

# Beyond the Uruguay Round: The Implications of an Asian Free Trade Area

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**ABSTRACT:** At the 1994 APEC meetings in Bogor, members made a commitment to form an APEC free trade area (FTA) by 2020. Using a multi-country, computable general equilibrium (CGE) model, this paper explores the impact of such an arrangement on Pacific Rim economies. An APEC FTA yields gains in GDP for all APEC countries, with larger gains for the developing countries which benefit more from the increased trade. There are advantages in making the FTA as broad as possible: omitting any one region (US, China, or ASEAN4) makes that region significantly worse off, and lowers the gains for all other members as well. The Asian NIEs have the most to gain from broad FTA membership—exclusion of China reduces Asian NIE gains by about half. Global trade liberalization including the EU and rest of world along with APEC is the most favorable outcome—with each APEC country gaining more from global liberalization than it does from joining an APEC FTA alone. *JEL Categories: F1; F4; O5.*

## INTRODUCTION

The growing interest in and acceleration towards regional integration arrangements represents one of the most significant paradigmatic shifts in the international policy arena over the last several decades. Only a decade ago, the conventional wisdom was that the scope for successful regional free trade initiatives was relatively limited, with the international landscape littered with examples of efforts that had fallen short of their original lofty goals. Preliminary negotiations over the Uruguay Round were just beginning in an environment characterized by suspicion over hidden agendas and North-South confrontation. An outside observer would have found tangible progress only among the industrialized nations of the (then) European Economic Community and North America, and even there the controversy engendered by efforts to define common standards, tax, and tariff regimes might easily have suggested that these initiatives would likely suffer a bureaucratic death. Earlier regional initiatives among the developing countries (such as the Andean Pact) had collapsed, and regional organizations that achieved some success (such as ASEAN) had done so by restricting their scope to cooperation on political and security issues.

The situation of a decade ago seems like ancient history when viewed from our current vantage point. The signing and implementation of the NAFTA agreement linking the North American economies has erased the notion that free trade agreements between developing and industrial economies were unattainable. After many years of uncertainty, the successful completion of the Uruguay Round Agreement (URA) has imparted substantial forward

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momentum to multilateral trade liberalization. New or revitalized regional groupings are advancing ambitious agendas of regional cooperation and trade liberalization, ranging from the Mercosur and Andean Pact groups in the Western Hemisphere to ambitious expansion plans for the European Union in coming years.

Despite this progress, substantial tensions remain in several areas. While the URA represents a victory for multilateralism, the possible proliferation of regional agreements has amplified concerns over the potential costs imposed by separation of the trading system into exclusive blocks.<sup>1</sup> NAFTA has set off a scramble in the Western Hemisphere among those not yet included, with nations from the Caribbean to Chile struggling with alternatives ranging from NAFTA accession to formation of separate free trade areas. In Asia, fears are expressed regarding the potential trade diversion that might occur as a result of NAFTA implementation, although most empirical estimates suggest that the losses would be small.<sup>2</sup>

Within East Asia, similar pressures are evident as well. The Pacific Rim members of the newly formed APEC forum have widely divergent views over the desirable role of this group in fostering trade liberalization. Some nations (such as the U.S. and Singapore) advocate free trade among APEC members by the year 2020, while others (led by China and Malaysia) argue for less ambitious objectives. Meanwhile, the evolution of APEC has forced the six ASEAN nations to reconsider the appropriate role for that group. Several years ago this group committed to plans for an ASEAN Free Trade Area (AFTA) that would reduce tariffs on most products to a maximum of five percent among the members by 2008: The pressure of events elsewhere recently resulted in an ASEAN decision to broaden the scope and accelerate the timetable so that major reforms would be completed by 2003 instead.

Among the factors generating pressure on Asian (and other) economies is the increasing globalization and integration of world markets, particularly as more and more regions leave behind their inward-looking policies and look outward for growth and markets. Import substitution policies and investment controls once provided insulation from international economic pressures to countries that adopted them, albeit at enormous cost. In today's climate, with massive (and somewhat fickle) foreign capital flows, and increasing competitive pressures in export markets, it is not enough for countries to simply make progress towards a more open trade and investment regime; exporting economies must devote equal attention to what their competitors are doing.

This situation seems particularly prevalent in East Asia. Without question, this region has benefitted enormously from rapid growth in world trade: The World Bank (1994) reports that over the last 25 years, the region's exports have grown by a factor of 30, corresponding to an increase in the share of world exports from 7-21 percent. This report goes on to argue forcefully that East Asia should aggressively pursue liberalization at a pace faster than that promised in the URA in order to provide a locomotive to pull the world trading system towards greater openness. But running counter to this sentiment is a less optimistic perception that the ordered historical progression of export-led growth from Japan to the Asian "tigers" to the next tier has now been supplanted by a more chaotic scramble for advantage in an increasingly competitive world. The response to trade liberalization for one country in Asia depends not only on its own actions, but also on what other countries do as well. For example, the impact of China's resurgence on the region (as well as the possible costs of any renewed isolation or exclusion from the WTO), the potential competition from Vietnam, and the long-run effect of changes in the distribution or

magnitude of foreign investment flows into the region were important factors behind the recent ASEAN decision to accelerate the timetable for its own free trade area.

It can be argued that concern over the policy environment in a country's economic neighbors may be beneficial, and even create momentum towards a self-fulfilling or virtuous circle of liberalization. But there is also the danger that such concerns can increase exclusionary pressures, or encourage strategic behavior that benefits the individual country but at the expense of the broader region.<sup>3</sup> While rarely openly identified as such, these pressures are evident in East Asia in areas ranging from 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 suggestions that any Asian free trade arrangement should exclude the United States.

This paper provides an empirical assessment of three different questions related to regional integration options for the broad Asian region:

1. What is the impact of an APEC free trade area on trade, welfare, and economic structure in the Pacific Rim economies?
2. What are the implications of pursuing free trade initiatives when one major partner is excluded? In particular, who gains and who loses when either China, the ASEAN economies, or the US is excluded from the FTA?
3. How do the various FTA alternatives compare with the more ambitious scenario of full world trade liberalization?

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. Our APEC CGE model consists of six linked country models: US, Japan, EU, Asian NIEs (Korea, Taiwan, Singapore), China (including Hong Kong), and ASEAN4 (Indonesia, Thailand, Philippines, and Malaysia).<sup>4</sup> Each country model has 10 sectors and two labor types, and is linked to other countries through explicit modeling of all bilateral trade flows for all traded sectors.

We use the model to simulate a series of alternative free trade scenarios, starting with a base case in which all tariff and non-tariff barriers are removed among the APEC economies (US, Japan, Asian NIEs, China, and ASEAN). We then contrast these static results with a model scenario that incorporates the notion that increased trade (or "openness") creates various externalities that directly increase productivity. Finally, we consider the implications of a free trade arrangement in which one economy (either China, ASEAN4, or the US) is left out, in order to assess quantitatively whether ASEAN4 or China gain from the exclusion of the other, and whether the Asian region is better off proceeding without the US as a partner.

The next section provides an overview of the economic structure, trade linkages, and structure of protection among countries in the APEC region, while also introducing the data used in our model. Section three introduces the conceptual tools that are needed to analyze trade liberalization and regional integration, and presents the main features of our APEC CGE model. Section four presents the alternative regional integration scenarios, and section five presents conclusions. An appendix contains a more complete description of the model.

### ECONOMIC STRUCTURE AND TRADE PATTERNS IN MAJOR APEC ECONOMIES

Our APEC model is constructed around a six-region, 10-sector, four-factor Social Accounting Matrix estimated for the year 1992.<sup>5</sup> 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. The purpose of this SAM-based data analysis is to provide an overview of the structure and linkages among the regional economies and lay the groundwork for an understanding of the simulation results reported later in this paper.<sup>6</sup>

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

|                                                           | <i>USA</i> | <i>Japan</i> | <i>China</i> | <i>ASEAN4</i> | <i>Asian<br/>NIEs</i> | <i>EU</i> |
|-----------------------------------------------------------|------------|--------------|--------------|---------------|-----------------------|-----------|
| <i>GDP and Trade Flows (billion US\$):</i>                |            |              |              |               |                       |           |
| Exports                                                   | 576.4      | 407.3        | 141.8        | 137.4         | 255.7                 | 731.8     |
| Imports                                                   | 618.9      | 318.4        | 157.3        | 127.0         | 236.6                 | 770.4     |
| GDP                                                       | 5899.1     | 3756.2       | 520.9        | 361.7         | 560.6                 | 6691.4    |
| <i>Trade Dependence (percent):</i>                        |            |              |              |               |                       |           |
| Export/GDP                                                | 9.8        | 10.8         | 27.2         | 38.0          | 45.6                  | 10.9      |
| Import/GDP                                                | 10.5       | 8.5          | 30.2         | 35.1          | 42.2                  | 11.5      |
| <i>Share in World Factor Endowment (percent):</i>         |            |              |              |               |                       |           |
| Land                                                      | 13.0       | 0.3          | 6.7          | 3.9           | 0.2                   | 5.7       |
| Total labor                                               | 5.1        | 2.6          | 28.8         | 5.6           | 1.2                   | 6.4       |
| Capital                                                   | 23.6       | 17.8         | 2.0          | 1.2           | 1.8                   | 30.1      |
| Agri. labor                                               | 0.2        | 0.3          | 41.4         | 6.1           | 0.5                   | 0.8       |
| <i>Factor Share in APEC Region Value Added (percent):</i> |            |              |              |               |                       |           |
| Land                                                      | 0.3        | 0.9          | 8.3          | 5.3           | 3.7                   | 0.4       |
| Labor                                                     | 64.7       | 58.8         | 53.1         | 29.3          | 53.0                  | 65.6      |
| Capital                                                   | 35.0       | 40.3         | 38.5         | 65.4          | 43.3                  | 34.0      |
| <i>Labor Cost (thousand \$):</i>                          |            |              |              |               |                       |           |
| Average wage                                              | 27.8       | 31.2         | 0.3          | 0.5           | 3.8                   | 27.0      |
| Average agri. wage                                        | 14.7       | 17.8         | 0.2          | 0.2           | 3.8                   | 19.5      |
| Average non-agri. wage                                    | 28.1       | 32.0         | 0.6          | 0.7           | 3.8                   | 27.4      |
| <i>Capital Return (percent):</i>                          |            |              |              |               |                       |           |
| Average capital rental                                    | 11.8       | 11.2         | 11.4         | 24.9          | 17.3                  | 10.6      |
| <i>Factor Proportions:</i>                                |            |              |              |               |                       |           |
| Agri. labor/total labor<br>(percent)                      | 2.1        | 5.8          | 66.6         | 39.1          | 8.2                   | 5.5       |
| Capital/labor ratio<br>(\$000/worker)                     | 127.7      | 190.6        | 2.0          | 4.7           | 18.1                  | 132.0     |
| Rental/wage ratio<br>(percent/\$000)                      | 0.4        | 0.4          | 36.4         | 47.7          | 4.5                   | 0.4       |

Sources. APEC model database derived from GTAP data (Hertel, in press)

Table 1 presents data on factor endowments, intensities, and costs for the regions included in the model. It reveals enormous differences in factor endowments and factor cost among these regions. ASEAN4 and China, as low-income developing countries, are poorly endowed with capital relative to labor. They have the lowest capital-labor ratios, the largest share of agriculture labor in the total labor force (half of their labor force is in agriculture), and the highest rental-wage ratio. The reverse is true for Japan, the European Union, and the United States. The Asian NIEs fall somewhere 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.

Since one focus of the model is on international trade flows, it is useful to present the trade structure in some detail. International trade theory generally identifies two different types of international trade. Trade among developed industrial countries with similar endowments and technology has been increasingly characterized as "intra-industry,"<sup>7</sup> whereas trade between high and low-income economies that have different factor endowments and technological processes is still on an inter-industry basis. The tremendous range in factor endowments and level of economic development among our model economies suggest that perhaps the traditional Heckscher-Ohlin arguments (based on different factor endowments) may explain trade among them to a large extent.

Table 2 presents the share of each region's exports and imports in total world trade from the base data used in the model. 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.<sup>8</sup> Overall, trade among the APEC regions in the model accounts for 70 percent of the total trade, with the rest of the world representing the rest.

Model data also reveal sizeable differences in structure and international comparative advantage among ASEAN4, China, the Asian NIEs, and industrial countries such as Japan, the United States, and the European Union. ASEAN4 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 because of a smaller service sector. Japan, the European Union, and the United States are dominated by a large service sector with a much smaller labor-intensive manufacturing sector. Again, the Asia NIEs lie between China and ASEAN4 and the industrial countries.

Trade shares are consistent with intuition about international comparative advantage. For example, a labor-intensive industry, textile and apparel, constitutes 18 percent of ASEAN4 and 42 percent of China's total exports, while machinery and equipment, which is capital and technology-intensive, makes up about 45 and 38 percent of their total imports respectively. The reverse is true for Japan and the United States. The Asia NIEs are in between, with a lower textile export share but a much higher machinery export share than China and ASEAN4, but a higher textile export share and a lower machinery and equipment export share than Japan and the United States.<sup>9</sup>

ASEAN4 and Asian NIEs have the highest trade dependence, especially in the capital-intensive machinery and equipment industries. 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 exported more one third of its labor-intensive textile and apparel output and imported one third of its machinery and equipment from

**Table 2**  
Sectoral Export and Import Shares in World Trade

|                                | USA  | Japan | China | ASEAN4 | Asian NIEs | EU   | ROW  | Total |
|--------------------------------|------|-------|-------|--------|------------|------|------|-------|
| <i>Shares in World Exports</i> |      |       |       |        |            |      |      |       |
| Grains                         | 54.8 | 0.0   | 7.5   | 5.2    | 0.2        | 11.0 | 21.3 | 100.0 |
| Other Agriculture              | 21.4 | 0.6   | 6.0   | 10.6   | 3.7        | 9.6  | 48.1 | 100.0 |
| Forestry & Fishery             | 16.9 | 1.9   | 4.7   | 16.6   | 8.7        | 5.4  | 45.7 | 100.0 |
| Energy & Minerals              | 4.0  | 0.4   | 2.4   | 7.6    | 0.3        | 6.2  | 79.2 | 100.0 |
| Food Processing                | 19.7 | 1.4   | 4.0   | 9.0    | 4.7        | 29.6 | 31.7 | 100.0 |
| Textile & Apparel              | 8.2  | 9.7   | 19.2  | 8.1    | 17.0       | 17.7 | 20.2 | 100.0 |
| Wood & Paper                   | 18.9 | 3.0   | 2.4   | 8.0    | 5.1        | 17.4 | 45.2 | 100.0 |
| Basic Intermediates            | 17.3 | 10.2  | 2.6   | 2.4    | 8.6        | 27.9 | 31.0 | 100.0 |
| Machinery & Equipment          | 22.8 | 23.7  | 2.6   | 2.9    | 9.4        | 23.4 | 15.2 | 100.0 |
| Services                       | 17.9 | 8.8   | 2.8   | 2.5    | 5.9        | 27.5 | 34.6 | 100.0 |
| Total                          | 17.9 | 12.7  | 4.4   | 4.3    | 7.9        | 22.7 | 30.1 | 100.0 |
| <i>Shares in World Imports</i> |      |       |       |        |            |      |      |       |
| Grains                         | 2.6  | 19.2  | 10.2  | 6.0    | 11.0       | 5.9  | 45.1 | 100.0 |
| Other Agriculture              | 14.3 | 13.7  | 4.8   | 3.9    | 9.4        | 37.1 | 16.8 | 100.0 |
| Forestry & Fishery             | 14.9 | 42.9  | 4.0   | 3.7    | 6.4        | 22.1 | 6.0  | 100.0 |
| Energy & Minerals              | 22.1 | 20.8  | 2.3   | 2.7    | 9.2        | 36.2 | 6.8  | 100.0 |
| Food Processing                | 15.1 | 16.5  | 5.2   | 3.3    | 6.2        | 22.4 | 31.3 | 100.0 |
| Textile & Apparel              | 26.7 | 7.5   | 7.1   | 2.7    | 5.1        | 26.4 | 24.5 | 100.0 |
| Wood & Paper                   | 20.6 | 9.6   | 4.1   | 2.3    | 5.3        | 33.2 | 25.0 | 100.0 |
| Basic Intermediates            | 17.1 | 8.5   | 6.9   | 6.7    | 10.0       | 20.7 | 30.1 | 100.0 |
| Machinery & Equipment          | 23.6 | 4.3   | 5.5   | 5.4    | 8.3        | 19.9 | 33.0 | 100.0 |
| Services                       | 12.5 | 12.9  | 3.0   | 1.9    | 5.4        | 24.8 | 39.5 | 100.0 |
| Total                          | 19.2 | 9.9   | 4.9   | 3.9    | 7.4        | 23.9 | 30.8 | 100.0 |

*Notes:* Calculated from APEC model data base derived from GTAP data (Hertel, in press)

abroad. The United States and Japan, as the two largest economies in the world, are relatively more self-sufficient. However, 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 States has relatively low trade dependency, at the sectoral level it exports significant shares of its textile and capital goods output, and imports large amounts of nondurable manufactured goods (textiles and apparel), machinery and equipment, and energy and mineral products.

Table 3 presents data on the directions of net trade flows in the base year for the regions in the model. They show that, among the advanced countries, minerals and energy are the major import sector, while capital-intensive manufactures are generally major net export sectors, except for machinery and equipment in the United States, where there is a large deficit with Japan (\$58 billion). The US is a net exporter of agricultural and food processing products and services, the EU has a surplus in food processing, intermediates, machinery, and services, and Japan has an enormous surplus (over \$200 billion) in the machinery and equipment sector, with much smaller positive balances for textiles and intermediates. China and ASEAN4 trade patterns exhibit some similarities: They are both net importers of capital-intensive manufactured products (basic intermediates, machinery and equipment), net exporters in labor-intensive manufactures and other primary products, and largely self-sufficient in food grains. The ASEAN4 trade surplus is diversified across mineral and energy products and other resource-based sectors as well as in textiles and apparel. The net trade data for the Asian NIEs reveal that these economies are net exporters both of labor-intensive manufactures (like China and ASEAN4) and technology and capital-intensive machinery and equipment (like the industrial countries), and net importers of intermediates and mineral and energy products. At the aggregate level, the Asian NIEs have a trade surplus with the United States, European Union, and China, but a large trade deficit with Japan.

East Asian countries have become important markets for developed countries, especially for manufactured products. The export share of the United States and European Union in the capital-intensive manufactured goods market to the Asian NIEs has exceeded their share to Japan. Asian countries have also become the largest market for manufactured intermediate exports from Japan. Most of the trade among the six regions included in the model is concentrated in manufactured goods, notably on labor-intensive consumer goods, basic intermediates, and machinery and equipment.

China and ASEAN4 also rely heavily on industrial countries as final markets for their exports, especially their natural resource-based sectors and labor-intensive nondurable manufactured products. In 1992, Japan represents the largest market for primary resource-based exports from China and ASEAN4 (forest and fishery, minerals and energy products), while the Asian NIEs and the United States are the largest market for ASEAN4 and Chinese consumer goods exports. In the meantime, China and ASEAN4 depend on industrial countries, especially Japan and the Asian NIEs, as their major supplier of basic manufactured intermediates, and machinery and equipment. The Asian NIEs are also heavily dependent on the industrial countries, especially the United States, as final markets for their manufactured products, but rely more on Japan than the US to supply their intermediate and capital-intensive manufactured goods.

The United States and Japan are the world's largest importing and exporting economies, but the composition of exports and imports for them is quite different, in both bilateral

**Table 3**  
**Direction of Net Trade Flows Among Regions in 1992**  
 (Billion US\$)

|                          | USA    | Japan  | China  | ASEAN4 | Asian NIEs | EU    | ROW    | TOTAL  |
|--------------------------|--------|--------|--------|--------|------------|-------|--------|--------|
| <i>The United States</i> |        |        |        |        |            |       |        |        |
| Grains                   | —      | 2.64   | 0.47   | 0.18   | 1.13       | 0.63  | 5.99   | 11.05  |
| Other Agriculture        | —      | 2.54   | 0.58   | -0.40  | 1.99       | 2.78  | -3.00  | 4.49   |
| Forestry & Fishery       | —      | 3.58   | -0.20  | -0.53  | 0.18       | 0.28  | -2.67  | 0.63   |
| Energy & Minerals        | —      | 1.14   | -0.40  | -0.92  | 0.53       | 0.0   | -42.71 | -42.33 |
| Food Processing          | —      | 5.21   | 0.79   | -1.25  | 1.09       | -0.69 | -0.0   | 5.14   |
| Textile & Apparel        | —      | -5.58  | -20.71 | -7.27  | -13.78     | -2.45 | -7.16  | -56.95 |
| Wood & Paper             | —      | 2.59   | -0.17  | -0.61  | -0.32      | 2.21  | -5.67  | -1.96  |
| Basic Intermediates      | —      | 0.24   | 1.56   | 1.05   | 4.13       | -4.74 | -1.35  | 0.89   |
| Machinery & Equipment    | —      | -57.98 | 0.49   | 0.66   | -8.25      | 15.28 | 40.52  | -9.27  |
| Services                 | —      | 17.18  | 1.43   | -0.53  | 2.40       | 36.59 | -11.25 | 45.82  |
| Total                    | —      | -28.42 | -16.18 | -9.61  | -10.89     | 49.93 | -27.31 | -42.48 |
| <i>Japan</i>             |        |        |        |        |            |       |        |        |
| Grains                   | -2.64  | —      | -0.34  | -0.0   | -0.0       | -0.0  | -1.03  | -4.05  |
| Other Agriculture        | -2.54  | —      | -0.88  | -1.11  | -0.49      | -0.37 | -2.95  | -8.34  |
| Forestry & Fishery       | -3.58  | —      | -0.71  | -2.91  | -1.67      | -0.31 | -3.90  | -13.08 |
| Energy & Minerals        | -1.14  | —      | -2.03  | -9.42  | 0.0        | -0.43 | -34.69 | -47.65 |
| Food Processing          | -5.21  | —      | -0.91  | -1.40  | -2.64      | -2.97 | -3.88  | -17.01 |
| Textile & Apparel        | 5.58   | —      | -1.88  | 0.0    | -1.40      | 2.79  | 1.41   | 6.55   |
| Wood & Paper             | -2.59  | —      | 0.30   | -1.72  | -0.0       | -0.34 | -3.04  | -7.47  |
| Basic Intermediates      | -0.24  | —      | 4.67   | 4.06   | 6.99       | -1.81 | -7.03  | 6.64   |
| Machinery & Equipment    | 57.98  | —      | 18.69  | 16.84  | 28.39      | 40.62 | 46.41  | 208.92 |
| Services                 | -17.18 | —      | 0.33   | -5.39  | -2.41      | -4.42 | -6.60  | -35.66 |
| Total                    | 28.42  | —      | 17.26  | -1.01  | 26.74      | 32.74 | -15.31 | 88.84  |

|                       |         |        |       |       |        |       |       |        |
|-----------------------|---------|--------|-------|-------|--------|-------|-------|--------|
|                       | China   |        |       |       |        |       |       |        |
| Grains                | -0.47   | 0.34   | —     | 0.10  | 0.60   | -0.17 | -0.97 | -0.56  |
| Other Agriculture     | -0.58   | 0.88   | —     | 0.0   | 0.33   | 0.80  | -0.67 | 0.76   |
| Forestry & Fishery    | 0.20    | 0.71   | —     | -0.34 | -0.0   | 0.0   | -0.39 | 0.22   |
| Energy & Minerals     | 0.40    | 2.03   | —     | -0.62 | 0.85   | -0.11 | -2.24 | 0.32   |
| Food Processing       | -0.79   | 0.91   | —     | -0.29 | 0.11   | -0.95 | -0.32 | -1.33  |
| Textile & Apparel     | 20.71   | 1.88   | —     | 0.24  | -7.23  | 13.35 | 8.40  | 37.34  |
| Wood & Paper          | 0.17    | -0.30  | —     | -1.04 | -0.77  | 0.17  | -0.22 | -1.99  |
| Basic Intermediates   | -1.56   | -4.67  | —     | 0.37  | -5.74  | -2.48 | -3.47 | -17.55 |
| Machinery & Equipment | -0.49   | -18.69 | —     | -0.72 | -8.21  | -3.19 | 0.26  | -31.03 |
| Services              | -1.43   | -0.33  | —     | -0.65 | -0.42  | 3.59  | -2.44 | -1.68  |
| Total                 | 16.18   | -17.26 | —     | -2.92 | -20.52 | 11.09 | -2.07 | -15.50 |
|                       | ASEAN 4 |        |       |       |        |       |       |        |
| Grains                | -0.18   | 0.0    | -0.10 | —     | 0.11   | 0.0   | -0.0  | -0.17  |
| Other Agriculture     | 0.40    | 1.11   | -0.0  | —     | 1.45   | 1.62  | -0.33 | 4.23   |
| Forestry & Fishery    | 0.53    | 2.91   | 0.34  | —     | 0.38   | 0.24  | -0.25 | 4.14   |
| Energy & Minerals     | 0.92    | 9.42   | 0.62  | —     | 3.47   | 0.0   | -3.24 | 11.27  |
| Food Processing       | 1.25    | 1.40   | 0.29  | —     | 1.06   | 1.38  | 1.04  | 6.42   |
| Textile & Apparel     | 7.27    | -0.0   | -0.24 | —     | -0.36  | 5.71  | 4.19  | 16.51  |
| Wood & Paper          | 0.61    | 1.72   | 1.04  | —     | 1.32   | 1.55  | 0.34  | 6.58   |
| Basic Intermediates   | -1.05   | -4.06  | -0.37 | —     | -5.88  | -2.37 | -3.80 | -17.54 |
| Machinery & Equipment | -0.66   | -16.84 | 0.72  | —     | -3.21  | -5.14 | -1.36 | -26.49 |
| Services              | 0.53    | 5.39   | 0.65  | —     | 0.42   | 1.73  | -3.28 | 5.44   |
| Total                 | 9.61    | 1.01   | 2.92  | —     | -1.25  | 4.84  | -6.73 | 10.40  |

**Table 3**  
Continued

|                       | USA    | Japan  | China                 | ASEAN4 | Asian NIEs | EU    | ROW    | TOTAL  |
|-----------------------|--------|--------|-----------------------|--------|------------|-------|--------|--------|
|                       |        |        | <i>Asian NIEs</i>     |        |            |       |        |        |
| Grains                | -1.13  | 0.0    | -0.60                 | -0.11  | —          | -0.0  | -0.39  | -2.29  |
| Other Agriculture     | -1.99  | 0.49   | -0.33                 | -1.45  | —          | 0.77  | -1.09  | -3.60  |
| Forestry & Fishery    | -0.18  | 1.67   | 0.0                   | -0.38  | —          | 0.11  | -0.52  | 0.74   |
| Energy & Minerals     | -0.53  | -0.0   | -0.85                 | -3.47  | —          | -0.13 | -15.94 | -20.98 |
| Food Processing       | -1.09  | 2.64   | -0.11                 | -1.06  | —          | -1.04 | -1.01  | -1.67  |
| Textile & Apparel     | 13.78  | 1.40   | 7.23                  | 0.36   | —          | 6.47  | 7.48   | 36.74  |
| Wood & Paper          | 0.32   | 0.0    | 0.77                  | -1.32  | —          | 0.20  | -0.30  | -0.26  |
| Basic Intermediates   | -4.13  | -6.99  | 5.74                  | 5.88   | —          | -3.62 | -2.67  | -5.77  |
| Machinery & Equipment | 8.25   | -28.39 | 8.21                  | 3.21   | —          | 6.07  | 14.51  | 11.85  |
| Services              | -2.40  | 2.41   | 0.42                  | -0.42  | —          | 6.08  | -1.72  | 4.36   |
| Total                 | 10.89  | -26.74 | 20.52                 | 1.25   | —          | 14.85 | -1.65  | 19.12  |
|                       |        |        | <i>European Union</i> |        |            |       |        |        |
| Grains                | -0.63  | 0.0    | 0.17                  | -0.0   | 0.0        | —     | 1.48   | 1.06   |
| Other Agriculture     | -2.78  | 0.37   | -0.80                 | -1.62  | -0.77      | —     | -11.87 | -17.46 |
| Forestry & Fishery    | -0.28  | 0.31   | -0.0                  | -0.24  | -0.11      | —     | -4.94  | -5.33  |
| Energy & Minerals     | -0.0   | 0.43   | 0.11                  | -0.0   | 0.13       | —     | -70.78 | -70.22 |
| Food Processing       | 0.69   | 2.97   | 0.95                  | -1.38  | 1.04       | —     | 3.82   | 8.09   |
| Textile & Apparel     | 2.45   | -2.79  | -13.35                | -5.71  | -6.47      | —     | -0.90  | -26.76 |
| Wood & Paper          | -2.21  | 0.34   | -0.17                 | -1.55  | -0.20      | —     | -14.24 | -18.03 |
| Basic Intermediates   | 4.74   | 1.81   | 2.48                  | 2.37   | 3.62       | —     | 14.44  | 29.46  |
| Machinery & Equipment | -15.28 | -40.62 | 3.19                  | 5.14   | -6.07      | —     | 91.20  | 37.55  |
| Services              | -36.59 | 4.42   | -3.59                 | -1.73  | -6.08      | —     | 66.60  | 23.03  |
| Total                 | -49.93 | -32.74 | -11.09                | -4.84  | -14.85     | —     | 74.81  | -38.63 |

trade with other Asian regions and trade with the rest of the world. For example, Japan's overall export share of manufactured goods is much higher than its import share, especially in the machinery and transportation equipment sector. The US is more balanced between manufactured imports and exports, but imports a larger share of labor-intensive nondurable manufactured goods than it exports. In bilateral trade, manufactured goods account for almost 90 percent of exports from Japan to the United States, with machinery and equipment representing 75 percent alone. Exports from the United States to Japan are considerably more diversified.

Fast-growing China and ASEAN4 are emerging as major players in manufactured trade with industrial countries (importing capital and technology-intensive products, while exporting labor-intensive manufactured goods), and have similar comparative advantage in labor-intensive goods, so there inevitably will be competition for markets in the major developed economies. In 1992, ASEAN4 has a larger share in industrial economy markets than China for almost all sectors except nondurable consumer goods, while China's share in the manufactured goods market in Asian NIEs exceeds that of ASEAN4. These trade pattern similarities suggest that trade liberalization among developing East Asia economies may induce intense competition, especially in export-oriented manufacturing sectors.

The data on trade and production structure is consistent with intuition about these economies based on conventional international trade theory. At one extreme, China and ASEAN4 are seen as 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 seen as major suppliers of capital/technology-intensive goods and as the final market for 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.

All this structural information will have important implications for changes in the pattern of trade among regions induced by trade liberalization and economic integration among the economies in East Asia and the Pacific. However, this information cannot be considered in isolation since changes in trade policies and protection levels in any of the regions and sectors will have impacts on other regions and sectors. The strength of a CGE model which includes all participating regions lies in its ability to simulate the shift in trade and production patterns induced by changes in trade policy.

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. It is widely accepted that the pattern and degree of protection are important determinants of the impact of trade liberalization. The larger the initial distortion, the greater the response to a particular policy change. Before reporting on the results of model simulations, it is necessary to provide a description of the sectoral and regional pattern of trade barriers in the multi-regional SAM. Table 4 presents *ad valorem* import protection rates for each region by sector and supplier, along with other sectoral taxes on exports and production. Note that these rates include the tariff equivalent of non-tariff barriers for agriculture and textiles, and anti-dumping duties for the US and EU.<sup>10</sup>

**Table 4**  
Domestic Tax and Bilateral Protection Rates by Sector and Region in 1992  
(Percent)

|                          | Production Tax/<br>Subsidy | Bilateral Tariff and NTB Protection |       |       |        |          |       |       |         |
|--------------------------|----------------------------|-------------------------------------|-------|-------|--------|----------|-------|-------|---------|
|                          |                            | USA                                 | Japan | China | ASEAN4 | Asia NIE | EU    | ROW   | Average |
|                          |                            | The United States                   |       |       |        |          |       |       |         |
| Grains                   | -31.3                      | —                                   | 7.7   | 3.9   | 4.8    | 3.8      | 4.4   | 6.2   | 5.9     |
| Other Agriculture        | -4.3                       | —                                   | 8.2   | 11.0  | 7.3    | 9.0      | 9.2   | 13.0  | 12.0    |
| Forestry & Fishery       | 2.1                        | —                                   | 0.0   | 0.1   | 0.5    | 1.8      | 1.3   |       |         |
| Energy & Minerals        | 7.2                        | —                                   | 1.0   | 2.1   | 0.6    | 0.2      | 0.6   | 0.6   | 0.6     |
| Food Processing          | 4.0                        | —                                   | 7.1   | 7.0   | 7.4    | 7.1      | 10.3  | 12.9  | 11.3    |
| Textile & Apparel        | 0.9                        | —                                   | 8.8   | 13.5  | 13.1   | 12.5     | 9.3   | 13.4  | 12.3    |
| Wood & Paper             | 1.3                        | —                                   | 4.9   | 2.2   | 5.2    | 3.6      | 2.8   | 1.5   | 2.1     |
| Basic Intermediates      | 3.3                        | —                                   | 22.2  | 12.6  | 4.8    | 6.0      | 9.0   | 5.9   | 8.6     |
| Machinery & Equipment    | 1.2                        | —                                   | 24.0  | 3.7   | 3.6    | 8.3      | 11.1  | 4.3   | 12.1    |
| Average (excl. services) | 1.7                        |                                     | 22.3  | 10.3  | 6.9    | 9.1      | 9.7   | 5.0   | 9.9     |
| Japan                    |                            |                                     |       |       |        |          |       |       |         |
| Grains                   | -6.5                       | 470.0                               | —     | 463.1 | 402.9  | 465.7    | 463.4 | 476.8 | 471.0   |
| Other Agriculture        | -24.7                      | 87.9                                | —     | 84.9  | 94.3   | 84.9     | 76.2  | 72.7  | 82.4    |
| Forestry & Fishery       | 2.5                        | 3.4                                 | —     | 3.2   | 3.1    | 4.9      | 3.9   | 4.2   | 3.8     |
| Energy & Minerals        | 2.7                        | 0.5                                 | —     | 0.0   | 1.5    | 2.0      | 2.7   | 0.6   | 0.7     |
| Food Processing          | 10.6                       | 34.0                                | —     | 20.1  | 24.4   | 37.0     | 50.2  | 60.5  | 41.2    |
| Textile & Apparel        | 2.5                        | 38.2                                | —     | 55.4  | 53.0   | 55.3     | 56.1  | 51.6  | 53.4    |
| Wood & Paper             | 1.7                        | 2.2                                 | —     | 2.6   | 9.6    | 5.2      | 4.0   | 3.8   | 4.5     |
| Basic Intermediates      | 5.9                        | 77.1                                | —     | 88.4  | 88.4   | 88.7     | 91.4  | 88.2  | 86.5    |
| Machinery & Equipment    | 3.0                        | 35.2                                | —     | 35.4  | 35.6   | 35.4     | 35.5  | 35.2  | 35.3    |
| Average (excl. services) | 3.5                        | 62.7                                |       | 51.9  | 24.7   | 49.8     | 53.0  | 33.4  | 45.1    |

[illegible]

**Table 4**  
Continued

|                          | Production Tax/<br>Subsidy |       | Bilateral Tariff and NTB Protection |        |          |      |       |         |  |
|--------------------------|----------------------------|-------|-------------------------------------|--------|----------|------|-------|---------|--|
|                          | USA                        | Japan | China                               | ASEAN4 | Asia NIE | EU   | ROW   | Average |  |
| Asian NIEs               |                            |       |                                     |        |          |      |       |         |  |
| Grains                   | -16.1                      | 325.0 | 385.7                               | 41.7   | —        | 30.6 | 82.6  | 247.8   |  |
| Other Agriculture        | -13.6                      | 112.8 | 135.5                               | 99.8   | —        | 76.8 | 115.1 | 126.1   |  |
| Forestry & Fishery       | 0.2                        | 12.8  | 12.5                                | 3.3    | —        | 13.0 | 11.1  | 8.1     |  |
| Energy & Minerals        | 0.2                        | 1.9   | 2.6                                 | 2.9    | —        | 2.7  | 3.1   | 3.0     |  |
| Food Processing          | 13.4                       | 16.0  | 15.3                                | 7.3    | —        | 19.7 | 22.5  | 18.0    |  |
| Textile & Apparel        | 1.0                        | 8.1   | 8.1                                 | 1.9    | —        | 10.6 | 9.1   | 6.9     |  |
| Wood & Paper             | 1.4                        | 4.4   | 4.8                                 | 7.2    | —        | 5.2  | 4.1   | 5.6     |  |
| Basic Intermediates      | 1.4                        | 8.3   | 7.3                                 | 6.4    | —        | 6.7  | 7.3   | 7.3     |  |
| Machinery & Equipment    | 1.8                        | 9.3   | 6.5                                 | 1.6    | —        | 9.6  | 7.9   | 8.9     |  |
| Average (excl. services) | 1.3                        | 9.2   | 35.4                                | 9.6    | —        | 10.0 | 11.4  | 14.5    |  |
| European Union           |                            |       |                                     |        |          |      |       |         |  |
| Grains                   | -4.3                       | 115.8 | 79.5                                | 127.0  | 120.8    | —    | 82.4  | 85.5    |  |
| Other Agriculture        | -28.0                      | 57.8  | 57.3                                | 58.5   | 58.4     | —    | 52.6  | 54.3    |  |
| Forestry & Fishery       | -0.4                       | 7.2   | 4.3                                 | 15.5   | 3.4      | —    | 7.0   | 7.2     |  |
| Energy & Minerals        | 0.1                        | 0.3   | 3.0                                 | 0.6    | 0.0      | —    | 0.3   | 0.4     |  |
| Food Processing          | 0.5                        | 9.4   | 16.7                                | 13.4   | 12.9     | —    | 28.9  | 23.9    |  |
| Textile & Apparel        | 0.8                        | 9.8   | 9.0                                 | 10.1   | 8.8      | —    | 10.9  | 9.6     |  |
| Wood & Paper             | 1.0                        | 9.1   | 4.5                                 | 6.0    | 3.6      | —    | 5.2   | 4.8     |  |
| Basic Intermediates      | 1.1                        | 14.2  | 13.6                                | 8.2    | 9.5      | —    | 7.9   | 9.7     |  |
| Machinery & Equipment    | 1.1                        | 19.1  | 8.1                                 | 6.8    | 9.2      | —    | 5.7   | 9.0     |  |
| Average (excl. services) | -1.0                       | 17.8  | 10.8                                | 13.6   | 10.5     | —    | 9.2   | 10.3    |  |

*Notes:* Production tax/subsidy is levied on domestic production

Bilateral tariff and NTB protection are the bilateral sectoral tariff and NTB-equivalents in the model.

*Sources:* Production tax and bilateral protection data drawn from the GTAP database (version 1994), which includes tariffs and the tariff equivalent of non-tariff barriers in the case of agriculture and textiles/wearing apparel, and the anti-dumping duties of Canada, European Union and the United States [Hertel (1996)]. The rates shown for Japan have been augmented by one-half the estimated ad valorem equivalent of existing NTBs, calculated from data reported in Sazanami, Urata, and Kawai (1995).

Because the GTAP data protection rates include non-agricultural NTBs for the US and EU, but only statutory tariff rates for Japan, the resulting protection rates suggest that the US and EU protect themselves much more heavily against Japanese products than Japan does against US and EU products. For example, US protection against Japan ranges from 5-24 percent in the industrial sectors, while the Japanese protection against US products (based only on official tariff schedules) ranges only from two to seven percent. To compensate for this uneven coverage, we have incorporated additional information on the *ad valorem* equivalent of Japanese NTBs, drawn from estimates provided in Sazanami, Urata, and Kawai (1995). These 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 bilateral protection rates for Japan reported in Table 4.

The import protection rates show substantial variations among commodity groups by sector and region. The high protection rates for agriculture and food products in the EU, Japan and Asian NIEs reflect the very high non-tariff barriers maintained in these regions. The average tariff rates in other sectors (except textiles) are generally low among developed countries and Asian NIEs, especially for mineral and energy products. But higher import barriers exist in ASEAN4 for almost all sectors.

Higher rates of protection also apply to individual commodity flows among some regions. For example, the United States and European Union impose higher rates on imports of manufactured intermediates, machinery and equipment from Japan, while Japan imposes higher rates on food imports from most of its trade partners and China imposes higher rate on textile for all its trade partners and on machinery and equipment on ASEAN4. However, these differentiated tariffs by source do not imply that discriminatory tariffs are applied by country. Instead, the differences emerge largely from aggregating the same disaggregated tariff schedule using import weights for each supplier; thus, if one country supplies relatively larger quantities of goods subject to higher tariffs, this category of goods is combined and the resulting statutory tariff is higher than for another country supplying low tariff items.

The domestic tax rates presented in the first column of Table 4 indicate that all regions except China subsidize agriculture. The subsidy in the United States is concentrated on grain production, while in EU and Japan it applies to other agricultural products as well.

## MODELING REGIONAL ECONOMIC INTEGRATION

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. 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,<sup>11</sup> the impact of the North American Free Trade Agreement,<sup>12</sup> and more recently the implications and options for Central America and the Caribbean of NAFTA implementation (Hinojosa-Ojeda, Lewis, & Robinson, 1994). In this section, we summarize several important analytic issues associated with analysis of free trade areas and

economic integration, provide a brief review of existing empirical analyses of Asian regional integration, and give an overview of the APEC CGE model.

### **Assessing the Static Impact of Customs Unions and Free Trade Areas**

Analysis of the consequences of preferential trading arrangements or customs unions on member and non-member countries has long been a major strand of international trade theory. Movements toward European regional integration and the emergence of other regional trading blocs have recently given this work special policy relevance. The theory of customs unions is concerned with the effects of preferential trading arrangements where member countries agree to lower their import tariffs to other members but not to the rest of the world. Free trade areas resemble customs unions, except that participant countries reserve the right to set their own tariffs on imports from the rest of the world, and "domestic content" or rules of origin regulations are required to limit the scope of the trading arrangement to goods produced primarily within the countries of the region.<sup>13</sup>

Note that analysis of customs unions or free trade agreements is distinct from the usual theoretical debates over the benefits of pursuing "free trade." Since such agreements do not include all countries, only a portion of total world trade is liberalized and numerous trade and nontrade-related distortions remain after the formation of a customs union or free trade area. As a result, the relevant theory is concerned with the task of comparing different "second-best" situations, with the standard outcome that the greater realism permitted by departing from the unrealistic "first-best" case comes at the expense of the generality of the conclusions that can be drawn from theory alone. It is thus impossible to specify general conditions under which the formation of a customs union or free trade area always results in an increase (or, indeed, a decrease) in welfare. The outcome is instead dependent on the relative strength of the "trade creation" and "trade diversion" effects; which effect dominates is an empirical question. In general, a free trade area increases welfare if its trade creation effects are relatively larger than its trade diversion effects; conversely, it lowers welfare if it diverts trade in net terms.<sup>14</sup>

*Trade creation* consists of the induced shift in demand away from domestically-produced, higher-cost products toward lower-cost products produced by FTA members. This shift results in production and consumption effects. The production effect is the savings generated by moving resources out of high-cost sectors (relative to other member countries). The consumption effect is a gain in consumers' surplus from the substitution of lower-cost foreign goods for higher-cost domestic goods.

*Trade diversion* consists of an induced shift in trade away from imports from non-FTA countries to potentially higher-cost imports from a FTA member (depending on the structure of protection of FTA members against excluded countries). With similar external tariff structures for FTA members, removing tariffs among members may only divert trade from non-members to members, with no change or even a decrease in welfare. The shift in trade structure has two potential effects. First, the cost of imported goods may increase (or at least not decrease), as they are now imported from a higher-cost FTA member. Second, consumers' surplus may decrease as a result of the substitution of higher-cost FTA-member goods for lower-cost foreign goods.

### **Dynamic Effects of Free Trade Areas**

Besides the static effects of trade creation and trade diversion, the creation of customs unions or FTAs can give rise to dynamic effects such as economies of scale, external economies, technical change, and increased investment. Dynamic effects include any effect that might increase the growth rate of economies participating in a customs union or FTA. The existing literature identifies numerous dynamic effects which affect different factor inputs, although there is relatively little consensus on the theoretical validity or empirical importance of these different linkages.<sup>15</sup>

Creation of a customs union or FTA leads to a larger internal market, permitting a greater degree of specialization, and leading ultimately to a reduction in costs. This cost reduction can result from fuller utilization of plant capacity, learning by doing, development of a pool of skilled labor and management, and so forth. Other dynamic effects include external economies, technical change, and change in investment. Of these effects, externalities in the form of technology spillovers are particularly important. According to Gunter and Mel-drum (1993), technology spillovers take place when advancements in knowledge made by one economic unit are adopted by other economic units. The creation of customs unions increases the prevalence of technology spillover as trade barriers are reduced. Spillovers can also occur as union members adopt uniform standards which bring together experts from member countries. Spillovers could decrease the cost of innovations; increase an industry's competitiveness; and increase both the technology gap and the difference in average costs between members and non-members of the customs unions.

Related dynamic effects involve the possibility of increased technology transfer to developing countries as an externality associated with export-led growth. For instance, de Melo and Robinson (1992) suggest that these externality effects are an important factor behind the superior performance of countries pursuing export-led industrialization strategies relative to those committed to import substitution. They use a CGE model to examine the impact of externalities that arise not only from exporting but also from importing capital equipment which embodies developed-country technology.

### **Existing Empirical Analysis of Asian Integration**

As noted in the above, the literature applying multi-country CGE models to evaluation of the impacts of economic integration is growing rapidly. The earlier models were used to analyze alternative tariff-cutting proposals in multilateral trade negotiations under the GATT (including the recently completed Uruguay Round) and other international trade policy issues such as North-South trade. More recent studies have concentrated on European Community market integration initiatives and the likely effects of the North American Free Trade Agreement (NAFTA) on current or future participants.<sup>16</sup>

The extensive CGE modeling efforts on Europe and North America economic integration reflect the demand for quantitative assessments of regional initiatives from policymakers in those regions, and these models have played an important role in the public debate over these efforts. The growing interest in economic cooperation in the Pacific Rim, along with East Asia's emergence as the principal engine of world economic growth, has led as well to increased demand for research similar to that conducted on Europe and North America. Until recently, however, contemporary analytic efforts on Asia remain rather limited relative to those on Europe or North America.

For example, Harrison and Kimbell (1986) developed a 12-region, 20-sector model to investigate the impact of trade liberalization and economic interdependence among Pacific Rim countries, although they did not explicitly include Hong Kong, Taiwan, and China in their study. Martin, Petri, and Yanagishima (1994) built a 19-region, 7-sector model to estimate the impact of concerted trade liberalization among East Asia countries. While that model has broad regional coverage, it does not model the production structure explicitly. There are no primary factors or inter-industry linkages, so that the structural effects of trade policy change are not easily analyzed. Wang (1994) developed a seven-region, six-sector model for world production and trade to estimate the impact of economic integration among East Asia Chinese economies, but did not address policy issues related to APEC or ASEAN.

Contemporary efforts to build multi-regional CGE models for the Asia-Pacific region are underway by participants in the Purdue Global Trade Analysis Project (GTAP).<sup>17</sup> Among recent GTAP applications, Young and Chyc (1994) conduct experiments on a 10-region, 3-sector version of the basic GTAP model and compare three scenarios for APEC regional trade liberalization. They found that a trade reform package that extends MFN status to the rest of the world, but does not require reciprocity, is not desirable for the APEC member countries, and suggest instead that APEC members would be better off to withhold tariff reduction with the rest of the world until reciprocity can be agreed to. This policy suggestion is somewhat at odds with that of Martin, Petri, and Yanagishima (1994), who argue the case for a MFN-based liberalization in East Asia *without* requiring reciprocity from non-Asian regions.

### The APEC CGE Model

The model developed in this paper consists of a multi-regional CGE framework containing a ten-sector, six-region, general equilibrium model, where the regional CGE models are interconnected through trade flows.<sup>18</sup> 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 will be described below.

The model data base consists of social accounting matrices (SAMs) for each country, including data on their trade flows.<sup>19</sup> 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, in press), supplemented by some additional data on factor endowments, particularly labor and non-tariff barriers in Japan. 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 drawn from a variety of econometric and informal 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 equilibrium solution exactly replicates the base data.

Each subregional or “country” CGE model follows closely what has become a standard theoretical specification for trade-focused CGE models.<sup>20</sup> In addition to 10 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 is produced according to a CES production function of the primary factors, with intermediate inputs demanded in fixed proportions. Producers are assumed to maximize profits, implying that each factor is demanded so that marginal 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 economy-wide average return for that factor.

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 subregion 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.<sup>21</sup> 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 CES 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 tariff and non-tariff revenues, which flow to the government. 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 a share 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 as a large supplier of imports to and demander of exports from the six model regions as a group. Each regional economy faces downward-sloping demand curves for sectoral exports. 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.

We have built the model to allow for the incorporation of 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 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.<sup>22</sup>

The externalities associated with imported intermediate input use ( $\rho^m$ ) and sectoral export performance ( $\rho^e$ ) affect productivity by entering into sectoral production functions (Equation 1), while the externality associated with aggregate exports ( $\rho^k$ ) 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  $FS_k = \sum_i F_{i,k}$ ).

(1) Production function:

$$X_i = \rho_i^m \cdot \rho_i^e \cdot \left[ \sum_f \alpha_{i,f} F_{i,f}^{-\gamma_{i,f}} \right]^{\frac{-1}{\gamma_{i,f}}}$$

(2) Aggregate capital stock

$$FS_{k,t} = FS_{k,0} \rho^k$$

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:

$$\rho_i^m = \left( \frac{MTOT_t}{MTOT_0} \right)^{n_m} \cdot n_i + (1 - n_i)$$

(4) Sectoral exports:

$$\rho_i^e = \left( \frac{E_{i,t}}{E_{i,0}} \right)^{\eta_e}$$

(5) Aggregate exports:

$$\rho^k = \left( \frac{ETOT_t}{ETOT_0} \right)^{\eta_k}$$

Each of the three effects operates through a simple elasticity equation: for example, an export-productivity elasticity ( $\eta^e$ ) 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.

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.<sup>23</sup> 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).<sup>24</sup> 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 inclusion of income effects, however, is really only a first step. It is important to explore other modeling approaches which permit the analysis of market penetration in environments of product differentiation and imperfect competition.<sup>25</sup>

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.

## **TOWARDS ASIAN FREE TRADE: APEC MODEL RESULTS**

### **Design of Alternative Scenarios**

The scenarios begin with consideration of the impact of an Asian Free Trade Area, then consider the implications of different regions not participating in (or being excluded from) the FTA: first China, then ASEAN4, and finally the US. We conclude by comparing the gains from the Asian FTA with more comprehensive trade liberalization encompassing areas outside of Asia. We also 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. We specifically model three externality channels which have been identified empirically as important in export-led development, including 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.

For each alternative scenario, the model generates results concerning the impact on real GDP, output, trade, value added, the real wages paid to each labor category, as well as the rental rate of capital and land. Trade diversion and trade creation impacts are evaluated through data on total, intraregional, and extraregional trade. However, 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 and income 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 “dynamics” 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 Impact of an Asian Free Trade Area**

In this section, we consider the impact of creating an Asian Free Trade Area encompassing all the APEC regions in our model: US, Japan, Asian NIEs, China, and ASEAN4. We simulate this possibility by elimination of all tariff and non-tariff barriers to imports *among* the participants, leaving intact each region's tariffs with non-member regions (in our model, EU and the rest of the world). In Experiment 1A, tariffs are eliminated under the assumption that there are no externalities or dynamic productivity linkages, while in Experiment 1B, the tariff removal is combined with the three different productivity linkages described in the previous section.

**Table 5**  
Asian Free Trade Area: Macro and Trade Performance  
(Experiment 1A: No Productivity Linkages)

|                | Percentage change from base |                 |                    |                |                     |
|----------------|-----------------------------|-----------------|--------------------|----------------|---------------------|
|                | Real GDP                    | Real Absorption | Real Exchange Rate | Terms of Trade | Export/output Share |
| United States  | 0.03                        | 0.04            | 2.29               | 0.03           | 0.18                |
| Japan          | 0.88                        | 0.74            | 7.29               | -1.33          | 0.47                |
| China          | 0.07                        | 0.13            | 2.55               | 0.07           | 0.54                |
| ASEAN 4        | 0.56                        | 0.36            | 3.09               | -0.40          | 1.36                |
| Asian NIEs     | 2.61                        | 2.44            | 8.51               | -0.33          | 1.01                |
| European Union | 0.00                        | 0.05            | 0.00               | 0.41           | -0.00               |

  

|                    | Billion US\$    |                |                 | Percentage Change from Base |                |                 |
|--------------------|-----------------|----------------|-----------------|-----------------------------|----------------|-----------------|
|                    | Trade Expansion | Trade Creation | Trade Diversion | Trade Expansion             | Trade Creation | Trade Diversion |
| United States      | 15.22           | 32.22          | -17.00          | 2.64                        | 19.70          | -4.12           |
| Japan              | 26.31           | 30.27          | -3.96           | 6.46                        | 13.09          | -2.25           |
| China              | 5.38            | 13.03          | -7.65           | 3.79                        | 16.97          | -11.77          |
| ASEAN 4            | 8.41            | 5.89           | 2.52            | 6.12                        | 6.35           | 5.65            |
| Asian NIEs         | 14.73           | 14.00          | 0.73            | 5.76                        | 8.98           | 0.73            |
| Total, FTA members | 70.04           | 95.41          | -25.37          |                             |                |                 |
| European Union     | -0.18           | -9.20          | 9.02            | -0.02                       | -4.32          | 1.74            |

Notes: Real GDP (C+I+G+E-M) provides a production-based measure of economic activity

Real Absorption (C+I+G) provides a welfare measure based on economywide real final demand by households, government, and investment. Changes in this measure equal the equivalent variation for the economy, with changes in government consumption and investment valued according to private consumer's preferences.

Export/Output Share indicates the change in the aggregate export/output ratio for the economy.

Trade Expansion is the increase in total exports for each region

Trade Creation is the increase in exports to members of the FTA, the trade creation figure for the European Union indicates the change in EU exports to FTA members

Trade Diversion is the increase in exports to non-FTA members, comprised of EU and rest of world

**Experiment 1A: Static Gains.** Table 5 presents the impact on macro and aggregate trade variables for Experiment 1A, in which tariffs among all five APEC economies are removed entirely. It is clear from the macro results that the impact of an Asian FTA is quite varied across the member economies. Growth in total exports ranges from three to four percent in the US and China, to around five to six percent in the Asian NIEs, ASEAN4, and Japan. Export/output shares rise by more than a percentage point in ASEAN4 and the Asian NIEs. Real GDP growth, which measures the increased domestic production (at base-period prices), ranges from near zero for the US and China, to an increase of 0.6 percent for ASEAN4, 0.9 percent for Japan, and 2.6 percent for the Asian NIEs. Real absorption growth, defined as the change in government and private consumption and investment (at base-period prices), follows a similar pattern.

The second section of the table summarizes the impact of the FTA on aggregate exports. The first column shows *trade expansion*, defined as the total increase in exports for each region; the second column shows *trade creation*, defined as the increment in exports to countries *inside* the FTA, and the third column shows *trade diversion*, or the change in trade to countries *outside* the FTA. The last three columns show the same three measures, expressed as percentage growth from the base data. The FTA easily satisfies the require-

ment that trade expansion exceeds trade diversion—new trade within the region is nearly four times larger than the decline of trade with regions outside the FTA, with the net expansion on the order of \$70 billion. While this criteria is also satisfied for each member of the FTA, the balance between trade creation and diversion varies significantly across regions: for the US, trade diverted represents around one half of trade created, while in Japan, the proportion is only around 10 percent. For both ASEAN4 and the Asian NIEs, there is no diversion: exports to non-FTA members actually rise.

In general terms, these results are consistent with findings from other modelling efforts of the impact of free trade. Despite the small individual declines in absorption or consumption, the aggregate changes in these magnitudes are positive. For APEC as a whole, GDP rises by \$52 billion and absorption by \$45 billion. The larger consumption (welfare) gains accrue to those regions that had the highest initial average levels of tariff protection: Japan, ASEAN4, and Asian NIEs. But in order to understand fully the factors shaping these aggregate outcomes, it is necessary to look at the impact on sectoral structure.

Underlying the expansion in aggregate trade are significant shifts in bilateral trade flows. Table 6 shows the *change* in the bilateral trade balances for each region in the model. The columns refer to the exporting region, the rows to the importing region; a positive number implies an *increase* in the bilateral trade balance for the exporter compared to the base. Thus, the value of \$0.88 billion in the upper left corner implies that the bilateral trade balance from the US to Japan rose by that amount, compared to the base; in other words, US export growth to Japan exceeded import growth from Japan.<sup>26</sup> The biggest shift in these flows occurs in the US-Asian NIEs relationship, where elimination of trade barriers among the APEC members results in a \$5.7 billion *fall* in the initial \$11 billion trade deficit between the US and Asian NIEs. It is notable that there is virtually no change in the US-Japan bilateral balance from establishing an APEC FTA. For the developing country members of APEC, the patterns differ markedly. ASEAN4 witnesses declining net trade with all other Asian regions and the US, and instead expands its trade by penetrating export markets in the EU and rest of the world; China experiences expansion in net trade with all regions *except* the rest of the world. The EU experiences worsening trade balances with all Asian markets, making up the losses through increased exports to the rest of the world. Some regions expand their net trade

**Table 6**  
Asian Free Trade Area: Change in Bilateral Trade Balances (Exp. 1A)  
(Change from Base: Billion US\$)

| <i>Change in Trade Balance<br/>from Region:</i> | <i>United<br/>States</i> | <i>Japan</i> | <i>China</i> | <i>ASEAN4</i> | <i>Asian NIEs</i> | <i>EU</i> |
|-------------------------------------------------|--------------------------|--------------|--------------|---------------|-------------------|-----------|
| To region:                                      |                          |              |              |               |                   |           |
| United States                                   | —                        | -0.88        | 1.07         | -1.19         | -5.72             | -3.62     |
| Japan                                           | 0.88                     | —            | 2.80         | -1.24         | 2.96              | -2.76     |
| China                                           | -1.07                    | -2.80        | —            | -0.42         | -1.97             | -0.61     |
| ASEAN 4                                         | 1.19                     | 1.24         | 0.42         | —             | 1.72              | -1.22     |
| Asian NIEs                                      | 5.72                     | -2.96        | 1.97         | -1.72         | —                 | -0.85     |
| European Union                                  | 3.65                     | 2.76         | 0.61         | 1.22          | 0.85              | —         |
| Rest of World                                   | -10.35                   | 2.64         | -6.88        | 3.35          | 2.17              | 9.06      |
| Sum                                             | 0.0                      | 0.0          | 0.0          | 0.0           | 0.0               | 0.0       |

*Note:* Trade balance defined as exports minus imports

with the rest of the world (Japan, ASEAN4, and Asian NIEs), while others (US and China) increase net trade within APEC and suffer declining balances with the rest of the world.

Table 7 decomposes the aggregate trade performance by portraying changes in export flows for each region by sector and destination. Looking first at the Japan-US flows, the greatest expansion in exports from the US to Japan is in grains (around \$10.5 billion), driven by the elimination of the 470 percent tariff and NTB protection that had existed in Japan; other contributions to growth occur in intermediate and capital goods sectors, where sizeable NTBs are eliminated as well. Japanese export expansion to the US, on the other hand, is concentrated almost exclusively in the machinery and equipment category (\$19 billion), with a smaller increment of \$2 billion in intermediate products. Again, US tariffs against Japanese products in these two sectors are the highest, although at 22-24 percent the distortions are much smaller than those eliminated in Japan. US export expansion to other Asian regions is varied: while substantial export growth to the Asian NIEs occurs in agricultural products, growth to ASEAN4 and China is relatively modest and concentrated in intermediates and capital equipment as well. Japanese exports to other Asian regions are concentrated in the intermediates and capital goods sectors.

For China and ASEAN4, the results suggest that there are important complementarities in their export opportunities within the context of greater Asian free trade. While textiles and apparel account for most of the export increase for these two regions to the US, growth in exports destined for Japan occurs in the grains and textile sectors for China, and in the other agriculture and basic intermediate sectors for ASEAN4. China exports more grains to the Asian NIEs, while ASEAN4 increases its other agricultural exports to this group.

Table 8 illustrates the extent of structural change occurring in the FTA economies by reporting the percentage changes in output, export, and import quantities, as well as the reallocation of labor and capital as a result of the tariff reductions.<sup>27</sup> The changes in output as a result of an Asian FTA reveal the extent to which existing patterns of import protection determine economic structure. Output of grains falls by one-fifth in Japan and one-sixth in the Asian NIEs and imports rise sharply as the substantial agricultural protection in these economies is eliminated. The increased US grain exports to these markets occurs not as a result of increased output (which increases by only one percent), but rather through diversion of exports from other markets, particularly the rest of the world. In Japan, there is a massive movement of capital out of agriculture sectors, and agricultural labor from the grains sector.<sup>28</sup> In the developing regions of Asia, ASEAN4 output of machinery and equipment and textiles grows by 12 percent each, while resource-based sectoral outputs generally fall. China experiences much less structural transformation in terms of output structure, with a four percent shift into textiles the biggest change.

**Experiment 1B: Trade-Productivity Linkages.** The results from Experiment 1A include no linkages or externalities from greater openness and trade expansion. While this clean comparative static experiment does allow calculation of the efficiency and welfare gains from introduction of the FTA, it also misses some possible important effects. In particular, empirical evidence suggests that there are positive dynamic feedbacks between trade and productivity which, if captured correctly, would tend to increase the benefits accruing to FTA participants and change the pattern of trade and structural change.

**Table 7**  
**Change in Sectoral Exports by Destination (Exp. 1A)**  
**(Change from Base: Billion US\$)**

|                       | USA   | Japan | China | ASEAN4               | Asian NIES | EU    | Rest of World | Total |
|-----------------------|-------|-------|-------|----------------------|------------|-------|---------------|-------|
|                       |       |       |       | <i>United States</i> |            |       |               |       |
| Grains                | —     | 10.54 | -0.01 | 0.02                 | 2.14       | 0.00  | -12.30        | 0.40  |
| Other Agriculture     | —     | 2.26  | 0.16  | 0.42                 | 3.48       | 0.00  | -5.91         | 0.43  |
| Forestry & Fishery    | —     | -0.16 | 0.03  | 0.09                 | 0.04       | 0.00  | 0.17          | 0.17  |
| Energy & Minerals     | —     | -0.05 | -0.00 | 0.02                 | 0.02       | 0.00  | 0.28          | 0.27  |
| Food Processing       | —     | 1.50  | 0.09  | 0.17                 | 0.25       | 0.00  | -1.45         | 0.56  |
| Textile & Apparel     | —     | 0.32  | 0.10  | 0.09                 | 0.17       | -0.01 | 0.33          | 1.00  |
| Wood & Paper          | —     | -0.10 | -0.00 | 0.06                 | 0.10       | 0.00  | 0.53          | 0.59  |
| Basic Intermediates   | —     | 3.56  | 0.32  | 0.34                 | 0.65       | 0.02  | -3.07         | 1.83  |
| Machinery & Equipment | —     | 4.73  | 0.21  | 0.68                 | 1.08       | -0.01 | 0.31          | 7.00  |
| Services              | —     | -0.99 | -0.00 | -0.00                | -0.10      | -0.04 | 4.11          | 2.97  |
| Total                 | —     | 22.43 | 0.89  | 1.88                 | 8.01       | -0.00 | -18.00        | 15.20 |
|                       |       |       |       | <i>Japan</i>         |            |       |               |       |
| Grains                | 0.00  | —     | 0.00  | 0.00                 | 0.00       | 0.00  | 0.00          | 0.00  |
| Other Agriculture     | 0.00  | —     | 0.00  | 0.01                 | 0.17       | 0.00  | -0.09         | 0.10  |
| Forestry & Fishery    | -0.00 | —     | 0.00  | 0.08                 | 0.00       | 0.00  | 0.02          | 0.12  |
| Energy & Minerals     | -0.00 | —     | 0.00  | 0.00                 | 0.00       | 0.00  | 0.03          | 0.05  |
| Food Processing       | 0.02  | —     | 0.02  | 0.02                 | 0.04       | 0.00  | 0.25          | 0.35  |
| Textile & Apparel     | 0.27  | —     | 0.81  | 0.36                 | 0.40       | -0.06 | 0.67          | 2.45  |
| Wood & Paper          | 0.03  | —     | 0.05  | 0.08                 | 0.04       | 0.00  | 0.04          | 0.23  |
| Basic Intermediates   | 1.90  | —     | 0.69  | 0.95                 | 1.27       | 0.03  | -3.87         | 0.97  |
| Machinery & Equipment | 18.67 | —     | 1.08  | 2.54                 | 1.05       | 0.15  | -5.18         | 18.30 |
| Services              | -0.16 | —     | -0.04 | -0.00                | -0.10      | -0.02 | 4.07          | 3.75  |
| Total                 | 20.68 | —     | 2.63  | 4.05                 | 2.88       | 0.10  | -4.00         | 26.35 |

|                       |       |       |       |       |       |       |       |       |  |
|-----------------------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| <i>China</i>          |       |       |       |       |       |       |       |       |  |
| Grains                | 0.00  | 2.22  | —     | 0.02  | 3.32  | 0.00  | -5.53 | 0.03  |  |
| Other Agriculture     | 0.03  | 0.78  | —     | 0.18  | 0.71  | 0.00  | -1.62 | 0.08  |  |
| Forestry & Fishery    | -0.00 | -0.04 | —     | 0.00  | 0.00  | 0.00  | 0.05  | 0.02  |  |
| Energy & Minerals     | 0.00  | -0.09 | —     | 0.06  | 0.03  | -0.00 | 0.01  | 0.01  |  |
| Food Processing       | 0.02  | 0.17  | —     | 0.11  | 0.05  | 0.00  | -0.31 | 0.03  |  |
| Textile & Apparel     | 1.71  | 1.49  | —     | 0.35  | 0.26  | -0.06 | 0.20  | 3.94  |  |
| Wood & Paper          | 0.00  | -0.01 | —     | 0.02  | 0.01  | 0.00  | 0.02  | 0.04  |  |
| Basic Intermediates   | 0.27  | 0.79  | —     | 0.24  | 0.17  | 0.00  | -1.37 | 0.10  |  |
| Machinery & Equipment | -0.03 | 0.24  | —     | 0.10  | 0.04  | -0.02 | 0.63  | 0.96  |  |
| Services              | -0.04 | -0.11 | —     | -0.00 | -0.03 | -0.0  | 0.33  | 0.15  |  |
| Total                 | 1.90  | 5.47  | —     | 1.06  | 4.62  | -0.08 | -7.81 | 5.16  |  |
| <i>ASEAN 4</i>        |       |       |       |       |       |       |       |       |  |
| Grains                | 0.0   | 0.05  | -0.00 | —     | -0.03 | 0.00  | -0.00 | 0.00  |  |
| Other Agriculture     | 0.07  | 1.09  | 0.03  | —     | 1.45  | 0.00  | -2.56 | 0.08  |  |
| Forestry & Fishery    | -0.01 | -0.15 | 0.05  | —     | 0.00  | -0.00 | 0.00  | -0.11 |  |
| Energy & Minerals     | -0.02 | -0.24 | 0.02  | —     | 0.11  | -0.00 | -0.46 | -0.59 |  |
| Food Processing       | 0.12  | 0.26  | 0.18  | —     | -0.04 | 0.00  | -0.45 | 0.07  |  |
| Textile & Apparel     | 0.56  | 0.31  | 0.03  | —     | 0.14  | -0.04 | 3.29  | 4.28  |  |
| Wood & Paper          | 0.05  | 0.12  | 0.22  | —     | 0.15  | 0.00  | -0.41 | 0.13  |  |
| Basic Intermediates   | 0.04  | 1.23  | 0.08  | —     | 0.19  | -0.00 | -1.62 | -0.08 |  |
| Machinery & Equipment | -0.09 | 0.38  | 0.07  | —     | -0.23 | -0.05 | 4.47  | 4.55  |  |
| Services              | -0.03 | -0.24 | -0.01 | —     | -0.02 | 0.00  | 0.35  | 0.05  |  |
| Total                 | 0.64  | 2.77  | 0.65  | —     | 1.71  | -0.09 | 2.62  | 8.30  |  |

**Table 7**  
Continued

|                       | USA                   | Japan | China | ASEAN4 | Asian NIES | EU    | Rest of World | Total |
|-----------------------|-----------------------|-------|-------|--------|------------|-------|---------------|-------|
|                       | <i>Asian NIEs</i>     |       |       |        |            |       |               |       |
| Grains                | 0.0                   | 0.0   | 0.000 | 0.00   | —          | 0.00  | 0.02          | 0.02  |
| Other Agriculture     | 0.0                   | 0.55  | 0.01  | 0.03   | —          | 0.02  | 0.19          | 0.80  |
| Forestry & Fishery    | -0.0                  | -0.03 | 0.00  | 0.24   | —          | 0.00  | 0.22          | 0.43  |
| Energy & Minerals     | -0.0                  | -0.0  | 0.00  | 0.01   | —          | -0.00 | -0.03         | -0.01 |
| Food Processing       | 0.03                  | 1.05  | 0.06  | 0.07   | —          | 0.00  | 1.11          | 2.32  |
| Textile & Apparel     | 1.05                  | 1.10  | 1.47  | 1.32   | —          | -0.06 | 3.30          | 8.19  |
| Wood & Paper          | 0.04                  | 0.0   | 0.09  | 0.10   | —          | 0.00  | -0.21         | 0.02  |
| Basic Intermediates   | 0.20                  | 2.70  | 0.61  | 0.84   | —          | 0.00  | -4.15         | 0.19  |
| Machinery & Equipment | 0.89                  | 0.82  | 0.36  | 0.85   | —          | -0.05 | 0.63          | 3.50  |
| Services              | -0.09                 | -0.36 | -0.02 | -0.00  | —          | 0.01  | -0.27         | -0.74 |
| Total                 | 2.12                  | 5.91  | 2.59  | 3.46   | —          | -0.07 | 0.89          | 14.90 |
|                       | <i>European Union</i> |       |       |        |            |       |               |       |
| Grains                | -0.00                 | -0.01 | -0.00 | -0.00  | -0.04      | —     | 0.07          | 0.01  |
| Other Agriculture     | -0.02                 | -0.07 | -0.00 | -0.00  | -0.05      | —     | 0.17          | 0.03  |
| Forestry & Fishery    | -0.0                  | -0.03 | -0.00 | -0.00  | -0.00      | —     | 0.04          | 0.00  |
| Energy & Minerals     | -0.07                 | -0.03 | -0.00 | -0.00  | -0.00      | —     | 0.10          | -0.01 |
| Food Processing       | -0.14                 | -0.34 | -0.04 | -0.03  | -0.15      | —     | 0.67          | -0.03 |
| Textile & Apparel     | -0.15                 | -0.19 | -0.03 | -0.0   | 0.09       | —     | 0.24          | -0.05 |
| Wood & Paper          | -0.07                 | -0.04 | -0.02 | -0.01  | -0.00      | —     | 0.12          | -0.03 |
| Basic Intermediates   | -0.56                 | -0.52 | -0.13 | -0.13  | -0.06      | —     | 1.21          | -0.20 |
| Machinery & Equipment | -2.40                 | -0.89 | -0.42 | -1.10  | -0.67      | —     | 5.63          | 0.14  |
| Services              | -0.22                 | -0.53 | -0.02 | -0.00  | -0.04      | —     | 0.77          | -0.04 |
| Total                 | -3.62                 | -2.71 | -0.68 | -1.30  | -1.02      | —     | 9.12          | -0.21 |

**Table 8**  
**Asian Free Trade Area: Structural Change (Exp. 1A: No Productivity Linkages)**  
**(Percent Change from Base)**

|                       | <i>Output</i> | <i>Exports</i> | <i>Imports</i> | <i>Labor</i> | <i>Capital</i> |
|-----------------------|---------------|----------------|----------------|--------------|----------------|
| <i>United States</i>  |               |                |                |              |                |
| Grains                | 0.9           | 4.1            | -2.5           | 0.4          | 1.8            |
| Other Agriculture     | 0.3           | 3.8            | -0.7           | -0.3         | 1.1            |
| Forestry & Fishery    | 1.2           | 3.9            | -1.7           | 0.4          | 1.8            |
| Energy & Minerals     | 0.7           | 3.5            | -2.0           | 0.7          | 0.7            |
| Food Processing       | 0.0           | 3.1            | -1.1           | 0.0          | -0.0           |
| Textile & Apparel     | 1.0           | 4.8            | 5.0            | 1.0          | 0.9            |
| Wood & Paper          | 0.3           | 3.3            | -1.5           | 0.3          | 0.2            |
| Basic Intermediates   | 0.1           | 3.1            | 1.5            | 0.1          | 0.0            |
| Machinery & Equipment | -0.4          | 3.4            | 6.8            | -0.4         | -0.4           |
| Services              | -0.0          | 2.3            | -1.4           | -0.0         | -0.0           |
| Total                 | 0.0           | 3.2            | 3.1            |              |                |
| <i>Japan</i>          |               |                |                |              |                |
| Grains                | -19.8         | 67.2           | 299.6          | -22.4        | -37.5          |
| Other Agriculture     | 1.1           | 34.2           | 48.4           | 8.0          | -13.0          |
| Forestry & Fishery    | 6.2           | 23.6           | -5.1           | 17.0         | -5.8           |
| Energy & Minerals     | 1.7           | 7.1            | -3.9           | 1.5          | 2.0            |
| Food Processing       | 5.6           | 27.1           | 13.7           | 5.4          | 5.9            |
| Textile & Apparel     | 2.7           | 11.4           | 14.3           | 2.6          | 3.0            |
| Wood & Paper          | 0.4           | 8.1            | -2.0           | 0.3          | 0.7            |
| Basic Intermediates   | -1.5          | 4.3            | 19.9           | -1.7         | -1.3           |
| Machinery & Equipment | 1.9           | 9.1            | 11.9           | 1.7          | 2.2            |
| Services              | -0.3          | 5.8            | -3.6           | -0.4         | 0.0            |
| Total                 | 0.3           | 8.3            | 8.7            |              |                |
| <i>China</i>          |               |                |                |              |                |
| Grains                | -0.5          | 2.5            | -2.8           | -0.3         | -2.6           |
| Other Agriculture     | -0.1          | 2.5            | 6.5            | 0.2          | -2.2           |
| Forestry & Fishery    | -0.7          | 1.4            | 6.0            | -0.2         | -2.6           |
| Energy & Minerals     | -0.6          | 0.3            | -0.6           | -0.9         | -0.4           |
| Food Processing       | -0.9          | 0.9            | 6.0            | -1.3         | -0.8           |
| Textile & Apparel     | 4.0           | 8.1            | 13.0           | 3.7          | 4.2            |
| Wood & Paper          | -1.1          | 1.9            | 7.0            | -1.4         | -0.8           |
| Basic Intermediates   | -1.1          | 1.1            | 5.5            | -1.4         | -0.9           |
| Machinery & Equipment | 0.3           | 4.1            | 2.9            | -0.0         | 0.5            |
| Services              | -0.2          | 0.8            | -0.7           | -0.5         | 0.0            |
| Total                 | 0.2           | 4.6            | 4.3            |              |                |
| <i>ASEAN 4</i>        |               |                |                |              |                |
| Grains                | -1.9          | 0.8            | 0.8            | -0.0         | -4.3           |
| Other Agriculture     | -1.7          | 1.4            | 24.6           | -0.0         | -4.3           |
| Forestry & Fishery    | -3.4          | -2.4           | 36.3           | 0.0          | -4.3           |
| Energy & Minerals     | -3.5          | -4.0           | 0.3            | -4.5         | -3.4           |
| Food Processing       | -1.4          | 0.9            | 9.1            | -2.2         | -1.1           |

**Table 8**  
Continued

|                       | <i>Output</i> | <i>Exports</i> | <i>Imports</i> | <i>Labor</i> | <i>Capital</i> |
|-----------------------|---------------|----------------|----------------|--------------|----------------|
| Textile & Apparel     | 12.2          | 21.1           | 27.8           | 11.2         | 12.6           |
| Wood & Paper          | -0.1          | 1.7            | 8.7            | -0.9         | 0.3            |
| Basic Intermediates   | -2.5          | -1.0           | 8.1            | -3.4         | -2.3           |
| Machinery & Equipment | 11.6          | 17.7           | 5.9            | 10.7         | 12.0           |
| Services              | -0.2          | 0.3            | -0.5           | -1.0         | 0.2            |
| Total                 | 0.9           | 7.5            | 7.5            |              |                |
| <i>Asian NIEs</i>     |               |                |                |              |                |
| Grains                | -17.9         | 81.9           | 221.2          | -27.8        | -44.4          |
| Other Agriculture     | 2.8           | 42.2           | 92.8           | 9.9          | -15.4          |
| Forestry & Fishery    | 9.3           | 18.8           | 1.9            | 25.5         | -3.4           |
| Energy & Minerals     | -1.8          | -2.7           | 0.3            | -2.1         | -1.4           |
| Food Processing       | 19.9          | 54.3           | -0.1           | 19.6         | 20.4           |
| Textile & Apparel     | 14.7          | 19.1           | 8.8            | 14.4         | 15.1           |
| Wood & Paper          | -0.3          | 0.4            | 5.1            | -0.6         | 0.0            |
| Basic Intermediates   | -0.1          | 0.7            | 6.0            | -0.5         | 0.1            |
| Machinery & Equipment | 1.4           | 4.2            | 2.4            | 1.2          | 1.8            |
| Services              | -1.4          | -1.8           | -0.9           | -1.7         | -1.1           |
| Total                 | 1.7           | 7.0            | 7.0            |              |                |

Table 9 summarizes the macro and trade implications of an Asian FTA when these three productivity linkages are incorporated. Any ambiguity from the previous experiment over the attractiveness of the FTA to its members is eliminated in this scenario. GDP, absorption, and consumption rise for all participants; aggregate APEC GDP rises by \$112 billion, and aggregate absorption rises by \$103 billion. The biggest relative gainers are China and ASEAN4, where GDP and absorption growth increase by 2-4 percentage points compared to the previous experiment. Overall trade expansion rises, although the impact again varies by region: ASEAN4 and China benefit the most, with ASEAN4 export growth reaching 11 percent. Aggregate trade creation is more than five times greater than trade diversion. More than half of ASEAN4 export growth occurs through higher exports to EU and the rest of the world, with nearly all export expansion over Experiment 1A occurring to markets outside APEC.

Table 10 shows the impact on bilateral trade balances. The US deficit with Japan is narrowed by \$1.4 billion, but this effect is swamped by movements in the US balance with other bilateral partners, again suggesting the futility of focusing on *bilateral* trade balances in a world driven by *multilateral* trading patterns. The shifting geographical focus of ASEAN4 trade is evident by the deteriorating trade balances with APEC regions, but improvements with EU and the rest of the world—in some sense, ASEAN4 is filling markets in the rest of the world that have been abandoned by other FTA members.

Table 11 portrays changes in sectoral exports by destination for each economy in the region. \$2.5 billion of the total \$7 billion increase in ASEAN4 exports over Experiment 1A occurs in the capital goods sector, and \$4 billion more in textiles growth. For China, the net export increment of \$3.5 billion is concentrated in the textile sector (\$2 billion), with expansion also occurring in intermediates and capital equipment. Relatively little change occurs in the pattern of export growth within APEC: the industrial economies of Japan and

**Table 9**  
Asian Free Trade Area: Macro and Trade Performance  
(Experiment 1B: Trade-Productivity Dynamic Linkages)

|                | Percentage change from base |                 |                    |                |                     |
|----------------|-----------------------------|-----------------|--------------------|----------------|---------------------|
|                | Real GDP                    | Real Absorption | Real Exchange Rate | Terms of Trade | Export/output Share |
| United States  | 0.19                        | 0.21            | 2.22               | 0.11           | 0.18                |
| Japan          | 1.44                        | 1.31            | 7.14               | -1.37          | 0.47                |
| China          | 2.16                        | 2.04            | 2.17               | -0.30          | 0.63                |
| ASEAN 4        | 4.72                        | 4.21            | 2.34               | -1.13          | 1.62                |
| Asian NIEs     | 3.21                        | 3.05            | 8.45               | -0.30          | 1.04                |
| European Union | 0.00                        | 0.06            | 0.00               | 0.49           | -0.0                |

  

|                    | Billion US\$    |                |                 | Percentage Change from Base: |                |                 |
|--------------------|-----------------|----------------|-----------------|------------------------------|----------------|-----------------|
|                    | Trade Expansion | Trade Creation | Trade Diversion | Trade Expansion              | Trade Creation | Trade Diversion |
| United States      | 16.18           | 34.76          | -18.59          | 2.81                         | 21.26          | -4.50           |
| Japan              | 28.66           | 33.37          | -4.71           | 7.04                         | 14.43          | -2.68           |
| China              | 8.94            | 13.76          | -4.8            | 6.30                         | 17.92          | -7.41           |
| ASEAN 4            | 15.24           | 6.48           | 8.76            | 11.09                        | 6.99           | 19.63           |
| Asian NIEs         | 16.42           | 16.70          | -0.28           | 6.42                         | 10.71          | -0.28           |
| Total, FTA members | 85.43           | 105.07         | -19.63          |                              |                |                 |
| European Union     | -0.27           | -7.38          | 7.12            | -0.04                        | -3.47          | 1.37            |

Notes: Real GDP (C+I+G+E-M) provides a production-based measure of economic activity.

Real Absorption (C+I+G) provides a welfare measure based on economywide real final demand by households, government, and investment. Changes in this measure equal the equivalent variation for the economy, with changes in government consumption and investment valued according to private consumer's preferences.

Export/Output Share indicates the change in the aggregate export/output ratio for the economy.

Trade Expansion is the increase in total exports for each region.

Trade Creation is the increase in exports to members of the FTA; the trade creation figure for the European Union indicates the change in EU exports to FTA members.

Trade Diversion is the increase in exports to non-FTA members, comprised of EU and rest of world.

**Table 10**  
Asian Free Trade Area: Change in Bilateral Trade Balances (Exp. 1B)  
(Change from Base: Billion US\$)

| Change in Trade Balance from |        |       |       |        |            |       |
|------------------------------|--------|-------|-------|--------|------------|-------|
| Region:                      | USA    | Japan | China | ASEAN4 | Asian NIEs | EU    |
| With region:                 |        |       |       |        |            |       |
| United States                | —      | -1.39 | 0.59  | -2.15  | -6.06      | -3.48 |
| Japan                        | 1.39   | —     | 2.12  | -2.71  | 2.84       | -2.54 |
| China                        | -0.59  | -2.12 | —     | -0.59  | -1.36      | -0.09 |
| ASEAN 4                      | 2.15   | 2.71  | 0.59  | —      | 3.13       | -0.38 |
| Asian NIEs                   | 6.06   | -2.84 | 1.36  | -3.13  | —          | -0.67 |
| European Union               | 3.48   | 2.54  | 0.09  | 0.38   | 0.67       | —     |
| Rest of World                | -12.48 | 1.09  | -4.75 | 8.20   | 0.79       | 7.15  |
| Sum                          | 0.00   | 0.00  | 0.00  | 0.00   | 0.00       | 0.00  |

Note: Trade balance defined as exports minus imports.

**Table 11**  
**Change in Sectoral Exports by Destination (Exp. 1B)**  
**(Change from Base: Billion US\$)**

|                       | USA   | Japan | China | ASEAN4               | Asian NIES | EU    | Rest of World | Total |
|-----------------------|-------|-------|-------|----------------------|------------|-------|---------------|-------|
|                       |       |       |       | <i>United States</i> |            |       |               |       |
| Grains                | —     | 10.70 | 0.0   | 0.03                 | 2.19       | 0.0   | -12.54        | 0.39  |
| Other Agriculture     | —     | 2.33  | 0.20  | 0.49                 | 3.58       | 0.0   | -6.18         | 0.42  |
| Forestry & Fishery    | —     | -0.11 | 0.04  | 0.10                 | 0.05       | 0.0   | 0.10          | 0.17  |
| Energy & Minerals     | —     | -0.04 | 0.0   | 0.03                 | 0.02       | 0.0   | 0.25          | 0.28  |
| Food Processing       | —     | 1.53  | 0.12  | 0.20                 | 0.26       | 0.0   | -1.52         | 0.60  |
| Textile & Apparel     | —     | 0.33  | 0.14  | 0.15                 | 0.20       | -0.02 | 0.33          | 1.13  |
| Wood & Paper          | —     | -0.09 | 0.0   | 0.09                 | 0.11       | 0.01  | 0.50          | 0.64  |
| Basic Intermediates   | —     | 3.63  | 0.40  | 0.48                 | 0.72       | 0.03  | -3.31         | 1.95  |
| Machinery & Equipment | —     | 4.82  | 0.41  | 1.18                 | 1.18       | -0.01 | 0.09          | 7.67  |
| Services              | —     | -0.81 | 0.09  | 0.06                 | -0.04      | -0.03 | 3.68          | 2.94  |
| Total                 | —     | 23.12 | 1.39  | 2.81                 | 8.43       | 0.0   | -19.60        | 16.16 |
|                       |       |       |       | <i>Japan</i>         |            |       |               |       |
| Grains                | 0.0   | —     | 0.0   | 0.0                  | 0.0        | 0.0   | 0.0           | 0.0   |
| Other Agriculture     | 0.0   | —     | 0.0   | 0.02                 | 0.18       | 0.0   | -0.11         | 0.09  |
| Forestry & Fishery    | -0.0  | —     | 0.0   | 0.10                 | 0.01       | 0.0   | 0.0           | 0.11  |
| Energy & Minerals     | 0.0   | —     | 0.0   | 0.01                 | 0.0        | 0.0   | 0.02          | 0.05  |
| Food Processing       | 0.02  | —     | 0.03  | 0.03                 | 0.04       | 0.0   | 0.25          | 0.37  |
| Textile & Apparel     | 0.29  | —     | 0.98  | 0.54                 | 0.46       | -0.06 | 0.52          | 2.71  |
| Wood & Paper          | 0.03  | —     | 0.06  | 0.10                 | 0.04       | 0.0   | 0.01          | 0.25  |
| Basic Intermediates   | 1.92  | —     | 0.82  | 1.35                 | 1.37       | 0.03  | -4.39         | 1.09  |
| Machinery & Equipment | 18.79 | —     | 1.53  | 3.55                 | 1.19       | 0.16  | -5.03         | 20.18 |
| Services              | -0.14 | —     | 0.04  | 0.04                 | -0.04      | -0.02 | 3.91          | 3.79  |
| Total                 | 20.86 | —     | 3.49  | 5.74                 | 3.25       | 0.11  | -4.76         | 28.70 |

|         |                       |       |       |      |      |       |       |       |       |
|---------|-----------------------|-------|-------|------|------|-------|-------|-------|-------|
| China   | Grains                | 0.0   | 2.25  | —    | 0.03 | 3.38  | 0.0   | -5.65 | 0.0   |
|         | Other Agriculture     | 0.03  | 0.80  | —    | 0.22 | 0.73  | -0.0  | -1.78 | -0.0  |
|         | Forestry & Fishery    | -0.0  | -0.03 | —    | 0.0  | 0.01  | 0.0   | 0.03  | 0.0   |
|         | Energy & Minerals     | 0.0   | -0.07 | —    | 0.09 | 0.03  | 0.0   | 0.04  | 0.10  |
|         | Food Processing       | 0.02  | 0.17  | —    | 0.13 | 0.05  | 0.0   | -0.34 | 0.03  |
|         | Textile & Apparel     | 1.72  | 1.53  | —    | 0.44 | 0.28  | -0.08 | 2.18  | 6.07  |
|         | Wood & Paper          | 0.0   | -0.0  | —    | 0.02 | 0.01  | 0.0   | 0.06  | 0.10  |
|         | Basic Intermediates   | 0.28  | 0.80  | —    | 0.31 | 0.19  | 0.0   | -1.26 | 0.33  |
|         | Machinery & Equipment | -0.03 | 0.25  | —    | 0.17 | 0.05  | -0.03 | 1.40  | 1.80  |
|         | Services              | -0.03 | -0.09 | —    | 0.03 | -0.01 | -0.0  | 0.63  | 0.51  |
| Total   |                       | 1.93  | 5.62  | —    | 1.44 | 4.74  | -0.12 | -4.95 | 8.66  |
| ASEAN 4 |                       |       |       |      |      |       |       |       |       |
|         | Grains                | 0.0   | 0.05  | 0.0  | —    | -0.03 | 0.0   | -0.02 | 0.0   |
|         | Other Agriculture     | 0.08  | 1.11  | 0.04 | —    | 1.50  | -0.0  | -2.78 | -0.05 |
|         | Forestry & Fishery    | -0.01 | -0.11 | 0.06 | —    | 0.01  | -0.0  | -0.06 | -0.11 |
|         | Energy & Minerals     | -0.01 | -0.18 | 0.04 | —    | 0.13  | -0.0  | -0.72 | -0.74 |
|         | Food Processing       | 0.12  | 0.27  | 0.20 | —    | -0.03 | 0.0   | -0.43 | 0.13  |
|         | Textile & Apparel     | 0.54  | 0.31  | 0.05 | —    | 0.19  | -0.08 | 7.21  | 8.22  |
|         | Wood & Paper          | 0.05  | 0.13  | 0.25 | —    | 0.17  | 0.0   | -0.39 | 0.22  |
|         | Basic Intermediates   | 0.04  | 1.26  | 0.09 | —    | 0.22  | 0.0   | -1.53 | 0.08  |
|         | Machinery & Equipment | -0.12 | 0.38  | 0.11 | —    | -0.23 | -0.07 | 7.03  | 7.10  |
|         | Services              | -0.03 | -0.20 | 0.02 | —    | -0.0  | -0.0  | 0.61  | 0.39  |
| Total   |                       | 0.62  | 3.00  | 0.86 | —    | 1.88  | -0.15 | 9.01  | 15.22 |

**Table 11**  
Continued

|                       | USA                   | Japan | China | ASEAN4 | Asian NIES | EU    | Rest of World | Total |
|-----------------------|-----------------------|-------|-------|--------|------------|-------|---------------|-------|
|                       | <i>Asian NIES</i>     |       |       |        |            |       |               |       |
| Grains                | 0.0                   | 0.0   | 0.0   | 0.0    | —          | 0.0   | 0.02          | 0.02  |
| Other Agriculture     | 0.0                   | 0.56  | 0.02  | 0.04   | —          | 0.02  | 0.12          | 0.76  |
| Forestry & Fishery    | -0.0                  | -0.01 | 0.0   | 0.27   | —          | 0.0   | 0.15          | 0.41  |
| Energy & Minerals     | -0.0                  | -0.0  | 0.01  | 0.02   | —          | -0.0  | -0.05         | -0.02 |
| Food Processing       | 0.03                  | 1.08  | 0.07  | 0.10   | —          | 0.0   | 1.15          | 2.43  |
| Textile & Apparel     | 1.06                  | 1.13  | 1.71  | 1.69   | —          | -0.07 | 4.02          | 9.54  |
| Wood & Paper          | 0.04                  | 0.0   | 0.11  | 0.13   | —          | 0.0   | -0.27         | 0.01  |
| Basic Intermediates   | 0.21                  | 2.75  | 0.77  | 1.35   | —          | 0.0   | -4.83         | 0.24  |
| Machinery & Equipment | 0.94                  | 0.85  | 0.61  | 1.41   | —          | -0.06 | -0.04         | 3.71  |
| Services              | -0.08                 | -0.29 | 0.04  | 0.07   | —          | 0.01  | -0.46         | -0.71 |
| Total                 | 2.20                  | 6.17  | 3.35  | 5.06   | —          | -0.08 | -0.09         | 16.62 |
|                       | <i>European Union</i> |       |       |        |            |       |               |       |
| Grains                | -0.0                  | -0.01 | -0.0  | 0.0    | -0.04      | —     | 0.06          | 0.01  |
| Other Agriculture     | -0.01                 | -0.07 | 0.0   | 0.0    | -0.04      | —     | 0.15          | 0.03  |
| Forestry & Fishery    | -0.0                  | -0.03 | 0.0   | 0.0    | -0.0       | —     | 0.03          | -0.0  |
| Energy & Minerals     | -0.06                 | -0.02 | 0.0   | 0.02   | 0.0        | —     | 0.04          | -0.02 |
| Food Processing       | -0.13                 | -0.33 | -0.0  | 0.0    | -0.14      | —     | 0.56          | -0.04 |
| Textile & Apparel     | -0.13                 | -0.17 | 0.03  | 0.04   | 0.12       | —     | 0.09          | -0.02 |
| Wood & Paper          | -0.07                 | -0.04 | -0.0  | 0.0    | -0.0       | —     | 0.08          | -0.03 |
| Basic Intermediates   | -0.53                 | -0.49 | -0.05 | 0.05   | -0.02      | —     | 0.79          | -0.24 |
| Machinery & Equipment | -2.36                 | -0.86 | -0.21 | -0.68  | -0.61      | —     | 4.82          | 0.10  |
| Services              | -0.19                 | -0.43 | 0.03  | 0.04   | -0.01      | —     | 0.49          | -0.07 |
| Total                 | -3.47                 | -2.48 | -0.19 | -0.52  | -0.85      | —     | 7.22          | -0.29 |

the US exhibit some additional penetration of ASEAN4 and China, but most of their export growth occurring to the rest of the world. Only for the Asian NIEs is the pattern different: most of the export growth in these economies occurs from broad-based export growth to ASEAN4 and China, with modest diversion of exports from the rest of the world to ASEAN4 and China.

### **The Costs of Exclusion from the Asian FTA**

The scenarios reported in the previous section are based on the assumption that all of the members of APEC are willing and able to participate in a possible Asian FTA. However, despite the apparent agreement at the November 1994 APEC meetings in Bogor on the goal of free trade by 2020, this outcome is not the only one possible. Both international and domestic pressures could still yield outcomes in which one or more APEC members chose not to participate, or was excluded from such an arrangement. Chinese difficulties at entering GATT/WTO, reluctance by some APEC members to include the US, and misgivings by some ASEAN members over the goal of free trade could over time contribute to evolution of an FTA composed of only a subset of current APEC members.

As these pressures will be played out primarily in the political arena, the model is of little use in predicting the outcome. But it is possible to use the model to consider the economic implications of excluding regions from the FTA. In this section, we consider the impact of three different configurations: an Asian FTA (1) without China; (2) without ASEAN4; and (3) without the US, relating the results to our earlier analysis of the full FTA, including trade-productivity linkages (Experiment 1B).

Table 12 indicates the macroeconomic implications of these alternative FTA membership possibilities. The first set of numbers repeat the findings for Experiment 1B, reported on earlier; the next three sets report results for separate simulations in which one region is excluded from the FTA. The results clearly demonstrate that there are gains from making the FTA as broad as possible. Omitting any one region makes that region significantly worse off, and lowers the gains from the FTA for *all* other members as well. As expected from the export results reported earlier, the Asian NIEs have the most to gain from broad membership in the FTA: exclusion of China reduces Asian NIE GDP and absorption gains by half, and exclusion of the US generates even larger declines. Aside from the Asian NIEs, exclusion of the US from the FTA has the greatest impact on Japan, reflecting the importance of its potential trade expansion to US markets: Japanese GDP growth drops from 1.4 to only 0.5 percent, and export growth falls from seven to three percent. As further indication of their complementarity, ASEAN4 and China have relatively little impact on one another: ASEAN4 loses 0.5 percent when China is excluded, while China loses only around 0.2 percent when ASEAN4 is excluded.

Table 13 summarizes the impact of the alternative FTA options on trade performance. The broad results are consistent across experiments: regions excluded from the FTA witness a fall in exports relative to the base, and a loss of markets to the FTA. Excluding China reduces US export expansion by \$1.5 billion, although this occurs as trade creation within the smaller FTA *rises* by \$2 billion, which is more than offset by a fall in exports to the rest of the world; excluding ASEAN4 lowers US trade creation opportunities by \$2 billion. Excluding either China or ASEAN4 lowers overall Japanese trade expansion by around 10 percent, with trade creation dropping by \$3 billion with China out and \$5.5 billion with ASEAN4 out. The biggest shift occurs when the US is

**Table 12**  
**Macro Performance for Alternative FTA Membership**  
**(Including Trade-Productivity Dynamic Linkages)**

|                                    | <i>Percentage change from base</i> |                        |                           |                       |                            |
|------------------------------------|------------------------------------|------------------------|---------------------------|-----------------------|----------------------------|
|                                    | <i>Real GDP</i>                    | <i>Real Absorption</i> | <i>Real Exchange Rate</i> | <i>Terms of Trade</i> | <i>Export/output Share</i> |
| <i>Full Asian FTA</i>              |                                    |                        |                           |                       |                            |
| United States                      | 0.19                               | 0.21                   | 2.22                      | 0.11                  | 0.18                       |
| Japan                              | 1.44                               | 1.31                   | 7.14                      | -1.37                 | 0.47                       |
| China                              | 2.16                               | 2.04                   | 2.17                      | -0.30                 | 0.63                       |
| ASEAN 4                            | 4.72                               | 4.21                   | 2.34                      | -1.13                 | 1.62                       |
| Asian NIEs                         | 3.21                               | 3.05                   | 8.45                      | -0.30                 | 1.04                       |
| European Union                     | 0.00                               | 0.06                   | 0.0                       | 0.49                  | -0.0                       |
| <i>FTA Excluding China</i>         |                                    |                        |                           |                       |                            |
| United States                      | 0.17                               | 0.18                   | 2.00                      | 0.02                  | 0.17                       |
| Japan                              | 1.20                               | 1.07                   | 6.25                      | -1.32                 | 0.42                       |
| ASEAN 4                            | 4.22                               | 3.76                   | 2.06                      | -1.07                 | 1.44                       |
| Asian NIEs                         | 1.78                               | 1.67                   | 5.67                      | -0.23                 | 0.87                       |
| China                              | 0.17                               | 0.40                   | 0.01                      | 0.78                  | 0.00                       |
| European Union                     | 0.00                               | 0.05                   | 0.00                      | 0.39                  | -0.00                      |
| <i>FTA Excluding ASEAN 4</i>       |                                    |                        |                           |                       |                            |
| United States                      | 0.18                               | 0.19                   | 2.12                      | -0.04                 | 0.18                       |
| Japan                              | 1.32                               | 1.19                   | 6.64                      | -1.33                 | 0.43                       |
| China                              | 2.00                               | 1.87                   | 1.91                      | -0.36                 | 0.57                       |
| Asian NIEs                         | 2.87                               | 2.67                   | 7.61                      | -0.45                 | 0.92                       |
| ASEAN 4                            | 0.18                               | 0.44                   | -0.06                     | 0.72                  | -0.00                      |
| European Union                     | 0.00                               | 0.05                   | 0.00                      | 0.38                  | -0.00                      |
| <i>FTA Excluding United States</i> |                                    |                        |                           |                       |                            |
| Japan                              | 0.52                               | 0.44                   | 3.16                      | -0.84                 | 0.23                       |
| China                              | 1.77                               | 1.60                   | 1.80                      | -0.51                 | 0.54                       |
| ASEAN 4                            | 3.82                               | 3.33                   | 1.73                      | -1.14                 | 1.33                       |
| Asian NIEs                         | 1.57                               | 1.46                   | 4.79                      | -0.25                 | 0.65                       |
| United States                      | 0.00                               | 0.05                   | -0.01                     | 0.47                  | -0.00                      |
| European Union                     | 0.00                               | 0.03                   | -0.00                     | 0.26                  | -0.00                      |

*Notes:* *Real GDP* (C+I+G+E-M) provides a production-based measure of economic activity.

*Real Absorption* (C+I+G) provides a welfare measure based on economywide real final demand by households, government, and investment. Changes in this measure equal the *equivalent variation* for the economy, with changes in government consumption and investment valued according to private consumer's preferences

*Export/output share* indicates the change in the aggregate export/output ratio for the economy.

excluded: the overall magnitude of trade expansion drops by more than half, and all of Japanese export growth occurs to markets within the FTA.

### **Regionalism versus Globalism: The Gains from Full Trade Liberalization**

The experiments summarized thus far have contrasted the gains from a broad-based APEC FTA against those from a more narrow grouping where an APEC member is excluded. The results quite clearly suggest that there is an advantage to forming an APEC

**Table 13**  
Trade Creation and Diversion for Alternative FTA Membership  
(Including Trade-Productivity Dynamic Linkages)

|                                    | Billion US\$       |                   |                    | Percentage change from base |                   |                    |
|------------------------------------|--------------------|-------------------|--------------------|-----------------------------|-------------------|--------------------|
|                                    | Trade<br>Expansion | Trade<br>Creation | Trade<br>Diversion | Trade<br>Expansion          | Trade<br>Creation | Trade<br>Diversion |
| <i>Full Asian FTA</i>              |                    |                   |                    |                             |                   |                    |
| United States                      | 16.18              | 34.76             | -18.59             | 2.81                        | 21.26             | -4.50              |
| Japan                              | 28.66              | 33.37             | -4.71              | 7.04                        | 14.43             | -2.68              |
| China                              | 8.94               | 13.76             | -4.82              | 6.30                        | 17.92             | -7.41              |
| ASEAN 4                            | 15.24              | 6.48              | 8.76               | 11.09                       | 6.99              | 19.63              |
| Asian NIEs                         | 16.43              | 16.07             | -0.28              | 6.42                        | 10.71             | -0.28              |
| Total, FTA members                 | 85.43              | 105.07            | -19.63             |                             |                   |                    |
| European Union                     | -0.27              | -7.38             | 7.12               | -0.04                       | -3.47             | 1.37               |
| <i>FTA Excluding China</i>         |                    |                   |                    |                             |                   |                    |
| United States                      | 14.69              | 36.71             | -22.02             | 2.55                        | 25.85             | -5.07              |
| Japan                              | 25.04              | 30.11             | -5.07              | 6.15                        | 15.52             | -2.38              |
| ASEAN 4                            | 13.63              | 6.17              | 7.45               | 9.92                        | 7.35              | 13.95              |
| Asian NIEs                         | 13.31              | 13.89             | -0.58              | 5.20                        | 11.36             | -0.43              |
| Total, FTA members                 | 66.66              | 86.88             | -20.22             |                             |                   |                    |
| China                              | 0.15               | -2.45             | 2.60               | 0.10                        | -3.20             | 4.00               |
| European Union                     | -0.19              | -6.73             | 6.54               | -0.03                       | -3.53             | 1.21               |
| <i>FTA Excluding ASEAN 4</i>       |                    |                   |                    |                             |                   |                    |
| United States                      | 15.56              | 32.89             | -17.33             | 2.70                        | 22.48             | -4.03              |
| Japan                              | 25.85              | 27.85             | -2.00              | 6.35                        | 13.84             | -0.97              |
| China                              | 8.18               | 12.68             | -4.50              | 5.77                        | 17.91             | -6.34              |
| Asian NIEs                         | 14.53              | 12.01             | 2.52               | 5.68                        | 9.34              | 1.98               |
| Total, FTA members                 | 64.12              | 85.43             | -21.31             |                             |                   |                    |
| ASEAN 4                            | 0.13               | -2.74             | 2.86               | 0.09                        | -2.95             | 6.42               |
| European Union                     | -0.16              | -6.52             | 6.36               | -0.02                       | -3.33             | 1.19               |
| <i>FTA Excluding United States</i> |                    |                   |                    |                             |                   |                    |
| Japan                              | 12.76              | 13.64             | -0.87              | 3.13                        | 10.64             | -0.31              |
| China                              | 7.53               | 15.62             | -8.09              | 5.31                        | 39.99             | -7.88              |
| ASEAN 4                            | 12.43              | 7.38              | 5.05               | 9.04                        | 11.18             | 7.07               |
| Asian NIEs                         | 10.02              | 15.56             | -5.54              | 3.92                        | 16.39             | -3.45              |
| Total, FTA members                 | 42.74              | 52.20             | -9.46              |                             |                   |                    |
| United States                      | -0.36              | -4.32             | 3.96               | -0.06                       | -2.64             | 0.96               |
| European Union                     | -0.20              | -2.16             | 1.96               | -0.03                       | -1.96             | 0.31               |

Notes: Trade Creation is the increase in exports to members of the FTA; the trade creation figure for the European Union indicates the change in EU exports to FTA members.

Trade Diversion is the increase in exports to non-FTA members, comprised of EU and rest of world.

FTA that is as broad as possible. But one important question remains: how does the APEC FTA compare with the more liberal scenario in which global trade liberalization occurs, encompassing not only the APEC nations but the EU and economies in the rest of the world as well?

Table 14 summarizes the outcome from a simulation that incorporates such trade liberalization (and continuing to include the trade-productivity linkages). Compared to the Asian

**Table 14**  
**World Trade Liberalization: Macro and Trade Performance**  
**(Including Trade-Productivity Dynamic Linkages)**

|                | <i>Percentage change from base</i> |                        |                           |                       |                            |
|----------------|------------------------------------|------------------------|---------------------------|-----------------------|----------------------------|
|                | <i>Real GDP</i>                    | <i>Real Absorption</i> | <i>Real Exchange Rate</i> | <i>Terms of Trade</i> | <i>Export/Output Share</i> |
| United States  | 0.24                               | 0.27                   | 2.87                      | 0.16                  | 0.24                       |
| Japan          | 1.74                               | 1.58                   | 8.29                      | -1.55                 | 0.59                       |
| China          | 2.92                               | 2.76                   | 2.79                      | -0.42                 | 0.79                       |
| ASEAN 4        | 5.82                               | 5.17                   | 2.86                      | -1.27                 | 1.96                       |
| Asian NIEs     | 3.31                               | 3.21                   | 8.68                      | -0.17                 | 1.15                       |
| European Union | 0.21                               | 0.23                   | 2.01                      | 0.10                  | 0.17                       |

  

|                    | <i>Billion US\$</i>    |                       |                        | <i>Percentage change from base</i> |                       |                        |
|--------------------|------------------------|-----------------------|------------------------|------------------------------------|-----------------------|------------------------|
|                    | <i>Trade Expansion</i> | <i>Trade Creation</i> | <i>Trade Diversion</i> | <i>Trade Expansion</i>             | <i>Trade Creation</i> | <i>Trade Diversion</i> |
| United States      | 21.11                  | 40.17                 | -19.07                 | 3.66                               | 12.69                 | -7.34                  |
| Japan              | 35.62                  | 42.46                 | -6.84                  | 8.75                               | 13.89                 | -6.74                  |
| China              | 11.49                  | 15.39                 | -3.90                  | 8.11                               | 13.93                 | -12.46                 |
| ASEAN 4            | 18.56                  | 8.08                  | 10.49                  | 13.51                              | 7.02                  | 46.93                  |
| Asian NIEs         | 17.94                  | 17.95                 | -0.01                  | 7.01                               | 9.03                  | -0.02                  |
| European Union     | 17.73                  | 21.14                 | -3.43                  | 2.42                               | 9.92                  | -0.66                  |
| Total, FTA members | 122.43                 | 145.19                | -22.76                 |                                    |                       |                        |

*Notes:* *Real GDP* (C+I+G+E-M) provides a production-based measure of economic activity

*Real Absorption* (C+I+G) provides a welfare measure based on economywide real final demand by households, government, and investment. Changes in this measure equal the *equivalent variation* for the economy, with changes in government consumption and investment valued according to private consumer's preferences.

*Export/Output Share* indicates the change in the aggregate export/output ratio for the economy

*Trade Expansion* is the increase in total exports for each region.

*Trade Creation* is the increase in exports to *members of the FTA*, the trade creation figure for the European Union indicates the change in EU exports to FTA members.

*Trade Diversion* is the increase in exports to *non-FTA members*, comprised of EU and rest of world.

FTA, everyone gains: the EU is now able to achieve gains from trade liberalization, with a 0.2 percent GDP increase approximately equal to the U.S. gain. The outward-oriented Asian economies continue to benefit from increased access to deregulated export markets, with ASEAN4 growth rising by 1.1 percentage points and Chinese growth expanding by 0.8 percent. Among the developed economies, Japan gains the most, with a 0.3 percentage point GDP rise relative to the Asian FTA.

In the aggregate, the world is better off with global liberalization: GDP rises by \$148 billion (without including any gain for the rest of the world), and absorption by \$140 billion, as compared to increases of only \$112 billion in GDP and \$103 billion in absorption in the APEC FTA scenario.<sup>29</sup>

## CONCLUSION

The simulations reported in this paper provide an assessment of the implications of an Asian FTA from several different perspectives. First, considering the impact of tariff and NTB elimination in a static, neoclassical experiment with no other changes, we find that the formation of an FTA is generally beneficial for its members, although the benefits range from quite small (for the US and China) to moderate (for the Asian NIEs). Trade creation exceeds

trade diversion by a factor of four. While the overall trade balance for each region is held constant, bilateral trade flows are substantially affected. ASEAN4 and China appear to have important complementarities in their export opportunities in the Asian FTA, with different sectoral and geographic patterns of export expansion.

Next, we consider the possible impact of possible linkages between improved trade performance and productivity. Including three different trade-productivity linkages, with relatively modest parameter choices, we find that the case for an Asian FTA is strengthened even further. All FTA members gain, and while the gains for the US are modest (around 0.2 percent of GDP), the gains for other members are quite substantial, exceeding three percent for ASEAN4 and the Asian NIEs..

We then consider the possibility that potential Asian FTA members might chose not to join, or be prevented from participating, through alternative simulations that exclude either China, ASEAN4, or the US from the FTA. The results are consistent: the excluded region suffers losses in GDP, absorption, consumption, and exports, while the members of the smaller FTA gain less than in the case of a broader FTA. These results suggest that, whatever the political pressures that might exist, the *economic* justification for not joining (or excluding) potential FTA members is weak.

Finally, we contrast the Asian FTA outcome with more comprehensive global liberalization, and find that global liberalization continues to dominate regional arrangements: all APEC regions gain from broadening the FTA to include the European Union and rest of the world.

## 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).<sup>30</sup> 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 [**X**<sub>*ij*</sub> 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  $\Pi$ , the *i* at the left of the parenthetic expression is the sectoral index over which summation occurs, and the two asterisks (\*\*) indicate exponentiation.<sup>31</sup>

**Table 15**  
Regional, Sectoral and Factor Classifications in the APEC CGE Model

| CTY1, CTY2 | Universe              | <i>Countries and Regions</i> |                                 |
|------------|-----------------------|------------------------------|---------------------------------|
|            |                       | Countries                    | Regions                         |
| K(CTY1)    | Countries             | USA                          | UNITED STATES                   |
|            |                       | EEC                          | EUROPEAN UNION                  |
|            |                       | JAP                          | JAPAN                           |
|            |                       | CHN                          | CHINA                           |
|            |                       | AS4                          | ASEAN 4                         |
|            |                       | NIE                          | ASIAN NIEs                      |
|            |                       | ROW                          | REST OF THE WORLD               |
|            |                       | USA                          | UNITED STATES                   |
|            |                       | EEC                          | EUROPEAN UNION                  |
|            |                       | JAP                          | JAPAN                           |
| I,J        | Sectors of production | CHN                          | CHINA                           |
|            |                       | AS4                          | ASEAN 4                         |
|            |                       | NIE                          | ASIAN NIEs                      |
|            |                       | <i>Sectors and groupings</i> |                                 |
|            |                       | GRAIN                        | GRAINS INCLUDING PROCESSED RICE |
|            |                       | OTHAG                        | OTHER AGRICULTURE               |
|            |                       | FANDF                        | FORESTS AND FISHING             |
|            |                       | MINES                        | ENERGY AND MINERALS             |
|            |                       | FOOD                         | FOOD PROCESSING                 |
|            |                       | TEXT                         | TEXTILE APPAREL                 |
|            |                       | 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                         |                                    |                              |
| iel(i,k)      | Aggregate CET export sectors                           |                                    |                              |
| ied(i,k)      | Downward sloping export demand from rest of world      |                                    |                              |
| 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)               |                                    |                              |
| iff,f         |                                                        | <i>Factors and groupings</i>       |                              |
|               | Factors of production                                  | CAPITAL                            | Capital stock                |
|               |                                                        | LAND                               | Agricultural land            |
|               |                                                        | AGLAB                              | Rural agricultural labor     |
|               |                                                        | INDLAB                             | Urban non-agricultural labor |
|               |                                                        | <i>Households and institutions</i> |                              |
| hh            | Households                                             | hhall                              | Single household category    |
| ins           | Institutions                                           | labr                               | Labor                        |
|               |                                                        | ent                                | Enterprises                  |
|               |                                                        | prop                               | Property income              |

**Table 16**  
Parameters in the APEC CGE Model

| <i>Basic Model Parameters</i> |                                                     |
|-------------------------------|-----------------------------------------------------|
| CLES(i,hh,k)                  | Household consumption shares                        |
| E0(i,cty1,cty2)               | Exports, base data                                  |
| EK0(i,k)                      | Total sectoral exports, all destinations, base data |
| EKPTL0(k)                     | Aggregate exports, all destinations, base data      |
| ENTR(k)                       | Enterprise income tax rate                          |
| ETA2(i,k)                     | Externality elasticity for aggregate exports        |
| ETAK2(i,k)                    | Externality elasticity for capital goods imports    |
| ETAM2(k)                      | Externality elasticity intermediate inputs          |
| FS0(off,k)                    | Aggregate factor supply, base data                  |
| GLS(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                         |
| PWE0(i,cty1,cty2)             | World price of exports, base data                   |
| PWEPX0(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                               |
| <i>Production and Trade Function Parameters</i>    |                                                        |
| AC(i,k)                                            | Armington function shift parameter                     |
| AD2(i,k)                                           | CES production function shift parameter                |
| AE(i,k)                                            | CET export composition function shift parameter        |
| ALPHA2(i,iff,k)                                    | CES factor share parameter                             |
| AT(i,k)                                            | CET function shift parameter                           |
| DELTA(i,k,cty1)                                    | Armington function share parameter                     |
| 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                           |
| RHOE(i,k)                                          | CET export composition function exponent               |
| RHOP(i,k)                                          | CES production function exponent                       |
| RHOC(i,k)                                          | Armington function exponent                            |
| RHOT(i,k)                                          | CET function exponent                                  |
| <i>Parameters for AIDS Import Demand Functions</i> |                                                        |
| 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 17**  
Variables in the APEC CGE Model

|                  | Price block                                              | Migration block                         |
|------------------|----------------------------------------------------------|-----------------------------------------|
| EXR(k)           | Exchange rate                                            | Wage differentials                      |
| PC(i,k)          | Consumption price of composite good                      | Labor migration flows (within category) |
| PD(i,k)          | Domestic prices                                          | Labor migration flows (across category) |
| PDA(i,k)         | Processors actual domestic sales price including subsidy | <i>Income and expenditure block</i>     |
| PE(i,k,cty1)     | Domestic price of exports                                | Private consumption demand              |
| PEK(i,k)         | Average domestic price of exports                        | Consumption taxes                       |
| PINDCON(k)       | Consumer price index                                     | Enterprise savings                      |
| PM(i,k,cty1)     | Domestic price of imports                                | Enterprise taxes                        |
| PQ(i,k)          | Price of composite goods                                 | Government transfers to enterprises     |
| PREM(i,k)        | Premium income from import rationing                     | Enterprise savings rate                 |
| PVA(i,k)         | Value added price including subsidies                    | Export tax revenue                      |
| PVAB(i,k)        | Value added price net of subsidies                       | Overall current account balance         |
| PWE(i,cty1,cty2) | World price of exports                                   | Foreign borrowing by government         |
| PWM(i,cty1,cty2) | World price of imports                                   | Foreign capital flow to enterprises     |
| PWERAT(i,k)      | Ratio of world export prices                             | Bilateral net foreign savings           |
| PWEX(i)          | benchmark world export price                             | Foreign savings                         |
| PX(i,k)          | Average output price                                     | Factor taxes                            |
| TM2(i,k,cty1)    | Import premium rates                                     | Government demand by sector             |
|                  |                                                          | GD(i,k)                                 |

| <i>Production Block</i> |                                             |                            |                                           |
|-------------------------|---------------------------------------------|----------------------------|-------------------------------------------|
| $D(i,k)$                | Domestic sales of domestic output           | $GDPVA(k)$                 | Nominal expenditure GDP                   |
| $E(i,cty1,cty2)$        | Bilateral exports                           | $GDTOT(k)$                 | Government real consumption               |
| $EK(i,k)$               | Aggregate sectoral exports                  | $GOVSAY(k)$                | Government saving                         |
| $INT(i,k)$              | Intermediate demand                         | $GOVREV(k)$                | Government revenue                        |
| $M(i,cty1,cty2)$        | Bilateral imports                           | $HHT(k)$                   | Government transfers to households        |
| $Q(i,k)$                | Composite goods supply                      | $HSAY(k)$                  | Aggregate household savings               |
| $SMQ(i,k,cty1)$         | Import value share in total sectoral demand | $HTAX(k)$                  | Household taxes                           |
| $X(i,k)$                | Domestic output                             | $ID(i,k)$                  | Investment demand (by sector of origin)   |
| <i>Factor Block</i>     |                                             | $INDTAX(k)$                | Indirect tax revenue                      |
| $AVWF(iff,k)$           | Average wage with current weights           | $MPS(hh,k)$                | Savings propensities by households        |
| $FDSC(i,iff,k)$         | Factor demand by sector                     | $REMIT(k)$                 | Remittance income to households           |
| $FPE(k)$                | Total farm program expenditures             | $TARIFF(k,cty1)$           | Tariff revenue                            |
| $FS(iff,k)$             | Factor supply                               | $VATAX(k)$                 | Value added taxes                         |
| $FT(k)$                 | Factor tax rate                             | $YH(hh,k)$                 | Household income                          |
| $WF(iff,k)$             | Average factor price                        | $YINST(ins,k)$             | Institutional income                      |
| $WFDIST(i,iff,k)$       | Factor differential I                       | $ZFIX(k)$                  | Fixed aggregate real investment           |
| $YFCTR(iff,k)$          | Factor income                               | $ZTOT(k)$                  | Aggregate nominal investment              |
|                         |                                             | <i>Externality Effects</i> |                                           |
|                         |                                             | $SAD(1,k)$                 | Aggregate exports externality parameter   |
|                         |                                             | $SAD2(1,k)$                | Intermediate inputs externality parameter |
|                         |                                             | $SAC(iff,k)$               | Capital goods externality parameter       |
|                         |                                             | $EKPTL(k)$                 | Aggregate exports                         |
|                         |                                             | $MKPTL(k)$                 | Capital goods imports                     |

Table 15 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 16 contains the parameter definitions used in the CGE model equations. Table 17 contains the variables that appear in the model.

### Model Specification

In addition to 10 sectors for each country model, the model has four factors of production (two labor types, land, and capital), as identified in Table 15. The output-supply and input-demand equations are shown in Table 18. Output is produced according to a CES production 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 18**  
Quantity Equations

|                                           |                                                                                                                                                                                     |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (1) $X(i,k)$                              | $= SAD(i,k)*SAD2(i,k)*AD2(i,k)*(SUM(iff,ALPHA2(i,iff,k)*FDSC(i,iff,k)**(-RHOP(i,k))))*(-1/RHOP(i,k));$                                                                              |
| (2) $(1-ft(k))*WF(iff,k)*WFDIST(i,iff,k)$ | $= 1-vatr(i,k)*pva(i,k)*SAD(i,k)*SA\ D2(i,k)*AD2(i,k)*$<br>$(SUM(f,ALPHA2(i,f,k)*FDSC(i,f,k)**(-RHOP(i,k))))*(-1/RHOP(i,k)-1)*ALPHA2(i,iff,k)*$<br>$FDSC(i,iff,k)**(-RHOP(i,k)-1);$ |
| (3) $INT(i,k)$                            | $= SUM(j,IO(i,j,k)*X(j,k));$                                                                                                                                                        |

**Table 19**  
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) $PEK(te,k)$         | $= SUM(cty1$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) $PWE(i,cty1,cty2)$ | $= pwm(i,cty2,cty1);$                                                   |

The price equations are shown in Table 19. In Equations 4 and 5, world prices are converted into domestic currency, including any tax or tariff components. Equation 13 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).

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 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 20. The country models incorporate official tariff revenue (TARIFF in Equation 15) which flows to the government, and the tariff equivalent of non-tariff barriers (PREM in Equation 16) which accrues as rents to the private sector.<sup>32</sup> 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 17-18 and 23-27). The single household category in each economy has a Cobb-Douglas expenditure functions (Equation 35). Real investment and government consumption are set in Equations 36 and 37, while aggregate government consumption and investment are set to fixed shares of GDP in Equations 39 and 40.

Export-related functions are shown in Table 21. Exports are supplied according to a CET function between domestic sales and total exports (Equation 42), and allocation between export and domestic markets occurs in order to maximize revenue from total sales (Equation 44). The rest of the world is modelled 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 47), 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 48, and each region's export price linked to that in Equation 49 by requiring that PWERAT equal one. The final equations in Table 21 specify how trade-related externalities are incorporated into the model. There are three different kinds of trade-productivity links. Equation 51 relates productivity in pro-

**Table 20**  
Income and Expenditure Equations

---

|                      |   |                                                                                                                                                                |
|----------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (14) YFCTR(iff,k)    | = | SUM(i, (1-ft(k))*WF(iff,k)*WFDIST(i,iff,k)*FDSC(i,iff,k));                                                                                                     |
| (15) TARIFF(k,cty1)  | = | SUM(i\$imi(i,k,cty1), TM(i,k,cty1)*M(i,k,cty1)*PWM(i,k,cty1))*EXR(k);                                                                                          |
| (16) PREM(i,k)       | = | SUM(cty1\$imi(i,k,cty1), TM2(i,k,cty1)*M(i,k,cty1)*PWM(i,k,cty1))*EXR(k);                                                                                      |
| (17) IND TAX(k)      | = | SUM(i, TX(i,k)*PD(i,k)*D(i,k));                                                                                                                                |
| (18) EXPTAX(k)       | = | SUM((i,cty1), te(i,k)*PWE(i,k,cty1)*E(i,k,cty1))*EXR(k);                                                                                                       |
| (19) YINST("labr",k) | = | SUM(la, YFCTR(la,k));                                                                                                                                          |
| (20) YINST("ent",k)  | = | YFCTR("capital",k) + EXR(k)*FKAP(k) - ENTS AV(k) - ENTAX(k) + ENTT(k) +<br>SUM(i,(1-sprem(i,k))*PREM(i,k));                                                    |
| (21) YINST("prop",k) | = | YFCTR("land",k);                                                                                                                                               |
| (22) YH(hh,k)        | = | SUM(ins, sintyh(hh,ins,k)*YINST(ins,k)) + rhsh(hh,k)*EXR(k)*REMIT(k) +<br>HHT(k)*thsh(hh,k);                                                                   |
| (23) ENTAX(k)        | = | ENTR(k)*(YFCTR("capital",k) + ENTT(k));                                                                                                                        |
| (24) FTAX(k)         | = | SUM((iff,i), ft(k)*WF(iff,k)*WFDIST(i,iff,k)*FDSC(i,iff,k));                                                                                                   |
| (25) HTAX(k)         | = | SUM(hh, hhtr(hh,k)*YH(hh,k));                                                                                                                                  |
| (26) VATAX(k)        | = | SUM(i, vatr(i,k)*PVA(i,k)*X(i,k));                                                                                                                             |
| (27) CONTAX(k)       | = | SUM(i, TC(i,k)*PQ(i,k)*Q(i,k));                                                                                                                                |
| (28) FPE(k)          | = | SUM(i, pie(i,k)*X(i,k));                                                                                                                                       |
| (29) GOVREV(k)       | = | SUM(cty1, TARIFF(k,cty1)) + IND TAX(k) + EXPTAX(k) + FTAX(k) + HTAX(k)<br>+ CONTAX(k) + SUM(i,sprem(i,k))*PREM(i,k) + ENTAX(k) + VATAX(k) +<br>FBOR(k)*EXR(k); |
| (30) GOVSAV(k)       | = | GOVREV(k) - SUM(i, GD(i,k)*PC(i,k)) - HHT(k) - ENTT(k) - FPE(k);                                                                                               |
| (31) HSAV(k)         | = | SUM(hh, MPS(hh,k)*((1.0-hhtr(hh,k))*YH(hh,k)));                                                                                                                |
| (32) ENTS AV(k)      | = | esr(k)*YFCTR("capital",k);                                                                                                                                     |
| (33) ZTOT(k)         | = | GOVSAV(k) + HSAV(k) + ENTS AV(k) + EXR(k) * FSAVE(k);                                                                                                          |
| (34) FSAVE(k)        | = | FBAL(k)-FKAP(k)-FBOR(k)-REMIT(k);                                                                                                                              |
| (35) 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);                                                                                      |
| (36) GD(i,k)         | = | gles(i,k)*GDTOT(k);                                                                                                                                            |
| (37) ID(i,k)         | = | zshr(i,k)*ZFIX(k);                                                                                                                                             |
| (38) ZTOT(k)         | = | SUM(i, PC(i,k)*ID(i,k));                                                                                                                                       |
| (39) GOVGDP(k)       | = | SUM(i, pc(i,k)*gd(i,k)) / gdpva(k);                                                                                                                            |
| (40) INVGDP(k)       | = | SUM(i, pc(i,k)*id(i,k)) / gdpva(k);                                                                                                                            |
| (41) GDPVA(k)        | = | SUM(i, PC(i,k)* (CDD(i,k)+GD(i,k)+ID(i,k))) + SUM((i,cty1), PWE(i,k,cty1) *<br>E(i,k,cty1))*EXR(k) - SUM((i,cty1), PWM(i,k,cty1) * M(i,k,cty1))*EXR(k);        |

---

duction 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 52 quantifies the externality associated with export performance—higher export growth relative to the base value at the sectoral level ( $EK/EK_0$ ) translates into a larger value of the productivity parameter SAD, which also directly affects domestic productivity (Equations 1 and 2). Equation 53 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.

The specification of the almost ideal demand system (or AIDS) for imports is shown in Table 22. The expenditure shares SMQ are given by Equation 58, where subscript *imi* refers to sectors, subscript *k* refers to the importing country, and subscript *cty1* refers to the

**Table 21**  
Export and Externality Equations

|                             |                                                                                                                          |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------|
| (42) $X(iel,k)$             | = $AT(iel,k)*(GAMMAK(iel,k)*EK(iel,k)**(-RHOT(iel,k)) + (1 - GAMMAK(iel,k)*D(iel,k)**(-RHOT(iel,k)))*(-1/RHOT(iel,k))$ ; |
| (43) $X(ien,k)$             | = $D(ien,k)$ ;                                                                                                           |
| (44) $EK(iel,k)$            | = $D(iel,k)*(PDA(iel,k)/PEK(iel,k)*GAMMAK(iel,k)/(1-GAMMAK(iel,k))**((1/(1+RHOT(iel,k))))$ ;                             |
| (45) $E(iec,k,cty1)$        | = $EK(iec,k) * (((gamma(iec,k,cty1)*PEK(iec,k)) / (ae(iec,k)**rhoe(iec,k) * pe(iec,k,cty1))) ** (1/(1+rhoe(iec,k))))$ ;  |
| (46) $PE(iecn,k,cty1)$      | = $PEK(iecn,k)$ ;                                                                                                        |
| (47) $EK(i,k,"row")$        | = $EK0(i,k,"row")*(PWE(i,k,"row")/PWE0(i,k,"row"))**(-etae(i,k))$ ;                                                      |
| (48) $SUM(k, E(i,k,"row"))$ | = $SUM(l, E0(i,l,"row")) * (PWEFX(i)/PWEFX0(i))**(-etaw(i))$ ;                                                           |
| (49) $PWE(i,k,"row")$       | = $PWERAT(i,k)*PWEFX(i)$ ;                                                                                               |
| (50) $M(i,cty1,cty2)$       | = $E(i,cty2,cty1)$ ;                                                                                                     |
| (51) $SAD2(i,k)$            | = $(mkptl(k)/mkptl0(k))**etam2(k)*(1 - pvab0(i,k) + pvab0(i,k) + SLACKAD2(i,k))$ ;                                       |
| (52) $SAD(iel,k)$           | = $(EK(iel,k)/EK0(iel,k))**etae2(iel,k) + SLACKAD(iel,k)$ ;                                                              |
| (53) $SAC("capital",k)$     | = $(EKPTL(k)/EKPTL0(k))**etak2(k) + SLACKAC("capital",k)$ ;                                                              |
| (54) $EKPTL(k)$             | = $SUM((cty1,i), PWE(i,k,cty1)*E(i,k,cty1))$ ;                                                                           |
| (55) $MKPTL(k)$             | = $SUM((cty1,ik), PWM0(ik,k,cty1)*M(ik,k,cty1))$ ;                                                                       |

**Table 22**  
AIDS Import Demand Equations

|                         |                                                                                                                                                |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| (56) $PM(i,k,k)$        | = $PD(i,k)$ ;                                                                                                                                  |
| (57) $LOG(PQ(i,k))$     | = $AQ(i,k) + SUM(cty2, AMQ(i,k,cty2)*LOG(PM(i,k,cty2))) + (1/2)*SUM((cty1,cty2), GAMMAQ(i,k,cty1,cty2)*LOG(PM(i,k,cty1))*LOG(PM(i,k,cty2)))$ ; |
| (58) $SMQ(imi,k,cty1)$  | = $AMQ(imi,k,cty1) + BETAQ(imi,k,cty1)*LOG(Q(imi,k)) + SUM(cty2,GAMMAQ(imi,k,cty1,cty2)*LOG(PM(imi,k,cty2)))$ ;                                |
| (59) $SMQ(i,k,k)$       | = $1 - SUM(cty1, SMQ(i,k,cty1))$ ;                                                                                                             |
| (60) $M(i,k,cty1)$      | = $smq(i,k,cty1)*PQ(i,k)*Q(i,k) / PM(i,k,cty1)$ ;                                                                                              |
| (61) $PD(i,k) * D(i,k)$ | = $SMQ(i,k,k) * Q(i,k)*PQ(i,k)$ ;                                                                                                              |

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 56, the "own" price of imports is simply the domestic price, and in Equation 61, D is determined by the  $SMQ_{i,k,k}$  share, while the import demands are determined in equation 60. The composite price index, PQ, is defined in Equation 57 as a translog price index (Deaton & Muellbauer, 1980).<sup>33</sup>

Table 23 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 62, 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 wages between the rural and unskilled urban markets (the EXR terms become

**Table 23**  
Migration Relations

---

|      |                        |                                            |
|------|------------------------|--------------------------------------------|
| (62) | $(AVWF(la,k)/EXR(k))$  | $= wgdfl(la,k,la,l)*(AVWF(la,l)/EXR(l)) ;$ |
| (63) | $FS(la,k)$             | $= FS0(la,k) + MIGL(la,k) + MIGRU(la,k) ;$ |
| (64) | $SUM(k, MIGL(la,k))$   | $= 0 ;$                                    |
| (65) | $SUM(la, MIGRU(la,k))$ | $= 0 ;$                                    |

---

**Table 24**  
Market-Clearing Equations

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|      |                |                                                                                       |
|------|----------------|---------------------------------------------------------------------------------------|
| (66) | $Q(i,k)$       | $= INT(i,k) + CDD(i,k) + GD(i,k) + ID(i,k) ;$                                         |
| (67) | $FS(iff,k)$    | $= SUM(i, FDSC(i,iff,k)) / SAC(iff,k) ;$                                              |
| (68) | $AVWF(iff,k)$  | $= SUM(i, (1-ft(k))*wfdist(i,iff,k)*wf(iff,k)*fdsc(i,iff,k))/SUM(j, fdsc(j,iff,k)) ;$ |
| (69) | $FSAV(k,cty1)$ | $= SUM(i, PWM(i,k,cty1)*M(i,k,cty1)) - SUM(i, PWE(i,k,cty1)*E(i,k,cty1)) ;$           |
| (70) | $FBAL(k)$      | $= SUM(cty1, FSAV(k,cty1)) ;$                                                         |

---

irrelevant). Domestic labor supply in each skill category in each country is then adjusted by the migrant labor flow (Equation 63), while the other two equations insure that workers do not "disappear" or get "created" in the migration process.

To complete the model, there are a number of additional "market-clearing" or equilibrium conditions that must be satisfied, as shown in Table 24. Equation 66 is the material balance equation for each sector, requiring that total composite supply ( $Q$ ) equal the sum of composite demands. Equation 67 provides equilibrium in each factor market; the  $SAC$  parameter provides the means to incorporate the externality associated foreign capital goods imports. Equation 69 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 70 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 macro-economic 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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## NOTES

1. Hughes Hallett and Primo Braga (1994) assess the implications of increased regionalism on progress towards a more liberal trade order, and conclude 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.
2. For example, 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 URA.
3. For example, Hinojosa-Ojeda, Lewis, and Robinson (1994) 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.
4. 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.
5. The data set is drawn primarily from the GTAP 1992 dataset, version 2, which is described in Hertel (in press). Features of this type of multi-regional SAM and aspects of its construction are described in Wang (1994).
6. Note that for model regions that are made up of more than one national economy (ASEAN4, Asian NIEs, 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 this intra-regional trade.
7. "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.
8. For example, the figures for ASEAN4 exclude trade among these four economies; 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.
9. Textiles provides an illustrative example of the point made earlier about the elimination of "intra-regional" trade during the combination of countries into our regional aggregates. If Hong Kong were included with the Asian NIEs rather than with China, then the share of textile exports *rises* in China (now excluding Hong Kong) but remains *unchanged* in the Asian NIEs (including Hong Kong). This occurs because the separation of China and Hong Kong means that the enormous export of textiles from China to Hong Kong (presumably for subsequent re-export) is counted as a Chinese export, rather than netted out as part of the consolidation of the individual country data sets.
10. As documented by Chyc et al. (in press), the protection data in the GTAP database (version 1994) include not only tariffs, but also the tariff equivalent of non-tariff barriers in the case of agriculture and textiles/wearing apparel, and the anti-dumping duties of Canada, European Union and the United States. The tariff data draw on original country submissions to the

GATT for the Uruguay Round. The source for agriculture protection data is from OECD and USDA/ERS estimates of Producer and Consumer Subsidy Equivalent (PSEs and CSEs).

11. 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).
12. See Hinojosa-Ojeda and Robinson (1992) and Brown (1992) for a review of NAFTA CGE models.
13. Robson (1987) identifies the two basic features that distinguish a free trade area from a customs union are that “the member countries retain the power to fix their own separate tariff rates on imports from the rest of the world; the area is equipped with rules of origin, designed to confine intra-area free trade to products originating in, or mainly produced in, the area.” See Hazlewood (1987) and Gunter (1989) for recent surveys of theoretical work in this area.
14. Our definitions here follow Robson (1987). We describe the effects with reference to free trade areas, since these are the focus of our analysis in this paper; the case of customs unions is analogous. Our characterization of the welfare impact is admittedly simplistic. Analysis of the sources of welfare gains and losses from customs unions or FTAs has generated an extensive literature; see Corden (1984) or Gunter (1989) for recent surveys.
15. Dynamic effects are summarized by Gunter and Meldrum (1993) with information from Baldwin (1989), El-Agraa (1989), and Gunter (1989).
16. Early surveys of such models can be found in Shoven and Whalley (1984) and Fretz, Srinivasan, and Whalley (1986), while a more contemporary survey is available in Brown (1992).
17. The primary reference to these efforts is Hertel (in press). The GTAP project is the source of much of the data used in our APEC model as well.
18. 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 (1994) for analysis of a Greater North America Free Trade Area (GNAFTA) using a similar model with labor migration permitted.
19. Social Accounting Matrices are described in Pyatt and Round (1985).
20. 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.
21. De Melo and Robinson (1989) and Devarajan, Lewis, and Robinson (1991) discuss the role of the real exchange rate in this class of model.
22. The various export and import externality features can be turned on or off as desired in carrying out model simulations.
23. 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).
24. 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 macroeconomic models.

25. There is active theoretical work on this approach that should lead to empirically implementable formulations. See Helpman and Krugman (1985) and Venables and Smith (1986). Devarajan and Rodrik (1989) discuss the potential importance of incorporating such factors into CGE models of developing countries. Harris (1984) and Cox and Harris (1985) incorporate imperfect competition into a CGE model of Canada. De Melo and Tarr (1992) have built a CGE model of the U.S. which incorporates imperfect competition to analyze the impact of trade policy with respect to steel, automobiles, and textiles.
26. Because we assume that the *aggregate* trade balance for each region remains unchanged, each column sums to zero.
27. Little structural change occurs in the EU because of its exclusion from the Asian FTA, so results for this region are not reported in the table. Because exports and imports are reported here in real terms, not dollar values, the figures differ from those reported in earlier tables. Aggregate capital and aggregate labor are fixed, so the sum of changes in factor use is zero; also, agricultural labor is employed only in the first three agricultural sectors, while non-agricultural labor works in the remaining sectors.
28. At present, agricultural and non-agricultural labor are kept separate, which is responsible for some of the large re-allocations of capital and labor in Japan and the Asian NIEs. Alternative simulations not reported here allow rural-urban migration, thereby facilitating adjustment and reducing the extent of capital reallocation, although the pattern of results changes very little.
29. While the estimated magnitudes of the gains under different FTA or global liberalization scenarios will be influenced by model parameters in the model, the qualitative outcome appears quite robust. Indeed, these findings are consistent both with trade theory and with other empirical modeling work that has concluded that global liberalization dominates unilateral reforms within individual economies or partial liberalization within FTAs.
30. 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).
31. 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.
32. 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).
33. 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.

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