# CGE Modeling and Analysis of Multilateral and Regional Negotiating Options

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## *ISSUES AND OPTIONS FOR THE MULTILATERAL, REGIONAL, AND BILATERAL TRADE POLICIES OF THE UNITED STATES AND JAPAN*

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**Discussants: Keith Maskus, University of Colorado**
**Keith Head, University of British Columbia**

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## I. Introduction

The United States and Japan are two of the key players in the global trading system even though they have at times been at odds regarding each other's trade and domestic policies. What we wish to explore in this paper are the options that the two nations have in prospective trade negotiations at the multilateral and regional levels. For this purpose, we will use two versions of the Michigan Model of World Production and Trade to provide some quantitative assessments of the economic effects of different options. The Michigan Model is a multi-country, multi-sector computational general equilibrium (CGE) model that we have used now for more than 25 years to analyze changes in multilateral and regional trade policies.

In Section II we first analyze the multilateral trade liberalization provisions of the Uruguay Round Agreements. For this purpose, we will use a 20 country/18 sector version of our CGE model. Then, in Section III, we consider the potential economic effects of the liberalization of trade in agriculture and services, which are currently in the early negotiation stages of a new WTO trade round as part of the built-in agenda mandated in the Uruguay Round. We also consider the liberalization of trade in industrial products, which is yet to be decided pending agreement among the WTO members on the agenda for a new round of trade negotiations. In our analysis in Section III, we will use a new version of the Michigan Model in which explicit allowance is made for the behavior of multinational corporations in the location of their economic activities. This new model version has been developed primarily to analyze services liberalization inasmuch as a domestic presence via foreign direct investment is

necessary to provide many services locally in host countries. Because of computational constraints, the services/FDI model has 20 countries/regions but only three aggregated sectors (agriculture, mining/manufacturing, and services). In Section IV, we analyze regional negotiating options of interest to the United States and Japan. These options include the removal of trade barriers between members of the Asia Pacific Economic Cooperation (APEC) forum and possible bilateral free trade agreements between Japan and Singapore, Japan and Mexico, Japan and Korea, and Japan and Chile. We also consider here a possible ASEAN-Plus-3 free trade agreement involving the ASEAN member countries together with Japan, China, and South Korea. Conclusions and implications for policy are discussed in Section V.

## II. Computational Analysis of Multilateral Trade Liberalization in the Uruguay Round

In this section we analyze the trade liberalization provisions in the Uruguay Round. As mentioned, we will use CGE model-based simulation analysis to assess the potential economic effects arising from the implementation of the liberalization provisions. The computational experiments consist of simulating the economic effects of reductions of tariffs and nontariff barriers on the bilateral trade of the countries/regions included in the model.

### Overview of the Michigan CGE Model

The distinguishing feature of the Michigan Model is that it incorporates some aspects of the New Trade Theory, including increasing returns to scale, monopolistic competition, and product heterogeneity. Some details follow. A more complete description of the formal structure and equations of the model can be found on line at www.spp.umich.edu/rsie/model/.

## Sectors and Market Structure

The version of the model to be used here consists of 20 countries/regions (plus rest-of-world) and 18 production sectors. The country/region and sectoral coverage are indicated in the tables noted below. Agriculture is modeled as perfectly competitive, and all other sectors as monopolistically competitive with free entry and exit of firms.

## Expenditure

Consumers and producers are assumed to use a two-stage procedure to allocate expenditure across differentiated products. In the first stage, expenditure is allocated across goods without regard to the country of origin or producing firm. At this stage, the utility function is taken to be Cobb-Douglas, and the production function requires intermediate inputs in fixed proportions. In the second stage, expenditure on monopolistically competitive goods is allocated across the competing varieties supplied by each firm. In the case of sectors that are perfectly competitive, since individual firm supply is indeterminate, expenditure is allocated over the industry as a whole. The aggregation function in the second stage is a Constant Elasticity of Substitution (CES) function.

## Production

The production function is separated into two stages. In the first stage, intermediate inputs and a primary composite of capital and labor are used in fixed proportion to output.[1] In the second stage, capital and labor are combined through a CES function to form the primary composite. In the monopolistically competitive sectors, additional fixed inputs of capital and labor are required. It is assumed that fixed capital and fixed labor are used in the same proportion as variable capital and variable labor so that production functions are homothetic.

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[1] Intermediate inputs include both domestic and imported varieties.

Supply Prices

To determine prices, perfectly competitive firms set price equal to marginal cost, while monopolistically competitive firms maximize profits by setting price as an optimal mark-up over marginal cost. The numbers of firms in sectors under monopolistic competition are determined by the condition that there are zero profits.

Capital and Labor Markets

Capital and labor are assumed to be perfectly mobile across sectors within each country. Returns to capital and labor are determined so as to equate factor demand to an exogenous supply of each factor. The aggregate supplies of capital and labor in each country are assumed to remain fixed so as to abstract from macroeconomic considerations (e.g., the determination of investment), since our microeconomic focus is on the intersectoral allocation of resources.

World Market and Trade Balance

The world market determines equilibrium prices such that all markets clear. Total demand for each firm or sector's product must equal total supply of that product. It is also assumed that trade remains balanced for each country/region, that is, the initial trade imbalance remains constant as trade barriers are changed. This assumption reflects the reality of mostly flexible exchange rates among the countries involved. Moreover, this is a way of abstracting from the macroeconomic forces and policies that are the main determinants of trade imbalances.

Trade Policies and Rent/Revenues

We have incorporated into the model the import tariff rates and export taxes/subsidies as policy inputs that are applicable to the bilateral trade of the various countries/regions with respect to one another. These have been computed using the "GTAP–4 Database" provided in

McDougall et al. (1998). It is assumed that the revenues from import tariffs are redistributed to consumers in the tariff-levying country and are spent like any other income. When tariffs are reduced, this means that income available to purchase imports falls along with their prices, and there is no bias towards expanding or contracting demand. The export barriers have been estimated as export-tax equivalents. They comprise: ordinary export taxes; the ad valorem tariff-equivalent rate of the Multi-Fibre Arrangement (MFA) quota premium; the ad valorem tariff-equivalent rate of voluntary export restraints (VERs); the export-subsidy equivalent of price undertakings; and the ordinary export subsidy rate. We assume that the revenues from export tariffs and rents from NTBs on exports are redistributed to the consumers in the foreign supplying countries and are spent like any other income.

Model Closure and Implementation

It is assumed in the model that aggregate expenditure varies endogenously to hold aggregate employment constant. Such a closure is analogous to the Johansen closure rule (Deardorff and Stern, 1990). The Johansen closure rule consists of keeping the requirement of full employment while dropping the consumption function. This means that consumption can be thought of as adjusting endogenously to ensure full employment. However, in the present model, we do not distinguish consumption from other forms of final demand. That is, we assume instead that total expenditure adjusts to maintain full employment.

The model is solved using GEMPACK (Harrison and Pearson, 1996). When policy changes are introduced into the model, the method of solution yields percentage changes in sectoral employment and certain other variables of interest. Multiplying the percentage changes by the levels projected for the year 2005, which is when the Uruguay Round provisions will have been

fully implemented, yields the absolute changes, positive or negative, which might result from the various liberalization scenarios.

## The Data

Needless to say, the data needs of this model are immense. Apart from numerous share parameters, the model requires various types of elasticity measures. Like other CGE models, most of our data comes from published sources.

As mentioned above, the main data source is "The GTAP-4 Database" of the Purdue University Center for Global Trade Analysis Project (McDougall et al., 1998). The reference year for this database is 1995. We have extracted the following data, aggregated to our sectors and regions, from this source:

1. Bilateral trade flows among 20 countries/regions, decomposed into 18 sectors. Trade with the rest-of-world (ROW) is included to close the model.
1. Input-output tables for the 20 countries/regions, excluding ROW
2. Components of final demand along with sectoral contributions for the 20 countries/regions, excluding ROW
3. Gross value of output and value added at the sectoral level for the 20 countries/regions, excluding ROW
4. Bilateral import tariffs by sector among the 20 countries/regions
5. Elasticity of substitution
6. Bilateral export-tariff equivalents among the 20 countries/regions, decomposed into 18 sectors

The monopolistically competitive market structure in the non-agricultural sectors of the model imposes an additional data requirement of the number of firms at the sectoral level. These

data have been drawn from the United Nations, *International Yearbook of Industrial Statistics, 1998*.[2]

We also need estimates of sectoral employment for the countries/regions of the model. These data have been drawn from: UNIDO, 1995, *International Yearbook of Industrial Statistics*, and the World Bank, 1997, *World Development Report*. The employment data have been aggregated according to our sectoral/regional aggregation to obtain sectoral estimates of workers employed in manufactures. The *World Development Report* was used to obtain data for the other sectors.[3]

We have projected the GTAP-4 1995 database to the year 2005 by extrapolating the labor availability in different countries/regions by an average weighted rate of 1.2 per cent per annum. This figure was computed from the growth rate forecasts for the period 1997-2010 provided for various countries in Table 2.3 of the World Bank's 1999 *World Development Indicators*. All other major variables have been projected, using an average weighted growth rate of GDP of 2.5 per cent per annum, for all of the countries/regions of our model during the period 1990-1997, as per Table 11 of the 1989/99 *World Development Report*.[4]

**Computational Scenarios**

The projected database provides us with an approximate picture of what the world could be expected to look like in 2005 if the Uruguay Round (UR) negotiations had not occurred. The UR reductions in trade barriers were implemented beginning in 1995 and will be completed by 2005. Accordingly, we have analyzed the impact of the UR-induced changes that are expected

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[2] It should be noted that the above source does not provide number-of-firms data for all countries. We have used the number-of-firms data for similar countries in these cases.

[3] We also need data on supply elasticities from ROW, which have been taken from the Michigan Model database.

to occur over the course of the 10-year implementation period as a consequence of the negotiated reductions in tariffs and non-tariff barriers. The scaled-up database for 2005 is then readjusted to mimic the world as it might look in the post-UR implementation. In Section III following, we will carry out some liberalization scenarios for the forthcoming WTO negotiating round, involving possible reductions in tariffs on agricultural products and manufactures and reductions of barriers to services trade and FDI.

In what follows, we report on the following four scenarios:

***UR-1*** *The Agreement on Textiles and Clothing (ATC) is analyzed by simulating the effects of the MFA phase-out under the Uruguay-Round (UR) agreement. This is done by assuming complete elimination of the MFA export-tax equivalents on textiles and wearing apparel for the developing countries/regions subject to the MFA and other quotas imposed on their exports to the industrialized countries.*

***UR-2*** *Agricultural liberalization is modeled according to the percentage reductions in import tariffs and export subsidies for the industrialized and developing countries as agreed upon in the Uruguay Round. Agricultural import tariffs were reduced by 20 percent for the industrialized countries and by 13 percent for the developing countries. Agricultural export subsidies were reduced by 36 percent for the industrialized countries and by 24 percent for the developing countries.*

***UR-3*** *All the countries/regions in the model are assumed to reduce their bilateral import tariffs as per the UR Agreement on mining and manufactured products.*[5]

***UR-4*** *This combines* ***UR-1, UR-2, and UR-3***.

**Computational Results**

Table 1 provides aggregate, or economy-wide, results from the scenarios as mentioned above for the countries/regions that have been modeled. Disaggregated results for the **UR-4** scenario for the United States and for Japan are reported in tables 2-3 [not yet completed].

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[4] See Hertel and Martin (1999) and Hertel (2000) for a more elaborate and detailed procedure for calculating year 2005 projections.

[5] See Francois and Strutt (1999) for details on the post-UR tariff rates.

To help the reader interpret the results, it is useful first to review the features of the model that serve to identify the various economic effects that are being captured in the different scenarios. Although the model includes the aforementioned features of the New Trade Theory, it remains the case that markets respond to trade liberalization in much the same way that they would with perfect competition. That is, when tariffs or other trade barriers are reduced in a sector, domestic buyers (both final and intermediate) substitute toward imports and the domestic competing industry contracts production while foreign exporters expand. With multilateral liberalization reducing tariffs and other trade barriers simultaneously in most sectors and countries, each country's industries share in both of these effects, expanding or contracting depending primarily on whether their protection is reduced more or less than in other sectors and countries. At the same time, countries with larger average tariff reductions than their trading partners tend to experience a real depreciation of their currencies in order to maintain a constant trade balance, so that all countries therefore experience mixtures of both expanding and contracting sectors.

Worldwide, these changes cause increased international demand for all sectors, with world prices rising most for those sectors where trade barriers fall the most. This in turn causes changes in countries' terms of trade that can be positive or negative. Those countries that are net exporters of goods with the greatest degree of liberalization will experience increases in their terms of trade as the world prices of their exports rise relative to their imports. The reverse occurs for net exporters in industries where liberalization is slight -- perhaps because it already happened in previous trade rounds.

The effects on the welfare of countries arise from a mixture of these terms-of-trade effects, together with the standard efficiency gains from trade and also from additional benefits

due to elements of the New Trade Theory. Thus, we expect on average that the world will gain from multilateral liberalization, as resources are reallocated to those sectors in each country where there is a comparative advantage. In the absence of terms of trade effects, these efficiency gains should raise national welfare measured by equivalent variation for every country, although some factor owners within a country may lose, as will be noted below. However, it is possible for a particular country whose net imports are concentrated in sectors with the greatest liberalization to lose overall, if the worsening of its terms of trade swamps these efficiency gains.

On the other hand, although the New Trade Theory is perhaps best known for introducing new reasons why countries may lose from trade, in fact its greatest contribution is to expand the list of reasons for gains from trade. It is these that are the dominant contribution of the New Trade Theory in our model. That is, trade liberalization permits all countries to expand their export sectors at the same time that all sectors compete more closely with a larger number of competing varieties from abroad. As a result, countries as a whole gain from lower costs due to increasing returns to scale, lower monopoly distortions due to greater competition, and reduced costs and/or increased utility due to greater product variety. All of these effects make it more likely that countries will gain from liberalization in ways that are shared across the entire population.

In perfectly competitive trade models such as the Heckscher-Ohlin Model, one expects countries as a whole to gain from trade, but the owners of one factor – the "scarce factor" – to lose through the mechanism first explored by Stolper and Samuelson (1941). The additional sources of gain from trade due to increasing returns to scale, competition, and product variety, however, are shared across factors, and we routinely find in our CGE modeling that both labor and capital often gain from liberalization. That is often the case here.

A final point to note about our model is the modeling and role of nontariff barriers, such as those applying to textiles and apparel. These are quantitative restrictions, captured in the model by endogenous tariff equivalents that rise and fall with changing supplies and demands for trade. The tariff equivalents generate quota rents that accrue to whatever group is granted the rights to trade under the restriction, which in the case of the MFA is the countries that export textiles and wearing apparel. Liberalization of these nontariff barriers reduces or eliminates these quota rents, and this can be costly to those who possessed them disproportionately beforehand. Therefore, it is not the case that exporting countries necessarily benefit from relaxation of these trade barriers, since their loss of quota rents can more than outweigh their gains from increased exports. Indeed, their exports can actually decline, along with their national welfare, if increased exports from other countries displace them in world markets.

In the real world, all of these effects occur over time, some of them more quickly than others. Our model is however static, based upon a single set of equilibrium conditions rather than relationships that vary over time. Our results therefore refer to a time horizon that is somewhat uncertain, depending on the assumptions that have been made about which variables do and do not adjust to changing market conditions, and on the short- or long-run nature of these adjustments. Because our elasticities of supply and demand reflect relatively long-run adjustments and because we assume that markets for both labor and capital clear within countries, our results are appropriate for a relatively long time horizon of several years – perhaps two or three at a minimum.

On the other hand, our model does not allow for the very long-run adjustments that could occur through capital accumulation, population growth, and technological change. Our results should therefore be thought of as being superimposed upon longer-run growth paths of the

economies involved. To the extent that these growth paths themselves may be influenced by trade liberalization, therefore, our model does not capture that.

Aggregate Results

As already mentioned, Table 1 reports various economy-wide changes for each of the countries/regions of the model. These include changes in exports and imports in millions of dollars, the changes in terms of trade, real wage rate and real return to capital in percentages, and changes in economic welfare measured by equivalent variation, both in millions of dollars and as percent of country GDP. The terms of trade is the world price of a country's exports relative to its imports. The equivalent variation is the amount of money that, if given to the country's consumers at initial prices, would be equivalent in terms of their level of welfare to the effects of the assumed liberalization. In general, as discussed above, a worsening (fall) in a country's terms of trade has an adverse effect on its consumers' welfare. But this can be outweighed by the other gains from trade due to economic efficiency and the other benefits modeled by the New Trade theory.

**UR-1: Elimination of the MFA Quota Constraints** – The results for the Uruguay Round elimination of the MFA quota and other bilateral constraints on developing country exports of textiles and apparel are indicated in Scenario A of Table 1. In interpreting these results, it should be noted that, with increased exports of these goods to world markets, their prices will fall and the terms-of-trade of the MFA exporting countries should deteriorate. This can be seen in column (3) in table 1, with the exception of Singapore and Taiwan that had minimal quota premiums to be removed. It is interesting that the Rest of Asia, which is dominated by India whose restrictions on exports were most extreme, shows a welfare gain indicating that exports are stimulated and efficiency is enhanced.

The developed countries, except for Japan, gain from MFA elimination. The loss for Japan is attributable to the fact that it did not restrict imports under the MFA. It therefore benefited from cheaper access to imports that were being diverted from other developed country markets. With removal of the MFA, that benefit is lost.

Changes in returns to labor and capital are mostly small.

**UR-2: Agricultural Liberalization –** This scenario includes both the reductions in tariffs on agricultural imports and in export subsidies that were negotiated as part of the Uruguay Round Agreement. The results shown in Scenario B of table 1 indicate that……

**UR-3: Liberalization of Mining and Manufactured Products** – Scenario C covers the reductions in import tariffs on mining and manufactured products that were negotiated in the Uruguay Round. The effects on welfare and returns to labor and capital are uniformly positive, indicating that both industrialized and developing countries gain from the liberalization of barriers on industrial products.

**UR-4: Combined Liberalization Effects (UR-1 + UR-2 + UR-3)** – The combined effects of the Uruguay Round liberalization are indicated in Scenario D of table 1. As noted, this table is the linear combination of UR-1, UR-2, and UR-3.

Sectoral Results [To be completed]

A major contribution that this sort of CGE modeling can make is to identify those sectors that will expand and those that will contract as a result of various patterns of trade liberalization, as well as the sizes of these changes. Given our assumption that expenditure adjusts within each country to maintain a constant level of total employment, it is necessarily the case that each country experiences a mixture of expansions and contractions at the industry level. This must be true of employment, and it is likely to be true as well for industry output. To report these

sectoral results in any detail is tedious, since there are 18 sectors in each country/region. We therefore report the sectoral results only for the United States and Japan in Tables 2-3 [not yet completed]. The sectoral results for other countries are available from the authors on request.

## III. Computational Analysis of Multilateral Trade Liberalization in the Forthcoming WTO Negotiations

### A New Version of the Michigan CGE Model

In contrast to the model we have used thus far, we wish now to report on a new version of the Michigan CGE model that focuses on the behavior of multinational firms. This new model draws upon the structure developed by Petri (1997) and Markusen, Rutherford, and Tarr (1999). The equations of the model and a list of variables are available from the authors on request.

In the new model, each multinational corporation (MNC) produces a differentiated product and allocates production to its various host-country locations. Each location has different characteristics of production. Therefore, the outputs supplied by a MNC from the various locations are imperfect substitutes. Consumers use a three-stage budgeting procedure. Two somewhat different demand structures have been employed in the literature. Petri (1997) assumes that consumers first allocate expenditure between an aggregate of the output of a representative firm headquartered domestically and an aggregate of the output of firms headquartered in other countries. In the second stage, expenditure on the import aggregate is allocated across the varieties produced by representative firms headquartered in each of the foreign countries. In the third stage, expenditure on the output of each representative firm is allocated across the various plant locations.

Dee and Hanslow (1999) have produced a variation of the Petri model. Like Petri, they assume that consumers follow a three-stage budgeting procedure. However, in the first stage,

consumers allocate expenditure between goods produced domestically and varieties imported. In this first stage, consumers are not concerned with the nationality of each firm's headquarters, but rather the nationality of the plant location. In the second stage, consumers allocate imports across goods produced by each trade partner. In the third stage, imports from each national source and domestically produced goods are allocated across the national firms. Dee and Hanslow also incorporate imperfect competition. Firms are assumed to set an optimal mark-up over marginal cost, but entry and exit may not occur so that firm profits may not be zero.

For our purposes here, we adopt the demand structure of Dee and Hanslow. However, we assume free entry so that each MNC's profits over all locations consequently sum to zero.

Turning to firm behavior, in order to undertake production each MNC must first employ capital and labor to engage in product development at their headquarters location. This expenditure generates a fixed cost of labor and capital at home. The MNC then faces a fixed set-up cost of capital and labor in each host-country location. Finally, production itself requires capital, labor, and intermediate inputs. Intermediate inputs are both produced locally and imported. They are then used in fixed proportion with the primary inputs.

Firms set a price for the output of each plant with an optimal mark-up of price over marginal cost. The elasticity of demand is derived assuming that each stage of the consumer's utility function is CES, with an elasticity of substitution equal to 3. However, the elasticity of substitution among various MNC products is taken to be 4.

Labor is taken to be freely mobile between sectors but not across borders. Therefore, there is a single equilibrium wage for each country. Capital, however, is mobile internationally, though not perfectly mobile. New firms that enter a market must purchase capital on international markets for installation in the host country. The degree of international capital

mobility can be set exogenously. The rate of return paid for capital depends on the international interest rate plus a risk premium, with the premium paid by capital importers in a country depending on the overall change in its capital stock. In the results presented below, we assume that a one per cent increase in a country's capital stock due to capital imports will generate a 0.5 percentage point increase in the interest rate.

A host country's barriers to FDI can be modeled in one of two ways. That is, the barriers to foreign firms may take the form of an increased fixed cost of locating in a host country. Alternatively, the barriers may take the form of a tax on installed capital. In what follows, we have selected the first type, modeling barriers that increase fixed cost.

Market equilibrium requires that consumers be willing to purchase the output sold by firms. In addition, each country is governed by a balance-of-trade constraint. Each country raises foreign exchange by selling products, collecting earnings on exported capital, receiving remittances of operating surpluses from foreign subsidiaries and receiving subsidies from foreign headquarters for local subsidiaries that run an operating loss. A country that exports physical capital is paid interest each year. In addition, each MNC subsidiary is required to rebate any operating profits back to headquarters. However, subsidiaries that lose money receive a subsidy from headquarters to cover operating expenses. Foreign exchange is spent on goods imports, interest paid on physical capital imports, and remittance of operating profits to headquarters.

## Data, Parameters, and Solution Procedure

The model comprises 18 countries/regions. The industrialized countries include: Australia; Canada; European Union; Japan; New Zealand, and the United States. The Asian developing countries include: China; Hong Kong; Indonesia; Korea; Malaysia; Philippines; Singapore, Taiwan; and Thailand. The group of Asian countries does not coincide with the

countries included in our preceding model, since the FDI data have come from a source other than GTAP. The remaining countries in the new model are: Chile; Mexico; and a group of Other Developing Countries. All other countries of the world are aggregated into a single rest-of-world (ROW). In order to keep the dimensions of the model manageable and to avoid lengthy solution time and associated computer-capacity constraints, each country/region is assumed to produce and trade only three aggregates of: agricultural products, mining/manufactures, and services. The basic data used are the same as the GTAP-4 data in the preceding model. But in the new model, as noted, we need data on FDI, which have been provided by the Productivity Commission of the Australian Government, courtesy of Philippa Dee.

The barriers to FDI were provided by Hoekman (2000), who has estimated the margins between price and marginal cost. Some of this gap is attributable to fixed cost. However, Hoekman's estimates vary across countries. Therefore, in most cases, some of the price-cost gap can also be attributed to barriers to FDI. The price-cost gap is smallest (in most sectors) for Hong Kong, a country considered to be freely open to foreign firms. Hence, we assume that the entire price-cost gap in Hong Kong is attributable to fixed cost. The excess in any other country in the model above the Hong Kong figures is taken to be due to barriers to establishment by foreign firms. Thus, the barrier is modeled as the cost increase attributable to an increase in fixed cost borne by MNCs attempting to establish an enterprise locally. In the simulations presented below, liberalization of these barriers is assumed to consist of reducing the average fixed cost by 33 per cent of the margin estimated by Hoekman.

Scenarios

We have run the following computational scenarios with the new model:

***Scenario A*** *33 per cent Reduction in Barriers to Trade and FDI in Agricultural Products, Mining and Manufactured Products, and Services*

***Scenario B*** *33 per cent Reduction in Barriers to Trade and FDI in Agricultural Products*

***Scenario C*** *33 per cent Reduction in Barriers to Trade and FDI in Mining and Manufactured Products*

***Scenario D*** *33 per cent Reduction in Barriers to Trade and FDI in Services*

***Scenario E*** *Scenario A, plus World Capital Stock Augmented by Two Percent*

The assumptions made in running the scenarios are as follows:

1. The risk-premium elasticity is set exogenously at 0.1, in order to allow for less than perfect international mobility of capital.
2. The world interest rate is set at 10 per cent to represent the long-term internal rate of return to capital.
3. Barriers to trade and FDI in services are modeled as an additional cost to fixed investment.
4. The demand structure follows Dee and Hanslow (1999). In the utility function, expenditure is first allocated to place of production and then allocated across multinationals.
5. The number of firms is varied to hold MNC profits at zero.
6. In order to get the model to solve, the mark-up of price over marginal cost is held fixed.[6]

Aggregate Results[7]

A summary of results is presented in table 4 for each of the four scenarios. The results for individual sectors are included in table 5. The countries/regions are listed in column (1), absolute changes in imports and exports in columns (2) and (3), the percentage change in the terms of trade in column (4), welfare effects, as measured by the equivalent variation, as a per

[6] Since the demand elasticity in the model does not move very much, fixing the price-cost margin and the demand elasticity does not have much of an impact on the model's results.

[7] The potential gains from a new WTO trade round are also analyzed in Hertel 2000, based on the GTAP CGE model, which is a widely used modeling structure. The version of the GTAP model used by Hertel differs from our new model insofar as Hertel does not include the behavior of MNCs and related international capital flows.

cent of GNP and in absolute terms in columns (5) and (6), and the per cent change in the real wage in column (7).

It can be seen in column (6) for Scenario A, which refers to a 33 per cent reduction in barriers to trade and FDI in agricultural products, mining and manufactured products, and services that total global welfare increases by $193.2 billion. For the group of industrialized countries shown, the welfare increase for Japan is $3.1 billion, which is equal to 0.06% of GNP, the United States, $45.8 billion (0.65% of GNP), and the European Union (EU), $41.6 billion (0.51% of GNP). The percentage increases in welfare are quite sizable for Australia (3.73%), Canada (4.71%), and New Zealand (10.00%) and for several of the developing countries in Asia.

For Scenario B, which refers to a 33 per cent reduction in post-Uruguay Round trade ad FDI barriers for agricultural products, global welfare can be seen to rise by $20.9 billion. Among the industrialized countries, the largest gainers are the United States, Australia, and Canada as resources are shifted into their agricultural sectors due to increases in world prices resulting from the agricultural liberalization. Japan especially and the EU show welfare declines as resources are apparently shifted out of agriculture as their agricultural protection is reduced. Most of the developing countries experience relatively small increases in welfare.

It is evident in Scenario C that a 33 per cent reduction in post-Uruguay Round barriers on mining and manufactured goods provides the greatest source of welfare gain. That is, global welfare is seen to increase by $141.2 billion. Among the industrialized countries, the largest absolute welfare gains are recorded for Japan, $53.3 billion (1.05% of GNP) and the EU, $28.3 billion (0.35% of GNP). The United States has a welfare gain of $6.1 billion (0.09% of GNP). For the Asian developing countries, there are sizable welfare gains especially for Taiwan, Korea, and China. These results for the liberalization of trade in mining and manufactured products

underscore the importance especially for the Asian developing countries of including this liberalization as one of the highest priority items on the agenda for a new trade round.

In Scenario D, which refers to services liberalization, global welfare is estimated to increase by $42.4 billion. All of the industrialized countries, except for Japan, show welfare gains. Most of the Asian developing countries also show welfare gains. The welfare declines for services liberalization indicated for Japan, Korea, and Other Countries are interesting to note. That is, the welfare effects in this new model are associated primarily with whether or not a country attracts or loses capital as a result of liberalization. Countries that experience an outflow of capital become "smaller" in the economic sense of the word. As the economy contracts, surviving firms produce less than before. The fall in firm output generally occurs in order to avoid a large loss in variety of domestically produced goods. The subsequent economy-wide reduction in realized scale economies is usually the source of the welfare loss.

The percentage change in wages is shown in column (7) of the tables. Wage changes generally reflect the changes in economic welfare. For liberalization of barriers to trade in all sectors combined, it can be seen that the increases in the real wage are substantial in many instances, especially in the Asian developing countries. The wage changes relating to agricultural liberalization by itself in Scenario B are all relatively small and some are negative. For mining/ manufactures liberalization in Scenario C, the wage increases are all positive particularly for the Asian developing countries and negative for Mexico and Rest of Cairns. For services liberalization in Scenario D, the wage changes are again mostly positive.

These wage changes mirror capital flows. That is, it is generally the case that countries that acquire capital will see an increase in capital per worker. The consequent rise in the marginal

value product of labor will thus raise wages. By contrast, wages are lower in countries where an outflow of capital occurs.

In Scenario A, there is a rise in the return to capital. Therefore, it is likely that, over time, there will be an increase in the world's capital stock. Thus, in panel E in table 1, we expand Scenario to also have the world capital stock increase by 2 per cent. This is the amount necessary to hold the real return to capital equal to the level in the base period. The results in panel E indicate that the welfare effects are now positive for all countries/regions in the model. For the world as a whole, welfare rises by $612.4 billion. Japan's welfare increases by $80.2 billion (1.58% of GNP) and the United States by $178.4 billion (2.52% of GNP). The increases for the other industrialized countries are also substantial, as is the case for the developing countries. It is evident accordingly that these welfare effects associated with an increase in the world's capital stock in response to an increase in the rate of return to capital are considerably larger than what we are used to seeing in CGE models such as our Michigan Model reported above and other similar CGE models. This may not be surprising because it has been apparent from previous CGE analyses of trade liberalization that have made allowance for international capital flows that the largest welfare gains stem from these flows rather than from the removal of consumer distortions in goods trade.[8]

Sectoral Results

The results for the three aggregated sectors—agriculture, manufactures, and services—are shown for the panel E liberalization in table 5. For each of the three sectors, we report the percentage changes in exports and imports, sectoral output, the number of firms, and the output of foreign-owned affiliates. Output increases economy-wide in just about every sector in all

[8] See for example Brown, Deardorff, and Stern (1992).

countries, the exceptions being relatively small output declines in Japan's agricultural sector and manufacturing in the Rest of Cairns. In general then, the international movement of capital determines whether an economy will expand or contract. Those countries that attract capital may expand production in all sectors, whereas those that lose capital may contract, depending on the extent to which capital stocks are augmented in response to the liberalization. It is also evident in panel E that there are generally significant increases in activity by foreign-owned affiliates, especially in those countries that record large increases in output.

## Conclusion

The foregoing presentation of our new CGE model has focused on the behavior of MNCs in response to an assumed 33 per cent reduction in post-Uruguay Round barriers to trade and FDI for agricultural products, mining/manufactured products, and services. The welfare effects, especially in the case in which the world capital stock was augmented by 2 per cent, were very large, much more so than in the base case with a fixed world capital stock and also as compared to most other CGE analyses of trade liberalization. What our new model makes clear is that capital formation can play a far more important and substantive role than consumer distortions in determining the welfare effects of trade liberalization. Thus, in analyzing the behavior of MNCs, the international allocation of physical capital should play a central role.

This said, how then should our computational results be interpreted? Since our new model is still a work in progress, the results presented should be taken as illustrative of the considerable potential benefits that may be realized with trade liberalization in the presence of MNCs and when international capital movements can occur in the form of FDI. This is especially important in the case especially of services negotiations in a new WTO trade round, given that commercial presence through FDI (mode 4) is characteristic of many services sectors and activities. Of course,

the additional possibility of liberalization of barriers to FDI in goods production reinforces this point. Furthermore, and again subject to the limitations of our new model and the need for more research, our results suggest the importance of further liberalization of trade in manufactures, which should be high on the negotiating agenda for a new trade round.

## IV. Analysis of Regional Negotiating Options

Both the United States and Japan are engaged in a number of regional arrangements. For the United States, this includes the North American Free Trade Agreement (NAFTA), which became effective in January 1994, and ongoing discussions and negotiations for a Free Trade Area for the Americas (FTAA). Both the United States and Japan are members of the Asia Pacific Economic Cooperation (APEC) forum. In an especially noteworthy change in its trade policy, according to the *Financial Times*, May 12, 2000, p. 1, Japan has recently been involved in discussing possible free trade agreements with Singapore and Mexico, and there has been some mention of similar arrangements with South Korea and possibly Chile. There has also been some discussion of a so-called ASEAN Plus-3 free trade agreement in which Japan, China, and South Korea would join together with the ASEAN nations.

Each of these regional arrangements raises the possibility of trade diversion. This has been of concern in the case of NAFTA, given the tariff differentials involved and the somewhat restrictive rules of origin that apply in such key sectors as textiles and clothing and automobiles. Thus far, however, according to Krueger (2000), there does not appear any clear evidence suggesting that trade diversion has occurred.

In what follows, we will investigate the following regional scenarios that involve both the United States and Japan, in the case of APEC, as well as the regional arrangements mentioned above that Japan is currently considering. These scenarios are as follows:

1. APEC trade liberalization
2. Japan-Singapore free trade agreement
3. Japan-Mexico free trade agreement
4. Japan-South Korea free trade agreement
5. Japan-Chile free trade agreement
6. ASEAN Plus-3 (China, Japan, and South Korea) free trade agreement

While we plan to carry out the foregoing regional scenarios as soon as time permits, it may nonetheless be useful to take note of some of our earlier work – Brown, Deardorff, and Stern (1996) – in which we carried out a computational analysis of the economic effects of an East Asian trading bloc (EATB). Starting with a Japan-South Korea FTA, we found that Japan would experience a welfare increase of 0.2 percent of its 1990 GDP ($4.9 billion). As additional East Asian countries were added in a FTA involving Japan, South Korea, Taiwan, and Singapore, Japan's welfare would rise by 0.3 percent of GDP ($8.8 billion). Thus, economic welfare was seen to rise as more and more countries were added to the prospective EATB. If the United States were also to become part of an EATB, the gains would be even greater, with Japan realizing a potential welfare gain of 1 percent of its 1990 GDP ($29.1 billion).

The sectoral results for Japan in our earlier study showed significant increases in Japan's total exports and imports in virtually all sectors. Its bilateral imports also showed sizable percentage increases from the other EATB countries and relatively small increases from the three NAFTA countries. With an EATB, Japan would become more specialized in its relatively more capital-intensive industries, and output would decline in its resource and labor-intensive sectors. Japan would also realize positive scale-economy effects throughout all its manufacturing sectors. Changes in employment would be comparatively small in all sectors except for clothing. The

largest absolute employment increases would occur in the machinery sectors, and employment would decline in Japanese agriculture and labor-intensive manufacturing. Japan's services sectors, assumed to be nontradable in this study, would also expand.

The issue that remains to be investigated is how the economic welfare of Japan and the members of each FTA and the rest-of-world would be affected if individual FTAs were to be separately negotiated rather than combined into a trading bloc in which all member countries were to eliminate their intra-bloc trade barriers. That is, the negotiation of individual FTAs might be expected to give rise to more trade diversion as compared to a more inclusive trading bloc. This is of course an empirical question to be further investigated.

## V. Conclusions and Implications for Policy

[To be completed.]

## References

Brown, Drusilla K., Alan V. Deardorff, and Robert M. Stern. 1992. "A North American Free Trade Agreement: Issues and a Computational Assessment," *The World Economy* 15:15-29.

Brown, Drusilla K., Alan V. Deardorff, and Robert M. Stern. 1996. "Computational Analysis of the Economic Effects of an East Asian Preferential Trading Bloc," *Journal of the Japanese and International Economies* 10:37-70.

Brown, Drusilla K. and Robert M. Stern. 1999. "Measurement and Modeling of the Economic Effects of Trade and Investment Barriers in Services," paper presented at the World Services Congress, Atlanta, November 1-3.

Deardorff, Alan V. and Robert M. Stern. 1990. *Computational Analysis of Global Trading Arrangements*. Ann Arbor: University of Michigan Press.

Dee, Philippa and Kevin Hanslow. 1999. "Multilateral Liberalization of Services Trade," paper presented at the World Services Congress, Atlanta, November 1-3.

Francois, Joseph and Anna Strutt. 1999. "Post-Uruguay Round Tariff Vectors for GTAP Version 4," processed, Faculty of Economics, Erasmus University, Rotterdam, The Netherlands.

Harrison, W.J. and Ken Pearson. 1996. "Computing solutions for large general equilibrium models using GEMPACK," *Computational Economics* 9:83-127.

Hertel, Thomas W. and Will Martin. 1999. "Would Developing Countries Gain from Inclusion of Manufactures in the WTO Negotiations?" Presented at the Conference on the "WTO and the Millennium Round," Geneva, September 20-21.

Hertel, Thomas W. 2000. "Potential Gains from Reducing Trade Barriers in Manufacturing, Services and Agriculture," *Federal Reserve Bank of St. Louis Review* 82:77-99.

Hoekman, Bernard. 2000. "The Next Round of Services Negotiations: Identifying Priorities and Options," *Federal Reserve Bank of St. Louis Review* 82:31-47.

Krueger, Anne O. 2000. "NAFTA's Effects: A Preliminary Assessment," *The World Economy* 23:761-775.

McDougall, Robert et al. 1998. *Global Trade: Assistance and Protection: GTAP-4 Database*, Purdue University, W. Lafayette, IN.

Petri, Peter A. 1997. "Foreign Direct Investment in a Computable General Equilibrium Framework," presented at the conference, "Making APEC Work: Economic Challenges and Policy Alternatives," March 13-14.

Stolper, Wolfgang and Paul A. Samuelson. 1941. "Protection and Real Wages," *Review of Economic Studies* 9:58-73.

**TABLE 1**
**SUMMARY RESULTS OF THE URUGUAY ROUND**
**CHANGE IN IMPORTS, EXPORTS, TERMS OF TRADE, WELFARE AND**
**THE REAL RETURN TO CAPITAL AND LABOR**
PERCENT CHANGE AND MILLIONS OF U.S. DOLLARS

| Country | Imports | Exports | Terms of Trade | Welfare | | Real Wage | Return to Capital |
|---|---|---|---|---|---|---|---|
| | (Millions) | (Millions) | (Percent) | (Percent) | (Millions) | (Percent) | (Percent) |
| **Scenario A: Elimination of the Multi-Fiber Arrangement** | | | | | | | |
| **Industrialized Countries** | | | | | | | |
| Japan | 268.1 | 465.1 | -0.031 | -0.009 | -589.5 | 0.004 | 0.016 |
| United States | 5320.9 | 3528.5 | 0.137 | 0.083 | 7556.2 | 0.056 | 0.076 |
| Canada | 690.2 | 601.0 | 0.068 | 0.149 | 1084.9 | 0.047 | 0.103 |
| Australia | 90.7 | 74.6 | 0.017 | 0.002 | 7.2 | 0.006 | 0.021 |
| New Zealand | 14.4 | 12.5 | 0.011 | 0.004 | 2.6 | 0.006 | 0.011 |
| EU and EFTA | 2123.7 | 1880.5 | 0.047 | 0.030 | 3296.3 | 0.023 | 0.039 |
| **Developing Countries** | | | | | | | |
| **Asia** | | | | | | | |
| Hong Kong | 2208.0 | 2405.3 | -0.208 | -0.099 | -127.7 | 1.027 | -0.103 |
| China | 2393.9 | 3304.0 | -0.354 | -0.020 | -183.7 | 0.067 | -0.028 |
| Indonesia | 157.9 | 217.0 | -0.087 | -0.071 | -180.8 | 0.030 | -0.038 |
| Korea | 436.7 | 436.0 | -0.001 | -0.006 | -35.7 | 0.037 | -0.019 |
| Singapore | -333.8 | -378.4 | 0.030 | -0.106 | -78.5 | 0.021 | 0.031 |
| Taiwan | 285.3 | 286.6 | 0.002 | -0.093 | -324.6 | -0.010 | -0.098 |
| Malaysia | -39.3 | -3.1 | -0.034 | -0.163 | -195.1 | 0.150 | -0.035 |
| Philippines | 199.1 | 276.4 | -0.240 | -0.020 | -17.5 | 0.228 | -0.012 |
| Thailand | 189.0 | 298.7 | -0.133 | -0.058 | -118.6 | 0.188 | -0.008 |
| Rest of Asia | 2055.1 | 2703.4 | -0.813 | 0.307 | 1757.1 | 0.123 | 0.204 |
| **Other** | | | | | | | |
| Chile | 15.4 | 15.5 | 0.000 | 0.038 | 30.3 | 0.005 | 0.012 |
| CCS | -161.9 | -136.4 | -0.030 | -0.041 | -681.2 | -0.001 | -0.007 |
| Mexico | -42.5 | 12.8 | -0.026 | -0.059 | -208.5 | -0.012 | -0.011 |
| RME | 159.7 | 171.1 | -0.007 | 0.034 | 289.8 | -0.012 | 0.084 |
| **Total** | **16030.6** | **16171.1** | | | **11282.9** | | |

**TABLE 1 (continued)**
**SUMMARY RESULTS OF THE URUGUAY ROUND**
**CHANGE IN IMPORTS, EXPORTS, TERMS OF TRADE, WELFARE AND**
**THE REAL RETURN TO CAPITAL AND LABOR**
PERCENT CHANGE AND MILLIONS OF U.S. DOLLARS

| Country | Imports | Exports | Terms of Trade | Welfare | | Real Wage | Return to Capital |
|---|---|---|---|---|---|---|---|
| | (Millions) | (Millions) | (Percent) | (Percent) | (Millions) | (Percent) | (Percent) |
| **Scenario B: Agricultural Trade Liberalization** | | | | | | | |
| **Industrialized Countries** | | | | | | | |
| Japan | | | | | | | |
| United States | | | | | | | |
| Canada | | | | | | | |
| Australia | | | | | | | |
| New Zealand | | | | | | | |
| EU and EFTA | | | | | | | |
| | | | | | | | |
| **Developing Countries** | | | | | | | |
| **Asia** | | | | | | | |
| Hong Kong | | | | | | | |
| China | | | | | | | |
| Indonesia | | | | | | | |
| Korea | | | | | | | |
| Singapore | | | | | | | |
| Taiwan | | | | | | | |
| Malaysia | | | | | | | |
| Philippines | | | | | | | |
| Thailand | | | | | | | |
| Rest of Asia | | | | | | | |
| | | | | | | | |
| **Other** | | | | | | | |
| Chile | | | | | | | |
| CCS | | | | | | | |
| Mexico | | | | | | | |
| RME | | | | | | | |
| | | | | | | | |
| **Total** | | | | | | | |

**TABLE 1 (continued)**
**SUMMARY RESULTS OF THE URUGUAY ROUND**
**CHANGE IN IMPORTS, EXPORTS, TERMS OF TRADE, WELFARE AND**
**THE REAL RETURN TO CAPITAL AND LABOR**
PERCENT CHANGE AND MILLIONS OF U.S. DOLLARS

| Country | Imports | Exports | Terms of Trade | Welfare | | Real Wage | Return to Capital |
|---|---|---|---|---|---|---|---|
| | (Millions) | (Millions) | (Percent) | (Percent) | (Millions) | (Percent) | (Percent) |
| **Scenario C: Liberalization Trade in Manufacturing** | | | | | | | |
| **Industrialized Countries** | | | | | | | |
| Japan | 7549.2 | 7527.0 | 0.004 | 0.274 | 17763.3 | 0.066 | 0.092 |
| United States | 11296.0 | 12329.8 | -0.125 | 0.133 | 12029.2 | 0.086 | 0.074 |
| Canada | 1213.1 | 1446.1 | -0.074 | 0.084 | 615.8 | 0.132 | 0.100 |
| Australia | 2246.9 | 2136.5 | 0.142 | 0.357 | 1566.2 | 0.345 | 0.348 |
| New Zealand | 635.5 | 393.6 | 1.112 | 1.006 | 738.3 | 0.438 | 0.340 |
| EU and EFTA | 14885.8 | 13646.7 | 0.119 | 0.291 | 31919.5 | 0.080 | 0.086 |
| **Developing Countries** | | | | | | | |
| **Asia** | | | | | | | |
| Hong Kong | 617.4 | 372.3 | 0.239 | 0.294 | 379.2 | 0.243 | 0.260 |
| China | 3191.9 | 1789.8 | 0.518 | 0.454 | 4116.1 | 0.205 | 0.207 |
| Indonesia | 884.2 | 870.3 | 0.026 | 0.314 | 795.1 | 0.303 | 0.216 |
| Korea | 2277.2 | 2176.7 | 0.055 | 0.627 | 3568.3 | 0.212 | 0.219 |
| Singapore | 2414.4 | 2430.4 | -0.017 | 1.207 | 897.4 | 1.528 | 1.745 |
| Taiwan | 1297.7 | 774.1 | 0.323 | 0.531 | 1863.6 | 0.260 | 0.258 |
| Malaysia | 2179.1 | 2746.0 | -0.518 | 0.956 | 1142.9 | 1.272 | 1.454 |
| Philippines | 2197.4 | 2771.9 | -1.749 | 1.598 | 1410.3 | 1.422 | 1.530 |
| Thailand | 1436.9 | 1105.4 | 0.378 | 0.899 | 1853.1 | 0.839 | 0.176 |
| Rest of Asia | 7658.8 | 10719.6 | -3.848 | 0.119 | 679.1 | 0.681 | 0.761 |
| **Other** | | | | | | | |
| Chile | 165.6 | 78.8 | 0.380 | 0.311 | 249.9 | 0.147 | 0.127 |
| CCS | 4257.2 | 3615.3 | 0.381 | 0.206 | 3444.5 | 0.080 | 0.032 |
| Mexico | 168.2 | 256.7 | -0.056 | 0.104 | 365.9 | 0.044 | 0.042 |
| RME | 2620.3 | 2036.1 | 0.263 | 0.572 | 4940.4 | 0.188 | 0.340 |
| **Total** | **69192.9** | **69223.1** | | | **90338.0** | | |

**TABLE 1 (continued)**
**SUMMARY RESULTS OF THE URUGUAY ROUND**
**CHANGE IN IMPORTS, EXPORTS, TERMS OF TRADE, WELFARE AND THE REAL RETURN TO CAPITAL AND LABOR**
PERCENT CHANGE AND MILLIONS OF U.S. DOLLARS

| Country | Imports (Millions) | Exports (Millions) | Terms of Trade (Percent) | Welfare (Percent) | Welfare (Millions) | Real Wage (Percent) | Return to Capital (Percent) |
|---|---|---|---|---|---|---|---|
| **Scenario D: Uruguay Round** | | | | | | | |
| **Industrialized Countries** | | | | | | | |
| Japan | | | | | | | |
| United States | | | | | | | |
| Canada | | | | | | | |
| Australia | | | | | | | |
| New Zealand | | | | | | | |
| EU and EFTA | | | | | | | |
| | | | | | | | |
| **Developing Countries** | | | | | | | |
| **Asia** | | | | | | | |
| Hong Kong | | | | | | | |
| China | | | | | | | |
| Indonesia | | | | | | | |
| Korea | | | | | | | |
| Singapore | | | | | | | |
| Taiwan | | | | | | | |
| Malaysia | | | | | | | |
| Philippines | | | | | | | |
| Thailand | | | | | | | |
| Rest of Asia | | | | | | | |
| | | | | | | | |
| **Other** | | | | | | | |
| Chile | | | | | | | |
| CCS | | | | | | | |
| Mexico | | | | | | | |
| RME | | | | | | | |
| | | | | | | | |
| **Total** | | | | | | | |

**TABLE 4**
**SUMMARY RESULTS FROM MARKET ACCESS LIBERALIZATION**
**PERCENT CHANGE IN IMPORTS, EXPORTS, TERMS OF TRADE,**
**WELFARE AND WAGES**
**Base Period**

| Country | Imports | Exports | Terms of Trade | Welfare | | Wage |
|---|---|---|---|---|---|---|
| | $ mill. | $ mill. | Percent Change | Percent | $ mill. | Percent Change |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Scenario A. Thirty-Three Percent Reduction in Barriers to Trade in Agriculture, Manufacturing and Services | | | | | | |
| Industrialized Countries | | | | | | |
| Australia | 4,907.38 | 5,395.31 | 0.35 | 3.73 | 12,779.55 | 2.92 |
| Canada | 7,752.24 | 12,300.43 | -1.20 | 4.71 | 26,821.44 | 4.61 |
| European Union | 29,847.35 | 23,017.54 | 0.43 | 0.51 | 41,553.68 | 0.67 |
| Japan | 29,842.36 | 22,399.44 | 0.75 | 0.06 | 3,053.16 | 0.06 |
| New Zealand | 1,534.25 | 1,946.29 | 0.39 | 10.00 | 5,736.82 | 8.03 |
| United States | 34,756.79 | 32,631.58 | 0.47 | 0.65 | 45,838.91 | 1.21 |
| Developing Countries | | | | | | |
| Asia | | | | | | |
| China | 19,752.44 | 23,817.34 | -2.21 | 2.17 | 15,351.44 | 3.17 |
| Hong Kong | 5,214.28 | 5,551.09 | 0.46 | 4.98 | 5,010.43 | 7.11 |
| Indonesia | 3,046.63 | 4,899.89 | -1.72 | 4.97 | 9,823.53 | 6.38 |
| Korea | 8,774.36 | 9,206.82 | -0.28 | 1.61 | 7,155.46 | 1.70 |
| Malaysia | 6,034.43 | 7,861.88 | -1.34 | 7.09 | 6,618.48 | 8.64 |
| Philippines | 2,239.05 | 2,826.30 | -2.29 | 2.07 | 1,424.29 | 4.21 |
| Singapore | 7,913.05 | 9,384.65 | -0.55 | 5.20 | 3,021.92 | 7.31 |
| Taiwan | 12,320.47 | 15,033.00 | -0.99 | 9.85 | 26,971.93 | 6.59 |
| Thailand | 4,248.31 | 4,134.70 | -0.63 | 0.62 | 1,002.76 | 1.53 |
| Other | | | | | | |
| Chile | 665.03 | 552.45 | -0.22 | -0.71 | -446.77 | 0.00 |
| Mexico | 1,141.02 | 177.77 | 0.30 | -1.05 | -2,883.43 | -0.75 |
| Rest of Cairns | 6,431.44 | 3,129.40 | 0.38 | -1.48 | -15,670.97 | -1.42 |
| Total | 186,420.90 | 184,265.89 | | | 193,162.63 | |

**TABLE 4 (continued)**
**SUMMARY RESULTS FROM MARKET ACCESS LIBERALIZATION**
**PERCENT CHANGE IN IMPORTS, EXPORTS, TERMS OF TRADE,**
**WELFARE AND WAGES**
**Base Period**

| Country | Imports | Exports | Terms of Trade | Welfare | | Wage |
|---|---|---|---|---|---|---|
| | $ mill. | $ mill. | Percent Change | Percent | $ mill. | Percent Change |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Scenario B. Thirty-Three Percent Reduction in Barriers to Trade in Agricultural Products | | | | | | |
| Industrialized Countries | | | | | | |
| Australia | 1079.10 | 1221.80 | 0.40 | 1.36 | 4653.30 | 0.69 |
| Canada | 803.76 | 781.08 | 0.08 | 0.59 | 3367.21 | 0.29 |
| European Union | 3001.29 | 1617.68 | 0.09 | -0.02 | -1724.56 | 0.00 |
| Japan | 4943.10 | 3656.31 | -0.22 | -0.44 | -22175.24 | -0.18 |
| New Zealand | 67.16 | 66.58 | 0.08 | 0.39 | 221.95 | 0.25 |
| United States | 6332.53 | 7210.73 | 0.21 | 0.42 | 30116.35 | 0.22 |
| Developing Countries | | | | | | |
| Asia | | | | | | |
| China | 727.72 | 337.00 | 0.09 | 0.15 | 1058.10 | -0.06 |
| Hong Kong | 190.19 | 202.75 | 0.06 | 0.07 | 75.37 | 0.22 |
| Indonesia | 154.91 | 55.97 | 0.06 | 0.13 | 255.78 | -0.12 |
| Korea | 990.20 | 1237.89 | -0.27 | -0.18 | -787.28 | -0.01 |
| Malaysia | 625.46 | 750.99 | -0.14 | 0.34 | 318.32 | 0.35 |
| Philippines | 208.42 | 251.40 | -0.10 | 0.46 | 314.23 | 0.19 |
| Singapore | 526.92 | 636.87 | -0.05 | 0.35 | 200.98 | 0.56 |
| Taiwan | 915.44 | 1127.04 | -0.19 | 0.14 | 394.38 | 0.25 |
| Thailand | 411.10 | 392.46 | 0.06 | 0.27 | 428.92 | 0.22 |
| Other | | | | | | |
| Chile | 41.02 | 38.94 | -0.03 | -0.03 | -17.11 | 0.00 |
| Mexico | 165.19 | 175.81 | 0.04 | 0.48 | 1325.60 | 0.23 |
| Rest of Cairns | 488.82 | 641.22 | 0.11 | 0.27 | 2885.75 | 0.15 |
| Total | 21,672.33 | 20,402.54 | | | 20,912.06 | |

**TABLE 4 (continued)**
**SUMMARY RESULTS FROM MARKET ACCESS LIBERALIZATION**
**PERCENT CHANGE IN IMPORTS, EXPORTS, TERMS OF TRADE,**
**WELFARE AND WAGES**
**Base Period**

| Country | Imports | Exports | Terms of Trade | Welfare | | Wage |
|---|---|---|---|---|---|---|
| | $ mill. | $ mill. | Percent Change | Percent | $ mill. | Percent Change |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Scenario C. Thirty-Three Percent Reduction in Trade Barriers in Manufacturing | | | | | | |
| Industrialized Countries | | | | | | |
| Australia | 3,384.68 | 3,636.22 | -0.05 | 1.75 | 5,989.11 | 1.23 |
| Canada | 1,245.73 | 1,220.51 | -0.03 | 0.02 | 118.10 | 0.03 |
| European Union | 21,176.38 | 18,276.28 | 0.21 | 0.35 | 28,334.77 | 0.09 |
| Japan | 19,909.34 | 19,490.03 | 0.57 | 1.05 | 53,320.17 | 0.48 |
| New Zealand | 1,203.73 | 1,356.29 | 0.81 | 7.08 | 4,060.01 | 4.41 |
| United States | 18,276.60 | 14,456.38 | 0.22 | 0.09 | 6,149.65 | 0.02 |
| Developing Countries | | | | | | |
| Asia | | | | | | |
| China | 17,050.00 | 21,286.57 | -2.18 | 0.84 | 5,971.38 | 2.03 |
| Hong Kong | 3,715.40 | 3,590.33 | 0.40 | 3.20 | 3,223.87 | 3.08 |
| Indonesia | 1,947.11 | 1,943.80 | -0.04 | 0.81 | 1,601.14 | 0.52 |
| Korea | 6,947.10 | 8,119.57 | -0.34 | 2.44 | 10,850.12 | 2.00 |
| Malaysia | 4,831.33 | 6,608.67 | -1.27 | 6.07 | 5,669.50 | 7.16 |
| Philippines | 1,753.03 | 2,223.49 | -2.06 | 1.01 | 697.85 | 2.65 |
| Singapore | 5,714.38 | 6,666.99 | -0.24 | 4.18 | 2,428.78 | 4.55 |
| Taiwan | 9,654.10 | 11,269.39 | -0.23 | 7.72 | 21,162.58 | 4.84 |
| Thailand | 3,542.01 | 3,837.64 | -0.89 | 0.87 | 1,399.44 | 1.32 |
| Other | | | | | | |
| Chile | 585.68 | 573.41 | -0.44 | -0.27 | -168.89 | 0.00 |
| Mexico | 502.05 | 144.63 | -0.04 | -0.61 | -1,679.35 | -0.71 |
| Rest of Cairns | 4,972.93 | 3,299.41 | -0.31 | -0.75 | -7,948.82 | -0.86 |
| Total | 126,411.58 | 127,999.59 | | | 141,179.39 | |

**TABLE 4 (continued)**
**SUMMARY RESULTS FROM MARKET ACCESS BY FOREIGN FIRMS**
**PERCENT CHANGE IN IMPORTS, EXPORTS, TERMS OF TRADE,**
**WELFARE AND WAGES**
**Base Period**

| Country | Imports | Exports | Terms of Trade | Welfare | | Wage |
|---|---|---|---|---|---|---|
| | $ mill. | $ mill. | Percent Change | Percent | $ mill. | Percent Change |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Scenario D. Thirty-Three Percent Reduction in Barriers to Trade in Services | | | | | | |
| Industrialized Countries | | | | | | |
| Australia | 464.18 | 582.07 | -0.01 | 0.65 | 2,227.08 | 1.09 |
| Canada | 5,768.93 | 10,428.69 | -1.26 | 4.15 | 23,614.37 | 4.37 |
| European Union | 5,861.80 | 3,126.25 | 0.15 | 0.17 | 14,139.40 | 0.57 |
| Japan | 5,136.66 | -765.47 | 0.41 | -0.56 | -28,481.94 | -0.25 |
| New Zealand | 277.60 | 562.95 | -0.54 | 2.57 | 1,475.00 | 3.67 |
| United States | 10,401.46 | 11,100.86 | 0.05 | 0.13 | 9,557.30 | 0.97 |
| Developing Countries | | | | | | |
| Asia | | | | | | |
| China | 2,145.87 | 2,479.97 | -0.14 | 1.27 | 8,980.65 | 1.36 |
| Hong Kong | 1,415.12 | 1,918.53 | 0.00 | 1.85 | 1,863.07 | 4.24 |
| Indonesia | 963.22 | 2,926.87 | -1.75 | 4.06 | 8,029.68 | 6.03 |
| Korea | 858.25 | -149.09 | 0.34 | -0.64 | -2,855.15 | -0.30 |
| Malaysia | 645.52 | 591.68 | 0.07 | 0.74 | 694.64 | 1.30 |
| Philippines | 300.82 | 389.56 | -0.17 | 0.68 | 470.62 | 1.51 |
| Singapore | 1,818.71 | 2,302.17 | -0.30 | 0.70 | 406.64 | 2.43 |
| Taiwan | 2,012.54 | 3,144.64 | -0.71 | 2.25 | 6,155.72 | 1.82 |
| Thailand | 313.48 | -92.48 | 0.21 | -0.54 | -871.07 | 0.00 |
| Other | | | | | | |
| Chile | 39.13 | -63.35 | 0.26 | -0.45 | -281.94 | -0.02 |
| Mexico | 465.85 | -180.90 | 0.31 | -0.99 | -2,724.66 | -0.32 |
| Rest of Cairns | 993.27 | -838.47 | 0.60 | -1.06 | -11,169.95 | -0.74 |
| Total | 39,882.40 | 37,464.49 | | | 42,399.41 | |

**TABLE 4 (continued)**
**SUMMARY RESULTS FROM MARKET ACCESS LIBERALIZATION**
**PERCENT CHANGE IN IMPORTS, EXPORTS, TERMS OF TRADE,**
**WELFARE AND WAGES**
**Base Period**

| Country | Imports | Exports | Terms of Trade | Welfare | | Wage |
|---|---|---|---|---|---|---|
| | $ mill. | $ mill. | Percent Change | Percent | $ mill. | Percent Change |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Scenario E. Thirty-Three Percent Reduction in All Barriers to Trade, Two Percent Increase in World Capital Stock | | | | | | |
| Industrialized Countries | | | | | | |
| Australia | 5,068.77 | 5,967.93 | 0.02 | 6.06 | 20,767.66 | 3.93 |
| Canada | 7,494.82 | 15,169.64 | -1.58 | 5.93 | 33,769.05 | 5.28 |
| European Union | -7,026.96 | 15,515.09 | -1.34 | 1.86 | 150,994.04 | 1.09 |
| Japan | 19,843.94 | 29,021.55 | -0.43 | 1.58 | 80,222.82 | 0.81 |
| New Zealand | 1,496.15 | 2,181.05 | -0.14 | 12.05 | 6,913.59 | 9.17 |
| United States | 31,631.29 | 35,750.03 | 0.00 | 2.52 | 178,426.86 | 1.98 |
| Developing Countries | | | | | | |
| Asia | | | | | | |
| China | 18,123.15 | 28,367.76 | -3.04 | 3.99 | 28,262.93 | 4.78 |
| Hong Kong | 6,948.76 | 6,126.15 | 0.02 | 10.21 | 10,275.55 | 9.00 |
| Indonesia | 2,612.83 | 5,691.18 | -2.42 | 7.31 | 14,440.68 | 7.85 |
| Korea | 7654.33 | 9845.61 | -1.00 | 4.16 | 18480.58 | 2.89 |
| Malaysia | 6,123.60 | 9,125.39 | -1.78 | 9.06 | 8,462.17 | 9.82 |
| Philippines | 2,469.76 | 2,840.61 | -2.65 | 6.33 | 4,360.79 | 6.21 |
| Singapore | 7,809.36 | 9,490.89 | -0.82 | 7.28 | 4,232.71 | 6.98 |
| Taiwan | 11,866.57 | 17,040.55 | -1.45 | 10.51 | 28,789.66 | 7.13 |
| Thailand | 4,620.52 | 5,019.01 | -1.25 | 4.81 | 7,739.40 | 3.90 |
| Other | | | | | | |
| Chile | 626.49 | 859.21 | -0.90 | 2.19 | 1,372.40 | 1.76 |
| Mexico | 992.04 | 2,441.09 | -0.35 | 1.23 | 3,401.34 | 0.99 |
| Rest of Cairns | 4,648.75 | 4,288.59 | -0.77 | 1.09 | 11,495.89 | 0.07 |
| Total | 133,004.19 | 204,741.30 | | | 612,408.13 | |

**TABLE 5**

**PERCENT CHANGE IN EXPORTS, IMPORTS, OUTPUT, NUMBER OF FIRMS AND OUTPUT OF FOREIGN-OWNED FIRMS BY SECTOR**
**THIRTY-THREE PERCENT REDUCTION IN BARRIERS TO MARKET ACCESS IN AGRICULTURE, MANUFACTURING AND SERVICES**
**WORLD CAPITAL STOCK AUGMENTED BY TWO PERCENT**
Percent Change

| Country | Sector | Exports | Imports | Output | No. Firms | Output of Foreign-Owned Firms |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Industrialized Countries | | | | | | |
| Australia | Agr. | 10.53 | -2.84 | 6.71 | 8.28 | 2.37 |
| | Mfr. | 13.89 | 9.04 | 4.79 | -1.74 | 13.81 |
| | Ser. | 0.58 | 4.22 | 2.26 | 1.72 | 1.67 |
| | Total | 9.79 | 7.37 | 3.22 | 0.33 | 7.90 |
| Canada | Agr. | 5.51 | 2.64 | 7.01 | 5.08 | 33.55 |
| | Mfr. | 9.22 | 3.97 | 9.26 | 3.51 | 18.42 |
| | Ser. | -1.97 | 6.81 | 3.25 | 0.97 | 23.77 |
| | Total | 7.63 | 4.33 | 5.73 | 2.22 | 19.33 |
| European Union | Agr. | 2.72 | -11.53 | 4.63 | -3.07 | 21.09 |
| | Mfr. | 2.10 | 2.52 | 1.07 | 0.12 | 21.71 |
| | Ser. | 0.46 | -2.65 | 0.80 | 0.27 | 21.25 |
| | Total | 1.73 | -0.83 | 1.02 | 0.17 | 21.32 |
| Japan | Agr. | 5.57 | 4.65 | -0.45 | 0.23 | 38.24 |
| | Mfr. | 6.41 | 7.23 | 0.80 | 0.50 | 25.36 |
| | Ser. | 2.86 | -0.25 | 0.26 | 0.28 | 18.24 |
| | Total | 6.00 | 4.76 | 0.45 | 0.41 | 23.40 |
| New Zealand | Agr. | 11.48 | -2.02 | 10.82 | 8.82 | 25.98 |
| | Mfr. | 18.20 | 10.17 | 11.21 | 5.97 | 18.63 |
| | Ser. | -1.08 | 9.68 | 6.41 | 2.36 | 18.00 |
| | Total | 12.82 | 9.36 | 8.24 | 4.05 | 20.41 |
| United States | Agr. | 23.23 | -5.22 | 5.21 | 5.30 | 37.36 |
| | Mfr. | 4.66 | 5.33 | 2.25 | -0.49 | 19.76 |
| | Ser. | 1.11 | 1.14 | 1.55 | 0.09 | 32.78 |
| | Total | 4.98 | 3.72 | 1.91 | -0.17 | 24.02 |

**TABLE 5 (continued)**

**PERCENT CHANGE IN EXPORTS, IMPORTS, OUTPUT,**
**NUMBER OF FIRMS AND OUTPUT OF FOREIGN-OWNED FIRMS**
**BY SECTOR**
**THIRTY-THREE PERCENT REDUCTION IN BARRIERS TO MARKET ACCESS IN**
**AGRICULTURE, MANUFACTURES AND SERVICES**
**WORLD CAPITAL STOCK AUGMENTED BY TWO PERCENT**
Percent Change

| Country | Sector | Exports | Imports | Output | No. Firms | Output of Foreign-Owned Firms |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Developing Countries | | | | | | |
| Asia | | | | | | |
| China | Agr. | 9.50 | -2.55 | 3.31 | 0.00 | 34.97 |
| | Mfr. | 14.04 | 14.74 | 4.44 | -0.38 | 26.82 |
| | Ser. | 10.02 | -5.07 | 3.63 | -1.34 | 37.61 |
| | Total | 13.49 | 11.30 | 3.97 | -0.57 | 32.17 |
| Hong Kong | Agr. | 15.83 | 2.79 | 19.05 | 27.86 | 19.00 |
| | Mfr. | 17.42 | 7.58 | 14.35 | 12.14 | 15.40 |
| | Ser. | 1.76 | 2.76 | 5.71 | 3.13 | 6.37 |
| | Total | 8.23 | 6.43 | 7.82 | 6.47 | 13.51 |
| Indonesia | Agr. | 14.25 | -6.76 | 8.79 | 4.51 | 27.92 |
| | Mfr. | 10.34 | 7.85 | 6.85 | -0.63 | 33.11 |
| | Ser. | 1.36 | 1.68 | 4.13 | 1.19 | 32.42 |
| | Total | 10.75 | 5.48 | 6.01 | 0.18 | 29.32 |
| Korea | Agr. | 5.58 | 3.59 | 1.96 | 1.86 | 7.80 |
| | Mfr. | 7.80 | 7.03 | 3.03 | 0.68 | 21.80 |
| | Ser. | 3.34 | -0.18 | 1.97 | 0.69 | 15.14 |
| | Total | 7.06 | 5.24 | 2.48 | 0.69 | 19.92 |
| Malaysia | Agr. | 6.35 | 19.56 | 6.50 | 0.90 | 23.92 |
| | Mfr. | 11.78 | 8.73 | 10.25 | 5.40 | 8.67 |
| | Ser. | 6.08 | -0.14 | 7.12 | 2.96 | 12.02 |
| | Total | 10.82 | 8.09 | 8.62 | 4.02 | 12.11 |
| Philippines | Agr. | 9.85 | -0.79 | 4.33 | 2.20 | 19.01 |
| | Mfr. | 13.88 | 10.97 | 4.79 | -0.81 | 24.44 |
| | Ser. | 5.47 | -3.63 | 3.17 | 0.74 | 32.15 |
| | Total | 11.00 | 6.98 | 3.96 | 0.14 | 24.37 |
| Singapore | Agr. | 13.40 | 5.10 | 12.45 | 18.56 | 6.58 |
| | Mfr. | 8.38 | 6.92 | 7.88 | 3.78 | 11.09 |
| | Ser. | 5.66 | 2.29 | 6.53 | 2.26 | 11.28 |
| | Total | 7.88 | 6.20 | 7.34 | 3.05 | 11.17 |
| Taiwan | Agr. | 5.65 | 21.64 | 4.93 | 0.34 | 20.47 |
| | Mfr. | 14.40 | 10.81 | 10.95 | 2.23 | 26.58 |
| | Ser. | -2.96 | 9.71 | 4.77 | 2.43 | 33.18 |
| | Total | 13.13 | 11.34 | 7.87 | 2.24 | 26.86 |
| Thailand | Agr. | 10.14 | -3.07 | 3.80 | 2.55 | 49.83 |
| | Mfr. | 7.94 | 8.95 | 1.80 | -0.48 | 27.09 |
| | Ser. | 4.99 | -3.33 | 2.35 | 0.24 | 41.12 |
| | Total | 7.58 | 5.77 | 2.24 | -0.13 | 35.48 |

**TABLE 5 (continued)**

**PERCENT CHANGE IN EXPORTS, IMPORTS, OUTPUT, NUMBER OF FIRMS AND OUTPUT OF FOREIGN-OWNED FIRMS BY SECTOR**
**THIRTY-THREE PERCENT REDUCTION IN BARRIERS TO MARKET ACCESS IN AGRICULTURE, MANUFACTURES AND SERVICES**
**WORLD CAPITAL STOCK AUGMENTED BY TWO PERCENT**
Percent Change

| Country | Sector | Exports | Imports | Output | No. Firms | Output of Foreign-Owned Firms |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Developing Countries Non-Asia | | | | | | |
| Chile | Agr. | 4.03 | -3.09 | 2.20 | 0.29 | 38.49 |
| | Mfr. | 5.50 | 6.00 | 0.76 | -0.18 | 35.68 |
| | Ser. | 3.53 | -2.81 | 0.61 | 0.57 | 34.26 |
| | Total | 4.82 | 3.57 | 0.87 | 0.20 | 36.59 |
| Mexico | Agr. | 4.23 | -1.71 | 1.70 | 0.13 | 38.66 |
| | Mfr. | 2.79 | 2.13 | 1.22 | -0.24 | 36.47 |
| | Ser. | 2.12 | -1.89 | 0.41 | 0.06 | 27.95 |
| | Total | 2.92 | 1.46 | 0.94 | -0.12 | 35.94 |
| Rest of Cairns | Agr. | 4.89 | -8.03 | 0.64 | 0.38 | 37.44 |
| | Mfr. | 6.08 | 9.07 | -0.23 | -0.63 | 29.84 |
| | Ser. | 2.68 | -3.63 | 0.01 | -0.22 | 29.87 |
| | Total | 5.35 | 5.06 | -0.03 | -0.49 | 30.60 |