The Effects of Trade Uncertainty on Chrysanthemum Trade between Taiwan and Japan

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Abstract

The study analyzed the effects of trade uncertainty on chrysanthemum trade between Taiwan and Japan. An econometric model comprises trade uncertainty was established and policy simulations were performed to evaluate the impacts of reducing trade uncertainty.

***Keywords*: chrysanthemum, trade uncertainty, trade liberalization.**

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Abstract

The study analyzed the effects of trade uncertainty on chrysanthemum trade between Taiwan and Japan. An econometric model comprises trade uncertainty factor was established and policy simulation analyses were performed to evaluate the possible impacts of reducing trade uncertainty under trade liberalization.

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1. Introduction

Chrysanthemum is the primary flower Taiwan exports. However, the exports showed decreasing trend in recent years. The volumes exported were 826,596 kilograms in 2001, and Japan was the major market. About 99% of the chrysanthemum exports went to the Japanese market.

Quarantine procedure is one of the measures Japanese government adopts to protect its domestic agricultural production. When chrysanthemum exports fail to pass the quarantine procedure, fumigation is required. According to statistics, the fumigated rate for Taiwan's chrysanthemum exports to Japan reached 90% during 1996-1997, and was 70% in 1998. Fumigation could damage the quality and the reputation of Taiwan's chrysanthemum exported. However, the degree of strictness of quarantine applied to the exports varied from time to time, hence caused the chrysanthemum exports facing with trade uncertainty. In addition, quality unevenness of exports, or standards that are not uniformly enforced could also cause trade uncertainty (not all exports are allowed to enter into the importing market).

It is suspected that the strictness of quarantine of a certain commodity is influenced by the domestic market conditions of supply and demand in Japan. During the seasons when Japan can produce enough chrysanthemum domestically, Japan might take stricter quarantine procedure to prevent foreign chrysanthemum exports from entering the Japanese domestic market. Trade uncertainty hence increased since not all of the amount exported each time is allowed to enter into Japan's chrysanthemum market.

Since global agricultural trade liberalization is an unavoidable trend, non-tariff trade barriers are to be disciplined, it is expected that trade uncertainty of chrysanthemum trade between Taiwan and Japan will be reduced gradually during the process of agricultural trade liberalization in Japan.

The main objective of this study is to explore the possible influences of reducing trade uncertainty of chrysanthemum trade between Taiwan and Japan through quantitative analyses.

2. Theoretical Framework

Uncertainty is one of the important factors people have to face when making decisions. Therefore, more and more economic studies taking uncertainty into account theoretically/practically.

W. Brainard & R. Cooper (1968) introduced uncertainty into international trade theory. They focused on the uncertainties of production and consumption. Roy J. Ruffin (1974) classified trade uncertainties into two categories: general price uncertainty and foreign trade uncertainty. In that paper, he re-examined the Ricardian Theory of Comparative Advantage when uncertainties exist. A few studies, such as: Goodwin, Grennes, and Wohlgenant (1990), Hennessy (1995), and Fraser (1995) analyzed the roles of price uncertainties in marketing.

P. Gallagher (1998) pointed out that trade uncertainty occurs when quality changes or when administrative trade barriers cause a chance that a

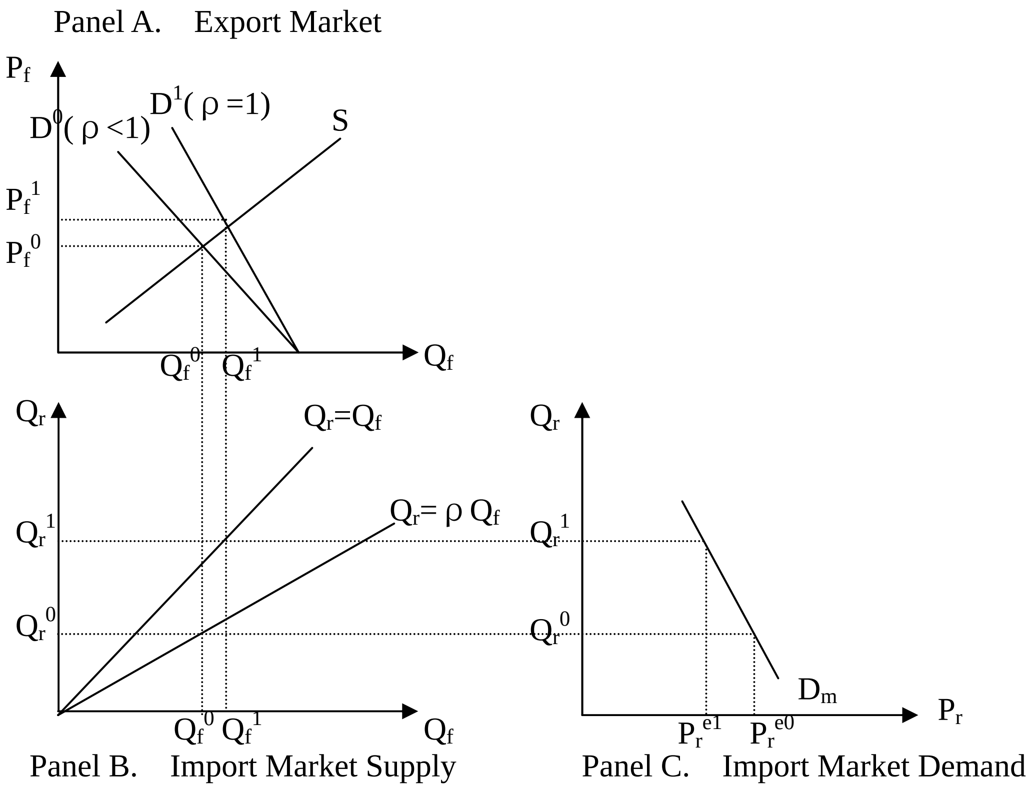

Fig. 1. Impacts of Trade Uncertainty on Trade

commodity can not enter the import market, especially in thin markets with few trade transactions and perishable commodities. The poultry trade between Eastern and Western Europe was analyzed. He found trade uncertainty reduced volume of trade, prices in the origin markets, while increased prices in the destination markets. A transaction with a success rate of 90% results in a difference between origin and destination prices that equals to a 15% import tariff. Comparing to a quota with the same import supply, the deadweight loss is larger when trade uncertainty is present.

Theoretically, the influences of trade uncertainty on prices and quantities of trade can be shown in Figure1. Panel A in Fig.1. shows price and trade equilibrium in the export market. Panel B shows the random supply for the import market, and Panel C shows the effect of fluctuating quantity on import prices.

When non-tariff trade barriers or uneven quality exists, the exported products will not enter the import market completely, then trade uncertainty occurs. Therefore, we can define $Q_r = \rho Q_f$ as the situation when exported products will not completely enter the import market, and the value of ρ is between zero and one. On the other hand, if non-tariff trade barriers or uneven quality does not exist under free trade, the exported products will completely enter the import market, the trade will be under certainty, and the value of ρ is one.

In Panel A, export prices and quantities are determined by export supply and marketing demand. Under trade uncertainty, as the chance that the product successful enter the import market is less than 1, equilibrium export price and quantity are given by the intersection of supply (S) and demand (D^0) at P_f^0 and Q_f^0, respectively. Equilibrium in the import market is then determined given the export market equilibrium. In Panel B, the line $Q_r = \rho Q_f$ defines the expected proportion of exports successfully entered the import market. The import price P_r^{e0} in Panel C is determined by the expected marketing quantity (Q_r^0) and the import demand curve (D_m).

Table 1

Influences of Trade Uncertainty on Quantity and Price Traded

	Export quantity	Export price	Import quantity	Import price
With trade uncertainty (ρ <1)	Q_f^0	P_f^0	Q_r^0	P_r^{e0}
Without trade uncertainty (ρ =1)	Q_f^1	P_f^1	Q_r^1	P_r^{e1}
Influences of reducing trade uncertainty (ρ increases)	increase ($Q_f^1 > Q_f^0$)	increase ($P_f^1 > P_f^0$)	increase ($Q_r^1 > Q_r^0$)	decrease ($P_r^{e1} < P_r^{e0}$)

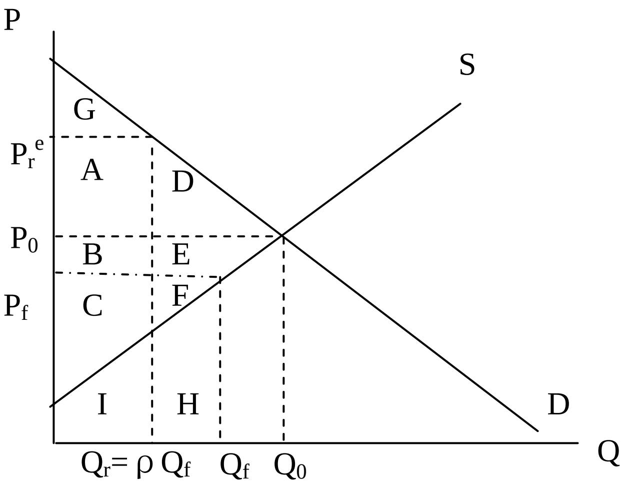

Fig. 2. Welfare Effect of Trade Uncertainty

Table 2.

Influences of Trade Uncertainty on Welfare

	Export price	Export quantity	Import price	Import quantity	Exporter surplus	Importer surplus	Total welfare
With trade uncertainty (ρ <1)	P_f	Q_f	P_r^e	ρQ_f	C+F	G	C+F+G
Without trade uncertainty(ρ =1)	P_0	Q_0	P_0	Q_0	B+C+E+F	A+D+G	A+B+C+D+E +F+G
Influences of reducing trade uncertainty (ρ increases)	increase ($P_0 > P_f$)	increase ($Q_0 > Q_f$)	decrease ($P_0 < P_r^e$)	increase ($Q_0 > \rho Q_f$)	increase (B+E)	increase (A+D)	increase (A+B+D+E)

Now consider how certainty would alter price and trade. The export demand under certainty, as the chance that the product successfully enter the import market equals to 1, is given by D^1. The expected import supply is given by the line $Q_r = Q_f$ in Panel B. It is obvious that the trade quantity increases from Q_r^0 to Q_r^1 and the import price declines from P_r^{e0} to P_r^{e1} when trade uncertainty is reduced. The influences of change in trade uncertainty upon quantity and price traded are summarized in Table 1.

The welfare effects of trade uncertainty can be presented in Fig. 2.. The price and quantity under free trade are P_0 and Q_0. Transportation costs are not included in Fig. 2., so that the import and export prices are equal. The surplus of importers is given by area A+D+G, the surplus of exporters is given by area B+C+E+F, and the total welfare is given by area A+B+C+D+E+F+G.

Now look at the situation of trade under uncertainty. Because trade uncertainty restricts quantity traded, the quantity supplied by the exporters is given by Q_f, while the expected import supply is given by ρQ_f. The marketing firms get the price spread, $P_r^e - P_f$ per unit. The profit obtained from sales in the import market, area A+B, equals the loss on unsold export-point purchases, area F+H, since the marketing arbitrage is zero in a competitive market. It is also assumed that the commodity is a perishable product, so the rejected product cannot be returned to the export market or shipped to other markets for resale. Under trade uncertainty, the importer surplus is given by area G, the exporter surplus is given by area C+F, and the total welfare is given by area C+F+G. Therefore, the deadweight loss under trade uncertainty equals to area A+B+D+E. The welfare effects of trade uncertainty are summarized in Table 2.

3. The Model

Suppose marketing firms buy products from the export market and sell them in the import market. The amount Q_f is bought from the export market and the amount Q_r is sold in the import market. The purchasing price in the export market is P_f, the selling price in the import market is P_r, and the transportation costs for each unit is c. The export supply function of Taiwan's chrysanthemum market can be specified as: $Q_f = \alpha_f + \beta_f P_f$, and the import demand function of Japan's chrysanthemum market as: $P_r = \alpha_r - \beta_r Q_r$.

Since the existence of non-tariff trade barriers or uneven quality, the transaction is uncertain, and the product may or may not be accepted for entering into the import market. Suppose a Bernoulli random variable:

$$x = \begin{cases} 1 & \text{wp} \quad \rho \\ 0 & \text{wp} \quad 1-\rho \end{cases}$$

The binary variable x has a value of unity when the product is accepted for entering into the import market and zero otherwise. The success probability ρ defines the chance that the product will successfully enter the import market. If non-tariff trade barriers or uneven quality exists, the products will not completely enter the import market, then trade uncertainty occurs, and the value of ρ is between zero and one. If non-tariff trade barriers or uneven quality does not exist under free trade, the products will completely enter the import market, the trade will be under certainty, and the value of ρ is one. Therefore, $Q_r = xQ_f$, and the supply and demand condition in the import market can be derived as:

$$P_r = \alpha_r - \beta_r Q_r$$

$$\Rightarrow P_r = \alpha_r - \beta_r x Q_f$$

The exchange rate between importing country and exporting country is e* and the transport cost is c, so the marketing firm's profit function is:

$$\tilde{\pi} = e^* P_r Q_r - P_f Q_f - cQ_f$$

Since it is assumed as a perishable agricultural product, the rejected product cannot be returned to the export market for resale. Then the marketing firm's profit function can be derived as:

$$\tilde{\pi} = e^* P_r (xQ_f) - P_f Q_f - cQ_f$$

$$\Rightarrow \tilde{\pi} = e^* (\alpha_r - \beta_r x Q_f)(xQ_f) - P_f Q_f - cQ_f$$

Dividing by Q_f gives:

$\pi = e^* \alpha_r x - e^* \beta_r x^2 Q_f - (P_f + c)$, where $\pi = \tilde{\pi} / Q_f$

The expectation of π is:

$$E(\pi) = e^* \alpha_r E(x) - e^* \beta_r Q_f E(x^2) - (P_f + c)$$

The expected value of a random variable is given by the sum of the population variance and the squared mean, so $E(x^2) = \sigma^2 + \mu^2$. Also, $\mu = \rho$, $\sigma^2 = \rho(1-\rho)$ for a binomial random variable. Substituting gives:

$$E(\pi) = e^* \alpha_r \rho - e^* \beta_r Q_f \left[\rho(1-\rho) + \rho^2\right] - (P_f + c) \quad .$$

Suppose the marketing firms have rational expectation, and the expected profits of arbitrage condition is zero, i.e. $E(\pi) = 0$. Therefore, the export demand function that comprises the behavior of importers and marketing firms can further be derived as: $P_f = e^* \alpha_r \rho - c - e^* \beta_r \rho Q_f$. It shows that an increase of the value of ρ will response to an increase of the demand curve's slope. Then, using the expectation of the import price $E(P_r) = \alpha_r - \beta_r \rho Q_f$, the expectation of profits can be written as:

$$E(\pi) = e^* E(P_r)\rho - e^* \beta_r Q_f \rho(1-\rho) - (P_f + c) = 0$$

Therefore, the marketing arbitrage equilibrium is given by $(P_f + c) = e^* \rho\left[E(P_r) - \beta_r Q_f (1-\rho)\right]$.

The trade uncertainty model comprises with four equations listed as follows can be adopted to describe how sellers, buyers, and marketing firms interact to determine market prices and quantities under trade uncertainty. The model can be used to analyze the welfare effects of trade uncertainty as well.

Table 3
Taiwan's Export Supply Function of Chrysanthemum to Japan

Variable	Variable name	Coefficient	Standard error	T value
C	Constant	114.6845	24.3387	4.7120***
$\nabla_{12}PF_t$	The export price after seasonal difference	15578.10	122.3713	127.302***
AR(1)	First order autoregressive	-0.1329	0.0778	-1.7085
SAR(12)	Seasonal autoregressive	-0.6823	0.1097	-6.2168***
MA(2)	Second order moving average	0.3167	0.1210	2.6163**
MA(3)	Third order moving average	0.4403	0.1142	3.8556***
SMA(12)	Seasonal moving average	-0.8854	0.1200	-7.3800***

Dependent variable：The export quantity after seasonal difference （$\nabla_{12}QF_t$）
R-Square＝0.9662，Adjusted R-Square=0.9506

note: * significant at 10%，** significant at 5%，*** significant at 1%.

Table 4
Japan's Import Demand Function for Chrysanthemum from Taiwan

Variable	Variable name	Coefficient	Standard error	T value
$\nabla_{12}QR_t$	The import quantity after seasonal difference	-0.0004	0.0002	-2.0076*
AR(1)	First order autoregressive	0.8829	0.3579	2.4668**
AR(2)	Second order autoregressive	-0.2561	0.1028	-2.4899**
AR(3)	Third order autoregressive	0.2877	0.1691	1.7010
SAR(12)	Seasonal autoregressive	-0.6038	0.0140	-43.0281***
MA(1)	First order moving average	1.3421	0.2908	4.6149***
MA(2)	Second order moving average	2.6042	0.7674	3.3933**
SMA(12)	Seasonal moving average	68.9136	52.3453	1.3165

Dependent variable：The import price after seasonal difference （$\nabla_{12}PR_t$）
R-Square＝0.9754，Adjusted R-Square=0.9582

note: *significant at 10%，** significant at 5%，*** significant at 1%

the export supply function: $Q_f = \alpha_f + \beta_f P_f$
the import demand function: $P_r = \alpha_r - \beta_r Q_r$
the relation of export and import quantities: $E(Q_r) = \rho E(Q_f)$
marketing arbitrage equilibrium:
$(P_f + c) = e^* \rho \left[E(P_r) - \beta_r Q_f (1-\rho) \right]$

Matching with the theoretical Framework of Fig. 1., $Q_f = \alpha_f + \beta_f P_f$ represents the supply curve of export market in Panel A; $P_r = \alpha_r - \beta_r Q_r$ represents the demand curve of import market in Panel C; $E(Q_r) = \rho E(Q_f)$ represents the relations of export and import quantities in Panel B; and due to marketing firms are demander of export market, the demand curve of export market in Panel A can represent marketing firms' arbitraging behavior, and be expressed as: $(P_f + c) = e^* \rho \left[E(P_r) - \beta_r Q_f (1-\rho) \right]$.

4. Empirical Analyses

Monthly data from January 1996 to September 1999 were used to conduct the empirical analyses of chrysanthemum trade between Taiwan and Japan. Before the trade uncertainty model could be solved together, the Taiwan's export supply function and Japan's import demand function for chrysanthemum must be estimated first. In order to emphasize the relation of price and quantity and to avoid autocorrelation problem, multiple variable time series models were built for Taiwan's export supply function and Japan's import demand function for chrysanthemum.

After diagnostic check of White noise, the empirical estimates of Taiwan's export supply function are presented in Table 3. After seasonal difference, the chrysanthemum export price is significant at 1 %, and the sign is positive as expected. The seasonal autocorrelation and seasonal moving average of error terms are also significant. After diagnostic check of White noise, the estimating results of Japan's import demand function are presented in Table 4. The chrysanthemum quantity after seasonal difference is significant, and the sign is negative as expected. The seasonal

Table 5
Impacts on the Volume and Price of Taiwan's Chrysanthemum Exports when Trade Uncertainty Changed

	Base	ρ increased 5%			ρ =1		
	ρ	ρ	Volume changed (%)	Price changed (%)	ρ	Volume changed (%)	Price changed (%)
January	0.8494	0.8918	0.1630	5.4201	1	0.5775	19.1995
February	0.9112	0.9567	0.2530	5.3437	1	0.4929	10.4118
March	0.9520	0.9996	0.1600	5.2452	1	0.1612	5.2844
April	0.2815	0.2956	0.1482	6.4690	1	7.4930	327.1714
November	0.5187	0.5447	0.4062	5.5614	1	7.4890	102.5439
December	0.9003	0.9453	0.4257	5.2821	1	0.9423	11.6925
Total	0.7355	0.7723	0.2229	5.4047	1	1.6179	39.2278

Table 6
Impacts on the Volume and Price of Japan's Chrysanthemum Imports when Trade Uncertainty Changed

	Base	ρ increased 5%			ρ =1		
	ρ	ρ	Volume changed (%)	Price changed (%)	ρ	Volume changed (%)	Price changed (%)
January	0.8494	0.8918	5.1712	-1.4095	1	18.4160	-5.0196
February	0.9112	0.9567	5.2656	-1.1017	1	10.2885	-2.1527
March	0.9520	0.9996	5.1680	-1.8807	1	5.2067	-1.8947
April	0.2815	0.2956	5.1555	-0.1681	1	281.8577	-9.1880
November	0.5187	0.5447	5.4264	-0.2385	1	107.2088	-4.7120
December	0.9003	0.9453	5.4470	-0.7072	1	12.1229	-1.5741
Total	0.7355	0.7723	5.2326	-0.9085	1	23.5779	-4.0939

Table 7
The Welfare Effects of Trade Uncertainty

	Policy Scenarios		
	With Trade Uncertainty		Without Trade Uncertainty
	(Comparative Base)	(ρ increased 5%)	(ρ =1)
Exporter surplus	85205603	89863688(+5.5%)	105487775(+23.8%)
Importer surplus	38697811	42827422(+10.7%)	49231284(+27.2%)
Total welfare	123903414	132691110(+7.1%)	154719059(+24.9%)

autocorrelation of error terms are also significant.

After the export supply and import demand functions were estimated, the whole trade uncertainty model was then solved together by Gauss-Seidel converge method. Before policy simulation, the model has carried out tests of historical simulation ability. Then policy simulation analyses were performed, by scenarios assuming different ρ values, to evaluate possible impacts of reducing trade uncertainty. The empirical results are summarized in Tables 5, 6, and 7.

When there is no trade uncertainty(ρ =1), the quantity and price of Taiwan's exports, as well as the quantity of Japan's imports will all increase as expected, while the price of Japan's imports will decline. Furthermore, the proportions changed in April and November are larger than the figures in other months, while the change in March is the most trivial. The results could be explained by the proposition that Japan takes less strict quarantine procedure to Taiwan's chrysanthemum exports in March when there is excess domestic demand; while it performs stricter quarantine in April and November to prevent Taiwan's chrysanthemum exports from entering the market when domestic supply is sufficient for domestic consumption.

Table 7 shows that total welfares both in Japan and in Taiwan will increase if the trade uncertainty is reduced. The simulation results also revealed that the degree of welfare improvement is positively related to the degree of reduction in the uncertainty. The social welfares measured by exporter surplus in Taiwan and importer surplus in Japan will increase by about 24% and 27%, respectively, if the trade uncertainty is completely eliminated.

5. Concluding Remarks

This study analyzed the import and export behaviors of chrysanthemum trade between Japan and Taiwan. The effects of trade uncertainty which might be caused partially by quarantine or uneven quality were examined by performing simulation analyses utilizing an econometric trade model comprises uncertainty factors.

Several conclusions could be drawn from the results of empirical analyses:

1. The chrysanthemum trade between Taiwan and Japan is significantly influenced by seasonal factors.
2. The degrees of trade uncertainty vary with the seasonal domestic supply and demand conditions in Japan. It could be explained by one of the possible reasons that Japan might not apply strict quarantine procedure to chrysanthemum imports when there is excess domestic demand for chrysanthemum in the domestic market; while it applies relatively stricter quarantine when there is less excess domestic demand.
3. If trade uncertainty was reduced, due to the eliminating of non-tariff trade barriers or the improvement of quality administration,Taiwan's chrysanthemum exports would be increased, and Japan's consumers can purchase more amount of chrysanthemum at lower prices, as suggested by theories.
4.The most significant impacts of reducing the chrysanthemum trade uncertainty occur in April and November, while the impact in March is the most trivial.
5. The total social welfares both in Japan and in Taiwan would be increased when the trade uncertainty is reduced. The simulation analyses also showed that the degree of welfare improvement is positively related to the degree of reduction in trade uncertainty. The social welfares (measured by exporter and importer surpluses) of the exporting and the importing countries will increase by 23.8% and 27.2%, respectively, if the trade uncertainty were completely eliminated.

In addition, several policy implications and suggestions could be extended from the conclusions:

1. Producers should improve the quality of products exported actively and persistently, and quality control should be strengthened to reduce the possible trade uncertainty. Hopefully the reputation of Taiwanese agricultural products could be raised and the competitiveness in the international market could be improved.

2. When a sound quarantine system is built up, preclearance system of agricultural exports should be adopted as Holland does. Japanese government personnel can be invited to take quarantine processes in Taiwan, before the products are shipped. By these means, the time needed for exports could be reduced, the quality of products exported could be improved, the degree of trade uncertainty could be decreased, and the welfares both in exporting and importing countries can be improved.

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