
Appendix B

GTAP Model Analysis: Simulating the Effect of a Korea-US FTA Using Computable General Equilibrium Techniques

JOHN P. GILBERT

To analyze the potential impact of a Korea-US free trade agreement, we have used counterfactual simulation with a computable general equilibrium (CGE) model. General equilibrium refers to the study of models in which an equilibrium is simultaneously obtained in more than one market. CGE models attempt to turn the abstract models of general equilibrium theory into a practical tool for policy analysis. This appendix provides a brief overview of the CGE approach, the particulars of the model used in this study, and more detailed simulation results than those presented in the main text.

The basic structure of a multiregional CGE model can be described as follows. Consider a global economy consisting of M regions indexed by r . Let \mathbf{V}^r be a vector (length F) of factor endowments in each region r , and \mathbf{P}^r be a vector (length N) of prices in each region r . We can then define the GNP functions for each region as $G^r(\mathbf{P}^r, \mathbf{V}^r) = \max\{\mathbf{P}^r \cdot \mathbf{Y}^r : \mathbf{V}^r\}$, and similarly the expenditure functions as $E^r(\mathbf{P}^r, U^r) = \min\{\mathbf{P}^r \cdot \mathbf{D}^r : U^r\}$, where U^r is aggregate utility in region r . The aggregate budget constraints are then:

$$S^r(\mathbf{P}^r, \mathbf{V}^r, U^r) = G^r(\mathbf{P}^r, \mathbf{V}^r) - E^r(\mathbf{P}^r, U^r) = 0 \quad r = 1, \dots, M \quad (1)$$

From the first-order conditions to the GNP maximization problem, we obtain sectoral supply functions by Hotelling's lemma and Hicksian

John P. Gilbert is currently a postdoctoral fellow in the Department of Agricultural Economics at Washington State University. He was previously a research economist at the APEC Study Center of New Zealand.

demand functions follow similarly from the derivative properties of the expenditure function, hence:

$$S_i(\mathbf{P}^r, \mathbf{V}^r, U^r) = D_i(\mathbf{P}^r, U^r) - Y_i(\mathbf{P}^r, \mathbf{V}^r) \quad i = 1, \dots, N; \quad r = 1, \dots, M \quad (2)$$

Equation 2 defines Hicksian net exports. With trade, there can be only one price vector, which we denote \mathbf{P} . International equilibrium then requires:

$$\sum_{r=1}^M S_i(\mathbf{P}, \mathbf{V}^r, U^r) = 0 \quad i = 1, \dots, N \quad (3)$$

By Walras's law, these equilibrium conditions are not independent, and any one of them can be dropped. Hence, one element of \mathbf{P} (say P_1) must be declared a numéraire price. The solution to the system of equations 1 through 3 then yields a relative price vector, aggregate utility levels, and net exports. We can subsequently derive factor prices from the GNP function:

$$W_j^r = W_j^r(\mathbf{P}, \mathbf{V}^r) \quad j = 1, \dots, F; \quad r = 1, \dots, M \quad (4)$$

Finally, since each sector is a price taker in factor markets, from the first-order conditions of sectoral cost minimization $C_i^r(\mathbf{W}^r, Y_i^r) = \min\{\mathbf{W}^r \cdot \mathbf{X}^r : Y_i^r\}$, we obtain factor demands:

$$X_{ij}^r = X_{ij}^r(\mathbf{W}^r, Y_i^r) \quad i = 1, \dots, N; \quad j = 1, \dots, F; \quad r = 1, \dots, M \quad (5)$$

In this simple model we have $M + MN + N + 2MF + MFN - 1$ variables but we have only $M + MN + N + MF + MFN - 1$ independent equations. In a neoclassical model the \mathbf{V}^r are declared exogenous, enabling the system to be solved.

While the basic framework described here is abstract, it illustrates the important features of CGE models. First, we can see that optimizing behavior is explicitly built into the model through the utility maximization conditions underlying the expenditure function and the profit maximization conditions underlying the cost and GNP functions. Second, economy-wide constraints are enforced, as the conditions underlying the GNP and expenditure functions reflect. Finally, we can see that the system explicitly captures the relationships between sectors—demand and supply in each market is a function of the complete relative price vector.

The typical applied model adds considerable complexity but retains the basic framework described by equations 1 through 5. Typical modifications include the introduction of intermediate inputs in production and final demands distinguished between households, government, trade, and capital creation. Most models also incorporate imperfect substitution between foreign and domestic goods and between alternative sources of imports (if multiregional). This latter assumption, known as the Arming-

ton (1969) specification, serves the dual purposes of dampening the trade and output responses to changes in relative prices and of allowing cross-hauling of products in the same category to be easily accommodated. Because they are designed for policy analysis by counterfactual simulation, most models will also incorporate a variety of distortions, most commonly in the form of taxes on various activities and rigidities in various markets.

CGE models may differ from the models of neoclassical general equilibrium in two other fundamental ways. First there is the question of closure—the selection of which variables in the model are to be exogenous. Various closures are possible and have been discussed at length elsewhere (Dewatripont and Michel 1987). The key point is that selecting different closures can have a significant impact on the model results. Second, some models do not maintain the assumption of perfect competition in all markets. A variety of specifications have been adopted to introduce imperfect competition into CGE models (Harris 1984 is the seminal contribution in this area). Again, this can have a significant effect on model results.

Because CGE models attempt to capture the features of real-world economies, they incorporate data on the structure of production and trade in the economy under consideration. In general, the starting point will be a national input-output table or SAM, and a set of trade matrices (for multiregional models). These data represent the state of the economy in question at one point in time—the base year. Also, specific functional forms must be employed to define the substitution relationships of a CGE model. Once the functional forms are decided upon, free parameters are obtained by either econometric estimation or (more frequently) literature searches. Profit and utility maximizing conditions are then assumed to hold in the base year, allowing the remaining parameters to be determined from the base data, a process called calibration.

Simulation in most CGE models involves examining comparative static results. That is, most models consider the role that changes in exogenous parameters (“shocks”) have on the allocation of goods among consumers and of resources among productive activities, and the consequences for economic efficiency. The models compare alternative equilibrium states but do not consider the path between the two states. The models thus have no explicit time dimension, and instead represent different time frames by altering microeconomic elements of the closure. The results of static simulations are often interpreted as representing how the economic system in question would have looked had the new policy been in place in the base year, after all relevant adjustments had taken place. Net welfare effects will generally be presented in terms of a money equivalent.¹

1. For further discussion of CGE models and their applications see Bandara (1991) and Decaluwe and Martens (1988). For a useful overview of the structure of Armington trade models see Devarajan and Lewis (1990).

Having introduced the basic terminology and provided an overview of the way in which CGE models are constructed and used, we turn to a brief overview of the specifics of the model used in this study.

The GTAP Model

The specific model used here is the Global Trade Analysis Project (GTAP) model. This is a publicly available, multiregional CGE model that has been extensively used in the literature. It has been fully documented in Hertel (1997).

The production side of the model assumes constant returns to scale technology and perfect competition. Production in each identified sector in each identified region is represented by a nested constant elasticity of substitution (CES) function. The model incorporates the Armington assumption, and as such, each firm uses a CES composite of domestically produced and imported intermediate goods in fixed proportions with a value-added CES composite (based on five endowed factors of production—land, natural resources, unskilled labor, skilled labor, and capital).

On the demand side, total income is allocated using fixed value shares across government, household, and savings expenditure. The single representative household then maximizes a constant differences in elasticities (CDE) objective function, which is calibrated to differing income and price elasticities of demand in each region and allows a rich description of final demand. In each case, consumption is of a CES composite of domestically produced and imported goods.

We adopt two microeconomic closures that reflect the choice of time frame. It is important to emphasize again that the time frame element cannot be interpreted in terms of calendar years, but rather in terms of the adjustments that are allowed to take place in the (unobservable) transition to a new equilibrium. In the first closure, we adopt a neoclassical approach—fixing the endowments of productive factors and allowing market prices to adjust to maintain full employment. This type of closure is often interpreted as representing the medium run, since it envisages a situation where the existing capital stock is able to move between sectors in response to variations in the rates of return to capital across sectors (thereby eliminating these variations). However, the period considered is not long enough for new investment to come online as productive capital.

The second closure we adopt is often termed a “steady-state” closure. Here the rate of return to capital is set exogenously and the level of the capital stock is allowed to adjust. We can interpret the time frame here as the time required for both the allocation and the level of the capital stock to adjust to a given policy change so as to equilibrate rates of return across sectors and to restore rates of return to their initial levels. The changes under this closure approximate the effect of investment expansion

Table B.1 Initial tariff levels by sector (weighted averages, percent)

Sector	US average	United States-Korea ^a	Korea average	Korea-United States ^b
Agriculture, forestry, and fisheries	4.4	0.6	45.8	75.9
Processed food	9.8	4.9	27.1	32.8
Mining and quarrying	0.2	0.4	3.8	1.6
Textiles and apparel	9.9	11.8	6.9	4.7
Chemical, rubbers, and plastics	3.2	7.6	7.2	7.3
Metals	1.8	4.5	5.6	3.4
Transportation equipment	1.4	2.4	4.8	3.1
Electronics	1.1	0.7	8.0	8.0
Other manufactures	2.0	3.4	7.7	7.4
Services	0.0	0.0	0.1	0.1
All sectors (average)	2.4	3.6	8.1	13.2

a. Weighted average tariff imposed by the United States on imports from Korea.

b. Weighted average tariff imposed by Korea on imports from the United States.

Source: GTAP4 database (McDougall et al., 1998).

following trade liberalization in a neoclassical model (see Wang and Zhai 1998).

The two macroeconomic closures reflect different assumptions about the current account balance. The first closure is the standard GTAP model closure. Global investment is assumed to be responsive to changes in the relative rates of return across regions. This does not affect productive capital stocks but does have an impact on saving and thus on the current account balance in each region (for further details see Hertel 1997). In the second closure, the current account balance is explicitly fixed. This is a conservative closure and can be interpreted as a partial long-run equilibrium with international capital mobility ignored.

Data and Aggregation

We have used version 4 of the GTAP database, which is detailed in McDougall, Elbehri, and Truong (1998). The full database contains information on 45 regions and 50 commodities and has a base year of 1995. The simulations presented here are based on an aggregated version of the data consisting of 10 regions and 10 commodities.

Within the GTAP database, tariffs and other taxes are represented as ad valorem equivalents of the actual applied rates. The GTAP database incorporates extensive information on distortions in goods sectors, including trade taxes/subsidies, output and input taxes/subsidies, and consumption taxes/subsidies. The database does not at present account for distortions in trade in services. The taxes are weighted appropriately during the aggregation procedure (table B.1). Tariffs and export subsidies

are defined on a region-to-region basis, which allows the model to be easily used for analysis of regional trading arrangements. This also implies that differing applied rates across regions reflect the different import compositions of trade within a given aggregation.

Simulation Procedure and Assumptions

We simulate the formation of an FTA between Korea and the United States by eliminating the bilateral tariffs between these two economies from the 1995 base, holding all other distortion levels in the system constant. Because of the likely sensitivity regarding agriculture in any agreement, we also simulate the removal of bilateral tariffs excluding those in the agricultural and food sectors. The scenarios are all run as comparative static simulations. We again emphasize that this gives us information on possible end outcomes, but not on the transition path, and that the time element is represented by the alternative microeconomic closures.

Because there is considerable uncertainty surrounding the parameters used in the model, we have adopted the approach of Arndt et al. (1997) in treating the Armington elasticities (which have the most significant impact on the results) as random variables. This implies that the results generated by the model are also random variables. Using the Gaussian quadratures technique developed by Arndt et al. (1996) and Arndt and Pearson (1998) for the GTAP model, it is possible to calculate means and standard deviations for the results, which give an indication of the sensitivity of the model to parameter changes and the degree of confidence that can be ascribed to any given result. (We use the same triangular distribution—with central values as in the GTAP database and minimum values of 0.1 and 0.2 for the lower and upper levels, respectively—of the Armington parameters assumed by Arndt et al. 1997).

Results

Net Welfare Effects

The welfare measure used in the results is the equivalent variation (EV) for each regional household, expressed in millions of 1995 US dollars. This can be interpreted as the change in regional household income at constant prices that is equivalent to the proposed change. Because the EV uses beginning-period prices as its base, welfare results from alternative simulations can be directly compared (although the time frame envisaged in the various closures needs to be taken into account). To give some idea of the magnitude of the welfare gains, we have also expressed them as

a percentage of initial regional GDP. These figures are presented in tables B.2 and B.3, respectively.

We have also included standard deviation estimates. Here and elsewhere, the units of the standard deviation figures match the units of the mean figures (i.e., in this case they are in millions of 1995 dollars). As rule of thumb, if a figure maintains the same sign within two standard deviations, we can be confident (more than 95 percent) that the sign is correct. Obviously, smaller deviations around the mean values indicate greater confidence in the results.

The results indicate that both Korea and the United States benefit in net welfare terms under all scenarios. Agricultural trade is shown to be quite important; the net gains are less than half if agriculture is excluded from the agreement. The net gains are roughly evenly spread between the two economies in absolute terms but are much bigger for Korea in relative terms. However, there is less confidence in the results for Korea—a reflection of the size of the economy. We also have quite clear evidence of substantial trade diversion: virtually all other economies lose in net welfare terms under all scenarios. This includes NAFTA partners. The most substantial losses are to Japan in absolute terms and to China and ASEAN in relative terms.

In order to help better understand the sources of welfare gains, we have used the welfare decomposition routines of Huff and Hertel (1996). In essence, this technique incorporates Harberger's fundamental equation of applied welfare economics into the GTAP model (breaking down welfare changes using the changes in movements of goods/factors across the distortions in the system—changes in the marginal utility of income reflect the fact that the CDE utility function is not homothetic). These figures are presented in tables B.4 and B.5, and again, the figures are expressed in millions of 1995 dollars.

We observe that the sources of gains from an FTA are quite different for the two economies. In the US case, most of the gains are from improvements in the terms of trade. These improvements reflect the benefits of export expansion into the Korean market. Allocative efficiency gains/losses are small (reflecting relatively low distortion levels in the economy). In the Korean case, terms-of-trade effects are less significant and sometimes even negative. Negative terms-of-trade effects reflect the costs associated with trade diversion. The largest gains for Korea come from improvements in allocative efficiency in production and imports (Vinerian trade creation). One interpretation would be that Korea has little to gain from an agreement with the United States relative to unilateral liberalization.

The net welfare results estimated in this model reflect the benefits of reallocation of resources (efficiency gains). These are generally relatively small. Dynamic gains from investment effects are approximated by the

Table B.2 Estimated net welfare effect of a Korea-US FTA under various scenarios (mean equivalent variation, in millions of 1995 dollars, standard deviation in parentheses)

Region	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run	Standard deviation	Medium run	Long run	Standard deviation	Medium run	Long run	Standard deviation	Medium run	Long run	Standard deviation
Australia and New Zealand (CER)	-296.3 (58.0)	-409.8 (79.8)		-17.6 (12.9)	10.6 (22.3)		-224.3 (42.1)	-448.6 (96.0)		-5.4 (9.1)	38.7 (22.7)	
Japan	-2,231.7 (531.1)	-3,581.9 (968.8)		-1,170.7 (370.8)	-1,941.2 (804.7)		-1,677.7 (487.2)	-3,411.6 (1,161.4)		-940.3 (351.2)	-2,243.7 (1,043.5)	
Korea	4,099.6 (1,266.7)	10,860.7 (2,771.3)		1,712.2 (645.0)	4,923.4 (1,414.6)		2,433.0 (1,267.0)	7,443.9 (2,849.1)		1,276.6 (630.5)	4,196.4 (1,426.9)	
China	-486.5 (308.5)	-927.8 (560.2)		-427.3 (201.4)	-666.0 (352.3)		-353.1 (326.5)	-775.7 (612.0)		-384.4 (205.2)	-623.7 (374.2)	
ASEAN	-519.8 (166.0)	-850.4 (343.4)		-278.7 (105.3)	-509.3 (235.4)		-465.7 (165.5)	-754.3 (338.9)		-245.3 (101.3)	-440.5 (224.1)	
Taiwan	-267.3 (77.8)	-467.6 (159.1)		-83.9 (27.4)	-157.0 (62.4)		-275.6 (87.0)	-471.8 (177.6)		-84.6 (29.3)	-154.1 (65.4)	
United States	3,783.4 (663.7)	8,934.6 (1,567.8)		1,532.4 (551.2)	4,186.1 (1,379.7)		3,606.2 (616.4)	11,311.6 (1,910.3)		1,298.8 (505.8)	4,987.5 (1,667.8)	
Canada	-293.4 (112.0)	-324.3 (188.9)		-193.3 (82.4)	-253.7 (133.9)		-228.9 (107.3)	-171.4 (239.3)		-168.0 (75.3)	-230.6 (148.2)	
Mexico	-138.7 (56.0)	-379.7 (243.2)		-94.1 (38.2)	-306.1 (160.3)		-110.1 (56.0)	-238.8 (292.3)		-82.4 (36.1)	-293.3 (179.1)	
Rest of world	-2,223.1 (625.7)	-3,813.9 (1,558.2)		-1,169.2 (372.9)	-1,689.7 (863.3)		-966.0 (564.9)	-2,112.3 (1,924.7)		-762.8 (331.8)	-1,210.7 (967.8)	
Sum of world	1,426.2 (403.5)	9,039.9 (1,489.3)		-190.3 (211.2)	3,597.3 (644.2)		1,737.7 (423.8)	10,371.0 (1,662.7)		-97.9 (201.9)	4,026.0 (715.8)	

ASEAN = Association of South East Asian Nations.

CER = Closer Economic Relations trade agreement.

Source: Model simulations.

Table B.3 Relative net welfare effect of a Korea-US FTA under various scenarios (estimated mean equivalent variation as a percentage of initial GDP)

Region	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run	Long run	Medium run	Long run	Long run	Medium run	Long run	Long run	Medium run	Long run	
Australia and New Zealand (CER)	-0.07	-0.10	0.00	0.00	0.00	0.00	-0.06	-0.11	0.00	0.00	0.01	
Japan	-0.04	-0.07	-0.02	-0.02	-0.04	-0.04	-0.03	-0.07	-0.02	-0.02	-0.04	
Korea	0.91	2.41	0.38	0.38	1.09	1.09	0.54	1.65	0.28	0.28	0.93	
China	-0.06	-0.11	-0.05	-0.05	-0.08	-0.08	-0.04	-0.10	-0.05	-0.05	-0.08	
ASEAN	-0.08	-0.14	-0.05	-0.05	-0.08	-0.08	-0.08	-0.12	-0.04	-0.04	-0.07	
Taiwan	-0.10	-0.17	-0.03	-0.03	-0.06	-0.06	-0.10	-0.17	-0.03	-0.03	-0.06	
United States	0.05	0.13	0.02	0.02	0.06	0.06	0.05	0.16	0.02	0.02	0.07	
Canada	-0.05	-0.06	-0.03	-0.03	-0.04	-0.04	-0.04	-0.03	-0.03	-0.03	-0.04	
Mexico	-0.05	-0.14	-0.03	-0.03	-0.11	-0.11	-0.04	-0.09	-0.03	-0.03	-0.11	
Rest of world	-0.02	-0.03	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01	
Sum of world	0.01	0.03	0.00	0.00	0.01	0.01	0.01	0.04	0.00	0.00	0.01	

ASEAN = Association of South East Asian Nations.

CER = Closer Economic Relations trade agreement.

Source: Model simulations.

Table B.4 Decomposition of estimated net welfare effect on Korea under various scenarios
(mean equivalent variation, millions of 1995 dollars)

Scenario	Allocative efficiency effect			Change in imports	Change in terms of trade	Change in marginal utility of income	Change in capital stock	Total
	Change in production	Change in consumption	Change in exports					
Flexible current account								
Full liberalization, medium run	862.7	75.9	50.5	1,645.1	1,509.5	-44.0	0.0	4,099.6
Full liberalization, long run	1,880.7	82.3	58.3	1,880.9	-120.1	-85.8	7,164.3	10,860.7
Excluding agriculture, medium run	89.4	11.2	55.7	110.1	1,445.9	-0.2	0.0	1,712.2
Excluding agriculture, long run	569.6	14.2	58.2	237.8	646.4	-1.4	3,398.5	4,923.4
Fixed current account								
Full liberalization, medium run	869.9	69.2	56.6	1,576.0	-102.0	-36.7	0.0	2,433.0
Full liberalization, long run	1,603.7	74.3	62.3	1,755.1	-1,150.0	-64.5	5,163.0	7,443.9
Excluding agriculture, medium run	91.2	9.5	56.0	90.3	1,029.7	-0.1	0.0	1,276.6
Excluding agriculture, long run	512.2	12.5	59.0	208.2	427.3	-1.0	2,978.3	4,196.4

Source: Model simulations.

Table B.5 Decomposition of estimated net welfare effect on the United States under various scenarios
(mean equivalent variation, millions of US dollars)

Scenario	Allocative efficiency effect			Change in imports	Change in terms of trade	Change in marginal utility of income	Change in capital stock	Total
	Change in production	Change in consumption	Change in exports					
Flexible current account								
Full liberalization, medium run	-154.5	84.4	-77.7	149.7	3,781.4	0.2	0.0	3,783.4
Full liberalization, long run	41.8	355.4	-7.8	112.6	2,773.6	0.5	5,658.6	8,934.6
Excluding agriculture, medium run	28.3	13.8	15.6	36.5	1,438.2	0.0	0.0	1,532.4
Excluding agriculture, long run	134.7	154.7	51.8	22.3	866.6	0.0	2,956.0	4,186.1
Fixed current account								
Full liberalization, medium run	-162.4	76.9	-66.4	125.2	3,632.8	0.2	0.0	3,606.2
Full liberalization, long run	161.5	456.5	-42.5	135.6	3,309.7	0.5	7,290.3	11,311.6
Excluding agriculture, medium run	15.8	7.0	28.6	26.8	1,220.6	0.0	0.0	1,298.8
Excluding agriculture, long run	172.9	188.9	41.3	31.8	1,048.5	0.0	3,504.2	4,987.5

Source: Model simulations.

use of a steady-state closure. However, the effects of scale economies that can exist under imperfect competition are not captured. Moreover, because of limitations in the available data, services protection is not captured. For this reason, the results presented here are probably lower-bound estimates of the potential welfare effects of the formation of a free trade area.

International Trade

We present trade effects in percentage change and volume terms, exploring the changes from different angles. Tables B.6 and B.7 give the percentage changes and standard deviations in Korea-US exports and US-Korea exports by sector. Tables B.8 and B.9 give the percentage changes and standard deviations of total Korean and US exports by sector. It is necessary to consider the initial level of trade (in some instances, for example, large percentage changes merely reflect very small initial trade levels). We have provided original trade data from the database in tables B.10 and B.11 for this purpose.

Tables B.12 and B.13 give the volume and percentage changes in total Korean and US exports by region (free on board [FOB] weights). Tables B.14 and B.15 give the volume and percentage changes in total Korean and US imports by region (again, using FOB weights). The model separates prices and quantities in the database by assuming initial prices equal to unity. Since the data values are expressed in millions of dollars, the quantity unit for volume changes in each sector is the amount that would have been sold in the initial equilibrium for \$1 million.

The results indicate small changes for the United States in terms of the overall export volume. There are moderate increases in agricultural exports when these goods are included in the agreement. The changes in export volumes are larger for Korea (table B.8). The largest percentage changes are for agriculture, but from a very small base and with a high degree of uncertainty (there is a heavy dependence on parameter values as indicated by high standard deviations). The figures are also large, but more stable, for textiles.

In terms of US-Korea trade (table B.7), there are large increases in US exports of agriculture and food products (where liberalized), transportation equipment, electronics, and other manufactures. All figures are reasonably robust. There are also large percentage increases in Korea-US exports of agriculture and food, but again from a tiny base and with considerable uncertainty (table B.6). There are more robust results for textiles, chemicals, and other manufactures.

The regional export and import patterns in tables B.12 through B.15 confirm the presence of trade diversion in trade from the United States to Korea. The United States increases exports to Korea substantially (table

Table B.6 Estimated bilateral trade effects on Korea under various scenarios (percentage change in Korea's export volumes to the United States' volumes, standard deviation in parentheses)

Sector	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run	Standard deviation	Medium run	Long run	Standard deviation	Medium run	Long run	Standard deviation	Medium run	Long run	Standard deviation
Agriculture, forestry, and fisheries	64.2 (49.9)	58.5 (47.9)	(1.7)	-3.1 (1.7)	-5.3 (2.6)	(2.6)	68.3 (52.0)	63.8 (50.6)	(1.5)	-2.5 (1.5)	-4.5 (2.4)	(2.4)
Processed food	92.4 (52.3)	91.2 (52.6)	(1.6)	-3.2 (1.6)	-3.9 (1.9)	(1.9)	97.4 (55.4)	96.2 (55.4)	(1.4)	-2.6 (1.4)	-3.3 (1.8)	(1.8)
Mining and quarrying	-3.5 (2.3)	-5.1 (3.2)	(1.1)	-0.4 (1.1)	-1.2 (1.5)	(1.5)	-1.8 (1.9)	-3.0 (2.7)	(1.0)	0.1 (1.0)	-0.7 (1.4)	(1.4)
Textiles and apparel	143.1 (71.0)	151.4 (76.9)	(54.4)	111.6 (54.4)	112.3 (55.5)	(55.5)	151.5 (75.9)	157.4 (80.3)	(54.1)	110.7 (54.1)	113.4 (56.0)	(56.0)
Chemical, rubbers, and plastics	32.3 (13.8)	35.5 (15.3)	(13.8)	32.3 (13.8)	33.5 (14.4)	(14.4)	34.9 (15.0)	37.1 (16.0)	(14.0)	32.6 (14.0)	33.8 (14.6)	(14.6)
Metals	19.7 (8.5)	25.1 (10.6)	(10.0)	23.2 (10.0)	26.7 (11.3)	(11.3)	23.1 (10.0)	27.0 (11.5)	(10.5)	24.8 (10.5)	27.1 (11.5)	(11.5)
Transportation equipment	16.5 (8.3)	23.0 (10.3)	(10.1)	22.5 (10.1)	26.7 (11.5)	(11.5)	23.0 (10.9)	27.7 (12.3)	(10.8)	24.9 (10.8)	27.8 (12.0)	(12.0)
Electronics	-1.8 (2.4)	1.9 (1.8)	(1.4)	1.8 (1.4)	3.8 (1.6)	(1.6)	1.3 (2.5)	3.9 (2.2)	(1.6)	2.6 (1.6)	4.2 (1.8)	(1.8)
Other manufactures	15.5 (6.6)	18.8 (7.6)	(6.7)	16.9 (6.7)	18.4 (7.4)	(7.4)	18.8 (7.7)	21.2 (8.5)	(7.1)	17.5 (7.1)	18.9 (7.6)	(7.6)
Services	-6.2 (2.9)	-3.5 (2.0)	(1.7)	-3.9 (1.7)	-2.4 (1.2)	(1.2)	-3.6 (2.5)	-1.7 (1.9)	(1.5)	-3.1 (1.5)	-2.0 (1.1)	(1.1)

Source: Model simulations.

Table B.7 Estimated bilateral trade effects on the United States under various scenarios (percentage change in US export volumes to Korea, standard deviation in parentheses)

Sector	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run		Medium run	Long run		Medium run	Long run		Medium run	Long run	
Agriculture, forestry, and fisheries	192.3 (52.4)	200.1 (54.5)	2.3 (1.0)	2.3 (1.0)	3.8 (1.4)		191.2 (51.7)	196.8 (53.0)	2.2 (1.0)	2.2 (1.0)	3.6 (1.4)	
Processed food	145.0 (62.4)	150.0 (64.0)	2.3 (1.2)	2.3 (1.2)	3.4 (1.4)		144.5 (62.4)	148.1 (63.6)	2.2 (1.2)	2.2 (1.2)	3.2 (1.4)	
Mining and quarrying	9.9 (3.7)	13.2 (3.9)	9.1 (3.6)	9.1 (3.6)	10.5 (3.7)		10.5 (3.7)	12.7 (3.8)	9.1 (3.7)	9.1 (3.7)	10.4 (3.7)	
Textiles and apparel	48.3 (24.5)	51.7 (26.6)	47.7 (21.8)	47.7 (21.8)	48.3 (22.3)		49.4 (25.7)	51.5 (27.1)	47.0 (21.7)	47.0 (21.7)	48.2 (22.3)	
Chemical, rubbers, and plastics	28.8 (10.2)	31.6 (10.7)	28.1 (10.3)	28.1 (10.3)	29.3 (10.5)		28.8 (10.3)	30.8 (10.7)	27.9 (10.3)	27.9 (10.3)	29.1 (10.5)	
Metals	18.6 (7.2)	21.4 (7.7)	18.7 (7.5)	18.7 (7.5)	20.6 (7.8)		19.0 (7.4)	20.8 (7.6)	19.4 (7.7)	19.4 (7.7)	20.4 (7.8)	
Transportation equipment	26.5 (7.9)	28.3 (8.1)	24.3 (7.9)	24.3 (7.9)	25.5 (7.9)		22.6 (7.6)	23.9 (7.8)	23.8 (7.7)	23.8 (7.7)	24.5 (7.8)	
Electronics	39.5 (12.9)	42.0 (13.3)	38.4 (13.0)	38.4 (13.0)	39.4 (13.2)		36.9 (12.7)	38.7 (13.0)	37.6 (13.0)	37.6 (13.0)	38.7 (13.1)	
Other manufactures	36.6 (13.8)	40.2 (14.7)	37.0 (14.1)	37.0 (14.1)	38.3 (14.7)		34.7 (13.9)	37.3 (14.5)	36.1 (14.1)	36.1 (14.1)	37.6 (14.5)	
Services	2.9 (1.6)	4.4 (1.4)	1.8 (0.9)	1.8 (0.9)	2.5 (0.8)		1.3 (1.2)	2.4 (1.3)	1.5 (0.7)	1.5 (0.7)	2.1 (0.7)	

Source: Model simulations.

Table B.8 Estimated trade effects on Korea under various scenarios (percentage change in Korea's total export volumes, standard deviation in parentheses)

Sector	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run	Long run	Medium run	Long run	Long run	Medium run	Long run	Long run	Medium run	Long run	
Agriculture, forestry, and fisheries	53.6 (42.8)	48.2 (41.0)	-5.3 (2.5)	-3.2 (1.6)	52.9 (43.3)	-2.6 (1.4)	57.3 (44.6)	52.9 (43.3)	-2.6 (1.4)	52.9 (43.3)	-4.6 (2.3)	
Processed food	51.4 (30.2)	50.6 (30.6)	-4.1 (1.9)	-3.5 (1.5)	54.3 (32.3)	-2.8 (1.4)	55.3 (32.2)	54.3 (32.3)	-2.8 (1.4)	54.3 (32.3)	-3.5 (1.7)	
Mining and quarrying	-5.4 (2.6)	-7.1 (3.4)	-3.4 (1.8)	-2.6 (1.3)	-5.2 (2.9)	-2.1 (1.2)	-3.8 (2.2)	-5.2 (2.9)	-2.1 (1.2)	-5.2 (2.9)	-3.0 (1.7)	
Textiles and apparel	30.5 (12.8)	34.7 (15.1)	15.1 (7.2)	13.8 (6.5)	37.6 (16.4)	14.4 (6.7)	34.8 (14.6)	37.6 (16.4)	14.4 (6.7)	37.6 (16.4)	15.7 (7.4)	
Chemical, rubbers, and plastics	0.9 (1.4)	3.1 (1.7)	1.9 (1.0)	0.8 (0.9)	4.2 (2.1)	1.3 (1.0)	2.7 (1.9)	4.2 (2.1)	1.3 (1.0)	4.2 (2.1)	2.1 (1.1)	
Metals	-3.9 (2.3)	0.1 (1.2)	1.4 (0.9)	-0.7 (1.0)	1.4 (1.5)	0.0 (1.0)	-1.3 (2.1)	1.4 (1.5)	0.0 (1.0)	1.4 (1.5)	1.7 (1.0)	
Transportation equipment	-5.8 (4.1)	-0.5 (2.9)	2.7 (1.9)	-0.1 (2.0)	3.0 (3.5)	1.4 (2.1)	-0.5 (4.0)	3.0 (3.5)	1.4 (2.1)	3.0 (3.5)	3.6 (2.1)	
Electronics	-4.4 (2.7)	-0.8 (1.6)	1.1 (1.0)	-0.7 (1.2)	1.2 (1.8)	0.1 (1.2)	-1.3 (2.5)	1.2 (1.8)	0.1 (1.2)	1.2 (1.8)	1.6 (1.0)	
Other manufactures	1.3 (2.2)	4.1 (2.2)	3.9 (1.7)	2.5 (1.4)	6.1 (2.8)	3.2 (1.6)	4.2 (2.6)	6.1 (2.8)	3.2 (1.6)	6.1 (2.8)	4.3 (1.8)	
Services	-5.5 (2.2)	-3.2 (1.6)	-2.2 (0.9)	-3.4 (1.3)	-1.7 (1.5)	-2.7 (1.2)	-3.2 (2.0)	-1.7 (1.5)	-2.7 (1.2)	-1.7 (1.5)	-1.8 (0.9)	

Source: Model simulations.

Table B.9 Estimated trade effects on the United States under various scenarios (percentage change in total US export volumes, standard deviation in parentheses)

Sector	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run	Standard deviation	Medium run	Long run	Standard deviation	Medium run	Long run	Standard deviation	Medium run	Long run	Standard deviation
Agriculture, forestry, and fisheries	11.8 (2.8)	12.4 (2.9)	(0.1)	-0.1 (0.1)	0.0 (0.1)		11.8 (2.7)	12.1 (2.8)	(0.1)	-0.1 (0.1)	0.0 (0.1)	
Processed food	2.6 (1.3)	3.2 (1.5)	(0.2)	-0.4 (0.2)	-0.2 (0.1)		2.7 (1.4)	3.1 (1.5)	(0.2)	-0.3 (0.2)	-0.2 (0.2)	
Mining and quarrying	0.0 (0.1)	0.0 (0.2)	(0.1)	0.0 (0.1)	0.0 (0.1)		0.0 (0.1)	0.0 (0.2)	(0.1)	0.0 (0.1)	0.0 (0.2)	
Textiles and apparel	-1.1 (0.5)	-0.6 (0.3)	(0.5)	0.6 (0.5)	0.9 (0.5)		-1.0 (0.5)	-0.9 (0.4)	(0.5)	0.7 (0.5)	0.8 (0.5)	
Chemical, rubbers, and plastics	0.6 (0.3)	0.9 (0.3)	(0.4)	0.9 (0.4)	1.1 (0.4)		0.6 (0.3)	0.8 (0.3)	(0.4)	1.0 (0.4)	1.1 (0.4)	
Metals	0.7 (0.3)	1.1 (0.4)	(0.5)	1.1 (0.5)	1.3 (0.5)		0.8 (0.4)	1.0 (0.4)	(0.5)	1.2 (0.5)	1.3 (0.5)	
Transportation equipment	-0.6 (0.4)	0.0 (0.3)	(0.3)	0.1 (0.3)	0.4 (0.2)		-0.5 (0.4)	-0.4 (0.3)	(0.4)	0.2 (0.3)	0.3 (0.3)	
Electronics	0.5 (0.3)	0.9 (0.3)	(0.4)	0.9 (0.4)	1.1 (0.4)		0.5 (0.3)	0.7 (0.3)	(0.4)	1.0 (0.4)	1.1 (0.4)	
Other manufactures	0.8 (0.3)	1.3 (0.4)	(0.5)	1.4 (0.5)	1.7 (0.6)		0.8 (0.4)	1.0 (0.4)	(0.5)	1.5 (0.5)	1.6 (0.5)	
Services	-0.7 (0.2)	-0.4 (0.2)	(0.2)	-0.3 (0.2)	-0.2 (0.1)		-0.6 (0.2)	-0.5 (0.2)	(0.1)	-0.3 (0.1)	-0.2 (0.1)	

Source: Model simulations.

Table B.10 Summary statistics from initial equilibrium (millions of 1995 dollars)

Region	GDP	Total exports	Total imports	Total exports to United States	Total exports to Korea	Total imports from United States	Total imports from Korea
Australia and New Zealand (CER)	405,301.9	77,992.3	87,856.0	6,263.1	5,892.6	16,364.2	2,373.0
Japan	5,091,655.0	484,058.6	435,255.0	131,371.4	36,729.1	89,298.0	26,378.9
Korea	451,163.3	139,488.7	152,867.0	27,168.2	0.0	34,906.0	0.0
China	813,366.8	284,776.0	279,610.3	64,389.1	8,935.0	28,576.5	20,010.4
ASEAN	613,444.4	356,842.9	387,750.7	69,190.1	11,107.5	49,720.0	17,932.5
Taiwan	276,255.4	129,807.5	108,746.0	31,488.8	2,895.5	23,264.6	4,340.5
United States	7,126,431.5	717,659.3	883,300.5	0.0	33,561.2	0.0	28,059.9
Canada	574,321.5	198,795.6	179,829.0	148,103.6	2,517.2	123,455.1	2,346.4
Mexico	279,290.5	83,737.1	70,797.8	63,538.3	338.4	50,540.0	1,036.2
Rest of world	12,683,094.0	3,189,165.5	3,304,570.3	307,838.8	44,130.5	327,721.0	41,954.6
Sum of world	28,314,324.0	5,662,323.0	5,890,582.5	849,351.4	146,107.0	743,845.3	144,432.4

CER = Closer Economic Relations trade agreement.

ASEAN = Association of South East Asian Nations.

Source: GTAP4 database (McDougall et al. 1998).

Table B.11 Initial exports/imports by sector (millions of 1995 dollars)

Sector	Exports from Korea to United States	Total exports from Korea	Exports from United States to Korea	Total exports from United States	Total imports to Korea	Total imports to United States
Agriculture, forestry, and fisheries	20.4	786.8	3,364.6	37,718.4	7,730.9	18,026.0
Processed food	147.9	2,195.6	1,070.8	27,859.3	4,383.2	22,638.6
Mining and quarrying	27.0	240.8	344.4	9,287.4	18,141.3	64,600.7
Textiles and apparel	3,368.8	21,634.1	388.7	17,408.6	6,984.0	70,432.2
Chemical, rubbers, and plastics	1,094.9	14,015.2	3,731.0	80,792.9	18,367.8	78,220.4
Metals	632.8	6,495.9	1,249.2	15,638.1	12,273.4	31,680.6
Transportation equipment	1,935.8	13,561.1	2,615.1	73,958.2	5,562.5	115,495.7
Electronics	5,175.9	13,862.0	2,072.8	53,558.7	5,487.0	88,371.9
Other manufactures	11,136.5	44,012.9	11,807.1	220,223.7	49,034.2	264,106.1
Services	3,628.3	22,684.4	6,917.6	181,214.0	24,902.8	129,728.3
Total	27,168.2	139,488.7	33,561.2	717,659.3	152,867.0	883,300.5

Source: GTAP4 database (McDougall et al. 1998).

B.13), but exports to all other regions fall. On the flip side of the equation, Korea imports more from the United States (by definition), but imports from most other regions fall (table B.14). The pattern is not quite so clear in the case of Korean exports and US imports (tables B.12 and B.15). While exports to the United States increase substantially (and US imports from Korea increase by definition), exports to other economies do not necessarily fall. Expansion of US income tends to result in increases in imports from Japan and in some cases ASEAN and Australia/New Zealand. Similarly, efficiency gains seem to allow Korea to expand exports to Japan, China, and ASEAN in some cases.

In terms of the limitations of this framework, it should be noted that trade estimates tend to be highly dependent on the Armington elasticities. This is reflected in the relatively high estimated standard deviations of some results. Also, the model is unable to capture “new” trade, only expansions and contractions in existing trade. However, at this level of aggregation, this issue does not come into play (since there are few initial zero trade flows).

Balance of Trade

The results presented in table B.16 are changes in the balance of trade (the value of exports at world prices less the value of imports at world prices), expressed in millions of dollars. Clearly, this statistic is relevant only when the closure allows flexibility of the current account (otherwise

Table B.12 Estimated change in Korean export volumes by region under various scenarios (volume change in total exports, percentage change in parentheses)

Region	Flexible current account						Fixed current account									
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture						
	Medium run	Long run	Medium run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run					
Australia and New Zealand (CER)	-88.2 (-3.8)	-10.1 (-0.4)	-73.7 (-3.2)	-34.5 (-1.5)	-13.3 (-0.6)	36.0 (1.6)	-53.7 (-2.3)	-23.9 (-1.0)	-88.2 (-3.8)	-10.1 (-0.4)	-73.7 (-3.2)	-34.5 (-1.5)	-13.3 (-0.6)	36.0 (1.6)	-53.7 (-2.3)	-23.9 (-1.0)
Japan	163.6 (0.6)	805.8 (3.2)	-852.2 (-3.3)	-521.0 (-2.0)	874.8 (3.4)	1,281.4 (5.0)	-658.5 (-2.6)	-428.2 (-1.7)	163.6 (0.6)	805.8 (3.2)	-852.2 (-3.3)	-521.0 (-2.0)	874.8 (3.4)	1,281.4 (5.0)	-658.5 (-2.6)	-428.2 (-1.7)
China	188.6 (1.0)	700.6 (3.7)	-585.0 (-3.1)	-330.0 (-1.7)	700.7 (3.7)	1,036.2 (5.4)	-447.6 (-2.3)	-261.8 (-1.4)	188.6 (1.0)	700.6 (3.7)	-585.0 (-3.1)	-330.0 (-1.7)	700.7 (3.7)	1,036.2 (5.4)	-447.6 (-2.3)	-261.8 (-1.4)
ASEAN	-370.9 (-2.1)	118.9 (0.7)	-496.6 (-2.9)	-247.1 (-1.4)	108.8 (0.6)	430.9 (2.5)	-364.4 (-2.1)	-178.9 (-1.0)	-370.9 (-2.1)	118.9 (0.7)	-496.6 (-2.9)	-247.1 (-1.4)	108.8 (0.6)	430.9 (2.5)	-364.4 (-2.1)	-178.9 (-1.0)
Taiwan	-105.9 (-2.4)	15.7 (0.4)	-131.4 (-3.0)	-67.7 (-1.6)	16.4 (0.4)	95.5 (2.2)	-98.0 (-2.3)	-50.9 (-1.2)	-105.9 (-2.4)	15.7 (0.4)	-131.4 (-3.0)	-67.7 (-1.6)	16.4 (0.4)	95.5 (2.2)	-98.0 (-2.3)	-50.9 (-1.2)
United States	7,108.8 (26.2)	8,226.8 (30.3)	6,471.3 (23.8)	6,922.5 (25.5)	8,188.8 (30.1)	8,996.2 (33.1)	6,636.1 (24.4)	7,087.4 (26.1)	7,108.8 (26.2)	8,226.8 (30.3)	6,471.3 (23.8)	6,922.5 (25.5)	8,188.8 (30.1)	8,996.2 (33.1)	6,636.1 (24.4)	7,087.4 (26.1)
Canada	-42.7 (-1.9)	21.7 (1.0)	-64.1 (-2.8)	-31.4 (-1.4)	23.9 (1.1)	69.0 (3.0)	-46.7 (-2.1)	-21.2 (-0.9)	-42.7 (-1.9)	21.7 (1.0)	-64.1 (-2.8)	-31.4 (-1.4)	23.9 (1.1)	69.0 (3.0)	-46.7 (-2.1)	-21.2 (-0.9)
Mexico	-20.3 (-2.0)	7.1 (0.7)	-25.8 (-2.6)	-12.1 (-1.2)	8.8 (0.9)	27.9 (2.8)	-18.2 (-1.8)	-7.8 (-0.8)	-20.3 (-2.0)	7.1 (0.7)	-25.8 (-2.6)	-12.1 (-1.2)	8.8 (0.9)	27.9 (2.8)	-18.2 (-1.8)	-7.8 (-0.8)
Rest of world	-1,227.8 (-3.0)	183.4 (0.5)	-1,325.0 (-3.3)	-611.1 (-1.5)	190.1 (0.5)	1,113.2 (2.7)	-944.1 (-2.3)	-410.9 (-1.0)	-1,227.8 (-3.0)	183.4 (0.5)	-1,325.0 (-3.3)	-611.1 (-1.5)	190.1 (0.5)	1,113.2 (2.7)	-944.1 (-2.3)	-410.9 (-1.0)

CER = Closer Economic Relations trade agreement.

ASEAN = Association of South East Asian Nations.

Source: Model simulations.

Table B.13 Estimated change in US export volumes by region under various scenarios (volume change in total exports, percentage change in parentheses)

Region	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run	Medium run	Medium run	Long run	Long run	Medium run	Long run	Medium run	Long run	Long run	
Australia and New Zealand (CER)	-255.5 (-1.6)	-178.3 (-1.1)	-90.1 (-0.6)	-54.5 (-0.3)	-224.9 (-1.4)	-213.7 (-1.4)	-73.6 (-0.5)	-61.0 (-0.4)				
Japan	-1,550.0 (-1.8)	-1,294.4 (-1.5)	-468.3 (-0.5)	-312.9 (-0.4)	-1,483.9 (-1.7)	-1,450.8 (-1.7)	-393.9 (-0.5)	-383.2 (-0.4)				
Korea	15,475.3 (46.1)	16,577.1 (49.4)	7,429.6 (22.1)	7,814.4 (23.3)	14,979.6 (44.6)	15,752.1 (46.9)	7,270.7 (21.7)	7,645.5 (22.8)				
China	-598.5 (-2.2)	-539.5 (-2.0)	-172.2 (-0.6)	-133.0 (-0.5)	-591.9 (-2.2)	-593.9 (-2.2)	-151.4 (-0.6)	-152.1 (-0.6)				
ASEAN	-760.4 (-1.6)	-641.6 (-1.3)	-303.0 (-0.6)	-232.7 (-0.5)	-742.9 (-1.5)	-735.4 (-1.5)	-260.3 (-0.5)	-260.4 (-0.5)				
Taiwan	-353.4 (-1.6)	-303.4 (-1.4)	-125.9 (-0.6)	-91.8 (-0.4)	-346.1 (-1.6)	-347.0 (-1.6)	-110.2 (-0.5)	-107.1 (-0.5)				
Canada	-937.6 (-0.8)	-723.1 (-0.6)	-439.8 (-0.4)	-324.0 (-0.3)	-870.6 (-0.7)	-764.0 (-0.6)	-388.0 (-0.3)	-351.1 (-0.3)				
Mexico	-399.3 (-0.8)	-360.4 (-0.7)	-173.7 (-0.4)	-160.4 (-0.3)	-361.8 (-0.7)	-357.6 (-0.7)	-146.8 (-0.3)	-173.8 (-0.4)				
Rest of world	-4,946.8 (-1.6)	-3,684.1 (-1.2)	-1,918.2 (-0.6)	-1,227.7 (-0.4)	-4,328.1 (-1.4)	-4,005.7 (-1.3)	-1,531.5 (-0.5)	-1,355.8 (-0.4)				

CER = Closer Economic Relations trade agreement.

ASEAN = Association of South East Asian Nations.

Source: Model simulations.

Table B.14 Estimated change in Korean imports by region under various scenarios (volume change in total imports, percentage change in parentheses)

Region	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run		Medium run	Long run		Medium run	Long run		Medium run	Long run	
Australia and New Zealand (CER)	-842.9 (-14.3)	-756.9 (-12.8)		23.7 (0.4)	83.7 (1.4)		-873.2 (-14.8)	-803.9 (-13.6)		15.5 (0.3)	70.5 (1.2)	
Japan	-1,204.1 (-3.3)	-637.1 (-1.7)		-1,484.4 (-4.0)	-1,206.9 (-3.3)		-1,642.9 (-4.5)	-1,170.6 (-3.2)		-1,582.1 (-4.3)	-1,306.4 (-3.6)	
China	-180.1 (-2.0)	-19.8 (-0.2)		-15.2 (-0.2)	63.0 (0.7)		-205.7 (-2.3)	-88.2 (-1.0)		-23.8 (-0.3)	47.3 (0.5)	
ASEAN	-989.8 (-8.9)	-799.6 (-7.2)		-265.1 (-2.4)	-160.8 (-1.4)		-1,060.4 (-9.5)	-918.6 (-8.3)		-282.0 (-2.5)	-188.8 (-1.7)	
Taiwan	-73.3 (-2.5)	-23.6 (-0.8)		-80.3 (-2.8)	-55.0 (-1.9)		-94.7 (-3.3)	-58.0 (-2.0)		-84.8 (-2.9)	-62.6 (-2.2)	
United States	15,475.3 (46.1)	16,577.1 (49.4)		7,429.6 (22.1)	7,814.4 (23.3)		14,979.6 (44.6)	15,752.1 (46.9)		7,270.7 (21.7)	7,645.5 (22.8)	
Canada	-140.0 (-5.6)	-93.9 (-3.7)		-64.5 (-2.6)	-41.0 (-1.6)		-161.0 (-6.4)	-127.7 (-5.1)		-68.8 (-2.7)	-48.4 (-1.9)	
Mexico	-16.6 (-4.9)	-11.0 (-3.3)		-4.7 (-1.4)	-2.0 (-0.6)		-18.3 (-5.4)	-14.4 (-4.2)		-5.1 (-1.5)	-2.7 (-0.8)	
Rest of world	-1,915.8 (-4.3)	-1,083.8 (-2.5)		-759.7 (-1.7)	-332.3 (-0.8)		-2,196.7 (-5.0)	-1,557.1 (-3.5)		-831.5 (-2.5)	-438.5 (-1.0)	

CER = Closer Economic Relations trade agreement.

ASEAN = Association of South East Asian Nations.

Source: Model simulations.

Table B.15 Estimated change in US imports by region under various scenarios (volume change in total imports, percentage change in parentheses)

Region	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run		Medium run	Long run		Medium run	Long run		Medium run	Long run	
Australia and New Zealand (CER)	104.6 (1.7)	76.0 (1.2)	-2.4 (0.0)	-6.1 (-0.1)	91.4 (1.5)	85.6 (1.4)	-5.6 (-0.1)	-5.2 (-0.1)				
Japan	1,057.0 (0.8)	487.5 (0.4)	418.1 (0.3)	74.5 (0.1)	725.9 (0.6)	728.9 (0.6)	231.5 (0.2)	210.4 (0.2)				
Korea	7,108.8 (26.2)	8,226.8 (30.3)	6,471.3 (23.8)	6,922.5 (25.5)	8,188.8 (30.1)	8,996.2 (33.1)	6,636.1 (24.4)	7,087.4 (26.1)				
China	-391.2 (-0.6)	-532.0 (-0.8)	-584.0 (-0.9)	-631.0 (-1.0)	-447.7 (-0.7)	-474.6 (-0.7)	-592.9 (-0.9)	-610.0 (-0.9)				
ASEAN	177.8 (0.3)	20.0 (0.0)	-181.8 (-0.3)	-264.7 (-0.4)	124.1 (0.2)	97.1 (0.1)	-216.3 (-0.3)	-244.8 (-0.4)				
Taiwan	10.7 (0.0)	-31.4 (-0.1)	-114.8 (-0.4)	-124.3 (-0.4)	0.8 (0.0)	12.0 (0.0)	-121.9 (-0.4)	-111.3 (-0.4)				
Canada	91.2 (0.1)	-7.1 (0.0)	-74.7 (-0.1)	-158.3 (-0.1)	-37.1 (0.0)	14.7 (0.0)	-136.1 (-0.1)	-137.6 (-0.1)				
Mexico	2.3 (0.0)	-121.2 (-0.2)	-42.7 (-0.1)	-145.7 (-0.2)	-87.5 (-0.1)	-112.2 (-0.2)	-77.9 (-0.1)	-131.3 (-0.2)				
Rest of world	421.8 (0.1)	-62.6 (0.0)	-636.1 (-0.2)	-780.4 (-0.3)	-190.5 (-0.1)	56.8 (0.0)	-851.3 (-0.3)	-729.8 (-0.2)				

CER = Closer Economic Relations trade agreement.

ASEAN = Association of South East Asian Nations.

Source: Model simulations.

Table B.16 Estimated effect on current account balances under various scenarios (mean change in millions of 1995 dollars, standard deviation in parentheses)

Region	Full liberalization		Excluding agriculture	
	Medium run	Long run	Medium run	Long run
Australia and New Zealand (CER)	197.4 (35.0)	-19.9 (25.3)	32.1 (9.4)	37.4 (8.1)
Japan	1,469.5 (177.3)	261.7 (302.7)	587.4 (90.2)	-278.3 (264.2)
Korea	-5,061.4 (744.8)	-4,665.4 (784.3)	-1,253.7 (123.2)	-985.3 (78.8)
China	78.3 (40.5)	48.0 (46.9)	33.0 (19.4)	3.1 (28.2)
ASEAN	64.0 (58.2)	62.8 (58.3)	95.4 (22.2)	78.2 (24.0)
Taiwan	7.6 (10.9)	-10.7 (13.9)	2.8 (2.8)	-4.5 (4.0)
United States	-509.2 (243.1)	2,702.0 (432.0)	-763.6 (197.3)	842.9 (328.2)
Canada	159.0 (25.2)	105.5 (35.3)	63.4 (16.7)	1.0 (17.1)
Mexico	112.6 (21.6)	51.5 (34.7)	45.2 (11.6)	-14.6 (18.4)
Rest of world	3,482.3 (437.9)	1,464.5 (423.1)	1,158.1 (170.0)	320.0 (114.0)

CER = Closer Economic Relations trade agreement.

ASEAN = Association of South East Asian Nations.

Source: Model simulations.

it is zero by definition). The results indicate that the US current account position worsens in the medium run and improves slightly in the long run.

The figures in tables B.17 and B.18 are the changes in bilateral trade balances, calculated on the same basis as the overall balance (that is, the value of exports at world prices less the value of imports at world prices, by region). Since only the overall current account balance is constrained in some closures, the bilateral balances can always vary. Because the trade balance can be either positive or negative, we need to be careful in interpreting the percentage changes, depending on whether the original position was in surplus or deficit. If the value change and the percentage change take the same sign, then an existing surplus has either risen or fallen. If the value change and the percentage change take opposite signs, an existing deficit has either become larger (if the percentage change is positive) or smaller (if the percentage change is negative).

The regional decomposition indicates improvement in the bilateral balance between the United States and Korea and deterioration between Korea and the United States by definition (see tables B.17 and B.18).

Table B.17 Estimated change in US bilateral trade balance under various scenarios (value change evaluated at central parameter values in millions of dollars, percentage change in parentheses)

Region	Flexible current account						Fixed current account										
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture							
	Medium run	Long run	Medium run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run						
Australia and New Zealand (CER)	-351.1 (-3.5)	-256.7 (-2.6)	-77.7 (-0.8)	-45.3 (-0.5)	-309.0 (-3.1)	-298.8 (-3.0)	-60.9 (-0.6)	-50.7 (-0.5)	Japan	-2,366.4 (5.1)	-1,638.5 (3.6)	-761.1 (1.7)	-336.0 (0.7)	-2,010.5 (4.4)	-2,033.0 (4.4)	-535.9 (1.2)	-533.4 (1.2)
Korea	9,594.5 (134.7)	9,832.4 (138.0)	1,051.3 (14.8)	1,060.7 (14.9)	8,119.0 (114.0)	8,268.6 (116.1)	734.7 (10.3)	747.3 (10.5)	China	-101.0 (0.3)	61.5 (0.2)	449.9 (1.2)	536.4 (1.4)	-46.8 (0.1)	-53.5 (0.1)	496.4 (1.3)	496.8 (1.3)
ASEAN	-840.8 (3.9)	-614.6 (2.8)	-54.9 (0.3)	71.3 (0.3)	-782.2 (3.6)	-784.8 (3.6)	19.2 (0.1)	26.9 (0.1)	Taiwan	-305.0 (3.2)	-228.6 (2.4)	8.1 (0.1)	45.9 (0.5)	-289.8 (3.1)	-312.5 (3.3)	31.3 (0.3)	19.4 (0.2)
Canada	-831.9 (2.8)	-643.2 (2.2)	-243.2 (0.8)	-120.6 (0.4)	-667.4 (2.3)	-689.0 (2.3)	-154.6 (0.5)	-159.0 (0.5)	Mexico	-302.3 (2.0)	-204.8 (1.3)	-65.7 (0.4)	7.1 (0.0)	-188.3 (1.2)	-198.4 (1.3)	-14.2 (0.1)	-14.2 (0.1)
Rest of world	-4,968.9 (-39.9)	-3,522.3 (-28.3)	-1,060.3 (-8.5)	-384.2 (-3.1)	-3,824.9 (-30.7)	-3,898.6 (-31.3)	-516.1 (-4.1)	-533.0 (-4.3)									

CER = Closer Economic Relations trade agreement.

ASEAN = Association of South East Asian Nations.

Source: Model simulations.

Table B.18 Estimated change in Korean bilateral trade balance under various scenarios (value change evaluated at central parameter values in millions of dollars, percentage change in parentheses)

Region	Flexible current account						Fixed current account								
	Full liberalization		Excluding agriculture		Full liberalization		Excluding agriculture		Full liberalization		Excluding agriculture				
	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run			
Australia and New Zealand (CER)	854.8 (-21.9)	823.5 (-21.1)	-82.4 (2.1)	-116.3 (3.0)	947.1 (-24.2)	912.0 (-23.3)	-59.8 (1.5)	-93.9 (2.4)	1,356.5 (-11.8)	1,251.5 (-10.9)	839.0 (-7.3)	806.8 (-7.0)	2,192.6 (-19.0)	1,092.2 (-9.5)	982.8 (-8.5)
Japan	421.8 (4.0)	654.3 (6.2)	-445.9 (-4.2)	-341.3 (-3.2)	865.6 (8.2)	1,002.6 (9.5)	-339.4 (-3.2)	-270.1 (-2.6)	847.1 (13.3)	1,034.9 (16.2)	-129.0 (-2.0)	-50.0 (-0.8)	1,321.7 (20.7)	-9.5 (-0.1)	35.7 (0.6)
China	-13.5 (-0.9)	34.0 (2.2)	-26.6 (-1.7)	-2.8 (-0.2)	111.1 (7.3)	137.3 (9.0)	3.8 (0.3)	18.6 (1.2)	-9,742.0 (151.1)	-10,023.5 (155.4)	-1,065.9 (16.5)	-1,094.0 (17.0)	-8,317.2 (129.0)	-762.2 (11.8)	-786.9 (12.2)
ASEAN	120.3 (-38.9)	121.4 (-39.3)	15.0 (-4.9)	15.1 (-4.9)	197.5 (-63.9)	197.8 (-64.0)	33.0 (-10.7)	31.2 (-10.1)	3.2 (0.5)	18.7 (2.7)	-15.7 (-2.3)	-8.5 (-1.2)	40.2 (5.8)	-9.7 (-1.4)	-4.1 (-0.6)
Taiwan	952.4 (-25.6)	1,261.7 (-34.0)	-329.4 (8.9)	-194.9 (5.2)	2,478.8 (-66.7)	2,583.3 (-69.5)	51.6 (-1.4)	86.6 (-2.9)	United States	Canada	Mexico	Rest of world			

CER = Closer Economic Relations trade agreement.

ASEAN = Association of South East Asian Nations.

Source: Model simulations.

Table B.19 Estimated effect on Korean/US factor incomes under various scenarios (percentage change, standard deviation in parentheses)

Region	Flexible current account						Fixed current account						
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture			
	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run	
Korea													
Unskilled labor	2.8 (0.7)	3.9 (1.0)	1.6 (0.4)	2.1 (0.5)	1.9 (0.8)	2.8 (1.1)	1.4 (0.4)	1.9 (0.5)	2.8 (1.1)	1.9 (0.8)	2.8 (1.1)	1.4 (0.4)	1.9 (0.5)
Skilled labor	3.2 (0.6)	4.3 (0.9)	1.5 (0.3)	2.0 (0.5)	2.2 (0.6)	3.0 (0.9)	1.3 (0.3)	1.7 (0.5)	3.0 (0.9)	2.2 (0.6)	3.0 (0.9)	1.3 (0.3)	1.7 (0.5)
Land	-25.7 (9.6)	-23.1 (10.2)	0.1 (0.3)	1.9 (0.7)	-25.9 (9.3)	-23.9 (9.9)	0.0 (0.3)	1.6 (0.7)	-23.9 (9.9)	-25.9 (9.3)	-23.9 (9.9)	0.0 (0.3)	1.6 (0.7)
Natural resources	-8.1 (3.5)	1.8 (3.5)	-5.8 (1.9)	-0.9 (1.7)	-3.8 (3.5)	3.1 (2.9)	-4.6 (1.7)	-0.6 (1.5)	3.1 (2.9)	-3.8 (3.5)	3.1 (2.9)	-4.6 (1.7)	-0.6 (1.5)
Capital	3.1 (0.6)	0.0 (0.0)	1.5 (0.3)	0.0 (0.0)	2.2 (0.7)	0.0 (0.0)	1.3 (0.3)	0.0 (0.0)	0.0 (0.0)	2.2 (0.7)	0.0 (0.0)	1.3 (0.3)	0.0 (0.0)
United States													
Unskilled labor	0.2 (0.1)	0.2 (0.0)	0.1 (0.0)	0.1 (0.0)	0.2 (0.0)	0.3 (0.1)	0.1 (0.0)	0.2 (0.1)	0.2 (0.1)	0.2 (0.0)	0.3 (0.1)	0.1 (0.0)	0.2 (0.1)
Skilled labor	0.2 (0.0)	0.2 (0.0)	0.1 (0.0)	0.1 (0.0)	0.2 (0.0)	0.3 (0.1)	0.1 (0.0)	0.2 (0.1)	0.2 (0.1)	0.2 (0.0)	0.3 (0.1)	0.1 (0.0)	0.2 (0.1)
Land	10.5 (1.9)	11.5 (2.1)	-0.2 (0.1)	0.1 (0.1)	10.5 (1.9)	11.3 (2.0)	-0.2 (0.1)	0.1 (0.1)	11.3 (2.0)	10.5 (1.9)	11.3 (2.0)	-0.2 (0.1)	0.1 (0.1)
Natural resources	-0.4 (0.2)	0.5 (0.1)	-0.1 (0.1)	0.4 (0.1)	-0.2 (0.1)	1.6 (0.1)	0.0 (0.1)	0.4 (0.1)	1.6 (0.1)	-0.2 (0.1)	1.6 (0.1)	0.0 (0.1)	0.4 (0.1)
Capital	0.3 (0.1)	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)	0.2 (0.0)	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)	0.2 (0.0)	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)

Source: Model simulations.

Improvement in the US bilateral balance with Korea tends to be offset by deterioration in bilateral balances with other economies (this is constrained to be the case where the overall current account is fixed but is true in general; see table B.17).

Caution needs to be used in evaluating both the overall and bilateral balances, since the former is determined largely by saving behavior in the domestic economy and the latter may not have a strong economic meaning.

Factor Incomes

Factor income results are presented in table B.19. Because the model contains only one household per region, income distribution issues must be analyzed in the Ricardian tradition, in terms of factor incomes. In the initial equilibrium, all factor incomes are normalized to unity in the initial equilibrium (i.e., we use efficiency wage units). Results are presented as percentage changes from this initial value. Note that the change in the return to capital is zero in all long-run simulations (by definition in the steady-state closure).

The results suggest insignificant income distribution effects in the United States under all scenarios (this in turn suggests that there is unlikely to be significant harm imposed on any particular group within the United States). The effects are larger for Korea. The largest changes are in land (a proxy for agricultural interests) in the simulations where agriculture is reformed. Here there are substantial rises in the United States and very substantial falls in Korea.

Output

In a manner similar to that used with the trade figures, output effects are presented in tables B.20 and B.21 as a percentage change in output volumes relative to initial output levels (table B.22). They indicate very small structural effects on the US economy (table B.21). There are larger but still small effects on Korea, except for the large and significant expansion of the textiles sector (table B.20).

Table B.20 Estimated output effects on Korea under various scenarios (percentage change in output by sector, standard deviation in parentheses)

Sector	Flexible current account						Fixed current account					
	Full liberalization			Excluding agriculture			Full liberalization			Excluding agriculture		
	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run
Agriculture, forestry, and fisheries	-4.2 (1.7)	-3.8 (1.7)	-0.2 (0.0)	0.0 (0.1)	-4.1 (1.6)	-3.8 (1.7)	-0.2 (0.0)	0.0 (0.0)	-4.1 (1.6)	-3.8 (1.7)	-0.2 (0.0)	0.0 (0.0)
Processed food	4.1 (1.5)	5.1 (1.6)	-0.1 (0.1)	0.3 (0.1)	4.1 (1.5)	4.8 (1.6)	-0.1 (0.0)	0.3 (0.1)	4.1 (1.5)	4.8 (1.6)	-0.1 (0.0)	0.3 (0.1)
Mining and quarrying	-1.9 (0.7)	-0.1 (0.6)	-1.3 (0.4)	-0.4 (0.3)	-1.0 (0.7)	0.2 (0.5)	-1.0 (0.4)	-0.3 (0.3)	-1.0 (0.7)	0.2 (0.5)	-1.0 (0.4)	-0.3 (0.3)
Textiles and apparel	19.4 (7.4)	23.0 (9.0)	7.6 (3.7)	8.9 (4.2)	22.2 (8.5)	24.7 (9.7)	8.0 (3.8)	9.2 (4.3)	22.2 (8.5)	24.7 (9.7)	8.0 (3.8)	9.2 (4.3)
Chemical, rubbers, and plastics	0.9 (0.4)	3.6 (0.8)	-0.1 (0.3)	1.2 (0.5)	1.6 (0.5)	3.5 (0.9)	0.0 (0.3)	1.1 (0.5)	1.6 (0.5)	3.5 (0.9)	0.0 (0.3)	1.1 (0.5)
Metals	-3.1 (1.4)	0.8 (0.7)	-1.5 (0.7)	0.5 (0.4)	-1.6 (1.5)	1.1 (0.8)	-1.1 (0.7)	0.6 (0.4)	-1.6 (1.5)	1.1 (0.8)	-1.1 (0.7)	0.6 (0.4)
Transportation equipment	-3.0 (1.9)	1.0 (1.1)	-0.8 (1.0)	1.2 (0.8)	-1.8 (1.8)	1.0 (1.2)	-0.5 (1.0)	1.2 (0.8)	-1.8 (1.8)	1.0 (1.2)	-0.5 (1.0)	1.2 (0.8)
Electronics	-2.8 (1.3)	0.5 (0.8)	-1.4 (0.8)	0.2 (0.5)	-2.1 (1.3)	0.3 (0.7)	-1.2 (0.7)	0.2 (0.5)	-2.1 (1.3)	0.3 (0.7)	-1.2 (0.7)	0.2 (0.5)
Other manufactures	-0.9 (1.3)	2.2 (1.0)	-0.5 (0.8)	1.0 (0.8)	0.4 (1.4)	2.6 (1.2)	-0.2 (0.8)	1.1 (0.9)	0.4 (1.4)	2.6 (1.2)	-0.2 (0.8)	1.1 (0.9)
Services	0.1 (0.2)	2.7 (0.6)	0.0 (0.1)	1.2 (0.3)	-0.4 (0.1)	1.5 (0.5)	-0.2 (0.1)	1.0 (0.3)	-0.4 (0.1)	1.5 (0.5)	-0.2 (0.1)	1.0 (0.3)

Source: Model simulations.

Table B.21 Estimated output effects on the United States under various scenarios (percentage change in output by sector, standard deviation in parentheses)

Region	Flexible current account						Fixed current account					
	Full liberalization		Excluding agriculture		Excluding agriculture		Full liberalization		Excluding agriculture		Excluding agriculture	
	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run	Medium run	Long run
Agriculture, forestry, and fisheries	1.6 (0.3)	1.8 (0.3)	-0.1 (0.0)	0.0 (0.0)	1.7 (0.3)	1.8 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Processed food	0.1 (0.1)	0.2 (0.1)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.2 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Mining and quarrying	-0.1 (0.0)	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)	-0.1 (0.0)	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Textiles and apparel	-1.2 (0.5)	-1.1 (0.5)	-0.7 (0.3)	-0.6 (0.3)	-1.3 (0.6)	-1.1 (0.6)	-0.6 (0.3)	-0.6 (0.3)	-0.6 (0.3)	-0.6 (0.3)	-0.6 (0.3)	-0.6 (0.3)
Chemical, rubbers, and plastics	0.0 (0.0)	0.2 (0.0)	0.1 (0.0)	0.1 (0.1)	0.0 (0.0)	0.2 (0.0)	0.1 (0.1)	0.1 (0.0)	0.1 (0.0)	0.1 (0.0)	0.1 (0.0)	0.2 (0.1)
Metals	-0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.2 (0.1)	-0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.2 (0.1)
Transportation equipment	-0.3 (0.1)	-0.1 (0.1)	-0.1 (0.1)	0.0 (0.0)	-0.2 (0.1)	-0.1 (0.1)	-0.1 (0.0)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.0)	0.0 (0.0)
Electronics	0.0 (0.1)	0.1 (0.1)	0.1 (0.1)	0.2 (0.1)	-0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.2 (0.1)
Other manufactures	0.0 (0.1)	0.2 (0.1)	0.2 (0.1)	0.3 (0.1)	0.0 (0.1)	0.2 (0.1)	0.0 (0.1)	0.0 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.3 (0.1)
Services	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.0)

Source: Model simulations.

Table B.22 Initial output levels by sector (millions of 1995 dollars)

Sector	Korea	United States
Agriculture, forestry, and fisheries	66,648.2	298,631.3
Processed food	87,806.3	544,394.3
Mining and quarrying	5,774.4	157,042.4
Textiles and apparel	52,031.8	234,759.3
Chemical, rubbers, and plastics	105,902.7	718,318.1
Metals	62,718.9	199,087.4
Transportation equipment	36,148.8	562,612.6
Electronics	46,416.5	311,269.6
Other manufactures	115,036.2	1,228,908.1
Services	457,234.6	7,933,941.0
Total	1,035,718.5	12,188,964.0

Source: GTAP4 database (McDougall et al. 1998).