JOURNAL OF ECONOMIC DEVELOPMENT
Volume 19, Number 2, December 1994

The Impact of North American Economic Integration on Taiwan

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Based on various tariff reduction scenario simulations, this paper analyzes the impact of the North American Free Trade Agreement (NAFTA) on Taiwan's exports from both the macroeconomic and microeconomic perspectives. The empirical result shows that macroeconomically, the cross elasticity of demand with respect to U.S. tariff reduction between Taiwan and Mexico is larger than that between Taiwan and Canada; this implies that Taiwanese products will face a greater threat from Mexican than Canadian products. For the microeconomic analysis, eight key Taiwanese export items (HS six-digit) were selected. Among them, the biggest impact resulting from U.S. tariff reduction on Taiwan's exports will be on plastic and rubber shoes (HS640391) followed by men's or boys' shirts of cotton (HS620520), and men's or boys' suits of synthetic fibers (HS620343). Automatic data processing machines and units (HS847192) and other articles of iron or steel (HS732690) will suffer the smallest impact. The economic intuition behind this result shows that Taiwan's low value-added products will face a larger negative impact than high value-added products after the implementation of NAFTA.

I. Introduction

The United States, Mexico and Canada completed negotiation of a North American Free Trade Agreement (NAFTA) on August 12, 1992. NAFTA was enacted on January 1, 1994 after the three countries' legislators ratified the agreement. According to the terms of the agreement, the three countries promise to phase out barriers to trade in goods

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and services in North America, eliminate investment barriers, and strengthen the protection of intellectual property rights and the environment. However, such a regional arrangement and the strict rules of origin in the agreement, particularly in automobiles and textiles, arouse fears of a protectionist trend which may be to the detriment of the existing free trade regime. As a consequence, for an export-oriented, U.S. market-dependent economy such as that of the Republic of China on Taiwan (hereafter referred to as ROC), NAFTA is an important concern for both the government and for industry leaders.

In terms of the trade perspective, in 1992, the ROC's merchandise exports to the United States were US$23.57 billion, about 29% of total ROC exports, and represented 12.8% of the ROC's GNP. Before the ROC government can find ways to reduce the U.S. export market concentration ratio, NAFTA and its further development will have a critical impact on the ROC's economic development and long-term prospects. Among NAFTA member countries, Mexico is a labor-abundant country, and its average wage level is about half as high as that of the ROC. In addition to the wage advantage, NAFTA removes many tariff and nontariff barriers to trade and investment among member countries, which will benefit Mexico's competitive position. The U.S. market expansion for Mexico will definitely cause some trade diversion away from the ROC's U.S.-bound exports.

Under such circumstances, the ROC government is anxious to figure out what possible impact NAFTA may have on the ROC.

As such, the purpose of this study is to assess the possible impact of NAFTA on the ROC's exports, and provide ROC industry and government with an understanding of the consequences of NAFTA for the ROC economy.

We begin in Section II by presenting a brief overview of the literature on NAFTA and its impact on both member and nonmember countries. The methodology used in the research is described in Section III. In Section IV, we present both micro and macro analyses to assess the possible economic effects of NAFTA on the ROC's exports. Our conclusions are summarized in Section V.

II. Literature Review on the Impact of NAFTA on Member and Nonmember Countries

As a result of the unification of the European Community, the formation of trading blocs and fragmentation within the world trading

community has become a trend that promotes regionalism. Considerations of possible economic benefits and political considerations have given rise to the emergence of NAFTA.

According to several studies [Brown, Deardorff and Stern (1992), Marwick (1991), Page (1991), Prestowitz, et al. (1991) etc.], macroeconomically, the removal or relaxation of each of these barriers will affect the economies of the three countries. The initial impact of NAFTA will occur on investment flows, and this had already begun to take place even before NAFTA negotiations were completed. Due to the international specialization of production, a significant amount of foreign capital will relocate to Mexico in order to take advantage of cheap land costs, lower wages and lax environmental standards. Accordingly, this will stimulate production in the labor-intensive sectors in Mexico, and the U.S. and Canada will shift to capital-intensive production. Following investment flows, a significant stimulus to trade flows will occur in the longer term.

Moreover, Mexico will become a stronger competitor in several labor-intensive sectors due to the following two factors. First, the removal of trade barriers under NAFTA will allow Mexican firms access to U.S. technologies, capital goods, and managerial expertise, which can modernize their production processes. Second, the U.S. market will provide opportunities for Mexican firms to take advantage of economies of scale. Consequently, potential competition from Mexico will shrink the ROC's U.S. market share and have a major influence on ROC-U.S. trade.

According to the empirical study of Brown, Deardorff and Stern (1992), intra-regional trade in North America will increase in comparison to a non-NAFTA scenario, and the market shares of these three participants in North America are expected to increase. The market share growth of each member country will be at the expense of the rest of the world, while low-cost producing Asian countries may be hurt most.

Under the assumption of removal of all tariffs on trade among these three NAFTA countries, and a 25% expansion of U.S. import quotas imposed on Mexican exports of agriculture, food, textiles and clothing, their microeconomic analysis also shows that the market share of Mexico's electrical machinery, clothing, and textile products in the U.S. market will increase 102.18%, 24.90%, and 14.10%, respectively, after integration. These three industries happen to be the ROC's major industries and this will cause a negative impact on the ROC's competitiveness in the above industries.

In addition, Peat Marwick (1991) applies a multisectoral computable general equilibrium model to evaluate the sectoral impact of NAFTA on Mexico and the U.S. With the assumption of US$25 billion in capital flows into Mexico after NAFTA, it is shown that sectors that are highly protected in the U.S., including textiles, apparel, and electronic components, will be contracting, while Mexico is expected to expand in these sectors.

However, since the above literature focuses mostly on the impact of NAFTA on member countries, we can only analyze the impact of NAFTA on the ROC through their indirect results. This gives us only rough qualitative rather than concrete quantitative results. Therefore, whether products from Mexico or Canada threaten ROC exports more, and to what degree, is also taken into consideration.

For these reasons, we extend our coverage to examine the impact of NAFTA on ROC exports through policy simulation.

III. Methodology

Within NAFTA, member countries promise to phase out barriers in trade and services in North America. Therefore, in order to analyze the future impact of NAFTA on the ROC's exports, we have to assume various tariff reduction scenarios as set by the U.S. government, and observe the difference in its import demand before and after NAFTA. Through the above procedure, we can evaluate the possible impact of NAFTA on ROC exports in the U.S. market.

A. The Model

We begin with an estimated U.S. import demand function for the ROC, Mexico and Canada in order to assess the impact of NAFTA on the total trade value of these countries. Traditionally, an aggregate import demand function can be expressed as the function of the ratio of import prices to domestic prices and domestic real income [Khan and Ross (1977), Boylan and Cuddy, et al. (1980)]. That is, $M = f(P_m/P_D, Y)$, where M is volume of import demand, P_m the dutiable price of imports, P_d the price of import substitutes, and Y domestic real income. However, in the setup, this import demand function takes a further step which the traditional import demand function does not; in order to analyze tariff reduction effecs, we not only separate the import tariff rate from relative price but also divide the tariff rate into two parts: member countries' tariff rate and nonmember countries' tariff rate.[1]

This technique incorporate the idea of competition from member and nonmember countries into the model. The model can be defined as follows:

(1) $M = f(P_m/P_D,\ t_3/(\beta_1 t_1 + \beta_2 t_2),\ t_3/t_0,\ Y)$

where M: volume of U.S. import demand from ROC
P_m: U.S. dutiable price of imports from ROC
P_D: price of U.S. import substitutes
Y: U.S. output effect
t_0: tariff rate for other countries' products exported to the U.S. market
t_1: tariff rate for Canadian products exported to the U.S. market
t_2: tariff rate for Mexican products exported to the U.S. market
t_3: tariff rate for ROC products exported to the U.S. market
β_1, β_2: coefficients for weighted tariff rate.

B. The Choice of Functional Form

The estimation method, functional form, and log structure of this study are quite different from other empirical studies. Rather than using the linear or log-linear functional form, this study employs the Box-Cox transfer functional form. Regarding the estimation method, a more generalized ARIMA is used to replace the OLS or Cochrane-Orcutt method. In addition, the transfer function is designed for the log structure. Therefore, in this study, the import demand function is estimated by the ARIMA transfer function.[2]

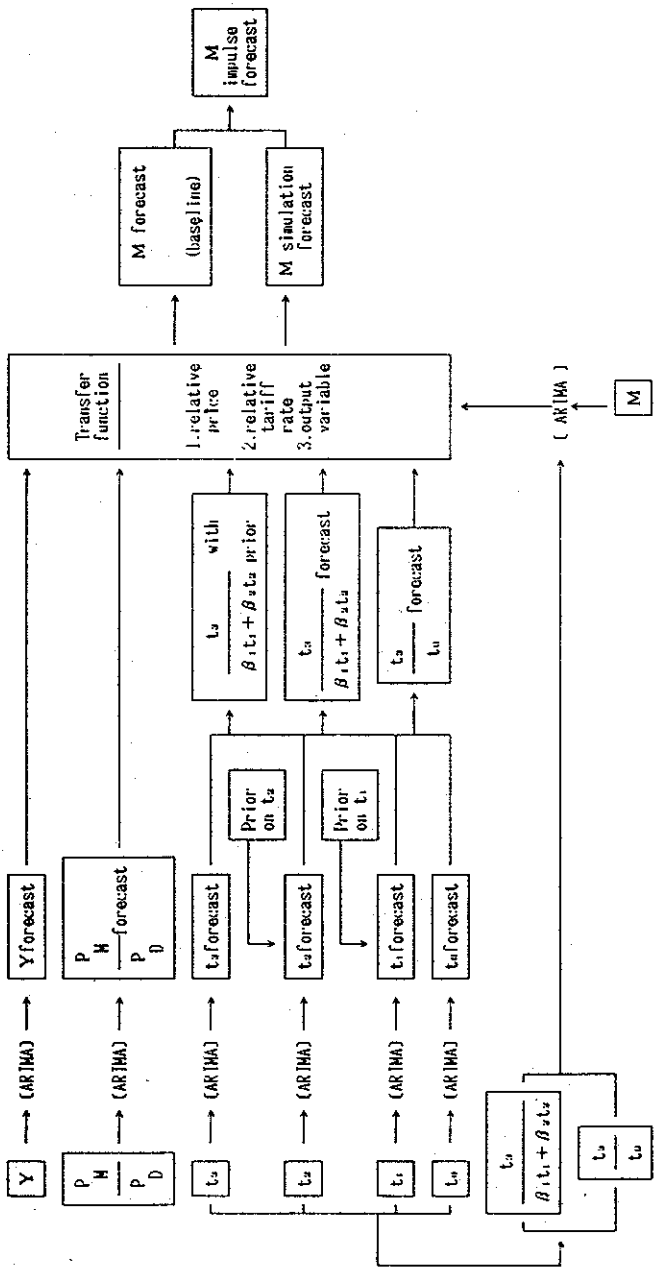
C. Structure of the Analysis Framework

According to the concepts mentioned above, Figure 1 expresses the structure of the analysis. In the figure, on the one hand, we use data for 48 months (from January 1989 to December 1992) to estimate U.S. import demand; the result we derive in this estimation will be the baseline estimation. On the other hand, various tariff rate reduction scenarios are assumed in order to simulate U.S. import demand. The

[1] See Hitiris and Petoussis (1984).
[2] See Box and Jenkins (1976) chap. 10 & 11 for further details.

Figure 1

Analysis Framework of the Impact of NAFTA on ROC Exports



Note: All notations are the same as that for the U.S. import demand function.

difference between baseline estimation and scenario simulation is NAFTA's impulse forecast.

D. Cross Elasticities & Scenario Analysis

The scenario analysis of this study is to assess the impact of NAFTA on the ROC's exports under various tariff reduction scenarios. However, the impact of NAFTA on ROC exports will come mostly from U.S. tariff reduction on Canadian and Mexican products, which hurts the ROC's market share in the U.S. Therefore, we then explore the cross elasticity of demand between the ROC and Canada, and between the ROC and Mexico, respectively, with respect to U.S. tariff reduction, which can be expressed as follows:

$$(2) \qquad \eta_{Mt_1} = \partial M/\partial t_1 \cdot t_1/M = v_2(B)(T_1/M)^{\lambda}(-\beta_1 t_1)$$

$$(3) \qquad \eta_{Mt_2} = \partial M/\partial t_2 \cdot t_2/M = v_2(B)(T_1/M)^{\lambda}(-\beta_2 t_2)$$

where M is the volume of U.S. imports from the ROC, and t_1 and t_2 represent U.S. tariff rates for Canadian and Mexican products, respectively, exported to the U.S. market.

From this equation, we know that the cross elasticity is equal to the impulse response function ($v_2(B)$) times a constant term, where λ, $\beta_1 t_1$, and $\beta_2 t_2$ are all constants, and $v_2(B)$ is an impulse response function.[3]

E. Sources of Data

In this study, U.S. import data are based on Harmonized System six-digit import items. Sampling periods are set between January 1989 and December 1992 for a total of 48 monthly sample points. These data come from the ROC Directorate-General "US Customs Import Export Data Disk."

The data for the price of U.S. import substitutes come from the Producer Price Index, which is published by the U.S. Department of Labor. The output effect variable data is from the Economic Indicators, published by the United States Government Printing Office.

[3] $v_2(B) = W_j(B)/\delta_j(B)$; $v_2(B)$ is an impulse response function which represents the multiple effect of explained variables on unexplained variables. The impulse value of $v_2(B)$ in this study is designed for a more generalized structure; that is, the disturbance term is assumed to follow the random process of ARIMA (p.d.q).

IV. Analysis of Results of the Empirical Study

This section is separated into two parts so that we can analyze the impact of NAFTA on ROC exports from both the macroeconomic and microeconomic perspectives. The macroeconomic approach simulates the possible impact on ROC aggregate products; the microeconomic analysis, based on HS 6-digit classification, analyzes eight key ROC export items to assess the economic impact of NAFTA.[4]

A. Macroeconomic Analysis

In 1992, the U.S. real weighted tariff rate for ROC imports averaged 6.11%, higher than those for Mexico and Canada (2.34 percent and 0.51 percent, respectively) (see Table 1). Table 1 shows that the cross elasticity of demand with respect to U.S. tariff reduction between the ROC and Mexico (0.0475) is larger than that between the ROC and Canada (0.0326). This implies that ROC products will face a greater threat from Mexican than Canadian products in the U.S. market. This result is not surprising since ROC products belong to similar market segments as Mexican products and are less similar to Canadian products.

In addition, U.S. output elasticity for ROC products is positive (2.9751). This reveals the fact that ROC products can increase their share in the U.S. market as long as the U.S. market keeps growing after NAFTA.

In order to examine NAFTA's impact on ROC exports more closely, we employ various scenarios to simulate possible impacts. As shown in Table 1, there are 12 scenarios, which are made up of "tariff reduction" and "output increase." The U.S. schedule for tariff reduction is assumed to be 25%, 50%, 75%, and 100% on the existing tariff rate. The positive output effect indicates the growth of the U.S. market after NAFTA. In addition, we assume three scenarios where U.S. output will grow by 0.5%, 1%, or 2%. By combining four tariff reduction schedules and three different output growth projections, we have 12 different scenarios. These scenarios are used to estimate the economic impact of NAFTA on exports for the ROC.

For instance, in Scenario 1, ROC exports as a whole will rise by US$5 million if the U.S. tariff rate is reduced by 25% and output in-

[4] Based on the Harmonized System (HS) six-digit classification, these eight items are selected from top 13 ROC U.S.-bound export items with a value over U.S.$50 million.

Table 1

THE VALUE OF IMPULSE SIMULATION OF NAFTA ON ROC's U.S.-BOUND EXPORTS
(Macroeconomic Analysis)

Import value (baseline: million U.S. dollars)	Scenario simulation			Price effect	Output effect	Cross effect	Total effect (million U.S.dollars)	ARIMA transfer function estimation	Explained variables		Basic statistics	
	Scenario assumption	Percentage of tariff reduction	Output growth effect						Name	Elasticity		
25,953	1	25%	0.5%	-178	180	+3	+5	$\nabla\nabla_{12}M(\lambda)$ $=0.0017$ $-0.8696\nabla\nabla_{12}R(\lambda)$ $-0.07755\nabla\nabla_{12}T_X(\lambda)$ $+0.278834\nabla\nabla_{12}T_M(\lambda)$ $+2.978692\nabla\nabla_{12}Y(\lambda)$ $+(1-0.45638\ B)$ $(1-0.30955\ B^{12})a$	The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Canada	0.0326	R^2	0.7316
	2	25%	1 %	-178	364	+2	+188					
	3	25%	2 %	-178	732	+1	+553					
	4	50%	0.5%	-366	180	-1	-187		The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Mexico	0.0475	adj R^2	0.5974
	5	50%	1 %	-366	364	-4	-6					
	6	50%	2 %	-366	732	-9	+357					
	7	75%	0.5%	-680	180	-4	-504		Relative price effect	-0.867	λ	0.001
	8	75%	1 %	-680	364	-10	-326					
	9	75%	2 %	-680	732	-22	+30		Output effect	2.9751	Periods of estimation	1989.1–1992.12
	10	100%	0.5%	-1784	180	-14	-1618		Average tariff rate	Canada	0.51%	
	11	100%	1 %	-1784	364	-29	-1449			Mexico	2.34%	
	12	100%	2 %	-1784	732	-60	-1112			ROC	6.11%	

creases by 0.5%. In Scenario 12, the combination of a 100% reduction in tariff rate and 2% output growth will cause a negative impact on ROC exports amounting to US$1.112 billion.[5]

B. Microeconomic Analysis

The result of the microeconomic analysis is shown in Table 2 to Table 9. Based on the tariff reduction schedule and output growth, we come up with 15 scenarios. The economic intuition behind the empirical analysis can be summarized as follows;

1. The cross elasticities of demand between the ROC and Mexico are basically larger than those between the ROC and Canada except for other articles of iron or steel (HS732690), which implies that Mexican products will impose more competitive pressure than Canadian products on the ROC's products in the U.S. market.
2. Among the eight products selected, the largest negative impact of a U.S. tariff reduction on ROC export items will be plastic and rubber shoes (HS640391), followed by men's or boy's shirts of cotton (HS620520), and men's or boys' suits of synthetic fibers (HS620343); automatic data processing machines and units (HS847192) and other articles of iron or steel (HS732690) will face the smallest impact. This finding can be interpreted as showing that the ROC's low value-added products are expected to face a large adverse impact than those of high-value added after the implementation of NAFTA.
3. Generally speaking, the higher the U.S. tariff rate before NAFTA, the larger the negative impact on ROC exports after NAFTA.

V. Conclusion

As an export-oriented country, the ROC's economic growth hinges on the world trade environment. After the unification of the European

[5] The scenario analysis simulates the effect of NAFTA on the ROC not only for 1994 but also for the next few years. For instance, suppose the U.S. tariff rate is reduced by 25% and output increases by 1% (the result is shown in Scenario 2 of Table 3) in 1995, while in 1996, the U.S. tariff rate is reduced by another 50% and output increases by another 1%. Combining Scenario 2 and Scenario 5, we can obtain Scenario 9 (i.e., 2% tariff rate reduction and 2% output growth). Thus, the total effect of NAFTA on the ROC will be U.S.$30 million.

Table 2

THE VALUE OF IMPULSE SIMULATION OF NAFTA ON ROC'S U.S.-BOUND EXPORTS (Microeconomic Analysis)

Import value (baseline: million U.S. dollars) : 1,963.07

HS	Product name	Scenario simulation			Price effect	Output effect	Cross effect	Total effect(million U.S. dollars)	ARIMA transfer function estimation
		Scenario assumption	Percentage of tariff reduction	Output growth effect					
HS 847192	Automatic data processing machines and units	1	20%	0.5%	-18.24	13.94	0.14	-4.16	$\nabla\nabla_{12}M(\lambda)$ = -0.008432 $-1.6\nabla\nabla_{12}R(\lambda)$ + (0.0748+0.091 B^2) $\nabla\nabla_{12}T_1(\lambda)$ +0.1096$\nabla\nabla_{12}T_2(\lambda)$ +3.0239$\nabla\nabla_{12}Y(\lambda)$ + (1-0.54157 B) (1-0.5825 B^{12})a
		2	40%	0.5%	-41.09	13.94	0.54	-26.59	
		3	60%	0.5%	-73.45	13.94	0.75	-58.76	
		4	80%	0.5%	-129.14	13.94	1.18	-114.02	
		5	100%	0.5%	-358.74	13.94	2.36	-342.44	
		6	200%	1 %	-18.24	28.17	0.29	10.22	
		7	40%	1 %	-41.09	28.17	1.01	-11.91	
		8	60%	1 %	-73.45	28.17	1.46	-43.77	
		9	80%	1 %	-129.14	28.17	2.38	-98.59	
		10	100%	1 %	-358.74	28.17	6.07	-324.50	
		11	20%	2 %	-18.24	56.53	0.57	38.86	
		12	40%	2 %	-41.09	56.53	2.02	17.46	
		13	60%	2 %	-73.45	56.53	3.02	-13.90	
		14	80%	2 %	-129.14	56.53	4.81	-67.80	
		15	100%	2 %	-358.74	56.53	12.01	-290.20	

Explained variables		Basic statistics	
Name	Elasticity		
The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Canada	0.205	R^2	0.6923
The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Mexico	0.751	adj R^2	0.4965
Relative price effect	-1.579	λ	0.001
Output effect rate	3.01	Periods of estimation	1989.1~ 1992.12
Average real tariff rate	Canada	0.46%	
	Mexico	0.76%	
	ROC	3.45%	

Table 3

THE VALUE OF IMPULSE SIMULATION OF NAFTA ON ROC's U.S.-BOUND EXPORTS (Microeconomic Analysis)

Import value (baseline; million U.S. dollars) : 47.83

HS	Product name	Scenario simulation			Price effect	Output effect	Cross effect	Total effect (million U.S. dollars)	ARIMA transfer function estimation	Explained variables		Basic statistics	
		Scenario assumption	Percentage of tariff reduction	Output growth effect						Name	Elasticity		
11 S 640391	Plastic and rubber shoes	1	20%	0.5%	-5.06	2.20	0.28	-2.58	$\nabla\nabla_{12}M(\lambda)$ = 0.01704 -10.6977$\nabla\nabla_{12}R(\lambda)$ -2.09927$\nabla\nabla_{12}T_1(\lambda)$ -3.111$\nabla\nabla_{12}T_2(\lambda)$ +(-16.43-19.06 B^4 -9.6 B^5)$\nabla\nabla_{12}Y(\lambda)$ +(1+0.24542 B) (1+0.72389 B^{12})a	The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Canada	5.8	R^2	0.8332
		2	40%	0.5%	-10.77	2.20	0.60	-7.97					
		3	60%	0.5%	-16.68	2.20	0.93	-13.55					
		4	80%	0.5%	-24.15	2.20	1.32	-20.63					
		5	100%	0.5%	-38.12	2.20	1.90	-33.96		The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Mexico	8.990	adj R^2	0.7271
		6	20%	1 %	-5.06	4.19	0.54	-0.33					
		7	40%	1 %	-10.77	4.19	1.14	-5.44		Relative price effect	-10.55	λ	0.001
		8	60%	1 %	-16.68	4.19	1.76	-10.73					
		9	80%	1 %	-24.15	4.19	2.50	-17.46		Output effect rate	2.18	Periods of estimation	1989.1~ 1992.12
		10	100%	1 %	-38.12	4.19	3.74	-30.19					
		11	20%	2 %	-5.06	7.69	0.98	3.61		Average real tariff rate	Canada		5.99%
		12	40%	2 %	-10.77	7.69	2.08	-1.00			Mexico		7.09%
		13	60%	2 %	-10.68	7.69	3.21	-5.78					
		14	80%	2 %	-24.15	7.69	4.57	-11.89			ROC		8.50%
		15	100%	2 %	-38.12	7.69	6.85	-23.58					

Table 4

THE VALUE OF IMPULSE SIMULATION OF NAFTA ON ROC's U.S.-BOUND EXPORTS
(Microeconomic Analysis)

Import value (baseline; million U.S. dollars) : 110.79

HS	Product name	Scenario simulation			Price effect	Output effect	Cross effect	Total effect(million U.S. dollars)	ARIMA transfer function estimation	Explained variables		Basic statistics	
		Scenario assumption	Percentage of tariff reduction	Output growth effect						Name	Elasticity		
HS 8481800	Taps, cocks, valves and similar appliances	1	20%	0.5%	-0.66	0.33	0.03	-0.30	$\nabla\nabla_{12}N(\lambda)$ = -0.18838 $-1.13192\nabla\nabla_{12}R(\lambda)$ $+(0.8769-0.7086\,B+2.9031\,B^2)\nabla\nabla_{12}T_1(\lambda)$ $+(-1.721+1.1414\,B)\nabla\nabla_{12}T_2(\lambda)$ $+2.3246\nabla\nabla_{12}Y(\lambda)$ $+(1-0.7772\,B^{12})a$	The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Canada	0.963	R^2	0.6682
		2	40%	0.5%	-1.64	0.33	0.07	-1.24					
		3	60%	0.5%	-3.05	0.33	0.14	-2.58					
		4	80%	0.5%	-5.49	0.33	0.24	-4.92					
		5	100%	0.5%	-19.00	0.33	1.57	-1.71		The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Mexico	1.518	adj R^2	0.5323
		6	20%	1 %	-0.66	0.68	0.05	0.07					
		7	40%	1 %	-1.64	0.68	0.13	-0.83					
		8	60%	1 %	-3.05	0.68	0.27	-2.10		Relative price effect	-1.116	λ	0.001
		9	80%	1 %	-5.49	0.68	0.50	-4.31					
		10	100%	1 %	-19.00	0.68	2.62	-15.70		Output effect rate	2.214	Periods of estimation	1989.1~1992.12
		11	20%	2 %	-0.66	1.37	0.10	0.81					
		12	40%	2 %	-1.64	1.37	0.24	-0.03		Average real tariff rate	Canada	0.81%	
		13	60%	2 %	-3.05	1.37	0.50	-1.18			Mexico	2.39%	
		14	80%	2 %	-5.49	1.37	0.01	-3.11			ROC	5.77%	
		15	100%	2 %	-19.00	1.37	4.95	12.68					

Table 5

THE VALUE OF IMPULSE SIMULATION OF NAFTA ON ROC's U.S.-BOUND EXPORTS (Microeconomic Analysis)

Import value (baseline: million U.S. dollars) : 89.91

HS	Product name	Scenario simulation			Price effect	Output effect	Cross effect	Total effect(million U.S. dollars)	ARIMA transfor function estimation	Explained variables		Basic statistics	
		Scenario assumption	Percentage of tariff reduction	Output growth effect						Name	Elasticity		
HS 620520	Men's or boys' shirts of cotton	1	20%	0.5%	-2.23	3.04	-0.06	0.75	$\nabla\nabla_{12}M(\lambda)$ =-0.05042 -0.19776$\nabla\nabla_{12}K(\lambda)$ -0.4729$\nabla\nabla_{12}T_1(\lambda)$ +8.10748$\nabla\nabla_{12}T_2(\lambda)$ +15.49571$\nabla\nabla_{12}Y(\lambda)$ +(1-0.202 B) (1-0.53379 B^{12})a +2.2246$\nabla\nabla_{12}Y(\lambda)$ +(1-0.7772 B^6)a	The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Canada	2.77	R^2	0.6575
		2	40%	0.5%	-4.19	3.04	-0.14	-2.01					
		3	60%	0.5%	-8.31	3.04	-0.24	-5.51					
		4	80%	0.5%	-13.88	3.04	-0.41	-11.25					
		5	100%	0.5%	-32.80	3.04	-1.03	-30.79		The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Mexico	5.72	adj R^2	0.4862
		6	20%	1 %	-2.23	6.45	-0.15	4.07					
		7	40%	1 %	-4.19	6.45	-0.34	1.20		Relative price effect	+0.195	λ	0.001
		8	60%	1 %	-8.31	6.45	-0.57	-2.43					
		9	80%	1 %	-13.88	6.45	-0.95	-8.38		Output effect rate	2.214	Periods of estimation	1989.1~ 1992.12
		10	100%	1 %	-32.80	6.45	-2.29	-28.64					
		11	20%	2 %	-2.23	13.25	-0.33	10.69		Average real tariff rate	Canada	13.35%	
		12	40%	2 %	-4.19	13.25	0.51	8.85			Mexico	18.99%	
		13	60%	2 %	-8.31	13.25	-1.21	3.73					
		14	80%	2 %	-13.88	13.25	-2.03	-2.66			ROC	20.98%	
		15	100%	2 %	-32.80	13.25	-4.77	-24.40					

Table 6

THE VALUE OF IMPULSE SIMULATION OF NAFTA ON ROC'S U.S.-BOUND EXPORTS
(Microeconomic Analysis)

Import value (baseline: million U.S. dollars) : 28.89

HS	Product name	Scenario simulation			Price effect	Output effect	Cross effect	Total effect(million U.S. dollars)	ARIMA transfer function estimation	Explained variables		Basic statistics	
		Scenario assumption	Percentage of tariff reduction	Output growth effect						Name	Elasticity		
620343	Men's or boys' suits of synthetic fibers	1	20%	0.5%	-0.79	0.78	-0.02	-0.03	$\nabla\nabla_{12}M(\lambda)$ $=-0.0169957$ $-2.10479\nabla\nabla_{12}K(\lambda)$ $-0.59002\nabla\nabla_{12}T_1(\lambda)$ $+0.304789\nabla\nabla_{12}T_2(\lambda)$ $+12.42583\nabla\nabla_{12}Y(\lambda)$ $+(1-0.14482\ B)$ $(1-0.51116\ B^{12})a$ $+2.2246\nabla\nabla_{12}Y(\lambda)$ $+(1-0.7772\ B^{6})a$	The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Canada	0.3567	R^2	0.8629
		2	40%	0.5%	-1.78	0.78	-0.05	-1.05					
		3	60%	0.5%	-3.06	0.78	-0.09	-2.37					
		4	80%	0.5%	-4.97	0.78	-0.16	-4.35					
		5	100%	0.5%	-9.79	0.78	-0.29	-9.30		The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Mexico	15.103	adj R^2	0.7943
		6	20%	1 %	-0.79	1.62	-0.05	0.78					
		7	40%	1 %	-1.78	1.62	-0.12	-0.28		Relative price effect	-2.083	λ	0.001
		8	60%	1 %	-3.06	1.62	-0.21	-1.65					
		9	80%	1 %	-4.97	1.62	-0.33	-3.68		Output effect rate	12.3857	Periods of estimation	1989.1~1992.12
		10	100%	1 %	-9.79	1.62	-0.61	-8.78					
		11	20%	2 %	-0.79	13.33	-0.11	2.43		Average real tariff rate	Canada	16.15%	
		12	40%	2 %	-1.78	13.33	-0.24	1.31			Mexico	26.72%	
		13	60%	2 %	-3.06	13.33	-0.41	-0.14					
		14	80%	2 %	-4.97	13.33	-0.66	-2.30			ROC	26.20%	
		15	100%	2 %	-9.79	13.33	-1.26	-7.72					

Table 7

THE VALUE OF IMPULSE SIMULATION OF NAFTA ON ROC's U.S.-BOUND EXPORTS
(Microeconomic Analysis)

Import value (baseline: million U.S. dollars) : 99.85

HS	Product name	Scenario simulation			Price effect	Output effect	Cross effect	Total effect(million U.S. dollars)	ARIMA transfer function estimation	Explained variables		Basic statistics	
		Scenario assumption	Percentage of tariff reduction	Output growth effect						Name	Elasticity		
7326900	Other articles of iron or steel (of tinplate)	1	20%	0.5%	-0.09	0.12	0	-0.57	$\nabla\nabla_{12}M(\lambda)$ $=-0.0452117$ $-3.98814\nabla\nabla_{12}K(\lambda)$ $-0.90720\nabla\nabla_{12}T_1(\lambda)$ $-2.37002\nabla\nabla_{12}T_2(\lambda)$ $+1.907329\nabla\nabla_{12}Y(\lambda)$ $+(1+0.20651\ B)$ $(1-0.24566\ B^{12})a$ $+2.2246\nabla\nabla_{12}Y(\lambda)$ $+(1-0.7772\ B^{12})a$	The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Canada	2.6152	R^2	0.4652
		2	40%	0.5%	-1.63	0.12	-0.01	-1.52					
		3	60%	0.5%	-3.03	0.12	-0.02	-2.92					
		4	80%	0.5%	-5.26	0.12	-0.02	-5.16		The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Mexico	0.3755	adj R^2	0.1979
		5	100%	0.5%	-12.26	0.12	-0.04	-12.18					
		6	20%	1 %	-0.69	0.23	0	-0.46		Relative price effect	-3.929	λ	0.001
		7	40%	1 %	-1.63	0.23	-0.02	-1.42					
		8	60%	1 %	-3.03	0.23	-0.02	-2.82					
		9	80%	1 %	-5.26	0.23	-0.04	-5.07		Output effect rate	4.8768	Periods of estimation	1989.1~1992.12
		10	100%	1 %	-12.26	0.23	-0.09	-12.12					
		11	20%	2 %	-0.09	10.45	-0.01	-0.25		Average real tariff rate	Canada		2.91%
		12	40%	2 %	-1.63	10.45	-0.03	-1.21			Mexico		0.87%
		13	60%	2 %	-3.03	10.45	-0.05	-2.63					
		14	80%	2 %	-5.26	10.45	-0.08	-4.89			ROC		5.56%
		15	100%	2 %	-12.26	10.45	-0.2	-12.01					

Table 8

THE VALUE OF IMPULSE SIMULATION OF NAFTA ON ROC's U.S.-BOUND EXPORTS
(Microeconomic Analysis)

Import value (baseline; million U.S. dollars) : 65.94

HS	Product name	Scenario simulation			Price effect	Output effect	Cross effect	Total effect(million U.S. dollars)	ARIMA transfer function estimation
		Scenario assumption	Percentage of tariff reduction	Output growth effect					
HS 620530	Men's or boys' shirts of man-made fibers	1	20%	0.5%	-2.29	1.33	-0.04	-1.00	$\nabla\nabla_{12}M(\lambda)$ $=0.00226$ $-1.28115\nabla\nabla_{12}R(\lambda)$ $+(0.2543+3.0924\ B)$ $\nabla\nabla_{12}T_t(\lambda)$ $-30.3203\nabla\nabla_{12}T_x(\lambda)$ $+9.2165\nabla\nabla_{12}Y(\lambda)$ $+(1-0.98\ B)$ $(1-0.5582\ B^{12})a_t$
		2	40%	0.5%	-5.19	1.33	-0.09	-3.95	
		3	60%	0.5%	-8.96	1.33	-0.02	-7.83	
		4	80%	0.5%	-13.89	1.33	-0.35	-12.91	
		5	100%	0.5%	-21.99	1.33	-0.81	-21.47	
		6	20%	1 %	-2.29	2.74	-0.08	0.37	
		7	40%	1 %	-5.19	2.74	-0.17	-2.62	
		8	60%	1 %	-8.96	2.74	-0.42	-6.64	
		9	80%	1 %	-13.89	2.74	-0.74	-11.98	
		10	100%	1 %	-21.99	2.74	-1.56	-20.81	
		11	20%	2 %	-2.29	15.55	-0.16	3.10	
		12	40%	2 %	-5.19	15.55	-0.37	-0.01	
		13	60%	2 %	-8.96	15.55	-0.88	-4.29	
		14	80%	2 %	-13.89	15.55	-1.68	-10.02	
		15	100%	2 %	-21.99	15.55	-3.21	-19.65	

Explained variables		Basic statistics	
Name	Elasticity		
The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Canada	2.714	R^2	0.7377
The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Mexico	4.56	adj R^2	0.5964
Relative price effect	-1.26	λ	0.001
Output effect rate	9.19	Periods of estimation	1989.1~ 1992.12
Average real tariff rate	Canada	19.59%	
	Mexico	28.42%	
	ROC	28.83%	

Table 9

THE VALUE OF IMPULSE SIMULATION OF NAFTA ON ROC's U.S.-BOUND EXPORTS
(Microeconomic Analysis)

Import value (baseline: million U.S. dollars) : 74.11

HS	Product name	Scenario simulation			Price effect	Output effect	Cross effect	Total effect(million U.S. dollars)	ARIMA transfer function estimation.	Explained variables		Basic statistics	
		Scenario assumption	Percentage of tariff reduction	Output growth effect						Name	Elasticity		
HS 853669	Coaxial, ribbon or flat cable connectors	1	20%	0.5%	-0.50	1.03	-0.02	0.51	$\nabla\nabla_{12}M(\lambda)$ $=0.01989$ $-6.208\nabla\nabla_{12}R(\lambda)$ $-0.19751\nabla\nabla_{12}T_1(\lambda)$ $-3.8603\nabla\nabla_{12}T_2(\lambda)$ $+6.321425\nabla\nabla_{12}Y(\lambda)$ $+(1-0.98\ B^2)a$	The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Canada	0.2275	R^2	0.5023
		2	40%	0.5%	-1.26	1.03	-0.04	-0.27					
		3	60%	0.5%	-2.62	1.03	-0.06	-1.65					
		4	80%	0.5%	-5.00	1.03	-0.09	-4.06		The cross elasticity of demand w.r.t. U.S. tariff reduction between ROC and Mexico	0.6397	adj R^2	0.2535
		5	100%	0.5%	-13.70	1.03	-0.19	-12.86					
		6	20%	1 %	-0.50	2.10	-0.03	1.57					
		7	40%	1 %	-1.26	2.10	-0.08	0.76		Relative price effect	-0.107	λ	0.001
		8	60%	1 %	-2.62	2.10	-0.11	-0.63					
		9	80%	1 %	-5.00	2.10	-0.18	-3.08		Output effect rate	6.27	Periods of estimation	1989.1—1992.12
		10	100%	1 %	-13.70	2.10	-0.41	-12.01					
		11	20%	2 %	-0.50	14.29	-0.08	3.71		Average real tariff rate	Canada		3.6 %
		12	40%	2 %	-1.26	14.29	-0.14	2.89			Mexico		4.6 %
		13	60%	2 %	-2.62	14.29	-0.21	1.46					
		14	80%	2 %	-5.00	14.29	-0.35	-1.06			ROC		5.3 %
		15	100%	2 %	-13.70	14.29	-0.83	-10.24					

Community (EC), its intra-regional trade is expected to increase from the current 63.4%, which thwarts the ROC's market expansion efforts in the EC. In addition, the Japanese market is hard to penetrate due to complicated marketing channels and nontariff barriers; this highlights the importance of the U.S. market to the ROC. In 1992, the ROC's merchandise exports to the United States were US$23.57 billion, about 29% of total ROC exports. If we take into consideration the ROC's direct investment in mainland China and the ASEAN countries which is aimed at the U.S. market, ROC product U.S. market dependence could easily be over 40%. Considering the strong market dependence and market potential, the ROC is certainly concerned about the impact of NAFTA's implementatin.

In order to assess the possible impact of NAFTA on ROC exports, with the removal of tariff and nontariff barriers to trade and investment, the NAFTA member countries are expected to boost their trade shares in the North American market at the expense of non-NAFTA exporters. We then are anxious to figure out the future impact of NAFTA on the ROC from both the macroeconomic and microeconomic perspectives. The macroeconomic approach focuses on the impact of NAFTA on the ROC's total trade value, while the microeconomic approach concentrates on the consequences of NAFTA for several key ROC industries.

The study shows that macroeconomically, U.S. output elasticity for ROC products is positive. This reveals the fact that ROC products can increase their share in the U.S. market as long as the U.S. market keeps growing after NAFTA. Additionally, the cross elasticity of demand with respect to tariff reduction between the ROC and Mexico is larger than that between the ROC and Canada; this implies that ROC products are expected to face a greater threat from Mexican than Canadian products in the U.S. market after NAFTA.

In the microeconomic analysis, we select eight key ROC export items (HS six-digit) to analyze the possible impact of NAFTA under U.S. tariff reduction. The empirical results show that, among the eight products, the biggest impact under U.S. tariff reduction will be on plastic and rubber shoes (HS640391), followed by men's or boys' shirts of cotton (HS620520), and mens' or boys' suits of synthetic fibers (HS620343). Automatic data processing machines and units (HS847192) and other articles of iron or steel (HS732690) will suffer the smallest impact. This implies that the ROC's low value-added products will face a larger negative impact than high value-added ones after NAFTA is enacted.

References

Box, G.E. and G.M. Jenkins, *Time Series Analysis: Forecasting and Control,* Revised edition, San Francisco, Holden-Day, 1976.

Boylan, T.A. and M.P. Cuddy, et al., "The Functional Form of the Aggregate Import Demand Equation: A Comparison of Three European Economies," *Journal of International Economics,* 10, 1980, 561-566.

Brown, D., A. Deardorff and R. Stern, "A North American Free Trade Agreement: Analytical Issues and a Computational Assessment," *The World Economy,* 15, 1, 1992, 11-29.

Hitiris, T. and E. Petoussis, "Price and Tariff Effects in a Dynamic Specification of the Demand for Imports," *Applied Economics,* 16, 1984, 15-24.

Khan, M.S. and K.Z. Ross, "The Functional Form of the Aggregate Import Demand Equation," *Journal of International Economics,* 7, 1977, 149-160.

Page, R.I., "The North American Free Trade Agreement and Its Implications for Canada's Relationship with the Countries of the Asia-Pacific," Pacific Economic Cooperation Conference, 1991, 49-63.

Marwick, P., *The Effects of a Free Trade Agreement Between the U.S. and Mexico,* KPMG Peat Marwick, Washington, D.C., 1991.

Prestowitz, C.V., et al., *The New North American Order: A Win-Win Strategy for U.S.-Mexican Trade,* Washington, D.C., Economic Strategy Institute, 1991.