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A Study of Import Demand for Agricultural and Ginseng Products from China

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Abstract

The aim of this study is to estimate the price elasticity of import demand for agricultural and ginseng products from China. The price elasticity of import demand for agricultural products from China was estimated to be -1.07 with a cross-price elasticity 0.44, and the income elasticity estimated to be 0.28. In the case of ginseng products, price elasticity was estimated to be -0.59 with a cross-price elasticity 0.16 and an income elasticity of 0.44. The results of the analysis showed that Chinese ginseng products were less sensitive to price changes as compared to the total agricultural products. In terms of income change, they were found to be more sensitive as compared to the total agricultural products. Because Chinese ginseng products are not greatly affected by price changes as compared to agricultural products, in which the damage amount would be limited even if a Korea-China FTA were to be concluded. Therefore, instead of focusing on imports defense, it is believed that the focus should be on expanding exports.

Keywords : Import demand analysis, Price elasticity, Cross-price elasticity, Income elasticity.

1. Introduction

1.1. Purpose of the Study

China has already concluded Free Trade Agreement (FTA) with 10 ASEAN nations, including Chile, Pakistan, etc., and it is pushing for more FTAs. Regarding the Korea-China FTA, both nations are promoting joint research related to industrial entities, government agencies, and educational institutions, and they are likely to agree sooner or later on trade issues. Korea's exports to China was $116.8 billion in 2010 (with $71.6 billion in imports from China), thereby making China the No. 1 trading partner of Korea. Since 1990, the imports of agricultural and ginseng products from China have been increasing at average

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annual growth rates of 7.7% and 27.6%, respectively. In particular, the growth rate of import of ginseng products was 19.9% higher than the growth rate of import of total agricultural goods. If the tariff barrier is eliminated in the future through a Korea-China FTA, the prices of agricultural products from China will decrease further, and as a result, agricultural product imports from China are to be expected to grow even further.

Currently, the ginseng products of Korea face changes in external conditions like the liberalization of trade, and in particular, it can be argued that China will become the biggest threat to Korea's ginseng industry. Considering this serious scenario, an analysis of import demand for ginseng products would be timely and relevant. Therefore, the purpose of this study is to estimate the demand elasticities of import demand for ginseng and agricultural products from China.

1.2. Status of Import and Export of Ginseng Products with China

Korea's agricultural product exports and imports are $3,324 and $13,894 million, respectively, thereby resulting in a trade deficit of $10,570 million. Korea is a representative nation of trade deficit for agricultural products; the deficit is expected to grow even wider with the opening of the markets through DDA, FTA, etc.

Table 1. Korea's 2010 exports and imports of agricultural products (Unit: millions of dollars, %)

Countries	Export		Import	
China	438	(13.18)	2,135	(15.37)
ALL	3,324	(100.0)	13,894	(100.0)

Note: Percentage in parentheses, MTI Code: 01 (Agricultural)
Source: Korea International Trade Association, Trade Statistics (www.kita.net)

In addition, Korea's exports and imports to China are $438 and $2,135 million respectively, thereby recording a trade deficit of $1,697 million; 13.18% of Korea's total exports of agricultural products went to China while 15.37% of Korea's total imports of agricultural products came from China.

In the case of ginseng products, 26.89% of Korea's total exports of ginseng went to China, while Korea's total ginseng imports came from China. Korea has maintained trade advantages in ginseng over China because most of the imported ginseng products come from China. But if an FTA is finalized in the future, it is expected that the imports of ginseng products from China will increase significantly. As such, an analysis of import demand for ginseng from China is indeed necessary at this time. This study will focus on how fluctuations in the prices of imported ginseng products from China affect the domestic imports of ginseng products in Korea.

This paper is organized as follows: In Section 2, the previous studies on import and export price elasticity are examined. In Section 3, the data and estimation methods are explained, and in Section 4, demand elasticities are estimated. Finally, in Section 5, the main

results of analyses of the paper are summarized and policy implications are discussed.

Table 2. Korea's 2010 exports and imports of ginseng products (Unit: thousands of dollars, %)

Countries	export		import	
China	30,589	(26.89)	3,553	(88.52)
ALL	113,739	(100.0)	4,014	(100.0)

Note: Percentage in parentheses, MTI Code: 0115 (ginseng)
Source: Korea International Trade Association Trade Statistics (www.kita.net)

2. Examination of Previous Studies

There has been no work that analyzed the economic effect of price changes following FTAs on the agricultural industry in Korea. Furthermore, few studies have been made on the economic effect of a Korea-China FTA in entire industries. Therefore, previous studies are summarized in Table 3 focusing on the analysis results of studies on the effect of FTAs on various industries.

Table 3. Previous studies on the economic effect of FTAs

Researcher	Content	Result
Oh and Hong (2007)	Analyses of economic spinning effect of Korea-India FTA on IT sector	The effect to expand trade scales of the FTA was estimated to be around 10.8%.
Kim (2001)	A study on the estimation of Korean trade functions	Korea's import/export were indicated to be very elastic toward domestic/foreign economic variables and non-elastic toward import/export prices.
Oh et al. (2005)	The economic effect of the execution of MRA in the IT sector	The costs of testing/certification may be reduced through MRA and this will reduce prices for imported/exported commodities, thereby increasing demand for import/export.
Kim and Park (2006)	Analysis of the economic effect of Korea-South Africa FTA	The effect to increase export by item based on a scenario assuming complete removal of duties exists in both countries.

Source: Kim et al. (2008)

Studies devoted to the import demand for ginseng products from China are very insufficient. Jung et al. (2006) stated in 'The Import Demand Analysis of Hong Kong International Ginseng Market' that, if the imported prices of Korean ginseng were to increase by $1,000 (USD) per ton, then the import volume would decrease by 1.196 tons. Additionally, if the prices of Japanese, North Korean, and Canadian ginseng products were to each increase by $1,000 (USD) per ton, then the import volume of Korean ginseng would increase by 0.401, 0.372, and 1.001 tons, respectively. However, they stated that if the ginseng products from the U.S. go up in import price by $1,000 (USD) per ton, the import volumes of Korean ginseng products would go down by 0.531 tons, and the import prices of ginseng products from China and other countries would have no effect.

In addition, it was found that if the gross domestic product of Hong Kong goes up by

$100 million (HKD), the imports of ginseng products from Korea will increase by 1.218 tons, this increase, which is more than the increases in ginseng from other countries, would be due to the preference level for Korean ginseng, being the highest.

They also estimated the total amount of ginseng imports by Hong Kong, and stated that the import volume goes down by 0.833 tons when the total import price of ginseng goes up by $1,000 (USD). In addition, if the gross domestic product of Hong Kong goes up by $100 million (HKD), the total imports of ginseng products by Hong Kong will increase by 1.076 tons. However, such analysis using annual data is insufficient in terms of time series, and since the explanatory variables are limited to price and income, it is difficult to properly control the changes in Hong Kong's inflation and economy. Also, because the result values are not in percentages, it is not easy to understand the level of changes.

Studies other than these on demand for imports of ginseng are seemingly non-existent. In the case of agricultural products, because of strong seasonality and susceptibility to various external factors such as climate change, natural disasters, etc., production goes through wild swings and forecasting is very difficult. Not only for agricultural products, but also across all industries, studies on import-export with China are not being conducted. As such, it can be said that this study is significant in that it is the first study conducted in Korea concerning the import-export of agricultural and ginseng products from China that derived results by establishing an optimum model for import-export analysis.

3. Data and Estimation

3.1. Data

This study used 12-years of monthly time series data from January 2000 through May 2011. In the case of the production index of all industries provided by Statistics Korea, the available data starting January 2000 was used. In particular, because of severe seasonal fluctuations of agricultural products, all the variables were seasonally adjusted using Census X12.

Table 4. A description of the variable

Variable		Parameter Description
The dependent variable	MQA	▪ Agricultural products imports from China (kg)
	MQG	▪ Ginseng imports from China (kg)
Explanatory variables	MPA	▪ Agricultural products import prices from China (U.S. dollars)
	MPG	▪ Ginseng import prices from China (U.S. dollars)
	KPA	▪ Domestic agricultural products prices (U.S. dollars)
	KPG	▪ Domestic ginseng prices (U.S. dollars)
	KIIP	▪ Domestic index of industrial product
	KER	▪ Dollar exchange rate
	KCPI	▪ Fresh food index

For the import prices and volumes of agricultural and ginseng products from China, the monthly trade statistical data from the Korea International Trade Association was used. For the production index of all industries and Korean won-USD exchange rates and domestic production of fresh food index, monthly data from Statistics Korea were used.

3.2. Estimation

Import demand analysis methods can be divided largely into general equilibrium analysis and partial equilibrium analysis. Partial equilibrium analysis, as compared to the general equilibrium analysis, offers an easy understanding and advantage in obtaining effects by items through the use of elasticity that are of signs and coefficient sizes that match theoretical and common intuitions (Oh et al., 2007).

In this study, models for elasticity estimation for the import demand for agricultural and ginseng products were established, and variables were selected to enable an estimation of price elasticity, as well as income elasticity and cross-price elasticity.

As a substitute variable for income, the production index of all industries was used. Based on the nature of agricultural products, the fresh food index was used instead of consumer price index. Also, logarithmic transformation was taken for all variables. This type of double-log model is often used in estimating actual elasticity since the slope coefficient β_i represents elasticity.

In this study, through a double log model, the price elasticity of import demand for agricultural and ginseng products from China was estimated, and the basic model was set as follows:

$$\ln MQ_t = a_0 + \beta_1 \ln KIIP_t + \beta_2 \ln\left(\frac{MP_t}{KCPI_t}\right) + \beta_3 \ln\left(\frac{KP_t}{KCPI_t}\right) + \beta_4 \ln KER_t + \beta_5 D08 + e_t$$

MQ_t : Imports of items, $KIIP_t$: Domestic index of industrial product, MP_t : Import prices, KP_t : Domestic prices, $KCPI_t$: Fresh Food Index, KER_t : Dollar exchange rate, $D08$: 2008 Financial Crisis dummy Variable.

However, regarding the suitability of the regression model for time-series data, the error term could not fully satisfy the assumptions that accompany white noise that is mutually independent. Because most time-series data is observed continuously in the time T hours from an equivalent observation target, it's a common phenomenon to see the error term having an autocorrelation.

Autocorrelation means the correlation among the series of observations from time-series data or cross-sectional data. Although in classical linear regression models, an analysis was possible under the assumption that there is no correlation among deranged items, this is an

unrealistic assumption, and for time-series data analysis, the error term can generally be represented as a function of previous values. Since the data used in this study is monthly data, an analysis was attempted through the use of generalized autoregressive conditional heteroscedasticity (GARCH (r, m)) under the assumption of following the $e_t \sim$AR model and conditional heteroscedastic. In addition, attempts will be made to compare with the estimates obtained from ordinary least squares (OLS).

3.3. Test of models

Most of time-series data are unstable with unit root and there is spurious regression problem in OLS. Instead of differencing the data, we applied cointegration test to find out whether there has been a long range relationship between the variables. The result of unit root test showed that four variables have unit root. For the case of first differenced data, no unit root was found for all variables.

The result of Johansen co-integration test showed that there has been at least one or more co-integrating relationship between the variables of model 1 and model 2. This implies that

Table 5. ADF unit root test results

	level		1st difference	
	t-Statistic	Prob	t-Statistic	Prob
ln(MQA)	-1.9121	0.3248	-8.3000	<.0001***
ln(MPA)	-2.3312	0.1656	-7.4608	<.0001***
ln(KPA)	-4.0563	0.0022***	-8.1936	<.0001***
ln(MQG)	-4.1708	0.0015***	-13.22915	<.0001***
ln(MPG)	-4.0439	0.0023***	-8.6181	<.0001***
ln(KPG)	-3.3258	0.0177**	-8.7015	<.0001***
ln(KER)	-0.6028	0.8621	-5.5914	<.0001***
ln(KIIP)	-1.2689	0.6383	-6.3396	<.0001***

Note: ** and *** denote statistical significance at the 5% and 1% level, respectively.

Table 6. Johansen cointegration tests

Model 1 (Import function for agricultural products from China)			
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.
r≤0*	0.554723	82.21361	0.0037
r≤1	0.210808	32.05198	0.6093
r≤2	0.175519	17.37376	0.6124
r≤3	0.083122	5.407674	0.7641
r≤4	0.000439	0.027242	0.8688
Model 2 (Import function for ginseng products from China)			
r≤0*	0.464604	74.80764	0.0189
r≤1	0.231813	36.07318	0.3927
r≤2	0.159048	19.72243	0.4418
r≤3	0.134202	8.982750	0.3670
r≤4	0.000779	0.048314	0.8260

* denotes the rejection of hypothesis at the 0.05 level.

there has been a long-term equilibrium relationship between respective variables even though some of the variables are more or less unstable. Although some of the variables are unstable as a result of unit root test, this analysis could be meaningful because there exists co-integrating relationship between variables.

In most of time series analysis, there exists autocorrelation problem of error terms. Godfrey's serial correlation test showed that model 1 is considered to be AR (14) and model 2 is considered to be AR (13). Also we did archtest to see whether there exist conditional heteroscedasticity. The result showed that model 1 should use the GARCH model and model 2 is not necessarily to use the GARCH model. We chose the GARCH model for all models.

4. Estimation Results

4.1. Import Function for Agricultural Products from China

The estimates of import function of agricultural product from China are shown in Table 7. First, although R-square, which represents the explanatory capability of the OLS estimates, showed a high explanatory capability of 0.8609, it was found that the error terms have autocorrelation because the Durbin-Watson statistic was 0.4020.

Table 7. Import function estimates of agricultural products from China

Variable	OLS estimates (OLS)		FGLS estimates (AR)		ML estimates (GARCH)	
	Estimates	Pr > |t|	Estimates	Pr > |t|	Estimates	Pr > |t|
Intercept	16.5623***	<.0001	15.7983***	<.0001	16.0348***	<.0001
MPA	-1.2341***	<.0001	-1.1730***	<.0001	-1.0747***	<.0001
KPA	0.7124***	<.0001	0.5284***	<.0001	0.4424***	<.0001
KIIP	0.4756***	0.0042	0.1580	0.2585	0.2827***	0.0033
KER	-0.6434***	0.0001	-0.5115**	0.0325	-0.5827**	0.0213
D08	0.2817***	0.0077	0.0959	0.1830	0.0833	0.3254
AR1			-0.7915***	<.0001	-0.8514***	<.0001
ARCH0					0.0035***	<.0001
ARCH1					0.9082***	0.0034
R^2	0.8609		0.9571		0.9558	
DW	0.4020		1.8283			

Note: ** and *** denote statistical significance at the 5% and 1% level, respectively.

R-square of FGLS estimated values was 0.9571 under the assumption that error terms follow AR (14) model, whereby showing a very high explanatory capability. In addition, with the Durbin-Watson value being around 2, it showed that there was no autocorrelation. Therefore, it was possible to ascertain that FGLS estimates were more efficient than OLS estimates. As the final model for this study, ARCH1 model that adjusts for conditional distribution models was selected, and R-square of ML estimated results was 0.9558.

The price elasticity of import demand for agricultural products from China was shown to be -1.07, which means that, if the price of imports increased by 10%, then the demand for

agricultural products from China would decrease by 10.7%. The cross-price elasticity of domestic agricultural products was shown to be 0.44, which means that if the price of domestic agricultural products increased by 10%, then the demand for agricultural products from China would increase by 4.4%. In addition, the income elasticity was shown to be 0.28, which means that if the income increased by 10%, the demand for agricultural products from China would increase by 2.8%. The import demand for agricultural products from China was very inelastic compared to the change in Korean income.

As shown, when the prices of agricultural products from China increase, the demand decreases, and when Korean people's income increases the demand increases. Therefore, these can be classified as normal goods.

Generally, goods are classified to be necessary when income elasticity is less than 1, neutral when income elasticity is equal to 1, and a luxury when income elasticity is over 1. Therefore, the above results showed that Chinese agricultural products were necessary goods to Korean people.

4.2. Import Function for Ginseng Products from China

The estimates of import function for ginseng product from China are shown in Table 8. First, R-square that represents the explanatory capability of the OLS estimation showed an explanatory capability of 0.6765. In addition, with the Durbin-Watson test result being 0.5795, it tells us that the error terms have serious autocorrelation.

Table 8. Import function estimates of ginseng products from China

Variable	OLS estimates (OLS)		FGLS estimates (AR)		ML estimates (GARCH)	
	Estimates	Pr > |t|	Estimates	Pr > |t|	Estimates	Pr > |t|
Intercept	4.3097	0.1145	6.5782	0.0913	6.5281**	0.0196
MPG	-0.5646***	<.0001	-0.5565***	<.0001	-0.5857***	<.0001
KPG	0.3638***	<.0001	0.1928***	0.0038	0.1643***	<.0001
KIIP	1.4200***	<.0001	1.0526***	0.003	0.4387**	0.039
KER	-0.2796	0.4068	-0.5342	0.2527	-0.4564	0.2515
D08	0.0947	0.5388	0.2325	0.1675	0.1606	0.2164
AR1			-0.3955***	<.0001	-0.6711***	<.0001
AR2			-0.2420***	0.0050	-0.1746**	0.0224
AR12			-0.1084	0.1359	-0.1432***	<.0001
ARCH0					0.0108***	<.0001
ARCH3					1.8006***	<.0001
R^2	0.6765		0.8300		0.8439	
DW	0.5795		1.3421			

Note: ** and *** denote statistical significance at the 5% and 1% level, respectively.

R-square of FGLS estimated values was 0.8300 under the assumption that error terms follow AR (13) model, whereby showing a high explanatory capability. However, it was shown that autocorrelation still existed. As the final model for this study, ARCH (3) model

that adjusts for conditional distribution models was selected, and R-square of ML estimated results was 0.8439.

The price elasticity of the import demand for ginseng products from China was shown to be -0.59, which means that if the price of import increased by 10%, the demand for ginseng products from China decreased by 5.9%. The cross-price elasticity of domestic ginseng products was shown to be 0.16, which means that if the price of domestic ginseng products increased by 10%, the demand for ginseng products from China increased by 1.6%. In addition, the income elasticity was shown to be 0.44, which means that if Korean income increased by 10%, the demand for ginseng products from China increased by 4.4%.

As with the agricultural products from China, when the prices of ginseng products from China increase, the demand decreases. Likewise, when the Korean people's income increases, demand increases. Therefore, these can be classified as normal goods. Concerning agricultural products from China, ginseng products imported from China were shown to be necessary goods.

5. Conclusion and Policy Implications

In this study, we estimated price elasticity, cross-price elasticity, and income elasticity by analyzing the import demand for agricultural and ginseng products from China. The price elasticity of import demand for agricultural products from China was estimated to be -1.07, cross-price elasticity 0.44, and income elasticity 0.28. In the case of ginseng products, price elasticity was estimated to be -0.59, substitute elasticity 0.16, and income elasticity 0.44.

Table 9. Comparison of elasticity (agricultural products and ginseng products)

	Chinese agricultural	Comparison	Chinese ginseng
The own price elasticity	-1.07	>	-0.59
The cross-price elasticity	0.44	>	0.16
The expenditure elasticity	0.28	<	0.44

The results of analysis showed that Chinese ginseng products were less sensitive to the price change and income change compared to the total agricultural products. The reason for this insensitivity in relation to the price, is that the cultivation period is long at 4-6 years, and in the case of Chinese ginseng, their products are used as ingredients for natural medicines. Even if the price increases. it is believed that the demand would not be affected that much. Income elasticity was seen to be somewhat higher than agricultural products, and although Chinese agricultural products and ginseng can be considered as necessary goods, the ginseng products were seen to being closer to neutral goods. From these estimated results of import functions. the following policy implications can be identified:

In the case of Chinese ginseng products, since they are not affected too greatly by price changes as compared to agricultural products, even if a Korea-China FTA were to be finalized, the damage amount would be limited. Therefore, instead of focusing on import

defense, it is believed that the focus should be on expanding the exports. In addition, since there doesn't seem to be significant conversion to Chinese ginseng products, even if the prices of Korean ginseng were to increase. Instead of coming up with policies to lower the prices, it is believed that the focus should be on improving the safety and quality of ginseng products. On top of that, in the case of Chinese ginseng products, since they react more sensitively to income as compared to agricultural products, there may be a need for carrying out diversification and differentiation policies to meet consumer preferences.

However, there certainly are limitations to this study. The biggest limitation of this study dealt with the selection of explanatory variables. Since the non-price variables that can affect demand quantity and the American ginseng products (even though small in import value) were excluded, these have become obvious limitations.

Lastly, this study covered only one model: import demand function model. Therefore, the effects that a Korea-China FTA can have on the ginseng trade with China were not calculated. If more China-related time-series data would be available, it would be possible to derive export demand function models, and the calculation of trade values using these export demand function models could be used as a future direction of study.

References

Jeong, H. B., Shon, U. D., Hahm, Y. T., Ko, S. K., Im, B. O. (2006). An Analysis of Import Demand for International Ginseng Market in Hong Kong, *Journal of Ginseng Research,* 30(3), 165-171.

Kim, A. H. (2001). Study on Estimation of Korea Export-Import Function, Korea Institute of Industrial Economics, *Industrial Economics Research,* 14(5), 121-134.

Kim, K. S., Park, Y. H. (2006). Korea-South Africa FTA Economic Analysis, International Regional Academy, *International Regional Studies,* 10(2), 414-438.

Kim, W. N., Kim, Y. J., Kang, H. G. (2007a). Study on Adult Male Smoking Rate Prediction Based on Tobacco Price Increase, *Journal of the Korean Data Analysis Society,* 9(5), 2245-2255.

Kim, W. N., Kim, Y. J., Kang, H. G. (2007b). Follow-Up Study on Tobacco and Health Care Demand Elasticity - Systematically Censored Demand Systematic Approach, *Journal of the Korean Data Analysis Society,* 9(3), 1165-1178.

Kim, W. N., Yang, H. S. (2010). Effects of Tobacco Price on Smoking and Health Care Demand, *Journal of the Korean Data Analysis Society,* 12(5), 2785-2794.

Kim, Y. J., Kim, W. N., Yang, H. S., Cho, M. S. (2008). A Study on the Demand Elasticity of Liquors Imported from China and the Effect of Korea-China FTA on Korean Alcohol Industry, *Journal of the Korean Data Analysis Society,* 10(6), 2967-2976.

Moon, S. Y. (2007). Study of Effects Free Trade Agreement Has on Soy Bean Trade, International Regional Academy, *International Regional Studies,* 11(1), 11-35.

Oh, W. G., Hong, S. P. (2007). Analysis of Economic Distribution Effect in IT Sector of Korea-India FTA, *International Regional Academy, Spring Conference Proceedings,* 1037-1056.

Oh, W. G., Yoon, C. H., Lim, K. S. (2005). Economic Effects of MRA on IT sector, *Journal of East Asian Economic Integration,* 9(2), 85-117.

Yoo, J. G. (2007). *Analysis of Trade Creation Effects on Industries from KORUS FTA,* Hanyang University, Master Thesis.