Do U.S. Agriculture Suppliers Benefit from South Korea-U.S. Free Trade Agreement? The Case of Orange Juice

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Abstract

This paper investigates the effect of the South Korea-U.S. Free Trade Agreement (KORUS-FTA) on U.S. competition with other suppliers for the import/export of orange juice. We use monthly trade data for 2007-2015 to estimate the import demand from the United States, Brazil, Israel, and the Rest of the World (ROW). Our results suggest that U.S. suppliers have surpassed Brazil and dominate the market. Moreover, we show that thanks to the KORUS-FTA, U.S. suppliers have gained significant welfare and trade value, which is particularly important for industries suffering from a shrinking domestic market.

JEL Code: Q13,Q17

Key words: free-trade agreement, import demand, orange juice, supplier welfare

1.Introduction

Trade agreements among countries play an important role in international trade and agricultural product exchanges. Bilateral free-trade agreements can significantly affect the supplier and consumer welfare in both countries. The South Korea-U.S. Free Trade Agreement (KORUS-FTA), implemented in March 2012, is designed to eliminate or reduce trade barriers to the market and enhance the economic relationship between the two countries (Heng et al. 2017). South Korea heavily relies on imports to meet consumers' growing demand for premium quality food and diet diversity, and agricultural product imports reached $25 billion in 2013. As a major exporter of various agricultural products to South Korea for decades, the United States supplied about 20% of total agricultural products imported in 2013 (USDA-ERS 2015a).

The nonalcoholic beverage market is growing in South Korea, and consumers' changed tastes and increased income have boosted the consumption for imported juice products. The total imports of major fruit juices in South Korea increased from $119 million in 2010 to $178 million in 2013 and the proportion of U.S. fruit juices increased from 35% to over 50% during this period (USDA-FAS 2014). Within the juice market, orange juice is the most popular, followed by grape juice and apple juice (USDA-ERS 2015b). Although South Korea produces a significant amount of tangerines, the local fruits are typically sold fresh rather than being processed, which provides a large market for foreign orange juice suppliers. There is strong competition in the world orange juice market and in South Korea. Brazil used to supply the majority of total juice imports and dominated the orange juice market in South Korea. However, the implementation of KORUS-FTA has changed the dynamics for imports, as the 54% tariff on frozen orange juice concentrate from the United States dropped to zero immediately. According to the USDA-FAS (2014), although Korea's imports of orange juice declined from 26,547 metric

tons (MT) to 22,238 MT between 2010 and 2013, imports of U.S. orange juice increased from 5,188 MT to 19,221 MT at the same time (figure 1). South Korea has ranked as the second largest consumer behind Canada for U.S. orange juice since the 2013/14 season (USDA-ERS 2016).

[Insert figure 1]

The U.S. domestic orange juice industry has been shrinking due to both supply side (e.g., citrus greening disease) and demand side (e.g., consumers' negative perception toward sugar content in juice) reasons. South Korea's imports of U.S. orange juice declined in 2014 because of the reduced citrus harvest but slowly recovered in 2015 (USDA-FAS 2014; Korea International Trade Association [KITA] 2016). Because imports from South Korea could provide a profitable opportunity for U.S. orange juice by selling at a premium, investigation on the effect of the KORUS-FTA on South Korea's import demand for orange juice and the competition of U.S. and other suppliers will provide useful information for the industry. Moreover, the case of orange juice provides a typical example to simulate and understand the effect of a FTA on U.S. suppliers' trade value and welfare. Our results suggest that U.S. suppliers have benefited from the KORUS-FTA but still face fierce competition and other challenges.

2.Literature Review

There is a relatively small amount of research investigating the effect of KORUS-FTA, although South Korea has become an important market for the United States. Moon, Lee, and Park (2013) surveyed South Korean consumers regarding oranges, and found that the majority of consumers noticed a drop in orange prices after the KORUS-FTA went into effect and one-fourth of the respondents increased their orange purchases as a result of lower price. Jones and Blayney (2014) studied the impact the KORUS-FTA on demand for imported dairy products, and

concluded that the FTA opened the South Korean dairy product market by reducing the tariff and expanded overall dairy imports. Moreover, we were unaware of any studies conducting welfare analysis related to the KORUS-FTA.

Analysis of import demand has provided a useful tool to understand the dynamics of imports and competition for various agricultural products in the investigated market. For example, Yang and Koo (1994) applied a source-differentiated AIDS model to annual data to estimate Japanese meat import demand from the United States, Thailand, and China, and they indicated that the United States has the largest potential for beef exports to Japan. Ramirez and Wolf (2008) studied the import demand for milk in Mexico from the United States, Oceania, and other countries, and found that the United States had a strong position enhanced by NAFTA and export subsides, while other countries also became important sources for milk imports during the analyzed period. Regarding the import demand for orange juice, Lee, Seale, and Jierwiriyapant (1990) used annual observations and a Rotterdam model to estimate the Japanese import demand for citrus and citrus juices from the United States, Israel, Argentina, Brazil, and the Rest of the World (ROW). They found that although the trade agreements between the United States and Japan liberalized the imports of citrus, the United States was losing its competitiveness in the citrus juice market and played a less important role than did Brazil. A more recent study by Liu, Kilmer, and Lee (2007) investigated the important demand for orange juice in Canada from the United States, Brazil, Mexico, and ROW, using semi-annual import data. They found U.S. orange juice was price inelastic and substituting with Brazilian orange juice, and that an expansion of total Canadian orange juice imports would favor the United States.

Previous studies on import demand typically use aggregated annual or semi-annual data, resulting in small sample size and possibly masking seasonality or any changes within a year.

However, using disaggregated trade data, particularly for agricultural products, is challenging. One major issue is the presence of zero trade flows, leading to undefined prices. As a result, how to derive import prices when the trade flow is zero is critical. Arnade, Gopinath, and Pick (2011) studied the household purchase of potato chips and derived choke prices using an iterative procedure and elasticities. The choke prices are defined as the price that reduces the demanded product to be zero. In the case of international trade, Muhammad (2013) investigated the import demand of apples in the United Kingdom from France, Italy, the Netherlands, the United States, New Zealand, and South Africa. He applied a similar procedure for deriving choke prices requiring only an initial elasticity value and the average observed price, and reported that the choke prices and demand estimates converge to the same results regardless of the initial elasticity values using this approach. Kuchler and Arnade (2016) applied the same procedure to derive choke prices and estimate consumer welfare from the seasonal import of fresh berries.

Our analysis aims to apply disaggregated trade data to provide a deeper understanding of how the KORUS-FTA affects the competition and welfare of U.S. agricultural product suppliers, using the case of orange juice, a representative agricultural product for which high tariffs existed prior to the agreement.

3.Methods

Deaton and Muellbauer (1980) developed the Almost Ideal Demand System (AIDS), which has been widely used in previous research. Using the AIDS model for the disaggregated trade data is appealing because the model does not require the log of quantity, which is undefined when trade flow is zero (Muhammad 2013).

The source-differentiated LA-AIDS model is specified as

$$(1) \qquad w_{it} = \alpha_i + \sum_j \gamma_{ij} lnp_{jt} + \beta_i \ln\left(\frac{X_t}{P_t}\right) + h_{1i}\cos\left(\frac{2\pi t}{12}\right) + h_{2i}\sin\left(\frac{2\pi t}{12}\right) + \theta_i FTA_t + \rho_i T + \epsilon_{it}$$

where w_{it} is the market share of orange juice from country of origin *i* for month *t*, X_t is the total expenditure on orange juice for month *t*, p_{jt} is the price of orange juice from origin *j* for month *t*, and lnP_t is the price index, defined as $\ln(P_t) = \sum_i w_{it} \ln(p_{jt})$. The cosine and sine terms are used to account for seasonality effects (Gould, Cox, and Perali 1991). FTA_t is a dummy variable, equal to one for the time period after the implementation of the KORUS FTA, and equal to zero otherwise. T is a time trend.

The theoretical restrictions of homogeneity, adding-up, and symmetry are imposed as follows:

(2) $\sum_i h_{1i} = \sum_i h_{2i} = \sum_i \theta_i = \sum_i \rho_i = 0,\ \sum_j \gamma_{ij} = 0, \sum_j \alpha_j = 1, \text{and } \gamma_{ij} = \gamma_{ji}.$

Expenditure and price elasticities are calculated by the following equations:

(3) Expenditure elasticity: $\eta = 1 + \frac{\beta_i}{w_i}$,

(4) Uncompensated elasticity: $e_{ij} = \frac{\gamma_{ij} - \beta_i w_j}{w_i} - \delta_{ij}$,

(5) Compensated elasticity: $e_{ij}^* = \frac{\gamma_{ij}}{w_i} + w_j - \delta_{ij}$,

where δ_{ij} is the Kronecher delta and equals to 1 if $i = j$ and 0 otherwise.

Empirically, one equation needs to be dropped from the demand system to avoid singularity, and the ROW equation is dropped in this case. A one-period lag autoregressive term was added to the three share equations to alleviate autocorrelation (Kuchler and Arnade 2016; Wakamatsu and Miyata 2016).

Following Muhammad (2013), the choke prices are derived using the general definition of a price elasticity: $e = dlnq/dlnp$, and an average price $\bar{p}$ and an average quantity $\bar{q}$.

From the definition, we can get the following relationship:

(6) $\frac{q' - \bar{q}}{\bar{q}} = e \frac{p' - \bar{p}}{\bar{p}}$.

At the choke price, $q' = 0$, and by solving the equation, the choke price can be represented as:

(7) $p' = (\frac{e-1}{e})\bar{p}$.

Given an initial price elasticity, the initial choke prices can be derived from equation (7), which is then used to estimate the demand system and calculate the new elasticities. The new elasticities are then used to derive the new choke prices. This procedure is repeated until convergence.

We further evaluate the economic consequences of the KORUS-FTA for U.S. orange juice producers and exporters, considering South Korea as a large-country importer with market power to affect the world price of U.S. orange juice. We use a simplified scenario to illustrate the welfare impact on U.S. producers in figure 2 assuming demand and supply equations are linear. S_{us} represents U.S. domestic production, ES_{us_kr} represents the export supply to South Korea, and ED_{kr_us} represents the demand for U.S. orange juice in South Korea. The tariff rate ($t = \frac{P'-P}{p}$) increases the retailer price received by South Korean consumers to *P'* and lowers the import price received by U.S. suppliers to *P*. Under price *P*, U.S. producers supply orange juice of S_1. As the tariff is eliminated under the FTA, and the import price of U.S. orange juice becomes *P**, which is determined by the export supply of the United States (ES_{us_kr}) and import demand of South Korea (ED_{kr_us}) at the equilibrium point *B*. Under price *P**, U.S. domestic orange juice supply increases to S_2, assuming all other effects are constant. Therefore, U.S. orange juice producers will gain welfare of $DCPP^*$, and U.S. orange juice export value will increase by ($P^*BQ_2O - PAQ_1O$).

[Insert figure 2]

4.Data

Monthly import quantities and values are collected from the Korea International Trade Association (KITA) for the period from January 2007 to December 2015. Quantities are measured in 1,000 kilograms (kg), and values are measured in $1,000 (all currency is in U.S. dollars). The import prices are calculated by dividing values by quantities. The supplying countries include the United States, Brazil, Israel, and the Rest of the World (ROW). ROW is an aggregation of all countries other than the United States, Brazil, and Israel.

Between 2007 and 2015, the average import price of orange juice was $2.79/kg from the United States; $2.07/kg from Brazil; $1.57/kg from Israel; and $2.92/kg from ROW. The average monthly import volume of orange juice was 627,172 kg from the United States; 907,179 kg from Brazil; 191,034 kg from Israel; and 67,409 kg from ROW (table 1). There were significant changes in importing patterns of South Korea after the KORUS-FTA, compared to the pre-FTA period. As shown in figure 3, the monthly average imported orange juice from the United States increased from 403,101 kg before the KORUS-FTA to 940,865 kg after the KORUS-FTA, while the average imports from Brazil decreased from 1,421,114 kg pre-FTA to 187,671 kg post-FTA. The average imports from Israel also experienced a decline while the average imports from ROW increased after the implementation of the KORUS-FTA.

[Insert table 1]

[Insert figure 3]

5.Results

The relationship between monthly prices and the calculated choke prices for each origin are shown in Figure 4, and the iteration procedure of generating choke prices based on uncompensated elasticities are presented in the Appendix. The calculated choke prices are above the highest observed actual orange juice prices for the United States and Brazil, while there are

several observed prices in Israel and ROW that exceed the calculated choke prices. This is mostly likely due to the large variation of prices from these origins within that period, as the choke prices are calculated using the average price.

[Insert figure 4]

5.1Estimated Results from LA-AIDS Model

The results of the source-differentiated LA-AIDS model are estimated using 108 monthly observations and are reported in table 2. A seemingly unrelated regression procedure was applied using SAS 9.4. The estimates for the ROW equation were recovered using the imposed restrictions. Although the estimated coefficients alone do not provide much interpretable information, the results show that the KORUS-FTA dummy for the United States is positive and significant at the 1% level, while the dummy for Brazil is negative and significant at the 1% level. This implies that the U.S. share of the market has significantly increased, while the share for Brazil has decreased significantly after the implementation of the KORUS-FTA, compared with the period before the agreement. Meanwhile, the FTA dummy is positive for ROW and negative for Israel, although not statistically significant. The only statistically significant time trend is associated with Israel, implying the share of orange juice imports from Israel has been decreasing over time, but the magnitude is small.

[Insert table 2]

The expenditure and price elasticities for orange juice from each origin are reported in table 3. The standard errors are simulated using the delta method. All own-price elasticities are negative and significant at the 1% level, as expected. Own-price elasticities range between -0.84 for the United States and -1.88 for ROW. Results indicate that the imported orange juice from the United States is the least price sensitive, and with a 1% increase in price, the import demand

will decrease by 0.84% in the South Korean market. The inelastic own-price elasticities for the United States and Brazil might suggest a stable relationship between South Korea and the two major suppliers. Imported orange juice from ROW is the most price sensitive such that with a 1% increase in price, the demand for ROW orange juice will decrease by 1.88%. Such results suggest that other countries (ROW) could increase their orange juice exports to South Korea if these countries decrease the price.

[Insert table 3]

Cross-price elasticities represent the competitive relationships among orange juices from different sources. If the cross-price elasticity is positive, the imported orange juice from the two sources are substitutes; if it is negative, the imported orange juice from the two sources are complements. Results show that if the U.S. orange juice price increases by 1%, there would be a 0.60% increase in orange juice imports from Brazil and a 2.11% increase in imports from ROW. Such results suggest that orange juice from Brazil and ROW are substitutes for U.S. orange juice.

ROW imports include various sources like Spain, Turkey, and Australia. These countries play an important role in supplying orange juice when the U.S. price increases. Although the United States currently dominates the market, other suppliers are competing for market share. When Brazilian orange juice price increases by 1%, then 0.46% and 1.30% more orange juice would be imported from the United States and Israel, respectively. When the price of Israeli orange juice increases by 1%, imports from Brazil will be increased by 0.28%, indicating Israeli orange juice mostly competes with Brazilian orange juice. When ROW increases price, the import demand for U.S. orange juice would be increased by 0.25%, suggesting that ROW orange juice is competing with U.S. orange juice.

Expenditure elasticities estimate the percent change in quantity when total expenditure on imported orange juice increases by one percent. The expenditure elasticities range between 0.42 for ROW and 1.32 for Brazil. The more than one expenditure elasticity indicates that if the total expenditure on imported orange juice change by 1%, imports from Brazil would change by 1.32%, the only country with this relationship. The smaller expenditure elasticities for imports from Israel (0.42) and ROW (0.49) indicate that imports from these sources are inelastic to the expenditure. Orange juice imports from the United States have an expenditure elasticity of 0.91, indicating that when total expenditure on imported orange juice increases or decreases by 1%, the demand for U.S. orange juice would increase or reduce by just less than 1%.

5.2Simulated Supplier Welfare and Export Value

We simulated the economic effects using monthly import data and other information sources. The KORUS-FTA was implemented in March 2012, so the average monthly import price and quantity for March 2009 to March 2012 (total 3 years) are calculated to approximate the pre-FTA scenario (point *A*), while the average import price and quantity for April 2012 to April 2015 (total 3 years) are used to approximate the post-FTA scenario (point *B*). As a result, point *A* is associated with a price *P* of $2.66/kg and an import quantity Q_1 of 414,000 kg; point B is associated with a price P^* of $2.84/kg and an import quantity Q_2 of 959,000 kg. With two points known, the linear equation of U.S. export supply to South Korea can be determined; thus the elasticity of export supply to Korea is around 13 at mid-point. To examine whether this calculated elasticity is reasonable, we calculated the elasticity of total U.S. orange juice export supply following Lemieux and Wohlgenant (1989) as $\varepsilon_{ES} = \frac{\varepsilon_{S_{us}}}{r_p} - \frac{\varepsilon_{D_{us}}}{r_c}$, where $\varepsilon_{S_{us}}$ and $\varepsilon_{D_{us}}$ are U.S. domestic total supply and demand elasticities, respectively, r_p is the ratio of export divided by domestic supply, and r_c is the ratio of export divided by domestic consumption. According to

USDA-FAS (2016), r_p is about 0.18 and r_c is about 0.12 in the 2014/2015 season. According to the U.S. International Trade Commission (2012), the domestic supply elasticity of U.S. orange juice is in a range of 2 to 4 and probably closer to the lower end with the current low inventory levels, so we assume an elasticity of 2 in this welfare analysis. The domestic demand elasticity is in a range of -0.4 to -0.8. The calculated elasticity of total export supply ranges between 14 and 28. As the export supply to South Korea should be less elastic than the total U.S. export supply of orange juice, we believe that the elasticity of 13 calculated from our dataset is in the right range.

The domestic supply in the pre-FTA scenario is calculated as an average of monthly domestic production between 2008/2009 and 2011/2012, reported in USDA-ERS (2012). The calculated pre-FTA domestic supply S_1 is about 20,717,000 kg, which is represented by point *C* with *P*. Assuming the mid-point domestic supply elasticity is around 2, we can further estimate the post-FTA domestic supply S_2 with the free trade import price *P**, which gives an estimate of 23,619,000 kg if the domestic supply curve does not shift. In this simulation, U.S. suppliers would approximately gain a welfare of $4 million ($DCPP^*$), and the trade value would gain about $1.62 million ($P^*BQ_2O - PAQ_1O$). Therefore, with the implementation of the FTA, U.S. suppliers will receive a higher price, thereby gaining welfare.

6.Conclusions

A bilateral free trade agreement can enrich consumers' choices and enhance suppliers' access to the market, which could result in welfare changes in both countries. The KORUS-FTA reduces trade barriers and provides U.S. suppliers with advantages to increase market share in this growing market, which is particularly important for industries that are struggling with a shrinking domestic market. The U.S. orange juice industry has been challenged by citrus

greening disease as well as by declining domestic consumption. Meanwhile, South Korea has heavily relied on imports to meet consumers' demand for fruit juices since the domestically produced fruits are usually consumed fresh. Moreover, the implementation of KORUS-FTA eliminated the tariff on U.S. orange juice immediately.

We found evidence suggesting that the KORUS-FTA significantly increased imports for U.S. orange juice while decreasing imports for Brazilian products. U.S. orange juice is the least sensitive to price changes, suggesting a stable relationship with South Korea, whereas imports from other countries (ROW) are the most price sensitive, suggesting an opportunity for these countries to gain market share by decreasing prices. U.S. orange juice mostly competes with products from Brazil and ROW, and competition from other countries could be further strengthened. South Korea imports orange juice from various countries, including Turkey, Spain, and Australia. For example, the value of orange juice imported from Spain increased from $51,000 in 2014 to $884,000 in 2015 (KITA, 2016). Although this is relatively small compared to the United States with $26.97 million in 2015, it demonstrates the ability of other countries (ROW) to change their position in the market. Also, the free trade agreement between South Korea and Australia (KAFTA) will eliminate the 54% tariffs on orange juice imported from Australia over five years by 2018 (Growder, 2016), another example of potential competition from ROW. Moreover, when the price of U.S. orange juice increases, a larger proportion of consumers would switch to orange juice imported from Brazil or ROW than vice versa. These results suggest that even though the United States has surpassed Brazil to become the main supplier of orange juice in South Korea thanks to the KORUS-FTA, this position could be challenged by lower juice price from other countries. Remaining competitive is critical to the

U.S. orange juice industry, as the continuous reduction in harvested oranges due to citrus greening in the United States may lead to higher prices.

Expenditure elasticities explain the relationship between imports and total expenditure for each country of origin. Orange juice imported from Brazil is found to be the most sensitive subject to the changes of total expenditure on imported orange juice, suggesting that Brazil would be hurt the most if the total expenditure on imported orange juice decreases. Imports from the United States would suffer slightly less reduction in demand than would Brazil, but the reduction would be much larger than for imports from Israel and ROW, once the total expenditure on orange juice declines.

The welfare analysis shows that the KORUS-FTA would increase U.S. supplier welfare and trade value by about $4 million and $1.62 million, respectively. Although the shrinking domestic supply would hurt U.S. suppliers in the real market, they are still better off because the welfare gain from the FTA.

In sum, this study provides evidence that U.S. orange juice exporters have significantly benefited from the KORUS-FTA. However, the ongoing spread of citrus greening in the United States and changes in consumers' perceptions and tastes worldwide may enhance competition from other countries, which are critical challenges for the U.S. orange juice industry.

References

Arnade, C., M. Gopinath, and D. Pick. 2011. How Much Do Consumers Benefit from New Brand Introductions? The Case of Potato Chips. *Journal of Agricultural and Resource Economics* 36: 79-93.

Deaton, A.S. and J. Muellbauer. 1980. An Almost Ideal Demand System. *American Economic Review* 70: 31-326.

Gould, B.W., T.L. Cox, and F. Perali. 1991. Demand for Food Fats and Oils: The Role of Demographic Variables and Government Donations. *American Journal of Agricultural Economics* 73(1): 212-221.

Growder, M. 2016. *Citrus in Australia's Free Trade Agreements*. Available at: https://www.citrusaustralia.com.au%2F_literature_211549%2FMarket_Outlook_16_Michael_Growder [accessed August 1, 2016].

Heng, Y., H. Kim, and L. House. 2017. An Overview of the Grapefruit Market in South Korea. Available at: https://edis.ifas.ufl.edu/pdffiles/FE/FE100300.pdf[accessed March 1, 2017].

Jones K.G. and D. Blayney. 2014. Assessing Changes in Dairy Product Import Demand: The Case of South Korea with Implementation of the KORUS FTA. *Agribusiness* 30(1): 74-84.

Korea International Trade Association (KITA). 2016. K-Statistics. Available at: http://www.kita.org/kStat/byCom_AllCount.do [accessed April 1, 2016].

Kuchler, F. amd C. Arnade. 2016. Consumers' Welfare and Off-Season Produce Imports. *European Review of Agricultural Economics* 43(4): 585-608.

Lee, J.Y., J. L. Seale, and P.A. Jierwiriyapant. 1990. Do Trade Agreements Help US Exports? A Study of the Japanese Citrus Industry. *Agribusiness* 6(5): 505-514.

Lemieux, C.M. and M.K. Wohlgenant. 1989. Ex Ante Evaluation of the Economic Impact of Agricultural Biotechnology: The Case of Porcine Somatotrophin. *American Journal of Agricultural Economics*. 71: 903-914.

Liu, Y, R.L. Kilmer, and J.Y. Lee. 2007. Canadian Orange Juice Imports and Production Level Import Demand. *Journal of Agribusiness* 25(1): 17-29.

Moon, H.P., H.K.Lee, and H.U.Park. 2013. Impacts of The KORUS FTA's Orange Import Tariff-Cut on Domestic Fruit Prices. *Journal of Rural Development* 54(1): 15-38.

Muhammad, A. 2013. Estimating Import Demand in the Presence of Seasonal Trade and Unobserved Prices. *Applied Economics Letters* 20: 446-451.

Riguelm, A.R. and C.A.Wolf. 2008. Source Differentiated Mexican Dairy Import Demand. *International Food and Agribusiness Management Review* 11(1): 35-50.

U.S. International Trade Commission. 2012. *Certain Orange Juice from Brazil*. Available at: https://www.usitc.gov/publications/701_731/pub4311.pdf [accessed September 20, 2016].

USDA_ERS. 2012. *Fruit and Tree Nuts Outlook*. Available at: http://www.ers.usda.gov/media/970458/fts354.pdf [accessed April 1, 2016].

USDA-ERS. 2015a. *South Korea: Trade*. Available at: http://www.ers.usda.gov/topics/international-markets-trade/countries-regions/south-korea/trade.aspx [accessed April 30, 2016].

USDA-ERS. 2015b. *Specialty & Processed Product Markets*. Available at: http://www.ers.usda.gov/topics/international-markets-trade/countries-regions/south-korea/specialty-processed-product-markets.aspx [accessed April 30, 2016].

USDA-ERS. 2016. *Fruit and Tree Nut Data*. Available at: http://www.ers.usda.gov/data-products/fruit-and-tree-nut-data/data-by-commodity-imports-and-exports.aspx?reportPath=/TradeR3/TradeTables&programArea=fruit&stat_year=2009&top=5&HardCopy=True&RowsPerPage=25&groupName=Citrus&commodityName=Oranges#Pc4071be3cfd84ae7b494255ddd83e9df_2_652 [accessed September 20, 2016]

USDA-FAS. 2014. *Gain Report: KS1451*. Available at: http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Fruit%20Juice_Seoul%20ATO_Korea%20-%20Republic%20of_12-16-2014.pdf [accessed August 1, 2016].

USDA-FAS. 2016. *Citrus: World Markets and Trade*. Available at: https://apps.fas.usda.gov/psdonline/circulars/citrus.pdf [accessed August 1, 2016].

Wakamatsu. H. and T. Miyata. 2016. Examining the Japanese Seaweed Market Before and After the Earthquake using a Partial Adjustment Model of LA-AIDS. *Fisheries Science* 82: 549-559.

Yang, S.R. and W.W. Koo. 1994. Japanese Meat Import Demand Estimation with the Source Differentiated AIDS Model. *Journal of Agricultural and Resource Economics* 19(2): 396-408.

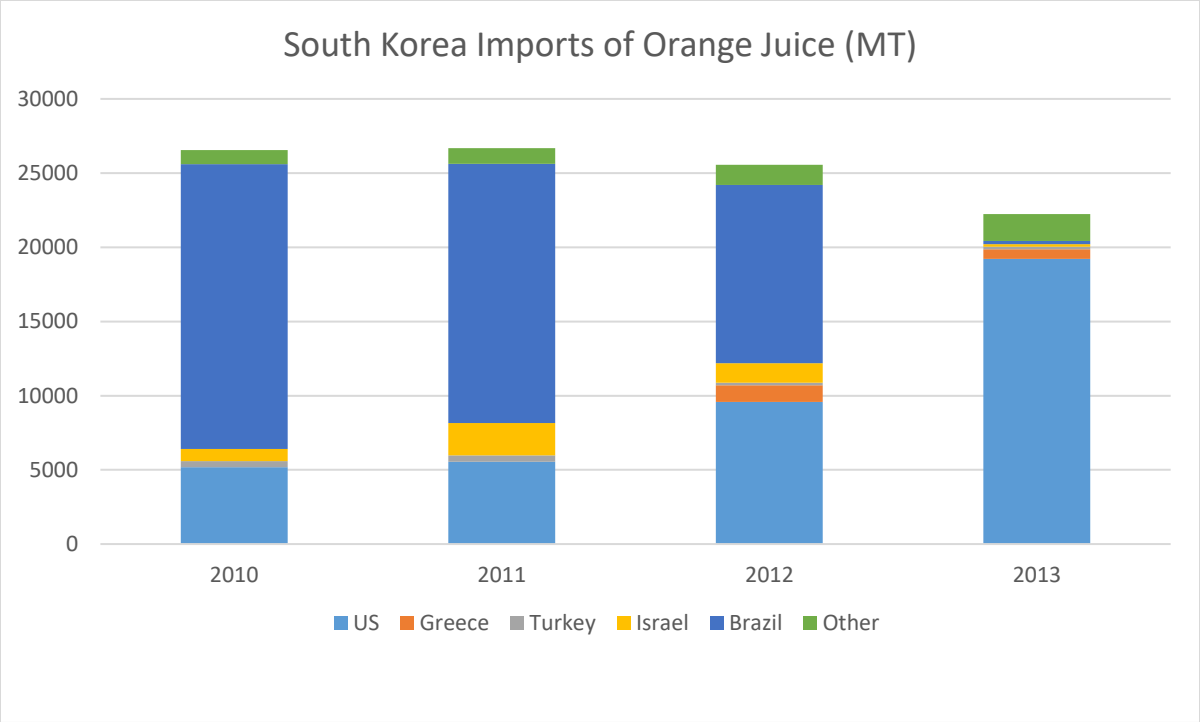

Figure 1. South Korea imports of orange juice (MT)

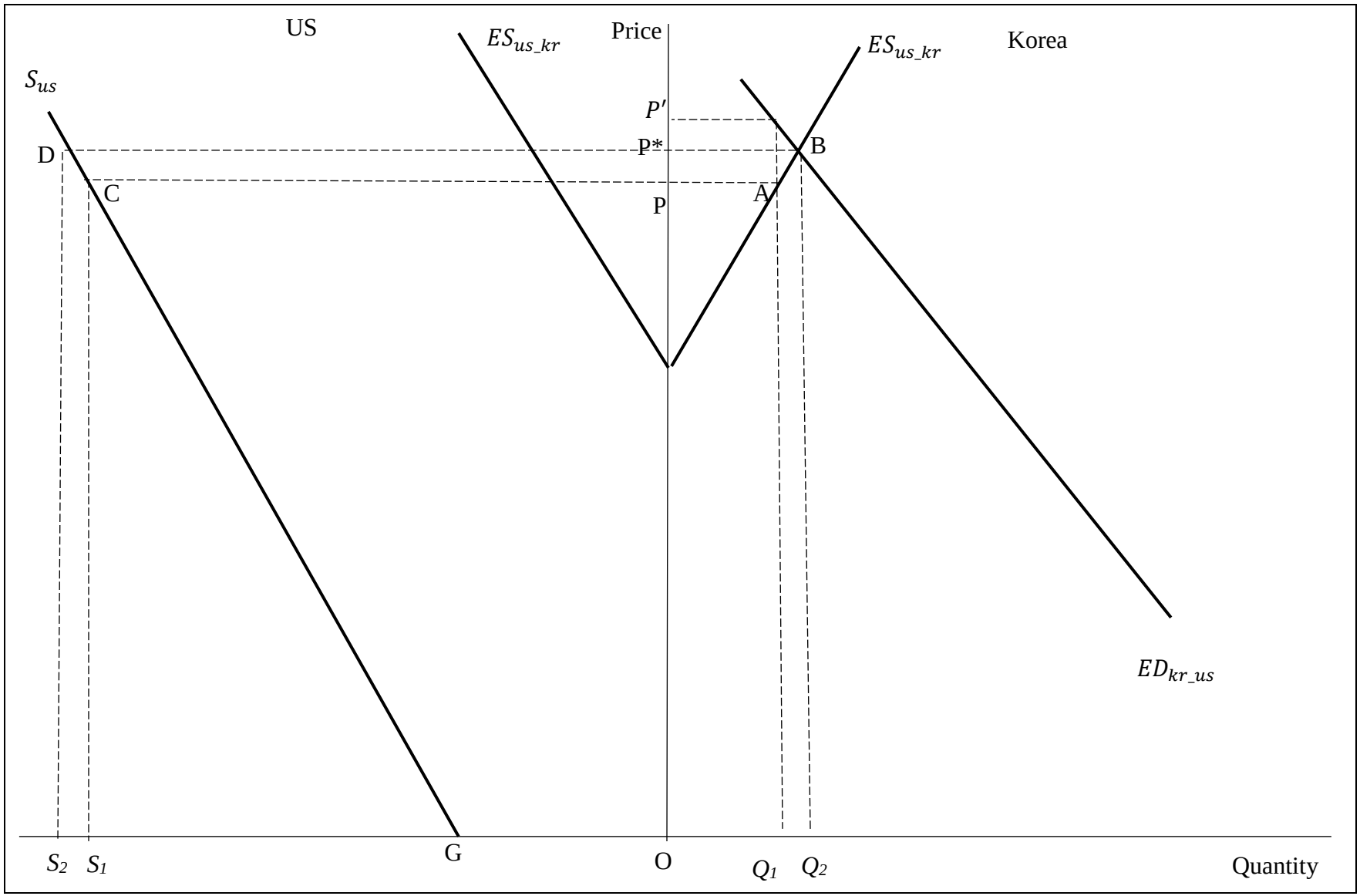

Figure 2. Effects of KROUS FTA on U.S. orange juice suppliers' welfare and trade value

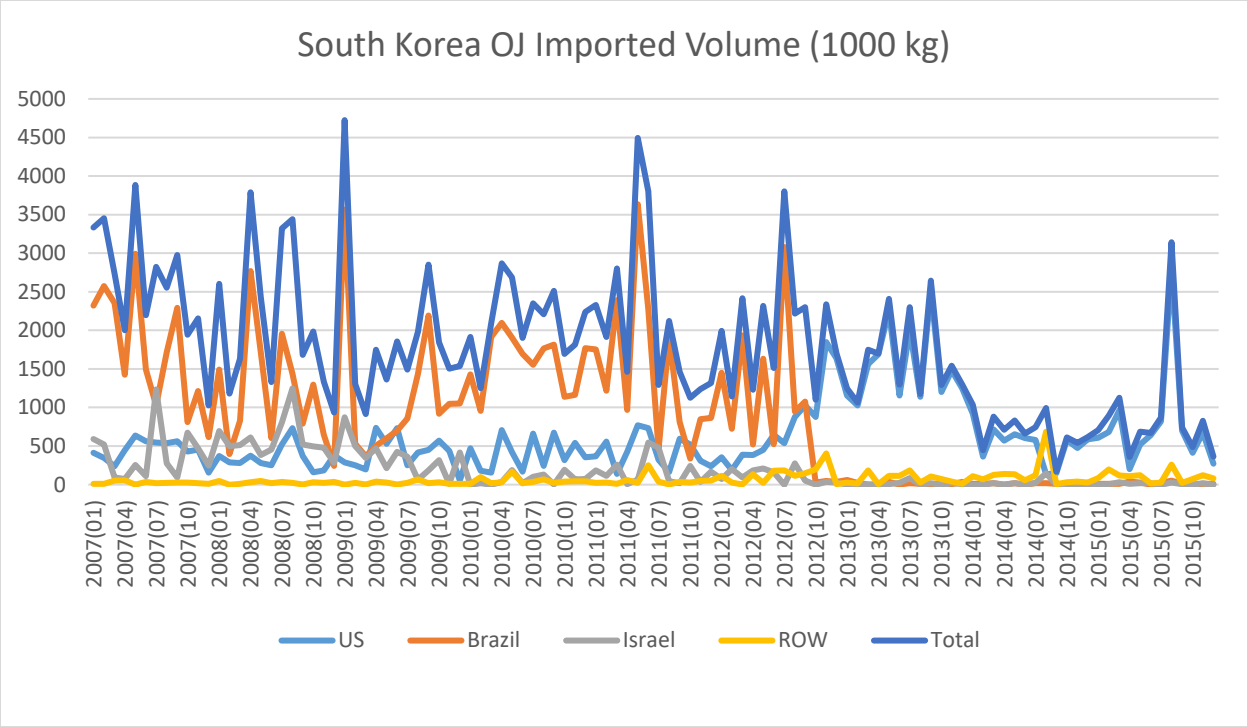

Figure 3. South Korea orange juice imports by sources

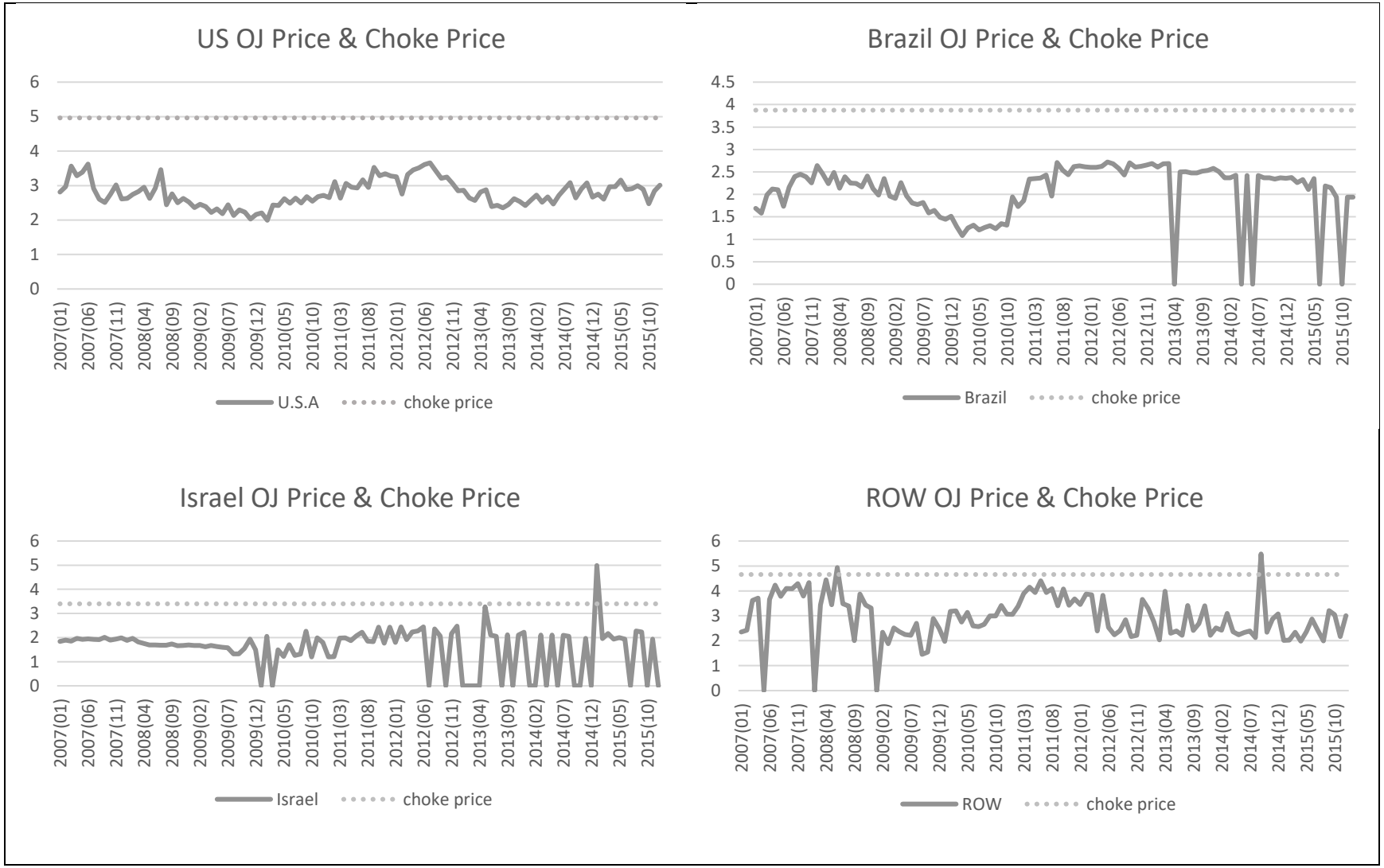

Figure 4. Observed monthly prices and choke prices

Table 1. Summary statistics for South Korea monthly orange juice imports by source

Variable	Mean	Std.Dev	Max	Min
Quantity (1,000kg)				
United States	627.17	498.02	2802.47	55.51
Brazil	907.18	917.99	3634.77	0
Israel	191.03	256.13	1247.09	0
ROW	67.41	89.95	686.60	0
Price ($1,000/1,000kg)				
United States	2.79	0.38	3.66	1.99
Brazil	2.08	0.62	2.72	0
Israel	1.57	0.87	4.98	0
ROW	2.93	0.92	5.48	0

Table 2. Estimation results from LA-AIDS demand model (standard error)

Variable	U.S. Share	Brazil Share	Israel Share	ROW Share
$Intercept$	0.50**	-0.48**	0.52***	0.46***
	(0.25)	(0.24)	(0.13)	(0.12)
$Time\ Trend$	0.001	0.001	-0.002***	0.0002
	(0.001)	(0.001)	(0.001)	0.0005
FTA	0.36***	-0.36***	-0.001	0.001
	(0.06)	0.06	0.031	0.033
lnp_{us}	-0.16*	0.04	0.02	0.10**
	(0.08)	(0.06)	(0.04)	0.04
lnp_{br}	0.04	-0.10	0.07**	-0.02
	(0.06)	0.07	0.03	(0.03)
lnp_{is}	0.02	0.07**	-0.07**	-0.03
	(0.04)	0.03	(0.03)	(0.02)
lnp_{row}	0.10**	-0.02	-0.03	-0.05*
	0.04	(0.03)	(0.02)	(0.03)
$lnXP$	-0.04	0.12***	-0.05**	-0.03**
	(0.03)	0.03	(0.02)	(0.02)
$Cosine$	0.01	-0.003	0.001	-0.01
	(0.02)	(0.02)	(0.01)	(0.01)
$Sine$	-0.01	0.02	-0.01	0.003
	(0.02)	(0.02)	(0.01)	(0.01)
R^2	0.80	0.79	0.51	

Note:*denotes significance at 10%, ** denotes significance at 5%, and *** denotes significance at 1%.

Table 3. Expenditure and price elasticities of demand for imported orange juice by source (standard error)

Variable	U.S. Price	Brazil Price	Israel Price	ROW Price	Expenditure
U.S. Quantity	-0.84***	0.46***	0.12	0.25**	0.91***
	(0.18)	(0.13)	(0.08)	(0.08)	(0.06)
Brazil Quantity	0.60***	-0.89***	0.28**	0.01	1.32***
	(0.17)	(0.19)	(0.09)	(0.08)	(0.08)
Israel Quantity	0.74	1.30**	-1.81***	-0.23	0.42**
	(0.45)	(0.41)	(0.37)	(0.26)	(0.20)
ROW Quantity	2.11**	0.09	-0.33	-1.88***	0.49*
	(0.66)	(0.54)	(0.37)	(0.53)	(0.27)

Note: *denotes significance at 10%, ** denotes significance at 5%, and *** denotes significance at 1%.

Appendix

Table A.1. Iteration procedure of generating choke prices (uncompensated elasticity)

Iteration	Country	Starting Elasticity	Choke Price	Ending Elasticity	Difference
0	U.S.	-1.000	5.571	-1.267	-0.267
	Brazil	-1.000	4.150	-1.378	-0.378
	Israel	-1.000	3.148	-1.831	-0.831
	ROW	-1.000	5.852	-1.891	-0.891
1	U.S.	-1.267	4.983	-1.280	-0.012
	Brazil	-1.378	3.912	-1.390	-0.012
	Israel	-1.831	3.335	-1.842	-0.011
	ROW	-1.891	4.722	-1.907	-0.016
2	U.S.	-1.280	4.962	-1.280	0.000
	Brazil	-1.390	3.880	-1.391	-0.001
	Israel	-1.842	3.381	-1.842	0.000
	ROW	-1.907	4.660	-1.906	0.001
3	U.S.	-1.280	4.962	-1.280	0.000
	Brazil	-1.391	3.875	-1.391	0.000
	Israel	-1.842	3.395	-1.842	0.000
	ROW	-1.906	4.658	-1.906	0.000
4	U.S.	-1.280	4.962	-1.280	0.000
	Brazil	-1.391	3.875	-1.391	0.000
	Israel	-1.842	3.399	-1.842	0.000
	ROW	-1.906	4.659	-1.906	0.000