The Impact of Microeconomic Structure Adjustment and Macroeconomic Variables under NAFTA on U.S. Agriculture

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BACKGROUND

On January 1, 2008, the last transitional agricultural trade restrictions established by North American Free Trade Agreement (NAFTA) were removed, marking an end to a 14-year process in which Canada, Mexico, and the United States - the three members of NAFTA - gradually removed thousands of tariff and non-tariff barriers to regional agricultural trade. As a result, the NAFTA countries' agricultural economies are increasingly behaving as one market (Zahniser and Crago, 2009).

Therefore, this market integration of agricultural economies might have enforced structure adjustment in member countries. According to recent research of the USDA, changes in agricultural commodity prices are felt across international borders as market integration opens new sales territories for producers, sometimes enabling further exploitation of economies of scale. It gives producers access to potentially cheaper inputs and creates new opportunities for Foreign Direct Investment (FDI). However, market integration also exposes producers to new competition from other producers in formerly isolated locations. For consumers, market integration provides access to new varieties of food products and offseason supplies of fresh fruit and vegetables and may lead to faster income growth. Greater competition is also likely to make food more affordable, thereby expanding consumer purchasing power (Zahniser and Crago, 2009).

OBJECTIVES

Much studies have analyzed the effect of NAFTA on U.S. agriculture before and during the implementation period of NAFTA. These studies have provided a valuable guide for policy makers to drive U.S. agriculture in the right direction given the open economic circumstance.

In addition to these studies, this study tried to identify structural adjustment under NAFTA. This effort is not limited to member countries but also includes the third trading partners to distinguish trade creation and diversion being generated by NAFTA. We adopt partial equilibrium theory to link the price of U.S. agricultural products to 1) tariff, 2) the third exporting rivals, 3) policy variables, and 4) structural adjustment in microeconomic level. This linkage is because NAFTA is the biggest regional market in the world.

ANALYTICAL FRAMEWORK

Price at World Market Equilibrium

The interaction in country i for agricultural product j can be simply expressed as:

(1) $P_i^j = -a_i^j Q_i^j + b_i^j Y_i + c_i^j$, and

(2) $P_i^j = a_i^j Q_i^j + d_i^j$,

where P is market price, Q is quantity demanded (or supplied), Y is income, a, b, c, and d represent passive parameters.

By using these passive parameters, quantities demanded and supplied are expressed as:

(3) $^{D}Q_i^j = -\frac{1}{a_i^j} P_i^j + \frac{b_i^j}{a_i^j} Y_i + \frac{c_i^j}{a_i^j}$, and

(4) $^{S}Q_i^j = \frac{1}{a_i^j} P_i^j - \frac{d_i^j}{a_i^j}$.

The effect on agricultural product j of NAFTA can be expressed as:

(5) $^{D}Q_i^j = -\frac{1}{a_i^j} P_i^j + \frac{b_i^j}{a_i^j} Y_i + \frac{c_i^j}{a_i^j} + \varsigma_i^j D + \xi_i^j \left(P_i^j \times D\right) + \zeta_i^j \left(Y_i \times D\right)$, and

(6) $^{S}Q_i^j = \frac{1}{a_i^j} P_i^j - \frac{d_i^j}{a_i^j} + \phi_i^j D + \varphi_i^j \left(P_i^j \times D\right)$,

where D is dummy variable (D = 1 after NAFTA and D = 0 before NAFTA).

If NAFTA changes price and income responsiveness in demand and supply sides of involved trading countries, the two equations will hold. In the case, excess supply (or excess demand) after NAFTA would be affected by depending upon how NAFTA influences price and income responsiveness in involved trading countries. This can be expressed as:

(7) $ED_i^j = -\frac{2}{a_i^j} P_i^j + \frac{b_i^j}{a_i^j} Y_i - \frac{d_i^j - c_i^j}{a_i^j} - \left(\phi_i^j - \varsigma_i^j\right) D - \left(\varphi_i^j - \xi_i^j\right) P_i^j D + \zeta_i^j D$, and

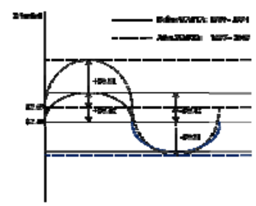
(8) $ES_i^j = \frac{2}{a_i^j} P_i^j - \frac{b_i^j}{a_i^j} Y_i + \frac{d_i^j - c_i^j}{a_i^j} + \left(\phi_i^j - \varsigma_i^j\right) D + \left(\varphi_i^j - \xi_i^j\right) P_i^j D - \zeta_i^j Y_i D$.

At world market equilibrium, excess supply is equal to excess demand. Therefore, US price of agricultural product j is determined as:

$$(9)\quad P_{US}^j = \Big(\overbrace{A\left({}^{US}t_i^j \mid a_i^j, {}^{US}\alpha_i^j\right) + E_P\left(\varphi_i^j, \xi_i^j \mid a_i^j, {}^{US}\alpha_i^j, {}^{US}t_i^j\right)}^{\substack{US \\ Tariff \\ Impact}}\Big)^{-1} \times \left\{ \overbrace{K\left({}^{K}t_i^j, P_K^j \mid a_i^j, {}^{K}\alpha_i^j\right)}^{\substack{Large \\ Group \\ Impact}} + \overbrace{E\left(\varsigma_i^j, \xi_i^j, \zeta_i^j, \phi_i^j, \varphi_i^j \mid \alpha_i^j, t_i^j, P_K^j, P_N^j, Y_i\right)}^{\substack{Structure \\ Adjustment \\ Impact}} \right\} + \overbrace{C}^{\substack{Constant \\ Term}} + \overbrace{G(Y_i)}^{\substack{Income \\ Impactt}} + \overbrace{N\left({}^{N}t_i^j, P_N^j \mid a_i^j, {}^{N}\alpha_i^j\right)}^{\substack{Smalls \\ Group \\ Impactt}}$$

EMPIRICAL EXAMPLE

Figure 1 shows U.S. annual corn price movements before and after NAFTA. As shown, average U.S. corn price increased after NAFTA. However, variance of price also increased after NAFTA, indicating that some of the prices after NAFTA were lower than the average price of before NAFTA. In actuality, U.S. corn prices are lower than those before NAFTA except for two exceptional periods including the beginning year of NAFTA and bio-ethanol booming years of the later 2000s.



[illegible]

Therefore, it is reasonable to think about a possibility of structural change of economies during the implementation of NAFTA in involved trading countries. For example, if price responsiveness in the U.S. agricultural market became more elastic after NAFTA, aggregate quantity demanded would decrease by price change leading to excess supply increases which press the price. In contrast, if price responsiveness of supply in Canada and Mexico became more elastic after NAFTA, aggregate quantity supplied would decrease slightly in price causing excess demand to increase, which would encourage U.S. price. Therefore, the effect of NAFTA on U.S. price will be affected by structural adjustment in member countries. In addition, if there are other exporters to Canada and Mexico and importers from the U.S., these countries might also effect U.S. price.

MONTE CARLO SIMULATION

Using U.S. corn industry, this study conducts *Monte Carlo* simulation covering the range of variation of parameter values at 95% confident intervals. For example, this study estimates passive parameters by using restricted SUR regression based on equations (9). And then we determine benchmark values of these parameters and calculate 95% confident intervals of the benchmark values by using t-distribution. The prices obtained by *Monte Carlo* simulation are a little higher than those obtained at benchmark values.

Table 1. NAFTA Effect on US Corn Price at Benchmark Values of Parameters

	NAFTA Effect																
	Structural Adjustment Effect								Tariff and Income Effect					US	MC	JK	Sum
	Price Elasticity				Income Elasticity				Tariff	Income Effect							
	US	MC	JK	Sum	US	MC	JK	Sum		US	MC	JK	Sum				
$^{1)}P_{US}^{corn}$									4.76								
$^{2)}P_{US}^{corn}$	5.24	4.78	4.48	4.94	4.62	4.75	4.77	4.63	4.88	5.28	4.77	4.76	5.29	6.18	4.96	4.52	5.94
ΔP_{US}^{corn}	0.48	0.02	-0.28	0.18	-0.14	-0.01	0.01	-0.13	0.12	0.52	0.01	0.00	0.53	1.42	0.20	-0.24	1.18
(%)	10.08	0.42	-5.88	3.78	-2.94	-0.21	0.21	-2.73	2.52	10.92	0.21	0.00	11.13	29.83	4.20	-5.04	24.79

P_{US}^{corn} is log corn price

$^{1)}P_{US}^{corn}$ *is log corn price before NAFTA*

$^{2)}P_{US}^{corn}$ *is log corn price calculated by reflecting NAFTA effect*

Table 2. Simulation of NAFTA Effect on US Corn Price

	NAFTA Effect																
	Structural Adjustment Effect								Tariff and Income Effect					US	MC	JK	Sum
	Price Elasticity				Income Elasticity				Tarif f	Income Effect							
	US	MC	JK	Sum	US	MC	JK	Sum		US	MC	JK	Sum				
$^{1)}P_{US}^{corn}$									5.34								
$^{2)}P_{US}^{corn}$	5.88	5.37	5.05	5.56	5.22	5.34	5.36	5.23	5.49	5.93	5.36	5.36	5.95	7.16	5.88	5.06	6.94
ΔP_{US}^{corn}	0.54	0.03	-0.29	0.22	-0.12	0.00	0.02	-0.11	0.15	0.59	0.02	0.02	0.61	1.82	0.54	-0.28	1.60
(%)	10.11	0.56	-5.43	4.12	-2.25	0.00	0.37	-2.06	2.81	11.05	0.37	0.37	11.42	34.08	10.11	-5.24	29.96

IMPLICATION

NAFTA has dismantled numerous barriers to regional agricultural trade. During the implementation period, the agricultural sectors of North American countries have become much more integrated, which might have influenced market structure. Using partial equilibrium trade theory, we can obtain the equilibrium price of U.S. agricultural products in an open economic condition. The equilibrium price is a function of five impact factors which will represent the new market circumstance created by NAFTA. This study shows that if agricultural product j is a normal good in country i (while an inferior good in country k), market integration leads country i to produce agricultural product j more because the price of agricultural product j increases more in the country i than before market integration. In contrast, country k produces agricultural product j less because the price of agricultural product j decreases more in the country k than before market integration. Therefore, market integration might accelerate specialization in the agricultural sector of each country through consumer preference.