable improved modeling of air pollution across all regions.[6] Direct inclusion of emissions and abatement activities in the GTAP model may eventually be desirable, rather than having just side modules.[7] Among other things, the model could then be modified to enable induced substitution towards less environmentally damaging output and the adoption of less-polluting technologies when environmental taxes are imposed or increased. Endogenizing environmental policies to income growth,[8] trade policy changes and changes in pollution, and including consumption pollution by various types of households (only one household exists in the present model), would be other useful extensions. Modified versions of the model could also be used to examine the economic effects of underpricing environmental or resource inputs. For instance, water for farmers is underpriced in

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[6] The weakness of the energy data in version 3 of GTAP led us to not focus particularly on energy in the current work. Those data have since been improved, and the process of incorporating them directly into the GTAP model is explained in Malcolm and Truong (1999).

[7] This will be particularly important for environmental degradation which impacts on production. Strutt in Ch. 4 above focuses on land degradation in Indonesia and by incorporating the feedback effects of erosion damage on land productivity, she has been able to value the loss of production associated with that erosion.

[8]The reasons for expecting citizens to seek a tightening of environmental standards and regulations/taxes on pollution and resource depletion as incomes rise, at least after middle-income status is reached, have been canvassed by, among others, Selden and Song (1994), Grossman and Krueger (1995), and Hettige, Mani and Wheeler (1998).

most countries: what would happen to world markets and the environment if all, or a subset of countries, created property rights over water or otherwise properly charged for water?

The policy debate will increasingly demand informed answers to questions on the environmental effects of international agreements, and the environmental-economic interactions are too complex for adequate answers to be forthcoming without formal modelling. However, our ability to model environmental impacts is not as well-developed as is our modelling of the traditional welfare effects of economic policy changes. Given the current paucity of many types of environmental data, only modest environmental modules may in many cases be appropriate, at least until more progress is made in estimating environmental damage functions. A global model such as GTAP seems an appropriate base from which to add environmental side modules or, better still, to build environmental data, equations and parameters directly into that economic model. The subsequent challenge will be to place monetary values on the environmental changes, as is attempted in Cole, Rayner and Bates (1998). Clearly this topic has a rich future research agenda, and one which is likely to be added to as the World Trade Organization moves into the next rounds of multilateral trade negotiations.

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Appendix Table 5A: Import tariffs without and with Uruguay Round liberalisation, by sector, Indonesia, 2010 (percent)

	2010 base	2010 after UR
Paddy rice	9.0	9.0
Other grains	0.0	0.0
Non-grain crops	54.7	38.3
Livestock	4.8	4.8
Forestry	14.4	14.4
Fisheries	29.8	29.8
Coal	5.0	5.0
Oil	0.0	0.0
Gas	5.0	5.0
Other minerals	4.9	4.9
Food processing	12.3	11.3
Textiles, clothing, leather	28.7	22.5
Wood products	34.4	31.0
Paper products	8.0	8.0
Petroleum & coal products	4.7	4.7
Chemicals, rubber & plastics	6.6	6.6
Non-metallic mineral products	14.1	12.9
Other manufactured products	15.6	15.4

Electricity, water & gas	0.0	0.0
Construction	0.0	0.0
Trade & transport	0.0	0.0
Other private services	0.0	0.0
Other public services	0.0	0.0

Source: GTAP database and authors' model results.

6

Impacts of agricultural protection growth at home and the WTO's Doha Round on Indonesian agriculture

KYM ANDERSON, ERWIDODO, TUBAGUS FERIDHANUSETYAWAN AND ANNA STRUTT

There is a mixture of views within East Asia about agricultural trade reform and hence about its inclusion in the Uruguay Round agreements and subsequent negotiations under the World Trade Organization (WTO). On the one hand, governments in the wealthier densely populated countries are under pressure to continue to protect their farmers from import competition and to be seen to be providing an adequate degree of food security. In the countries with a stronger comparative advantage in agricultural products, on the other hand, governments are keen to secure more access to markets for their farmers' exports.[1] This difference of views within East Asia surfaces periodically in APEC as well as WTO fora. Since it is mirrored in other parts of the world too, agriculture is guaranteed to be a controversial part of the Doha round of multilateral trade negotiations, just as it was in the Uruguay Round.

Given the high degree of distortion in world food markets that existed in the 1980s (Tyers and Anderson 1992), every impartial observer agrees that one of the great achievements of the Uruguay Round (UR) was to start to bring agricultural policies under GATT discipline, and to agree

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[1] The recent financial crisis in East Asia strengthened the agricultural comparative advantage of several developing countries in the region, as capital withdrawal effectively 're-agriculturalised' these economies soimewhat (Anderson and Strutt 1999).

to return to the negotiating table by the turn of the century.[2] Following the signing of the UR accord in 1994, non-tariff barriers to agricultural imports have been tariffied and bound and the tariff bindings are scheduled for phased reductions. As well, farm production and export subsidies also have been reduced, mostly between 1995 and 2000 (with developing countries having an extra four or more years). That UR Agreement on Agriculture, together with the SPS Agreement (to limit the use of quarantine import restrictions to cases that can be justified scientifically as a risk to human, animal or plant health) and the Dispute Settlement Agreement (which has greatly improved the process of resolving trade conflicts), hopefully means that agricultural trade will be less chaotic in future than prior to the formation in 1995 of the new WTO. Much remains to be done, however, before agricultural trade is as fully disciplined or as liberal as world trade in manufactures.

This chapter has four main parts. It first explores empirically the scope for further gains from liberalising agricultural markets in OECD countries, both absolutely and relative to the welfare gains from cutting those countries' barriers to imports of textiles and other manufactures. The second section explores what is likely to be included in the next agricultural negotiations. We then ask if the likelihood of the Doha Round delivering sizeable agricultural protection cuts and benefiting the world's poor (the vast majority of whom are developing country farmers) would be significantly greater if negotiations include protection cuts for other sectors and at least some of the new issues on the WTO's agenda. The fourth section examines whether rule-making efforts to accommodate new issues should be de-linked from the agricultural negotiations on border measures, rather than simply included under the three headings used in the Uruguay Round Agreement on Agriculture (import market access, export subsidies, and domestic support). The latter approach may be more expedient, but it prolongs the day when agriculture is fully integrated with other sectors in the WTO. In the final section of the chapter we list the next steps needed, as we see it, to maximize the chances through WTO disciplines of keeping the agricultural reform process going.

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[2] On the long history of exceptional treatment of agriculture in the GATT, see Josling, Tangermann and Warley (1996).

The potential gains from further agricultural policy reform

The post-1950s period saw substantial growth in agricultural protection and insulation in the advanced industrial economies and its subsequent spread to newly industrialising economies (Johnson 1973; Anderson and Hayami 1986; Lindert 1991; Tyers and Anderson 1992). That tendency accelerated in the 1980s to the point where some protectionist countries went beyond self-sufficiency to generate surpluses that could be disposed of only with the help of export subsidies. While this led to serious budgetary pressures and increasing domestic opposition to the cost of agricultural support policies, protection growth none the less continued. Traditional agricultural-exporting countries thus insisted that the Uruguay Round of multilateral trade negotiations must focus on reversing this agricultural protection trend. The Round's Agreement on Agriculture that resulted from that effort has altered the climate of farm policy making, to the point where reforms in OECD countries—e.g., attempts to shift from price and trade measures to more direct forms of farm income support—have laid the foundations for reducing international price-depressing assistance to farmers.

The Uruguay Round is scheduled to be fully implemented in all sectors and regions by 2005. At that time, what will be the potential for further gains from reforming agricultural markets of OECD countries compared with the gains from protection cuts in other sectors? That question has been addressed in a recent paper that make use of the global economy-wide model known as GTAP. Anderson, Hoekman and Strutt (2001) use Version 3 of GTAP to project the world economy to 2005 following full implementation of the Uruguay Round. Their estimates of the extent of distortions to world trade that will remain in 2005 is given in Table 6.1, assuming China and Taiwan joined the WTO by then (as indeed they have). According to those estimates, the agriculture and processed food sector will still be a major anomaly. Globally, it has twice the import tariff average of textiles and clothing and nearly four times that for other manufactures. At the same time, significant distortions to farm production and exports will still be in place if no further policy reforms occur. The pattern of distortions will still differ between regions, with the numbers in parentheses in Table 6.1 showing OECD countries subsidising, and developing countries taxing, farm production and exports.[3]

What is the economic significance of these projected distortions in the different sectors? That depends not only on the size of those ad valorem price wedges but also on the value society places on the production and consumption distortions induced by them. Those quantity distortions depend largely on the value of production of each sector and the importance of its products in consumption. Table 6.2 provides an indication of the relative importance of the various sectors in regional and world production, consumption and trade.

Consider first the effects of removing distortions to OECD country markets for (1) agriculture and processed food, (2) textiles and clothing, (3) other manufacturing, and (4) all goods combined, and then for (5) all developing economies' goods markets, and finally for (6) all OECD and developing economies' goods markets together.[4]

The welfare consequences of these alternative comparative static scenarios are summarised in Table 6.3. If both OECD and developing countries were to liberalise all their goods markets in 2005 post-UR, these results suggest global welfare would be greater by US$260 billion per year.[5] Almost one-third (32 percent) of the estimated global gains

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[3] Version 4 of the GTAP data base gives lower estimates of protection levels for 2005 than Version 3, but the relativities across sectors are quite similar in the two version. See Hertel and Martin (1999, Table 3). On reasons for this pattern of distortions across countries, including its anti-trade bias, see Anderson (1995). There are of course many other distortions to markets that are not captured in Table 6.1, the most notable being those affecting services trade and government procurement. Until estimates of the extent of those latter distortions are available for a wide range of countries, however, their magnitude or effects cannot be compared with those that are captured in Table 6.1.

[4] The relatively very small economies of 'Former Soviet Union and Central Europe' and 'Rest of the World' are assumed not to change their policies in these scenarios.

[5] This is a gross underestimate of the *aggregate* gains from trade liberalisation for several reasons: because services and government procurement policies are excluded; because no account is taken of the benefits of increasing the degree of competition and the scope for scale economies; because of the high degree of regional and product aggregations in the version of the model used; and because the dynamic growth-enhancing consequences of reform are not captured. Those omissions may not distort greatly the estimated *relativity* of the gains from reforming the various markets for goods, however.

Table 6.1: Post-Uruguay Round tariffs (and agricultural production and export subsidies)[b], various country groups, 2005

(percent)

Region	Agriculture + food processing	Mining	Textiles and clothing	Other manuf-actures
1.Western Europe	30 (2, 21)	0	11	4
2.NAFTA	15 (3, 2)	0	18	7
3.Australia + New Zealand	3 (0, 0)	0	25	9
4.Japan + Korea	57 (-2, 0)	3	9	4
5.China, Hong Kong, Taiwan	22 (-5, 0)	1	2	2
6.Southeast Asia (ASEAN)	19 (-3, -3)	3	15	11
7.South Asia	19 (0, 0)	8	55	29
8.North Africa + Middle East	24 (-4, 0)	19	38	24
9.Sub-Saharan Africa	13 (-1, -9)	10	18	9
10.Central + South America	12 (-1, -1)	6	27	18
11. Central Europe + FSU	8 (0, 0)	1	6	5
12.Rest of the World	50 (-1, -7)	23	60	28
All OECD economies (1-4)	***36 (1, 7)***	***1***	***14***	***6***
All developing econs. (5-10)	***20 (-2, -2)***	***6***	***12***	***11***
ALL ECONOMIES[a] (1-12)	***29 (0, 3)***	***2***	***14***	***8***

[a] Includes 'Former Soviet Union+Central Europe' and 'Rest of World'

[b] Production and export subsidy rates for agriculture are shown in parentheses in column 1.

Source: Anderson, Hoekman and Strutt (2001).

from goods trade liberalisation are estimated to come from agricultural reform in OECD countries – even though farmers in those countries contribute only 4 percent of global GDP and less than one-tenth of world trade (see Table 6.2).

Textiles and clothing reforms appear to pale by comparison with farm reform: their welfare contribution is only one-eleventh that of agriculture's. The reasons for this big difference are several. One is that distortions to prices for agriculture are more than twice those for textiles and clothing, according to Table 6.1. Another is that the latter products contribute only 1.5 percent to the value of world production and 5 percent to the value of world trade, half or less the shares for farm products (Table 6.2). But two assumptions made by the modellers also contribute to this result. One is that it is assumed China and Taiwan join the WTO before 2005 and enjoy the same accelerated access to OECD markets under the UR Agreement on Textiles and Clothing (ATC) as other developing countries that already are WTO members. The other crucial assumption is that OECD countries fully implement the ATC. The latter is far from certain to happen though, particularly if China were to join the WTO soon and be given more access to textile markets in the next five years. Dropping either of those assumptions reduces very substantially the estimated gains from Uruguay Round implementation (Anderson *et al.* 1997b), and therefore would raise the potential gains from textile and clothing reform in the Doha Round. Even so, agricultural protection would remain far more costly to the world economy than barriers to textiles and clothing trade – and more costly even than protection to other manufactures, despite the latter having much bigger shares in the value of world production and trade than farm products.

The WTO membership was right, therefore, to insist that OECD agricultural reform must continue into the new century without a pause. Developing countries have a major stake in that process continuing: according to the above GTAP results, the farm policies of OECD countries are almost as harmful to developing economies as their own trade-distortionary policies. Certainly OECD textiles and clothing policies harm them greatly, but less than half as much as OECD farm policies (middle row of Table 6.3). Barriers to OECD imports of 'Other Manufactures', by contrast, actually help developing economies. The reason is that those trade restrictions lower international prices of those products, thereby improving the terms of trade of developing countries.

Table 6.2: Sectoral shares of GDP, post-Uruguay Round in 2005, of private household consumption in 1995, and of trade in 1997 **(percent)**

	Agriculture & food processing	Minerals and fuels	Textiles and clothing	Other manuf.	Services	ALL PRODUCTS
SECTORAL SHARES OF REGIONAL GDP:						
All OECD economies	5	3	0.8	19	72	100
All developing economies	19	9	4.4	16	52	100
ALL ECONOMIES[a]	8	4	1.5	18	68	100
REGIONAL & SECTORAL SHARES OF GLOBAL GDP:						
All OECD economies	4	2	0.6	15	58	80
All developing economies	3	1	0.7	3	8	16
ALL ECONOMIES[a]	8	4	1.5	18	68	100
SHARES OF REGIONAL HOUSEHOLD ONSUMPTION						
All OECD economies	11	0	[b]	18	71	100
All developing economies	30	1	[b]	24	45	100
SECTORAL SHARES OF WORLD TRADE:	**9**	**9**	**5**	**57**	**20**	**100**

[a] Includes 'Former Soviet Union and Central Europe' and 'Rest of the World', hence is not just the weighted sum of rows 1 and 2.

[b] Included with 'Other Manufactures'.

Source: Anderson, Hoekman and Strutt (2001) and Hertel and Martin (1999), calculated using the GTAP model.

Table 6.3: Effects on economic welfare (equivalent variation in income) of removing distortions to various goods markets post-Uruguay Round, major economic regions, 2005[b]
(percent, and 1992US$ billion p.a. difference from post-UR base case in 2005)

	Contribution from removing distortions in OECD economies' markets for:					
Region	Agriculture and food processing (percent)	Textiles and clothing (percent)	Other manufactures (percent)	**Contribution from removing distortions in all goods markets of OECD economies (sum of cols 1-3) (percent)**	**Contribution from removing distortions in all goods markets of developing economies (percent)**	**Net benefit from removing distortions in all goods markets of OECD and developing economies ($ billion p.a.)**
All OECD economies	29	-3	42	**68**	**32**	**217**
	(-50)	(192)	(6)	**(-37)**	**(98)**	**(20)**
All developing economies	44	21	-23	**42**	**58**	**45**
	(97)	(84)	(76)	**(75)**	**(-249)**	**(-106)**
ALL ECONOMIES[a]	32	3	27	**62**	**38**	**260**

[a] Includes 'Former Soviet Union and Central Europe' and 'Rest of the World', hence is not just the sum of OECD and developing economies.

[b] Numbers in parentheses are the percentage of each result that is due to the change in the terms of trade, most of the rest being the change in allocative efficiency.

Source: Anderson, Hoekman and Strutt (2001), using the GTAP model.

Welfare decomposition of the GTAP results shows that three-quarters of the loss to developing economies from OECD countries removing restrictions on their imports of 'Other Manufactures' is because of the raised international price of these products (see numbers in parentheses in Table 6.3).

Furthermore, Anderson, Hoekman and Strutt (2001) find that each of the major developing-country regions benefits in terms of real income gains from OECD agricultural policy reform. The net gains, on a per capita per year basis, range from $1 in South Asia to $4 in Southeast Asia, $6 in Sub-Saharan Africa, and $30 in Latin America. The gains per farm household in those regions would be many times greater, however, after consumers losses are subtracted from the net national gains.

Even for the OECD economies themselves, despite the fact that agriculture and food represent only about 5 percent of their GDP, abolishing their remaining agricultural protection in 2005 would contribute more than one-quarter of their welfare gains from liberalising all goods trade globally – and more than two-fifths of the gains from liberalising trade in all goods in the OECD alone.[1]

What to include in the agricultural negotiations of the next WTO round

Given the enormous potential for gains from farm trade liberalisation, there is great pressure from farm-exporting countries to ensure further substantial agricultural reforms occur in the next few years. Japan and Korea, however, remain reluctant to embrace further reform. The European Union, too, is finding it difficult to get a consensus for more than modest reform of its Common

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[1] By contrast, textile and clothing trade reform appears to harm OECD economies slightly. Recall that VER quotas on developing country textile and clothing exports are scheduled to be replaced by OECD import tariffs on those goods by 2005 under the Uruguay Round's ATC. The very considerable projected efficiency gains from subsequently lowering those tariffs in the next WTO round are just slightly more than offset by the rise in the international price of those goods, according to the welfare decomposition results summarised in parentheses in Table 6.3.

Agricultural Policy under its Agenda 2000 (on which its WTO negotiating position will be based -- see Tangermann 1999).

How should the next round of agricultural negotiations proceed? The fact that (often discriminatory) farm export subsidies are still being tolerated continues to distinguish agricultural from industrial goods in the GATT, a distinction that stems from the 1950s when the United States insisted on a waiver for agriculture of the prohibition of export subsidies. Moreover, even by the turn of the century farm export subsidies need be only about one fifth lower than they were in the late 1980s to comply with the agreement. True, the budgetary expenditure on export subsidies is to be lowered by 36 percent from the base period, but for some commodities it may be only the agreed cut in the *volume* of subsidised exports (21 percent for industrial countries, 14 percent for developing countries) that bites because international food prices are now higher than in the base period, so exportable surpluses can be disposed of with lower subsidy outlays.

The extent of reductions in bound tariffs by the end of the decade will be even more modest than for export subsidies: the *unweighted* average tariff cut must be 36 percent (24 percent for developing countries), but it could be less than one sixth as a *weighted* average, since each tariff item need be reduced by only 15 percent of the claimed 1986-88 tariff equivalents (10 percent for developing countries).[2]

Moreover, the claimed tariff equivalents for the base period 1986-88, and hence the initial tariff bindings, are in many cases far higher than the actual tariff equivalents of the time. The European Union, for example, has set them on average at about 60 percent above the actual tariff equivalents of the CAP in recent years, while the United States has set theirs about 45 percent above recent rates – and developing countries are even more involved in the practice (Ingco

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[2] Tangermann (1994) gives the example of a country with four items subject to tariffs, three sensitive ones with 100 percent duty rates and one with a 4 percent duty. Reducing the three high rates to 85 percent (a 15 percent cut) and eliminating the 4 percent rate (a 100 percent cut) would give an unweighted average cut of 36.25 percent. This would meet the requirement for an unweighted average cut of 36 percent and minimum cuts per item of 15 percent, but it would allow high protection on sensitive products to remain and it may increase the dispersion of rates.

1995, 1996). 'Dirty' tariffication has two consequences. One is that actual tariffs may provide no less protection by the turn of the century than did the non-tariff import barriers of the late 1980s/early 1990s. The other consequence of binding tariffs at such a high level is that it allows countries to set the actual tariff below that but to vary it so as to stabilize the domestic market in much the same way as the EU has done in the past with its system of variable import levies and export subsidies -- and has continued to do since 1995 (Tangermann 1999). This means there has been little if any of the reduction in fluctuations in international food markets this decade that tariffication was expected to deliver.

It is true that some countries have agreed also to provide a minimum market access opportunity, such that the share of imports in domestic consumption for products subject to import restrictions rises to at least 5 percent by the year 2000 under a tariff quota (less in the case of developing countries). But that access is subject to special safeguard provisions, so it only offers potential rather than actual access (another form of contingent protection). As well, market access rules formally introduce scope for discriminating in the allocation of import quotas between countries, where within-quota imports attract a much lower tariff than above-quota imports. Perhaps even more importantly, the administration of such quotas tends to legitimize a role for state trading agencies. When such agencies have selling rights on the domestic market in addition to a monopoly on imports of farm products, they can charge excessive mark-ups and thereby distort domestic prices easily and relatively covertly -- just as such agencies can hide export subsidies if they are given a single-desk selling monopoly. There are thus elements of quantitative management of both export and import trade in farm products now legitimized under the WTO, including scope for discriminatory distortions to trade volumes as well as prices.

The third main component of the Uruguay Round Agreement on Agriculture is that the aggregate level of domestic support (AMS) for industrial-country farmers is to be reduced to four-fifths of its 1986-88 level by the turn of the century. That too will require only modest reform in most industrial countries because much of the decline in the AMS had already occurred by the mid-1990s. This has been possible because there are many forms of support that need not be included in the calculation of the AMS, the most important being direct payments under production-limiting programs of the sort adopted by the US and EU. A risk that needs to be curtailed is that the use of such "blue box" instruments, as with exempt "green box" instruments such as quarantine and environmental provisions, may spread to other developed countries and other commodities as farm income support via trade and direct domestic price support measures become WTO-constrained.

Given the limited progress over the past five years in making agriculture more market-orientated, the first priority for the next WTO agricultural negotiations must be to further that process. That may not be as difficult to agree to now as it was when the Uruguay Round was being launched, given unilateral farm policy reforms in the United States and -- at least to some extent -- in the EU and Japan during the mid-1990s (IATRC (1997, Chs. 1, 2 and 6) and Tracy (1997)).

Nothing less than a ban on farm *export subsidies* is needed to bring agriculture into line with non-farm products under the GATT. With respect to *domestic subsidies*, an early decision needs to be taken as to whether to strengthen or abandon the attempt to constrain domestic policies under the WTO. Even though a plausible case can be made for the latter (Snape 1987), the Cairns Group may well decide to pursue the former. The 'blue box' items, containing the US and EU direct payments to farmers who restrict their output or at least some inputs, were granted exemption through to 2003 from challenge under the Blair House agreement as a way of moving the Uruguay Round talks forward. But with the policies of the US and EU gradually being reformed for internal reasons in recent years, and in particular with the further de-coupling of farm income support measures from production as with America's FAIR Act of 1996, it may be possible to remove the 'blue box' in the next round of talks. Then efforts to tighten the 'green box' criteria could be made, so as to reduce the loopholes they provide for continuing output-increasing subsidies, and to further reduce the Aggregate Measure of Support. One of the possible benefits of getting countries to commit to reduce further their AMS is that it will encourage them to make more of their policies conform to the 'green box' criteria, the rewards for which are exemption from the AMS and avoidance of challenge (IATRC 1997, Ch. 11). That in turn makes it all the more important that the 'green box' criteria are tightened such that policy instruments so exempted are not in practice encouraging further production.

The third and perhaps most important area requiring attention has to do with *import market access*. Tariffication has made restrictions to imports much more transparent, but the degree of 'water' currently in those tariffs exaggerates the barriers and makes most bindings ineffective. The combination of dirty tariffication by developed economies and the adoption of very high ceiling bindings by developing economies allows countries still to vary their protection as they wish in response to changes in domestic or international food markets. Getting those bound tariffs down from 50-250+ percent to the 0-15 percent range of tariff rates for manufactures is the challenge ahead. If the steady rates of reduction of the past are used, it will be several decades before that gap is closed.

At least three options for reducing tariffs on farm products present themselves. One is a large across-the-board tariff cut. Even if as much as a 50 percent cut by, say, 2005 is accepted, however, that would still leave some very high tariffs. A second option is the "Swiss formula" used for manufactures in the Toyko Round, whereby the rate of reduction for each item is higher the greater the item's tariff level. This has the additional economic advantage of reducing the dispersion in rates that was introduced or exacerbated during the Uruguay Round. And a third option is the one used successfully in the information technology negotiations, namely, the "zero-for-zero" approach whereby, for selected products, tariffs are eliminated altogether. In contrast to the second option, this third option would increase the dispersion of tariffs across products, increasing the risk that resources will be wastefully diverted from low-cost to higher-cost activities. While that might appeal as a way of allowing attention to then focus on the politically difficult items such as dairy and sugar, the manufacturing sector experience with long-delayed reductions in protection of textiles and cars makes it difficult to view this option optimistically as a quick solution.

The above tariff reductions refer to out-of-quota imports. There is also a pressing need to focus on in-quota imports, that is, those that meet the minimum access requirements in the UR Agreement on

Agriculture (generally 5 percent of domestic sales by 2000 for developed economies). Agricultural-exporting countries are understandably reluctant to suggest the *tariff-rate quota (TRQ)* be removed, because the TRQ provides at least some market access at low or zero tariffs[3]. Nor would allowing TRQs to be auctioned be seen by all as a solution, because that would be like imposing the out-of-quota tariff on quota-restricted trade that the TRQ was designed to avoid.

Perhaps the best alternative to banning TRQs is to expand them, so as to simultaneously reduce their importance, increase competition, and lessen the impact of high above-quota tariffs. One can imagine an outcome that is either optimistic or pessimistic from a reformer's viewpoint. On the one hand, the optimists would say: if the TRQs were to be increased by, say, the equivalent of one percent of domestic consumption per year, it would not be very long in most cases before the quota became non-binding. Expanding the TRQ could thereby be potentially much more liberalising in the medium term than reducing the very high out-of-quota tariffs. Such an approach may require binding within-quota tariffs at a reasonable level (such as that for manufactures), and perhaps allowing countries not to have to reduce those bound within-quota tariffs before the quota becomes redundant.

Negotiators familiar with the tortuous efforts to reform the quota arrangements for textiles and clothing trade, on the other hand, see the agricultural TRQs as yet another MFA: a multilateral food arrangement![4] Since the first inception of textile quotas was around 1960, it looks like it will take fifty years or so before they are finally abolished. If that is the expected lifetime of agricultural TRQs, a strong case could be made by the Cairns Group and others for the total elimination of agricultural TRQs (along with export subsidies and credits) and a radical reduction in bound (out-of-quota) tariffs. The quid pro quo could be to give up on trying to discipline farm domestic supports: the almost infinite scope for re-instrumentation makes that very difficult anyway and, as Snape (1987) has pointed

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[3] Nearly 1,400 TRQs have been notified to the WTO so far, about 200 of which are country-specific rather than global. On the complexities of TRQs, see Skully (1999).

[4] Credit goes to Joe Francois for suggesting that aconym.

out, constraints on border measures would ensure the cost of domestic supports was exposed via the budget and thereby subjected to regular domestic political scrutiny.

The above agenda for those seeking more liberal agricultural markets will be resisted by those seeking a continuation of special favours for protected agricultural sectors. The latter are forming coalitions with other groups to find reasons/excuses for not lowering trade barriers and/or to lobby for interventions abroad that would raise their competitors' costs. The key issues being raised by these groups that are likely to be more prominent in the next WTO negotiations than in the Uruguay Round, are discussed below. In assessing the implications of these priorities for farm and trade policies, the following should be kept in mind: that where there are several policy objectives, typically an equal number of policy instruments is required to deal efficiently with them; that the most efficient policy instrument for achieving a particular objective will be that which addresses the concern most directly; that trade measures in particular are rarely the most efficient instruments for addressing non-trade concerns; and that trade reforms will be welfare-improving so long as optimal domestic interventions are in place to deal with those non-trade concerns.[5]

The claim is often made that a high level of food self-sufficiency is necessary before a nation feels food-secure. This is inconsistent with the usual definition of food security though, which is that everyone always has access to the minimum supply of basic food necessary for survival. Lower rather than higher consumer prices for food would by that definition boost the number of food-secure people, suggesting *lower* import barriers and export subsidies should be called for.

However, becoming more dependent on food imports does raise questions about the preparedness of exporters to always supply foreign markets. For that reason, food importers may call for stronger disciplines on the exceptions to GATT Article XI.1 which prohibits export restrictions other than export taxes. For example, GATT Article XI.2(a) permits temporary quantitative export restrictions to relieve critical food shortages in an exporting country.

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[5] What follow draws on Anderson (1998b).

True, the URAA's Article 12 added some discipline to that provision, requiring that due consideration be given to the effects of such a restriction on WTO members who are food importers, that such affected members be consulted, and that the WTO be notified of the nature and duration of the restriction. Even more discipline could be called for in the Doha and subsequent rounds. For example, if it were shown that in the past longer-term customers were being served first and charged less in years of shortfall, agricultural-exporting countries could be asked to cease that practice and instead provide non-discriminatory access to their supplies of basic foodstuffs at all times.

In addition to concerns about food security, there are also concerns about food safety. The demand for higher quality, safer food rises with per capita incomes. However, perceptions about the safety of different foods and food production and processing methods, and conformity assessment procedures, differ greatly -- even among countries with similar income levels. These differences can be exaggerated when groups with an economic interest in trade restrictions join forces with extremist lobby groups pushing for excessive food safety measures. The rapid rise in media hype over genetically modified organisms (GMOs) is a clear case in point: it has fueled consumer concerns in Western Europe to such an extent that this issue may well be on the agenda for the next agricultural negotiations in some form. Developing countries' farmers are concerned for different reasons: because intellectual property protection in their country is so poor that producers of GM seeds may not sell the new varieties to them, causing their agricultural comparative advantage to diminish; and because some high-income countries may erect barriers to prevent GMOs originating in developing countries from penetrating their markets. For the sake of farmers and consumers everywhere, and to reduce uncertainty for R&D firms seeking to invest further in GMOs, it is imperative that rules and standards governing trade in GMOs be clarified.

Why agriculture needs other sectors and "new trade agenda" issues in the Doha Round

The probability of the next WTO round delivering significant agricultural reforms and thereby benefiting the world's poor (the vast majority of whom are developing country farmers) will be greater if negotiators include protection cuts for other sectors and perhaps some of the new issues on the WTO's agenda.

Textile reform should be included, not least to reduce the likelihood that OECD countries renege on current obligations under the Uruguay Round's Agreement on Textiles and Clothing. The above simulation results suggest that further textile reform would give a major welfare boost to developing economies. It would boost the manufacturing exports of the most densely populated of Asia's developing countries. But since they in turn would then import more farm products, reductions in textile barriers indirectly also boosts the farm sectors of other countries.[6]

In return for reducing barriers to agricultural and textile markets in rich countries, developing countries would be leant on to liberalise their manufacturing and services markets and their government procurement procedures. The welfare gains to developing country agriculture (and the overall economy) from such non-farm policy reform could well be as large as those countries' gains from farm policy reform by OECD countries. This is because of the direct impact those reforms would have on developing countries' farm input costs and the cost of services required to market their farm outputs, as well as the standard indirect general equilibrium effects on the cost of mobile labour and capital of reducing assistance to highly protected non-farm sectors.

As for new trade agenda issues, their inclusion in the Doha Round is considered by some (including East Asian developing country) negotiators as undesirable because it would distract their attention from the current agenda items. On the other hand, however, their inclusion would have the advantage that more non-agricultural groups would take part in the round which could counter-balance forces favouring agricultural (and other sectoral) protection. As well, better rules on some of those new issues would reduce the risk of farm trade measures being replaced or made ineffective by

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[6] Similarly, if China were to be admitted to the WTO, and in the process restrained from raising protectionist barriers to farm imports and given more access to US and EU textile markets, the agricultural sectors of other East Asian countries would benefit (Anderson *et al.* 1997a,b).

domestic agricultural measures and technical barriers to trade that may be almost as trade-distorting – a risk that has grown considerably in recent years (Anderson 2000; Roberts, Josling and Orden 1999).

The decline in traditional trade barriers will cause attention to focus increasingly on the trade-impeding effects of domestic regulatory regimes. This is what has given rise to the so-called "new trade agenda." It revolves around policies such as the setting and enforcing of product standards, state-trading, subsidy regimes, export controls, competition law, and government procurement practices. Such policies can effectively distort competition, even if applied on a nondiscriminatory basis.

Virtually all these new issues have relevance to the agricultural liberalisation agenda. The Uruguay Round negotiations on agriculture focused only on some of them, notably production subsidies and product standards. In the Uruguay Round progress was made in designing rules for the application of sanitary and phytosanitary standards (SPS), and disciplining the ability of governments to grant agricultural production subsidies. However, disciplines are either weak, country-specific or nonexistent in many other areas, including the extra-territorial application of production process standards and competition-related policy and regulation. The latter include the nexus of state-trading, export taxes and cartels, and intellectual property (broadly defined to include indications of geographic origin, traditional expressions, breeder's rights and seed varieties).

While attempts to discipline and regulate the use of domestic subsidies under GATT auspices have been pursued for decades with little success, somewhat greater progress was made in the Uruguay Round with sanitary and phytosanitary (SPS) standards. The SPS Agreement seeks to ensure that any SPS measures are imposed only to the extent necessary to ensure adequate food safety and animal and plant health on the basis of scientific information, and are the least trade-restrictive measures available to achieve the risk reduction desired. Although there is substantial "wiggle room" in the wording of disciplines, consultations between WTO members are leading to conflict resolution in numerous cases. The dispute settlement evidence to date shows that exporting countries can succeed in obtaining rulings against the most egregious cases of protectionist abuse of standards (Roberts 1998). A problem that confronts developing countries in this area, however, is that they may find it difficult to satisfy partner countries that their domestic institutions can be trusted to enforce the required standards. Alternatively, such institutions may not be able to perform testing and certification functions effectively without imposing significant burdens on trade.

The focus of GATT/WTO negotiations has always been on increasing the contestability of markets by reducing/eliminating discrimination against foreign products and producers. One way to apply this rule of thumb to the new trade agenda is to seek to extend the reach of the non-discrimination principle to issues such as subsidies, competition legislation, foreign investment regimes, and government procurement practices. In all these areas governments are currently free to pursue discriminatory policies, and often do.

Liberalising foreign investment and extending the national treatment principle to foreign suppliers of goods and services would have a significant impact in terms of "leveling the playing field". An open investment regime in general, complemented by a commitment to apply national treatment to the supply of service sectors in the GATS context would go a long way in making markets more contestable. Investment liberalisation is already on the agenda of the GATS for service sectors, as nations can make specific commitments on market access and national treatment for foreign providers who seek to establish a "commercial presence", that is, to engage in foreign direct investment (FDI). This approach could be extended to investment more generally, including in agriculture where restrictions are often very severe (as in Indonesia).

Why "new trade agenda" issues for agriculture should be treated generically

Should rule-making efforts to accommodate the new issues be de-linked from the agricultural negotiations on border measures? A suggestion by Josling (1998) is to incorporate all the new issues as they apply to agriculture under the three headings used in the Uruguay Round Agreement on Agriculture, viz. import market access, export subsidies, and domestic support. While such an approach may be more expedient, it simply prolongs the day when agriculture is fully integrated with other sectors in the WTO. While that separation remains, WTO rules are less clear, and exceptional (i.e, less-liberalising) treatment is encouraged. Thus a more generic approach to the new issues should be entertained.

Conceptually, the matter is relatively clearcut: what is required is a determination as to whether domestic policies that have detrimental effects on foreign suppliers can be justified on public interest grounds. More specifically, it can be asked whether a more-efficient, less trade-distorting policy instrument can be identified to achieve a particular objective. If so, the presumption would be that the measure can be contested. Of course, making this basic economic principle operational in the international context is not straightforward, not least because in practice measures may be pursued because a nation has the power to influence the terms of trade in its favour, and because there will always be differences in opinion as to whether alternative instruments are feasible or not.

Snape (1987) has argued that, with respect to subsidies, governments should be left free to pursue whatever domestic policies they wish -- an argument that can be extended to regulatory policy more generally. A rationale for this argument is that in practice it is impossible to determine when subsidies are economically “legitimate” in the sense of offsetting market failures or being the least-cost instrument to pursue certain non-economic objectives, and that governments and interest groups will always be able to identify instruments that are not subject to multilateral disciplines to pursue their aims. The result of pursuing multilateral disciplines is then a never-ending process with uncertain benefits.

This argument is unlikely to be acceptable to policymakers, however. If negotiations on domestic policies are to be pursued, though, a strong case can be made that specific rules just for agriculture are not necessary. Consider four sets of examples.

Domestic subsidies

Agreements on subsidies (and countervailing duties) should apply to all sectors of economic activity equally. The WTO Subsidies Agreement is supposed to be reviewed in 1999. Currently, that agreement takes a similar approach to the Agriculture Agreement and defines a set of general non-actionable subsidies. These include support for research, aid for disadvantaged regions, and assistance to firms adapting plants to new environmental measures. Disciplines in the area of services are yet to be developed and are likely to figure on the agenda of the prospective negotiations on services. Given a general desire by WTO members to define clearer rules on subsidy practices, efforts should be made to merge the agricultural disciplines with those applying to other merchandise and to be developed for services, so that a common set of rules and principles emerge.

Competition policies, including state trading

Similar arguments apply to competition policies. For example, many countries have government-sanctioned single-desk selling agencies/export monopolies for agricultural commodities, and the activities of such entities have become a concern to the international community. State trading was considered a relatively minor aspect of policy among the original signatories of the GATT, and is not subject to serious constraints under GATT law. Partly this reflects the fact that it was most prevalent in agriculture—a sector that remained largely outside the purview of multilateral discipline until the Uruguay Round. However, with the re-introduction of agriculture in the WTO, the adoption of multilateral disciplines for services (GATS), and the prospective accession to the WTO of many economies in transition, state trading has become a higher-profile issue that is part of the much bigger complex of policy questions to do with the conditions of competition in markets.

Two distinct approaches currently are pursued in the WTO regarding state trading (Hoekman and Low 1998; Ingco and Ng 1998). The first is to subject the behaviour of such entities to multilateral disciplines such as nondiscrimination and transparency, enforced through WTO dispute settlement (Art. XVII of GATT). The second is to negotiate on national treatment and market access on a case-by-case basis (Arts. XVI and XVII of GATS). As it stands, Article XVII is worded quite broadly and potentially covers a wide range of activities, but its disciplines are weak. Specifically, STEs are simply to abide by MFN and not to impose price mark-ups on domestic sales that exceed the relevant tariff bindings.

The issue of STEs is a subset of the more general problem of dealing with the possible anti-competitive effects of entities with dominant positions or exclusive rights and privileges. In the recent WTO agreement on basic telecommunications, a set of pro-competitive regulatory principles were adopted by countries that require the establishment of independent regulatory authorities to monitor the behaviour of dominant telecom suppliers and ensure interconnection on the basis of cost. Efforts to extend the reach of such principles more broadly to both STEs and other firms with exclusive rights should be pursued, with common rules applying to all such entities whatever the sector of activity in which they are engaged.

Technical standards, including SPS measures

Many countries use very blunt quarantine instruments such as import bans that excessively restrict imports well beyond what is necessary for protecting the health of their plants and animals (and citizens in the case of food safety concerns). For example, there are outright bans on imports of many products, including from agricultural-exporting countries seeking to preserve a disease-free image. The levels of protection involved are in some cases equivalent to tariffs of more than 100 percent.[7] Without some form of notification requirement on WTO members that forces them to disclose the degree to which trade is restricted by such measures, reform in this area is likely to be confined to the very small proportion of those cases that are brought before the WTO's dispute settlement body. The expense of such legal proceedings and the time involved in concluding each case ensures the pace of reform by that means alone would be glacial.

Perceptions about the safety of different foods and food production and processing methods, and conformity assessment procedures,

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[7] See James and Anderson (1998) and Roberts and DeRemer (1997). The latter study reports more than 300 technical barriers to imports in 63 countries that are believed to threaten, constrain or block almost US$5 billion of US farm exports.

differ greatly even among countries with similar income levels. The WTO Dispute Settlement case between the US and EU on beef hormones showed that differences of opinion on standards are difficult to resolve even with the best scientific advice. Other examples are irradiated food, cheese made from unpasturised milk, and genetically modified organisms (Mahe and Ortalo-Magne 1998, Henson 1998). Increasingly over time such issues will arise under the Uruguay Round's SPS and Technical Barriers to Trade agreements. But they will also arise in other, non-agriculture-related contexts. As with state-trading, subsidies, and competition and industrial policies more generally, here again there is a strong case for developing common disciplines for all types of products, whether agricultural or not. There is nothing special about food as compared to, say, regulation of dangerous chemicals or heavy metals which may enter into the production and disposal of manufactured goods.

Environmental standards

Attempts to "export" environmental or social standards have become particularly controversial in recent years. Agriculture's contribution to the natural environment is most probably negative in a net sense. Some claim that it is adding to biodiversity and the landscape by preserving, for example, hedgerows in Europe, but that could be done simply by paying some landowners not to destroy their hedgerows. Others in rich countries claim that farmers need to be compensated for adopting less-environmentally damaging farming practices. This pay-the-polluter idea is the opposite of the OECD-sponsored polluter-pays principle, whereby farmers would be taxed according to the extent of the damage their practices cause.[8]

Of major importance to developing country exporters of farm products is the erection of trade barriers against foreign products because of the way they are produced. Mexico won its case at the GATT against the US ban on imports of tuna that were deemed to be caught in nets unfriendly to dolphin, and the shrimp/turtle case had

[8] Presumably it is rationalised as subsidising the use of an abatement technology that provides a positive externality, but that logic ignores the source of the abated damage in the first place.

a similar outcome, but both cases have made the GATT/WTO very unpopular with environmental groups. Developing countries will need to continue to argue against import restrictions being allowed on products produced by methods not liked by importing countries – otherwise there would be no end of restrictions being imposed on such grounds (Anderson 1998). As with all the other issues discussed in this section, there is no need or rationale for agriculture-specific approaches. The issues are generic; rule-making (and opposition to certain types of rules) should also be general in nature.

Final remarks

Traditional agricultural market access liberalisation should continue to be the key priority issue for developing countries. From an agricultural perspective, attention should focus also on reducing protection granted to manufacturing and services industries in developing countries themselves, as protection in those sectors bestows a significant anti-agricultural bias in many low- and medium-income economies, making it more difficult for them to benefit from the agricultural trade reform of OECD countries. Those reforms can be done unilaterally, but the WTO offers an opportunity to obtain a quid pro quo, and can be a useful instrument through which to lock in such reforms. As far as the multilateral agricultural agenda is concerned, the focus should be on further reducing agricultural protection in industrialised countries so as to give developing country farmers better access to export markets.

The next stage of agricultural reform will, however, be conducted in an environment in which globalisation forces (including ever-faster international transfers of information, ideas, capital, skills and new technologies) will be having ever-stronger impacts on markets but simultaneously may trigger sporadic policy backlashes. Examples of the former forces affecting agriculture include the new genetically engineered crop seeds that are part of the biotechnology revolution in the seed and pesticide industries. Both industries are also experiencing surges in economies of scale which, together with the liberalisation of the world's financial markets over the past 15 or so years, is encouraging rapid expansion of foreign direct investment by large multinational corporations. The WTO is a contributor to that expansion (e.g., in providing more secure property rights for seeds through the TRIPs agreement). The privately optimal international location of production may well change in non-trivial ways as a result, bringing forth new forces for adjustment. The current East Asian financial crisis reminds us that in stressful circumstances governments may be tempted either to embrace the forces of change and facilitate efficient and rapid adjustment to the new market-driven circumstances, or to try to resist change by turning their back on reform and intervening in those markets.

Given that attempts to reduce, let alone eliminate, traditional measures of farm protection will confront significant resistance in numerous countries, the mercantilist logic of trade negotiations requires that the agenda of the next set of multilateral negotiations should include "new trade agenda" items. High-income countries are demandeurs on services, investment and competition policies, creating the potential for beneficial issue linkages and tradeoffs. Many of the new regulatory issues are not sector-specific. Any new disciplines and agreements therefore should ideally apply across-the-board.

However, care should be taken not to pursue the benefits of international agreements on too many new trade issues. From an economic development perspective the main gains to poorer countries will come from market access liberalisation: reducing agricultural and textile protection in OECD countries at least to the levels applied to other manufactures, and reducing the anti-agriculture bias in developing countries induced by their own protectionist and regulatory policies in manufacturing and services. Limited analytical and negotiating resources in developing countries make a number of them hesitant about the Doha Round having lots of new issues, to say the least. But developing countries may need to agree to discuss at least some of the new trade issues if they want to ensure agricultural market access remains high on the Doha Round's agenda.

There are clearly many challenges as well as opportunities ahead. For Cairns Group members and other developing countries interested in seeing agricultural market reforms continue in the 21st century, their key immediate priorities can be summarised as follows:

- ensure all the main forms of distortions to agricultural markets are high on the Doha agenda, to minimize the possibility that reforms in one area are offset by policy re-instrumentation to trade-distortive support measures not yet disallowed;
- facilitate the accession of new members to the WTO, particularly those aspirants that are significant in world agricultural markets such as Russia, Ukraine and Vietnam;
- keep explaining why trade reforms are desirable and why they need not be a threat to food security, to food safety, or to the environment, especially if appropriate first-best policy instruments are used to address the latter concerns; and
- explore the prospects for more coalition-building among WTO members and for reducing animosity between members where that is based on incomplete or incorrect information.

Agricultural-exporting countries also have a clear, if indirect, interest in ensuring the continuation and spread of rapid industrialisation in densely populated Asia and elsewhere, for that will expand those developing countries' net imports of farm products. That industrialisation in turn depends heavily on advanced economies honouring and then extending their commitments to liberalise markets for labour-intensive manufactures, especially textiles and clothing. Scope may exist for agricultural exporters and textile exporters to work collectively to ensure the continuation of reform to textile and clothing trade.

At home, food-exporting countries will do themselves a favour by removing their own remaining domestic or trade policy barriers to their agricultural exports. This includes reducing any under-investment in public infrastructure in rural areas. That will enhance their chance of gaining further market openings following the Doha Round.

As for densely populated food-importing developing countries, the idea of them following the steps of more-industrial economies, in the sense of protecting their farmers increasingly from import competition as economic growth proceeds, is no longer a long-run option under the WTO. The economically superior option, of facilitating adjustment by farmers to market forces, will yield far greater dividends -- and yet will not lead to the feared disappearance of their agricultural sectors. Indeed it is likely to lead to specialisation in production that may even see some new niche firms/industries emerge with high value added differentiated farm products that are internationally very competitive.

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7

Effects of agricultural policy reform on household and regional income distribution in Indonesia

PETER WARR AND PREM THAPA

Introduction

The economic crisis of the late 1990s had economic and political consequences which are still unfolding. Within the crisis affected countries, large numbers of rich and poor people were adversely affected. The effects on the poor operated through a contraction in the demand for labour, on the one hand, and increases in commodity prices, especially for internationally traded goods, on the other. These problems have apparently been more severe in Indonesia that anywhere else. Not all poor people in Indonesia were adversely affected. Some smallholder agricultural producers whose products are exported benefited substantially from the depreciation of the national currency, the rupiah. Nevertheless, most poor people, including most agricultural producers, seem to have been harmed, especially those who are net purchasers of food. Food prices have thus been a special concern in the policy response to the crisis.

The staple food of Indonesia, rice, has been a special focus of government intervention for decades. The National Logistics Planning Agency, Bulog, has been charged with regulating food markets, especially rice, and has enjoyed a monopoly in rice imports. One objective of Bulog's interventions in the rice market has been to stabilise domestic rice prices relative to international prices and it has done this effectively (Timmer 1996). Another objective has been to ensure adequate supplies to consumers and this has been reflected in suppression of the average level of domestic prices below the average levels of international prices.1 In the absence of Bulog's interventions, domestic rice prices would have been more variable and their average level would apparently have been somewhat higher.

In the wake of the crisis, the large depreciation of the rupiah raised food prices to a degree that outstripped increases in money wages for those Indonesians fortunate enough to retain their jobs. The affordability of food for the poorest people thus became a special focus of policy concern and this was reflected in special measures intended to target additional food subsidies, especially for rice, to the poorest households. In these special market operations, rice is sold at prices equivalent to around 50 to 60 percent of market prices, themselves significantly below international prices. As the depreciation of the rupiah continued, following the crisis, these subsidies grew in importance. The gap between international prices and domestic rice prices increased and the level of rice imports also increased substantially. These subsidies are the principle focus of this paper.

In addition to rice subsidies, the government has also subsidised fertilisers. Political forces have played a large role in determining the levels and composition of these subsidies, but in part, the fertiliser subsidies may be seen as an attempt to counteract the lower level of rice production which results from the production tax implicit in the suppression of average domestic rice prices below average levels of international prices. Beyond this, the government adheres to an objective of rice self-sufficiency and fertiliser subsidies have thus been considered to be justified well beyond the rates that would raise rice production to the level it might have taken under an non-interventionist policy. As with rice subsidies, the budgetary

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[1]This description is controversial in that some observers have disputed that average rice prices have been significantly below international rates. Nevertheless, to the extent that it is true, it applies to prices averaged over many years. It does not apply in each individual year. There have been years in which rice prices have been above international prices and years of the opposite. See Timmer (1996) for a fuller discussion.

cost of fertiliser subsidies became much larger in real terms in the wake of the economic crisis.

Under the special market operations (OPK) Bulog sets the price of rice to low income families at Rp.1,000 per kg., although there have been frequent claims that individual families are sometimes charged much more than this by local governments under the guise of transport or other costs. The rice concerned is usually third grade (25 percent broken). To calculate the approximate rate of subsidy implicit in that price, we may take the Bangkok price of US $250 per ton for 25 percent broken rice, add US $14 for transport cost and multiply by 1.2 for retail markups. At an exchange rate of Rp.8050/US$, this comes to approximately Rp.2,550 per kg. According to this calculation the rate of subsidy is currently around 60 percent. Hard data on the distribution of subsidised sales by expenditure levels of recipient households is not currently available.

Under the special market operations, Bulog sold around 350,000 tons of rice at these subsidised prices between July, when the program started, and the end of December 1998. The monthly amounts of subsidised sales increased steadily over this period to just over 100,000 tons in December. At cif prices these sales were worth around US$ 110 million and the subsidy was worth around US$ 66 million.

A package of deregulation agreed with the World Bank and announced on 1 December 1998, included the following features:

- Liberalisation of the rice market in which prices are determined by market mechanisms and in which general importers are permitted to import rice;
- Special market operations for rice at subsidised prices to be targeted to food insecure people, defined as those with incomes below the official poverty line;
- The rates of rice subsidies to be reduced to no more than 20 percent;
- All food subsidies for commodities other than rice to be eliminated; and

- Fertiliser subsidies to be eliminated and their prices to be determined by market mechanisms.2

These provisions were due to be implemented at the commencement of the new financial year, beginning 1 April, 1999. Clearly, they are very substantial policy changes. Measures (i) and (iv) apparently do not rule out the use of border interventions such as tariffs or import subsidies, but they do greatly reduce the scope of Bulog's role. According to the scheme, the rice subsidies would remain, but at reduced rates. Our objective in this chapter is to examine the effects of changing the subsidy rate within the neighbourhood of the 20 percent subsidy rate set as the target. In the course of this analysis we explore the effects of alternative schemes for targeting the rice subsidy by household group. For this purpose we utilise a general equilibrium model of the Indonesian economy recently constructed and named WAYANG, after the Indonesian puppet theatre.

The following section describes the general features of the WAYANG model. The third section outlines the simulation exercises performed with it. We then summarise the results and conclude.

The WAYANG Model

A detailed paper describing the full model is available (Warr *et al.* 1998 and Appendix 1 of this volume). The present summary is intended to be as non-technical as possible to enable non-specialist readers to grasp the essential features of the model. WAYANG is a conventional, real, micro-theoretic general equilibrium model of the Indonesian economy. Its features are designed primarily to enable it to address micro-economic policy issues relevant for Indonesia. The principal distinguishing features of WAYANG are:

- its solid empirical basis;
- its disaggregated industry and commodity structure; and
- its detailed income distributional capabilities.

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[2]This provision applies to urea, SP-36 and Potassium Chloride.

This section briefly describes the major elements of WAYANG model, its theoretical structure, its database, and features of the WAYANG parameter file.

Overview of the model

The structure of the model itself is relatively conventional. WAYANG belongs to the class of general equilibrium models which are linear in proportional changes, sometimes referred to as Johansen models, after the seminal work of Johansen (1964), which also used this approach. WAYANG shares many structural features with the highly influential ORANI general equilibrium model of the Australian economy (Dixon *et al.* 1982), which also belongs to this Johansen category, but these features have been adapted in light of the realities of the Indonesian economy.

There are two principal versions of the WAYANG model: a *national* version and a *regional* version. The regional version is larger and somewhat more complex. For the purposes of this paper, it will be sufficient to describe the national version. Five features of the model, described in turn, are its industries, commodities, factors of production, households, and market behaviour.

Industries

The national model contains 65 producer goods and services produced by 65 corresponding industries - 18 agricultural industries and 47 non-agricultural.[3] Each industry produces a single output, so the set of commodities coincides with the set of industries. The various industries of the model are classified as either export-oriented or import-competing. In the normal closure used for experiments with WAYANG the level of exports of an export-oriented industry are treated as being endogenous, while the exports of an import-competing industry are treated as being exogenous.[4] The criterion used to classify these industries is the

[3]'Agricultural' industries are here defined to include three natural resource extraction industries: wood (21), hunting and other forest products (22) and sea fishing and other marine products (23).

[4] Given that the exported and domestically sold good are treated as being identical, this assumption is necessary to make it possible to separate the domestic price of the import competing good from the price of the exported

ratio of an industry's imports to its exports. If this ratio exceeds 1.5, then the industry is regarded as producing an importable. If the import/export ratio is less than 0.5, then the industry is deemed to be export-oriented. For ratios between 0.5 and 1.5, additional relevant information is used in classifying the industry.

Commodities

WAYANG contains two types of commodities - producer goods and consumer goods. Producer goods come from two sources - domestically-produced and imported. All 65 producer goods are in principle capable of being imported, although in fact some have zero levels of imports in the database, services and utilities representing most of the examples. The 20 consumer goods identified in the model are each transformed from the producer goods, where the proportions of domestically produced and imported producer goods of each kind used in this transformation is sensitive to their (Armington) elasticities of substitution and to changes in their relative prices.

Factors of production

The mobility of factors of production is a critical feature of any general equilibrium system. 'Mobility' should be interpreted to mean mobility across economic activities (industries), rather than geographical mobility. The greater the factor mobility that is built into the model, the greater is the economy's simulated capacity to respond to changes in the economic environment. It is clearly essential that assumptions about the mobility of factors of production be consistent with the length of run that the model is intended to represent.

Within the WAYANG structure, a wide degree of flexibility is permitted in the treatment of factor mobility. This is illustrated by the treatment of labour. Four types of labour are identified: agricultural labour, production labour, administration labour and professional labour. The first two forms of labour are relatively less skilled than the other two.

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good. Otherwise, the Armington structure we have described above would be redundant.

Obviously, agricultural labour is used primarily in agriculture and production labour is used primarily in industry. The degree to which they substitute of one another is a crucial question and one where the model user has considerable flexibility. If they are treated as perfect substitutes, this is equivalent to assuming and one factor of production, say 'unskilled labour', is mobile across the entire economy, implying that their wages must be equalised. If they do not substitute for one another at all, this is equivalent to assuming that agricultural and industrial labour are discrete types of labour and there is no need for their wages to move together. These two characterisations of the labour market may be expected to have quite different implications for adjustment of the various industries, as well as very different income distributional implications.

The other two factors of production are capital and land and again the user has considerable flexibility in specifying the degree of mobility of these factors across industries. For example, it is possible to assume that capital is mobile across all industries, that it is immobile (fixed) in every industries, or that it is mobile among only some industries. A common assumption is that there are two kinds of capital - one that is mobile among agricultural industries and another mobile among non-agricultural industries, but with no mobility between them. In this treatment, agricultural capital is thought of as machinery such as tractors of various kinds, which can be used in a variety of agricultural activities. Non-agricultural capital is thought of as industrial machinery and buildings. Any combination of these treatments is possible within WAYANG.

Land is used primarily in agriculture but its mobility among agricultural industries is a matter which users of the model can determine. Land can be mobile among all agricultural industries, fixed in each, or mobile among only some sets of industries. When factors are immobile - industry specific - changes in relative prices do not cause any reallocation of these inputs across industries. In some cases, as with capital, this may be thought of as a short run treatment, as a movement to other sectors is assumed to require sufficient re-tooling costs as to render such reallocations economically infeasible. In a long run setting, the amounts available of each of these region and sector-specific capital resources would adjust as a result of the investments made in each time period of the model. When capital is treated as industry-specific the length of run implicit in the model's comparative static adjustment processes should be thought of as being between two and four years.

Households

The model contains ten households - seven rural and three urban - differentiated by socio-economic group. They are based on the households defined in the 1993 *Social Accounting Matrix* produced by the Central Bureau of Statistics in Jakarta (BPS)[5]. The households are described below. The sources of income of each of these households are different, depending on their ownership of factors of production, as derived from the BPS *Social Accounting Matrix*, and their demand behaviour also differs from one another, as reflected in the set of demand elasticities entering the WAYANG database.

Market behaviour

The microeconomic behaviour assumed within WAYANG is competitive profit maximisation on the part of all firms and utility maximisation on the part of consumers. Markets for final outputs, intermediate goods and factors of production all clear at prices which are determined endogenously within the model. Variations to this assumption are possible, however, and this is important for factors of production, especially labour. Labour can be unemployed in WAYANG and this is accomplished in modelling terms through closure decisions, by allowing real or nominal wages to be fixed (exogenous) and thereby allowing the supply of labour to be demand-determined (endogenous). Thus, 'market clearing' as defined here, does *not* necessarily mean full employment.

Theoretical structure

The analytical structure of the model includes the following major components:

- A complete consumer demand system based on the 20 consumer goods, for each of the 10 individual households;

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[5]BPS is an Indonesian abbreviation for *Biro Pusat Statistik* (Central Bureau of Statistics), Jakarta.

- A factor demand system which relates the demand for each primary factor to industry outputs and prices of each of the primary factors, which reflects the assumption that factors of production may be substituted for one another in ways that depend on factor prices and on the elasticities of substitution between the factors;

- The distinction between skilled and unskilled labour, which are nested within the production functions of all non-agricultural industries, using a constant elasticity of substitution (CES) aggregation;

- An intermediate good demand system which assumes that intermediate goods are used in each industry in proportion to the output produced (the Leontief assumption);

- Zero profit conditions for each industry determining specific factor returns from commodity prices, intermediate good prices and mobile factor returns;

- Demands for imported and domestically produced versions of each good, incorporating Armington elasticities of substitution between the two;

- Market clearing conditions for each commodity and factor of production ensuring that aggregate demand does not exceed aggregate supply for that commodity or factor;

- A set of equations determining the incomes of the 10 households from their (exogenous) ownership of factors of production, reflecting data derived from the 1993 Social Accounting Matrix, the (endogenous) rates of return to these factors, and any net transfers from elsewhere in the system;

- Rates of import tariffs and excise taxes across commodities, rates of business taxes, value added taxes and corporate income taxes across industries, and rates of personal income taxes across households which reflect the structure of the Indonesian tax system, using data from the Indonesian Ministry of Finance; and

- A set of macroeconomic identities that ensures the standard macroeconomic accounting conventions are observed.

The nominal exchange rate between the rupiah and the US dollar is fixed exogenously. The role within the model of the exogenous nominal exchange rate is to determine, along with international prices, the nominal domestic price level. Thus, for example, if all prices are flexible a ten percent increase in the exchange rate will result in a ten percent increase in all nominal domestic prices but no change in any quantity determined within the model.

Production functions assume constant returns to scale. This assumption enters the model via the factor demand functions, which are homogeneous of degree one in output, and through the zero profit conditions, which equate unit commodity prices to unit costs of production. All behavioural functions are homogeneous of degree zero in prices. There are four mobile or semi-mobile primary factors of production: skilled labour, unskilled labour, agricultural mobile capital and non-agricultural mobile capital. In addition, each industry also uses an industry-specific fixed factor. Two factors are freely mobile across all 20 agricultural industries: unskilled labour and mobile agricultural capital. Three primary factors are freely mobile among the 40 non-agricultural industries: skilled labour, unskilled labour and non-agricultural mobile capital. Only unskilled labour is freely mobile across all 60 industries.

Skilled labour is defined as those in the work force with more than a specified level of education. Skilled labour is not used in agriculture because agricultural census data confirm that very little educated labour is engaged in agricultural production. Mobile agricultural capital consists of equipment such as tractors and cultivation equipment with a variety of agricultural uses but little or no non-agricultural use. Mobile non-agricultural capital includes non-agricultural land and structures such as buildings not necessarily devoted to any particular production activity. When relative prices change, it is possible for owners of such assets to rent them out to other non-agricultural producers facing more profitable circumstances.

Industry-specific capital, consisting of assets devoted to a particular line of production activity, also exists in each of the 60 industries. In agriculture, this means land. Outside agriculture, it means industry-specific production equipment. Changes in relative prices do not cause a reallocation of such capital inputs to other sectors in the short run, because of the re-tooling costs involved. The length of run implicit in the model's comparative static adjustment processes should be thought of as being between two and four years.

Database

This section provides a description of INDOSAM: a disaggregated social accounting matrix (SAM) for Indonesia, with a 1993 base. This SAM is intended to serve as the database for WAYANG, but it has other potential uses as well. The year 1993 is currently the latest for which it is possible to assemble the information required for construction of a social accounting matrix for Indonesia.

Three principle data sources, all compiled by the government's principal statistical agency, the Central Bureau of Statistics, BPS, were used to construct INDOSAM-93: (i) the 1990 input-output tables (subsequently referred to as IO 90); (ii) the updated input output table for 1993 (subsequently IO 93); (iii) the 1993 social accounting matrix (subsequently SAM 93). The IO 90 and SAM 93 are available from BPS in published form. The IO 93 is an unpublished and preliminary update of the 1990 input output tables, kindly provided to the authors by BPS. The table specifies 66 sectors. Other, supplementary, data sources were also used in the construction of specific tables, as described below. Abbreviations are used for these supplementary sources in the text and full references are provided at the end of the paper.6

The principal data sources

The 1993 social accounting matrix produced by BPS (SAM 93) provided the starting point for the database but substantial additions to the information in SAM 93 were required. SAM 93 contains 22 production sectors, which is insufficient for the purposes of this study. In addition, the SAM 93 does not include the detail of

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[6] The final two references listed, [Statistical Year Book 95] and [IFS 96], were also used to verify some data contained in the Indonesian sources cited when the meaning or accuracy of published data seemed to require checking.

tax payments and household sources of income that are required. The updated 1993 input output table (IO 93) is a revision of the 1990 IO table (IO 90), published previously, and specifies 66 production sectors. For the purposes of the present study, modifications to the data contained in IO 93 were needed for the following reasons:

- The table specifies only total intermediate goods and services transactions for each pair of producing and purchasing industries, at producer prices, and unlike the 1990 table, these transactions are not divided into goods and services from domestic and imported sources;
- The table includes a sector (number 66, labelled "unspecified sector"), which is included as a balancing item, but it does not describe a true sector of the economy and in any case the data for this sector indicates negative final demand, an economic impossibility;
- The updated table (IO 93) derived from BPS was not fully balanced. The major imbalances were that for most industries defined in the table, the industry-specific elements of row 210 (total input) were not equal to those of row 600 (total output), and the elements of row 200 (total imports) plus row 600 (total output) were not equal to those of row 700 (total supply).

These problems were overcome as follows:

- The shares of imported intermediate goods and domestically produced intermediate goods for each cell of the table, as implied by the published 1990 IO table, were used to divide intermediate goods transactions into domestic and imported components;
- Sector 66 was aggregated with the much larger sector 65 (labelled "other services"), which eliminated the problem of negative final demands; and
- The revised table was balanced using the RAS adjustment method to ensure that all required accounting identities were observed.

Elasticity files

The elasticity files used in WAYANG were borrowed from empirical estimates derived econometrically for a similar model of the Thai economy, known as PARA. The elasticity files concerned were the consumer demand system and the factor demand elasticities. In both cases, these elasticities were amended to match the differences between the databases for WAYANG and PARA so as to ensure the homogeneity properties required by economic theory. The Armington elasticities of substitution between imports and domestically produced goods and the elasticities of export demand were set at default values. All Armington elasticities were set at 2 and all export demand elasticities were set at 20.

Characteristics of households

Since our study focuses on the way external shocks affect the various households of the model it is important to summarise the characteristics of the ten households represented in WAYANG. Table 7.1 provides this summary. The seven rural households account for 73 percent of total population and 61 percent of total consumption expenditure. The four poorest household categories, measured in terms of expenditure, are all rural. Poverty, in Indonesia as elsewhere in the developing world, is overwhelmingly a rural phenomenon.

Table 7.1: Classification of households in Indonesia

Household categories	Population in households		Annual consump. expenditure		Annual capita expenditure
	Total in 1993 (million)	Share %	Total value (billion Rupiah)	Share %	(thous. Rupiah)
RURAL Households		(73.2)		(60.9)	
HH1 Landless	18.70	10.0	8,878	4.7	475
HH2 Small Cultivator (<0.5 ha.)	51.30	27.3	36,512	19.4	712
HH3 Medium Cultivator (0.5 to 1 ha.)	11.60	6.2	9,146	4.8	788
HH4 Large Cultivator (> 1 ha.)	12.00	6.4	13,607	7.2	1,134
HH5 Non-Agricultural labour: low income	16.60	8.8	12,164	6.4	733
HH6 Rural non-labour households	2.90	1.5	3,317	1.8	1,144
HH7 Non-Agricultural labour: high income	24.30	13.0	31,309	16.6	1,288

URBAN Households		(26.8)		(39.0)	
HH8 Urban labour: low income	23.30	12.4	21,273	11.3	913
HH9 Urban non-labour household	4.80	2.6	5,275	2.8	1,099
HH10 Urban labour: high income	22.10	11.8	47,080	25.0	2,130
All households	187.60	100.0	188,599	100.0	1,005

Source BPS, Sistem Neraca Sosial Ekonomi Indonesia 1993, p. 111.

The sources of income for the various households are important for the general equilibrium properties of the model and these are summarised in Table 7.2.

Table 7.2: Sources of gross household factor incomes in Indonesia

(percentage)

Household categories	Skilled labour	Unskilled labour	Land	Capital	Total
RURAL Households					
HH1 Landless	1.9	45.9	3.3	48.9	100
HH2 Small Cultivator (< 0.5 ha.)	5.0	42.8	7.1	45.1	100
HH3 Medium Cultivator (0.5 to 1 ha.)	4.5	52.6	6.2	36.8	100
HH4 Large Cultivator (> 1 ha.)	5.8	65.8	3.9	24.5	100
HH5 Non-Agriculture labour: Low income	26.1	33.2	5.2	35.5	100
HH6 Rural non-labour households	5.8	14.5	1.7	78.0	100
HH7 Non-Agricultural : high income	29.7	39.0	2.1	29.2	100
URBAN Households					
HH8 Urban labour: low income	20.7	11.2	3.4	64.7	100
HH9 Urban non-labour household	14.1	18.4	5.5	62.0	100
HH10 Urban labour: high income	37.2	14.8	0.5	47.5	100
All Households	23.4	28.8	2.9	44.9	100

Source: WAYANG models database

The simulations

Our simulations required first amending the standard form of the model to incorporate subsidies on consumer goods. This required changes to the equation set and the database. The consumer demand equations were amended to incorporate household-specific subsidies on each commodity. The government revenue used to finance these subsidies was then allowed for by adding a new equation which aggregates government spending on consumption subsidies and incorporating this term into the overall government budget balance equation. The database was amended to allow for a base level of a 20 percent subsidy on rice consumption. To preserve the balance of the existing database the value of the reduced consumer spending this represented was added to household savings. The additional government revenue required to finance the consumption subsidies was similarly incorporated without disturbing the balance of the system by subtracting this amount from government savings.

Model closure

The objective of the simulations is, in part, to derive effects that changes in the levels of consumption subsidies have on household welfare. Within the single-period horizon of the model, the measure of household welfare is its real consumption. The macroeconomic closure must be made compatible with this measure by ensuring that the full economic effects of the shocks to be introduced are channelled into current-period household consumption and do not 'leak' into other directions, with real-world welfare implications not captured by the welfare measure. In this context, issues of macroeconomic closure may thus be seen in part as devices for minimising inconsistencies between the use of a single-period model to analyse welfare results and the multi-period reality that the model represents. The real values of the current account balance, real government spending and real investment are each held fixed in the chosen closure because in all these cases, changes to the real value of the variables concerned have real world consequences not captured by the welfare measure.

To prevent intertemporal and other welfare leakages from occurring, the simulations are conducted with balanced trade (exogenous balance on current account), to ensure that the potential benefits from the export tax do not flow to foreigners, through a current account surplus, or that increases in domestic consumption are not achieved at the expense of borrowing from abroad, in the case of a current account deficit. For the same reason, real government spending and real investment demand for each good are each held fixed exogenously. The government budget deficit is held fixed in nominal terms and this is achieved by across-the-board adjustments to personal income tax rates, in response to changes in government revenue so as to restore the base level of the budgetary deficit.

Closure decisions are also required for the markets for skilled and unskilled labour. The WAYANG model has no explicit labour supply behaviour within it and model closure decisions must provide the equivalent of labour supply information. The labour supply assumption employed here is that levels of aggregate employment are exogenous, and thus that the aggregate supply of skilled and unskilled labour are fixed.

The shocks

The shocks applied were in every case an increase in the rate of subsidy on rice from the base rates of 20 percent to 50percent. The simulations reported differ as to which household or combination of households receive this increased subsidy. This increase in the subsidy rate multiplies the rate of subsidy by 2.5 and thus corresponds to a 150 percent increase in the rate of the subsidy. This increase in the subsidy rate was first applied to all households and we refer to this as simulation A. Then we applied this rate of increase in the subsidy (an increase from a 20 percent subsidy rate to a 50 percent subsidy rate) for individual households only, holding the subsidy rate for all other households constant at the base rate of 20 percent. We do this for each of the five poorest households identified in the model. The first four of these, households 1, 2, 3 and 5, are the poorest rural households and the fifth is the poorest urban household, household 8. Thus simulation B1 increases the subsidy rate for household 1 alone, and simulations B2, B3, B5 and B8 apply the same rate of subsidy increase to households 2, 3, 5 and 8.

Results

The results of the simulations are reported in Table 7.3.

Simulation A

An increase in the subsidy rate across all households from 20 to 50 percent increases aggregate consumption of rice by around 7.5 percent. The market price of rice, allowing for the subsidy, declines by 31 percent but net of the subsidy the price increases by 7.5 percent. The relatively small increase in the unsubsidised price indicates that the aggregate market supply for rice as a consumer good is relatively elastic. This aggregate supply comes from two sources, domestic production and imports, which are imperfect substitutes (all Armington elasticities are set at 2.0). Imports of rice increase by 12.6 percent and domestic production of paddy increases by 6 percent. In the base year used for the database, imports were under 1 percent of total rice supplies.

The increase in the producer price of paddy (3.8 percent) induces a large increase (14.6 percent) in the return to paddy land. Since paddy production is labour intensive, the increased profitability of rice also induces an expansion in the demand for unskilled labour which raises real wages for unskilled labour, economy-wide, by 5.1 percent. Real wages for skilled labour increase also, but by a much smaller amount. Returns to capital outside agriculture decline, a consequence of the increase in real wages squeezing the return to capital.

The decline in the consumer price of rice forces down the aggregate consumer price index by 4 percent (rice comprises 12.2 percent of total expenditure). This, combined with the factor income changes described above leads to an increase in the real gross incomes of all households. This is not the same as an increase in disposable incomes, however, because the government's subsidisation of rice has a budgetary cost. Aggregate budgetary expenditures increase by 7.8 percent and deflating this by the consumer price index, real government expenditures increase by 11.8 percent. Financing this increased level of expenditure requires increased taxes and the tax that adjusts in our simulations is the personal income tax rate. This tax rate increases by 30.4 percent.

The households which emerge as the largest net gainers (largest increases real consumption expenditure) are those which benefit most from the increases in the return to land and unskilled labour, but which are not significant parts of the personal income tax base. These are the small, medium and especially the large land owners. Rural owners of capital (household 6) lose, primarily from the increase in their income tax obligations, as do urban owners of capital (household 9).

Table 7.3 Estimated effects of increases in rice consumption subsidies with fixed aggregate employment, Indonesia

(all numbers are percentage rate changes, unless otherwise specified)

SIMULATION	A	B1	B2	B3	B5	B8
SHOCKS:						
Rice consumption subsidy rate increased from 20% to 50%	All households	HH1 only	HH2 only	HH3 only	HH5 only	HH8 only
A. Macro Results:						
A.1. Overall Economy						
Gross Domestic Product						
Nominal (local currency)	-1.31	-0.02	-0.28	-0.82	-0.03	-0.09
Real	-1.07	-0.02	-0.23	-0.07	-0.02	-0.08
GDP Deflator	-0.24	-0.01	-0.05	-0.02	-0.01	-0.02
Consumer Price Index	-4.08	-0.07	-0.95	-0.27	-1.30	-0.25
Wage						
Nominal Skilled	-2.21	-0.03	-0.46	-0.15	-0.05	-0.14
Unskilled	1.03	0.01	0.21	0.07	0.02	0.07
Real Skilled	1.87	0.04	0.49	0.12	1.25	0.11
Unskilled	5.11	0.08	1.16	0.34	1.33	0.32
Returns to variable capital (nominal)						
Non-agriculture	-0.54	-0.01	-0.11	-0.04	-0.01	-0.03
Agriculture	3.71	0.05	0.78	0.25	0.09	0.24
Returns to Land						
Paddy land	14.58	0.19	3.08	0.95	0.35	0.97
Beans land	2.16	0.02	0.43	0.16	0.05	0.12
Maize land	5.46	0.07	1.13	0.39	0.13	0.32

Table 7.3 cont.

	A	B1	B2	B3	B5	B8
Employment						
Skilled	*	*	*	*	*	*
Unskilled	*	*	*	*	*	*
A.2 External Sector						
Export revenue (foreign currency)	0.07	0.00	0.01	0.01	0.00	0.00
Import bill (foreign currency)	0.07	0.00	0.01	0.01	0.00	0.00
A.3 Government Budget						
Nominal revenue (local currency)	7.75	0.10	1.70	0.50	0.20	0.58
Nominal expenditure (local currency)	7.75	0.10	1.70	0.50	0.20	0.58
Budget deficit (in levels)						
A4 Household Sector						
Nominal consumption (local currency)	-2.16	-0.03	-0.46	-0.13	-0.05	-0.15
Real consumption	1.92	0.04	0.49	0.14	1.25	0.10
B. Sectoral Results (aggregates)						
Agriculture	1.51	0.02	0.31	0.10	0.04	0.10
Manufactures	1.37	0.02	0.29	0.09	0.03	0.09
Services	-0.17	0.00	-0.04	-0.01	-0.01	-0.01
Natural resources	-0.05	-0.01	-0.10	-0.02	-0.01	-0.04
Agricultural processing	4.51	0.01	0.94	0.29	0.11	0.30
C. Sectoral Results (by industry)						
Domestic supply						
Paddy	5.93	0.08	1.25	0.38	0.14	0.40
Beans	0.03	0.00	0.00	0.01	0.00	0.00
Maize	0.38	0.00	0.08	0.03	0.00	-0.07

Table 7.3 cont.

	A	B1	B2	B3	B5	B8
Imports						
Paddy	*	*	*	*	*	*
Beans	4.20	0.05	0.88	0.28	0.10	0.27
Maize	9.45	0.12	1.98	0.64	0.22	0.61
Milled rice	12.66	0.16	2.68	0.82	0.31	0.85
D. Government Budgetary Position						
Revenue:						
Personal Income tax collection	30.42	0.32	5.42	1.98	0.65	2.06
(personal income tax rate shifter)	30.72	0.33	5.49	1.20	0.65	2.09
Corporate tax	0.36	0.00	0.08	0.02	0.01	0.02
Indirect taxes						
Excise	0.97	0.01	0.20	0.07	0.02	0.06
Business	0.49	0.01	0.10	0.04	0.01	0.03
Other	0.71	0.01	1.50	0.05	0.02	0.05
Tariff	0.14	0.00	0.03	0.01	0.00	0.01
Expenditure:						
Government consumption	-0.05	-0.01	-0.11	-0.04	-0.01	-0.04
Consumption subsidy	159.0	2.8	36.7	10.5	5.0	9.8
Change in value of consump. subsidy**	7124	123	1645	470	224	439
Change in total gov. expenditure **	5132	68	1123	335	130	381
** in billion Rupiah 1993 constant prices						
E. Income						
E.1 Nominal Gross Income						
Rural: HH1 Landless	0.14	0.01	0.09	0.03	0.01	0.03

Table 7.3 cont.

	A	B1	B2	B3	B5	B8
HH2 Small cultivator	0.38	0.01	0.08	0.03	0.01	0.02
HH3 Medium cultivator	0.45	0.01	0.09	0.03	0.01	0.03
HH4 Large cultivator	0.51	0.01	0.11	0.04	0.01	0.03
HH5 Non-agriculture labour: low income	-0.23	-0.01	-0.05	-0.02	-0.01	-0.02
HH6 Non-labour	-0.19	-0.00	-0.04	-0.01	-0.00	-0.01
HH7 Non-agricultural labour: high income	-0.32	-0.00	-0.07	-0.02	-0.01	-0.02
	0.00	0.00	0.00	0.00	0.00	0.00
Urban: HH8 labour: low income	-0.56	09.01	-0.12	-0.04	-0.01	-0.04
HH9 non-labour	-0.28	-0.01	-0.06	-0.02	-0.01	-0.02
HH10 labour: high income	-0.89	-0.01	-0.19	-0.06	-0.02	-0.06
E.2 Real gross income changes (deflated by household)						
Rural: HH1 Landless	2.33	1.67	0.14	0.04	0.02	0.04
HH2 Small cultivator	5.34	0.00	5.21	0.01	0.00	0.01
HH3 Medium cultivator	6.07	0.00	0.01	6.02	0.00	0.00
HH4 Large cultivator	6.14	0.00	0.02	0.01	0.00	0.01
HH5 Non-agriculture labour: low income	1.96	0.00	0.04	0.01	1.76	0.01
HH6 Non-labour	2.56	0.01	0.09	0.03	0.01	0.03
HH7 Non-agricultural : high income	5.17	-0.01	-0.10	-0.03	-0.01	-0.03
Urban: HH8 labour: low income	1.73	0.00	0.06	0.02	0.01	0.02
HH9 non-labour	1.91	0.00	-0.20	-0.06	-0.02	-0.06
HH10 labour: high income	3.44	-0.01	-0.20	-0.06	-0.02	-0.06
E.3 Real Consumption						
Rural: HH1 Landless	1.28	1.64	-0.04	-0.02	-0.01	-0.03
HH2 Small cultivator	3.29	-0.02	4.81	-0.11	-0.04	-0.13

Table 7.3 cont.

	A	B1	B2	B3	B5	B8
HH3 Medium cultivator	3.60	-0.03	-0.55	6.49	-0.07	-0.21
HH4 Large cultivator	4.05	-0.03	-0.50	-0.19	-0.06	-0.19
HH5 Non-agriculture labour: low income	0.15	-0.02	-0.28	-0.11	1.73	-0.11
HH6 Non-labour	-0.27	-0.02	-0.40	-0.15	-0.05	-0.16
HH7 Non-agricultural : high income	2.83	-0.04	0.69	-0.25	-0.1	-0.25
Urban: HH8 labour: low income	0.63	-0.01	-0.21	-0.08	-0.03	1.72
HH9 non-labour	-0.66	-0.02	-0.40	-0.15	-0.05	-0.16
HH10 labour: high income	1.48	-0.04	-0.64	-0.23	-0.08	-0.23
F. Prices						
F.1 Domestic producer prices						
Agricultural commodities						
Paddy	3.79	0.05	0.80	0.25	0.09	0.25
Beans	1.57	0.02	0.32	0.11	0.04	0.10
Maize	2.33	0.03	0.49	0.16	0.05	0.14
Cassava	0.26	0.00	0.05	0.03	0.00	0.01
Vegfruit	-0.21	0.00	0.05	0.00	-0.01	-0.03
F.2 Consumer price of rice						
Market price (without subsidy)	7.52	0.02	0.34	0.11	0.04	0.11
Price to subsidise consumer households	-31.5	-39.0	-38.7	-38.9	-39.0	-38.9
F.3 CPI BY Household						
Rural: HH1 Landless	-1.92	-1.67	-0.05	-0.02	-0.01	-0.02
HH2 Small cultivator	4.96	0.00	-5.14	0.02	0.01	0.01
HH3 Medium cultivator	-5.62	0.01	0.08	-5.98	0.01	0.02

Table 7.3 cont.

	A	B1	B2	B3	B5	B8
HH4 Large cultivator	-5.62	0.01	0.09	0.03	0.01	0.03
HH5 Non-agriculture labour: low income	-2.19	-0.01	-0.09	-0.03	-1.76	-0.03
HH6 Non-labour	-2.75	-0.01	-0.13	-0.04	-0.02	-0.04
HH7 Non-agricultural : high income	-5.49	0.00	0.40	0.01	0.00	0.01
Urban: HH8 labour: low income	-2.29	-0.01	-0.13	-0.04	-0.14	-1.72
HH9 non-labour	-2.19	-0.01	-0.12	-0.04	-0.01	-0.04
HH10 labour: high income	-4.34	0.00	0.01	0.00	0.00	0.00
G. Rice consumption quantity by household						
Aggregate rice consumption	7.52	0.10	1.59	0.49	0.18	0.50
Rural: HH1 Landless	6.60	7.83	--	--	--	--
HH2 Small cultivator	7.50	--	9.36	--	--	--
HH3 Medium cultivator	7.68	--	--	10.71	--	--
HH4 Large cultivator	7.98	--	--	--	--	--
HH5 Non-agriculture labour: low income	5.82	--	--	--	8.11	--
HH6 Non-labour	5.34	--	--	--	--	--
HH7 Non-agricultural : high income	7.08	--	--	--	--	--
Urban: HH8 labour: low income	8.64	--	--	--	--	11.92
HH9 non-labour	7.02	--	--	--	--	--
HH10 labour: high income	7.86	--	--	--	--	--

-- = negligible

It is by no means the case that the households which gain the most from the rice subsidy are those for which rice forms the largest part of their total expenditure. The poorest households tend to be those for which the share of rice in their total expenditures is the highest. The response of factor returns and their implications for households' real incomes is what is overlooked by this perspective and this is one of the contributions a general equilibrium treatment can provide.

Simulations B1 to B8

When the increased rice subsidy is applied to household 1 (the poorest rural household) alone, it gains in terms of aggregate real consumption and its gain is somewhat larger than the case where all households receive the subsidy. Comparing the return to household 1 in these two cases, the reduction in the price of rice to household 1 is larger in simulation B1 because when the subsidy is also applied to all other households, the unsubsidised price of rice is bid up, making the subsidy inclusive price larger in simulation A than in B1. This effect outweighs the benefit household 1 receives from the bidding up of the return to unskilled labour that results when all other households also receive the subsidy.

Similarly, when other households are the sole recipients of a rice subsidy (simulations B2, B3, B5 and B8), household 1 is a small net loser, resulting from the bidding up of the unsubsidised price of rice which it faces. Each household gains from being a recipient of the subsidy, but is a small net loser from the granting of the subsidy to other households.

Simulations C and D1: changing the labour market closure

The above results were derived with fixed levels of total employment. While this must no be confused with an assumption of full employment, in the post-crisis environment the assumption of exogenous employment is clearly artificial. How do the results change when this assumption is amended. The economic crisis reduced real wages considerably. It could not be argued that real wages were fixed. That assumption would be as unrealistic as fixed aggregate employment. Nominal wages showed much greater stability. Accordingly, we experiment with this labour market closure for both skilled and unskilled workers. Nominal wages are assumed to be 'sticky'. Supplies of skilled and unskilled labour were thus assumed to be infinitely elastic and these exogenous nominal wages.

Table 7.4 shows the results. They are presented only for an across the board increase in rice subsidies and for an increase applied only to household 1. These results may then be compared with results for simulations A and B1. The results are surprisingly insensitive to the change of labour market treatment. The decline in the consumer price index is similar to above and real wages for skilled and unskilled labour rise, but in the case of the unskilled the increase is smaller than that obtained under simulations A and B1. Employment for skilled workers declines but the increase in demand for unskilled labour in paddy production induces an increase in aggregate employment of unskilled workers. The net effect on the interests of the various households is very similar to that obtained with completely inelastic labour supply assumptions. Artificial assumptions about labour supply are therefore not the source of our results.

Conclusion

A consumption subsidy on rice has effects on different consumers that are not identical to those that would be predicted on the basis of the share of rice in the total expenditure of these households. Household incomes and household tax obligations are affected as well. Household incomes are affected by the factor market consequences of the subsidies. In so far as domestic producer prices of rice are increased by the consumption subsidies, factors of production that are used intensively in rice production enjoy increased returns. Households who own these factors benefit. The way factor markets respond depends on labour market conditions as well as other factors and in the post-crisis environment the way these circumstances are modelled will affect the simulated results. Finally, subsidies have to be paid for. The manner in which the government revenue cost of the subsidies is met will therefore influence the distributional consequences across households. These issues illustrate the value of a general equilibrium treatment of the effects of interventions such as a rice subsidy through exposing the general equilibrium mechanisms that are involved.

Table 7.4: Estimated effects of increases in rice consumption subsidies with fixed nominal wages, Indonesia

(all numbers are percentage rate changes, unless otherwise specified)

	C	D1
SHOCKS:	All households	HH1 only
Rice consumption subsidy rate increased from 20% to 50%		
A. Macro Results:		
A.1 Overall Economy		
Gross Domestic Product		
Nominal (local currency)	-1.05	-0.01
Real	-1.10	0.06
GDP Deflator	0.04	0.00
Consumer Price Index	-3.88	-0.70
Wage		
Nominal Skilled		
Unskilled		
Real Skilled	3.88	0.70
Unskilled	3.88	0.70
Returns to variable capital (nominal)		
Non-agriculture	-0.28	-0.00
Agriculture	3.76	0.05
Returns to land		
Paddy land	15.24	0.20
Beans land	3.70	0.05
Maize land	67.62	0.10
Employment		
Skilled	-0.92	-0.01
Unskilled	0.58	0.01
A.2 External Sector		
Export revenue (foreign currency)	0.19	0.02
Import bill (foreign currency)	0.18	0.02
A.3 Government Budget		
Nominal revenue (local currency)	8.60	0.11
Nominal expenditure (local currency	8.06	0.11
Budget deficit (in levels)		
A.4 Household sector		
Consumption		
Nominal (local currency)	-1.88	-0.03
Real	2.00	0.04
Nominal gross income changes		
Rural: HH1 Landless	0.40	0.00
HH2 cultivator	0.46	0.00

Table 7.4 cont.	C	D1
HH3 Medium cultivator	0.46	0.00
HH4 Large cultivator	0.42	0.00
HH5 Non-agriculture labour: low income	0.11	0.00
HH6 Non-labour	0.02	0.00
HH7 Non-Agricultural : high income	-0.00	0.00
Urban: HH8 labour: low income	-0.11	-0.00
HH9 non-labour	0.08	0.00
HH10 labour: high income	-0.35	-0.00
Real Gross Income Changes (deflated by household-specific CPI)		
Rural: HH1 Landless	2.11	1.67
HH2 Small cultivator	5.30	0.00
HH3 Medium cultivator	6.02	0.00
HH4 Large cultivator	6.01	0.00
HH5 Non-Agriculture labour: poor	2.06	0.00
HH6 Non-labour	2.41	0.00
HH7 Non-Agricultural : rich	5.34	-0.00
Urban: HH8 labour: low income	1.81	0.00
HH9 non-labour	1.94	0.00
HH10 labour: high income	3.77	-0.00
Real Consumption Expenditures		
Rural: HH1 Landless	1.06	1.63
HH2 Small cultivator	3.22	-0.02
HH3 Medium cultivator	3.51	-0.03
HH4 Large cultivator	3.87	-0.03
HH5 Non-Agriculture labour: low income	0.24	-0.01
HH6 Non-labour	-0.44	-0.02
HH7 Non-Agricultural : high income	3.00	-0.03
Urban: HH8 labour: low income	0.70	-0.01
HH9 non-labour	-0.65	-0.02
HH10 labour: high income	1.82	-0.03

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8

Effects of farm policy reform on Indonesia's secondary food crops

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The economic crisis of the late 1990s led to an overhaul of Indonesia's agricultural policies. Influenced by the conditional loan requirements set by the International Monetary Fund (IMF) and other donor institutions, the government has liberalised trade policies. As pre-crisis policies imposed less interventions on secondary food than other crops, however, the impact of policy reform (especially trade policies) on these commodities is expected to be less.

This chapter has several objectives. It provides background data on secondary crops. It also contains details of institutional arrangements concerning these crops. Finally, it contains analysis of the assumed effects of altering R&D investments, so that they favour secondary food crops (i.e. maize, soybean and cassava) more than in the past, using the economy-wide WAYANG model (described in Appendix 1 of this volume).

Production and trade

Indonesia's agricultural land decreased around 1.1 million hectares during the period 1983-1993 (Kasryno, 1997). However, the harvested area of agricultural commodities has increased: an increase of cropping intensity has compensated for a decrease in land usage. During the period from 1969 to 1999, the harvested area of rice increased by 1.6 percent, maize 1.4 percent and soybean 3.5 percent annually, while cassava slightly decreased by 0.5 percent.

Up to mid-1997, the agricultural sector was very instrumental in supporting Indonesia's economic development. Growth in agricultural output, which was around 3 percent over 25 years, made it possible to provide relatively cheap food for the domestic population of more than 200 million people. Agriculture absorbs around 50 percent of employment, and supports the development of manufacturing industries by providing raw materials and cheap labour.

In the second half of 1997, El Nino hit the country causing the worst drought for half a century. This led to a temporary decline of agricultural production capacity of the country. Moreover, the financial crisis exacerbated the decline in farmers' real incomes. The price of agro-inputs also increased with the rupiah's collapse. Consequently, food production in 1997 and 1998 was lower than in 1996.

Rice production declined from 51 million tons (unhusked paddy) in 1996 to 49 million tons in 1997, and dropped again to 49 million tons in 1998 (Figure 8.1). The decline of rice production in 1997 was mainly due to a decrease in harvested area of around 430,000 hectares. In 1998, the government launched its special effort to increase production by expanding planted acreage and increasing cropping intensity. As a result, in 1998 harvested acreage was around 500,000 hectares higher than that of 1997. But because farmers could not afford key inputs, notably fertiliser, the rice yield in 1998 was lower than that of the previous two years.

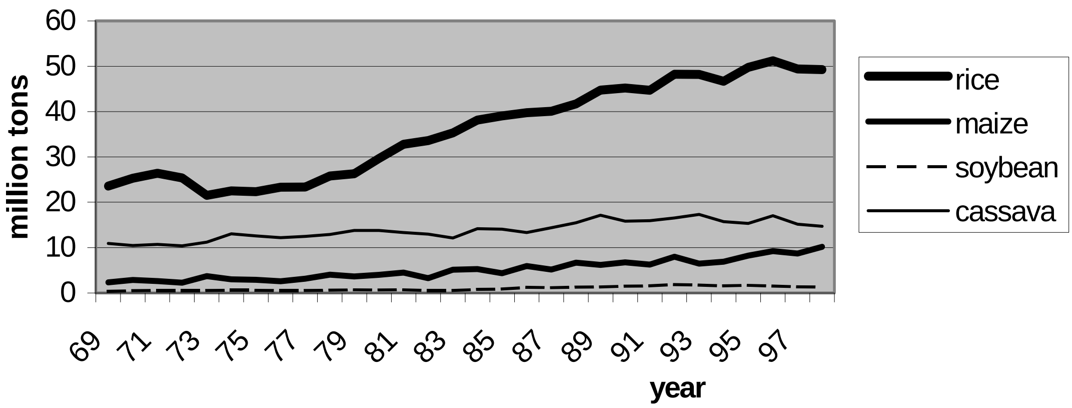
Production of maize declined from 9.3 million tons (dry kernel) in 1996 to 8.8 million tons in 1997. This was largely due to the decline of harvested acreage from 3.7 million hectares in 1996 to 3.4 million hectares in 1997, even though yields increased from 2.5 tons to 2.6 tons per hectare. In 1998, production of maize increased from 8.8 million tons to 10.2 million tons due to an increase in harvested acreage (from 3.4 million to 3.8 million hectares) and yields (by 0.03 tons per hectare). These increases resulted from government programs to boost the production of three main food-crop commodities, namely rice, maize and soybean.

Unlike rice and maize, which recovered in 1998 as a result of government intervention, production of soybean decreased from 1.5

million tons in 1996 to 1.3 million tons in 1999. This was largely due to a decrease in harvested acreage (from 1.3 million hectares to 1.1 million hectares) and yield increases from 1.19 tons to 1.21 tons per hectare. The relatively wet dry season in 1998 hindered soybean production.

President Habibie's administration, with its Cabinet of Reformation, paid close attention to food supplies (rice in particular) for the majority of Indonesians. Two policies included permitting imports of rice, and *Gema Palagung* (a self-reliance movement that sought to increase production of rice, soybean and maize).

Figure 8.1: Production of rice, maize, soybean and cassava, 1969-1998



Source: Erwidodo and Prayogo Hagi (1999).

Even though *Gema Palagung* showed some success, food imports in 1997 and 1998 increased sharply. Imports of rice were 3.6 million tons in 1997 and 5 million tons in 1998. Among other foods, soybean imports increased from 0.6 million tons in 1996 to 0.7 million tons in 1998, and imports of maize increased from 0.6 million to 1.1 million tons. Exports of cassava decreased from 0.29 million tons in 1996 to 0.18 million tons in 1997.

Table 8.1: Shares of food in household expenditure by income group, Indonesia, 1999

Commodity	Group of yearly expenditure (Rp.000)					
	< 100 (%)	100-299 (%)	300-499 (%)	500-749 (%)	>= 750 (%)	Average (%)
Rice						
Share (%)	35.2	23.8	11.9	8.7	8.4	26.6
Participation (%)	99.1	98.6	89.6	80.1	81.1	96.1
Maize						
Share (%)	1.7	0.2	0.1	0.1	0.1	0.7
Participation (%)	11.1	7.2	5.1	3.6	6.1	8.0
Soybean						
Share (%)	2.6	2.5	1.9	1.4	1.3	2.4
Participation (%)	59.8	66.7	65.3	63.3	59.0	63.7
Cassava						
Share (%)	1.1	0.5	0.2	0.1	0.1	0.7
Participation (%)	39.6	33.4	21.3	15.4	15.1	32.4
Instant noodle						
Share (%)	0.7	1.4	1.9	1.6	1.3	1.2
Participation (%)	28.1	40.5	53.2	53.8	47.8	39.0
Chicken meat						
Share (%)	0.5	1.6	2.9	3.1	3.2	1.4
Participation (%)	6.3	20.4	39.4	44.1	44.7	20.1
Eggs						
Share (%)	1.7	2.6	2.8	2.4	2.5	2.3
Participation (%)	45.4	61.5	70.0	67.5	70.0	57.7
Total food						
Share (%)	74.9	67.4	53.0	44.5	31.3	68.5
Total expenditure (Rp.000)	**361.6**	**630.3**	**1,208.4**	**1,785.9**	**3,511.5**	**606.0**
No. of HH samples	17,282	30,545	3,137	678	272	51,914

Source: Calculated from BPS's SUSENAS 1999

How important are secondary food crops for Indonesia?

According to Shindo (1991) many countries in Asia during the 1970s and 1980s pushed their secondary food crops onto marginal and rain-fed lands. In Indonesia, this is also the case, despite maize accounting for 40 to 60 percent, and soybean meal for 20 percent of animal feed.

Table 8.2: Indonesia's rice, maize, and soybean production, 1996 to 1999

Year/ Commodity [(a)]	Production (000 ton)	Harvested area (000 ha)	Yield (ton/ha)
Rice :			
1996	51,102	11,570	4.42
1997	49,377	11,140	4.43
1998	48,472	11,613	4.17
1999 [b)]	48,663	11,494	4.23
Maize :			
1996	9,307	3,743	2,49
1997	8,771	3,355	2,61
1998	10,059	3,834	2,62
1999 [(b)]	8,682	3,267	2,64
Soybean :			
1996	1,517	1,279	1,19
1997	1,357	1,119	1,21
1998	1,306	1,091	1,20
1999 [b)]	1,296	1,076	1,21

a Rice (unhusked paddy), maize (dry kernel) and soybean (dry seed)

b Estimate

Source: Suryana et al. (1999) and Solahuddin (1999).

During the past 30 years rice accounted for almost 65 percent of harvested area, maize around 20 percent and both soybean and cassava around 7 percent each (Table 8.2). Secondary food crops are not competing with rice in terms of land use. Indonesian farmers use irrigated land for rice. Farmers plant secondary food crops on irrigated land only in the dry season, when water is not sufficient for rice to grow. Such crop rotations help reduce the incidence of pests and diseases. However, there is a trend to push secondary food crops to less fertile, non-irrigated lands.

Table 8.1 shows that only 8 percent of the population consumes maize, 33 percent cassava and 64 percent soybeans, compared with 96 percent for rice. Out of the 69 percent of aggregate income spent on food, maize and cassava account for less than 1 percent and soybean 2 percent. For rice, the proportion is 27 percent. About 39 percent of households consume instant noodles, which are processed from wheat, a fully imported raw material.

Rice is the main food of 96 percent of the Indonesian population. Beyond its economic value, it also has political and social importance. Only after 1985, when Indonesia achieved rice self-sufficiency, did the government turn to maize and soybean as crops worthy of attention in terms of policy targets and R&D funding. Since the economic crisis, the government has turned back to rice. Old political and social considerations have resulted in a return to a policy bias towards rice, regardless of the economic possibilities for other crops.

The growth of animal feed industries, the increase in demand for fresh and processed products due to income increases, and derived demand due to increasing demand for chicken and eggs are driving an increase in demand for secondary food crops. In addition, secondary crops are becoming increasingly important as staple foods.

Pre-crisis policies on secondary food crops

By presidential decree in 1978, BULOG's mandate was to maintain the price of rice, sugar, wheat and other main food (including maize and soybean). The role of BULOG decreased after the economic crisis, in response to the demands of the International Monetary Fund (IMF). A floor price policy, implemented in 1980 and applied to maize, soybeans and mung beans, was terminated in 1990.

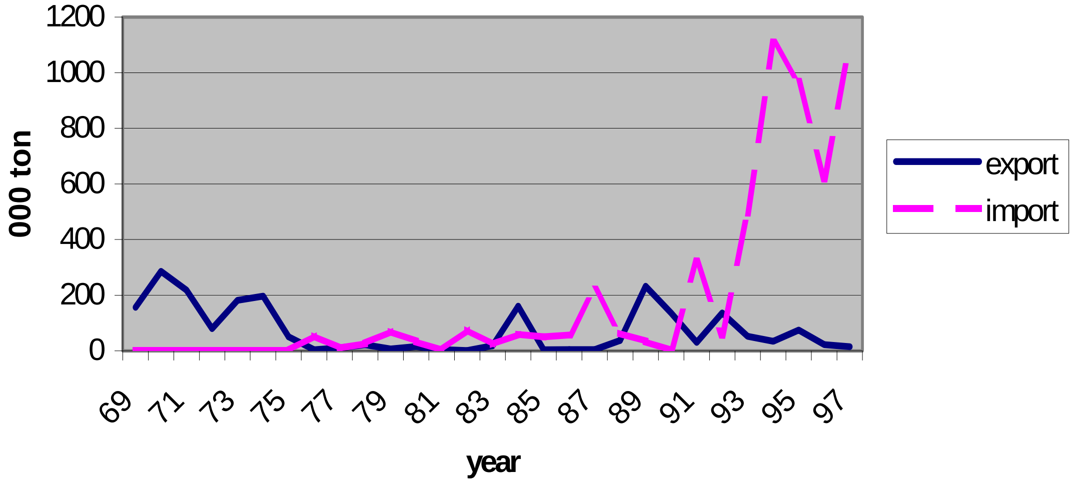
The following are some details of policies implemented for each of the secondary crops.

Maize

The floor price policy of maize was initially implemented on February 1978 on the basis of production costs, the market price of the previous year and the expected possible producers' margin. The floor price was adjusted every year. This policy was ineffective, as the prevailing farm gate market price was generally higher.

An input subsidy was implemented to encourage farmers to use improved technology such as fertilisers. Yet fertiliser subsidies were basically applied to all agriculture commodities. Due to budgetary

Figure 8.2: Maize imports and exports,, Indonesia, 1969 to 1997



Source: Erwidodo and Prayogo Hadi (1999).

considerations, the government gradually reduced the subsidy. In 1998, only a subsidy on urea fertiliser remained, but it too was removed in 1999.

BULOG and village cooperatives (KUD) had a large influence on marketing and distribution policies. KUD purchased maize from farmers and then sold it to BULOG. In the early years, the procurement policy was considered manageable, and up to 1988 BULOG had control over inter-island and inter-provincial marketing.

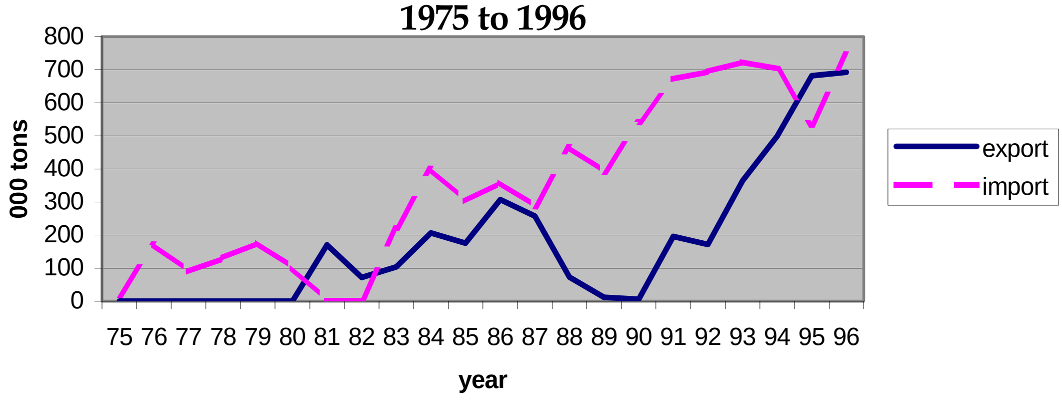
However, major production areas of maize spread to new cropping lands in Sulawesi and Sumatra, while consumption remained concentrated in Java. Transport costs became increasingly expensive, as BULOG centralised sales to maintain price stabilisation. In 1988, BULOG relinquished its role for all crops other than rice.

Self sufficiency in maize fell over the mid-1990s (Figure 8.2). In 1998, domestic production of maize increased, but the demand by feed industries sharply declined due to the economic crisis: most poultry farms collapsed, the farm gate price dropped and farmers suffered substantial losses and increasing insolvency. In trade policy, the main instrument was an import tariff, but this was eventually removed.

Soybean

Soybean received special attention because of its importance as a main source of protein. Indonesia has been a net importer of soybean. To reduce Indonesia's dependence on the international market (see Figure 8.3), the government proclaimed a policy

Figure 8.3: Soybean exports and imports, Indonesia, 1975 to 1996



Source: Erwidodo and Prayogo Hadi (1999).

objective of self-sufficiency in soybean in 1986. A series of intensification programs were implemented to increase soybean production. The government defined areas for expansion, and improved seed distribution and credit provision.

Import controls have insulated the domestic price of soybeans from the international market. BULOG imported and sold soybeans to private traders or producers of tofu and *tempe* (the cooperatives called KOPTI) at a higher price. However, since 1988, soybean imports have been mainly in the form of beans since domestic soybean meal industries began operating. To protect that infant processing industries, an import tariff of 35 percent was imposed on soybean meal. The government also used a floor price policy, but without effect as again it was usually lower than the farm gate price. In June 1991, the government removed BULOG's monopoly on soybean meal importation. In addition, the import tariff was reduced from 10 to 5 percent, but a 30 percent surcharge was implemented. In 1993, this surcharge was removed and in return the government implemented a local content requirement: the feed industries were obliged to purchase 40 percent of their need from domestic sources. In June 1994, the local content requirement was reduced to 30 percent, and the import tariff was eliminated. Local content was further reduced to 20 percent and then in April 1996, all trade regulation on soybean meals was completely removed.

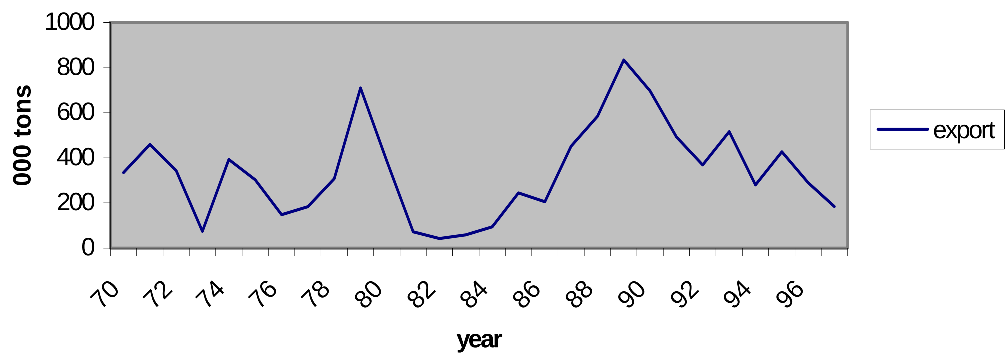
Cassava

There has been no prominent government policy related to production of cassava, with attention instead paid to marketing and trade. In domestic marketing, business associations were expected to deal within the cassava marketing system. The association has to ensure the procurement of dried and sliced manioc at the minimum price of 70 percent of current FOB price at the exporter level. The association also has to buy cassava from farmers at the price of 13.6 percent of the current tapioca price.

The government imposed an export quota and import tariff on cassava. The quota applied only to exports to Europe, ostensibly to prevent the price of cassava falling, despite Indonesia's small share (8 percent) of global cassava trade. This annual quota increased from 500,000 tons in 1982 to 700,000 tons in 1983-1984, and eventually to 825,000 tons in 1985-1988. This remained unchanged, but was attained only between 1988 and 1993 (see Figure 8.4).

An import tariff was imposed on various cassava products. The highest rate, 30 percent, was imposed on primary products including dried-sliced cassava and pellet. The lowest, on manioc starch, was 5 percent. The entire tariff remained unchanged until 1998, when it was reduced reducing from 10 to 5 percent.

Figure 8.4: Cassava export, 1970-1997



Source: Erwidodo and Prayogo Hadi (1999).

Wholesalers and factory owners dominated the marketing structure of cassava, setting the price. Prices of fresh and dried cassava fluctuated erratically year by year, leading to generally low farm gate returns. In response, a price agreement policy was implemented in 1987. This was between farmers and cassava flour millers, and between traders and millers. The price for fresh cassava was agreed at 13.6 percent below the selling price of cassava flour and the price of dried cassava was 70 percent below the selling price of cassava chips/pellets. The average of fresh cassava at the farm gate in the year 1987 and 1988 was above the agreement level and hence encouraged farmers to increase production. Subsequently Indonesia was able to fulfil the cassava chip and pellet export quota to the European Community. However, the prices of fresh and dried cassava dropped in the year of 1989 and 1990 when the price agreement ceased.

Post-crisis agricultural policy changes

On December 2, 1998 the government announced various deregulations. One was to end BULOG's monopoly on imports of rice. Another was to impose an import tariff on food (including rice) of just 5 percent. Recognising the differences in production costs across regions, the government set three regional floor prices for rice, i.e. Java plus several neighboring provinces (with floor price at Rp.1,400/kg unhusked rice, equivalent to Rp.2,390/kg rice), Sumatra (Rp.1,450/kg) and Eastern Indonesia (Rp.1,500/kg).

The distribution of cheap rice was targeted to the poor (the families of laid-off workers and people under the poverty line). Each poor household was entitled to get 20 kg of rice at Rp.1,000/kg (about one third of the market price).

Also, the subsidy on fertiliser was eliminated, as had already happened to pesticides and other agro-chemicals. PT PUSRI's government-sanctioned monopoly on fertiliser distribution ceased. Any firm can now import and distribute fertiliser down to, and including, the district level. Cooperatives and local traders are encouraged to become local suppliers at the farm level. However, for specific remote areas, a distribution subsidy is still provided. PT PUSRI retains its responsibility to provide fertilisers to remote areas for the KUT program.

Subsidised farm credit has widened its scope and its credit limit per hectare. The coverage of crops eligible for KUT was increased from 19 to 34 commodities. The government has increased the ceiling of allocated credit funds from Rp.150 billion in 1997 to Rp.3,500 billion in 1998, and to Rp.6,500 billion in 1999. In Java, 50 percent of the total amount covers rice farming, compared with only 25 percent elsewhere.

The interest rate of farm credit was lowered to only 10.5 percent. This implies a huge subsidy compared to even the pre-crisis period, let alone the current market interest rate. In 1996, the market interest rate was 20 percent and the rate in recent years has been well above 30 percent (which includes a substantial risk premium).

These deregulations may, in the long term, encourage Indonesian farmers to modernise, become self-reliant and business oriented. The role of government in this environment should be to improve transport and communications infrastructure, particularly in more remote areas. These, together with the remarkable efforts of the government in raising literacy rates over the past three decades, should improve the access of farmers to necessary market information.

What can secondary food crops expect from current policy adjustment?

An important issue concerns greater regional autonomy that leads to decentralisation of development activities. The intent is that each province will focus on its own programs. Suryana et al. (1998) predict that in the future Java will concentrate on high value commodities such as horticulture, beef and dairy cattle, broiler and hens, fresh fish, prawns, and high quality rice to fulfill urban demand and provide export revenues.

There is a rapid conversion of agricultural land to non-agricultural uses in Java. Hence, the opportunity cost of agricultural land keeps increasing, indicating that secondary crops appear unlikely to have a bright future in Java. Any positive impact arising in Java from secondary crops will be through indirect impacts leading to lower input costs for feed industries and processed food. As the economy returns to growth, incomes will increase and so too will demands for secondary food crops.

We now turn to modelling a scenario in which we assume that R&D funds have been diverted from rice to three secondary crops, soybeans, maize and cassava. We use WAYANG, a 65 sector model of the Indonesian economy with features designed to capture key elements of a strongly agrarian economy (see Warr, Marpudin, daCosta and Tharpa 1998; Wittwer 1999 and Appendix 1 of this volume). WAYANG is designed to depict a medium-term time horizon, possibly of two to four years, in which we compare the effects of a modelled shock to a base case. In agricultural industries, unskilled labour and variable capital are mobile between industries. The land allocation, which accounts for about one-fifth of total costs of production, is assumed fixed. And fertiliser is a fourth primary factor of production, substitutable with labour, capital and land in agriculture. These assumptions imply that there is a moderate degree of supply responsiveness, but not as much as if we assumed that land also was transferable between activities.

The modelled scenario is an all-input productivity increase of 10 percent for these three crops relative to the base case. Our reasoning is based on the economic principle that in activities with a sub-optimal level of investment, the rate of return or realised earning on that investment will be higher than if such activities receive an optimal level of investment. Therefore, on the premise that increasing investment on these crops moves R&D investment closer to an optimal allocation between activities, we impose a productivity gain to denote the increase in returns arising from this reallocation.

First, we consider the impact of the assumed productivity gain on these secondary crops (Table 8.3). Each of the three crops gains. For soybeans and maize, most of the output gain is import replacing. For cassava, the local market absorbs all the increased output. The only other industry we note is fertiliser: as output growth for both maize and cassava is slightly smaller than the reduction in input requirements, in percentage terms, derived demands for inputs decrease in each of these industries. The reduced derived demand for fertiliser results in a slight decrease in fertiliser output.

Table 8.3: Effects of productivity gains in soybean, maize and cassava cropping in Indonesia
(percentage change from base case)

Industry output	Local market	Import	Export	**Total output**
Soybeans	0.4	6.7	0.0	7.1
Maize	0.9	7.8	0.0	8.8
Cassava	6.3	0.0	0.0	6.3
Fertiliser	-0.3	0.0	0.0	-0.3
Household real consumption[a]				
Rural 1	0.11	Rural 6	0.18	
Rural 2	0.21	Rural 7	0.12	
Rural 3	0.12	Urban 1	0.18	
Rural 4	0.15	Urban 2	0.09	
Rural 5	0.05	Urban 3	0.27	
Regional impacts		Labour income	Output	Employment
Java/Bali		0.05	0.23	0.00
Sumatra		0.06	0.19	0.07

Other	-0.25	0.30	-0.07

[a] Rural 1 = landless; Rural 2 = < 0.5 ha; Rural 3 = 0.5-1.0 ha; Rural 4 = > 1.0 ha; Rural 5 = low income, non-ag.; Rural 6 = medium income, non-ag., Rural 7 = high income, non-ag; Urban 1 = low income; Urban 2 = medium income; Urban 1 = high income.

Source: Authors' WAYANG model projections.

All households gain from productivity growth in secondary crops. Aggregate consumption is the only macroeconomic entity on the consumption side to be endogenous, so that all variations from base-case welfare are reflected in household consumption.

Finally, at the regional level, there is an increase in output in each region, although returns to labour decrease in regions other than Java/Bali and Sumatra. Consequently, there is a small transmigration from other regions to Sumatra. The issue of what happens to agricultural land with urban encroachment in Java is not modelled, and in all probability would result in output and employment declines in Java relative to other regions.

In conclusion, we believe that Indonesia will gain from a greater emphasis on secondary crops via a re-allocation of R&D funds. Output gains depend both on the assumed magnitude of productivity growth arising from a partial redirection of funds, and on the ability of individual industries to export.

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9

Effects of agricultural policy reform in Indonesia on its food security and environment

ERWIDODO, GLYN WITTWER AND RANDY STRINGER

The ongoing socioeconomic crisis enveloping Indonesia has dramatically reversed decades of rapid economic growth, steady progress in poverty reduction, and substantial improvements in food security.[1] Before the crisis, Indonesia was frequently cited as one of the highest performing Asian economies with per capita GDP growth in the top 10 percent of all developing countries. Since the crisis began in August 1997, however, the rupiah's value dropped by as much as 80 percent before a partial recovery. In 1998, inflation soared to an estimated 100 percent; and GDP fell by an estimated 14 percent in 1998 (World Bank, 1998). Indonesia's poor are especially vulnerable to the falling incomes, increasing prices and rising unemployment and underemployment brought on by these crisis-induced events. World Bank simulations suggest a 12 percent decline in real GDP in 1998 would add some 9 million people to the more than 20 million living in poverty before the crisis began (World Bank, 1998).

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[1]There were four key microeconomic causes of Indonesia's crisis: the rapid build up of private debt; well-recognised flaws in the banking system; inadequate governance; and the timing of the crisis in relation to political events (World Bank, 1998).

Indonesia's capacity to address the crisis initially was complicated by forest fires, drought, floods and a sharp decline in crude oil prices. During 1997, one million hectares of forest fires in Kalimantan and Sumatra damaged ecosystems, destroyed crops, disrupted transport and tourism, increased the incidence of respiratory problems and strained Indonesia's relations with neighbouring Singapore and Malaysia (Solahuddin, 1998). Estimates of the economic damage to Indonesia's logging and timber industries (excluding environmental and health costs) are set at more than US$900 million (Tay, 1998). One estimate of the 1997 fire's impact on increased health care costs and foregone tourism income for Indonesia, Malaysia and Singapore is US$1.4 billion (Tay, 1998).

A prolonged drought throughout 1997/98 reduced export crop production and, more importantly for the country's food security objectives, contributed to a large drop in paddy production. Initial estimates suggest that the 1998 paddy crop is nearly 10 percent below the 1996 production level (FA0, 1998; CBS, 1999). The drought's impact has been worse in the islands of the country's east, which is drier and contains a higher proportion of low-income households than Java.

Around one-third of the country's population spend 69 percent or more of their total expenditures on food (SUSENAS, 1996). Thus, the collapsing demand, rising unemployment, falling food production, increasing food prices and rapidly expanding numbers of malnourished has stressed the fundamental role agriculture must play in revitalizing the economy. The agricultural sector's potential to contribute has been greatly enhanced by crisis-induced policy reforms that have removed many of the long-standing disincentives facing producers, traders and processors. This dramatically changed policy environment provides an important foundation for a partial re-agriculturalisation of the economy.

One purpose of this chapter is to provide insights into how agriculture can contribute to overcoming the negative consequences of the crisis in the medium-term period. A computable general equilibrium (CGE) model of Indonesia, WAYANG, is used to model the consequences of a real devaluation, a productivity decline and a loss of the country's endowment of productive factors. WAYANG is a single-country, 65-sector CGE model of the Indonesian economy.[2] The analysis focuses on medium-term shifts in production across industries to provide some indication of expected output changes arising from one key crisis-related impact: a real devaluation of the rupiah.

This chapter is organised into five sections. An overview of how the socio-economic crisis has impacted on the agricultural sector is followed by details the agriculture-related policy responses induced by the crisis. The modelling scenarios and results are then discussed, before finishing with some concluding comments.

Crisis-related impacts on rural communities and agriculture

Among the on-going concerns facing agricultural policymakers is what the devaluation means for food security and what can be done to minimize the negative consequences for both food production and access to food. The devaluation's direct and indirect impacts on food consumers and producers work in opposing directions. For example, while agricultural wages represent an important cost component for food production, they are also the primary income source for many households. In part, the crisis shocks should encourage food production since drops in real wages reduce food production costs, which would provide incentives to boost production.

For wage-dependent landless workers, however, falling incomes reduce food demand, counteracting the production-enhancing effects of lower production costs. Likewise, as the price of export crops increase relative to non-exported food crops, producers will

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[2] The model, detailed in Wittwer (1999) and summarised in Appendix 1 of this volume, is adapted from an earlier version developed at ANU by Peter Warr and associates, and ORANI-G.

shift land, labour and other inputs towards the more-profitable opportunities.

It is ironic that in Indonesia, agricultural households tend to be more vulnerable to food insecurity than urban residents. Before the crisis, the average per capita expenditure of agricultural households was about 57 percent higher than the poverty line (World Bank, 1998). In contrast, average per capita expenditure among households in both manufacturing and construction was more than twice the poverty line. Unskilled agricultural wages have fallen in real terms as urban workers whose jobs have been lost in construction, manufacturing, and import-dependent food processing activities migrated back to the countryside to look for work.

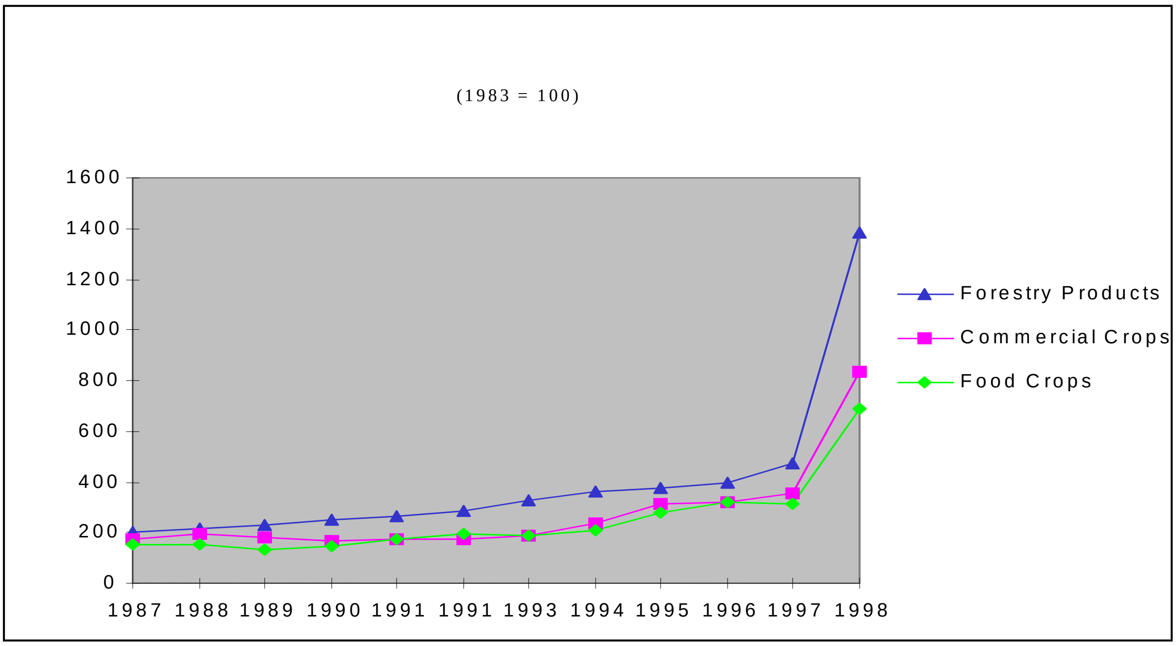
Empirical evidence demonstrates that this influx of labour into the countryside is placing downward pressure on agricultural wages. Table 9.1 presents evidence of real wage declines in Indonesia during the period of January 1997 to January 1998. As expected, regions closest to Jakarta, Central and East Java saw the largest declines (12 percent and 13 percent, respectively).

Table 9.1: Changes in real wages for weeding in selected provinces of Indonesia, 1997-98

Province	12 Month Change Jan 97 to Jan 98	6 Month Change July 97 to Jan 98
West Java	-6.8	-10.0
Central Java	-12.1	-13.4
East Java	-13.1	-11.2
West Sumatra	-5.2	-5.0
South Sulawesi	-8.0	-5.7
West Nusa Tenggara	-8.2	-12.0

Source: World Bank (1998b).he devaluation provides increased opportunities for expanding traditional exports crops (cocoa beans, coffee, tea and fishery and forestry products), as well as exports of fruits and vegetables (See Figure 9.1). As prices of vegetables increase relative to rice prices, producers tend to substitute vegetables for rice production. Table 9.2 highlights the trend in relative output prices. The price ratio of paddy to agricultural wages changed significantly compared with the price ratio of vegetables to agricultural wages between August 1997 and June 1998. As the relative output prices of these two commodities continued to diverge, policymakers attempting to control rice prices through generalised subsidies found it increasingly difficult to compensate rice producers via input subsidies.

Figure 9.1: Wholesale price indices for export commodity groups, Indonesia, 1987 to 1998



The increasing food prices and falling real input costs stimulate production and agricultural income, but reduce the real income, effective demand and food security situation of landless agricultural workers and consumers who depend on the market for their food supplies. For agricultural workers, declining real wages harm their ability to feed their families, to school their children, and to provide adequate health care. These are especially important concerns for Indonesia where 11 million rice producers cultivate less than 0.35 hectares and an estimated 7 million rural households are landless (Tabor, Dillon and Sawit, 1998).

Figure 9.2 provides data showing just how much faster food prices rose relative to the average wage. The partial equilibrium impact on income of a 40 percent rise in the real price of rice (the estimated price rise if trade were liberalised at prices prevailing in late 1998) is simulated in Table 9.3. The income losses range from 7.5 percent to 14 percent. Income declines of this proportion for the poorest one-third of the country's population have serious implications for the country's food security objectives. On the other hand, what is not taken into account in the simulations presented in Table 9.3, is that rice producers gain from the real price rise.

Table 9.2 Increase in the price of paddy and vegetables relative to wages, various regions of Indonesia, 1997-98

Province	August 1997 to June 1998 (% change)	
	Paddy	Vegetables
West Java	35	79
Central Java	30	44
Yogyakarta	54	156
East Java	31	89
North Sumatra	9	86
South Sulawesi	32	23

Source: Authors' calculations based on BPS (1998).

Figure 9.2: Indices of farm household consumer prices, food prices, and agricultural wages, West Java, 1997-98

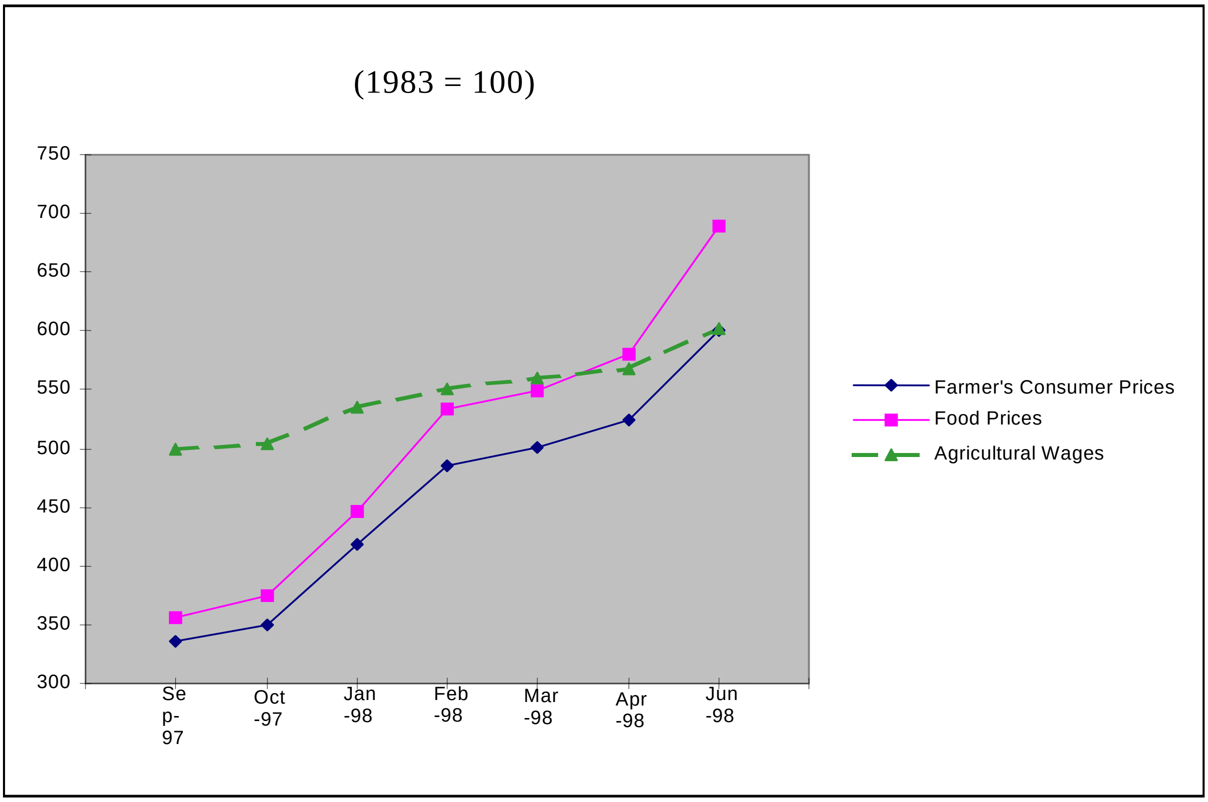


Table 9.3: Effects of a 40 percent real price rise for rice, Indonesia, 1998

Expenditure Group (1996 Rp/month)	**Under 15000**	**15000-19999**	**20000-29999**	**30000-39999**	**40000-59999**
Rice expenditure share	44%	34%	26%	21%	15%
Income elasticity	0.7	0.6	0.6	0.5	0.3
Compensated demand elasticity	-0.14	-0.14	-0.14	-0.14	-0.14
Price elasticity (Slutsky Equation)	-0.44	-0.34	-0.30	-0.25	-0.19
Kg purchased/mth before price rise	6.25	7.39	8.26	8.70	8.73
Price per kg before price rise	850	850	850	850	850
Real rice price rise (=40%)	1190	1190	1190	1190	1190
Kg purchased/mth after price rise	5.14	6.35	7.11	7.78	6.97
Food expenditure share	83%	72%	69%	66%	62%
Expenditure on food (Rupiahs/month)	10,095	13,475	18,305	23,384	31,100
Expenditure on cereals (Rupiahs/month)	6,467	7,115	7,705	7,998	8,377
Expenditure on rice (Rp/month)	5,315	6,280	7,024	7,392	7,418
Total monthly expenditure	12,210	18,676	26,537	35,463	49,896
Loss in consumer income	**-14%**	**-12%**	**-9%**	**-8%**	**-6%**

Source: SUSENAS, 1996 and authors' partial equilibrium calculations

The Ministry of Population's (BKKBN) estimates for May 1998 were that 16.7 percent of the households in Indonesia (some 34 million individuals) could be classified as badly impoverished -- households that were unable to satisfy their basic needs. Table 9.4 presents data on changes in poverty since 1976, including estimates of the growth in poor since the crisis. The Ministry of Food and Horticulture estimates that 40 percent could have been classified as food insecure.

The highest absolute number of food insecure rural households are in Java.

Food insecurity and malnutrition have immediate consequences for those households effected. Chronic malnutrition blinds, otherwise debilitates and kills, reducing physical capacity, lowering productivity, stunting growth, and inhibiting learning. In the world's poorest regions and countries, one-third of deaths among children are due to malnutrition (Del Roso 1992). Decreased access to food and nutrition leads to declining learning capacity, school performance, and school attendance; to more school and work days lost to sickness; and to lower earnings, shorter work lives and a less productive work force.

Table 9.4: Incidence of poverty in Indonesia, 1976 to 1998[a]

	Millions			Percentage		
Year	Urban	Rural	**Total**	Urban	Rural	**Total**
1976	9.5	44.2	**54.2**	38.8	40.4	**40.1**
1980	9.4	32.8	**42.3**	29.0	28.4	**28.6**
1990	7.2	17.2	**25.9**	16.8	14.3	**15.1**
1996	10.0	15.3	**22.5**	9.7	12.3	**11.3**
1998 (est.)	15.0	32.0	**53.0**	20.0	30.0	**26.0**
1998 severely food insecure	9.6	24.3	**32.0**			

[a] 1976-1996 are BPS statistics while the 1998 values are estimated by Tabor et al.

Source: BPS (1998) and Tabor et al. (1998).

In a review of the crisis, Tabor, Dillon and Sawit (1998) argue that three events contributed to a significant increase in absolute poverty: a fall in average real incomes of 10 to 14 percent, a rise in urban unemployment (estimated to be as high as 15 million persons), and a rise in food prices facing the poor. Between January 1996 and May 1998, food prices rose 11 percent in real terms. Tabor et al. (1998) estimate that the crisis could have caused an increase of 8 million urban poor and 23 million rural poor; and there would be approximately 9.6 million urban and 24.3 million rural food-insecure individuals in mid-1998 (Table 9.4).

The highest estimate of poverty levels was that of the Ministry of Women's Affairs. This ministry classified 56 percent of the population, or around 113 million persons, as poor. In 1996, 22.5 million persons were classified as absolutely poor of which about 7.2 million were in urban area and 15.3 in rural area. Another 37 million were reported as "nearly poor". With falling real wages and shocks to food production, the great majority of these "nearly poor" households would have fallen below the poverty line. This implies that 50-55 million persons could be classified as absolutely poor, of which 38 million live in the rural areas.

These crisis-related impacts have long-term consequences for future income, agricultural productivity and aggregate production possibilities. Many households respond to negative economic shocks by pulling their children out of school. An estimated 17.5 million school age children (out of a total 53 million) in 1997 were reported to be out of school to earn an income (Tabor et al. 1998). Even with the planned abolition of school fees, these numbers would have risen as the increased opportunity cost of keeping children in school rose. Government estimates suggest that about 6 percent of primary school students and 13 percent of junior secondary school students were at risk of dropping out (approximately 1,650,000 and 1,100,000 students respectively), while an additional 400,000 primary school graduates were expected to not continue their education (World Bank, 1998)[3].

The outlook for health is also sobering. The sharp exchange rate depreciation raised the prices of medicines, vaccines, contraceptives and other medical supplies. Drug prices increased two- to three-fold relative to when the crisis began. In some communities, health centres have had to close because of a lack of medicines.

Recent estimates suggest that primary, junior and secondary school drop-out rates rose rapidly. Government estimates presented in

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[3] As cited by Tabor et al. (1998), UNICEF estimates that 8 percent of the 30 million primary school children and 14 percent of the 10 million junior high school students droped out of school as a result of the economic crisis.

Table 9.5 show that drop-out rates more than doubled from 1997/98 to 1998/99. Evidence from the much smaller 1986/87 shock, however leads one to expect the overall impacts to be large. During that period enrolment rates fell from 62 percent to 52 percent at the junior secondary level and took a decade to recover. Virtually the entire decline was from poor households (Atinc and Walton 1998).

Table 9.5: The impact of the crisis on school enrolments in Indonesia, 1998-99

			Change 98/98 to 98/99	
	1997/98	1998/99	Absolute	Percentage
PRIMARY				
Enrolment (millions)	29.27	28.99	-0.28	-1%
Drop-outs (millions)	0.76	1.65	0.89	117%
Drop-out rate	2.6%	5.7%		119%
JUNIOR SECONDARY				
Enrolment (millions)	9.69	8.33	-1.36	-14%
Drop-outs (millions)	0.47	1.11	0.64	136%
Drop-out rate	5.1%	11.5%		126%

Source: World Bank (1998a).

The drop in enrolment levels raises serious medium- and long-term growth implications for Indonesia's economy. The development literature suggests strongly that basic education, skill development and institutional reforms are all necessary conditions for increasing productivity growth and taking advantage of the increased competition resulting from market liberalisation (Krueger, 1995; Rodrigo and Thorbecke, 1997; World Bank, 1998a). While measuring how much basic education actually contributes to economic growth remains part of an ongoing empirical debate, few dispute the fundamental role played by education in the agricultural development process. Schooling and basic education foster agricultural innovations, enhance producers' abilities to reallocate resources in response to policy reforms and to adapt to fluctuating input and output prices, and promote the use of new technologies, including best practice resource management techniques (World Bank, 1998; Foster and Rosenzweig, 1993, 1995, 1996).

Crisis-induced agricultural policy responses

Crisis-induced policy responses impact directly and indirectly on producer and consumer price incentives, affecting competition in output, input and credit markets, and the use of natural resources and environmental services. Moreover, agricultural suppliers, producers, processors, and traders are influenced directly by the policy response and indirectly via how producers and consumers respond.

Among its many attempts to address the impacts of the drought and the economic crisis, Indonesia's policymakers worked with the international community to establish a series of appropriate policy responses. The Minister For Economy, Finance and Industry provided periodically a letter of intent to the Managing Director of the International Monetary Fund which included an outline of the government's policy reforms and specified the types and timing of the actions to be taken.

The macroeconomic, trade and agriculture policy reforms implemented in response to the crisis were wide ranging. Since September 1997, Indonesian policy-makers have taken steps to reduce tariffs on more than 500 food items to 5 percent. They have eliminated local content requirements for dairy products and dismantled export controls for plywood and wood products. The government has withdrawn BULOG's import and trading monopolies for wheat, wheat flour, garlic, sugar and soybeans, abolished the clove monopoly and reduced agricultural export taxes to 10 percent. Inter-provincial commodity trade restrictions have been eliminated. Other policy reforms include removing the export restriction on oil palm products, privatising plantations, estates and input suppliers, liquidating cooperatives and removing land use regulations restricting producer crop choices.

The September 1998 memorandum includes an annex outlining a strategy for Indonesian food subsidies and another annex outlining a seven-point strategy for rice. Important food and agricultural sector reforms include eliminating BULOG's monopoly on wheat, sugar and soybeans imports; suspending the VAT on rice and other essential commodities; eliminating wheat and sugar subsidies;

phasing out soybean subsidies; removing export bans on wheat, soybeans and sugar; eliminating import subsidies and relevant import duties for soybean meal and fishmeal; and for the first time in 30 years, allowing private traders to import rice.

Unlike pre-crisis reforms that were often motivated by budgetary constraints, these price and trade reforms reflect the government's inability to enforce export bans and to hold down food prices in local markets. Illegal exports and trader markups forced the early implementation of these policies. Indeed, the government's price interventions have not been effective. From January to June 1998, BULOG raised procurement and market operation prices three times. Procurement prices for paddy were increased to Rp.600, then to Rp.700 and finally to Rp.1000 per kilogram in June. BULOG also attempted to lower rice prices for consumers by selling large quantities in the market at Rp.1750 to Rp.2000 per kilogram. Prices remained high, among other reasons, because the rice distribution system allowed speculators to buy subsidised rice and sell it at higher prices. In addition, large amount of rice were being exported illegally to neighbouring countries.[4] In an attempt to curb speculation, BULOG raised its reference price to between Rp.2000 and Rp.3500 per kilogram, depending on the quality of the rice.

Due to the lower than expected second rice harvest, panic hoarding, and sharp rises in rice prices, the targeted rice price program (covering 2 million people) was expanded to cover 7.5 million people by October, and potentially 15 million families by 1999. In addition, BULOG plans to increase substantially the quantity of rice released into the market at below market prices and maintained a high release level until the main harvest.

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[4] More than 1900 tons of rice were seized at Sunda Kelapa harbour in North Jakarta as it was being prepared to be exported to Kuching, Malaysia. The rice was found in boats, containers, trucks, and warehouses at the harbour. The remaining 380 tons were seized from traders who tried to mixing low quality rice and good quality rice before selling it in open market to gain greater profit.

Making the best use of agriculture to address poverty and food security

One of the most important short-term goals for improving food security in Indonesia was to utilise the poverty reduction potential of its agricultural sector. Periods of high agricultural growth rates are associated with falling rural poverty and increasing food security (Binswanger and von Braun 1991; Timmer 1992; Bell and Rich 1994; Johnson 1993). Strong agricultural growth leads to lower food prices (for urban consumers and rural net-food buyers), increased income generating opportunities for food producers and jobs for rural workers (thus reducing rural-urban migration, with positive consequences for real urban wage rates), and positive intersectoral spillover effects including migration, trade and enhanced productivity (Lipton and Ravallion, 1995; Timmer 1992). In the past, Indonesia's rapid agricultural growth substantially reduced rural poverty, improved food security in both rural and urban sectors, and provided a significant demand-side stimulus for non-agricultural goods and services.

Much of this past progress in providing increased food availability in Indonesia has resulted primarily from increased domestic food production. Despite rapid industrialisation, Indonesia's cereal self-sufficiency ratio increased from 90 percent to 95 percent, with rice yields increasing from 3.3 kg/ha to 4.3 kg/ha during this period between 1979/81 to 1989/91. Martin and Warr (1993) conclude that technical change in Indonesia has been faster in agriculture than in the rest of the rest of the economy due to such programs as rice intensification (BIMAS, INMAS, INSUS), public investment in irrigation and in adaptive research and dissemination of modern varieties, and the subsidies for credit, fertilisers and pesticides.

Indonesia's rice self-sufficiency initiatives involved a range of food and agricultural policies aimed at boosting rice production. The government established public investment programs, import restrictions, procurement policies and price controls. Rice intensification provided irrigation, fertiliser, pesticides, HYV seeds, credit extension, technical assistance and related capital improvements. Irrigation alone is credited with contributing to around 50 percent of the growth in rice production through increased yields during the 1980s and early 1990s. In total, the rice area under HYVs increased by 75 percent since the late 1970s, bringing the new technology to 3.5 million hectares and 6 million farmers.

The subsidised inputs and credit, expanded marketing channels and extension services all contributed to sharp increases in fertiliser and pesticide use. Fertiliser subsidies kept the retail price 40 percent below its economic value and helped keep Indonesian farmgate prices among the lowest in Asia during the 1980s. Fertiliser applications increased by 500 percent in many areas, with applications rates more than twice those in the Philippines and three times those in Thailand (FAO, 1992). Subsidy programs maintained a prominent role throughout the 1980s. By 1987, the fertiliser subsidy alone consumed 35 percent of the government's expenditure on agriculture. The irrigation subsidy cost about US $110 per hectare. Together, rice-related subsidies for fertilisers, pesticides, HYV seeds, credit and irrigation amounted to more than US $1 billion per years in the late 1980s.

However, after three decades of steady gains in agricultural productivity, growth rates of food production began to lag. Annual rice yield growth in Indonesia has dropped from 5.2 percent in the 1971-83 period, to 3.1 percent in 1984-90, to less than 3 percent since. Warning signs include declining growth of arable and irrigated areas, and increasing competition for resources between agriculture and other sectors. The use of inputs such as fertiliser and pesticides has declined due to environmental and health concerns. Falling world food prices have discouraged investment in agriculture, particularly agricultural research.

Indonesia's agricultural sector was growing relatively slowly even before the drought and economic crisis hit. The same trend of declining agricultural comparative advantage in the process of industrialisation experienced by structural changes in developing countries worldwide. The share of agricultural output in total production in developing countries as a group has declined from 29 percent in 1965 to 17 percent in 1990. In Indonesia, agriculture's share of GDP has fallen from 45 percent in the early 1970s to around 17 percent in the mid-1990s and is expected to be less than 10 percent by 2020 (Anderson and Pangestu, 1995).

Anderson and Pangestu (1995) examine how three sets of influences affected structural change in Indonesia's agricultural sector: external events, domestic macroeconomic and non-agricultural policies, and domestic food and agricultural policies. Their study suggests that while petroleum sector prices represent the most important external event influencing the country's economic growth pattern (both the boom period during the 1970s and the critical 60 percent drop in real oil prices between 1982-86), it has been the prudent, market-driven approach to macroeconomic management and the liberalisation of foreign trade and investment since 1985 which laid the foundation for the continuous rapid economic growth in all sectors.[5]

Modelling the aftermath of the Indonesian crisis

The gravity of the problems facing Indonesia makes modelling of crisis-related scenarios a task that is potentially trivialising. Nevertheless, modelling can provide insights into adjustments to external shocks. On this basis, we present the projections of a real devaluation of the rupiah here to gain some insights into effects on average income and its distribution.

WAYANG is a model of real activity, without a financial sector. Therefore, we are somewhat restricted in what we are able to model, as the devaluation of the rupiah was due to a collapse in the financial sector. We have explored two methods of ascribing a real devaluation to the model. In early attempts, we imposed a sharp decline in the Indonesia's terms of trade on the model to induce a

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[5] While these polices and programs have been highly successful, Indonesia's economic success is also due to an abundant natural resource base. Oil, natural gas, coal, tin nickel and gold are all found in substantial amounts, along with one of the world's riches tropical commercial forests. With more than 13,000 islands, the county's marine area is six times larger than its land area. Together renewable and exhaustible primary resources contribute 40 percent of GDP. Primary sector exports account for 70 percent of total exports, with agriculture contributing about 50 percent of non-oil exports.

real devaluation of approximately the magnitude that has been observed since 1998. But the reality is that, at least in 2000, the terms of trade have improved relative to pre-crisis times due to the soaring price of crude oil and petroleum. And at no time was there any sharp deterioration in Indonesia's terms of trade, indicating the financial rather than terms-of-trade origins of the rupiah's decline. A recovery of the rupiah has not accompanied the improving terms of trade. This leads to an alternative method, to shock the balance of trade surplus within the model, in keeping with the theory that a real devaluation induces an increase in the international trade surplus. There are differences between the two approaches. The first allows us to depict the full magnitude of the observed real depreciation. But the second depicts more realistically the impact on the trade balance (imposed exogenously) and household consumption, while capturing only a fraction of the real depreciation. Available trade data indicate that the balance of trade surplus between 1997 and 2000 increased by around 10 percent of GDP. Within WAYANG, a shock of this magnitude induces a real depreciation of around 14 percent, perhaps only one half of the actual depreciation.

Table 9.6: Key closure choices in the WAYANG model of the Indonesian economy[a]

Variable capital (national)	X	Variable capital (industry)	N
National labour	X	Industry labour	N
National land	X	Industry land	X
Sector-specific capital (non-ag.)	X	Tariff rate	X
Aggregate investment	X	Various tax rates	X
Wage shifter	X	Change in budget deficit	X
Import prices	X	Technological change	X
Export prices	X	Current account deficit	X

X = exogenous; N = endogenous.

[a] Differences from Table 2 of the Wayang handbook (Wittwer 1999) are: x5tot, x2tot_i and delbudget are exogenous instead of f5tot2, omega and f1inc_tax.

Table 9.6 summarises the closures used in the simulation. The national stocks of both labour and mobile capital are exogenous, but endogenous at the industry level. That is, if an industry responds positively to a particular shock, it attracts labour and mobile capital from other industries. Since WAYANG usually simulates in a short- to medium-term time horizon, each non-agricultural industry includes specific capital as a factor of production.

On the expenditure side at the macroeconomic level, the government's budget balance remains exogenous, as does real government expenditure. Real investment also remains exogenous. This implies that the only component of real absorption to vary with any shock is aggregate household consumption. In reality, we would expect real government spending to decline in the short term relative to a base case. We would also expect households, in response to the crisis at least in the short term, to sell off savings in response to declining incomes, in order to maintain consumption. The modelled closure implies the opposite in the medium term.[6] Clearly, a large increase in the balance of trade surplus will have a large negative impact on the only endogenous component of real absorption, household consumption, for a given level of economic activity. This implies that our measure of welfare, which depends only on real consumption, will be sharply negative.

The scenarios presented here assume a degree of adjustment within the Indonesian economy. As noted above, the Indonesian government has responded to the crisis by liberalising markets and by removing legislative restrictions on agricultural land use. Given the nature and extent of the crisis, a much longer period may be needed before agents respond fully to liberalisation and before market and social institutions begin operating effectively.

In this experiment, the economy experiences a real devaluation in the medium term. The rupiah in the early part of 1998 suffered from

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[6] Consider the macroeconomic identity $C + I + G = S + T + M$. With the closure, $G - T$ is exogenous and $X - M$ increases. Since I is exogenous, this ensures that S, national savings, increases. That is, in the medium term, we would expect real investment to be funded increasingly by domestic savings following a real devaluation.

a classic overshoot, reaching a bottom of 15,000 to the US dollar. By late October 1998, its value had settled at around 7,500. In 2000, the rupiah followed many currencies in the world in depreciating markedly against the US dollar.

Given the potential array of influences, the model is used to predict which industries might win and which might lose from the real devaluation. The magnitude of the gain or loss to a particular industry from a real devaluation depends on a number of influences, including the export intensity of sales of the industry's output, the import intensity of production, overall cost changes, the fate of other industries intensive in purchases of the output of this industry, and the proportion of household sales in total sales.

We turn first to industry outcomes. To assist in explaining an industry's change in output, we apportion the change to the sum of three effects using Fan decomposition.[7] This explains total sales as the sum of the local market, import share and export effects. A pattern we might expect across all sectors in response to a large real devaluation is for household purchases to decline, due to falling household expenditures. But since imports are now more expensive than domestic substitutes for most commodities, we might expect domestic purchases to increase relative to imports. That is, domestic purchases of a particular commodity may increase or decline, with substitution of the domestic for the imported commodity.

In Table 9.7, we have separated all primary and manufactures sectors into "winners" and "losers" from the devaluation. We will explain the outcomes for several industries. First, note that real consumption declines for each household by between 14 percent (for "Urban3": the high income urban household) and 21 percent (for "Rural4": rural households in agriculture with more than 1 hectare of land). This means that the expenditure effect for each commodity will be negative, as there are no inferior goods in the model. In addition, the prices of all imports rise relative to CPI, although the

[7] Fan decomposition is named after Mr Fan Mingtai of the Beijing Institute of Quantitative and Technical Economics. This is explained in the WAYANG technical document (Wittwer 1999).

price rises of many domestically-produced goods are less than CPI. Concerning domestic demand, some goods will have a negative price effect and some a positive effect, depending on whether the domestic-import composite consumer price rises or falls relative to CPI. Clearly, for goods with a high import weighting, the price effect will be negative. For all goods in all households, the negative expenditure effect dominates the outcomes, so that real consumption declines. But domestically-sourced household purchases of some goods increase. Among crop sectors that increase output in response to the devaluation, we discuss three: rubber, other estate crops and palm oil. For rubber, there are two sources of positive growth, as is evident in the local market and export columns in Table 9.7. The positive local market effect is due to sales as inputs to manufactured rubber and plastics, an industry that gains significantly with the devaluation. Direct exports of rubber also increase. Other estate crops suffer due to the expenditure effect, but a large export effect more than compensates for this, with a net gain in output.

Oil palm also has a positive local market contribution to output (5.5 percent, explaining all the output increase). This crop is an important input into manufactured oils & fats. As the latter manufacturing sector experiences a net increase in output due to the export contribution, this implies a positive local market sales effect for palm oil. Among other primary inputs, wood and other forest products also benefit from large local market contributions. This is due to purchases by bamboo & wood manufactures, which has a large increase in exports. The increase in output of other forest products is also due to a substantial increase in direct exports (9.5 percent out of total output of 20.2 percent). Coal & ores and sea fish are other primary industries to benefit.

Why do some crops lose from the real devaluation? Any commodity reliant on households for a large proportion of sales is likely to suffer a substantial negative local market contribution, due to the negative expenditure effect. We project output declines in maize (53 percent of total sales are to households), cassava (74 percent) and vegetables and fruit (91 percent), because export expansion is not sufficient to compensate fully for reductions in local sales. Paddy rice is another loser from the devaluation, as the expenditure effect dominates the outcome. Among manufactures that gain from the real devaluation, food processing and bamboo & wood benefit from large export contributions to growth.

Table 9.7: Estimated effects of a real depreciation in Indonesia
(percentage change from base case)

	Local Market	Import Share	Export	Total		Local Market	Import Share	Export	Total
Crops +					*Manufacturing +*				
Oth. Forestry	10.4	0.3	9.5	20.2	Nonfer. metals.	6.3	-1.8	20.3	24.8
Oth. Estate crops	-6.5	2.9	21.9	18.3	Oth manu.	7.8	3.7	12.4	23.9
					Bamboo/wood	-3.6	0.1	21.7	18.2
Rubber	11.1	0.5	2.6	14.3	Yarn	9.2	-0.1	8.4	17.5
Other crops	-5.5	19.3	0.0	13.8	Chemical	4.1	8.5	5.0	17.5
Fibre	13.4	0.3	0.1	13.8	Food proc.	-5.5	2.4	18.3	15.2
Tobacco	-10.0	8.3	10.6	8.9	Textiles	-1.7	2.5	12.7	13.5
Oth. Agri.	-4.2	0.7	11.6	8.0	Nonmetals	-0.6	6.6	6.2	12.2
Oil Palm	5.5	0.0	0.0	5.6	Manu paper	-1.7	8.0	5.7	12.0
Beans	-5.7	9.6	0.4	4.3	Metal prod.	-2.0	7.3	5.1	10.5
Tea	-4.8	3.8	4.2	3.2	Rubber & plastic	-1.0	1.7	9.5	10.2
Crops –					Basic iron	2.2	2.6	3.9	8.6
Coconut	-6.4	0.0	1.9	-4.5	Electrical	-2.6	-0.2	11.4	8.6
Maize	-8.8	0.2	1.5	-7.1	Petrol	-0.8	0.6	4.7	4.5
Coffee	-7.7	0.0	0.0	-7.7	Crude oil	2.6	-0.1	1.6	4.1
Cassava	-10.8	0.0	2.1	-8.6	Manu oils & fats	-8.6	2.0	9.7	3.2
Veg. & fruit	-11.8	1.1	0.2	-10.5	Transport equip	-4.9	0.8	6.7	2.5
Clove	-12.6	0.0	0.0	-12.5	Cement	-2.2	0.1	2.2	0.1
Paddy rice	-13.2	0.0	0.0	-13.2	*Manufacturing –*				
Oth. primary +					Nonfer. metals.	-9.3	7.5	0.6	-1.2
Wood	11.2	0.5	0.2	11.9	Sugar cane	-2.8	0.0	0.0	-2.8
Coal & metal ores	5.1	0.2	5.4	10.7	Manu. Flour	-11.1	6.0	0.9	-4.2
Oth. Mining	-1.1	2.2	1.1	2.2	Manu. Oth food	-12.0	4.2	4.2	-3.6
Oth. primary –					Fertiliser	-14.1	4.4	3.2	-6.5
Seafish	-8.7	0.0	4.6	-4.1	Beverages	-13.7	5.8	1.2	-6.6
Livestock	-19.4	0.1	0.4	-18.9	Cigarettes	-14.4	0.1	1.5	-12.8
Meat prod.	-22.6	0.7	0.0	-21.9	Milled rice	-13.9	0.2	0.5	-13.2
Poultry	-24.0	0.5	0.0	-23.5	**Household**		**Aggregate consumption**		
Regional		**Output**			Rural 1		-19.4		
Java/Bali		-0.4			Rural 2		-20.3		
Sumatra		0.4			Rural 3		-20.7		
Other		0.2			Rural 4		-20.9		
					Rural 5		-18.8		

	Rural 6	-15.3
	Rural 7	-18.2
	Urban 1	-16.4
	Urban 2	-18.3
	Urban 3	-14.2

Source: Authors' WAYANG model projections.

There are several different reasons why some manufactures lose from the devaluation. Domestic household sales account for a large proportion of total sales of milled rice, flour, sugar, other food, cigarettes and beverages, so that they lose through the adverse expenditure effect. Fertiliser is treated within the model as a substitutable primary factor in agricultural production. Farmers therefore substitute out of fertiliser and into other primary inputs whose prices are less dependent on world markets.

As mentioned, all households suffer a decline in aggregate consumption, which is tied to household income in WAYANG's consumption function. Finally, we note that output in the Java/Bali region declines by 0.4 percent, while rising in Sumatra (0.4 percent) and the remaining islands (0.2 percent). Two of the crops gaining the most in percentage terms from the devaluation, rubber and other estate crops, are grown mostly in provinces other than in the Java/Bali region. Among the losing crop industries shown in Table 9.7, Java/Bali accounts for in excess of 50 percent of production of all but coffee and clove. The other primary industries gaining from the depreciation are relatively small in Java/Bali. We assume in the database that Java/Bali accounts for 73 perc ent of service industry activity. Services, on a cost share weighted basis, suffer a decline in output of 2.0 percent due to the devaluation. In summary, the outer islands have the potential to increase economic activity as a consequence of the real devaluation.

As mentioned in the introduction, the Indonesian government (with World Bank support) is attempting to address the rapid deterioration of access to and provision of education in the wake of the crisis. But the problem is potentially so large that even with active measures, millions of future producers are likely to have dropped out of school. We could attempt to model a decline in productive capacity. On the other hand, it is possible that with a partial restoration of provision and participation in schooling, the progress made in previous decades in Indonesia in raising literacy levels will continue. In some regions, escalating civil unrest since the crisis started makes this unlikely for some time.

One of the disturbing aspects of the real depreciation is the rising cost of some essential imports. The difficulties Indonesia faces in maintaining health services with the spiralling cost of pharmaceutical items is outlined above. An important concern is whether the social effects of these increasing costs may be far greater than indicated by the model. On the other hand, the model is not a forecasting tool. Even if the real depreciation persists for a number of years, the international price of many pharmaceutical items may fall over time. Within the scenario, a real depreciation induces substitution of domestically-produced for imported goods. Potentially, the depreciation could encourage increased manufacturing of pharmaceutics within Indonesia. Alternatively, importers may turn increasingly to cheaper generic brands, thereby alleviating some of the pain of rising costs.

Since 1997, the crisis in Indonesian has resulted in capital flight, rising unemployment, civil disturbances, and the loss of social and market institutions. Modelling of these disruptions explicitly is beyond the scope of the WAYANG model. The depreciation exercise presumes that disruption is not so great as to prevent movement of some resources between industries in the medium-term. This partial movement alleviates some of the acute symptoms of the crisis. On the other hand, further mobility assumptions, in the longer term, would act to restore the economy to a growth path.

Conclusion

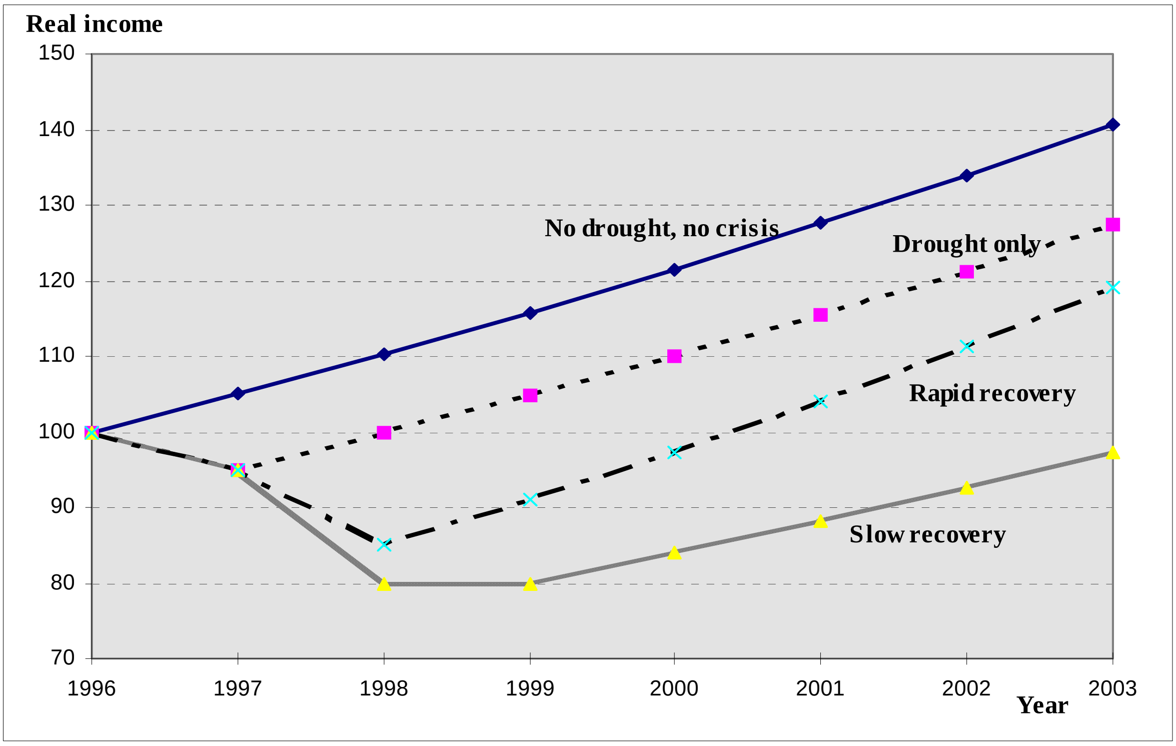
The depth and extent of the Indonesian economic crisis suggests that several years are required before the economy resumes its past growth rates. There appears to be a restoration of sorts under way in the new millennium, despite continuing civil unrest in some provinces. There is little doubt that international financial markets and investors will once more consider Indonesia favourably if peace can be negotiated in various trouble spots in the archipelago. Conversely, continuing strife until now appears to have hindered the recovery of the rupiah since its initial collapse.

Supposing the economy, in the absence of a crisis, had continued to grow at more than 5 percent a year. With the contractions in 1997 and 1998 alone, the crisis would have the effect, by 2003, of reducing national income by around 25 percent from the counter-factual with no crisis (Figure 9.3). The "slow recovery" path shown in Figure 9.3 indicates a more grave outcome, in which real income does not recover its 1996 level by 2003.

The modelling in this chapter is an attempt to understand how and why the Indonesian economy has altered in the wake of the crisis. There are, however, several difficulties in using a comparative static approach to model elements of the crisis. For example, with the collapse of the rupiah has come inflation, as modelled. Inflation creates uncertainty. This in turn exacerbates a loss in investor confidence. Partial indexation of wages in Indonesia has the effect of increasing the share of income accruing to certain types of labour at the expense of other factors and, in an inflationary environment, can contribute to an increase in unemployment. As mentioned above, there is some evidence of falling wages in the agricultural sector. Indexed wages within manufactures would reduce the opportunities for such industries to take advantage of increased import substitution and export sales in response to the devaluation. Indexed wages have not been modelled in the scenario presented here.

It would appear that no Asian economy has escaped the crisis of the late 1990s, but Indonesia has suffered more than other nations. The drought of 1997 alone would have caused difficulties that might have lasted beyond a year or two. Even without the dramatic capital flight and loss of investor confidence that occurred in the wake of the drought, it is highly probable that the economy would still have contracted in 1997. The stylised 'no drought, no crisis' growth path shown in Figure 9.3 assumes away a natural event and implies a growth rate that, in 1997 at least, would not have been possible even had the most judicious of economic management been in place for some time. A more reasonable counter-factual from which to consider policy analysis is the 'drought only' growth path. The difference between the 'slow recovery' income and 'drought only' income by 2003 is around 30 percent, compared with around 10 percent between the 'rapid recovery' and 'drought only' scenarios.

Figure 9.3: Stylised growth scenarios for Indonesia in the wake of the crisis



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10

Impacts of trade policy reform on income distribution and poverty in Indonesia

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Globally, markets have become much more integrated in recent years. Such integration creates enormous opportunities for the world economy, bringing vast benefits for some, but losses, and maybe even suffering, for others. The tendency among trade economists for much of the last fifty years has been to argue that trade is Pareto improving, increasing the national income of all countries engaging in trade and eventually boosting all households when there has been sufficient time for re-structuring and adjustment to the changing circumstances. However, the focus on Pareto improvement and the 'trickle down' effect of trade reform appears no longer sufficient to justify opening up to global markets. Rather, recent debate has seen the focus shift specifically to how poor households are affected by the opening of markets – even though we know from economic theory that trade is not the first-best income re-distribution measure except under limiting circumstances (Corden 1997).

Whilst a number of different groups could be harmed by changing commodity and factor prices, many argue that what is happening to poor households should be of primary importance since they are most vulnerable and because the re-distributive nature of trade policy is marginalising and impoverishing poorer people relative to wealthier people in many parts of the world. There are fears that trade policies are causing price increases for basic necessities, employment losses for poor people working in contracting industries, and declining unskilled wage rates, all contributing to worsening poverty.

A series of recent papers have sought to quantify the effects of increasing global integration on the poor using quantitative modelling and detailed household consumption and income survey data[1]. This paper considers the issue in the single country context for Indonesia. Indonesia has been pursuing trade liberalisation policies since the 1970s. Unlike some countries whose dismantling of trade barriers has been across the board, Indonesia's pattern of protection removal has been highly selective. Well into the 1990s tariffs remained high in certain sectors of the Indonesian economy such as certain basic chemicals, motor vehicles, plastics, leather, textiles and cosmetics. In addition, non-tariff barriers to trade, in the form of restrictive licensing and marketing arrangements, remain high in key intermediate industrial goods and strategic food sectors.

For decades Indonesia has been committed to poverty alleviation. Up until the Asian financial crisis of the late 1990s, Indonesia had experienced substantial reductions in poverty. Agricultural research, rural education and health policies, pricing policy for basic consumption goods (such as rice), and a fairly successful family planning program contributed to substantial improvements in living conditions for poor families. Due to the increase in absolute poverty at the time of the Asian financial crisis, awareness has been diverted more strongly than ever to ways in which reform and rebuilding could improve the welfare of poor families, who tend to be concentrated in rural areas, particularly on the Western islands.

Given the commitment to liberalisation and poverty reduction, this paper asks how would further trade liberalisation affect poverty alleviation and income distributional goals. Further trade reform is likely to have considerable re-distributive consequences. From existing theories, we might expect unskilled labour to benefit in real terms. Indonesia's comparative advantage lies in unskilled labour

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[1] See McCullock, Winters and Cirera (2001) and Reimer (2002) for surveys of the emerging literature that seeks to quantify how international trade affects the poor in developing countries.

intensive goods, whose price would be expected to rise with more openness to trade (Stolper-Samuelson, 1941). Specific capital used intensively in benefiting sectors might also experience real gains (Jones, 1971). In order to get more definite answers, we need to know about the structure of the Indonesian economy and the protection schedule. The WAYANG computable general equilibrium (CGE) model of the Indonesian economy (see Appendix 1 of this volume) captures that information. The model has seven rural and ten urban household groups classed according to factor ownership, enabling us to study between- and within-group income distributional issues.

This chapter is structured as follows: the first section describes the CGE model and the methodology for analysing welfare changes, poverty, and income distribution following a trade policy shock. The second section presents the base trade simulation and the results, under a standard and alternative closure. The third section considers two important model extensions, first to see some regional disaggregation of the results, and second to see how the results change when imperfect competition and increasing returns to scale are introduced. The final section addresses some caveats on the results and concludes.

A CGE framework for analysing income distribution, poverty and trade policy

This chapter employs the WAYANG CGE model, developed initially by Warr and Azis (1997) and adapted by Wittwer (1999). The particular aggregation of the model chosen for this paper has 82 industries each producing a single commodity (listed in Appendix Table 10A). The advantage of the WAYANG model in its original form for this paper is the inclusion of ten broad household groups. The household disaggregation allows the determination of the impact of policy changes on the welfare of different households classed according to socio-economic categories that are recognisable for policy purposes and that exhibit relatively stable characteristics. Table 10.1 shows the household classification.

Table 10.1: Classification of households in WAYANG

Household	Household description	Population share (%)
rural1	Landless	10.0
rural2	Small Cultivator (< 0.5ha)	27.3
rural3	Medium Cultivator (0.5 – 1ha)	6.2
rural4	Large Cultivator (> 1ha)	6.4
rural5	Non-Ag Labour: Low Income	8.8
rural6	Non-Labour: Rural	13.0
rural7	Non-Ag Labour: High Income	1.5
urban1	Urban Labour: Low Income	12.4
urban2	Non-Labour:Urban	11.8
urban3	Urban Labour: High Income	2.6

SOURCE: Warr and Azis (1997).

The sources of income for the ten household groups are exogenous in the model, shown in Table 10.2. Unskilled labour is the most important factor in the rural 1, rural 5 and urban 2 households. Besides the non-labour households, these groups are also the highest recipients of transfers. As expected, skilled labour contributes significantly to the wealthiest four household groups. With few exceptions, fixed capital is the most significant income source for all household income portfolios. This category includes interest, rent other than land rent (buildings etc..), dividends, imputed rent on housing and enterprise income from non-agricultural production.

Each household group also has a consumption profile that is exogenous in the model. In the original WAYANG model, the consumption shares were identical across the ten household groups. The shares were revised, to be more reflective of actual consumption patterns, for the purpose of analysing the poverty dimensions of trade policy. SUSENAS[2] 1993 data was used from Levinsohn et al. (1999) [3].

Table 10.2: Factorial sources of income for households in Indonesia

(%)

Household	Unskilled labour	Skilled labour	VCA[a]	VCN[b]	FCN[c]	Land	Transfers
rural1	48	1	0	8	26	1	15
rural2	25	6	1	15	45	1	6
rural3	14	3	1	16	54	7	5
rural4	8	4	1	18	57	7	6
rural5	40	6	0	8	28	5	12
rural6	13	25	0	11	33	2	16
rural7	5	22	1	13	47	10	3
urban1	24	13	1	14	42	3	4
urban2	35	18	0	6	19	2	19
urban3	1	24	1	17	52	3	1

SOURCE: Wayang Database. (a) Variable Capital used in Agricultural Sectors. (b) Variable Capital used in non-Agricultural Industries. (c) Fixed Capital used in non-Agricultural industries. (d) Transfers including inter-household, government and foreign transfers.

Modifications to incorporate income distribution

Examining distributional issues in a multi-household model can take the form of between-group studies or between-&-within-group studies. WAYANG contains information on between-group differences in consumption and factor earnings. However, the model reveals nothing about within-group inequality, which is assumed to be exogenous. Assuming distributional neutrality within-groups can be justified by arguing that certain types of economic changes affect between-group distributions whilst leaving within-group relative distributions unchanged (Dervis et al., 1982). Azis et al. (2001) provide empirical support for this proposition for

[2] SUSENAS is an extensive household consumption survey conducted every three years by the Central Bureau of Statistics (Badan Pusat Statistik, BPS).

[3] The more detailed consumption profile for the 82 commodities in WAYANG, and how it was adapted, is reported in Croser (2002).

Indonesia by looking at actual distributions before and after the Asian financial crisis. They conclude that the overall shape of income distribution remains stable through periods of adjustment.

In choosing the distributional function, the majority of household studies assign a Pareto or lognormal distribution to accord with socio-economic characteristics of households (see for example, Dervis et al. 1982). In recent studies, use has been made of a more flexible beta distribution which can take on various asymmetric forms (for example, Decaluwe et al., 1999). Contrary to the lognormal, the beta function can be left-skewed, right-skewed or symmetric, enabling the distribution for, say, rural landless households to differ markedly with that for, say, large landowners. Bordley et al. (1996) provide empirical support for use of the beta distribution as a more appropriate functional form for income distribution analysis.

The functional form of the beta distribution is given by:

Eq 1: $$I(y;p,q)=\frac{1}{\beta(p,q)}\frac{(y-mn)^{p-1}(mx-y)^{q-1}}{(mx-mn)^{p+q-1}}$$

where

$$\beta(p,q)=\int_{mn}^{mx}\frac{(y-mn)^{p-1}(mx-y)^{q-1}}{(mx-mn)^{p+q-1}}dy \qquad p>1, q>1,\ mn<y<mx$$

and y is income, mn is minimum income, mx is the maximum income, and p and q are parameters which together determine whether the distribution is skewed to the left, skewed to the right, or symmetric. Values of p and q can be estimated by non-parametric methods from survey data, or derived by a method of moments process, provided two or more moments of the distribution are known. For this paper, the beta distribution parameters are taken from Azis (2000) who estimates the actual non-parametric income distribution for each of the household categories in WAYANG from the 1996 SUSENAS sample of over 200 000 households. Each of these distributions is horizontally scaled to accord with the mean household income in the 1993 database[4]. Table 10.3 shows the parameters and variables for constructing the beta distributions. Figure 10.1 shows the resulting income distributions for the ten WAYANG household groups.

Table 10.3: Variables and parameters for constructing beta distributions for Indonesia

Household	Max Income (000 Rp)[b]	Min Income (000 Rp)[b]	Mean Income (000 Rp)[a]	p [c]	q [c]	Group poverty (%)[d]
rural1	16186	0	669	2.37	60.77	32.1
rural2	17170	0	830	3.7	110.54	29.9
rural3	44470	1	1910	3.7	110.54	2.5
rural4	75430	1	2430	3.7	110.54	0.5
rural5	39612	0	1813	3.16	64.35	2.0
rural6	16102	0	873	2.01	33.83	19.6
rural7	54449	8	2386	2.53	53.66	1.8
urban1	39751	10	1591	2.19	55.72	9.6
urban2	24972	48	1488	1.59	25.33	13.3
urban3	96168	9	4777	1.86	34.23	1.6
Indonesia						**14.0**

SOURCES: (a) WAYANG database. (b) Horizontally scaled to accord with Azis (2000). (c) Azis (2000). (d) Poverty headcount rate estimated at BPS poverty lines (see text).

Poverty measures

To compare poverty pre- and post-simulation, a Foster-Greer-Thorbecke (F-G-T) poverty measure can be applied to each distribution. The F-G-T measure consists of a class of additively decomposable poverty measures that capture the headcount poverty rate, the depth, and the severity of poverty. It is based on the specification of a monetary poverty line, z, as shown below. When $\alpha = 0$, the P_α measure captures the headcount rate of poverty up to the

[4] Azis (2000) reports only the distribution for rural farmers combined. That is, small, medium and large cultivators are grouped together to estimate one distribution for farmers with land. Consequently, rural 2, 3 and 4 households in WAYANG all have the same shape distribution scaled to the WAYANG mean for each.

monetary poverty line. As α increases, the relative importance accorded to individuals below the poverty line increases.

Eq 2: $$P_\alpha = \int_{mn}^{z} \left(\frac{z-y}{z} \right)^{\alpha} I(y;p,q)\partial$$

The F-G-T measures are dependent on, and sensitive to, the setting of monetary poverty lines. If it can be agreed where to set a poverty line, one can gauge the amount of poverty in populations by measuring the extent of poverty for each constituent household and totalling using a suitable aggregator function. However, setting a poverty line is a non-trivial exercise[5]. In this paper, the BPS monetary poverty line of 442 664 Rupiah per person per year is adopted for urban areas, and deflated by 18.5 percent for rural areas (Suryahadi et al., 2000)[6]. For comparison pre- and post-simulation, the monetary poverty line is disaggregated into a basket of n basic needs commodities according to shares reported in Pradhan et al. (2000)[7]. The monetary poverty line is then the sum of the value of each commodity in the basket of basic needs, V_n, as shown below.

Eq 3: $$z = \sum_n V_n \qquad \text{where} \qquad V_n = Q_n^p p_n$$

and Q_n^p is the quantity of the n^{th} basic need commodity, which is assumed invariant from one simulation to another and applies to all households, and p_n is the price of the n^{th} basic need commodity, determined endogenously in the model. In this sense, the monetary poverty line is a fixed basket of basic needs whose value is determined endogenously.

5 See Dhanani and Islam (2002) for a comprehensive review of the difficulties of specifying monetary poverty lines.

6 Deflating urban poverty lines for rural areas is common. There is some controversy over what is an appropriate deflator. Dhanani and Islam (2002) suggest the rural poverty line is often deflated by too much and suggest that difference in the price of basic food commodities between urban and rural areas is to the order of 11 percent.

7 See Croser (2002) for the full specification of the basket of basic needs.

The graphs in Figure 10.1 show the poverty line for each household group. For the rural 1 household, for example, 32 percent of this group is in poverty in contrast to the higher income household groups for which less than 2 percent of the group is in poverty. For Indonesia as a whole, 14 percent of the population is impoverished, which is consistent with official headcount estimates of poverty in Indonesia in 1993[8].

The income distributions, complete with monetary poverty lines can now be used to determine what happens to the various groups under different policy regimes. The most important determinant underpinning the resulting income distributions is factor ownership. Recall from Table 10.2 the factorial sources of income for households. When an exogenous shock is simulated, each household group changes its income, because of changes in factor rewards, and thereby increases or decreases poverty and its position in the economy's income distribution. Similarly, each household will change its expenditure depending on price movements. The consumption patterns will be important for analysing the effects of an exogenous policy shock on household welfare.

CV measures

The methodology outlined so far enables us to determine what is happening to between-group income distribution in the face of trade policy shocks. Using a small amount of additional data, this section of the paper relaxes the distributional neutrality assumption. In the earlier simulations, all individuals in a particular household group were assumed to have the same factor income profile. However, knowing something about the factor earning profile of the household at the poverty line can enable within-group comparison.

[8] The official BPS estimate of poverty is 13.7 percent for the year of 1993.

Figure 10.1: Beta distributions for the WAYANG household groups

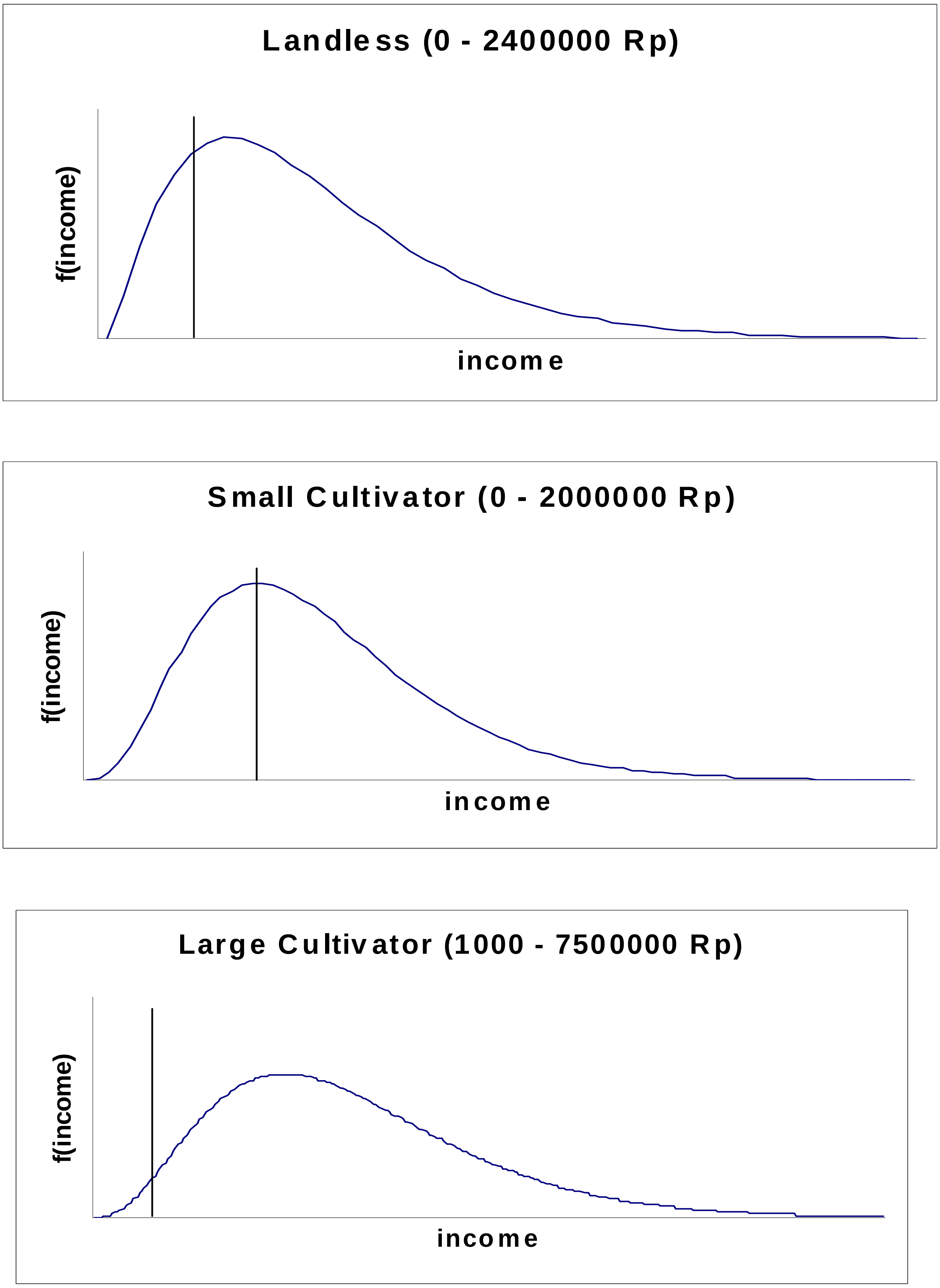
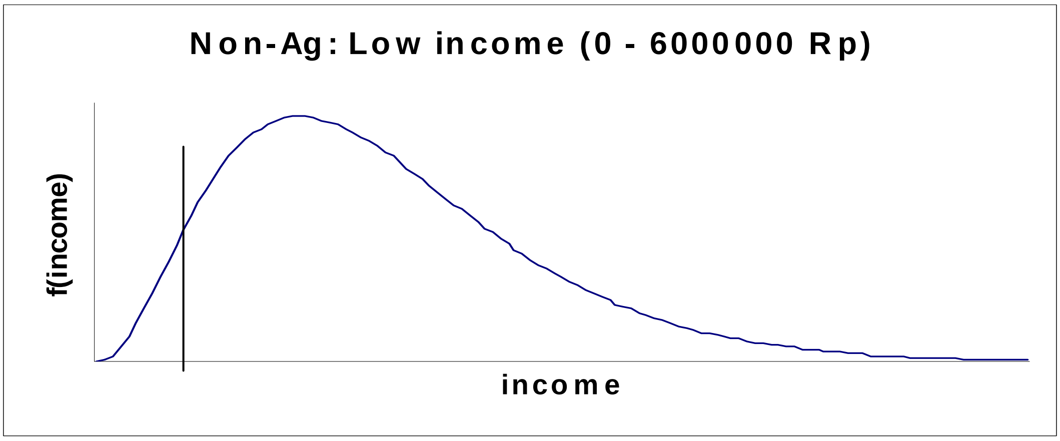
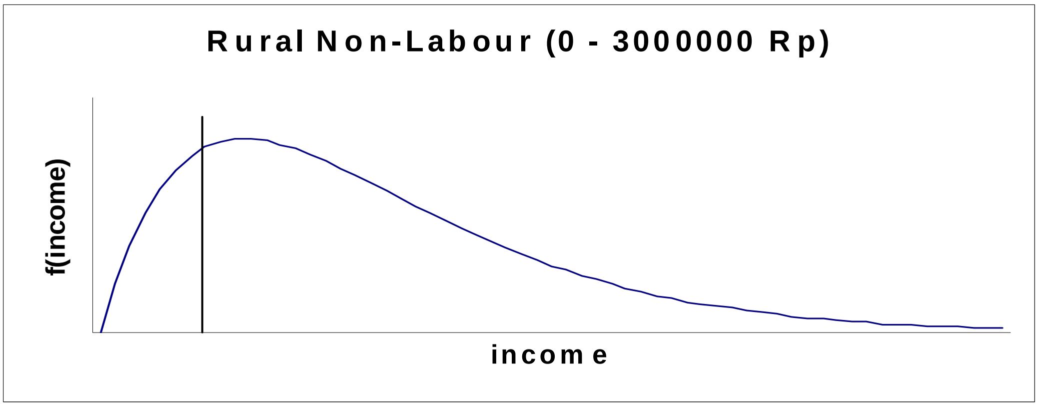


Figure 10.1 (continued)





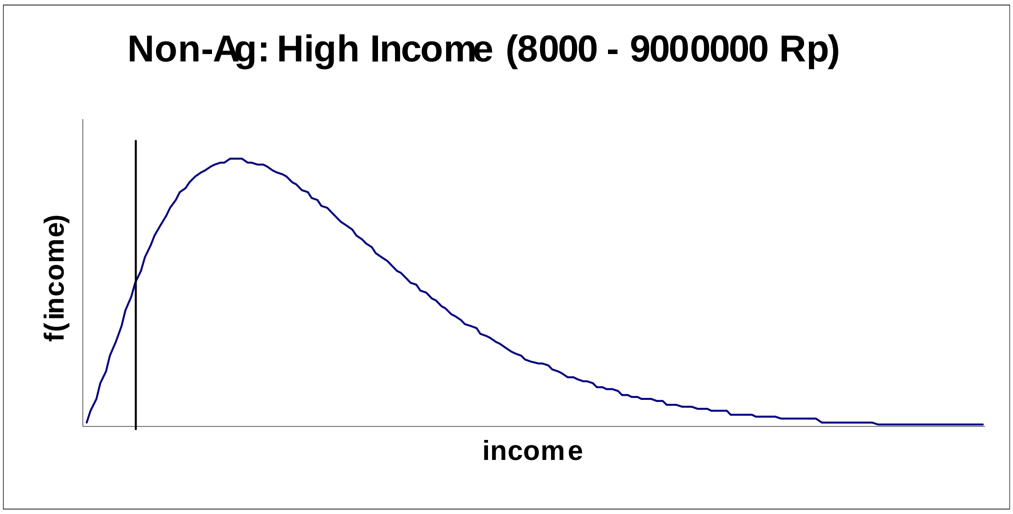
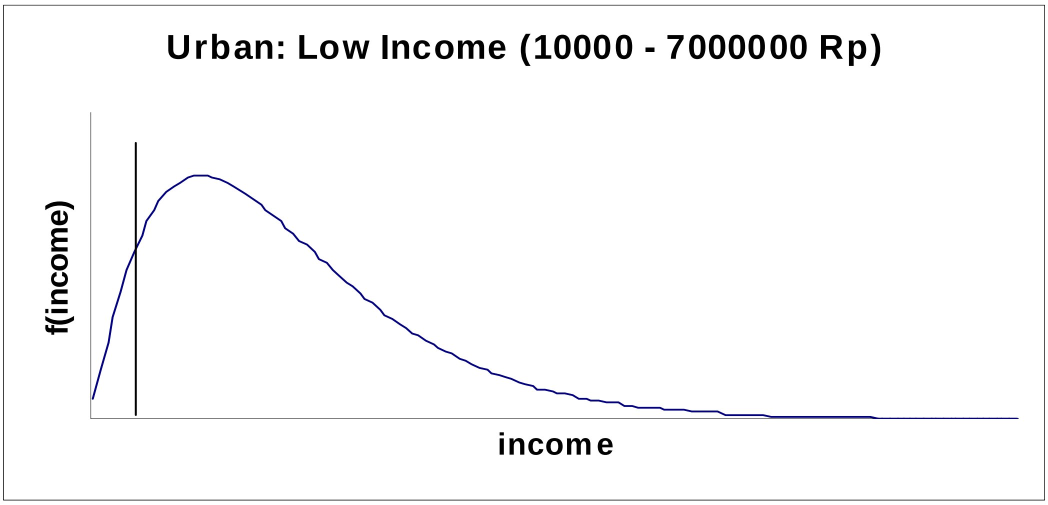
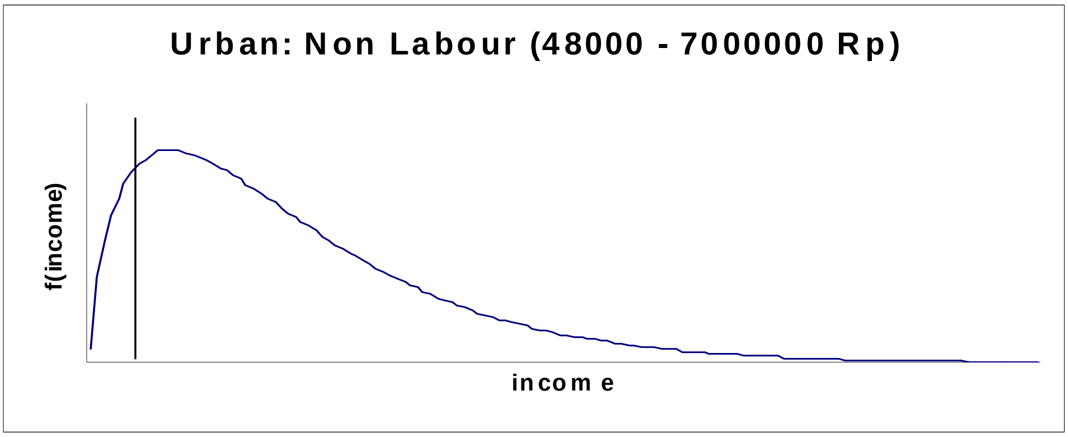
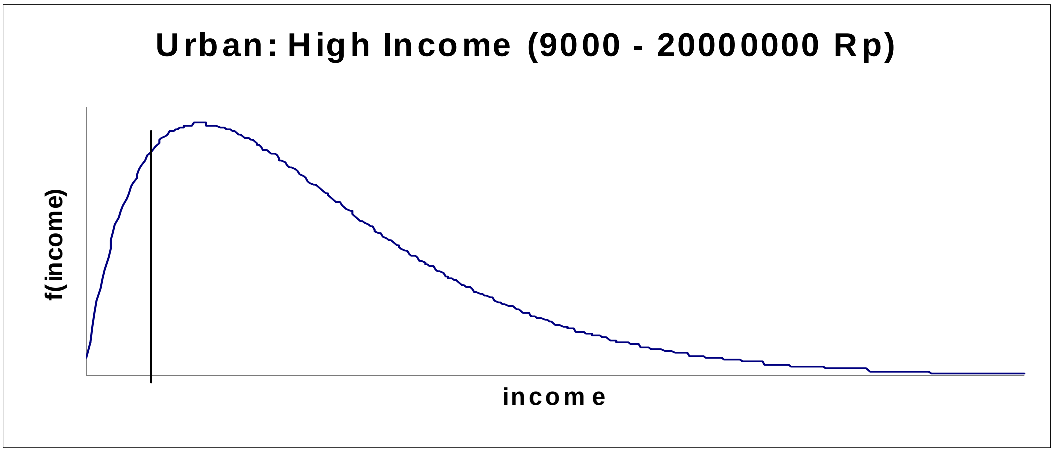


Figure 10.1 (continued)







This small step towards understanding the within-group changes, inspired by Hertel et al. (2000), is facilitated through the use of compensating variation (CV) measures. The aim of a CV measure in this study is to try to grasp how households in different parts of the income distribution behave in response to trade policy changes.

Consider the most basic CV measure:

Eq 4: $$cv^i = -[y^i - \sum_n \vartheta_n^i p_n]$$

where y^i is the percentage change in income, ϑ_n^i is the i^{th} group's budget share of good n and p_n is the percentage change in the price of good n. Let us define a marginal household as a household whose income is equal to the monetary poverty line. For a marginal household, the CV measure is given by:

Eq 5: $$-cv^m = (y - CPI) + \sum_f (\Omega_f^m - \Pi_f)\varpi_f - \sum_n (\Theta_n^f - \lambda_n) p_n$$

On the right hand side, the first bracketed expression is the per-capita change in income relative to initial expenditure. The second bracketed expression is the change in the marginal household income relative to the mean household, where Ω_f^m is the share of primary factor *f* in the marginal households income, Π_f is the share of primary factor *f* in per capita household income, and ϖ_f is the percentage change in the return to factor *f*. The third term is the change in the marginal household CPI relative to per capita CPI, where the marginal households share of each commodity is given by Θ_n^f whilst the mean households share is λ_n. This expression can be reduced to the basic CV measure.

Equations 4 and 5 represent a CV measure for the mean household and the marginal household in each of the ten WAYANG groups. The factor income profile and consumption shares for the mean household are in the WAYANG database, as reported earlier. The consumption bundle for the marginal household in each group is the basket of basic needs. The factor income profile for each of the ten marginal households comprises mainly unskilled labour. Land is considered important for the poor households in the medium and large cultivating groups. However all other groups at the poverty line rely exclusively on unskilled labour. Hertel et al. (2000) and Friedman (2002) reveal how important unskilled labour and transfers are for the poorest people in the Indonesian economy. This is unlikely to differ significantly across the household groups.

Using the model to examine the effects of trade policy reform

The removal of tariff and non-tariff barriers to trade

Given that non-tariff barriers (NTBs) are the key to Indonesia's protectionist policies, the simulation performed on the model's base year equilibrium comprises the complete removal of all import tariffs and the most widely used non-tariff barriers, import licenses. Import licences are modelled as tariff-equivalent barriers[9]. Table 10A shows the tariff and NTB schedule. Closure is defined by a set of constraints that represent a short-term framework[10].

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9 Details of how the differences between a tariff and an import licence are handled in the WAYANG model are contained in Croser (2002). Of particular importance, however, is the assumption that quota rents accrue to the wealthiest urban households who rely heavily on capital in non-agricultural sectors for a significant proportion of their income.

10 Land and fixed capital are specified as sector specific. Variable capital in agriculture can move between the 15 agricultural industries but the total stock is fixed. Similarly, variable capital in non-agriculture can move between non-agricultural sectors, but the aggregate stock is fixed. In the labour market the total employment level is fixed exogenously. However, employment in

The removal of all trade barriers results in real GDP expanding by 1.4 percent, owing mainly to an expansion of exports (Table 10.4). The industries to experience the greatest output gains are leather, carpet and rope, yarn and kapok, fertiliser and pesticides, knitting mills and clothing. An increase in exports drives this expansion. Service sectors enjoy expansions as a result of the expansion of the local market.

Most industries previously protected suffer when trade is liberalised. Households and producers substitute cheaper imported goods for domestic goods. Most noticeably output falls for other manufactures, manufactured metals, construction equipment, manufactured electrical, manufactured chemicals, manufactured non-metals and communications equipment. The most significant changes in agricultural industries are the fall in soy and other beans and ground nuts output due to the removal of very high NTBs.

Table 10.4: Estimated effects on Indonesia's macroeconomy and on factor returns (% change in variables*)

Variable	Base simulation	Alternativ e closure	IRTS and imperfect competition
Real GDP (Exp)	1.41	1.52	3.49
Export Volume Index	11.11	8.92	14.01
Import Volume Index	8.02	8.96	7.90
Export Price Index	-2.65	-2.13	-3.38
Import Price Index	-11.09	-11.04	-11.09
Balance of Trade *	0.94	0.95	1.40
Consumer Price Index (CPI)	-3.78	-2.82	-3.28
Employment of Unskilled Workers	0.00	-2.39	0.00

individual industries and the wage rate can adjust to give some indication of which wage earners will be the net winners and losers from trade policy changes. Technical change and other shift variables are assumed to not undergo any change. The exchange rate is held fixed as the numeraire. The macroeconomic closure specifies aggregate investment as fixed, whilst private consumption and government spending move with real income. The trade balance absorbs variations in real income.

Real Return to Unskilled Labour	0.19	2.82	3.37
Real Return to Skilled Labour	1.80	1.78	4.31
Real Return to Land	1.93	2.47	4.55
Real Return to Fixed Capital in Non-Ag.	3.63	3.00	5.11
Real Return to Variable Capital in Ag.	2.01	2.47	4.54
Real Return to Variable Capital in Non-Ag.	1.75	1.17	4.87

SOURCE: WAYANG Simulation Output. * Balance of trade is expressed as a fraction of GDP, not as a percentage.

Factor returns

Industry expansions and contractions place upward and downward pressure on the real returns to factors used intensively in their production or specific to those industries. In general, firms experiencing increases in output increase demand for fixed factors, which now become relatively scarcer, placing upward pressure on the real return to these factors. However, at the same time, falls in import-competing sector outputs decrease the demand for these fixed factors, placing downward pressure on the real returns.

Aggregate employment was held fixed in this simulation, even though labour was able to move between sectors. As expected, the results indicate that labour moves out of contracting sectors and into sectors expanding in line with Indonesia's international competitiveness. The results indicate that the real return to the labour composite is increasing under this trade policy scenario by 1.2 percent (Table 10.4). However, interestingly the real wage for skilled labour is increasing by 1.8 percent, much more than the real wage rate for unskilled labour, increasing only marginally by 0.2 percent. This result appears contrary to the expected results for Indonesia. We would expect unskilled labour intensive sectors to expand, placing upward pressure on the unskilled wage rate. Industry results reveal that the industries which experience the largest expansions in output (listed above), with the exception of fertiliser and pesticides, are sectors that intensively employ unskilled labour and variable capital. Industries experiencing the greatest output falls are overwhelmingly the protected manufacturing industries, which are similarly intensive in unskilled labour and fixed capital. Their contraction mitigates the upward pressure placed on the unskilled wage rate.

One explanation for this result has to do with the capacity for tradeable sectors to expand. In this model we are seeing a movement of resources away from the previously protected import-competing sectors to those that are internationally competitive exporters. However, in the WAYANG model, modest export demand elasticities allow only limited expansion of overseas demand[11]. Consequently, when the resources from inefficient industries are freed up they do not necessarily go to the tradeable export sector. Instead, some of the sectors experiencing gains are actually the service sectors that are non-tradeable and intensive in the use of skilled labour.

The conclusion to draw is that unskilled labour does not do as well in the single country model context for two reasons; firstly because the structure of protection in Indonesia protects unskilled labour in manufacturing industries and secondly because unskilled labour intensive industries have only limited expansion potential. Industries selling to the domestic market experience increases in output because domestic demand elasticities are higher, in absolute terms, than the export demand elasticities.

For landowners, the real return to land falls significantly for two industries; ground nuts and soy and other beans. These two industries were previously highly protected and the removal of trade barriers results in a contraction of output in these industries and the resulting downward pressure on returns to land specific to these sectors. Households producing these commodities or owning land employed in these sectors not only lose in the form of decreased demand for their goods and decreased quota rents, but also from the falling return land. There is upward pressure on the real return to land in most other sectors, especially other food and fibre crops and raw rubber, such that the aggregate real rate of return to land increases by 1.9 percent.

For specific capital owners, those who benefit own capital specific to expanding industries whilst there are significant downward pressures on the returns to specific capital in contracting industries. This accords with the hypothesized results from the Jones-Neary specific-factors model (Jones, 1971). If we aggregate across all fixed

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[11] Armington elasticities are specified as 6 and export demand elasticities as –4 in line with Dixon and Rimmer (2001). Sensitivity analysis of export demand elasticities reveals that higher absolute export demand elasticities allow greater expansion of export industries. The real unskilled wage rate increases by more suggesting that poor households may fare better than reported in the base simulation.

capital in non-agriculture, there is a 3.6 percent increase in the real rate of return. Variable capital owners in non-agricultural and agricultural sectors experience increases in the real rate of return of 1.8 and 2.0 percent respectively.

Households

The decline in the price of most imports and the follow-on decline in the price of most domestically produced goods forces the aggregate consumer price index (CPI) down by almost 4 percent. Nominal income similarly falls for all ten household groups. This corresponds to a leftward horizontal shift of the beta income distribution (shown in Figure 10.2 for household rural 1). The most substantial shifts occur for the urban 3 household, whose nominal take-home income falls 7.4 percent, due mainly to the decline in quota rents. The rural 1, rural 5 and urban 2 groups also experience above average declines in nominal income, due to their reliance on unskilled labour as a source of income.

Figure 10.2: The beta distribution and monetary poverty line for the Rural 1 household group pre- and post-trade policy reform

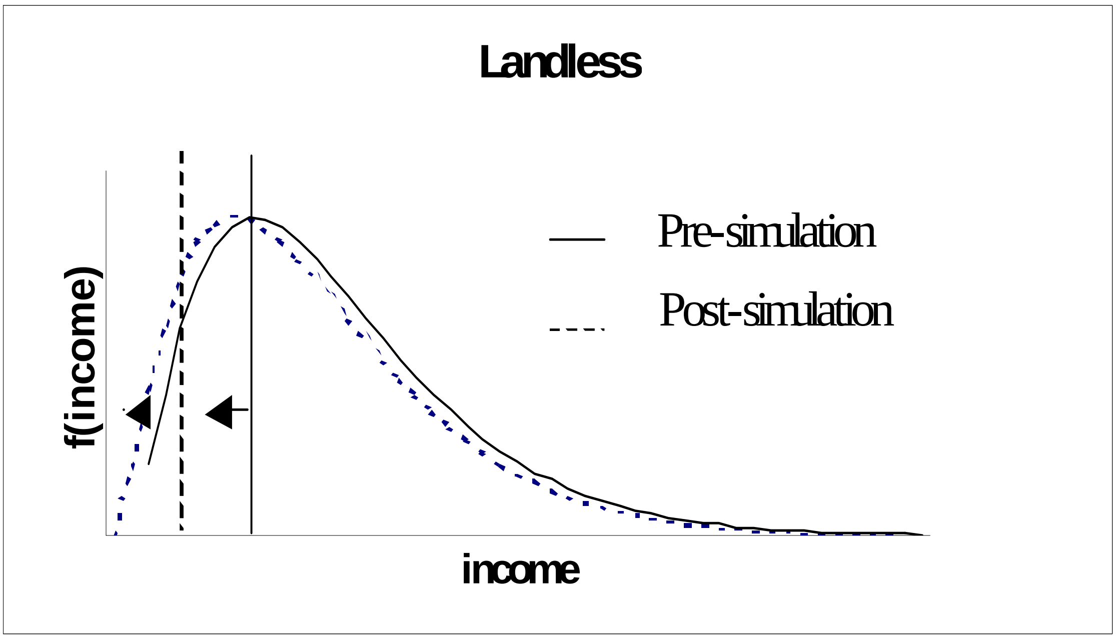

Table 10.5: Poverty headcount measures in Indonesia following policy reform (%, with improvement in poverty in parentheses)

Household	Base simulation	IRTS and imperfect competition
rural1	31.5 (-0.6)	30.6 (-1.5)
rural2	28.9 (-1.0)	27.9 (-2.0)
rural3	2.3 (-0.1)	2.2 (-0.3)
rural4	0.4 (0.0)	0.4 (-0.1)
rural5	1.9 (-0.1)	1.8 (-0.2)
rural6	19.1 (-0.5)	18.6 (-0.9)
rural7	1.8 (-0.1)	1.7 (-0.2)
urban1	9.2 (-0.3)	8.9 (-0.6)
urban2	13.0 (-0.3)	12.7 (-0.6)
urban3	1.7 (0.1)	1.7 (0.1)
Indonesia	**13.6 (-0.4)**	**13.1 (-0.9)**

SOURCE: Author's Calculations from WAYANG simulation output.

The poverty implication of the fall in nominal income can be gauged by reference to new monetary poverty lines, which are 4.1 percent lower than the initial lines. This is a larger shift than the CPI shift, owing to large reductions in the price of soy and other beans and ground nuts. The fall in the nominal income of households coupled with the even bigger fall in the monetary poverty line lifts people from poverty in nine of the ten household groups. For households beginning with large incidences of poverty, rural 1, rural 2 and rural 6, there is significant poverty alleviation of 0.6, 1.0 and 0.5 percent respectively. The poverty line is relatively near the mode for these groups, such that the sensitivity of the headcount poverty rate to the poverty line is quite high. Headcount poverty increases for the urban three household group due to the very large fall in the nominal income. Overall, there is a 0.4 percent improvement in Indonesia's poverty headcount rate.

CV measures

CV measures are reported in Table 10.6. For nine of the ten mean household groups the measure is negative indicating that no compensation is required for the household group to achieve the same level of utility after the trade policy shock. The urban 3 mean household has a positive CV measure indicating that this group would need to be compensated to the extent of 3.5 percent of their initial expenditure to enjoy the same level of utility as before the shock.[12]

Decomposition of these measures reveals that it is factor income differences which drive the results. Mean households deriving their income from skilled labour do best under this simulation: rural 6, rural 7 and urban 2. Conversely, the least gain accrues to the rural 1, rural 2, rural 5 and urban 1 households which rely on unskilled labour. The other household groups, with a diversified income portfolio, fare somewhere in between. The urban 3 mean household is the only household to require compensation to enjoy the same level of utility as before the liberalisation, owing mainly to the loss in quota rent income. Turing to the marginal household in each socio-economic group, the results suggest that tariff liberalisation is sufficient to improve the utility level of each. Taking the difference between the per capita and marginal household reveals that the gap between the two is widening for nine of the ten groups. The mean household has a more diversified income portfolio and therefore fares better when trade is liberalised. On the other hand, the

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[12] Alternative simulations were run in which the rural 4 (large landowner) households were assumed to be the recipients of quota rents. Macro and industry results do not differ substantially, however, the CV measure for the urban 3 household is negative and that for the rural 4 is positive. In reality, the loss of quota rents is likely to be shared across several socio-economic household groups such that we would expect those losing quota rents to be worse off but all other households could be expected to gain from the trade liberalisation.

marginal household, reliant on unskilled wages facing downward pressure, fares less well.

Table 10.6: CV measures for Indonesia

Household	Base simulation		Alternative		IRTS simulation	
	PC	M HH	PC	M	PC	M HH
rural1	-1.01	-0.68	-1.67	-1.77	-3.03	-3.17
rural2	-1.15	-0.37	-1.20	-1.61	-3.12	-3.14
rural3	-1.40	-0.37	-1.32	-1.61	-3.16	-3.14
rural4	-1.73	-0.37	-1.55	-1.61	-3.38	-3.14
rural5	-1.21	-0.68	-1.84	-1.77	-3.13	-3.17
rural6	-1.63	-0.50	-1.40	-1.66	-3.28	-3.27
rural7	-1.73	-0.50	-1.56	-1.66	-3.52	-3.27
urban1	-1.22	-0.82	-1.34	-1.45	-3.20	-3.46
urban2	-1.67	-0.82	-2.22	-1.45	-3.43	-3.46
urban3	3.50	-0.82	4.30	-1.45	1.83	-3.46

SOURCE: Author's Calculations from WAYANG Simulation Output. PC HH – per capita household, M HH – marginal household.

Alternative labour market closure

An alternative closure swap in which the aggregate employment of unskilled labour is set endogenously with the nominal unskilled wage rate held fixed results in increased unemployment of unskilled workers as a result of contracting import-competing sectors which intensively employ unskilled workers. For those lucky enough to remain employed, their real wage rate increases significantly, as opposed to a minor improvement in the base simulation. This is despite a smaller fall in the price of goods which intensively employ unskilled labour brought about by the smaller fall in the price of their main primary input. The CPI falls by 2.8 percent and the basket of basic needs by a smaller 1.8 percent. For households, the alternative closure results in more favourable CV measures and a closing gap between nearly all marginal and mean households

(Table 10.6). However, one needs to consider the loss of employment potentially pushing many households into poverty.

Extensions

Regional results

This extension of the results considers a Leontief, Morgan, Polenske, Simpson and Tower (1965) (hereafter, LMPST) regional decomposition of the results[13]. This provides some insight into how trade liberalisation affects three broad regions: the densely populated Java and Bali, Sumatra, and the Other Islands. The regional profile (Table 10.7) indicates that much of Indonesia's industrialisation has taken place in Java and Bali where 75 and 73 percent of manufactures and services are produced respectively. Regional poverty estimates appear fairly similar in aggregate across the three regions, despite poverty being very high in some regions such as East Nusa Tenggara and Irian Jaya, and very low in others like Aceh and Riau.

The trade policy simulation results indicate that the Java and Bali region has the least to gain from further liberalisation (Table 10.8). Gross regional product (GRP) and aggregate regional employment both fall in Java and Bali, whilst output and employment expand in Sumatra and the Other islands. The sectoral changes in output analysed earlier go part way to explaining this observation. Many of the contracting import-competing manufacturing industries are highly concentrated in the Java and Bali region. Consequently the decline in these industries output adversely effects this region. Whilst the expanding industries of textiles, clothing, yarn and kapok, leather and carpet and rope are also concentrated in Java and Bali, their output expansions are insufficient to boost the entire region.

[13] The LMPST decomposition is a top-down extension; industry, macroeconomic, and factor return changes are identical to the base simulation (see Dixon et al., 1982).

Table 10.7: Sectoral shares in regional output and poverty by region in Indonesia (%)

Region [a]	JavaBali	Sumatra	Other Islands
Population share [b]	**62**	**21**	**17**
Urban Headcount Poverty [b]	11	8	8
Rural Headcount Poverty [b]	25	21	27
Total headcount poverty [b]	**20**	**18**	**23**
Share of output [c]	**60.8**	**21.9**	**17.3**
Agriculture	0.42	0.20	0.38
Tobacco	0.86	0.08	0.06
Tea	0.79	0.21	0.00
Raw Rubber	0.07	0.70	0.23
Palm Oil	0.01	0.80	0.19
Coffee	0.17	0.71	0.12
Forestry and	0.03	0.11	0.86
Wood	0.03	0.12	0.85
Manufacturing	0.75	0.15	0.10
Services	0.73	0.20	0.07

SOURCE: (a) JavaBali includes Jakarta, W Java, C Java, Yogyakarta, E Java and Bali. Sumarta includes Aceh, N Sumatra, W Sumatra, Riau, Jambi, S Sumatra, Bengkulu and Lampung. The Other Islands include W Nusa Tenggara, E Nusa Tengarra, East Timor, W Kalimantan, C Kalimantan, S Kalimantan, E Kalimantan, N Sulawesi, C Sulawesi, S Sulawesi, SE Sulawesi, Maluku and Irian Jaya. (b) Author's Calculations from data provided in Freidman (2002) at the BSP National Price Poverty Line. (c) WAYANG database.

Table 10.8: Estimated effects of reform on regional output, employment and wages (% change)

Variable	JavaBali	Sumatra	Other islands
Gross regional product	-0.14	0.36	0.17
Aggregate regional emplt	-0.25	0.52	0.41
Regional wage bill	-2.79	-2.11	-2.52

SOURCE: WAYANG model simulation output

Conversely, Sumatra and the Other Islands produce intensively outputs which experience significant growth. Raw rubber, palm oil and coffee are significant for Sumatra and experience output increases of 3.5, 1.5 and 0.4 percent respectively. These increases tend to be due to increased demand from the domestic market. The other islands produce sea products, forest and hunting, wood and coconut intensively which all increase by between 0.4 and 2.2 percent. The regions of Sumatra and the Other Islands combined also account for more than 90 percent of the production of coal, crude oil, natural gas and metal ore mining. All of these sectors expand, due to increasing export opportunities.

In addition to the fall in output of manufacturing industries, the declining aggregate wage income in the Java and Bali region results in a decrease in regional consumption, thus multiplying the effect of the decline in GRP. The specification of services as local commodities means they must be consumed in the region in which they are produced. Thus, when the aggregate wage bill for Java and Bali falls, consumption of locally produced perishables and services must also decline. The result is that the decrease in GRP for Java and Bali is greater than the national average.

Increasing returns to scale and imperfect competition

It is well accepted that trade liberalisation, in the presence of increasing returns to scale (IRTS) and imperfect competition, might be more beneficial to households than reported in the base simulation. Trade tends to induce a pro-competitive effect that can reinforce the usual comparative advantage sources of a gain from trade. Of particular interest in this case study is that when trade in liberalised in the model, the decline in unskilled wages is due to contracting manufacturing industries. However, imperfect competition market structures may lead to growth of the manufacturing sectors due to the realisation of scale economies and the erosion of market power. This may offset downward pressure on unskilled wages to some extent. This fundamental indeterminacy regarding the welfare benefits of trade liberalisation for developing countries was first discussed by Devarajan and Rodrik (1991).

This simulation requires first amending the WAYANG model to incorporate features of imperfect competition and IRTS. This paper uses parts of the Abayasiri-Silva and Horridge (1996) scale model. A subset of 26 food processing, manufacturing and service industries are considered to exhibit IRTS at the firm level (denoted by * in Appendix Table 10A). Scale economies are generally inconsistent with perfect competition and therefore monopolistic competition is assumed to prevail in these industries also.

The production function for these 26 sectors is re-formulated to take account of some fixed cost in the production process as shown below.

Eq 6: $$X^{f} = G(inputs) = G^{f}(inputs) - FC$$

where X^{f} is firm output, FC is fixed costs of production invariant to output levels, $G^{f}(inputs)$ is a scalar multiple of the original CRTS $G(inputs)$ function. The dual function of G^{f} is the marginal cost (MC) of producing a unit of output at given input prices.

IRTS is characterised by a movement down the AC curve. Such a movement can be brought about by changes in firm output, fixed costs and the marginal cost of producing a unit as shown in the AC equation below.

Eq 7: $$AC = \frac{TC}{X^{f}} = \frac{(FC + X^{f}).MC}{X^{f}}$$

When trade liberalisation occurs, marginal and fixed costs are assumed to remain constant such that the only way a firm can experience IRTS in the short run is to have an expansion of output, spreading fixed costs over greater output. International trade could bring about this expansion by eroding the market power of imperfectly competitive firms.

The imperfect competition structure assumed to exist for the 26 sectors is monopolistic competition[14]. Under monopolistic competition firms produce slightly differentiated products in the various markets in which they operate. The demand for each variety is less than perfectly elastic, thus firms can price as monopolists to

[14] There exists a wide variety of potential market structures which have been used in the literature (see Francois and Roland-Holst, 1997).

exploit their market niche (equation 8). However, pricing must be at average cost under the assumption of free-entry and exit in the long run (equation 9).

Eq 8: $$\frac{P - MC}{P} = \frac{1}{\varepsilon}$$

Eq 9: $$P = AC$$

where P is the firm's price and ε is the perceived elasticity of demand for each variety (or each firm). Each firm's perceived elasticity of demand depends on the number of varieties, N, the share of imports in the market, S^M, the elasticity of substitution between its variant and other variants, γ, and between domestic and imported varieties, σ, as shown below.

Eq 10: $$\varepsilon = \sigma \quad S^{M}(1/N) + \gamma \quad (1 - 1/N)$$

When opening up to trade, the domestic price rises relative to import prices and the perceived elasticity of demand increases. Thus, greater competition results in an erosion of each of the domestic firms market power and greater falls in the price of commodities in industries with unrealised economies of scale and imperfect competition. The expansion of output, in the face of a trade policy shock is generally larger in these industries. For industries, such as the protected manufacturing firms in Indonesia, there is pressure to contract due to increased competition. At the same time, erosion of their market power exerts pressure to expand output.

Re-calibrating the model to include IRTS and imperfect competition features[15] and re-running the base simulation reveals that many of the manufacturing industries experience smaller output contractions than in the base simulation. For these industries there are two offsetting effects at play. Firstly the removal of protection is resulting in a decrease in output since this sector is no longer able to

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[15] This required incorporating internal economies of scale by specifying the IRTS scale parameter as exogenous and equal to a positive value to capture unrealised scale economies.

compete with cheaper import varieties of the same good. At the same time however, opening up to trade is causing an erosion of market power, stimulating firms to expand output and move down their AC curve. Overall, gross domestic product of the Indonesian economy increases by 3.5 percent (Table 10.4).

Manufacturing industries have larger price falls. Other industries tend to experience a smaller price fall that in the base simulation. This is because the price of factors increase by more than in the base simulation (Table 10.4). Overall the CPI falls by about the same amount as in the base simulation.

The enhanced performance of the manufacturing industries means the unskilled real wage rate performs much better when industrial organisation features of the Indonesian economy are incorporated into the model. Table 10.4 shows that the real unskilled wage increases 3.4 percent, as opposed to 0.2 percent with CRTS. This results in an increase in the real income of most household groups.

The increasing factor returns, coupled with the CPI fall of 3.3 percent results in an increase in the nominal income of six of the ten household groups, with a corresponding rightward shift of the beta distribution. For the remaining four households, the beta distribution shifts leftward, but only by a small amount. The monetary poverty line shifts leftward 3.3 percent. Poverty levels are significantly lower for all household groups. Overall the poverty headcount rate falls by 0.9 percent with improvements in rural households 1, 2 and 6 experiencing reductions of more than 0.9 percent (Table 10.5)

The CV measures confirm that when trade is liberalised, IRTS and imperfect competition can bring greater benefits to those at the bottom of the income distribution than CRTS and perfect competition. The only group with lower welfare after the liberalisation is the mean urban 3 household due to the loss of quota rents. All other per-capita and marginal households gain however, with the gap between the mean and marginal household closing for six of the ten socio-economic groups. This is a more positive result than the base simulation and emphasises that in Indonesia, trade liberalisation is likely to bring substantial gains from trade not only because it yields an efficiency gain but because economies of scale can be realised and imperfect competition structures are eroded.

Caveats

The results presented in this section suggest that once a new equilibrium is reached it is possible that average and marginal households in each socio-economic group will be better off, with the exception of households losing quota rents. However, the comparative static nature of the model ignores changes in poverty or income distribution during the transition to a new equilibrium. Such short-term adjustments to changes could have important consequences for poverty. For example, the effect of a contracting sector forcing household heads out of a job may result in impoverished circumstances and starvation for poor families before a new equilibrium is reached. Winters (2000a) suggests that the loss of a job is probably the common proximate cause of households descending rapidly into poverty.

The WAYANG model is also silent on the way in which poor households respond to shocks. Whilst positive shocks may deliver great benefits if households can switch their activities to take advantage of them, WAYANG captures nothing about the ability of poor households to switch between activities and avoid impoverishing circumstances. On the other hand, a risk averse farmer may be unable to take advantage of trade liberalisation in the sense that they are not able to be entrepreneurial and benefit from switching from say subsistence farming to a cash crop. Similarly, they may be hampered by domestic market regulations, not captured in the WAYANG model, which inhibit their supply response. A priority area for further research is to analyse how poor people respond to policy changes. Under what circumstances do poor households take advantage of positive shocks and what action do households take to minimize the chances of falling into poverty?

A further limitation of the WAYANG model is the presence of only two types of labour in the model. The paper considers only one type of unskilled labour. However, in Indonesia, unskilled labour may not be completely mobile in the economy. This, for example, could result in workers in the textiles, clothing and footwear industries experiencing a higher increase in their real wage rate than the average for all unskilled labour. A more disaggregated labour profile would allow for greater insight into how trade policy changes are affecting different poor households. Studies for India reveal that rigidities in the labour market are very important in addressing poverty alleviation (Winters, 2000b).

A more problematic caveat on these results is the distribution of wealth within the household unit. Trade policy may have some potential negative effects on the family household if, for example the benefits from higher cash crop profits are not distributed equally within the household. Women and children may be especially susceptible to exclusion from such rewards. These issues should be taken very seriously but they are beyond the scope of the present study.

Conclusions

The major issues addressed in this study are: what is the effect of further trade liberalisation on poor households in Indonesia, and is the gap between mean-income and poor households closing for different socio-economic groups and for Indonesia as a whole. Since the effect of trade policy on poverty and income distribution can operate through many transmission channels - enterprises, households and governments - a CGE model for Indonesia is used which transparently identifies the direct and indirect pro- and anti-poor influences on these channels.

The model simulates the complete removal of all tariffs and tariff-equivalent import licences. The consequences for poverty alleviation are captured through between-group analysis using the flexible beta distribution and a fixed consumption bundle of basic needs. The beta distribution shifts horizontally to capture the effect of factor price changes on income distribution for the ten different household groups. Commodity price changes, for the invariant basket of basic needs, enable the monetary poverty line to shift horizontally. The gap between poor households and the average household in each of the ten socio-economic groups is captured using basic CV welfare measures.

The results suggest that trade liberalisation reduces poverty and improves the welfare of household groups. However, wealthier households may benefit by more than poorer households, thus widening the gap between the mean and marginal households in each socio-economic group. Factor price changes are the key to understanding this result. Liberalisation does not boost the wages of low skilled workers, relative to other workers and capital owners, as many might expect, owing to the initial pattern of protection, which shelters this group.

Greater welfare gains can be made once allowance is made for imperfect competition and scale economies. Whilst only one variation of these industrial organisation features is modelled in this paper, it demonstrates potential pro-competitive effects of trade liberalisation, including falling market power and expanding output in imperfectly competitive manufacturing sectors.

Further trade liberalisation would benefit the Indonesian economy not only through more efficient use of resources and specialisation but also owing to the erosion of market power and the realization of scale economies. All households stand to gain from such policy reform, except those who perhaps benefit from quota rents under the current protection regime. However, since the model is silent on the transition from one equilibrium to another, short-term government assistance may be warranted to offset any potential negative impacts of policy change.

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Appendix Table 10A: Tariff and NTB schedule for Indonesia, 1993

Commodity	Tariff rate (%) [a]	NTB equivalent (%) [b]	Tariff + NTB protection (%)
*ManuWoodProd	9.8	33.3	43.1
*OthManu	16.3	26.5	42.8
VegFruit	11.7	27.1	38.8
*PreservFood	12.9	23.3	36.3
NonAlcBvrgs	8.4	26.0	34.5
*ManuRubbPlas	7.9	24.8	32.8
Meat	6.0	24.0	30.0
SoyOtBeans	0.6	28.9	29.5
AlcohTabac	5.5	23.2	28.7
WheatProd	1.8	25.1	26.9
Elec_Gas	25.0	0.0	25.0
*ManuMetal	6.0	18.9	24.9
SeaProduct	3.2	21.5	24.6
GroundNut	0.9	20.8	21.6
*ProcessFood	8.6	11.6	20.2
*ManuNonmetal	4.3	14.7	19.0
*CommunEquip	1.0	16.8	17.8
*Machinery	2.5	13.8	16.3
SugarConfect	1.0	13.9	14.9
*ManuElectric	4.1	10.1	14.2
*ConstrEquip	1.7	11.9	13.5
*ManuChemical	3.0	9.6	12.6
Quarrying	3.5	8.1	11.5
*ManuPaperPro	2.2	9.2	11.5
Coal	4.0	6.7	10.6
PetrlRefPr	3.3	6.6	9.9
Coconut	0.0	9.0	9.0

*Textile	2.7	5.7	8.4
NatGas_GThr	0.0	7.3	7.3
*Clothing	3.5	3.7	7.1
AnimalFeeds	1.1	5.5	6.6
*TransRepair	4.5	1.2	5.7
LivestoProd	0.5	4.0	4.5
*CarpetRope	1.9	2.1	4.1
OilPalm	3.2	0.0	3.2
RubberRaw	1.3	1.7	3.0
OthAgric	0.4	2.4	2.8
*ManuIronStee	2.0	0.0	2.0
*Rice	0.0	2.0	2.0
CassOroot	1.6	0.0	1.6
*ManuNFBM	1.5	0.0	1.5
FertPest	1.0	0.0	1.0
MetalOreMini	0.9	0.0	0.9
*KnittMills	0.9	0.0	0.9
Yarn_Kapok	0.7	0.0	0.7
AnmVgOil	0.7	0.0	0.7
Maize	0.2	0.0	0.2
*Leather	0.1	0.0	0.1
OtService	0.1	0.0	0.1
OFooFibCr	0.0	0.0	0.0
CrudeOil	0.0	0.0	0.0
Paddy	0.0	0.0	0.0
SugarCane	0.0	0.0	0.0
Tabacco	0.0	0.0	0.0
Coffee	0.0	0.0	0.0
Tea	0.0	0.0	0.0
Wood	0.0	0.0	0.0
ForestHunt	0.0	0.0	0.0

Agricservice	0.0	0.0	0.0
Copra	0.0	0.0	0.0
LiqNatGas	0.0	0.0	0.0
WaterSupply	0.0	0.0	0.0
Building	0.0	0.0	0.0
AgricConst	0.0	0.0	0.0
PublicWork	0.0	0.0	0.0
GasElConst	0.0	0.0	0.0
OConstruct	0.0	0.0	0.0
*Trade	0.0	0.0	0.0
RestHotel	0.0	0.0	0.0
*RoadRailTrav	0.0	0.0	0.0
*SeaAirTrav	0.0	0.0	0.0
*SrvcToTrans	0.0	0.0	0.0
Cmunication	0.0	0.0	0.0
BankInsur	0.0	0.0	0.0
BusiReales	0.0	0.0	0.0
GeneralGovt	0.0	0.0	0.0
GovEducation	0.0	0.0	0.0
GovHealtSrvc	0.0	0.0	0.0
OGovSrvc	0.0	0.0	0.0
PrvEdSrvc	0.0	0.0	0.0
PrvHealthSrv	0.0	0.0	0.0
OPrvSrvc	0.0	0.0	0.0
Simple Average	**2.2**	**6.1**	**8.4**

SOURCES: * indicates this firm belongs to the subset of industries which exhibit IRTS and imperfect competition features. (a) Author's Calculations from the WAYANG Database. (b) Estimates based on Fane (2001), Fane and Phillips (1991), and Wymenga (1991).

Appendix 1

The WAYANG Model of the Indonesian economy

GLYN WITTWER

WAYANG is a comparative static computable general equilibrium (CGE) model. It is a linearised model in the ORANI school (Dixon, Parmenter, Sutton and Vincent, 1982). However, WAYANG has been adapted to take account of some of the specific characteristics of a developing, largely agrarian economy (Warr, Marpudin, da Costa and Tharpa, 1998). As with other recent versions of models of this school, it uses an ORANI-G format in the model code, within the GEMPACK software used to solve the model (Harrison and Pearson 1994). Wittwer (1999) presents a detailed elaboration of WAYANG, adapted from Horridge, Parmenter and Pearson (1998).

There are 65 industries in WAYANG producing 65 commodities. WAYANG contains data and parameters to characterise six different sets of commodity sales. These are inputs to (1) production and (2) investment, sales to (3) households, (4) exports and (5) government, and (6) changes in stocks. In addition, the model includes details of production costs, including purchases of intermediate commodities, primary factors and other costs. WAYANG also includes a unique module capturing the distribution of incomes and expenditures between ten different households, who, by assumption, own all factors of production. The model contains a small fiscal extension and finally, a top-down regional disaggregation of the Indonesian economy. This appendix outlines the model by going through each of the above components systematically.

WAYANG's database

Figure A.1 is a diagram of WAYANG's input-output database. The column headings in the main part of the figure (an absorption matrix) identify the following buyers:

(1) producers divided into I industries;

(2) investors divided into I industries;

(3) ten representative households;

(4) an aggregate foreign purchaser of exports;

(5) a government demand category; and

(6) changes in inventories.

The entries in each column show the structure of the purchases made by the agents identified in the column heading. Each of the C commodity types identified in the model can be obtained locally or imported from overseas. Only domestically produced goods appear in the export column. M of the domestically produced goods are used as margins services (wholesale and retail trade, and various transport commodities). These are required to transfer commodities from their sources to their users. Each transaction includes commodity taxes. In addition to intermediate inputs, current production requires inputs of primary factors.

The 'MAKE' matrix maps industry outputs to commodities. Since all industries in WAYANG each produce a unique commodity in the present database, this is a diagonal matrix. Finally, import tariff revenues appear as a separate matrix ('V0TAR'), because we assume that tariff rates are independent of the type of buyer.

Figure A1: WAYANG's database

		Absorption Matrix					
		1	2	3	4	5	6
		Producers	Investors	Household	Export	Other	Change in Inventories
	Size	← I →	← I →	← H →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ C×S ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Margins	↑ C×S×M ↓	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	n/a
Taxes	↑ C×S ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	n/a
Labour	↑ O ↓	V1LAB					
Capital	↑ 1 ↓	V1CAP					
Land	↑ 1 ↓	V1LND					
Other Costs	↑ 1 ↓	V1OCT					

C = Number of Commodities
I = Number of Industries

S = 2: Domestic,Imported,
O = Number of Occupation Types

M = Number of Commodities used as Margins

H= Number of Households

	Joint Production Matrix
Size	← I →
↑ C ↓	MAKE

	Import Duty
Size	← 1 →
↑ C ↓	V0TAR

Structure of production

Inputs into production include domestic and imported commodities, two types of labour, land (in agricultural industries only), several types of capital (i.e., fixed in non-agricultural sectors and mobile in all sectors) and 'other costs'. In theory, WAYANG allows each industry to produce several commodities, although with the present database, all industries are single product. We keep the multi-input, output production specification manageable with a series of separability assumptions. For example, the assumption of *input-output separability* implies that the generalised production function for some industry:

$$F(\text{inputs},\text{output}) = 0 \qquad \text{(A.1)}$$

may be written as:

$$G(\text{inputs}) = X1 = H(\text{output}) \qquad \text{(A.2)}$$

where X1 is an index of industry activity. At the top level, we combine commodity composites, a primary-factor composite and 'other costs' using a Leontief or production function (i.e., all such demands are proportional to X1). Each commodity composite is a CES (constant elasticity of substitution) function of a domestic good and the imported equivalent. The primary-factor composite is either a translog or CES aggregation of the various primary factors.

The unique system of primary factor demands within WAYANG

The system of primary factor demands is the first of the model-specific features of WAYANG. It contains two different sets of primary factors, one for agricultural and the other for non-agricultural industries. In agriculture, there are four factors, land, unskilled labour, variable capital and fertiliser. In other industries, the three substitutable factors are composite labour, variable capital and fixed capital. Different types of capital are mobile between mutually exclusive subsets of industries. While only unskilled labour is used in agriculture, it is mobile between all industries. Fertiliser is treated as a primary input to recognise its substitutability with other factors of production in agriculture. In the non-agricultural subset, each industry uses specific capital in production (i.e., immobile between industries) in addition to variable capital, implying a short- to medium-run time horizon in which there is only partial capital reallocation.

A translog functional form for primary factor demands is available to utilise econometric estimates of own- and cross-price elasticities based on the translog form. In addition, the modeller has the option of using the CES form which, while more restrictive, solves more reliably than the translog form in large change simulations. The demand equations for primary factor v in industry j, for the agricultural and non-agricultural industry sets, are of the form:

$$x_{vj}^{(1)} - a_{vj} = x_{j}^{(0)} - B\left(p_{vj}^{(1)} - \sum_{m} H_{vmj}^{*} p_{mj}\right) - B\left(a_{vj}^{(1)} - \sum_{m} H_{vmj}^{*} a_{mj}\right) - (1-B)\left(p_{vj}^{(1)} + a_{vj}^{(1)} - p_{j}^{(1)}\right)$$

where $H_{vmj}^{*} = H_{mj} + \dfrac{\beta_{vmj}}{H_{vj}}$, and β_{vmj} is a matrix of estimated translog coefficients. B = 1 for the translog form and 0 for the CES form of the equation. The x terms denote percentage quantity changes, the p terms percentage price changes and the a terms denote percentage technological changes.

Demands for intermediate inputs

The Armington assumption that imports are imperfect substitutes for domestic supplies is applicable to all commodity purchases within WAYANG, including those for intermediate usage. Composite commodity (i.e., of domestic and imported origins) demands are simply proportional to industry activity, except for fertiliser used in agriculture, which is substitutable with other primary factors.

Sales to other users

Demands for investment inputs

The present version of WAYANG is static and therefore contains no linkages between year-by-year investment and accumulated capital stocks. Indeed, we usually assume in comparative static simulations that aggregate investment remains exogenous. However, total investment demands by industry may change relative to the base case, as investment in most industries is related to rates of return. Since inputs to investment are proportional to total investment by industry, such changes in investment demands imply an equivalent percentage change in input demands to investment. The Armington assumption of imperfect substitution between sources also applies.

Household demands

There are ten households in WAYANG. The total expenditures of each household are related to after-tax and after-transfer (i.e., net transfers from government and foreigners, plus transfers between households) incomes via a consumption function. A given expenditure is allocated to each commodity within the model using a Klein-Rubin function. This is of an additive functional form, implying that there is no specific substitutability between commodities. Household expenditures on each commodity are split between a subsistence or committed component, regardless of changes in incomes and prices, and a supernumerary component. The aggregate percentage change in supernumerary expenditures (weighted by marginal budget shares) provides a measure of the percentage change in household utility. The Armington assumption allocates composite commodity demands to either domestic products or imports based on changes in relative prices.

Export demands

WAYANG's exports are divided into two groups. First, *traditional* exports include mostly primary or downstream primary products. Exports account for large shares of total output for most commodities in the traditional-export category. The second group comprises *non-traditional* exports. Exports account for only small shares in total output for these commodities. Volumes of traditional exports are declining functions of their prices in foreign currency terms.

Dixon and Rimmer (2001) derive an expression relating the export demand elasticity for commodity *i* (ε_i) to the own-price elasticity of demand (η_i)

and the foreign elasticity of substitution between Indonesian and alternative sources of supply of good *i* (i.e., the Armington parameter, ϕ_i):

$$\varepsilon_i = \{\eta_i(1 - S_{0i}) \; - \; \phi_i S_{0i}\} S_{\text{fob}i}$$

where S_{0i} denotes the non-Indonesian share in foreign purchases of good *i*, and $S_{\text{fob}i}$ is the share of f.o.b price of Indonesian good *i* in its purchaser's price in foreign countries. In virtually all markets, Indonesia's share of sales is small, so S_{0i} is close to 1. If we assume a typical margin on sales in foreign countries, $S_{\text{fob}i}$ is 0.7. If the Armington parameter ϕ_i = 6, then the export demand elasticity ε_i equals about -4. Larger export demand elasticities imply larger Armington parameters that are not supported by econometric evidence.

Non-traditional exports are small and volatile, but in recent years aggregate non-traditional exports have experienced rapid growth in many countries. In WAYANG, non-traditional exports comprise a Leontief aggregate. This means that the commodity composition of non-traditional exports is exogenous. Export demands are solved via an aggregated constant elasticity of demand equation, similar to the export demand equations for individual commodities that apply to the traditional group.

Other demands

The level and composition of aggregate government consumption may be kept exogenous. In some scenarios this is, together with exogenous aggregate investment and an exogenous balance of trade (at a constant CPI), a convenient way of directing all income changes in a policy simulation to changes in household demands. Alternatively, through a change in closure, government consumption may move with real aggregate household consumption.

There is no theory in WAYANG to calculate changes in stocks of commodities. Without exogenous shifts, the percentage change in the volume of each commodity going into inventories equals the percentage change in the domestic industry's output.

Prices

Each transaction in WAYANG includes margins (retail and wholesale markups and various transport margins). In the absence of technical change, the percentage change in margins demands equal the percentage change in the volume of a commodity sold at a particular point.

The price of each transaction to the purchaser includes the basic or producer price, plus margins and taxes. Purchasers' prices in levels terms therefore differ between producers, investors, households, exports and government.

Market-clearing equations

WAYANG includes the usual market-clearing equations of single-country CGE models. That is, the domestic supply of each commodity must equal sales to producers, investors, households and governments, plus changes in inventories. Supplies must also equal demands of imported commodities.

In the treatment of households, WAYANG includes a number of additional market-clearing equations. Households own all factors of production. Therefore, the factors demanded by industries must equal household supplies of these factors.

Income distribution by households

Households own all income earning factors in the model and consequently, with each scenario we are able to observe income distribution effects by household. As already mentioned, household expenditures are tied to after-tax and after-transfer incomes by household. The ten households in the model include landless rural labourers, three groups of rural agricultural households, three rural non-agricultural households and three urban households. The landless household, for example, earns one-tenth the income per capita of the wealthiest urban household.

The small fiscal extension of WAYANG contains a number of direct (income, value-added and corporate) and indirect (business, excise, import tariff and other) taxes. Different types of taxes have different impacts on income distribution. For example, the value-added tax (VAT) applies only to non-agricultural industries, so that raising the VAT rate will impact most on these industries, and consequently impact most adversely on those households whose factor ownership is relatively high in these industries. The income tax rate, on the other hand, is imposed on each household independent of the industries in which they earn their income.

The regional module of WAYANG

WAYANG includes a 'top-down' regional module. In a 'top-down' implementation of regional disaggregation, the regional equations are simply an extension to the existing national model. This contrasts with a 'bottom-up' approach, in which every core equation has a regional dimension. This greatly complicates model modifications and is more demanding on computer memory for a given commodity disaggregation. A 'top-down' regional model misses out on some aspects of 'bottom-up' modelling. The main advantage of the 'top-down' approach is that it is relatively parsimonious in data requirements, notably obviating the need for inter-regional trade data. This approach also makes model modifications much simpler, in particular in the case where the modeller wishes to introduce dynamics to the CGE model.

The original ORANI approach, as explained in Dixon et al. (1982), and modified later in the MONASH model (Dixon, Parmenter and Rimmer, 1998), is used in WAYANG to disaggregate the model to three regions. The first step in bypassing the need for inter-regional trade data is to impose a dichotomy between regionally traded (national) goods and regionally non-traded (local) goods. Local goods are not subject to inter-regional trade. The rationale for local industries producing local commodities (i.e., regional autarky) is that in the model, the Indonesian archipelago is divided into three regions with separate islands or island clusters: Java/Bali, Sumatra and the remaining islands. The natural separation of regions by sea ensures that there are some commodities and industries that are not traded between regions.

For national commodities, we assume that the regional location of production is independent of the location of demand. Each regions' share of the economy-wide output is exogenous. In addition, the share of each commodity in user region *r* which is sourced from region *s* is the same for all *r*. The approach outlined simplifies the data requirements.

Regional WAYANG computations are decomposed into three parts. In the first part (i.e., the core of the model), the economy-wide effects of the relevant exogenous shock are computed. In the second part, the economy-wide activity levels in industries producing national commodities are allocated to regions using exogenous shares. In the third part, projections of regional outputs of local goods are computed through a system of commodity-balance equations.

We require additional data for the regional extension of WAYANG. For each industry in the three regions, we need to know the initial regional share of output and investment. And for each commodity, we need to know the regional share of national exports and the regional share of government demands. No additional data are needed to calculate the regional share of household consumption. It is assumed that the initial share of regional household consumption for all commodities is equal to the share of economy-wide labour income earned in that region multiplied by economy-wide labour income.

Regional shares for each household consumption commodity move with regional shares in labour income multiplied by the income elasticity. This appears to be the appropriate assumption in Indonesia. In an economy in which social security benefits account for a significant proportion of household income, as in Australia, movements in regional income per household would be brought closer together across regions. Hence, in the MONASH model of the Australian economy (on which the WAYANG regional extension is based), regional shares of private consumption move with regional population shares. Regional shares of exports and government spending are assumed constant at the commodity level unless exogenously changed.

WAYANG includes an intra-regional sourcing constraint on local commodities. That is, the aggregate output of any local commodity is equal to aggregate demand for the commodity within the region. And the percentage change in output of national industries in each region is set equal to the economy-wide percentage change in output. The model also calculates regional totals of wage bills, gross region products and industry contributions to changes in outputs. Finally, the model includes equations to calculate percentage changes in aggregate employment in each region and total employment by industry in each region.

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Appendix 2

The GTAP Model and database

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Introduction

The Global Trade Analysis Project (GTAP) model is a global computable general equilibrium (CGE) model[1] which has its origins in the SALTER model (Jomini et al. 1991). Since its inception in 1993, GTAP has become widely used and respected by researchers and policy-makers around the world.

In this Appendix we introduce some of the key features of the GTAP database and model, applications of which are used in a number of chapters in this book. We then explain how results from the GTAP model can be analysed and we conclude with a summary of some of the main advantages and limitations of global CGE analysis.

The GTAP database

The GTAP model and database are publicly available and fully documented; these features enhance the credibility of modelling work and facilitate comparability of analysis. The global database is updated approximately every eighteen months, with contributions coming from throughout the GTAP network of international organisations and country experts. Version 3 of the database comprises 37 commodities and 30 countries (McDougall 1997), while Version 4 of the database comprises 50 commodities and 45 regions

[1] Hertel (1997). For more-updated information on the GTAP model and database, see www.gtap.org.

(McDougall et al. 1998). In both versions, Indonesia is one of the countries specified and there is a relatively heavy disaggregation for agricultural sectors. Table A1 details the countries and regions in recent versions of the GTAP database, while Table A2 shows the commodity breakdown. To aid computation and to highlight the implications for the regions and sectors of particular interest, the GTAP database is generally aggregated to a smaller number of regions and sectors when running simulations and interpreting results.

Table A1: Country and regional disaggregation in GTAP, versions 3 and 4

Version 4		**Version 3**	
Region	Description	Region	Description
AUS	Australia	AUS	Australia
NZL	New Zealand	NZL	New Zealand
JPN	Japan	JPN	Japan
KOR	Korea	KOR	Republic of Korea
IDN	Indonesia	IDN	Indonesia
MYS	Malaysia	MYS	Malaysia
PHL	Philippines	PHL	Philippines
SGP	Singapore	SGP	Singapore
THA	Thailand	THA	Thailand
CHN	China	CHN	China
HKG	Hong Kong	HKG	Hong Kong
TWN	Taiwan	TWN	Taiwan
IND	India	IDI	India
LKA RAS	Sri Lanka Rest of South Asia	RAS	Rest of South Asia
CAN	Canada	CAN	Canada
USA	United States of America	USA	United States of America
MEX	Mexico	MEX	Mexico
CAM	Central America &	CAM	Central America &

	Caribbean		Caribbean
ARG	Argentina	ARG	Argentina
BRA	Brazil	BRA	Brazil
CHL	Chile	CHL	Chile
VEN	Venezuela	RSM	Rest of South America
COL	Colombia		
RAP	Rest of the Andean Pact		
URY	Uruguay		
RSM	Rest of South America		
GBR	United Kingdom	E_U	European Union 12
DEU	Germany		
DNK	Denmark		
REU	Rest of European Union		
SWE	Sweden	EU3	Austria, Finland, Sweden
FIN	Finland		
EFT	EFTA	EFT	European Free Trade Area
CEA	Central European Associates	CEA	Central European Associates
FSU	Former Soviet Union	FSU	Former Soviet Union
TUR	Turkey	MEA	Middle East and North
RME	Rest of Middle East		Africa
MAR	Morocco		
RNF	Rest of North Africa		
SAF	South African Customs Union	SSA	Sub Saharan Africa
RSA	Rest of southern Africa		
RSS	Rest of sub-Saharan Africa		
ROW	Rest of World	ROW	Rest of World
VNM	Viet Nam		

Table A2: Commodity disaggregation in GTAP, versions 3 and 4

Version 4		**Version 3**	
Commodity	Description	Commodity	Description
PDR	Paddy rice	PDR	Paddy rice
WHT	Wheat	WHT	Wheat
GRO	Cereal grains nec	GRO	Grains
V_F	Vegetables, fruit, nuts	NGC	Non grain crops
OSD	Oil seeds		
C_B	Sugar cane, sugar beet		
PFB	Plant-based fibres		
OCR	Crops nec		
CTL	Bovine cattle, sheep and goats, horses	OLP	Other livestock
OAP	Animal products nec		
RMK	Raw milk		
WOL	Wool, silk-worm cocoons	WOL	Wool
FOR	Forestry	FOR	Forestry
FSH	Fishing	FSH	Fisheries
COL	Coal	COL	Coal
OIL	Oil	OIL	Oil
GAS	Gas	GAS	Gas
OMN	Minerals nec	OMN	Other minerals
CMT	Bovine cattle, sheep and goat, horse meat products	MET	Meat products
OMT	Meat products nec		
MIL	Dairy products	MIL	Milk products
PCR	Processed rice	PCR	Processed rice
VOL	Vegetable oils and fats	OFP	Other food products
SGR	Sugar		
OFD	Food products nec		
B_T	Beverages and tobacco products	B_T	Beverages and tobacco

TEX	Textiles	TEX	Textiles
WAP	Wearing apparel	WAP	Wearing apparels
LEA	Leather products	LEA	Leather etc
LUM	Wood products	LUM	Lumber
PPP	Paper products, publishing	PPP	Pulp paper etc
P_C	Petroleum, coal products	P_C	Petroleum and coal
CRP	Chemical, rubber, plastic products	CRP	Chemicals, rubbers and plastics
NMM	Mineral products nec	NMM	Nonmetallic minerals
I_S	Ferrous metals	I_S	Primary ferrous metals
NFM	Metals nec	NFM	Nonferrous metals
FMP	Metal products	FMP	Fabricated metal products
MVH OTN	Motor vehicles and parts Transport equipment nec	TRN	Transport industries
ELE OME	Electronic equipment Machinery & equipment nec	OME	Machinery and equipment
OMF	Manufactures nec	OMF	Other manufacturing
ELY GDT WTR	Electricity Gas manufacture, distribution Water	EGW	Electricity water & gas
CNS	Construction	CNS	Construction
T_T	Trade, transport	T_T	Trade and transport
OSP	Financial, business, recreational services	OSP	Other services (private)
OSG	Public admin and defence, education, health	OSG	Other services (govt)
DWE	Dwellings	DWE	Ownership of dwellings

Structure of the GTAP Model

The GTAP model is large Johansen-style model that assumes optimising behaviour by firms and households, subject to the various constraints of the economy. Prices and quantities of produced commodities are endogenously determined and markets are generally assumed to clear. Households satisfy their budget constraints and firms make zero pure profits. As with most general equilibrium models, the GTAP model emphasises the structural detail of the economy. Interactions between domestic sectors and other economies are explicitly modelled.

Producers choose inputs that minimize production costs subject to separable, constant returns to scale technologies. Constant elasticity of substitution (CES) functions provide substitution possibilities between primary factors. Since substitution is possible between primary factors, industry inputs depend on both the scale effect of the level of industry output and the substitution effect of changes in relative prices of primary factors.[2] Market clearing conditions equate supply with demand for each factor of production. However for intermediate inputs, the assumption of a Leontief function implies no substitution between different intermediates or between them and a composite primary factor. This means that firms choose their optimal mix of primary factors independently of the prices of intermediate inputs.

The GTAP model has a relatively sophisticated representation of consumer demand, which is particularly important when modelling large income growth shocks (as in a number of chapters in this book). The representation of consumer demand allows for differences in both the price and income responsiveness of demand in different regions, depending upon the level of development of the region and the particular consumption patterns observed in that region. Non-homothetic preferences are captured through use of a

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[2] In the standard Version 3 of the GTAP database, three primary factors (land, labour and capital) are identified. For some of the work presented in this book we disaggregate the database to include five primary factors (land, unskilled labour, skilled labour, natural resources and capital). This five-factor split is a standard feature in Version 4 of GTAP.

constant difference of elasticities (CDE) function. This falls between the CES function that is commonly used in CGE models and fully functional forms (Hertel and Tsigas 1997). The advantage of this demand system is that non-homothetic demand can be calibrated to replicate a pre-specified vector of own-price and income elasticities of demand (Huff et al. 1997). These income elasticities can be crucial, particularly when projecting large structural changes in the economy.

The GTAP model assumes an Armington structure for imports. They are distinguished by origin and aggregated at the border. At the border, the composite import is distinguished from the domestically produced commodity and the optimal mix is determined. For imported production inputs, CES functions determine first the sourcing of imports and then, based on the resulting composite price for imports, the optimal mix of imported and domestic goods. The CES function used is homothetic in total expenditure, implying that the choice between imports and domestic production is independent of the level of income (Hertel and Tsigas 1997).[3]

Analysing simulation results

The GTAP model can be used to address a wide range of comparative-static questions. In a given economic environment that abstracts from other factors which might affect the outcome, what are the implications of a given policy change? The answer is not a forecast of the actual expected outcome; it is a conditional projection of the influence of that policy change alone. Time is not explicitly modelled in the standard GTAP model.[4] The standard GTAP model is fundamentally an equilibrium model and the proper time frame

[3] Increasing the Armington elasticities was shown to lead to more accurate simulation results in a backcasting exercise with GTAP (Gehlhar 1997). With this in mind, and following previous work on projecting with GTAP, the standard Armington elasticities are doubled in many of the GTAP applications appearing in this book.

[4] There is now a dynamic version of the GTAP model available (see www.gtap.org for further details).

to use in interpreting results is the time span that it takes for all markets to reach a new equilibrium after being hit by a shock.

Analysis of results from GTAP simulations can provide important insights into what is likely to happen to a wide range of variables including sectoral output, prices and international trade. The GTAP model is also frequently used to gauge the potential welfare implications of policy changes. Improvements in welfare can come from a number of sources including: better allocation of existing resources; more favourable terms of trade; and additional resources or improved technology. Welfare changes in GTAP simulations are typically measured by an equivalent variation (EV) in income. To assist interpretation, this measure can be decomposed into four effects: allocative efficiency effects; terms of trade effects; marginal utility of income effects; and the effects of more resources or improved technology (Huff and Hertel 1996).

Allocative efficiency gains result when resources are reallocated into areas of more efficient production. These gains (or losses) can be further decomposed to find the allocative efficiency effect attributable to a given commodity and region, which can in turn be further decomposed by tax instrument. The second effect reflects movements in the terms of trade which can be decomposed into three components: contribution of changes in world prices, contribution of changes in regional export prices and contribution of changes in regional import prices (McDougall 1993). Marginal utility of income effects are somewhat less important than the first two effects, they simply reflect non-homothetic household preferences and are driven largely by the parameters of the CDE household preference function.[5] Finally there is the welfare gain arising from better technology or increased resource availability.

[5] When policy shocks increase household utility, the proportion of income spent on inferior goods reduces, leaving more income available for all other goods and a positive effect on welfare.

Advantages and limitations of global CGE analysis

CGE modelling provides a powerful tool for simulating and analysing structural and policy changes which have economy-wide impacts. Many policy reforms such as trade liberalisation -- even if directed to just one sector -- affect other sectors of the economy, and this can only be captured in a multisectoral economy-wide model. Furthermore, most reforms are piecemeal with the impacts depending in part on remaining distortionary policies, again requiring a system-wide analysis. An important advantage of using a global model rather than a national one, even though the primary focus may be on results for Indonesia, is that the structural and policy changes of other countries can be incorporated explicitly into the modelling.

CGE modelling helps to make explicit the implications and tradeoffs of alternative courses of action: it is ideal for examining the effects of policy changes on resource allocation and it enables us to assess relative gainers and losers. Interactions between sectors and between economies are often important. Without formal modelling, it is easy to miss the many complex and often indirect effects of a policy change which empirical modelling can help to reveal. Quantitative models also enable us to examine the sensitivity of results to key behavioural assumptions and parameter values that can help us to trace the source of disagreements. Furthermore CGE models such as GTAP have a powerful capacity to incorporate new theoretical and empirical evidence as it appears, in a useable and relatively transparent manner.

Increasing levels of experience and improved computational capability have led to significant advances in CGE modelling in recent years. Models are becoming more powerful and more easily accessible; in particular, the availability of special purpose software such as General Equilibrium Modelling Package (GEMPACK) has lessened the need for programming skills. GEMPACK is a set of general-purpose software specifically designed to assist the implementation of large economic models. It is essentially an algebraic modelling language that permits the user to write out and read the model in a transparent fashion, even with no previous programming experience. All of the GTAP applications in this book are implemented and solved using GEMPACK (Harrison and Pearson 1996).

Given the inevitable data and modelling problems, results for any CGE model are not precise and this may be even more of an issue for a large global model. However, the advantage of the GTAP model and database is that users are often active contributors and researchers can collaborate to move the model and database forward. The GTAP model summarises and aggregates a huge amount of knowledge. It enables quantification of policy tradeoffs and it can facilitate better-informed policy debates. There are however large elements of subjective judgement involved in building and using models, and CGE models "are nothing more nor less than analytical tools designed to assist in reaching a better informed understanding of issues to which judgements must ultimately be applied" (Powell 1977).

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