Journal of Rural Developement 23 (Summer 2000): 71~82

RESEACH NOTE

MEASURING THE EFFECTS OF TRADE LIBERALIZATION IN AGRICULTURE

Eor Myong-Keun*

ABSTRACT

This paper specified an import demand function to measure the effects of trade liberalization more precisely. Using monthly data rather than annual data on import quantity, prices, and income, this study can reflect recent changes in consumer's tastes and patterns of expenditure. Under the assumption of tariff abolition, import of grape would increase to 27 thousand tons as the price fall to 1,600 won per kilogram by 2010. It has negative impacts on grape and pear producers' income. Even though considering positive effects on consumer's surplus, the loss of producer's revenue would be 5,190 million won in 2010.

I. Preface

Every member economy has begun to implement the WTO agreements on trade liberalization since 1995. At the same time, regional agreements such as NAFTA, EU, AFTA have rapidly expanded for immediate and direct effects of free trade by some member economies. Nobody can be able to disregard the worldwide trends of the comprehensive trade liberalization in any area including agriculture.

Korea which has been sensitive in agricultural sector needs to measure the effects of trade liberalization prior to the WTO

* Fellow, Korea Rural Economic Institute, Seoul, Korea.

new round negotiations or free trade agreements (FTA). It should commit the implementing schedules and prepare its policy measures against the liberalization. It would be better to prioritize the areas or try to implement with flexibility according to its impacts of trade liberalization in agricultural sector.

This paper reviewed some previous studies in order to select the more adequate approach to measuring the effects of the trade liberalization in agricultural products. Then, the model will be empirically applied to measure the consequence of the free trade agreement with Chile, especially in relation to the fruit sector.

II. Approaches to Measure the Effect of Trade Liberalization

The method of measuring the effect of trade liberalization can be classified into the general equilibrium model and partial equilibrium model. The general equilibrium model is kind of a static approach that would assume the whole economy is at the equilibrium and it would resume its equilibrium through some processes even at the exogenous shock of trade liberalization such as tariff reductions on some sectors. As a result, this model can assess the effects of trade liberalization on the whole economy as well as that on the corresponding sectors. It can trait several parameters of the model that have changed at the shock but it cannot estimate the direct impact of the shock on related variables of the model.

Partial equilibrium model is an approach that can measure the movement of specific variables such as an import quantity, production, income, through the estimation of demand and supply function. This approach assumes that trade liberalization in some sectors affects directly on that sector only so that we can simply measure the effects or the changes in some specific variables.

While it might be difficult to properly consider the spill-over effects on other sectors, this approach can assess the direct impacts on the corresponding sector. More specifically, partial equilibrium model would be suitable when exogenous

shocks come to some limited sectors or the intensity of impacts are relatively weak.

There are some studies on measuring the effects of trade liberalization using the general equilibrium model such as Kim and Cheong (1996), ERS (1998) and Cheong (1999). Kim and Cheong (1996) estimated that agricultural production reduces by 880 million dollars and 90 million dollars by the increases in agricultural import from Australia and Canada, respectively through the FTA with each countries.

ERS (1998) argued that agricultural export and import toward Latin America would increase by 30 percent and 6 percent when the US join the FTAA. At the same time, however, agricultural export toward member countries of NAFTA, Canada and Mexico would decrease slightly (less than 1 percent).

Cheong (1999) measured the effects of FTA between Korea and Chile using the computable general equilibrium (CGE) model. He assessed the increment of Korean welfare to be 960 million dollars if tariffs are completely abolished. He also argued that impacts on agricultural sector would be small since domestic agricultural production would decrease by only 11 million dollars and agricultural imports from Chile increase by 40 million dollars.

A CGE model configurated by applying the theory of general equilibrium to the computer program. Recently, it is widely used in estimating sectoral effects of the changes in international trade relations. This model, however, is a static model and inevitably underestimate the spill-over effects if the scale of current trade is small. Moreover, this model has its limit that it needs some parameters, elasticities of substitution which should be determined exogenously.

There are also some studies that measure the effects of trade liberalization on import and export by Ryou and Lee (1998) and Park, Joo and Shim (1999). Baek and Yang (1996), Lee, Choi and Park (1998) and Lee (1999) estimated price and income elasticities of demand for fruits or grape using demand function approach. Ryou and Lee (1998) assessed the effects of tariff reduction of the early voluntary sectoral liberalization (EVSL) in

APEC on imports. They measured that price elasticities of imports were -0.5115 for forestry products, -0.4807 for oilseed, and -1.3287 for processed food so that the impact would be relatively greater in food sector.

Park, Joo and Shim (1999) also estimated import demand functions for fisheries products and got the result that the fisheries products were unit elastic with respect to price change but elastic for income change. So that trade deficit would be around 3.3 million dollars when the trade is liberalized in the fisheries sector with Chile.

Baek and Yang (1996) estimated the price elasticity of demand for grape is inelastic (-0.48) while the income elasticity is elastic (1.23) using the partial equilibrium model and time-series data during 1970-1997. Lee, Choi and Park (1998) measured the price and income elasticities of demand for grape, -0.439 and 1.066, respectively. Even though they used the linearly applied almost ideal demand system (LA/AIDS), their results can be used to confirm the previous one. Lee (1999) also estimated demand function for grape and measured that price elasticity was -0.153 and income elasticity 1.87. He also enlightened that grape has weak substitutional relation with banana.

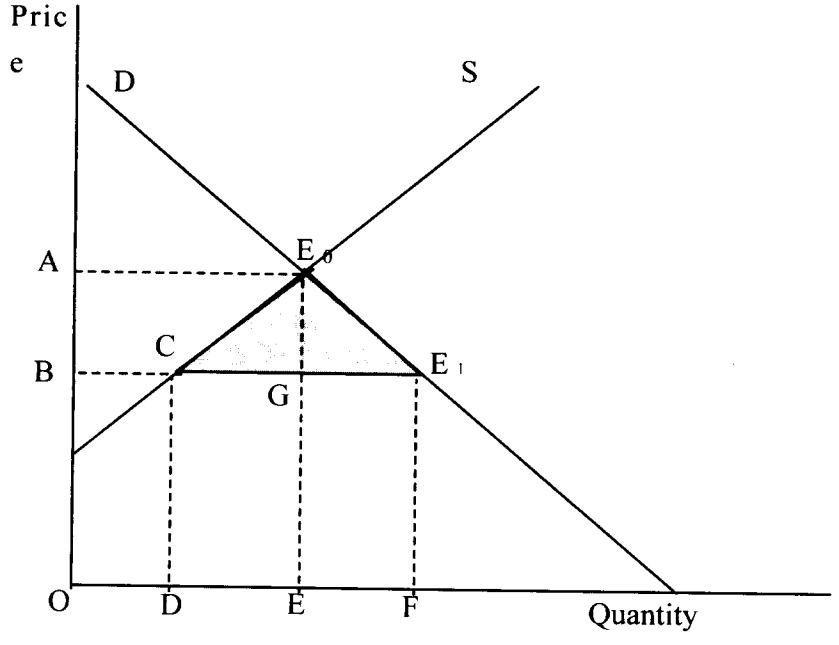
Shares of agriculture in domestic production and trade are relatively small in Korea, and the effects of agricultural trade liberalization on other sectors are usually negligible. Especially, trade liberalization of fruit or some specific product, grape, can hardly affect the non-agricultural sectors. Therefore, it'll be better to use the partial equilibrium approach rather than the general equilibrium one.

III. Measuring the Effects of Trade Liberalization[1]

The effects of abolishing tariff can be expressed by sum of consumers' surplus and producers' surplus. When the tariff on

[1] This part used the similar contents with that of page 111 and 112 of Eor, Lee and Choe (1999).

Figure 1. Changes in Consumer and Producer's Surplus by the Price Fall



grape reduced to zero, the import price also goes down which raises import of grape. It will lower the domestic price of grape from OA to OB and domestic consumption will increase to OF (Figure 1). Consumers' surplus increases by AE_0E_1B while the producers' surplus reduces by AE_0CB and hence net welfare increases by CE_0E_1.

But as far as the welfare change of importing country is concerned, changes in domestic producers' income may becompared with the changes in consumers' surplus. In agriculture which has sector-specific production factors, domestic producers' income usually depends on the revenues, price multiplied by quantity sold. In this case, domestic producers' revenue reduces from AE_0EO to BCDO since domestic production decreases from OE to OD as price falls owing to the tariff abolished.

That is, we need to compare the area of AE_0E_1B and that of AE_0EDCB to get the net effects of trade liberalization on importing country. By estimating import demand functions, we can easily calculate those areas since the function can provide us with the import price and income elasticities of import demand.

IV. Estimation of Import Demand Functions for Fruits

1. Model Specification

Let's assume that free trade agreement implies only zero percent of tariff. Also, assume that abolishment of tariff on grape results in surging imports from Chile. Quantity of imported grape is a function of the import and domestic prices, household income and the price of substitute or complements. The import demand function can be written as:[2]

$$(1) \quad M_G = f(P_{GM}, P_{GD}, Y, P_{OD})$$

where M_G is the quantity of imported grape; P_{GM} is an imported price; P_{GD} is a domestic price; Y is a household income and P_{OD} is the prices of other fruit.

Assume that the demand system has the Cobb-Douglas functional form, we can specify linear in log equation for estimation after we divide each side of the equation by domestic price, P_{GD}, and take logarithms:

$$(2) \quad \ln M_G^* = \alpha + \beta \ln P_{GM}^* + \gamma \ln Y^* + \delta \ln P_{OD}^* + \ln \varepsilon_t$$

Since the imported grape is assumed to be perfect substitute with domestic one, parameters β, γ, δ can be considered as the price elasticity, income elasticity, and elasticity of substitution (complement) of import demand for grape, respectively. Superscript to the variables mean that they are relative prices and real income.

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[2] Park, Joo and Shim (1999) didn't specify the price of substitute or complement in their import demand function.

2. Data

Most studies on demand function have used annual time-series data on quantity imported, price and income for more than twenty years. Since demand functions are estimated under the assumption of fixed consumer tastes, it'll be better to use monthly rather than annual data if available. This study used the monthly data of each variable during January of 1996~September of 1999. The source of import quantity and prices is *Monthly Trade Statistics* issued by Korean Customs Service. Domestic price of grape was the wholesale price determined in the market in each month.

3. Empirical Results

The results of estimating import demand function can be summarized as equation (3). According to the equation estimated, the price elasticity of grape import demand is -3.8, which is high enough to be a luxurious good. Income elasticity is also high 2.63. It seems that grape is a substitute of pear and complement of apple. But the relation between grape and apple is insignificant.

$$\begin{aligned} (3)\quad LMG = {} & -11.9 - 3.81LRPG^{**} + 2.63LRY^{*} - 1.40LRPA \\ & \quad (-1.44) \quad (-4.1) \qquad (2.45) \qquad (-1.0) \\ & + 4.45LRPP^{*} + 0.1DM \\ & \quad (2.78) \qquad (0.23) \end{aligned}$$

where $R^2 = 0.654$, coefficients with * and ** are significant at 5% and 1% level, respectively and the numbers in parentheses are t-values; *LMG* is logaritm of *MG*; *LRPG* is logarithm of *PGM*; *LRY* is logarithm of *Y*; *LRPA* is logarithm of relative price of apple with respect to that of grape; *LRPP* is logarithm of relative price of pear with respect to that of grape; and *DM* is a dummy variable which is 1 for May and 0 for other months every year.

According to the estimation of import demand function for

grape using monthly data, price elasticity of demand is -3.81, which is absolutely greater than any other estimated results for domestic grape using annual data. Income elasticity is 2.45 which is also higher than any other former estimates. These explain that demand for imported grape is more elastic than domestic one with respect to price as well as income.

4. Perspectives of Import and Producers' Welfare

Assume that tariff rate of 47 percent in 2000 is proportionally reduced to zero percent by 2010. Also, assume that annual average rate of economic growth is 5.5 percent. Under these assumptions and using the results of estimation, the impacts of tariff abolition on grape import will be a price fall from 2,300 won per kilogram to 1,700 won and an increase in import to 26,900 tons per year by 2010.

According to the existing studies on supply elasticity of grape, declining price causes reduced domestic production of grape by 3,000 tons, though total supply increases to 53,900 tons owing to the increased import. As a result, revenue of the green house grape producer diminishes to 43.2 billion won per year in 2010 from 69 billion won in 2000 (Table 1). The reductions of

TABLE 1. Changes in Greenhouse Grape Producer's Income

	2000	2010	Changes	Remarks
Price (won/kg)	2,300	1,600	-700	Tariff reduced to 0%
Import (ton)	6,700	26,900	20,200	ε_p = -4.1, ε_v = 2.45
Production (ton)	30,000	27,000	-3,000	η_p = 0.2*
Total Supply (ton)	36,700	53,900	17,200	Production + Import
Producer's Income (million won)	69,000	43,200	-25,800	Production multiplied by price

* Using the average of estimated elasticity of supply by Baek and Yang (1996) and Lee (1999).

TABLE 2. Effects on Pear Producer's Income

	2000	2010	Changes	Remarks
Price (won/kg)	1,770	1,735*	-35	$\varepsilon_{GP} = 0.134$**
Production (ton)	250,000	248,700	-1,300	$\eta_D = 0.09$***
Producer's Income (million won)	442,500	431,400	-11,100	

* Average prices of pear sold in spring (1,664 won) and in fall/winter (1,770 won) seasons.
** Lee and Choi (1999) estimated cross elasticity between grape and pear.
*** Supply elasticity estimated by Cho and Cho (1993).

25.8 billion won in producers' revenue may be divided into 2,000 farmers, approximately 13 million won in average.

Surged import of grape in the spring season have a spill-over effects on other fruit, pear, in this case. Using the existing results of Lee and Choi (1999), Cho and Cho (1993) on supply elasticity of pear and cross elasticities between pear and grape, we can measure that the price of pear would fall from 1,770 won per kilogram in 2000 to 1,664 won in 2010 (Table 2). This, in turn, causes reductions in production by 1,300 tons in 2010. Quantity of pear sold in spring season at the lower price is approximately one third since most pear is sold during fall and winter season at the old price. As a result, reductions in revenue of pear producers sum to 11.1 billion won in total.

5. Changes in Consumer's Surplus and Producer's Revenue

As the price of grape is lowered, consumer's surplus increases by lowered price and expanding consumption. Increase in consumer's surplus consists of two parts; transferred from producer's surplus and net increases in consumption. Since we have already measured the lowered price and increased quantity of consumption, changes in consumer's surplus can easily be calculated.

Changes in surplus transferred from producers by the price fall of 700 won per kilogram are 25.7 billion won (Table 3).

TABLE 3. Changes in Consumer's Surplus and Producer's Income

	2010	Remarks
Changes in surplus from price fall (million won)	25,690	(2,300-1,600) won × 36,700tons
Surplus from increase in consumption (million won)	6,020	(53,900-36,700) tons × 700won ÷ 2
Total changes in consumer's Surplus (million won)	31,710	
Changes in producer's income (million won)	-36,900	Grape producer's income: -25,800 Pear producer's income: -11,100

Adding the second part of the consumer's surplus of 6 billion won coming through the increases in consumption of grape, total changes in consumer's surplus are 31.7 billion won.

The amount of total increases in consumers' surplus was greater than the reduced amount of grape producers' revenue but smaller than the total reduction of producers' revenue if it includes pear producers' revenue reduction. In conclusion, trade liberalization in the form of tariff abolition on grape results in negative effects in producers' income though it brings positive effects in consumers' surplus. The former would exceed the latter by 5,190 million won in 2010.

V. Conclusions

In this study, effects of import liberalization on import quantity, prices, and on producers' revenue were addressed with respect to grape. This paper employed somewhat different approach from the existing studies in that this model specified an import demand function rather than general demand function. Under the partial equilibrium assumption, import demand function seems to measure the direct effects of tariff abolition more precisely. Also, this study used monthly data on import quantity, prices, and

income, differently from the existing studies that have used annual data because the monthly data can better reflect the recent changes in consumer's tastes and patterns of expenditure.

Major conclusions can be briefly summarized. When tariff is abolished by 2010, as the price of imported grape is lowered, import would increase by two factors, changes in price and income. Most observation confirmed that grape is price elastic and at the same time income elastic as it is a luxurious good. It is prospected that grape import may increase to 27 thousand tons by 2010 and that pushes up consumers' surplus while it lowers domestic grape producers' income at the same time. It also has negative impacts on pear producers' income.

More specifically, grape and pear producers' revenues will decrease by 25,800 and 11,100 million won, respectively, in 2010. They exceed the increments in consumers' surplus by 5,190 million won in 2010. Thus, trade liberalization of some specific products may bring domestic producers' income reduction, even though it also increases consumers' surplus.

REFERENCES

Baek, Jong-Hee and Yang Hae-Young. 1996. "Economic Analysis on Grape Marketing (in Korean)." *Korean Agricultural Policy Review* 25(2).

Cheong, Inkyo. 1999. "The Economic Effects of Free Trade Agreements between Korea and Chile (in Korean)." paper presented at the seminar of April, 2, 1999, Korea Institute for International Economic Policy.

Cho, Duck-Rae and Cho Jae-Hwan. 1993. *Long-Term Perspectives on Demand and Supply of Fruits and Policy Issues* (in Korean). Research Report R277. Korea Rural Economic Institute,

Economic Research Service. 1998. "Free Trade Area of the Americas: Potential Advantages for U.S. Agriculture." *Agricultural Outlook*, USDA.

Eor, Myong-Keun, Lee Jaeok and Choe Yoon-Kook. 1999. *Free Trade Agreement between Korea and Chile in Agriculture* (in Korean). Korea Rural Economic Institute. C99-35-1.

Kim, Tae-Hyung and Cheong Inkyo. 1996. *A Study on Economic Feasibility of the Small-Scale RTA of Korea* (in Korean). Policy Report 96-15. Korea Institute for International Economic Policy.

Korean Customs Service. Each month. *Monthly Trade Statistics.*

Lee, Joong-Woong. 1999. *Perspectives of Demand and Supply of Grape and its Policy Issues* (in Korean). Research Report R403. Korea Rural Economic Institute.

Lee, Kyei-Im and Choi Ji-Hyeon. 1999. "Seasonal Fruit Demand Analysis with AIDS (in Korean)." *Korea Rural Economic Review* 22(3).

Lee, Kyei-Im, Choi Ji-Hyeon, and Park Joon-Kee. 1998. A *Study on Fruits Consumption Patterns* (in Korean). R391. Korea Rural Economic Institute.

Park, Seong-Kwae, Joo Mun-Bae and Shim Ki-Seop. 1999. "The Effects of Korea-Chile FTA on Korean Fisheries Industry (in Korean)." paper presented at the seminar of the Effects of Korea-Chile FTA and Sectoral Strategy, October 15, 1999, Korea Institute for International Economic Policy

Ryou, Jai-Won and Lee Honggue. 1998. *The Economic Effects of Early Sectoral Trade Liberalization* (in Korean). Policy Report 98-07. Korea Institute for International Economic Policy.