THE IMPACTS OF TARIFF LIBERALIZATION ON TAIWAN AND APEC ECONOMIES: A MULTIREGIONAL GENERAL EQUILIBRIUM ANALYSIS

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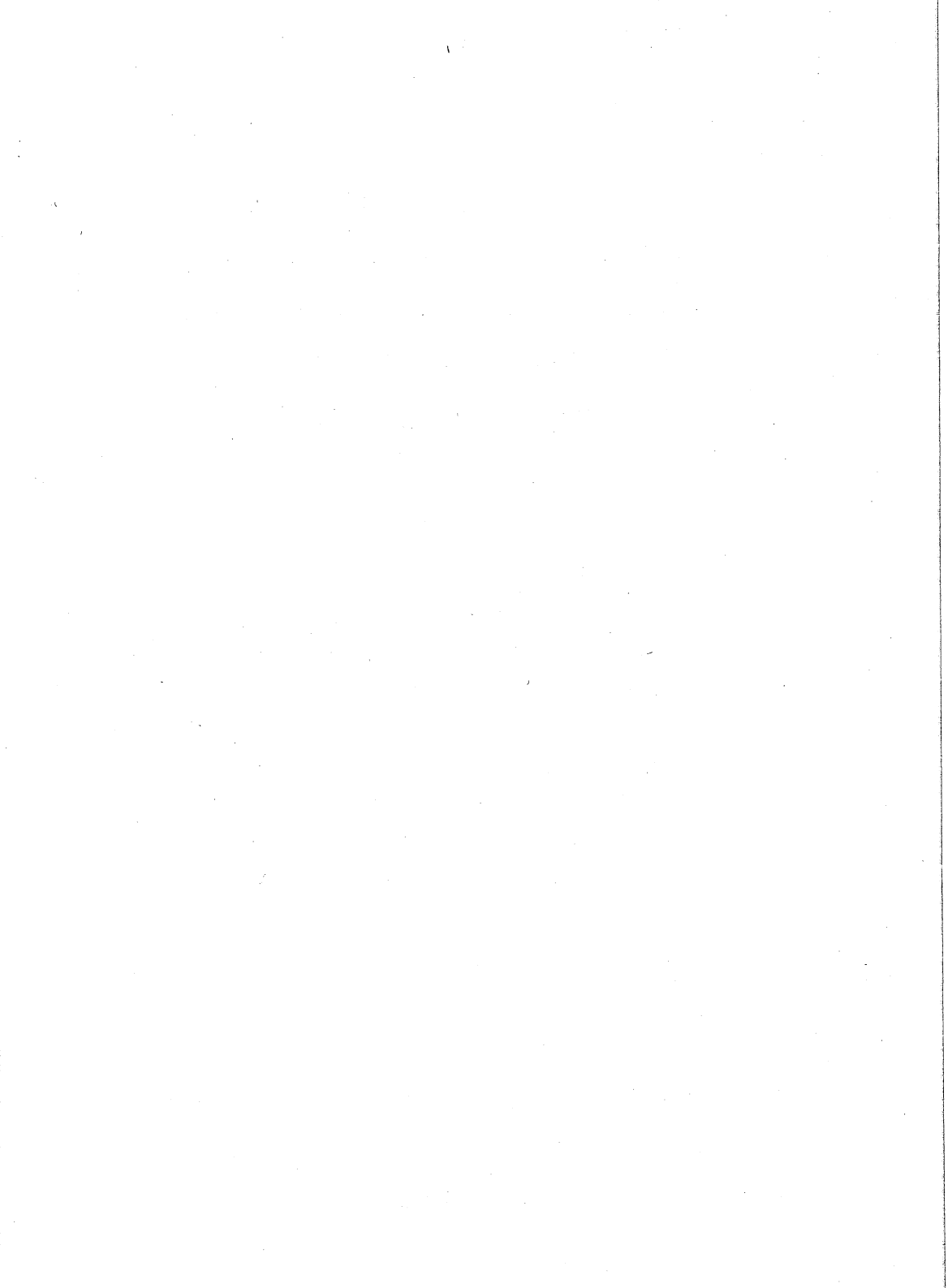
YUNCHANG JEFFREY BOR, WEN-JUNG LIEN, AND SU-WAN WANG*

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Abstract

This paper uses a multiregional computable general equilibrium model to evaluate the impact of tariff reduction on Taiwan as well as on other regions of APEC.   Because Taiwan is one of very few non-WTO member countries, she has to deal with both the WTO and APEC free trade action plans in handling trade liberalization problems between herself and other countries. Tariff reduction is the most transparent measure among the various trade barriers and tariff liberalization is the most prominent trade policy of Taiwan's government agencies.   The empirical evidence shows that tariff reduction has positive impacts on both Taiwan's and the world's economies, in areas such as global trade and the welfare effect.   However, it creates differing impacts on the trade surplus for different industries of various regions of the world.

Key words: Tariff Reduction, Free Trade, CGE Model, Taiwan, APEC

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I. Introduction

Free trade is the most important objective of the WTO (World Trade Organization) and APEC (Asia Pacific Economic Cooperation). There are many actions planned to meet this goal, such as reduction of tariff and nontariff barriers, and elimination of restrictions on services, transportation, and the investment sectors, etc., which are required to be taken at prescribed stages, by the years 2000, 2004, and/or 2010. Among these actions, tariff reduction has the highest priority, and is the most transparent measure of barriers by the WTO and APEC. For example, APEC's 1995 Bogor Declaration required clearly that each APEC economy develop and propose plans of action for tariff reduction/elimination considering intra-APEC trade trends and sectors or products related to industries in which the reduction/elimination of tariffs may have a significant impact on economic growth in the Asia Pacific region.

In this decade, Taiwan and other economies of the Asia Pacific region have enjoyed successful economic growth. The Asia Pacific region has gradually become the third center of the world economy and international trade (the other two being North America and the European Union). However, due to the fact that Taiwan is not a member of WTO (as most countries in APEC are), the difficulties and ambiguities increase when Taiwan negotiates with other economies on trade liberalization issues. For example, does Taiwan belong to the developed economy category or that of developing economy? Thus, what kind of standard -- a higher standard of a developed economy or a lower one of a developing economy -- should Taiwan take into consideration? In addition, on which time schedule for tariff reduction -- WTO's schedule or APEC's -- should Taiwan follow? In order to understand the trade relationship between Taiwan and other countries, and to identify the impact of free trade on various industries, a multiregional computable general equilibrium (CGE) model is set up to investigate the

problem.

Recently, the computable general equilibrium model has become a popular method with which to deal with impact analysis of economic policy issues. Basically, this type of model provides useful insights into the likely effects of a disturbance in one part of the economy on activity in other parts (Dixon, 1993). In the study of regional free trade and tariff reduction, many papers use the computable general equilibrium model to carry out specific regional empirical studies, such as Clarete (1989), Doroodian, Boyd, and Piracha (1994), Feltenstein (1992), Goulder and Eichengreen (1992), Kohler (1991), Lewis, Robinson, and Wang (1995), and McMahon (1990). Among this research, Lewis, Robinson, and Wang (1995) is the only one which focused on the Pacific Rim economies. They concluded that an APEC free trade agreement yielded gains in GDP for all APEC countries, with larger gains for the developing countries which benefited more from the increased trade.

The basic assumption, that tariff liberalization is beneficial for Taiwan and other regional economies, will be examined in this paper. From the empirical evidence of the research here, some general conclusions about welfare and the flow of trade among sectors and economies are made in the final section of the paper. Major experiments are conducted with multiregional CGE closure with emphasis on tariff reduction. According to both the APEC and WTO agendas, target years for projection and subsequent evaluation of the present paper are: 2000, 2004, and 2010. Since the service sector is tariff-free in Taiwan, the major burden of tariff reduction will fall on the agricultural and manufacturing sectors. In general, average tariff reduction will follow the standards required by APEC and WTO. The impact on macroeconomic and trade variables, such as GDP, welfare, and balance of trade, are of interest to government agencies and academic researchers. The multiregional CGE model employed in this research can be useful in finding answers, and should provide valuable information to both economists and policymakers.

II. Procedures, Database, and Model Structure

The basic procedures for conducting a computable general equilibrium model are quite similar to standard CGE research (Bor 1996).

- Collect input-output accounting data for the base year;

- Build a general equilibrium model;

- Calibrate the necessary parameters and check the consistency condition; and

- Change exogenous variables to create shocks and simulate the effects of hypothetical policies.

Basically, the database and the model used in this research are adopted from the Global Trade Analysis Project (Hertel, 1996), Purdue University, USA, which can be used to conduct quantitative analyses of international economic issues in an economy-wide context. The major reasons for using the GTAP as our standard database and CGE model are: (i) GTAP maintains a good up-to-date bilateral world trade database; (ii) GTAP constructs a fairly easy-to-use CGE international trade model; and (iii) the Economic Commission and the Commission of Trade and Investment of APEC have decided to use the GTAP database in conducting world free trade analysis. The first two reasons provide a good opportunity to focus on the empirical study without worrying about the costs of collecting data and building a model. Indeed, it requires a lot of time and effort to do a satisfactory job in the first two steps of conducting CGE analysis. The third reason provides a logical foundation for using the GTAP database. Because of the consistency of database, the results of this paper can be compared with future research results of the APEC commissions.

GTAP was established in 1992 to lower the cost of data entry for researchers seeking to conduct quantitative analysis of international economic issues in an economy-wide framework. The Project contains

three major components: (i) a fully documented, publicly available, global database, (ii) a standard modeling framework, and (iii) software for manipulating the data and implementing the standard model. For a detailed description of the GTAP model structure, see Hertel (1996). It will not be elaborated here.

In order to simplify the input-output structure of the database and for the special needs of this research, the world is divided into four regions: Taiwan, North America, other APEC economies, and the rest of the world (Table 1). Sectors have been aggregated into agriculture, manufacturing, and services (Table 2).

Table 1. Regions and Their Countries

Regions	Countries
1. Taiwan	Taiwan
2. North American Region	United States of America, Canada, Mexico
3. Other APEC Economies	Japan, Korea, Indonesia, Malaysia, Philippines, Singapore, Thailand, Mainland China, Hong Kong, Australia, New Zealand
4. Rest of the World	Regions not elsewhere classified

The software used is Release 5.1 of the GEMPACK Software Suite, developed by the IMPACT Project, Monash University, Australia (Impact Project and KPSOFT 1993). The key idea of GEMPACK follows the linearization method of Johansen (1960) which first transforms most of the nonlinear equations into linear equations. Then, it uses a multistep method to capture the nonlinear approximation of the solution. Thus, most of the variables in linear equations are represented as "percentage change" variables. This is exactly the same as the elasticity concept in economics, and is one of the major benefits of using the GEMPACK software.

Table 2. Sectors and Commodities

Sectors	Commodities
1. Agriculture	Paddy rice
	Wheat
	Other grains
	Nongrain crops
	Wool
	Other livestock
	Forestry
	Fishing
2. Manufacture	Coal
	Oil
	Gas
	Other minerals
	Processed rice
	Meat products
	Milk products
	Other food products
	Beverages and tobacco
	Textiles
	Wearing apparel
	Leather
	Lumber and wood
	Pulp and paper
	Petroleum and coal products
	Chemicals, rubber, and plastics
	Nonmetallic mineral products
	Primary ferrous metals
	Nonferrous metals
	Fabricated metal products
	Transport equipment
	Machinery and equipment
	Other manufacturing
3. Services	Electricity, water, and gas
	Construction
	Trade and transport
	Other private services
	Government services
	Ownership of dwellings

III. Simulations of Tariff Reduction

Since APEC plans to take the tariff reduction action plan of WTO into account when they propose their own free trade action plan, the simulation here combines both APEC's and WTO's tariff reduction targets. In addition, most of the APEC economies also hope to extend free trade agreements further and deeper (than the WTO target) because most of them are trade-oriented countries. They hope that they can move ahead with global free trade agreements so as to mitigate potential political pressure when negotiating the opening of markets with other countries, especially the United States. The general background of the WTO tariff reduction action plan is detailed below.

According to GATT's tariff reduction agreement (and the subsequent WTO tariff reduction agreement), trade commodities are divided into two groups, agricultural products and industrial products (crude oil and oil products are not included). The reference baseline for tariffs is the tariff in existence in September 1986 for each country. For agricultural products, developed countries were to cut tariffs by 36% from the baseline within six years. The lowest reduction rate for a single agricultural product was required to be no less than 15%. Developing countries were to cut the tariff on agricultural products by 24% from the baseline within ten years. The lowest reduction rate for a single agricultural product was to be no less than 10%, except for a very few items under special treaty. For industrial products, all countries were required to cut tariffs by at least 1/3 from the baseline within the same period of time (i.e., six years for developed countries and ten years for developing countries).

Thus, in this paper, there are four projection steps:

1. WTO 2000: following the WTO target, in the year 2000, industrialized economies complete their tariff reduction action; developing economies complete one-half of their tariff reduction action.

2. WTO 2004: following the WTO target, in the year 2004, all WTO members complete their tariff reduction action.

3. APEC 2004: in the year 2004, APEC economies will reduce tariffs further than in the case of WTO 2004 (see Table 3 for comparison).

4. APEC 2010: in the year 2010, APEC economies will carry on their tariff reduction action (see Table 3).

The detailed tariff reduction program is given in Table 3. From Table 3, simulations 1 and 2 basically follow the WTO schedule. The rates are calculated from the baseline of the GATT agreement. For industrial products, the rates are estimated by the weighted average method; for agricultural products, the rates are estimated by the simple average method. Simulations 3 and 4 show cases of the proposed APEC action plan. It is obvious that the APEC countries are more ambitious in tariff liberalization. Among them, Taiwan will take a comparatively serious attitude toward reducing tariffs. For example, in 2004, Taiwan plans to reduce tariffs by 45% for both industrial products and agricultural products, compared with 40% for other APEC economies; in 2010, Taiwan will reduce the tariff for agricultural products by 10% more, compared with a total of 50% for other APEC economies.

IV. Simulation Analysis

The simulation results are summarized in Tables 4 - 8. First of all, equivalent variation (i.e., using status quo prices as the base and asking what income change at the current prices would equal the proposed change, Varian 1984) has been used to estimate the welfare change because it represents standardized consumers' surplus. One can see from Table 4, using 1992 as the base year, the world equivalent variation increases US$29,895 million in the case of WTO 2000; US$39,387 million in the case of WTO 2004; US$46,525 million in the case of APEC 2004; and US$56,392 million

Table 3. Simulation of Tariff Reduction

(%)

Sectors	Regions	WTO 2000	WTO 2004	APEC2004	APEC2010
Agriculture	Taiwan	36.00	36.00	45.00	60.00
	North American Region	36.00	36.00	45.00	50.00
	Other APEC Economies	20.00	30.00	40.00	50.00
	Rest of the World	30.00	36.00	36.00	40.00
Manufacture	Taiwan	33.33	33.33	45.00	60.00
	North American Region	31.78	34.65	40.00	60.00
	Other APEC Economies	24.84	33.47	40.00	50.00
	Rest of the World	22.15	30.59	30.59	35.00

Table 4. Impact on Global Welfare and Trade

$(US\$10^6, \%)$

Items	WTO 2000	WTO 2004	APEC 2004	APEC 2010
World Equivalent Variation[*]	29,895	39,387	46,525	56,392
Global Trade	4.70	6.09	6.76	8.39

*: million US$ of the base year 1992

Table 5. Impact of Tariff Reduction Simulation on Taiwan

$(US\$10^6, \%)$

Items	WTO 2000	WTO 2004	APEC 2004	APEC 2010
Real GDP	0.85	0.85	1.03	1.04
Per capita utility	1.03	1.15	1.29	1.62
Equivalent variation[*]	2,183	2,440	2,752	3,468
Trade surplus[*]	632	707	792	994
1. Agriculture[*]	-534	-523	-833	-1,305
2. Manufacture[*]	1,695	1,754	2,221	3,105
3. Services[*]	-529	-524	-596	-806
Export				
1. Agriculture	17.28	18.03	18.24	21.75
2. Manufacture	4.59	4.95	6.16	8.21
3. Services	-1.01	-0.73	-0.82	-1.25
Import				
1. Agriculture	36.30	36.76	44.18	57.51
2. Manufacture	3.47	3.89	4.80	6.23
3. Services	2.81	3.15	3.60	4.66

*: million US$ using the base year 1992

Table 6. Impact of Tariff Reduction Simulation on North America

(US$10^6, %)

Items	WTO 2000	WTO 2004	APEC 2004	APEC 2010
Real GDP	0.03	0.03	0.03	0.31
Per capita utility	0.05	0.08	0.09	0.09
Equivalent variation*	3,319	5,253	5,942	5,811
Trade surplus*	386	-602	-663	-666
1. Agriculture*	7,526	10,626	14,130	18,696
2. Manufacture*	-10,381	-13,773	-17,826	-24,077
3. Services*	2,469	2,545	3,073	4,715
Export				
1. Agriculture	22.44	28.59	36.17	44.08
2. Manufacture	4.42	4.86	5.23	7.60
3. Services	1.41	1.59	1.86	2.66
Import				
1. Agriculture	8.91	9.62	11.94	13.32
2. Manufacture	4.90	5.70	6.53	9.17
3. Services	0.25	0.56	0.60	0.44

*: million US$ using the base year 1992

Table 7. Impact of Tariff Reduction Simulation on Other APEC Economies

(US$10^6, %)

Items	WTO 2000	WTO 2004	APEC 2004	APEC 2010
Real GDP	0.29	0.41	0.53	0.65
Per capita utility	0.36	0.49	0.59	0.72
Equivalent variation*	16,286	22,399	26,774	32,793
Trade surplus*	422	716	1,139	1,395
1. Agriculture*	-5,624	-8,954	-13,085	-17,494
2. Manufacture*	4,030	7,026	11,093	15,012
3. Services*	2,016	2,644	3,131	3,877
Export				
1. Agriculture	11.72	16.60	20.92	25.72
2. Manufacture	4.57	6.24	7.57	9.52
3. Services	1.80	2.38	2.76	3.41
Import				
1. Agriculture	17.25	25.16	33.89	41.77
2. Manufacture	4.43	5.86	6.79	8.43
3. Services	0.88	1.19	1.34	1.67

*: million US$ using the base year 1992

Table 8. Impact of Tariff Reduction Simulation on
Rest of the World

(US$$10^6$, %)

Items	WTO 2000	WTO 2004	APEC 2004	APEC 2010
Real GDP	0.10	0.13	0.13	0.15
Per capita utility	0.90	0.10	0.12	0.15
Equivalent variation*	8,106	9,293	11,053	14,316
Trade surplus*	668	-823	-1,272	-1,728
1. Agriculture*	-4,566	-5,371	-5,322	-6,199
2. Manufacture*	-5,759	-8,701	-10,414	-12,797
3. Services*	9,657	13,249	14,464	17,268
Export				
1. Agriculture	13.11	15.80	16.10	17.72
2. Manufacture	5.69	7.67	7.68	9.54
3. Services	2.61	3.49	3.88	4.70
Import				
1. Agriculture	16.16	19.07	19.23	21.37
2. Manufacture	5.59	7.60	7.74	8.99
3. Services	0.20	0.20	0.30	0.48

*: million US$ using the base year 1992

in the case of APEC 2010. As for the volume of global trade, and once again using 1992 as the base year, the WTO 2000 case will increase 4.7%, the WTO 2004 case will increase 6.09%, the APEC 2004 case will increase 6.76%, and the APEC 2010 case will increase 8.39%. Thus, overall, tariff liberalization will have a positive effect on global welfare and global trade. Although the differences in both the equivalent variation and global trade between the WTO 2004 and APEC 2004 cases are minor, the stronger free trade policy of APEC countries still results in a positive impact on the world economy.   The impact on each region is discussed in the following sections.

1. Impact of Tariff Liberalization on the Economy of Taiwan

From Table 5, it is clear the overall impact of tariff liberalization on

Taiwan is quite positive. The real GDP will increase 0.85% (again, compared to the real GDP of base year 1992) for both WTO 2000 and WTO 2004, 1.03% for APEC 2004, and 1.04% for APEC 2010. Per capita utility will increase 1.03% for WTO 2000, 1.15% for WTO 2004, 1.29% for APEC 2004, and 1.62% for APEC 2010. The equivalent variation using the base year 1992 will cause an increase of US$2,183 million for WTO 2000, US$2,440 million for WTO 2004, US$2,752 million for APEC 2004, and US$3,468 million for APEC 2010.

On the other hand, the tariff liberalization policy has a positive impact on the manufacturing sector of Taiwan, while the free trade policy creates a negative impact on the agricultural and services sectors of Taiwan at the same time. This result reflects the fact that industrial products are more competitive than agricultural products and services in Taiwan because the original tariff barriers for industrial products in Taiwan's market are smaller than for agricultural products, and because of the small-scale style of business and lack of efficiency which results from overprotection (nontariff) of the services market. This can be seen from the recent huge movement of nontariff liberalization in the transportation and communication sectors in Taiwan's market. However, compared to the base year 1992, the net effect on the total trade surplus is still positive in all four cases: US$631 million for WTO 2000, US$707 million for WTO 2004, US$792 million for APEC 2004, and US$994 million for APEC 2010.

In general, tariff liberalization results in some overall benefits from growing international trade to Taiwan. However, government agencies should also notice that there is a tradeoff among sectors. Usually, a negative impact on the agricultural sector will create serious political problems in Taiwan, just as it does in most of Asia.

2. *Impact of Tariff Liberalization on the Economies of the North American Region*

The overall impact of tariff liberalization on North America is positive but small. Continuing here with comparison to the base year 1992, Table 6

shows that the real GDP will increase only 0.03% for WTO 2000, WTO 2004, and APEC 2004, and 0.31% for APEC 2010.   Per capita utility will increase 0.05% for WTO 2000, 0.08% for WTO 2004, and 0.09% for APEC 2004 and APEC 2010.   The equivalent variation will increase US$3,319 million for WTO 2000, US$5,253 million for WTO 2004, US$5,942 million for APEC 2004, and US$5,811 million for APEC 2010.   Note that the equivalent variation for APEC 2010 is beginning to decrease.   This is a reflection of the fact that further tariff liberalization cannot create further welfare improvement in this region.   Basically, North America already has the best free trade situation in the world.

With regard to the trade surplus, tariff liberalization has a small negative impact on the net total trade surplus of the North American region. Although the agricultural sector and services sector increase their exports greatly, they are still unable to make up the tremendous loss of trade surplus from the manufacturing sector.   This result indicates that (i) tariff liberalization policy may not create a prosperous condition in a free-trade region which already exists such as the North American region, and (ii) different regions will have differing impacts from tariff liberalization policy among sectors.   Thus, regional governments should initiate different trade policies according to the results of tariff liberalization.   For the North American region, due to the competitive nature of the agricultural and services sectors, these two sectors will enjoy fast growth in the future.   The net total trade surplus will decrease by US$385 million for WTO 2000, US$602 million for WTO 2004, US$663 million for APEC 2004, and US$666 million for APEC 2010.   For further detailed impacts, refer to Table 6.

3. Impact of Tariff Liberalization on the Economies of Other APEC Countries

Table 7 demonstrates that the overall impact of tariff liberalization on other APEC economies is also positive.   Using the base year 1992 throughout, the real GDP will increase 0.29% for WTO 2000, 0.41% for

WTO 2004, 0.53% for APEC 2004, and 0.65% for APEC 2010.   Per capita utility will increase 0.36% for WTO 2000, 0.49% for WTO 2004, 0.59% for APEC 2004, and 0.72% for APEC 2010.   The equivalent variation will increase US$16,286 million for WTO 2000, US$22,399 million for WTO 2004, US$26,774 million for APEC 2004, and US$32,793 million for APEC 2010.

Tariff liberalization has a positive impact on both the manufacturing sector and services sector in this region, while free trade creates a negative impact on the agricultural sector.   This result shows that the agricultural sector will suffer a dramatic increase in the import of products in the future due to the cutting or cancelling of tariff barriers.   On the other hand, the manufacturing and services sectors will enjoy the benefits of a free competitive environment much more than before.   The net effect on the total trade surplus is moderately positive in all simulations: US$422 million for WTO 2000, US$716 million for WTO 2004, US$1,139 million for APEC 2004, and US$1,395 million for APEC 2010.

4. Impact of Tariff Liberalization on the Economies of the Rest of the World

The overall impact of tariff liberalization on the rest of the world is positive but relatively small.   Compared with base year 1992, Table 8 shows the real GDP will increase 0.10% for WTO 2000, 0.13% for WTO 2004 and APEC 2004, and 0.15% for APEC 2010.   Per capita utility will increase 0.09% for WTO 2000, 0.10% WTO 2004, 0.12% for APEC 2004, and 0.15% for APEC 2010.   The equivalent variation will increase US$8,106 million for WTO 2000, US$9,293 million for WTO 2004, US$11,053 million for APEC 2004, and US$14,316 million for APEC 2010.

As for the trade surplus, tariff liberalization has a negative impact on the net total trade surplus of the rest of the world.   Although the services sector increases exports tremendously, the manufacturing and agricultural sectors all suffer a loss of trade surplus.   This demonstrates the fact that both agricultural and manufacturing products have higher trade protection in this

area.   Net total trade surplus will decrease US$668 million for WTO 2000, US$823 million for WTO 2004, US$1,272 million for APEC 2004, and US$1,728 million for APEC 2010.

V. Summary and Conclusions

From the above simulations, the impacts on the international trade surplus are summarized in Table 9.   Then, using Table 9 and other welfare indicators, several important conclusions can be drawn from this paper, as follows:

Table 9. Summary of Effects of Trade Surplus for Each Region

Region	Agriculture	Manufacture	Services	Total
Taiwan	-	+	-	+
North American Region	+	-	+	-
Other APEC Economies	-	+	+	+
Rest of the World	-	-	+	-

+: positive impact; -: negative impact

1. Tariff liberalization creates positive impacts on both the global and regional welfare.   Taiwan and other APEC economies will improve their welfare faster than North America and the rest of the world.

2. The impacts on the net total trade surplus for each region are different. Taiwan and other APEC economies will have positive trade surplus effects, while the North American region and the rest of the world will have negative trade surplus effects.   This result implies that Taiwan and other APEC economies will continue to be an important focus of future global trade.   The flow of trade also indicates that the Pacific region will have very strong economic activity in the next decade.

3. For agricultural products, the North American region is the only dominant region in international trade.   That is, all other regions will

depend upon the export of agricultural products from North America, especially the other APEC economies because they have significant negative impacts on the trade surplus of agricultural products.

4. For industrial products, Taiwan and other APEC economies have better competitive conditions to sell their products.   The North American region and the rest of the world are the targets of these products.

5. For services, Taiwan is the only region that has a negative trade surplus. This reflects the truth that Taiwan's service sector cannot compete with the service sectors of other regions because of the small-scale style of business and lack of efficiency due to overprotection (nontariff) of the services market.

6. Taiwan, other APEC countries, and the rest of the world should watch out for potential political problems when opening their markets to agricultural products in the future.   Since the North American region is the only source of pressure, government agencies should handle negotiations carefully with this region.

7. From comparison of the simulations, a one-step reduction of both the tariffs on manufacturing and agricultural products may be a better solution for free trade policy.   In most of the regions, the overall performance of WTO 2004 and APEC 2004 are not so significant as the overall performance of the first case of WTO 2000.   That is, the marginal differences of the impacts on real GDP, welfare variables, and trade surplus are quite small between WTO 2000 and WTO 2004 or APEC 2004.   Although the model in this paper is not a dynamic one, the projection from the above simulation can still demonstrate that governments should try to reduce the expectation of future tariff liberalization as much as possible.   A one-step adjustment that then maintains all sectors in a stable situation is a better policy than a multistep or separate adjustment policy because a one-step adjustment will reduce the overall unfavorable impact on the economy.

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