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Partners or Predators?

The Impact of Regional Trade Liberalization on Indonesia

Jeffrey D. Lewis
Sherman Robinson

How are Indonesia and other Pacific Rim economies affected by various scenarios of regional integration and liberalization? And how is their trade affected by major realignments of international exchange rates (particularly yen/dollar movements)?

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Summary findings

Lewis and Robinson empirically assess the impact on Indonesia and other Pacific Rim economies of various regional integration and liberalization scenarios, including the completed Uruguay Round, further global liberalization, and the creation of Association of Southeast Asian Nations (ASEAN) or APEC free trade areas.

They also consider how major realignments of international exchange rates (particularly yen/dollar movements) affect the general pattern of world trade, and Indonesia in particular.

In their analysis, they use a multicountry, computable general equilibrium (CGE) model to quantify the impact of trade liberalization on countries, sectors, and factors. The extended APEC-CGE model consists of nine linked country models: Indonesia, Malaysia and Singapore (together), the Philippines, Thailand, China (including Hong Kong), Asian newly industrializing countries (Republic of Korea and Taiwan, China), Japan, the United States, and the European Union. Each country model has 12 sectors and two labor types and is linked to other countries through explicit modeling of bilateral trade flows for each traded sector.

The empirical results lead to several conclusions:

• Eliminating tariff and nontariff barriers in industrial countries — especially the phasing out of the Multifibre Agreement — gives Asian developing countries a significant opportunity to expand their exports and achieve potentially large productivity gains.

• Creation of an APEC free trade area gives participants significant benefits, with little effect on nonmembers. Creation of an ASEAN free trade area gives its members little benefit. The ASEAN countries would be better advised to work toward more liberalization under GATT or to hasten the creation of the APEC free trade area rather than to create only an ASEAN free trade area.

• All economies, including those in Asia, gain the most from further multilateral liberalization. From an economic perspective, creating a regional free trade area is consistent with a continuing pursuit of global liberalization as well.

• Major realignments of exchange rates, such as current yen/dollar movements, significantly affect bilateral trade balances and the volume and direction of world trade. But they have less effect on the sectoral structure of production and trade within countries than does trade liberalization. Sectoral protection and subsidy rates vary greatly and their elimination yields significant efficiency gains. Changes in exchange rates have less effect.

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Jeffrey D. Lewis
World Bank

Sherman Robinson
International Food Policy Research Institute

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Address comments to: Jeffrey D. Lewis, World Bank, 1818 H Street, NW, Washington, DC 20433, USA.

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1. Introduction

After two decades of relatively modest progress in the area of multilateral trade liberalization and regional trading arrangements, the last few years have witnessed a near stampede. In addition to the much-heralded conclusion of the Uruguay Round Agreement in late 1994, nearly every region of the world has established a bewildering and in some respects conflicting range of preferential trade or integration initiatives. Latin American economies have responded to implementation of NAFTA with a combination of lobbying efforts to gain similar access through NAFTA accession as well as a range of new or revitalized competing regional agreements, from the Pacto Andino in the north to Mercosur in the south. Eastern European economies scramble to affiliate with the EU, which in turn worries about whether it is preferable to "deepen" before it "broadens". Australia and New Zealand pursue implementation of their Close Economic Relation, and economies in southern Africa contemplate regional initiatives that revolve around the central role played by South Africa, emerging from isolation after almost two decades of confrontation with its neighbors.

Within East Asia, competing forces are also apparent. The commitment made in Bogor in November 1994 by the APEC countries to create an APEC free trade area by the year 2020 represents only the most recent regional integration initiative. Reconsideration of the potential role for the ASEAN group has been underway for some years, with pressures for expansion to potential new members (such as Vietnam) competing with the belief that the existing grouping needs to broaden its scope from traditional concerns with politics and security to economic issues. Several years ago plans were developed for an ASEAN Free Trade Area (AFTA) that would reduce tariffs on most products to a maximum of 5 percent among members by 2008. The pressure of events resulted in an ASEAN decision to broaden the scope and accelerate the timetable, with major reforms due to be completed by 2003.

This trend towards regional integration and liberalization represents an important shift in international policy. Only a decade ago, the conventional wisdom was that the scope for successful regional free trade initiatives was relatively limited, a conclusion supported by an international landscape littered with attempts that had fallen short of their original lofty goals. But any conclusion that this trend represents the final triumph of free trade doctrines over insularity and protectionism must be viewed with suspicion. Many recent initiatives seem motivated more by fear of being left behind by one's competitors than by any conviction that the benefits of liberalization or greater integration outweigh the costs. The proliferation of regional agreements has also raised concerns that the world trading system will separate into exclusive blocks.[1] NAFTA has set off a scramble in the Western Hemisphere among those not yet included, and has

* The authors acknowledge the assistance of Tom Hertel, Glenn Harrison, Will Martin, and Zhi Wang in preparing the data used in the paper.

[1] Hughes Hallett and Primo Braga (1994) assess the implications of increased regionalism on progress towards a more liberal trade order, and conclude that regional arrangements are unlikely to work as building blocs towards a "perfect" GATT. Instead, they argue that the best approach for developing countries threatened by the growing strength of regional arrangements is to encourage and strengthen the multilateral trade system, particularly the emerging WTO. Empirical work to date on the implications of regional arrangements does not, however, support this pessimistic view of their impact.

given rise to fears in Asia over its potential trade diversion (although most empirical estimates suggest that the losses would be small).[2] There is also disagreement within APEC over whether future liberalization should apply to non-members (such as the EU).

There is some basis for the concerns voiced by those who view the process as one of "join or be left behind." The increasing globalization and integration of world markets has generated powerful pressures for change, particularly as more and more regions abandon inward-looking policies and look outward for growth and markets. While a development strategy hinging on import substitution and investment controls once provided insulation (albeit costly) from international economic pressures, the environment has changed. Today, with massive (and, as the Mexican experience has shown, fickle) foreign capital flows, and increasing competitive pressures in export markets, it is not enough for countries simply to make progress towards a more open trade and investment regime--exporting economies must devote equal attention to what their competitors are doing.

For East Asia, the region that has benefitted the most from the rapid expansion in world trade over the last quarter century, this means that those economies must run faster just to stay in place. The orderly passing of the mantle of export-led growth from Japan to the Asian "tigers" and then to the next tier has been supplanted by a more chaotic scramble for advantage in an increasingly competitive world. The response to domestic and trade policy liberalization for one country in Asia depends not only on its own actions, but also on what other countries do as well. The impact on the region of China's resurgence, potential competition from Vietnam, and increased private foreign investment flows affect regional policies (such as the ASEAN decision to accelerate its free trade area timetable) as well as national policies (such as income tax reform in Indonesia or infrastructure financing in China).

Concern over the policy environment in competitor countries may create momentum towards a self-fulfilling or virtuous circle of liberalization, which is far preferable to the more destructive circle of protectionism and trade wars. In Indonesia, the public rationale for reform packages in the last year that have lowered corporate taxes and diluted foreign ownership restrictions has made specific comparisons to the corresponding policy environment in other Asian economies. But these competitive pressures can also serve to increase exclusionary pressures or encourage strategic behavior that benefit one country at the expense of the broader region.[3] In East Asia, these pressures play a role in the debate over the proper role of APEC, the ongoing negotiation over the pre-requisites for and timing of China's admission to the WTO, efforts to maintain a separate role for ASEAN, and even some suggestions that any Asian free trade arrangement should exclude the United States.

The political economy of the reform process generates further pressures on reform-oriented policymakers. Whether unilateral, regional, or multilateral in origin, structural changes associated with trade liberalization creates losers among a vocal and often quite powerful group of domestic interest groups. Failure to identify the winners and quantify the gains frequently means that reform efforts fail, and policymakers are well aware that there is only a limited public tolerance before reform "fatigue"

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[2] Using partial equilibrium and gravity flow trade models, Primo Braga, Safadi, and Yeats (1994) estimate that total NAFTA-induced trade diversion losses could cost East Asian economies around $380-700 million, concentrated largely in sectors where high U.S. trade barriers exist. But as they point out, these losses are less than 1 percent of the gains that are expected to accrue to this region from successful implementation of the Uruguay Round Agreement.

[3] For example, Hinojosa-Ojeda, Lewis, and Robinson (1995) analyze the potential for welfare-reducing "prisoner's dilemma" outcomes in an analysis of regional integration options for Central America and the Caribbean after NAFTA.

sets in. In this context, it is important to distinguish initiatives that promise large gains to the economy from those that offer relatively little. For example, will Indonesia gain more from implementation of a preferential ASEAN free trade area, or from future extension of the multilateral tariff cuts undertaken in the Uruguay Round?

This paper offers a preliminary empirical assessment of the impact on Indonesia of alternative regional integration and liberalization opportunities:

(1) What is the impact of the Uruguay Round on trade, welfare, and economic structure in Indonesia and the other Pacific Rim economies?

(2) What are the likely gains from future initiatives, such as implementation of an ASEAN free trade area or further multilateral liberalization along the lines of the Uruguay Round?

(3) How do major realignments in international exchange rates (particularly yen-dollar movements) affect Indonesia and the general pattern of trade and growth?

We approach these questions using a multi-country, computable general equilibrium (CGE) model to analyze the impact of trade liberalization on countries, sectors, and factors.[4] Our extended APEC-CGE model consists of nine linked country models: Indonesia, Thailand, Philippines, Malaysia and Singapore (together), China (including Hong Kong), Asian NICs (Korea and Taiwan), the US, Japan, and the EU.[5] Each country model has twelve sectors and two labor types, and is linked to other countries through explicit modeling of bilateral trade flows for each traded sector.

We use the model to simulate a series of alternative scenarios, starting with the impact on Indonesia and other APEC economies of the Uruguay Round Agreement, based on detailed country tariff schedules prepared by the GATT that reflect the specific commitments on tariff reduction and bindings made during the Uruguay Round negotations. We also analyze scenarios illustrating the effects of additional multilateral liberalization, the implementation of an ASEAN FTA, and the eventual completion of an APEC FTA. Finally, we assess the implications for Indonesia of a substantial realignment in the real yen-dollar exchange rate under different assumptions regarding Indonesia's exchange rate policy response.

The next section provides an overview of the economic structure, trade linkages, and protection structure among countries in the APEC region, while also introducing the data used in our model. Section three presents the main features of our APEC-CGE model. Section four presents the empirical results, and section five presents conclusions. An appendix contains a complete description of the model.

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[4] An earlier version of this model (with six regions and ten sectors) was used to analyze the impact of an APEC FTA on regional economies, and assess the costs of excluding individual APEC members from the FTA. See Lewis, Robinson, and Wang (1995).

[5] Our APEC model does not include all current members of APEC, of which there are now eighteen. Excluded from our model are the industrial economies of Australia, New Zealand, and Canada, the small Pacific economies of Brunei and Papua New Guinea, and Mexico and Chile in Latin America.

Table 1: Factor Endowment, Income Shares, Factor Intensity, and Trade Dependence in APEC Model Regions

	Indonesia	Thailand	Philippines	Singapore & Malaysia	China	Korea & Taiwan	Japan	USA	EU
GDP and Trade Flows (billion US$):									
Exports	39.5	37.6	17.2	105.9	141.2	195.1	411.5	576.5	732.0
Imports	32.7	43.9	17.1	104.6	157.2	164.2	322.5	618.6	770.2
GDP	129.5	108.3	54.4	102.3	519.9	517.9	3694.2	5898.4	6680.4
Trade Dependence (percent):									
Export/GDP	30.5	34.7	31.6	103.6	27.2	37.7	11.1	9.8	11.0
Import/GDP	25.3	40.5	31.5	102.3	30.2	31.7	8.7	10.5	11.5
Factor Share in APEC Region Value Added (percent):									
Land	13.6	4.9	7.5	6.5	9.8	4.6	1.2	1.6	0.8
Labor	28.9	21.5	41.6	39.1	53.2	53.1	58.8	64.7	65.6
Capital	57.5	73.6	50.9	54.4	37.0	42.3	40.0	33.7	33.7
Labor Cost (thousand $):									
Average wage	0.5	0.6	0.8	3.8	0.3	8.5	31.3	27.9	26.8
Average agri. wage	0.2	0.1	0.5	0.8	0.2	3.9	18.4	14.5	19.9
Average non-agri. wage	0.7	1.5	1.1	4.9	0.6	9.6	32.1	28.2	27.2
Capital Return (percent):									
Average capital rental	30.4	26.1	16.3	15.8	11.4	18.4	11.2	11.8	10.6
Factor Proportions:									
Agri. labor/total labor (percent)	46.7	63.0	45.9	25.9	65.7	19.4	5.8	2.1	5.5
Capital/labor ratio ($000/worker)	3.0	8.1	6.1	33.8	1.9	37.0	190.1	123.5	130.0
Rental/wage ratio (percent/$000)	65.6	42.3	20.0	4.1	36.9	2.2	0.4	0.4	0.4

Source: APEC model database derived from GTAP data (Hertel, 1996)

2. Economic Structure and Trade Patterns in APEC Economies

Our APEC model is constructed around a nine-region, twelve-sector, four-factor, Social Accounting Matrix estimated for the year 1992.[6] This section outlines the structure of production, demand, income, taxation and trade patterns in the base year for each economic region included in the model, and briefly describes the patterns of protection among the relevant regions.[7]

Table 1 presents data on factor endowments, intensities, and costs for the regions included in the model, and indicates the enormous differences in size, role of trade, factor endowments and factor cost among these regions. Low-income APEC economies (Indonesia, Thailand, Philippines, and China) as well as Korea & Taiwan exhibit broad similarities: exports and imports represent around 25-35 percent of GDP, Singapore & Malaysia have trade shares over 100 percent, and the much larger OECD economies (Japan, US, and EU) depend on trade for only around 10 percent of GDP. The low-income developing countries are more poorly endowed with capital relative to labor: capital-labor ratios are lower, the share of agriculture labor in the total labor force remains around one half, and the rental-wage ratio is much higher. The pattern is reversed for Japan, the European Union, and the United States, while Korea & Taiwan and Singapore & Malaysia fall between the advanced industrial countries and the poorer Asian developing countries. Their agricultural labor share is larger than that of the industrial economies, but is much smaller than that in China and ASEAN4. Compared to Japan, the European Community, and the United States, they have a lower capital intensity and a higher relative capital-labor price.

International trade theory generally identifies two different types of international trade. Trade among developed industrial countries with similar endowments and technology is largely "intra-industry," with high exports and imports within sectors, whereas trade between high and low-income economies (with very different factor endowments and technological processes) is largely inter-industry, with more sectoral specialization.[8] With a tremendous range in factor endowments and income levels among the APEC economies, there is ample scope for Heckscher-Ohlin forces (based on different factor endowments) to influence trade.

Table 2 presents the share of each region's exports and imports in total world trade from the base data used in the model. The OECD economies dominate the machinery and equipment sector, while China and Korea & Taiwan are major participants in the textiles and apparel sectors (along with the EU). The export market shares for manufactured goods in developing ASEAN economies indicate that Indonesia has significant shares only for textiles and apparel (around 4 percent) and wood and paper (5 percent), while Thailand is best represented in the food processing, apparel, and othe light manufactured sectors.

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[6] The data set is drawn primarily from the GTAP 1992 dataset, version 2, which is described in Hertel (1996).

[7] For model regions that are made up of more than one national economy (Korea & Taiwan, Singapore & Malaysia, China, and EU), all figures on exports and imports reported in these tables (and used in the model) refer to trade with economies *outside* that region, and thus exclude trade that occurs among members of the same region. In constructing the regional data sets, this "within region" trade is netted out and treated as another source of domestic demand. Thus care must be taken in comparing trade shares and structure with other published sources on regional trade flows that do not adjust for intra-regional trade.

[8] "Intra-industry" in this context refers to the two-way trade between industries which produce commodities that are similar in input requirements and highly substitutable in use, such as similar televisions manufactured by different producers.

Table 2: Sectoral Export and Import Shares in World Trade
(Percent)

	Indonesia	Thailand	Philippines	Singapore & Malaysia	China	Korea & Taiwan	Japan	USA	EU	Rest of World	Total
Shares in World Exports:											
Grains	0.1	6.4	0.0	0.0	7.4	0.2	0.0	54.0	10.6	21.1	100.0
Other Agriculture	3.5	3.5	1.0	1.9	6.1	3.7	0.5	21.6	9.7	48.4	100.0
Forestry & Fishery	3.6	5.9	1.2	7.9	4.7	7.5	1.8	17.1	5.4	45.0	100.0
Energy & Minerals	5.0	0.5	0.3	1.9	2.4	0.2	0.4	3.9	6.1	79.3	100.0
Food Processing	1.4	3.6	1.1	4.7	4.1	2.8	1.3	19.8	29.5	31.6	100.0
Textiles	3.6	1.7	0.2	1.5	10.2	20.6	10.3	9.3	22.4	20.2	100.0
Apparel	3.5	3.8	2.1	3.1	28.5	10.1	0.8	4.4	13.4	30.4	100.0
Other Light Manufact.	1.7	2.8	0.6	3.3	17.7	16.2	16.4	10.1	17.7	13.5	100.0
Wood & Paper	4.5	0.7	0.5	3.5	2.4	3.9	3.0	18.9	17.4	45.2	100.0
Basic Intermediates	1.0	0.5	0.3	3.8	2.6	5.4	10.3	17.3	27.9	31.0	100.0
Machinery & Equipment	0.2	0.8	0.3	4.1	2.6	7.0	23.8	22.7	23.4	15.1	100.0
Services	0.4	0.8	0.7	2.4	2.8	4.4	8.7	17.9	27.5	34.5	100.0
Total	1.2	1.2	0.5	3.3	4.4	6.0	12.8	17.9	22.7	30.1	100.0
Shares in World Imports:											
Grains	2.9	0.7	1.3	3.3	9.9	9.3	20.0	2.5	5.9	44.1	100.0
Other Agriculture	1.5	1.4	0.3	2.5	4.8	7.7	14.0	14.0	37.5	16.3	100.0
Forestry & Fishery	0.1	3.7	0.3	1.7	4.0	5.2	41.6	14.8	21.9	6.8	100.0
Energy & Minerals	0.6	1.4	0.9	2.8	2.2	6.3	21.3	22.0	36.0	6.4	100.0
Food Processing	0.7	0.9	0.9	3.0	5.2	4.0	15.8	15.2	22.5	31.9	100.0
Textiles	1.8	1.7	1.3	4.9	16.1	5.1	5.8	10.6	19.4	33.4	100.0
Apparel	0.0	0.0	0.0	0.9	1.3	0.7	10.2	32.4	33.4	20.9	100.0
Other Light Manufact.	0.5	0.8	0.2	3.0	5.8	2.6	8.1	31.6	25.4	21.9	100.0
Wood & Paper	0.6	1.1	0.3	1.7	4.2	3.8	9.6	20.6	33.2	25.0	100.0
Basic Intermediates	1.7	2.6	0.8	4.1	6.9	7.3	8.9	17.0	20.6	30.0	100.0
Machinery & Equipment	1.3	1.8	0.6	4.4	5.5	5.5	4.3	23.6	19.8	33.3	100.0
Services	0.6	0.5	0.3	2.0	3.0	4.1	12.8	12.5	24.8	39.5	100.0
Total	1.0	1.4	0.5	3.2	4.9	5.1	10.0	19.2	23.9	30.9	100.0

Note: Calculated from APEC model data base derived from GTAP data (Hertel, 1996).

Aggregation of individual economies into regions for use in the model involved netting out trade among the combined economies, so that these data will not match data from other statistical sources on world trade volumes.[9] Overall, trade among the APEC regions in the model accounts for 70 percent of total trade, with the rest of the world representing the rest.

Data presented in Table 3 also reveal sizeable differences in structure and international comparative advantage among ASEAN, China, the Asian NICs, and industrial countries such as Japan, the United States, and the European Union. ASEAN developing economies and China are more primary-intensive than the industrial countries, and their manufacturing sectors, especially the labor-intensive textile and apparel products, are relatively larger than in the advanced countries (with a smaller service sector). Japan, the European Union, and the United States are dominated by a large service sector and sizeable intermediate and capital goods sectors. These three sectors account for 85-90 percent of output and value added in these economies, as compared to only around 60 percent in the ASEAN economies (and even less in China).

Trade shares are consistent with intuition about international comparative advantage. For example, labor-intensive textiles and apparel constitute 24 percent of China's total exports, 15 percent for Indonesia, and 12 percent for Thailand and Philippines. Capital and skill-intensive machinery and equipment in turn make up 37-43 percent of total imports for these same economies. The pattern is reversed for Japan and the United States; more than 90 percent of Japanese exports occur in the intermediate, capital good, and service sectors. Korea and Taiwan are in between, with a lower textile export share but a much higher machinery export share than China and ASEAN, but a higher textile export share and a lower machinery and equipment export share than Japan and the United States.

Singapore & Malaysia has the highest trade dependence, importing and exporting nearly 40 percent of total output. The exports/output and imports/absorption ratios for this amalgamated economy provide a striking illustration of the empirical importance of two-way trade: in nine of twelve sectors, Singapore & Malaysia export more than one-third of sectoral output; in six of these nine export sectors, they also import more than one-third of total demand. Fifteen years of market-oriented economic reform have also led China to become more strongly linked with the world economy, especially in manufacturing products. In 1992, China (including Hong Kong) exported more than one-half of its labor-intensive apparel and light manufacturing output, and imported one-third of its machinery and equipment from abroad. The United States and Japan are relatively more self-sufficient, although Japan's poor natural resource base leads it to rely on other countries for nearly half of its total mineral and energy use, while it exported nearly one-fourth of its total machinery and equipment production to foreign markets. Although the United State has relatively low trade dependency, at the sectoral level it exports significant shares of light manufacturing and capital goods output, and imports large amounts of apparel, machinery and equipment, and energy and mineral products.

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[9] For example, the figures for China exclude the enormous trade flows between China and Hong Kong; similarly, the rest of world figures include only trade between the rest of world and other regions in our model, not among the many countries lumped together in our rest of world aggregate.

Table 3: Structure of Production, Factor Income, Demand and Trade Patterns for APEC Regions: 1992

	Sectoral Composition (percent)					Ratios (percent)		Factor Composition of Value Added (percent)			
	Output (1)	Value added (2)	Final demand (3)	Imports (4)	Exports (5)	Exports/ Output (6)	Imports/ Absorption (7)	Land (8)	Labor (9)	Capital (10)	Total (11)
Indonesia											
Grains	7.8	7.2	8.0	1.9	0.0	0.1	3.4	31.7	22.2	46.1	100.0
Other Agriculture	7.8	11.8	6.7	2.8	5.7	12.8	5.5	38.7	19.4	41.9	100.0
Forestry & Fishery	2.9	4.4	1.7	0.1	2.9	17.6	0.7		16.6	83.4	100.0
Energy & Minerals	7.8	12.3	0.0	4.3	29.5	65.8	19.0	54.1	9.9	36.0	100.0
Food Processing	5.1	2.1	7.3	2.5	4.1	13.7	7.3		25.2	74.8	100.0
Textiles	4.7	1.5	0.7	4.2	7.0	24.7	13.7		32.6	67.4	100.0
Apparel	1.1	0.3	0.2	0.0	8.1	90.4	9.9		50.2	49.8	100.0
Other Light Manufacturing	1.3	0.8	0.6	2.3	6.2	80.6	50.9		27.5	72.5	100.0
Wood & Paper	3.8	2.7	0.7	2.1	12.9	58.4	15.8		25.0	75.0	100.0
Basic Intermediates	8.8	7.0	2.8	21.6	10.5	20.8	30.2		13.8	86.2	100.0
Machinery & Equipment	3.8	2.1	10.8	41.3	5.0	23.0	60.4		29.9	70.1	100.0
Services	45.0	47.6	60.4	16.8	8.1	3.1	5.3		40.8	59.2	100.0
Total	100.0	100.0	100.0	100.0	100.0	16.9	14.5	13.6	28.9	57.5	100.0
Thailand											
Grains	4.0	4.3	1.4	0.4	3.7	17.1	2.2	26.8	11.7	61.5	100.0
Other Agriculture	5.3	6.8	3.3	2.1	5.9	20.7	9.3	28.6	14.7	56.7	100.0
Forestry & Fishery	2.4	3.5	1.9	2.7	5.1	38.9	25.8		13.2	86.8	100.0
Energy & Minerals	2.2	3.4	0.0	7.5	3.1	25.7	45.3	53.0	11.7	35.3	100.0
Food Processing	9.2	6.2	9.0	2.3	10.5	21.2	6.2		15.1	84.9	100.0
Textiles	4.4	2.6	1.0	2.9	3.4	13.6	13.2		20.3	79.7	100.0
Apparel	4.0	2.3	4.0	0.0	9.2	35.4	0.7		34.8	65.2	100.0
Other Light Manufacturing	2.9	3.0	1.6	2.5	10.4	65.5	29.9		14.2	85.8	100.0
Wood & Paper	2.4	1.8	1.0	2.7	2.2	17.0	21.4		20.7	79.3	100.0
Basic Intermediates	7.9	4.7	3.1	24.1	5.4	12.6	38.5		13.4	86.6	100.0
Machinery & Equipment	7.2	4.9	20.6	43.1	22.9	59.0	58.4		24.6	75.4	100.0
Services	47.8	56.5	53.1	9.6	18.2	7.1	4.5		25.3	74.7	100.0
Total	100.0	100.0	100.0	100.0	100.0	18.3	19.7	4.9	21.5	73.6	100.0
Philippines											
Grains	6.7	6.5	4.1	1.6	0.0	0.2	4.0	35.6	52.2	12.2	100.0
Other Agriculture	8.1	11.2	5.3	1.1	3.7	8.1	2.4	41.0	55.0	4.0	100.0
Forestry & Fishery	4.9	7.1	5.1	0.6	2.2	8.0	2.2		33.0	67.0	100.0
Energy & Minerals	1.3	1.3	0.3	12.7	3.5	45.5	69.6	39.9	33.3	26.7	100.0
Food Processing	13.5	9.4	17.6	5.6	7.4	9.6	7.3		32.4	67.6	100.0
Textiles	1.2	0.7	0.7	6.0	0.9	12.2	41.2		41.6	58.4	100.0
Apparel	2.0	1.1	1.2	0.5	11.1	70.8	11.7		61.0	39.0	100.0
Other Light Manufacturing	1.1	0.8	0.6	2.0	4.9	80.3	50.8		48.0	52.0	100.0
Wood & Paper	2.3	1.4	1.0	2.0	3.2	23.6	15.8		42.5	57.5	100.0
Basic Intermediates	8.5	3.4	3.5	18.2	6.1	12.7	28.4		27.5	72.5	100.0
Machinery & Equipment	5.0	2.1	8.7	37.2	21.7	75.5	70.8		44.4	55.6	100.0
Services	45.3	55.0	51.8	12.6	35.2	13.6	5.3		40.7	59.3	100.0
Total	100.0	100.0	100.0	100.0	100.0	17.0	16.8	7.5	41.6	50.9	100.0

Table 3 (continued)

	Sectoral Composition (percent)					Ratios (percent)		Factor Composition of Value Added (percent)			
	Output (1)	Value added (2)	Final demand (3)	Imports (4)	Exports (5)	Exports/ Output (6)	Imports/ Absorption (7)	Land (8)	Labor (9)	Capital (10)	Total (11)
Singapore and Malaysia											
Grains	1.7	2.7	1.6	0.7	0.0	0.0	13.5	35.5	21.7	42.8	100.0
Other Agriculture	2.3	4.2	2.8	1.6	1.1	16.6	24.3	36.5	22.4	41.1	100.0
Forestry & Fishery	2.0	4.6	1.3	0.5	2.4	44.3	15.3		15.3	84.7	100.0
Energy & Minerals	3.3	7.2	0.2	6.4	4.3	47.6	59.5	55.2	8.0	36.8	100.0
Food Processing	4.9	2.0	5.9	3.2	4.9	37.7	29.0		27.8	72.2	100.0
Textiles	0.9	0.3	2.1	3.6	1.1	47.7	72.2		63.2	36.8	100.0
Apparel	1.2	0.6	1.1	0.8	2.7	61.9	39.8		53.2	46.8	100.0
Other Light Manufacturing	2.6	1.2	2.2	4.0	4.4	66.3	62.4		33.2	66.8	100.0
Wood & Paper	3.3	3.0	1.4	1.8	3.7	42.8	27.3		51.6	48.4	100.0
Basic Intermediates	11.3	8.6	4.7	15.8	14.5	50.3	51.5		21.2	78.8	100.0
Machinery & Equipment	26.2	12.8	20.5	45.7	41.9	63.6	64.1		42.6	57.4	100.0
Services	40.2	52.8	56.1	16.0	19.0	18.6	16.2		49.3	50.7	100.0
Total	100.0	100.0	100.0	100.0	100.0	38.9	38.9	6.5	39.1	54.4	100.0
China											
Grains	7.6	12.1	7.7	1.4	1.1	1.8	2.4	27.9	58.2	14.0	100.0
Other Agriculture	9.3	17.0	11.2	1.9	2.8	3.7	2.9	29.0	59.0	12.0	100.0
Forestry & Fishery	1.9	3.4	1.8	0.8	1.1	7.1	6.0		80.7	19.3	100.0
Energy & Minerals	2.6	3.9	0.4	3.4	3.9	18.1	17.3	39.4	34.4	26.2	100.0
Food Processing	5.6	2.6	8.5	3.7	3.2	7.0	8.8		24.4	75.6	100.0
Textiles	5.8	2.7	4.0	7.9	5.6	11.0	16.6		42.5	57.5	100.0
Apparel	3.5	1.9	2.8	0.8	18.5	53.7	6.0		54.6	45.4	100.0
Other Light Manufacturing	4.0	2.3	2.6	5.2	17.5	53.6	26.7		46.8	53.2	100.0
Wood & Paper	2.7	1.8	1.3	3.0	1.9	8.7	14.0		45.9	54.1	100.0
Basic Intermediates	13.0	8.2	2.7	17.9	7.4	7.0	16.6		32.5	67.5	100.0
Machinery & Equipment	12.4	7.2	15.8	37.6	19.9	19.7	32.6		43.0	57.0	100.0
Services	31.6	36.9	41.2	16.4	17.0	6.6	7.1		58.3	41.7	100.0
Total	100.0	100.0	100.0	100.0	100.0	11.8	13.3	9.8	53.2	37.0	100.0
Korea and Taiwan											
Grains	2.3	3.5	1.8	1.2	0.0	0.1	5.6	47.2	42.3	10.5	100.0
Other Agriculture	3.5	5.5	2.9	3.0	1.2	5.8	10.4	46.0	45.3	8.8	100.0
Forestry & Fishery	1.2	2.0	1.2	1.0	1.2	17.7	12.9		46.4	53.6	100.0
Energy & Minerals	1.5	2.0	0.5	9.0	0.2	2.5	46.1	28.0	53.3	18.7	100.0
Food Processing	6.7	2.1	11.0	2.7	1.6	4.0	5.5		51.7	48.3	100.0
Textiles	3.6	1.8	0.5	2.4	8.1	36.7	12.4		51.9	48.1	100.0
Apparel	1.4	0.8	1.6	0.4	4.7	48.2	6.7		73.6	26.4	100.0
Other Light Manufacturing	2.7	1.9	0.8	2.3	11.7	70.6	27.2		66.5	33.5	100.0
Wood & Paper	3.0	2.2	1.0	2.7	2.3	12.5	12.2		58.5	41.5	100.0
Basic Intermediates	17.2	10.6	2.2	18.2	11.3	10.9	14.0		37.5	62.5	100.0
Machinery & Equipment	15.2	9.8	15.0	36.1	38.5	42.1	34.7		58.3	41.7	100.0
Services	41.6	57.8	61.3	21.1	19.1	7.6	7.1		55.8	44.2	100.0
Total	100.0	100.0	100.0	100.0	100.0	16.5	14.1	4.6	53.1	42.3	100.0

Table 3 (continued)

	Sectoral Composition (percent)					Ratios (percent)		Factor Composition of Value Added (percent)			
	Output (1)	Value added (2)	Final demand (3)	Imports (4)	Exports (5)	Exports/ Output (6)	Imports/ Absorption (7)	Land (8)	Labor (9)	Capital (10)	Total (11)
Japan											
Grains	1.3	1.4	0.7	1.3	0.0	0.0	4.0	29.5	50.0	20.5	100.0
Other Agriculture	1.3	1.8	0.8	2.8	0.0	0.4	8.6	29.9	49.8	20.3	100.0
Forestry & Fishery	0.7	0.8	0.3	4.2	0.1	1.1	20.6		54.7	45.3	100.0
Energy & Minerals	0.8	0.8	0.0	15.5	0.2	1.8	48.0	32.2	46.5	21.3	100.0
Food Processing	5.6	2.4	7.8	5.5	0.4	0.4	4.2		56.6	43.4	100.0
Textiles	1.0	0.6	0.4	1.4	1.9	11.2	6.6		73.5	26.5	100.0
Apparel	0.9	0.5	1.8	2.9	0.2	1.2	12.5		76.9	23.1	100.0
Other Light Manufacturing	1.1	0.8	1.2	3.5	5.6	30.3	17.5		61.8	38.2	100.0
Wood & Paper	3.7	2.7	1.2	3.4	0.8	1.3	4.1		67.0	33.0	100.0
Basic Intermediates	10.5	6.5	2.2	11.3	10.2	5.7	4.8		47.1	52.9	100.0
Machinery & Equipment	15.7	12.3	14.9	14.4	62.3	23.2	5.1		59.1	40.9	100.0
Services	57.3	69.3	68.7	33.9	18.1	1.9	2.7		59.9	40.1	100.0
Total	100.0	100.0	100.0	100.0	100.0	5.9	4.6	1.2	58.8	40.0	100.0
United States											
Grains	0.5	0.5	0.0	0.0	2.0	22.9	1.3	19.6	38.3	42.1	100.0
Other Agriculture	1.6	1.1	0.5	1.4	2.4	8.6	5.6	20.0	38.0	41.9	100.0
Forestry & Fishery	0.4	0.3	0.0	0.8	1.0	15.4	13.6		42.1	57.9	100.0
Energy & Minerals	2.4	2.8	0.0	8.4	1.6	3.9	18.4	44.8	25.3	29.9	100.0
Food Processing	4.4	2.3	5.2	2.7	3.8	5.0	3.8		51.0	49.0	100.0
Textiles	0.8	0.5	0.4	1.3	1.2	9.2	10.3		78.6	21.4	100.0
Apparel	0.7	0.5	1.5	4.8	0.7	6.0	30.0		82.4	17.6	100.0
Other Light Manufacturing	0.5	0.4	1.1	7.2	2.4	27.6	52.3		63.8	36.2	100.0
Wood & Paper	3.9	3.1	1.9	3.8	3.7	5.5	5.9		69.8	30.2	100.0
Basic Intermediates	8.8	5.1	4.4	11.2	12.2	7.9	7.8		69.5	30.5	100.0
Machinery & Equipment	11.0	9.0	11.2	41.0	42.4	22.1	22.2		78.4	21.6	100.0
Services	65.1	74.4	73.6	17.3	26.5	2.3	1.6		64.9	35.1	100.0
Total	100.0	100.0	100.0	100.0	100.0	5.7	6.1	1.6	64.7	33.7	100.0
European Union											
Grains	0.7	0.6	0.2	0.2	0.3	9.3	1.8	10.6	67.7	21.7	100.0
Other Agriculture	2.7	3.2	0.9	3.1	0.8	2.5	7.2	11.0	68.0	21.0	100.0
Forestry & Fishery	0.4	0.4	0.2	0.9	0.2	3.7	13.6		26.9	73.1	100.0
Energy & Minerals	3.4	1.9	0.2	11.0	2.0	3.6	18.5	18.5	69.2	12.3	100.0
Food Processing	6.9	4.1	8.1	3.3	4.5	4.8	3.2		58.8	41.2	100.0
Textiles	1.7	1.2	1.7	1.9	2.4	8.8	7.7		76.2	23.8	100.0
Apparel	0.7	0.5	0.9	4.0	1.7	15.4	30.0		76.2	23.8	100.0
Other Light Manufacturing	0.8	0.6	1.2	4.6	3.4	26.6	33.6		74.2	25.8	100.0
Wood & Paper	3.6	2.4	1.9	4.9	2.7	4.9	8.9		70.7	29.3	100.0
Basic Intermediates	10.2	7.7	4.0	10.9	15.5	9.4	7.4		47.5	52.5	100.0
Machinery & Equipment	11.1	8.7	9.8	27.7	34.4	20.0	17.3		79.6	20.4	100.0
Services	57.7	68.8	70.9	27.5	32.1	3.6	3.3		65.7	34.3	100.0
Total	100.0	100.0	100.0	100.0	100.0	6.5	6.8	0.8	65.6	33.7	100.0

Table 4: Sectoral Exports, Imports, and Net Trade Flows and Trade Dependence in APEC Model Regions
(Billion US$)

	Indonesia	Thailand	Philippines	Singapore & Malaysia	China	Korea & Taiwan	Japan	USA	EU
Exports:									
Grains	0.03	1.39	0.01	0.0	1.61	0.04	0.0	11.70	2.30
Other Agriculture	2.25	2.23	0.64	1.19	3.90	2.39	0.34	13.81	6.18
Forestry & Fishery	1.17	1.90	0.38	2.56	1.52	2.42	0.58	5.51	1.73
Energy & Minerals	11.64	1.17	0.60	4.57	5.53	0.43	0.96	9.27	14.37
Food Processing	1.60	3.97	1.27	5.21	4.52	3.17	1.47	22.17	32.99
Textiles	2.75	1.28	0.15	1.18	7.83	15.98	7.98	7.08	17.24
Apparel	3.14	3.48	1.93	2.91	26.12	9.36	0.74	4.03	12.27
Other Light Manufacturing	2.45	3.91	0.84	4.63	24.78	22.78	22.97	14.12	24.89
Wood & Paper	5.09	0.83	0.54	3.96	2.73	4.47	3.46	21.54	19.80
Basic Intermediates	4.17	2.02	1.05	15.39	10.52	22.01	41.96	70.29	113.49
Machinery & Equipment	1.99	8.63	3.72	44.29	28.14	75.07	256.43	244.44	251.92
Services	3.19	6.86	6.04	20.09	24.08	37.22	74.67	152.56	234.83
Total	39.46	37.67	17.19	105.97	141.27	195.34	411.58	576.51	732.01
Imports:									
Grains	0.62	0.15	0.28	0.71	2.15	2.02	4.34	0.55	1.28
Other Agriculture	0.93	0.92	0.18	1.63	3.05	4.92	8.92	8.96	23.94
Forestry & Fishery	0.04	1.20	0.10	0.54	1.27	1.68	13.42	4.76	7.06
Energy & Minerals	1.42	3.29	2.18	6.66	5.28	14.71	49.97	51.68	84.70
Food Processing	0.81	1.01	0.96	3.34	5.84	4.44	17.64	16.92	25.12
Textiles	1.35	1.29	1.03	3.81	12.40	3.91	4.44	8.16	14.93
Apparel	0.03	0.04	0.08	0.83	1.18	0.61	9.34	29.66	30.53
Other Light Manufacturing	0.76	1.08	0.33	4.14	8.19	3.70	11.39	44.27	35.63
Wood & Paper	0.69	1.20	0.35	1.92	4.73	4.37	10.89	23.50	37.81
Basic Intermediates	7.05	10.58	3.12	16.58	28.10	29.93	36.39	69.36	83.97
Machinery & Equipment	13.50	18.92	6.37	47.78	59.16	59.28	46.33	253.90	213.55
Services	5.49	4.22	2.15	16.70	25.85	34.66	109.40	106.86	211.69
Total	32.69	43.91	17.13	104.63	157.22	164.24	322.47	618.60	770.18
Net Trade (Exports - Imports)									
Grains	-0.59	1.23	-0.27	-0.71	-0.54	-1.99	-4.33	11.15	1.03
Other Agriculture	1.32	1.31	0.46	-0.44	0.85	-2.54	-8.57	4.85	-17.76
Forestry & Fishery	1.13	0.70	0.28	2.02	0.24	0.74	-12.84	0.74	-5.33
Energy & Minerals	10.23	-2.12	-1.58	-2.08	0.25	-14.27	-49.01	-42.41	-70.33
Food Processing	0.80	2.96	0.31	1.87	-1.32	-1.27	-16.17	5.24	7.87
Textiles	1.40	-0.02	-0.87	-2.63	-4.57	12.07	3.54	-1.09	2.32
Apparel	3.11	3.45	1.84	2.08	24.94	8.75	-8.60	-25.64	-18.26
Other Light Manufacturing	1.69	2.82	0.51	0.49	16.58	19.08	11.58	-30.15	-10.73
Wood & Paper	4.39	-0.37	0.19	2.04	-2.00	0.10	-7.43	-1.96	-18.01
Basic Intermediates	-2.89	-8.57	-2.06	-1.18	-17.59	-7.92	5.57	0.94	29.52
Machinery & Equipment	-11.52	-10.29	-2.65	-3.49	-31.02	15.79	210.10	-9.46	38.38
Services	-2.30	2.64	3.89	3.39	-1.78	2.56	-34.73	45.70	23.14
Total	6.77	-6.24	0.05	1.34	-15.94	31.10	89.12	-42.09	-38.17

Table 4 summarizes the sectoral net trade flows for the regions in the APEC model. The final line shows that trade surplus (+) or deficit (-). Japan generates a $89b surplus, matched largely by the deficits in the US (-$42b) and EU (-$38b). Among the developing countries, only China and Thailand have notable deficits, while Indonesia shows a $7b trade surplus. From a sectoral perspective, among the advanced countries, minerals and energy are the major net import sector. Japan generates an enormous net export ($210b) in the capital goods sector, while the US has the biggest surplus in services and agriculture. Indonesia exports substantial energy and minerals, and imports capital goods; China exports apparel and light manufacturing, and imports intermediates and capital goods.

The data on trade and production structure are consistent with intuition based on conventional international trade theory. At one extreme, China and ASEAN are major competitors in labor-intensive nondurable manufactured exports and an important current and future importer of capital/technology-intensive products for their industrialization program. At the other extreme, Japan, the EU, and the US are major suppliers of capital/technology-intensive goods and major importers of labor-intensive consumer products. Asian NIEs are an intermediate case between the two extremes. They are important suppliers of all manufactured goods to China and ASEAN4, and growing demanders and suppliers of technology/capital-intensive products from Japan, EU, and the United States, while still remaining important suppliers of labor-intensive goods to industrial countries.

Most general equilibrium analyses of regional economic liberalization focus on the removal of *ad valorem* equivalent price distortions against imports that arise from existing trade barriers and other sources. This is also the primary focus of the simulations conducted in this paper, since the pattern and degree of protection are important determinants of the impacts of trade liberalization. The larger the initial distortion, the greater the response to a particular policy change.

Table 5 presents *ad valorem* import protection (tariff plus NTB) rates for each region by sector, along with other sectoral taxes and subsidies on exports and production. While the GTAP data base contains detailed tariff information, this was compiled prior to the conclusion of the Uruguay Round negotiations. The primary source for our tariff data is information obtained by the World Bank following the Uruguay Round from the GATT on the specific tariff commitments made by each participant. After reconciliation of this information to the sector and regional aggregation available in our model data, the result for each region is a set of sectoral tariff rates by origin (although only the average from all sources is shown in Table 5).[10]

[10] Because information on tariffs for Taiwan and China was not available from the GATT, the earlier GTAP rates were used for these countries.

Table 5: Sectoral Tariffs, Export Taxes, and Production Taxes
(Percent *ad valorem*)

	Indonesia	Thailand	Philippines	Singapore & Malaysia	China	Korea & Taiwan	Japan	USA	EU
Import Tariffs and NTBs:									
Grains	0.5	8.5	10.0	0.3	0.6	309.8	327.3	4.8	69.3
Other Agriculture	62.8	47.9	34.4	0.7	11.4	68.0	31.8	33.2	40.8
Forestry & Fishery	18.9	38.1	12.1	1.9	8.9	6.9	3.4	0.2	8.1
Energy & Minerals	0.6	17.6	10.7	0.2	5.0	4.1	0.7	0.4	0.2
Food Processing	21.8	46.4	24.7	3.3	10.6	29.1	113.7	11.3	23.9
Textiles	33.9	61.4	39.2	7.0	20.2	10.5	10.4	9.8	11.7
Apparel	43.2	79.4	49.4	5.8	8.5	15.4	61.6	20.8	13.2
Other Light Manufacturing	19.0	44.7	35.4	3.5	13.0	11.3	8.2	7.5	5.6
Wood & Paper	10.3	26.6	30.8	3.7	10.3	7.4	4.1	2.1	4.8
Basic Intermediates	6.8	27.6	19.8	4.9	9.9	9.0	87.0	8.6	9.7
Machinery & Equipment	16.2	39.6	22.2	3.5	13.0	13.5	35.2	12.1	9.0
Total	12.7	31.9	19.1	3.0	10.2	14.4	29.0	8.5	7.1
Production Taxes (+) and Subsidies (-):									
Grains	-1.8	-0.3	1.5		2.2	-16.1	-6.5	-40.4	-4.8
Other Agriculture	-1.7	-0.3	2.4	0.2	2.7	-14.8	-24.8	-4.7	-28.7
Forestry & Fishery	0.7	1.9	4.2	0.0	7.6	0.2	2.5	2.5	-0.5
Energy & Minerals	0.6	8.0	16.3	0.0	8.4	0.2	2.7	7.5	0.1
Food Processing	7.2	14.6	4.9	0.3	11.8	14.5	10.6	4.2	0.5
Textiles	1.6	2.2	2.4	0.8	7.7	1.2	2.3	1.0	0.9
Apparel	20.7	5.5	4.8	0.6	12.3	2.8	1.9	0.6	1.0
Other Light Manufacturing	8.7	5.0	10.5	0.3	14.5	4.2	5.2	1.7	1.0
Wood & Paper	2.6	3.2	2.7	0.8	9.6	1.6	1.7	1.3	1.1
Basic Intermediates	-5.5	7.8	11.8	1.1	12.7	1.7	6.3	3.6	1.3
Machinery & Equipment	2.3	9.5	9.9	0.7	10.4	3.7	3.9	1.6	1.4
Services	2.3	2.6	3.5	1.4	6.7	3.6	3.2	6.0	1.3
Total	1.1	4.3	4.4	1.0	7.9	2.6	3.5	4.7	0.3
Export Taxes (+) and Subsidies (-):									
Grains				0.8				-8.2	-200.9
Other Agriculture				15.3				-0.0	-22.2
Forestry & Fishery				7.4					-0.1
Energy & Minerals				10.2	0.1				2.0
Food Processing				6.5				-1.3	-14.6
Textiles	4.2	4.6	4.7	6.1	6.3	1.4			0.2
Apparel	30.4	16.6	27.2	30.8	18.2	14.4			0.1
Other Light Manufacturing		0.0		0.3					0.0
Wood & Paper				4.5	0.2	0.0	0.0		0.1
Basic Intermediates	0.1	0.2		2.6	0.9	0.2	0.6		4.9
Machinery & Equipment				0.9	0.0	0.1	1.4		0.9
Services				1.8					-0.3
Total	2.7	1.7	3.1	3.3	3.8	0.9	0.9	-0.2	-0.4

Included in the protection estimates are the tariff equivalent of non-tariff barriers for agriculture, and NTB equivalents for industrial products only for the major OECD economies (US, Japan, and EU). While the some NTBs for the US and EU related to textile quotas and anti-dumping could be obtained from the GTAP data, only statutory tariff rates were available for Japan. Because no Japanese NTBs were included, this protection structure indicated that the US and EU protect themselves much more heavily against Japanese products than Japan does against US and EU products. To compensate for the absence of NTB information for Japan, we have incorporated additional information on the *ad valorem* equivalent of Japanese NTBs, drawn from estimates provided in Sazanami, Urata, and Kawai (1995).[11]

The import protection rates show substantial variations by sector and region. The high protection rates for agriculture and food products in the EU, Japan, and Korea & Taiwan reflect the high non-tariff barriers. The pre-URA average tariff rate across all goods averages 10-13 percent for Indonesia and China, 20 percent for the Philippines, and 32 percent for Thailand, although there is a great deal of sectoral variation in the rates.

The domestic tax rates presented in the second section of Table 5 indicate that most regions subsidize agriculture, with a particularly large subsidy in the United States on grain production while in the EU, Japan, and Korea & Taiwan the subsidy is directed towards other agricultural products as well. The enormous export subsidy provided by the EU to grain exports (and to a lesser extent, to other agriculture as well) is quite noticeable. The prevalence of export taxes in the textiles and apparel in the developing economies are due to the Multifibre Agreement (MFA). In our model, we represent the MFA through export taxes levied in the *exporting* economy, thereby implicitly assuming that the rents associated with the MFA accrue to the exporting nations, rather than being shared with the importers. The export-tax equilavent of the MFA ranges from 4-6 percent for textiles to 16-30 percent for wearing apparel in the Asian developing economies.

3. The APEC-CGE Model

In this paper, APEC-centered regional integration is analyzed through the use of a multi-country computable general equilibrium (CGE) model. Such models are designed to quantify many of the economic forces accompanying regional integration that are considered in international trade theory.[12] The APEC-CGE model we have developed is in the tradition of recent multi-country CGE models developed to analyze the impact of the Uruguay Round of GATT negotiations and the impact of the North American Free Trade Agreement.[13]

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[11] Their estimates, based on unit value index comparisons, suggest sizeable non-tariff protection across a wide range of industrial products. For our purposes, we have chosen to increase reported tariff and NTB rates by one-half of the NTB equivalent calculated by these authors, resulting in the higher average protection rates for Japan reported in Table 5.

[12] For a more complete discussion of the analytic and modeling issues related to analysis of free trade areas, and a discussion of earlier efforts for Asia, see Lewis, Robinson, and Wang (1995).

[13] These models, in turn, have built on multi-country models developed to analyze the impact of the Tokyo Round of GATT negotiations — in particular, the multi-country CGE model developed by Whalley (1985). Our model starts from the WALRAS model developed at the OECD to analyze the impact of the current GATT negotiations on the major OECD countries (OECD, 1990) and the RUNS model described in Goldin, Knudsen, and van der Mensbrugghe (1993). See Hinojosa-Ojeda and Robinson (1992) and Brown (1992) for a review of NAFTA CGE models.

The model developed in this paper consists of a multi-regional CGE framework containing a twelve-sector, nine-region, general equilibrium model, where the regional CGE models are inter-connected through trade flows.[14] For the purpose of describing the model, it is useful to distinguish between the individual "country" models and the multi-region model system as whole, which determines how the individual country models interact. When the model is actually used, the *within* country and *between* country relationships are solved for simultaneously.

The APEC-CGE model includes several features that are not ordinarily incorporated into other multi-country CGE trade models. First, when modeling import demands, the Almost Ideal Demand System (AIDS) specification is adopted. This specification allows import expenditure elasticities to be different from one and also allows cross-country substitution elasticities to vary for different pairs of countries. Second, to capture the potential dynamic effects of trade liberalization, the APEC model can include equations for generating positive externalities through both export expansion and the importation of new capital goods. These new features are described below.

The model data base consists of social accounting matrices (SAMs) for each country, including data on their trade flows.[15] The development of a consistent multi-country data base is itself a major task; for our model, we relied primarily on the GTAP database [Hertel (1996)], supplemented by some additional data on factor endowments (particularly labor) and tariff and non-tariff barriers. The SAM starts from multisectoral input-output data, which are expanded to provide information on the circular flow of income from producers to factors to "institutions," which include households, enterprises, government, a capital account, and trade accounts for each partner country, and for the rest of the world. These institutions represent the economic actors whose behavior and interactions are described in the CGE models. The parameter estimates for the sectoral production functions, consumer expenditure functions, import aggregation functions, and export transformation functions were estimated from base-year data and from a variety of econometric sources. The various parameters used in the model represent point estimates for the base year (1992) and the model was benchmarked so that its base solution replicates the base data.

Each sub-regional or "country" CGE model follows closely what has become a standard theoretical specification for trade-focused CGE models.[16] In addition to twelve sectors for each country model, the model has four factors of production (two labor types, land, and capital). For each sector, the model specifies output-supply and input-demand equations. Output supply is given by translog value added cost functions, while intermediate inputs are demanded in fixed proportions. Producers are assumed to maximize profits, implying that each factor is demanded so that marginal revenue product equals marginal cost. However, factors need not receive a uniform wage or "rental" (in the case of capital) across sectors; it is possible to impose sectoral factor market distortions that fix the ratio of the sectoral return to a factor relative to the economywide average return for that factor.

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[14] The model also permits regional interactions through endogenous migration of capital and labor, but for all experiments presented in this paper, this feature is not used. See Hinojosa-Ojeda, Lewis, and Robinson (1995) for analysis of a Greater North America Free Trade Area (GNAFTA) using a similar model that includes labor migration.

[15] Social Accounting Matrices are described in Pyatt and Round (1985).

[16] Robinson (1989) surveys CGE models applied to developing countries. Shoven and Whalley (1984) survey models of developed countries. The theoretical properties of this family of trade-focused CGE models are discussed in Devarajan, Lewis, and Robinson (1990). A full presentation of the APEC-CGE model appears in the appendix of this paper.

In common with other CGE models, the model only determines relative prices and the absolute price level must be set exogenously. In our model, the aggregate consumer price index in each sub-region is set exogenously, defining the *numeraire*. The advantage of this choice is that solution wages and incomes are in real terms. The solution exchange rates in the sub-regions are also in real terms, and can be seen as equilibrium price-level-deflated (PLD) exchange rates, using the country consumer price indices as deflators.[17] World prices are converted into domestic currency using the exchange rate, including any tax or tariff components. Cross-trade price consistency is imposed, so that the world price of country A's exports to country B are the same as the world price of country B's imports from country A. Composite demand is for a translog aggregation of sectoral imports and domestic goods supplied to the domestic market. Sectoral output is a CET (constant elasticity of transformation) aggregation of total supply to all export markets and supply to the domestic market.

Each "country" model traces the circular flow of income from producers, through factor payments, to households, government, and investors, and finally back to demand for goods in product markets. The country models incorporate tariffs which flow to the government, and non-tariff revenues which go to the private sector. Each economy is also modelled as having a number of domestic market distortions. There are sectorally differentiated indirect, consumption, and export taxes, as well as household and corporate income taxes. The single aggregate household in each economy has a Cobb-Douglas expenditure function, consistent with optimization of a Cobb-Douglas utility function. Real investment and government consumption are fixed as shares of GDP in the model simulations.

One implication of including these varied existing distortions, which capture in a stylized way institutional constraints characteristic of the economies, is that policy choices must be made in a second-best environment. In our simulations involving the establishment of FTAs, we are not considering scenarios which remove all existing distortions. Existing taxes and factor-market distortions are assumed to remain in place, along with existing import barriers against the rest of the world. In this second-best environment, economic theory gives little guidance as to the welfare implications of forming a FTA.

Sectoral export-supply and import-demand functions are specified for each country. In common with other CGE models (both single and multi-country), the APEC-CGE model specifies that goods produced in different countries are imperfect substitutes. At the sectoral level, in each country, demanders differentiate goods by country of origin and exporters differentiate goods by destination market. Exports are supplied according to a CET function between domestic sales and total exports, and allocation between export and domestic markets occurs in order to maximize revenue from total sales. The rest of the world is modeled simply as a supplier of imports to and demander of exports from the nine model regions as a group. Production activities in the rest of the world are not explicitly modeled; instead, this region is assumed to have flat export-supply curves and downward-sloping aggregate import-demand curves.

The model incorporates three different kinds of trade-productivity links. The first relates sectoral productivity to sectoral imports of intermediate and capital goods—the extent of productivity increase depends on the share of intermediates in production. Second is an externality associated with sectoral export performance—higher export growth translates into increased domestic productivity. Finally, there

[17] De Melo and Robinson (1989) and Devarajan, Lewis, and Robinson (1991) discuss the role of the real exchange rate in this class of model. We fix the exchange rate for the rest of world, thereby defining the international *numeraire*.

is an externality associated with aggregate exports—increased exports make physical capital more productive, an effect which is embodied in the capital stock input to the production process.[18]

The externalities associated with imported intermediate input use (ρ^m) and sectoral export performance (ρ^e) affect productivity by entering into sectoral production functions [equation (1)], while the externality associated with aggregate exports (ρ^k) is directly embodied as an increase in the initial capital stock ($FS_{k,0}$) [equation (2)] and therefore enters the production function indirectly as an increase in the capital input. $F_{i,f}$ are the sectoral factor inputs into the production process (including capital); X_i is sectoral output, and FS_k is the economywide aggregate capital stock (so $FS_k = \Sigma_i F_{i,k}$).

(1) Production function: $$X_i = \rho_i^m \cdot \rho_i^e \cdot [\sum_f \alpha^{i,f} F_{i,f}^{-\gamma^{i,f}}]^{\frac{-1}{\gamma^{i,f}}}$$

(2) Aggregate capital stock: $$FS_{k,t} = FS_{k,0} \cdot \rho^k$$

The three externality relationships are shown in equations (3)-(5). *MTOT* and *ETOT* in equations (3) and (5) correspond to aggregate imports and exports for each region, E_i is sectoral exports, and n_i is the share of intermediate inputs in production. The subscripts *0* and *t* refer to the base period and experiment, respectively:

(3) Intermediate inputs: $$\rho_i^m = (\frac{MTOT_t}{MTOT_0})^{\eta_m} \cdot n_i + (1 - n_i)$$

(4) Sectoral exports: $$\rho_i^e = (\frac{E_{i,t}}{E_{i,0}})^{\eta_e}$$

(5) Aggregate exports: $$\rho^k = (\frac{ETOT_t}{ETOT_0})^{\eta_k}$$

Each of the three effects operates through simple elasticity equation: for example, an export-productivity elasticity (η^e) of 0.25 for industrial sector exports from developing regions means that a 10 percent rise in real exports would result in a 2.5 percent increase in total factor productivity in that sector. In general, the elasticities used for the industrialized regions (US, EU, Japan) are less than half the values used for the developing regions.

While there is fairly widespread agreement that these feedbacks exist, there is less consensus on the channels through which they operate, and how large they are. For our purpose, we are more interested in showing how such linkages might affect analysis of the FTA; thus, we have included three different linkages that operate through different channels. With little empirical estimation to draw on, the choice of externality parameters to use in the model is based largely on guesswork. We have chosen fairly modest parameters, to avoid overstating the case; for example, our sectoral export-productivity linkage effects for the developing Asian regions are given an elasticity parameter around one-half that used by de Melo and Robinson (1992) in their analysis of the Korean growth performance.

[18] The various export and import externality features can be turned on or off as desired in carrying out model simulations.

For many single-country and multi-country models, a lack of detailed econometric work forced modelers to use simple functional forms, with few parameters, for the import-aggregation and export-transformation functions. The common practice is to use a constant elasticity of substitution (CES) function for the import aggregation equation, which is a very restrictive functional form and has led to empirical problems.[19] As a result of these limitations, modelers have begun to explore other formulations, while maintaining the fundamental assumption of product differentiation. In this model, we have used a flexible specification of the demand system called the almost ideal demand system (or AIDS).[20] The AIDS specification allows non-unitary income elasticities of demand for imports and also pairwise substitution elasticities that vary across countries. The specification generates more realistic trade-volume and terms-of-trade effects when analyzing the impact of expanded North American regional trade under an FTA.

The APEC-CGE model, like other multi-country CGE models, has a medium to long-run focus. We assume, for example, that factor markets clear. While sectoral employment changes, aggregate employment is assumed to remain unchanged. We report the results of comparative static experiments in which we "shock" the model by changing some exogenous variables and then compute the changed equilibrium solution. We do not explicitly consider how long it might take the economy to reach the new equilibrium. The model's time horizon has to be viewed as "long enough" for full adjustment to occur, given the shock. While useful to understand the pushes and pulls the economies will face under the creation of an FTA, this approach has obvious shortcomings. In particular, it does not consider the costs of adjustment, such as transitional unemployment, that might occur while moving to the final equilibrium.

4. Towards Asian Free Trade: APEC Model Results

Design of Alternative Scenarios

The first set of scenarios analyzes the impact of a sequence of liberalization possibilities on APEC economies, beginning with implementation of Uruguay Round Agreement commitments, followed by possible future multilateral liberalization (i.e., the successor to the URA), adoption of an ASEAN FTA, a possible APEC FTA, and finally, the impact of global trade liberalization involving areas outside of Asia. We contrast the static gains from free trade arrangements with the more substantial improvements that might occur as a result of dynamic linkages between trade expansion and productivity by incorproating the effects on aggregate and sectoral productivity of increased exports and the productivity-enhancing importation of new technologies via imports of capital and intermediate goods.

The second set of scenarios examines how international currency realignments (specifically the yen-dollar rate) affect Indonesia and other Asian economies under different assumptions as to whether the Indonesian exchange rate follows the dollar or remains pegged to a balanced yen-dollar basket.

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[19] Armington (1969) used the specification in deriving import-demand functions, and the import aggregation functions are sometimes called Armington functions. Devarajan, Lewis, and Robinson (1990) discuss in detail the properties of single-country models which incorporate imperfect substitution. Brown (1987) analyzes the implications of using CES import aggregation functions in multi-country trade models. Others have criticized the use of the CES function on econometric grounds. See, for example, Alston *et al.* (1989).

[20] Hanson, Robinson, and Tokarick (1990) use the AIDS function in their 30-sector single-country CGE model of the U.S. They estimate the sectoral import demand functions using time-series data and find that sectoral expenditure elasticities of import demand are generally much greater than one in the U.S., results consistent with estimates from macroeconometric models.

For each alternative scenario, the model generates results concerning the impact on real GDP, output, trade, value added, real wages, as well as the rental rate of capital and land. Our scenarios should be interpreted as controlled experiments rather than as forecasts of performance that might occur with each option. The actual growth pattern will be the result of many more factors than just trade policy, especially macroeconomic policies. Both the comparative static and dynamic-externality experiments are meant to describe the impact of different patterns of trade liberalization in the medium to long run. Use of the term "dynamic" here does not imply the actual path of the transition, but rather the net cumulative effect over time of positive productivity externalities that could potentially result from regional integration.

The Uruguay Round and Beyond

The Uruguay Round commitments require action on a number of different policy fronts: (1) conversion of many existing NTBs into tariffs and a commitment to real tariff reductions (for some countries) or a promise to "bind" tariffs below certain levels; (2) reduction in export and production subsidies (primarily in the OECD economies); and (3) dismantling the Multifibre Agreement over the coming decade, thereby eliminating the massive distortions that have characterized these industries.

The importance of the tariff and NTB reductions varies substantially by country. Using data obtained from the GATT, we can calculate the change in tariff rates to which each country is committed.[21] Table 6 shows the average sectoral tariffs for each region before and after the Uruguay Round, along with figures on the percent reduction in tariffs that occurs from the UR commitments. Tariff reductions for developing countries range from a low of 4 percent in Indonesia (where modest sectoral tariff cuts are concentrated in sectors with few imports), to 8 percent for the Philippines, and 22-23 percent for Thailand and Singapore & Malaysia. The cuts for the OECD countries range from 26 percent in the EU to 40 percent in Japan.

As part of this experiment, we also assume that the non-agricultural NTBs in the OECD economies decline by half as part of the Uruguay Round, resulting in a drop in the average NTB to 7.9 percent in Japan, 2.3 percent in the US, and 0.9 percent in the EU. Agricultural production subsidies are reduced by 20 percent in OECD economies and 13 percent in developing economies, while agricultural export subsidies are reduced by 36 percent in the US and EU (see Table 5). And finally, the dismantling of the MFA is reflected in the elimination of export taxes on textiles and apparel in the major developing country exporters--Indonesia, Thailand, Philippines, Singapore & Malaysia, China, and Korea & Taiwan.

[21] Because no information on the Uruguay Round commitments by China was available, we have assumed that sectoral tariffs for China will be reduced by the average sectoral reduction undertaken by Indonesia and the Phillipines.

Table 6: Post Uruguay Round Average Tariffs by Sector and Region

	Indonesia	Thailand	Philippines	Singapore & Malaysia	China	Korea & Taiwan	Japan	USA	EU
Pre-Uruguay Round Import Tariff Rates (percent):									
Grains	0.5	8.5	10.0	0.3	0.6	309.8	327.3	4.8	69.3
Other Agriculture	62.8	47.9	34.4	0.7	11.4	68.0	31.8	33.2	40.8
Forestry & Fishery	18.9	38.1	12.1	1.9	8.9	6.9	3.4	0.2	8.1
Energy & Minerals	0.6	17.6	10.7	0.2	5.0	4.1	0.7	0.4	0.2
Food Processing	21.8	46.4	24.7	3.3	10.6	29.1	108.5	4.8	12.8
Textiles	33.9	61.4	39.2	7.0	20.2	10.5	7.6	9.4	8.6
Apparel	43.2	79.4	49.4	5.8	8.5	15.4	13.8	18.6	13.2
Other Light Manufacturing	19.0	44.7	35.4	3.5	13.0	11.3	8.2	7.5	5.6
Wood & Paper	10.3	26.6	30.8	3.7	10.3	7.4	3.6	1.3	4.6
Basic Intermediates	6.8	27.6	19.8	4.9	9.9	9.0	4.0	3.5	5.9
Machinery & Equipment	16.2	39.6	22.2	3.5	13.0	13.5	3.2	2.9	6.1
Average	12.7	31.9	19.1	3.0	10.2	14.4	13.3	3.9	5.4
Post-Uruguay Round Import Tariff Rates (percent):									
Grains	0.5	8.5	10.0	0.3	0.6	151.7	183.4	1.7	69.3
Other Agriculture	62.8	47.9	34.4	0.7	11.4	57.0	29.3	33.1	40.8
Forestry & Fishery	18.9	16.2	10.3	1.0	8.2	5.1	2.3	0.1	7.0
Energy & Minerals	0.6	13.3	10.7	0.2	4.9	3.7	0.0	0.4	0.0
Food Processing	21.8	46.4	24.7	3.3	10.6	19.0	70.4	3.3	12.0
Textile	26.3	28.5	28.3	4.9	15.1	8.0	5.2	6.7	6.4
Wearing Apparel	36.3	30.3	31.9	4.7	6.3	13.8	9.2	16.7	11.5
Other Light Manufacturing	17.2	30.1	35.4	2.7	12.3	6.4	6.4	5.0	3.3
Wood & Paper	9.9	17.6	27.6	2.7	9.6	4.1	1.3	0.4	0.6
Basic Intermediates	6.8	24.6	18.8	4.6	9.6	4.4	1.4	1.9	3.5
Machinery & Equipment	15.9	29.7	20.7	2.4	12.5	9.1	0.1	1.7	3.6
Average	12.1	24.4	17.5	2.3	9.4	9.1	8.0	2.8	4.0
Percentage Reduction in Tariff Rates from Uruguay Round Commitments:									
Grains						51.0	44.0	63.9	
Other Agriculture						16.1	7.9	0.2	
Forestry & Fishery		57.4	14.8	46.2	7.4	26.2	32.4	28.4	14.2
Energy & Minerals		24.4	0.1	1.2		9.6	99.8	5.0	59.7
Food Processing						34.7	35.1	31.4	6.3
Textiles	22.5	53.6	27.8	30.5	25.1	23.6	31.3	28.5	25.5
Apparel	16.0	61.8	35.5	17.6	25.8	9.8	33.2	10.0	13.0
Other Light Manufacturing	9.7	32.7		23.9	4.8	43.4	22.0	32.9	42.0
Wood & Paper	3.5	34.0	10.5	27.8	7.0	45.2	64.4	73.2	87.0
Basic Intermediates	1.1	10.9	5.4	6.4	3.2	51.2	65.0	46.6	41.0
Machinery & Equipment	1.9	25.0	6.6	29.8	4.2	32.6	96.2	42.8	41.3
Average	4.1	23.6	8.1	22.1	7.3	36.9	39.8	28.2	26.4

Note: *Pre-Uruguay round tariffs* do not include non-agricultural NTBs that are included in the data in Table 5.
Percentage reduction in tariff rates calculated as percentage change in the pre- and post-Uruguay round tariffs.

Table 7 summarizes the impact of the Uruguay Round on real GDP and exports for the APEC economies. The experiment is carried out in stages: first, the tariff and NTB cuts, and second the (additional) impact of subsidy reduction and MFA removal. Looking first at the tariff effects (columns 1-2), all economies gain from the Uruguay Round, with GDP increments ranging from .01 percent in the US to 1.33 percent for Korea & Taiwan. The pattern and magnitude of tariff cuts has a substantial impact on how much each country can expect to benefit from post-URA trading opportunities. Economies that have liberalized more are in a position to reap greater efficiency gains from reallocation of domestic resources than those that have acted less boldly. Among the developing economies, Indonesia, China, and the Philippines commited to relatively modest tariff reductions (4-8 percent) and correspondingly gain little in real GDP from the elimination of distortions. Total world exports grow by 2.1 percent, or around $48 billion. The biggest winners are again those economies that have offered up the largest tariff reductions, as the real exchange rate depreciation that results from substantial tariff cuts in Japan and Korea & Taiwan stimulates exports from these economies.

Table 7: GDP and Export Growth from the Uruguay Round
(Percent change from base)

	URA Tariffs Only		Full URA Commitments		Full URA & Externalities	
	Real GDP	Exports	Real GDP	Exports	Real GDP	Exports
Indonesia	0.08	0.07	1.60	3.14	3.40	5.92
Thailand	0.54	3.10	0.81	3.58	3.43	7.15
Philippines	0.21	0.98	1.74	3.37	2.47	2.54
Singapore & Malaysia	0.10	0.64	2.10	1.54	2.79	0.76
China	0.04	-0.05	0.61	1.81	0.97	1.61
Korea & Taiwan	1.33	2.43	1.45	2.97	1.78	3.42
Japan	0.66	5.32	0.68	5.49	1.03	5.91
United States	0.02	1.81	0.03	1.99	0.16	2.17
European Union	0.01	1.26	0.02	1.45	0.13	1.59
Total	-	2.14	-	2.56	-	2.82

Notes: *Real GDP* provides a production-based measure of economic activity.
Exports is the increase in total exports for each region.

When we include the subsidy reductions and MFA removal into the experiment (columns 3-4), the outcome is quite similar for the OECD economies, but much more favorable for the developing APEC economies, due to the stimulus provided to exports from elimination of MFA-related export taxes. GDP growth rises sharply in Indonesia and the Philippines to 1.6-1.7 percent, and global export expansion reaches 2.6 percent ($58 billion).

The results in columns 1-4 include no linkages or externalities from the greater openness and trade expansion that occurs as a result of the Uruguay Round implementation. This comparative static experiment does miss some potentially important dynamic feedbacks between trade and productivity which, if captured correctly, will likely increase the benefits accruing to economies committed to greater liberalization through the Uruguay Round. Columns 5-6 summarize the GDP and export implications of the Uruguay Round when the three productivity linkages incorporated in the model are included. Inclusion of these possible dynamic effects further increases GDP growth in the developing ASEAN economies. The biggest relative gainers are Indonesia, Philippines, and Thailand, where GDP growth exceeds 3 percent, and exports expand by over $15 billion. Incremental Indonesian exports occur primarily in the apparel and light manufacturing sectors (which includes products such as footwear).

There are divergent perspectives within Asia on how the trading system should evolve following implementation of the Uruguay Round commitments. Some argue for an ASEAN focus, others expand their sights to include the broader APEC grouping, while another group stresses the need to follow up the successful conclusion of the Uruguay Round with similar initiatives to negotiate further multilateral liberalization in world trade. To illuminate the tradeoffs (if any) among these different perspectives, we have run a series of experiments with the APEC-CGE model that quantify the contribution of each to growth and structural change in the APEC economies.

Table 8: GDP and Export Growth from Future Liberalization Alternatives

	Incremental Effect of:				Total
	URA-II	ASEAN FTA	APEC FTA	Free Trade	effect
Change in GDP from Base (Percent)					
Indonesia	0.40	0.03	0.66	0.25	1.34
Thailand	0.59	0.18	0.82	0.37	1.96
Philippines	0.67	0.14	1.17	0.32	2.30
Singapore & Malaysia	0.23	0.04	0.29	0.09	0.65
China	0.12	-0.01	0.15	0.09	0.35
Korea & Taiwan	0.85	0.00	2.00	0.41	3.26
Japan	0.86	0.00	0.77	0.39	2.02
United States	0.05	0.00	0.01	0.02	0.08
European Union	0.13	0.00	-0.02	0.09	0.20
Change in Exports from Base (Billion $)					
Indonesia	0.74	0.14	1.22	0.40	2.50
Thailand	1.51	0.59	2.20	0.99	5.29
Philippines	1.07	0.29	2.01	0.80	4.17
Singapore & Malaysia	0.34	0.06	1.16	0.05	1.61
China	2.11	-0.01	3.62	1.29	7.01
Korea & Taiwan	3.08	-0.01	6.49	1.52	11.08
Japan	30.60	-0.02	12.27	5.25	48.10
United States	9.83	0.00	4.25	1.32	15.40
European Union	13.39	0.02	0.01	12.50	25.92
Total	62.68	1.05	33.23	24.13	121.09

Table 8 reports the impact on real GDP of various regional or multilateral trading initiatives. The numbers reflect the *incremental* impact on GDP of each experiment: in other words, the effect of adding one new feature to those included in the previous experiment. The starting point is the implemented Uruguay Round in the model *without* trade-productivity externalities: in other words, the results reported in columns 3-4 of Table 7. The first experiment considers the impact of another multilateral reform along the lines of the Uruguay Round: tariffs and export subsidies are cut by 36 percent in all countries, non-agricultural NTBs in the OECD economies are eliminated, and agricultural production subsidies are cut by 36 percent as well. In the second experiment, we add to this the creation of an ASEAN FTA, represented by the complete elimination of all tariffs *among* the four ASEAN regions in the model (Indonesia, Thailand, Philippines, and Singapore & Malaysia). Next, we simulate the eventual creation of an APEC FTA, which eliminates tariffs among all the APEC members, leaving protective barriers only against the EU and rest of world. Finally, we consider the case of global liberalization with the removal of all remaining import barriers among the regions in our model.

The results in Table 8 suggest that the different regional liberalization alternatives would have very different effects on the individual economies. The biggest gains come from completion of a subsequent round of multilateral tariff and subsidy reductions along the lines of the Uruguay Round. This URA-II would yield $62 billion of additional exports, and increase real GDP by around $50 billion, more than the estimated gains from actual Uruguay Round. The largest benefit from URA-II accrues to Japan, in part because it achieves further efficiency gains from elimination of the remaining non-agricultural NTBs. But ASEAN economies gain as well: exports grow by of $3.6 billion, and real GDP expands by $1.7 billion.

Creation of an ASEAN FTA based on free trade among ASEAN economies alone offers only very modest gains. Incremental GDP growth is positive, but small (around $350 million), as is the $1.0 billion increase in total ASEAN exports. Indonesia gains the least in terms of GDP growth (only 0.03 percent), and expands its exports by only around $140 million. While these figures may understate the potential gains from an ASEAN FTA due to factors such as economies of scale due to rationalization of production facilities, or other deliberate policies to encourage intra-ASEAN trade, our empirical results confirm what has been a consistent lesson of the East Asian growth experience: maximum gains are achieved by focusing on international markets, not regional ones.

Creation of an APEC FTA, on the other hand, would generate substantial additional benefits beyond a more narrow ASEAN FTA. GDP expands for all APEC economies, while the European Union would experience a small decline. Total GDP expansion reaches $42 billion, and exports rise by $33 billion. Finally, global trade liberalization would generate further gains of $25 billion in GDP across all regions, although the ASEAN economies gain a smaller share of this total, as the benefits are spread around more evenly.[22]

Exchange Rates and Trade

Since the mid-1970s, with the collapse of the fixed exchange rate system among the OECD countries, there have been a number of major currency realignments. In the 1980s, the US real exchange rate first appreciated greatly, as the U.S. balance of trade worsened, and then depreciated in the latter half of the decade. Recently, the U.S. dollar is again depreciating and the Japanese yen is appreciating. To see how such swings in real exchange rates affect the world trading system, and ASEAN countries in particular, we ran a series of exchange rate experiments with the APEC-CGE model, starting from the pre-Uruguay Round base (without any changes in tariffs or non-tariff protection).[23]

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[22] These results are consistent with earlier empirical work reported in Lewis, Robinson, and Wang (1995).

[23] We also adjusted the behavior of export supply and import demand functions for the rest of the world, limiting their supply and demand response. Without adjustment, these partial equilibrium equations generate unrealistic swings in the rest-of-world trade balance with exchange rate shocks. A model with a complete set of regional CGE models behaves more symmetrically.

We ran two sets of experiments to explore the sensitivity of trade flows to changes in exchange rates. The first sequence consists of five experiments, depreciating the US dollar in 5 percent steps to 25 percent. These experiments indicate the impact of changes in the US exchange rate alone. Figure 1 presents the results for aggregate US real exports and imports, and also shows the effect on Indonesian exports and imports as well. For the US, for each percentage point real depreciation, real exports increase and imports decrease by just under a half of a percentage point each. Given a 25 percent depreciation, the net trade balance for the US improves by almost $90 billion. The effect is roughly linear, amounting to an improvement of about $3.5 billion in the balance of trade for each percentage point real depreciation.

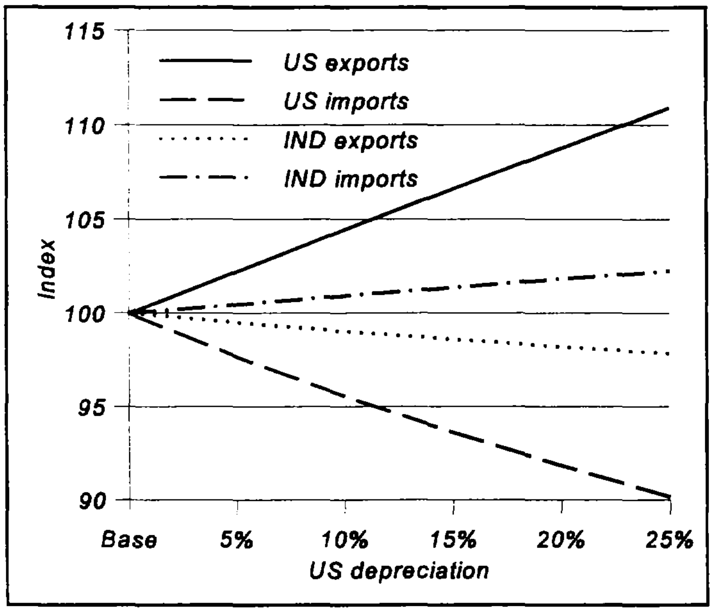

Figure 1: Real exports and imports, US and Indonesia

A US real depreciation leads all other countries to increase their imports and decrease their exports. The effect is largest for Japan, which, for a 25 percent US depreciation, decreases exports and increases imports by 5 percent each. The effect for the developing ASEAN countries is somewhat smaller, ranging from 2–4 percent. For Indonesia, from Figure 1, a 25 percent real depreciation of the dollar leads to a 2.2 percent decline in real exports and a 2.3 percent increase in real imports, worsening the balance of trade.

In the second sequence of experiments, we first specified a 10 percent US depreciation and, at the same time, a 10 percent appreciation of the Japanese yen, while leaving other exchange rates unchanged. We then did two additional experiments in which we assumed that Indonesia depreciated 5 percent and 10 percent, following the dollar down. Table 9 shows the changes in the bilateral trade flows for the US, Japan, and Indonesia from the third experiment, in which Indonesia follows the US depreciation (thereby depreciating by 20 percent against the yen and 10 percent relative to other ASEAN currencies).

Table 9: Bilateral Trade Balance Changes

Region	Change in net trade balance: ($US billions): US	Japan	Indonesia
Indonesia	0.18	-1.45	—
Thailand	0.73	-0.78	0.06
Philippines	0.41	-0.34	0.01
Singapore & Malaysia	2.25	-1.84	0.17
China	2.82	-1.74	0.14
Korea & Taiwan	3.25	-2.53	0.24
Japan	19.72	—	1.45
US	—	-19.72	-0.18
European Union	10.17	-5.58	0.31
Rest of world	8.29	-2.61	0.46
Total	47.84	-36.30	2.66

Note: Results reported for Experiment 3; US 10 percent depreciation, Japan 10 percent appreciation, and Indonesia 10 percent depreciation. Trade balance equals exports minus imports.

The combination of Japanese appreciation and US and Indonesian depreciation affects bilateral trade balances. The overall US trade balance improves by $47.84 billion, while that of Japan deteriorates by $36.3 billion. Bilaterally, the largest change is the US-Japan balance, which moves by $19.72 billion in favor of the US. The US improves its trade balance with all regions, while the Japanese bilateral trade balances all worsen.

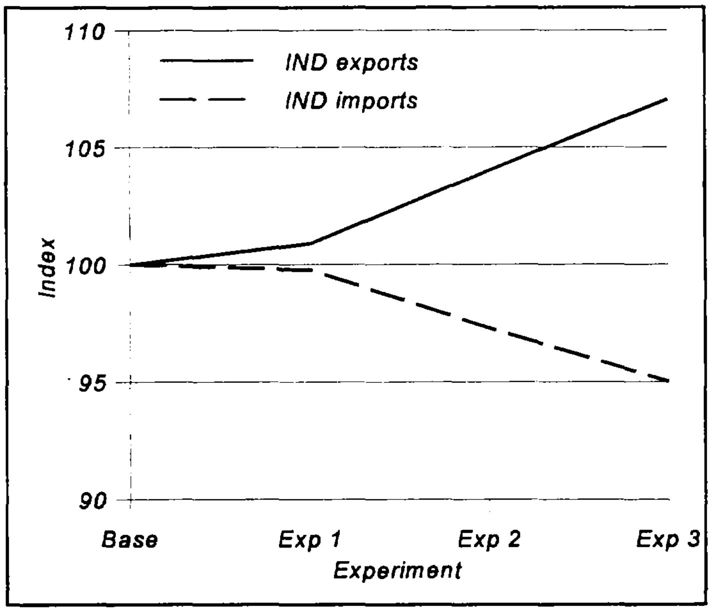

Figure 2: Indonesian exports and imports

The changes in Indonesia's real exports and imports for the three experiments are given in Figure 2. Indonesia improves its trade balance when Japan appreciates its exchange rate by 10 percent and the US depreciates by 10 percent (Experiment 1), but the effect is much more dramatic when Indonesia depreciates along with the dollar (Experiments 2 and 3). The improvement of the trade balance by $2.66 billion (Table 9) is largely due to the improvement with Japan ($1.45 billion). Even though Indonesia depreciates along with the dollar, its trade balance with the US actually worsens slightly ($0.18 billion), which is more than offset by the other bilateral improvements.

While Indonesia is affected by swings in the US and Japanese exchange rates, it is far more affected by how it chooses to manage its own exchange rate in response to these external movements. In the face of swings in the U.S. and Japanese exchange rates, more careful consideration needs to be given to the net effect of these changes on Indonesia's real exchange rate, taking account of the composition of trade as well as the customary focus on the impact on the value of debt-service payments. Changes in the yen-dollar rate affect trade flows as well as the "below the line" debt service items, and in turn will affect the country's sustainable balance of trade and its equilibrium real exchange rate. The net effects need to be sorted out, as a simple rule-of-thumb such as tying the currency to the dollar alone is unlikely to yield the correct answer.

The effects of changes in exchange rates on aggregate trade are similar in magnitude to effects arising from trade liberalization. Trade liberalization, however, generates much greater changes in the sectoral structure of trade and production. Exchange rate changes affect all tradable prices together, and the resulting changes in equilibrium prices and production tend to move in the same direction. Sectoral protection rates, however, are more varied and trade liberalization that moves toward uniform and lower rates leads to major structural changes. The elimination of sectorally differentiated distortions also has a larger effect on aggregate efficiency than changes in exchange rates. The exchange rate experiments had very small effects on aggregate GDP, much smaller than those arising from trade liberalization.

5. Conclusions

The last decade has seen major changes in the world trading system. The Uruguay Round of GATT negotiations was sucessfully completed, yielding less liberalization than was originally hoped, but more than was expected by many. In addition, there has been a proliferation of regional trading arrangements, including NAFTA, Mercosur, and the Pacto Andino in the Americas; APEC and ASEAN in the Pacific; and expansion of the EU in Europe. While the post-war trend toward increased trade liberalization was maintained and deepened in the 1980s, the decade also saw wide swings in bilateral trade balances and real exchange rates, with resulting "structural adjustment" programs in a number of developing and developed countries. These swings also had significant effects on real trade flows.

We have developed a multi-country trading model that focuses on the APEC region to analyze the impact on the Asian economies of : (1) trade liberalization under both the Uruguay Round and regional free trade initiatives, and (2) realignments in international exchange rates. The model is used as a simulation laboratory to sort out the relative empirical importance of the various trends in liberalization and macro adjustment. The empirical results lead to a number of conclusions:

- The lower income APEC countries have committed themselves to only very modest reductions in protection under the new GATT agreement. The gains from liberalization, however, are greater for countries that eliminate protection and domestic distortions in an environment where their trading partners also open their markets. Increasing international market access while maintaining a distorted and protected domestic economy does not yield significant benefits, because the economy cannot adjust to take advantage of the new opportunities.

- Elimination of tariff and non-tariff barriers in developed countries, especially the phasing out of the Multifibre Agreement (MFA), provides a significant opportunity for Asian developing countries to expand their exports and achieve significant productivity gains. The potential gains are quite large.

- Creation of an APEC free trade area (APEC FTA) provides significant benefits to the participants, with little effect on non-members. Establishing an APEC FTA leads to some trade diversion away from non-members, but total trade creation is much larger, leading to significant efficiency gains.

- Creation of an ASEAN regional free trade area provides little benefit to its members. The ASEAN countries would be far better advised to work toward more liberalization under GATT or hasten the creation of the APEC FTA rather than create an ASEAN FTA alone.

- While establishing regional free trade areas such as the APEC FTA yields significant efficiency gains, even greater gains are achieved by further multilateral liberalization. From an economic perspective, creating a regional FTA is consistent with pursuing continued global liberalization as well. Member countries gain both from the FTA and from further multilateral liberalization.

- Major realignments of exchange rates, such as the yen-dollar movements that are currently occurring, have significant effects on bilateral trade balances and on the volume and direction of world trade. The effects on the sectoral structure of production and trade within countries, however, are less than those arising from trade liberalization. Sectoral protection and subsidy rates are highly variegated, and their elimination yields signficant efficiency gains. Changes in exchange rates have less effect on allocative efficiency across sectors.

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Appendix: Structure of the APEC-CGE Model

Solving the CGE Model

The CGE model presented here has been developed and solved using a package called the General Algebraic Modeling System (or GAMS).[24] GAMS embodies two related developments of the last several years. First, the increasing power and availability of personal computers allows every modeler to have desktop access to computational resources that were once available only on mainframe computers. Second, the development of packaged software to solve complex mathematical or statistical problems such as that posed by our CGE model has permitted modelers to return their attention to economics.

To a great extent, the GAMS representation of model equations is easily read as standard algebraic notation. Subscripts indicating countries, sectors, or factors appear in parentheses [Xij becomes **X(i,j)**], and a few special symbols are used to indicate algebraic operations [Σ becomes **SUM**, Π becomes **PROD**]. For example, the Cobb-Douglas consumer price index equation:

$$PINDCON = \prod_i PC_i^{pwtc_i}$$

is represented in GAMS as:

PINDCON = PROD(i, PC(i)pwtc(i,k))**

where **PROD** stands for the product operator Π, the **i** at the left of the parenthetic expression is the sectoral index over which summation occurs, and the two asterisks (**) indicate exponentiation.[25]

Table 10 lists the regional, sectoral, and factor classifications used in the model, as well as identifying the sectoral subsets that are needed in the equations of the model. Table 11 contains the parameter definitions used in the CGE model equations. Table 12 contains the variables that appear in the model.

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[24] GAMS is designed to make complex mathematical models easier to construct and understand. In our case, we are using it to solve a large, fully-determined, non-linear CGE model (where the number of equations and number of variables are equal), although GAMS is suitable for solving linear, non-linear, or mixed integer programming problems as well. For a thorough introduction to model-building in GAMS, see Brooke, Kendrick, and Meeraus (1988).

[25] There are a few other syntax rules and conventions that appear in the equations shown below. The "$" introduces a conditional "if" statement in an algebraic statement. For example, PM(i,k,cty1)$imi(i,k,cty1) = xxx will carry out the expression shown for all PM(i,k,cty1) that belong to the set imi(i,k,cty1); in other words, calculate an import price for all sectors in which there are imports.

Table 10: Regional, Sectoral and Factor Classifications in the APEC-CGE Model

Countries and regions			
CTY1, CTY2	Universe	IND	INDONESIA
		THA	THAILAND
		PHL	PHILIPPINES
		AS2	SINGAPORE & MALAYSIA
		CHN	CHINA
		NIC	KOREA & TAIWAN
		JAP	JAPAN
		USA	UNITED STATES
		EEC	EUROPEAN UNION
		ROW	REST OF THE WORLD
K(CTY1)	Countries	IND	INDONESIA
		THA	THAILAND
		PHL	PHILIPPINES
		AS2	SINGAPORE & MALAYSIA
		CHN	CHINA
		NIC	KOREA & TAIWAN
		JAP	JAPAN
		USA	UNITED STATES
		EEC	EUROPEAN UNION
Sectors and groupings			
I,J	Sectors of production	GRAIN	GRAINS INCLUDING PROCESSED RICE
		OTHAG	OTHER AGRICULTURE
		FANDF	FORESTS AND FISHING
		MINES	ENERGY AND MINERALS
		FOOD	FOOD PROCESSING
		TEXT	TEXTILES
		WEAR	APPAREL
		OLMF	OTHER LIGHT MANUFACTURING
		WOOD	WOOD AND PAPER
		INTER	BASIC INTERMEDIATES
		CAPGD	CAPITAL GOODS
		SERV	SERVICES
im(i,k)	Import sectors		
imn(i,k)	Non-import sectors		
ie(i,k)	Export sectors		
ien(i,k)	Non-export sectors		
imi(i,k,cty1)	Bilateral imports in base data		
iei(i,k,cty1)	Bilateral exports in base data		
ie1(i,k)	Aggregate CET export sectors		
ied(i,k)	Downward sloping export demand from rest of world		
iedw(i,k)	Aggregate rest of world export demand function		
iec(i,k)	Sectors with second level export CET		
iecn(i,k)	Sectors with second-level competitive exports		
ik(i)	Capital and intermediates goods sectors (INTER, CAPGD)		
iag(i)	Agricultural sectors (GRAIN, OTHAG, FANDF)		
iagn(i)	Non-agricultural sectors		
iserv(i)	Service sector (for GDP accounts) (SERV)		
Factors and groupings			
iff,f	Factors of production	CAPITAL	Capital stock
		LAND	Agricultural land
		AGLAB	Rural agricultural labor
		INDLAB	Urban non-agricultural labor
Households and institutions			
hh	Households	HHALL	Single household category
ins	Institutions	LABR	Labor
		ENT	Enterprises
		PROP	Property income

Table 11: Parameters in the APEC-CGE Model

Basic model parameters	
CLES(i,hh,k)	Household consumption shares
EB(i,cty1,cty2)	Exports, base data
EKB(i,k)	Total sectoral exports, all destinations, base data
EROWB(i)	Total sectoral exports to rest of world, from all regions
EKPTL0(k)	Aggregate exports, all destinations, base data
ENTR(k)	Enterprise income tax rate
ETAE2(i,k)	Externality elasticity for aggregate exports
ETAK2(i,k)	Externality elasticity for capital goods imports
ETAM2(k)	Externality elasticity intermediate inputs
FS0(iff,k)	Aggregate factor supply, base data
GLES(i,k)	Government expenditure shares
GOVGDP(k)	Government expenditure to GDP ratio
HHTR(hh,k)	Household income tax rate
INVGDP(k)	Investment to GDP ratio
IO(i,j,k)	Input-output coefficients
LSH(hh,k)	Household transfer income shares
MKPTL0(k)	Imports of capital goods, base data
PIE(i,k)	Ag. program producer incentive equivalent per unit
PVAB0(i,k)	Base-year value added price
PWEB(i,cty1,cty2)	World price of exports, base data
PWEFXB(i)	Benchmark world export price
PWM0(i,cty1,cty2)	World market price of imports, base data
PWTC(i,k)	Consumer price index weights (PQ)
RHSH(hh,k)	Household shares of remittance income
SINTYH(hh,ins,k)	Household distribution of value added income
SPREM(i,k)	Share of premium revenue to the government
TC(i,k)	Consumption tax rates
TE(i,k)	Tax rates on exports
THSH(hh,k)	Household transfer income shares
TM(i,k,cty1)	Tariff rates on imports
TX(i,k)	Indirect tax rates
VATR(i,k)	Value added tax rate
ZSHR(i,k)	Investment demand shares
Production and trade function parameters	
AC(i,k)	Armington function shift parameter
AE(i,k)	CET export composition function shift parameter
AMV(i,k)	Share parameter in translog production function
AT(i,k)	CET function shift parameter
AVS(i,k)	Stone price index constant in translog production function
BETAV(i,k)	Coefficient in translog production function
ETAE(i,k)	Export demand elasticities for rest of world
ETAW(i)	Aggregate export demand elasticities for rest of world
GAMMA(i,k,cty1)	CET export composition function share parameters
GAMMAK(i,k)	CET function share parameter
GAMMAV(i,k)	Price parameter in translog production function
RHOE(i,k)	CET export composition function exponent
RHOT(i,k)	CET function exponent
Parameters for AIDS import demand functions	
SMQ0(i,k,cty1)	Base year import value share
AQS(i,k)	Constant in Stone price index
AMQ(i,k,cty1)	Share parameter in AIDS function
AQ(i,k)	Constant in translog price index
BETAQ(i,k,cty1)	Coefficient in AIDS function
GAMMAQ(i,k,cty1,cty2)	Price parameter in AIDS function

Table 12: Variables in the APEC-CGE Model

Price block	
EXR(k)	Exchange rate
PC(i,k)	Consumption price of composite good
PD(i,k)	Domestic prices
PDA(i,k)	Processors actual domestic sales price including subsidy
PE(i,k,cty1)	Domestic price of exports
PEK(i,k)	Average domestic price of exports
PINDCON(k)	Consumer price index
PM(i,k,cty1)	Domestic price of imports
PQ(i,k)	Price of composite goods
PREM(i,k)	Premium income from import rationing
PVA(i,k)	Value added price including subsidies
PVAB(i,k)	Value added price net of subsidies
PWE(i,cty1,cty2)	World price of exports
PWM(i,cty1,cty2)	World price of imports
PWERAT(i,k)	Ratio of world export prices
PWEFX(i)	benchmark world export price
PX(i,k)	Average output price
TM2(i,k,cty1)	Import premium rates
Production block	
D(i,k)	Domestic sales of domestic output
E(i,cty1,cty2)	Bilateral exports
EK(i,k)	Aggregate sectoral exports
INT(i,k)	Intermediate demand
M(i,cty1,cty2)	Bilateral imports
Q(i,k)	Composite goods supply
SMQ(i,k,cty1)	Import value share in total sectoral demand
SMV(i,f,k)	Factor share in sectoral value added
X(i,k)	Domestic output
Factor block	
AVWF(iff,k)	Average wage with current weights
FDSC(i,iff,k)	Factor demand by sector
FPE(k)	Total farm program expenditures
FS(iff,k)	Factor supply
FT(k)	Factor tax rate
WF(iff,k)	Average factor price
WFDIST(i,iff,k)	Factor differential
YFCTR(iff,k)	Factor income

Migration block	
WGDFL(la,k,lb,l)	Wage differentials
MIGL(la,k)	Labor migration flows (within category)
MIGRU(la,k)	Labor migration flows (across category)
Income and expenditure block	
CDD(i,k)	Private consumption demand
CONTAX(k)	Consumption taxes
ENTSAV(k)	Enterprise savings
ENTAX(k)	Enterprise taxes
ENTT(k)	Government transfers to enterprises
ESR(k)	Enterprise savings rate
EXPTAX(k)	Export tax revenue
FBAL(k)	Overall current account balance
FBOR(k)	Foreign borrowing by government
FKAP(k)	Foreign capital flow to enterprises
FSAV(k,cty1)	Bilateral net foreign savings
FSAVE(k)	Foreign savings
FTAX(k)	Factor taxes
GD(i,k)	Government demand by sector
GDPVA(k)	Nominal expenditure GDP
GDTOT(k)	Government real consumption
GOVSAV(k)	Government saving
GOVREV(k)	Government revenue
HHT(k)	Government transfers to households
HSAV(k)	Aggregate household savings
HTAX(k)	Household taxes
ID(i,k)	Investment demand (by sector of origin)
INDTAX(k)	Indirect tax revenue
MPS(hh,k)	Savings propensities by households
REMIT(k)	Remittance income to households
TARIFF(k,cty1)	Tariff revenue
VATAX(k)	Value added taxes
YH(hh,k)	Household income
YINST(ins,k)	Institutional income
ZFIX(k)	Fixed aggregate real investment
ZTOT(k)	Aggregate nominal investment
Externality effects	
SAD(i,k)	Aggregate exports externality parameter
SAD2(i,k)	Intermediate inputs externality parameter
SAC(iff,k)	Capital goods externality parameter
EKPTL(k)	Aggregate exports
MKPTL(k)	Capital goods imports

Table 13: Quantity Equations

(1)	SMV(i,f,k)	=	AMV(i,f,k) + BETAV(i,f,k)*LOG(X(i,k)) + SUM(iff$ivi(i,iff,k), GAMMAV(i,k,f,iff) *LOG(WF(iff,k)*WFDIST(i,iff,k))) ;
(2)	WF(f,k)*WFDIST(i,f,k)*FDSC(i,f,k)	=	smv(i,f,k)*(1-vatr(i,k))*PVA(i,k)*X(i,k) ;
(3)	INT(i,k)	=	SUM(j, IO(i,j,k)*X(j,k));

Model Specification

In addition to ten sectors for each country model, the model has four factors of production (two labor types, land, and capital), as identified in Table 10. The output-supply and input-demand equations are shown in Table 13. Output is produced according to a translog value added cost function of the primary factors (equation 1), with intermediate inputs demanded in fixed proportions (equation 3). Producers are assumed to maximize profits, implying that each factor is demanded so that marginal product equals marginal cost (equation 2). In each economy, factors are not assumed to receive a uniform wage or "rental" (in the case of capital) across sectors; "factor market distortion" parameters (the WFDIST that appears in equation 2) are imposed that fix the ratio of the sectoral return to a factor relative to the economywide average return for that factor.

Table 14: Price Equations

(4)	PM(imi,k,cty1)	=	PWM(imi,k,cty1)*EXR(k) * (1 + TM(imi,k,cty1) + tm2(imi,k,cty1)) ;
(5)	PE(iei,k,cty1)	=	PWE(iei,k,cty1) * (1 - te(iei,k))*EXR(k) ;
(6)	PEK(ie,k)	=	SUM(cty1$pt(k,cty1), PE(i,k,cty1) * E(i,k,cty1)) / EK(i,k) ;
(7)	PDA(i,k)	=	(1 - TX(i,k)) * PD(i,k) ;
(8)	PQ(i,k)*Q(i,k)	=	PD(i,k)*D(i,k) + SUM(cty1$imi(i,k,cty1), (PM(i,k,cty1)*M(i,k,cty1))) ;
(9)	PX(i,k)*X(i,k)	=	PDA(i,k)*D(i,k) + SUM(cty1$iei(i,k,cty1), (PE(i,k,cty1)*E(i,k,cty1))) ;
(10)	PC(i,k)	=	PQ(i,k) * (1 + TC(i,k)) ;
(11)	PINDCON(k)	=	PROD(i, PC(i,k)**pwtc(i,k)) ;
(12)	PVA(i,k)	=	PX(i,k) - SUM(j,IO(j,i,k)*PC(j,k)) + PIE(i,k);
(13)	LOG(PVA(i,k))	=	LOG(AVS(i,k)) + SUM(iff, SMV0(i,iff,k)*LOG(WF(iff,k)*WFDIST(i,iff,k))) ;
(14)	PWE(i,cty1,cty2)	=	pwm(i,cty2,cty1) ;

The price equations are shown in Table 14. In equations 4 and 5, world prices are converted into domestic currency, including any tax or tariff components. Equation 14 guarantees cross-trade price consistency, so that the world price of country A's exports to country B are the same as the world price of country B's imports from country A. Equation 6 defines the aggregate export price as the weighted sum of the export price to each destination. Equation 7 calculates the domestic price, net of indirect tax. Equations 8 and 9 describe the prices for the composite commodities Q and X. Q represents the aggregation of sectoral imports (M) and domestic goods supplied to the domestic market (D). X is total sectoral output, which is a CET aggregation of total supply to export markets (E) and goods sold on the domestic market (D). Equation 10 defines the consumption price of composite goods from the composite good price (PQ) and consumption taxes (tc). Equation 12 defines the sectoral price of value added, or "net" price (PVA), as the output price minus the unit cost of intermediate inputs (from the input-output coefficients), plus production incentives from exogenous agricultural producer subsidy schemes (PIE). Equation 13 is the Stone price index used with the translog production functions (equations 1 and 2).

In the APEC-CGE model, the aggregate consumer price index in each region is set exogenously (PINDCON in equation 11), defining the *numeraire*. The advantage of this choice is that solution wages and incomes are in real terms; moreover, since our Cobb-Douglas price index is consistent with the underlying Cobb-Douglas utility function, the changes in consumption levels generated by the model are exactly equal to the *equivalent variation*. The solution exchange rates in the sub-regions are also in real terms, and can be seen as equilibrium price-level-deflated (PLD) exchange rates, using the country consumer price indices as deflators. The exchange rate for the rest of the world is fixed, thereby defining the international *numeraire*.

Table 15: Income and Expenditure Equations

(15)	YFCTR(iff,k)	=	SUM(i, (1-ft(k))*WF(iff,k)*WFDIST(i,iff,k)*FDSC(i,iff,k));
(16)	TARIFF(k,cty1)	=	SUM(i$imi(i,k,cty1), TM(i,k,cty1)*M(i,k,cty1)*PWM(i,k,cty1))*EXR(k) ;
(17)	PREM(i,k)	=	SUM(cty1$imi(i,k,cty1), TM2(i,k,cty1)*M(i,k,cty1)*PWM(i,k,cty1))*EXR(k) ;
(18)	INDTAX(k)	=	SUM(i, TX(i,k)*PD(i,k)*D(i,k)) ;
(19)	EXPTAX(k)	=	SUM((i,cty1), te(i,k)*PWE(i,k,cty1)*E(i,k,cty1)*EXR(k)) ;
(20)	YINST("labr",k)	=	SUM(la, YFCTR(la,k)) ;
(21)	YINST("ent",k)	=	YFCTR("capital",k) + EXR(k)*FKAP(k) - ENTSAV(k) - ENTAX(k) + ENTT(k) +
			SUM(i,(1-sprem(i,k))*PREM(i,k)) ;
(22)	YINST("prop",k)	=	YFCTR("land",k) ;
(23)	YH(hh,k)	=	SUM(ins, sintyh(hh,ins,k)*YINST(ins,k)) + rhsh(hh,k)*EXR(k)*REMIT(k) + HHT(k)*thsh(hh,k) ;
(24)	ENTAX(k)	=	ENTR(k)*(YFCTR("capital",k) + ENTT(k)) ;
(25)	FTAX(k)	=	SUM((iff,i), ft(k)*WF(iff,k)*WFDIST(i,iff,k)*FDSC(i,iff,k));
(26)	HTAX(k)	=	SUM(hh, hhtr(hh,k)*YH(hh,k)) ;
(27)	VATAX(k)	=	SUM(i, vatr(i,k)*PVA(i,k)*X(i,k)) ;
(28)	CONTAX(k)	=	SUM(i, TC(i,k)*PQ(i,k)*Q(i,k)) ;
(29)	FPE(k)	=	SUM(i, pie(i,k)*X(i,k)) ;
(30)	GOVREV(k)	=	SUM(cty1, TARIFF(k,cty1)) + INDTAX(k) + EXPTAX(k) + FTAX(k) + HTAX(k) + CONTAX(k) +
			SUM(i,sprem(i,k)*PREM(i,k)) + ENTAX(k) + VATAX(k) + FBOR(k)*EXR(k);
(31)	GOVSAV(k)	=	GOVREV(k) - SUM(i, GD(i,k)*PC(i,k)) - HHT(k) - ENTT(k) - FPE(k) ;
(32)	HSAV(k)	=	SUM(hh, MPS(hh,k)* ((1.0-hhtr(hh,k))*YH(hh,k)));
(33)	ENTSAV(k)	=	esr(k)*YFCTR("capital",k) ;
(34)	ZTOT(k)	=	GOVSAV(k) + HSAV(k) + ENTSAV(k) + EXR(k) * FSAVE(k);
(35)	FSAVE(k)	=	FBAL(k)-FKAP(k)-FBOR(k)-REMIT(k) ;
(36)	CDD(i,k)	=	SUM(hh, CLES(i,hh,k)*YH(hh,k)*(1.0-hhtr(hh,k))*(1.0-mps(hh,k))) / PC(i,k) ;
(37)	GD(i,k)	=	gles(i,k)*GDTOT(k) ;
(38)	ID(i,k)	=	zshr(i,k)*ZFIX(k) ;
(39)	ZTOT(k)	=	SUM(i, PC(i,k)*ID(i,k)) ;
(40)	GOVGDP(k)	=	SUM(i, pc(i,k)*gd(i,k)) / gdpva(k) ;
(41)	INVGDP(k)	=	SUM(i, pc(i,k)*id(i,k)) / gdpva(k) ;
(42)	GDPVA(k)	=	SUM(i, PC(i,k)* (CDD(i,k)+GD(i,k)+ID(i,k))) + SUM((i,cty1), PWE(i,k,cty1) * E(i,k,cty1))*EXR(k) -
			SUM((i,cty1), PWM(i,k,cty1) * M(i,k,cty1))*EXR(k) ;

The circular flow of income from producers, through factor payments, to households, government, and investors, and finally back to demand for goods in product markets is shown in the equations in Table 15. The country models incorporate official tariff revenue (TARIFF in equation 16) which flows to the government, and the tariff equivalent of non-tariff barriers (PREM in equation 17) which accrues as rents to the private sector.[26] Each economy is modelled as having a number of domestic market distortions, including sectorally differentiated indirect, consumption, and value-added taxes as well as factor, household, and corporate income taxes (equations 18-19 and 24-28). The single household category in each economy has a Cobb-Douglas expenditure functions (equation 36). Real investment and government consumption are set in equations 37 and 38, while aggregate government consumption and investment are set to fixed shares of GDP in equations 40 and 41.

Table 16: Export and Externality Equations

(43)	X(ie1,k)	=	AT(ie1,k)*(GAMMAK(ie1,k)*EK(ie1,k)**(-RHOT(ie1,k)) + (1 - GAMMAK(ie1,k))*D(ie1,k) **(-RHOT(ie1,k)))**(-1/RHOT(ie1,k)) ;
(44)	X(ien,k)	=	D(ien,k) ;
(45)	EK(ie1,k)	=	D(ie1,k)*(PDA(ie1,k)/PEK(ie1,k)*GAMMAK(ie1,k)/(1-GAMMAK(ie1,k))) **(1/(1+RHOT(ie1,k)));
(46)	E(iec,k,cty1)	=	EK(iec,k) * (((gamma(iec,k,cty1)*PEK(iec,k)) / (ae(iec,k)**rhoe(iec,k) * pe(iec,k,cty1))) **(1/(1+rhoe(iec,k)))) ;
(47)	PE(iecn,k,cty1)	=	PEK(iecn,k) ;
(48)	EK(i,k)	=	EKB(i,k)* (PWE(i,k,"row")/PWEB(i,k))**(-etae(i,k)) ;
(49)	SUM(k, E(i,k,"row"))	=	EROWB(i) * (PWEFX(i)/PWEFXB(i))**(-etaw(i)) ;
(50)	PWE(i,k,"row")	=	PWERAT(i,k)*PWEFX(i) ;
(51)	M(i,cty1,cty2)	=	E(i,cty2,cty1) ;
(52)	SAD2(i,k)	=	(mkptl(k)/mkptl0(k))**etam2(k))*(1 - pvab0(i,k)) + pvab0(i,k) + SLACKAD2(i,k);
(53)	SAD(ie1,k)	=	(EK(ie1,k)/EKB(ie1,k))**(etae2(ie1,k)) + SLACKAD(ie1,k) ;
(54)	SAC("capital",k)	=	(EKPTL(k)/EKPTL0(k))**etak2(k) + SLACKAC("capital",k) ;
(55)	EKPTL(k)	=	SUM((cty1,i), PWE(i,k,cty1)*E(i,k,cty1)) ;
(56)	MKPTL(k)	=	SUM((cty1,ik), PWM0(ik,k,cty1)*M(ik,k,cty1)) ;

Export-related functions are shown in Table 16. Exports are supplied according to a CET function between domestic sales and total exports (equation 43), and allocation between export and domestic markets occurs in order to maximize revenue from total sales (equation 45). The rest of the world is modeled as a large supplier of imports to each model region at fixed world prices. Rest of world demand for regional exports can either be modelled as occurring at fixed world prices, or with two alternative mechanisms to capture possible terms of trade effects. First, each region can be characterized as facing its own downward-sloping demand curve based on its total exports (equation 48), where the price it faces is a function of the amount it exports relative to the base. Second, one can characterize the export price for each region as determined by aggregated changes in the export market, so that the average world price is set in equation 49, and each region's export price linked to that in equation 50 by requiring that PWERAT equal 1. The final equations in Table 16 specify how trade-related externalities are incorporated into the model. There are three different kinds of trade-productivity links. Equation 52 relates productivity in

[26] Because the GTAP data source used combines tariffs and NTBs together, in the APEC model data both tariffs and NTBs are treated as tariffs (TM) only, except for the additional NTBs on industrial goods for Japan, which are kept as separate NTBs (TM2).

production to imports of intermediate and capital goods. The extent of productivity increase depends on the share of intermediates in production. The productivity parameter, SAD2, appears in the production function and profit maximization equations (1 and 2). Equation 53 quantifies the externality associated with export performance — higher export growth relative to the base value at the sectoral level (EK/EKB) translates into a larger value of the productivity parameter SAD, which also directly affects domestic productivity (equations 1 and 2). Equation 54 represents the externality associated with aggregate exports. Increased aggregate exports yields a higher value of SAC, which is "embodied" in the capital stock input into the production process.

Table 17: AIDS Import Demand Equations

(57)	PM(i,k,k)	=	PD(i,k) ;
(58)	LOG(PQ(i,k))	=	LOG(AQS(i,k)) + SUM(cty2, SMQ0(i,k,cty2)*LOG(PM(i,k,cty2))) ;
(59)	SMQ(imi,k,cty1)	=	AMQ(imi,k,cty1) + BETAQ(imi,k,cty1)*LOG(Q(imi,k)) +
			SUM(cty2,GAMMAQ(imi,k,cty1,cty2)*LOG(PM(imi,k,cty2))) ;
(60)	SMQ(i,k,k)	=	1 - SUM(cty1, SMQ(i,k,cty1)) ;
(61)	M(i,k,cty1)	=	smq(i,k,cty1)*PQ(i,k)*Q(i,k) / PM(i,k,cty1) ;
(62)	PD(i,k) * D(i,k)	=	SMQ(i,k,k) * Q(i,k)*PQ(i,k) ;

The specification of the almost ideal demand system (or AIDS) for imports is shown in Table 17. The expenditure shares SMQ are given by equation 59, where subscript *imi* refers to sectors, subscript *k* refers to the importing country, and subscript *cty1* refers to the source of the imports (another region or the rest of the world). We adopt the notation convention that when $k = cty1$, we are describing the domestic component of composite demand (D). Hence in equation 57, the "own" price of imports is simply the domestic price, and in equation 62, D is determined by the $SMQ_{i,k,k}$ share, while the import demands are determined in equation 61. The composite price index, PQ, is defined in equation 58 as a Stone price index [Deaton and Muellbauer (1980)].[27]

Table 18: Migration Relations

(63)	(AVWF(la,k)/EXR(k))	=	wgdfl(la,k,la,l)*(AVWF(la,l)/EXR(l)) ;
(64)	FS(la,k)	=	FS0(la,k) + MIGL(la,k) + MIGRU(la,k) ;
(65)	SUM(k, MIGL(la,k))	=	0 ;
(66)	SUM(la, MIGRU(la,k))	=	0 ;

Table 18 outlines the labor migration relations in the model (which are not used in the simulations reported in this paper), equilibrium international migration levels are determined which maintain a specified ratio of real wages in the two labor categories in the countries, measured in a common currency. According to equation 63, the international migration equilibrium requires that real average wages (AVWF) remain in a fixed ratio (WGDFL) for each migrating labor category in the two countries, measured in a common currency. Similarly, internal migration in each country maintains a specified ratio of average real

[27] Robinson, Soule, and Weyerbrock (1991) analyze the empirical properties of different import aggregation functions in a three-country model of the U.S., European Community, and rest of world that is broadly similar to our APEC CGE model. Green and Alston (1990) discuss the computation of various elasticities in the AIDS system when using the Stone or translog price indices.

wages between the rural and unskilled urban markets (the EXR terms become irrelevant). Domestic labor supply in each skill category in each country is then adjusted by the migrant labor flow (equation 64), while the other two equations insure that workers do not "disappear" or get "created" in the migration process.

Table 19: Market-Clearing Equations

(67)	Q(i,k)	=	INT(i,k) + CDD(i,k) + GD(i,k) + ID(i,k) ;
(68)	FS(iff,k)	=	SUM(i, FDSC(i,iff,k)) / SAC(iff,k) ;
(69)	AVWF(iff,k)	=	SUM(i, (1-ft(k))*wfdist(i,iff,k)*wf(iff,k)*fdsc(i,iff,k))/SUM(j, fdsc(j,iff,k)) ;
(70)	FSAV(k,cty1)	=	SUM(i, PWM(i,k,cty1)*M(i,k,cty1)) - SUM(i, PWE(i,k,cty1)*E(i,k,cty1)) ;
(71)	FBAL(k)	=	SUM(cty1, FSAV(k,cty1)) ;

To complete the model, there are a number of additional "market-clearing" or equilibrium conditions that must be satisfied, as shown in Table 19. Equation 67 is the material balance equation for each sector, requiring that total composite supply (Q) equal the sum of composite demands. Equation 68 provides equilibrium in each factor market; the SAC parameter provides the means to incorporate the externality associated foreign capital goods imports. Equation 70 is the balance condition in the foreign exchange market, requiring that import expenditures equal the sum of export earnings and net foreign capital inflows; equation 71 is the overall trade balance equation, summing up the bilateral trade balances.

Model Closure

The APEC model permits a number of different "closure" choices that affect the macroeconomic relationships in the model. In all simulations reported in this paper, we have assumed that the aggregate trade balance (FBAL) is fixed for each country, and that the exchange rate (EXR) varies to achieve external balance. Fixed investment and government consumption shares in GDP (GOVGDP and INVGDP) are also fixed exogenously in equations 39 and 40. To satisfy the government budget constraint in equation 30, we permit lump-sum household transfers (HHT) to be determined as a residual. Since investment is fixed as a share of GDP, some component of aggregate savings must be free to move; we require that household savings rates (MPS) adjust to achieve savings-investment balance.

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