Vol. 02, No. 03: June (2014)

Journal of Economic & Financial Studies

Open access available at http://journalofeconomics.org

Implications of the US -South Korea free trade agreement on agricultural exports from the US✧

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H I G H L I G H T S:

1. We study the impact of S. Korea – US Free Trade agreement (KORUS) on California's agricultural exports.
2. Import demand estimation methodology is appropriate for an ex-post analysis is utilized in this study.
3. KORUS has implications on market access in S. Korea for agricultural products from various other countries.
4. Results reveal that California's agricultural exports will now become more competitive in S. Korea.

Article History

Received: 25-05-2014
Accepted: 23-06-2014
Available online: 26-06-2014

Keywords:
Free trade agreement;
KORUS;
Market access.

JEL Classification:
Q1; F1; F6.

ABSTRACT

The United States-S. Korea Free Trade Agreement (KORUS FTA) became effective in 2012 and is expected to create new opportunities and improve access for one another's markets. It is expected to benefit the US agricultural sector particularly as S. Korea maintains high trade barriers for agricultural imports. This paper analyses the impact of KORUS FTA on the agricultural exports from the US with an example of table grapes. The results obtained by using the Import demand estimation method show that table grape exports will become more competitive in S. Korea due to the KORUS FTA. The paper also calculates preference indices for various agricultural imports from the US and rest of the world before and after the free trade agreement in S. Korean agricultural markets. This will help in understanding the implications of KORUS FTA not only on the US-S. Korean agricultural trade, but also between S. Korea and the rest of the world.

DOI: http://dx.doi.org/10.18533/jefs.v2i02.61

1.0 Introduction

The United States has Free Trade Agreements (FTAs) in force with as many as twenty countries since its first FTA with Israel in 1985. A free trade agreement (FTA) is an agreement between the countries party to that agreement to remove trade barriers such as tariffs and import quotas (Urata, 2002). Along with the elimination of trade barriers, some of the recent FTAs also incorporated rules governing foreign direct investment, intellectual property rights protection, environmental and labor issues, etc., in their agreements (Cooper, 2014). The FTAs not only help in the expansion of the markets but also aid in creating greater competition leading to more efficiency and better growth of the economies of the participating countries (Urata, 2002). There have been many studies that analyzed the impact of FTAs on their member countries. It has been found that on average, an FTA approximately doubles two

✧ A working paper version of this manuscript was first made available at http://www.fresnostate.edu/jcast/cab/documents/Implications%20of%20the%20South%20Korea.pdf

countries bilateral trade after ten years (Baier and Bergstrand, 2006). Many other studies also found a significant effect of economic integration on trade flows among member countries (Abramis, 1980; Brada and Mendez, 1985).

Out of all the FTAs that the US has signed, the North American Free Trade Agreement (NAFTA) in 1994 has created the largest FTA in the world. Due to this agreement, the U.S. agricultural exports to NAFTA countries increased by an annual average of 9.5 percent compared to a 2.8 percent annual increase to its non-NAFTA partners between 1993 and 1998 (Burfisher, Robinson and Thierfelder, 2001). Later, the US signed the Central American Free Trade Agreement (CAFTA) in 2004 with five countries among many other FTAs with countries as Australia, Peru, Chile, etc. The latest one that the US signed was with South Korea, which was called as United States-Korea Free Trade Agreement (KORUS FTA) and was signed on June 30, 2007. The agreement became effective on March 15, 2012 creating new opportunities to many sectors in S. Korea and the US by improving access to one another's markets. S. Korea is already the seventh largest trading partner for the US since 2004, and its position is bound to strengthen much further because of the KORUS FTA. In 2012, the total US exports to S. Korea stood at $42b whereas imports are $62b, thereby having an overall trade deficit with S. Korea. However if we take only the food and agricultural sectors, the US has a trade surplus of about $5.9b before the KORUS FTA came into existence (US Census Bureau, 2014). In this context, although the KORUS FTA will lower the trade barriers between the two countries in all sectors of trade, the US agricultural sector is expected to benefit significantly as S. Korea maintained high trade barriers for agricultural imports. According to the US International trade Commission, KORUS FTA is estimated to increase the US agricultural exports to Korea by minimum $1.9 billion upon full implementation of the agreement.

This paper analyses the impact of KORUS FTA on the agricultural exports from the state of California in the United States. The paper explains the schedule for removing tariffs on major agricultural exports from California and how it may benefit California exporters in S. Korean markets. The paper uses the example of Table grapes and analyses the impact of KORUS FTA on both the US and S. Korea. The second section explains the relevance of KORUS FTA for California agriculture and types of market access it will get in S. Korea. The third section explains the methodology for determining preferential indices for US agricultural products before and after KORUS FTA. The fourth section analyzes the results of that analysis. The paper concludes with the table grape sector and how it is impacted in both S. Korea and the US due to KORUS FTA.

1.01 Importance of KORUS FTA

Before KORUS FTA was signed, the US had Free Trade Agreements with 11 countries, whereas S. Korea has FTAs with six countries and is a member of the ASEAN group of nations. According to the U.S. Department of Commerce, the KORUS FTA is estimated to increase US merchandise exports by nearly $11 billion annually. It is also expected to improve the US market share in the S. Korean market, currently the third largest import supplier. U.S. exports face an average 6.2 percent tariff on goods they export to S. Korea. Following the KORUS FTA, tariffs will be eliminated on over 95 percent of US exports of consumer and industrial products within five years. Elimination of tariffs took place immediately for two-thirds of agricultural goods after the agreement was implemented (USTR, 2012). The U.S. exported about $6.9 billion worth agricultural products to S. Korea in 2011. The major products include the red meat products, food and feed grains and fruits and fruit preparations. The value of selected agricultural product imports by S. Korea and the share of the U.S. and other competitors are given in the below table 01.

The KORUS agreement is expected to have a positive impact for California as many of the products produced in the state are exported to S. Korea. The agreement is expected to open up new markets for key sectors of California like computers and electronic products, agricultural products, machinery manufacturing and transportation equipment. The KORUS FTA will eliminate tariffs and other barriers on a range of California's agricultural products, including dairy, beef, vegetables, fruits and tree nuts. S. Korea agricultural exports to US may be less effected by of the KORUS FTA, but it is expected to have a positive impact for other sectors such as automobiles and other machinery goods.

Table 01: Value of S. Korean imports and shares of US and other competitors, 2011

Commodity	S. Korea's Imports ($m)	Share of U.S. (%)	Other Competitors and their share (%)
Beef and Products	1522	39	Australia (51), ROW (10)
Dairy	610	26	EU (26), New Zealand (16), ROW (32)
Cotton	855	47	Brazil(34), Australia (14), ROW (5)
Wine	132	8	EU (58), Chile (22), ROW (12)
Oranges	170	95	Chile (3), ROW (2)
Table Grapes	115	13	Chile (87)
Rice	124	32	NA
Almonds(Shelled)	85	99	Chile (1)
Walnuts (Shelled)	81	100	-
Orange Juice	66	25	Brazil (62), ROW (13)

Cherries	48	95	New Zealand (3), ROW (2)
Tomatoes, processed	35	34	China (34), EU (23), ROW (9)
Grape Juice	11	92	Israel (8)
Raisins	10	94	Chile (4), ROW (2)
Lemons	10	85	Chile (14), ROW (1)

Source: WTO database, 2013

In 2011, the total value of agricultural exports from California to S. Korea was about $781 million (See table 2). S. Korea is the sixth largest destination for California exports, constituting about five percent of total exports in 2011. Agricultural exports from California to S. Korea increased by 35 percent in 2011 compared to 2010. Among all the agricultural exports from California to S. Korea, oranges and orange products ranked first followed by rice, beef, almonds and walnuts respectively (other products can be seen in the table 2 below.) Agricultural exports, which have shown very high growth rates, over 60 percent in 2011 over the previous year, include rice, dairy products, cotton, pistachios, prunes and strawberries. The value of the exports of each of the above products is more than $2 million.

Table 02: Agricultural Exports from California to S. Korea, 2011

Commodity	Exports ($m)	Growth over previous year (%)	Rank among all destinations*
Total	781.4	35	6
Oranges and products[3]	153.0	33	23
Rice	123.9	68	14
Beef and products[5]	97.4	28	27
Almonds	84.3	32	-
Walnuts	84.2	27	8
Dairy and products[2]	66.7	67	-
Cotton[2]	46.1	80	11
Hay	34.4	-4	17
Table Grapes	13.8	59	-
Tomatoes, Processed	12.1	-10	-
Raisins	10.0	20	-
Wine	9.9	1	-
Cherries	9.3	-11	9
Lemons	8.6	40	-
Pistachios	7.2	109	-
Prunes	4.8	125	-
Grape Juice	4.3	-36	11
Strawberry	2.4	195	-

*Ranks were given where they were available
Source: CDFA Statistics

Lee and Sumner (2011) have categorized how the KORUS FTA creates more market access for agricultural products. They identified four mechanisms: *(1) the immediate opening of certain markets without restrictions (2) the phase-out of tariffs over a specified number of years (3) the expansion of tariff rate quotas with the phase out of over quota tariffs and (4) the imposition of safeguard measures.* Safe guard measures are basically a quantity or price triggers, which once reached, additional duties are imposed to give protection to domestic farmers. The table 3 shows the base tariff levels and number of years it takes for them to go to zero for major agricultural exports from California to S. Korea. With the advent of KORUS FTA, the agricultural product exporters in California may also overcome some of the competition from Chile, which has had a FTA with S. Korea (Lee and Sumner, 2009). It may also improve the competitiveness of US exporters compared to S. Korean domestic producers especially in table grapes and rice, where import barriers were quite high.

2.0 Materials and methods

The most important provisions in KORUS FTA are those that increase market access. The farmers in California will be better able to sell into markets that reduce barriers, and S. Korea will have greater access to California markets and as well as markets of other states of US. Along with tariff cuts there are other aspects of market access such as relaxation of tariff rate quotas where they exist and other conditions that affect the cost of selling into a foreign market or that influence the costs of others selling into domestic markets.

The impact of an FTA is in essence to change the tariff heading for goods coming from a particular country. In the simplest example, consider a country with a two-part tariff schedule: one 'column' for preferred partners, say in a free trade area, and one for all other WTO members (MFN schedule). Entry into a free-trade area with a country moves the applicable tariff from the MFN column into the tariff-free column. The impact of that on market access will depend on (a) how competitive the newly preferred supplier is relative to other suppliers, both preferred and

non-preferred; (b) how great the degree of preference implied by the free trade area is; and (c) how much export capacity the newly-preferred country has. With a high degree of preference, only the low cost suppliers will be able to make use of the new market opportunities.

To understand the impact on potential imports into the US can be best judged by comparing access for S. Korea before and after the KORUS FTA. But, for this potential impact to be realized, there has to be capacity in S. Korea to expand exports. To conduct an analysis would require detailed investigation of the possibilities for investment and expansion in these sectors and the competitiveness of such new production. Such an analysis is beyond the scope of this study.

With respect to market access in S. Korea, the goods from the U.S. gain preference relative to those countries that do not have a free trade arrangement with S. Korea. This means that the competitiveness will be a function of the current trade agreements that S. Korea has with other countries. The California suppliers, along with those in other states, would move (over a transition period) from supplying at MFN tariffs to having duty-free access. The advantage of this depends on which other suppliers already enjoy such privileges and whether the US more competitive than the other suppliers.

The effective impact of KORUS FTA in providing additional export market opportunities for California agricultural products will be a change in the additional preferences that California gains for its exports to S. Korea relative to its competitors. In general terms, the gains in preference that will result from KORUS FTA can be illustrated in terms of where US goods will fit in the basic tariff access structure currently in place. For example, the three major categories used to describe the level of access afforded to exporting countries to S. Korea, in order of preference, are (1) duty free, where imports enter S. Korea with zero tariff (2) preferred access, where imports enter S. Korea with a tariff less than those of other countries and (3) most favored nation status, where imports enter S. Korea with tariffs equal to those of all other countries not included in the first two categories. In this format the potential benefits for California agricultural products will be where they shift to a higher preference category.

In order to gain a more precise understanding of what benefits may accrue to California agricultural product exporters, as a result, of KORUS FTA, a detailed analysis of the specific changes in tariffs currently in place for those products is necessary. This paper follows the methodology followed by Paggi, et al. (2005) in calculating the impact of Central America Free Trade Agreement (CAFTA) on US agricultural trade. The methodology calculates preference indices for three countries with different types of market access. It assumes that three exporters serve one import market. Let us consider the case of KORUS FTA by considering three countries: Country A, United States, and Rest of the World (ROW). Country A has a free trade agreement with S. Korea and faces zero tariff rates; the United States faces an MFN rate before the free trade agreement ($TAus^0$) but free trade access after KORUS FTA ($TAus^1$), and the ROW faces the MFN tariff levels.

A detailed derivation of the preference indices for the three types of countries relative to one another is given in Appendix A. From the results of the derivation, before the KORUS FTA, preference index for the US relative to country A ($\Theta us^0 a$) and the ROW ($\Theta us^0 row$) is expressed as the following:

$$\Theta us^0 a = \frac{Mus^0 a}{Nus^0} = Pd\left(\frac{1}{1+TAus^0} - 1\right) * \left(\frac{1+TAus^0}{Pd}\right) = -TAus^0 \quad \text{…… … … … . Eq. 1}$$

$$\Theta us^0 row = \frac{Mus^0 row}{Nus^0} = Pd\left(\frac{1}{1+TAus^0} - \frac{1}{1+TArow}\right) * \left(\frac{1+TAus^0}{Pd}\right) = 0 \quad \text{… … … … … … Eq. 2}$$

After KORUS FTA, they are:

$$\Theta us^1 a = \frac{Mus^1 a}{Nus^1} = \left(\frac{Pd - Pd}{Pd}\right) \text{… … … … … … … … . Eq. 3}$$

$$\Theta us^1 row = \frac{Mus^1 row}{Nus^1} = \left(1 - \frac{1}{1 + TArow}\right) \text{… … … … … … . . Eq. 4}$$

The above four indices are used to examine the preferences of the United States relative to other exporters for some of the California Agricultural products. An example is calculated in the footnote below[1] for Table grapes imported by S. Korea from Chile and the US. In the case of table grapes, KORUS FTA brings positive changes in the preferential index for the US by 45 percent relative to Chile, which has a duty free access with S. Korea due to FTA, and by 31 percent relative to those other exporters who face MFN tariff level. The results for the other commodities selected

[1] For example, S. Korea import table grapes with MFN rate of 45 percent. So, before KORUS FTA, the preference index for the US relative to country A with zero tariff ($\Theta us^0 a$) and the ROW, which faces an MFA rate ($\Theta us^0 row$), is expressed as the following:

$\Theta us^0 a = \frac{Mus^0 a}{Nus^0} = Pd\left(\frac{1}{1+0.45} - 1\right) * \left(\frac{1+0.45}{Pd}\right) = -0.45 = -TAus^0$ and $\Theta us^0 row = \frac{Mus^0 row}{Nus^0} = 0$, since $TAus^0 = TArow$`

After KORUS FTA they are $\Theta us^1 a = \frac{Mus^1 a}{Nus^1} = \left(\frac{Pd-Pd}{Pd}\right) = 0$ and $\Theta us^1 row = \frac{Mus^1 row}{Nus^1} = \left(1 - \frac{1}{1+0.45}\right) = 0.31$

for analysis are presented in table 3. The preferential index of US/MFN after KORUS agreement is implemented shows that the US exporters enjoy a considerable advantage over other exporters with MFN tariffs.

Table 03: Estimated Preference Indices for the Imports of Selected California Agricultural Products by S. Korea.

			Before KORUS		After KORUS		
Commodity	Base Tariff before KORUS FTA (%)	Number of years for complete tariff phase out	Index US/ Free	Index US /MFN	Index US/ Free	Index US /MFN	
Beef and Products	40	15	-40	0	0	28.6	
Dairy - Butter	89	TRQ	-89	0	0	47.1	
Dairy -Cheese	36	TRQ	-36	0	0	26.5	
Cotton	0	Immediate	0	0	0	0.0	
Wine	15	Immediate	-15	0	0	13.0	
Oranges	50	TRQ (In season); 6 (Off season)	-50	0	0	33.3	
Table Grapes	45	17 (In season); 4 (Off season)	-45	0	0	31.0	
Almonds(Shelled)	8	Immediate	-8	0	0	7.4	
Walnuts (Shelled)	30	6	-30	0	0	23.1	
Orange Juice	54	5	-54	0	0	35.1	
Cherries	24	Immediate	-24	0	0	19.4	
Tomatoes, processed	8	Immediate	-8	0	0	7.4	
Grape Juice	50	Immediate	-50	0	0	33.3	
Raisins	21	Immediate	-21	0	0	17.4	
Lemons	30	2	-30	0	0	23.1	
Pistachios(Shelled)	30	Immediate	-30	0	0	23.1	

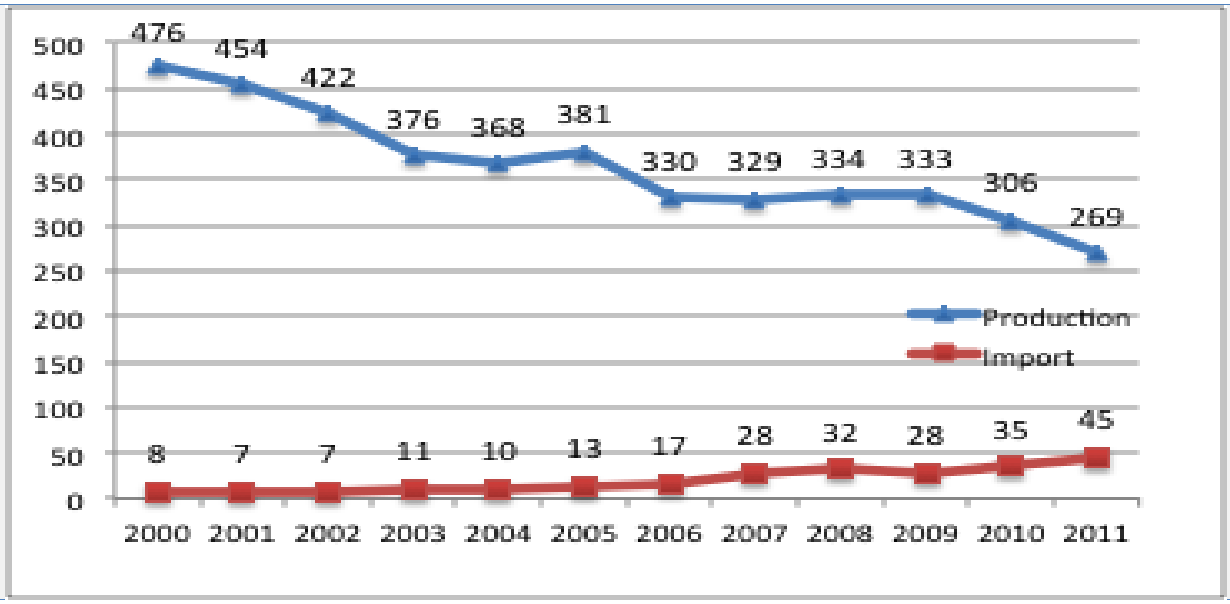
Source for Tariff values: USTR tariff schedule

In order to analyze the impact of KORUS FTA on table grape exports from the US, this paper uses the model of import demand estimation. The details of the model are explained in the next section.

3.0 Results and discussion

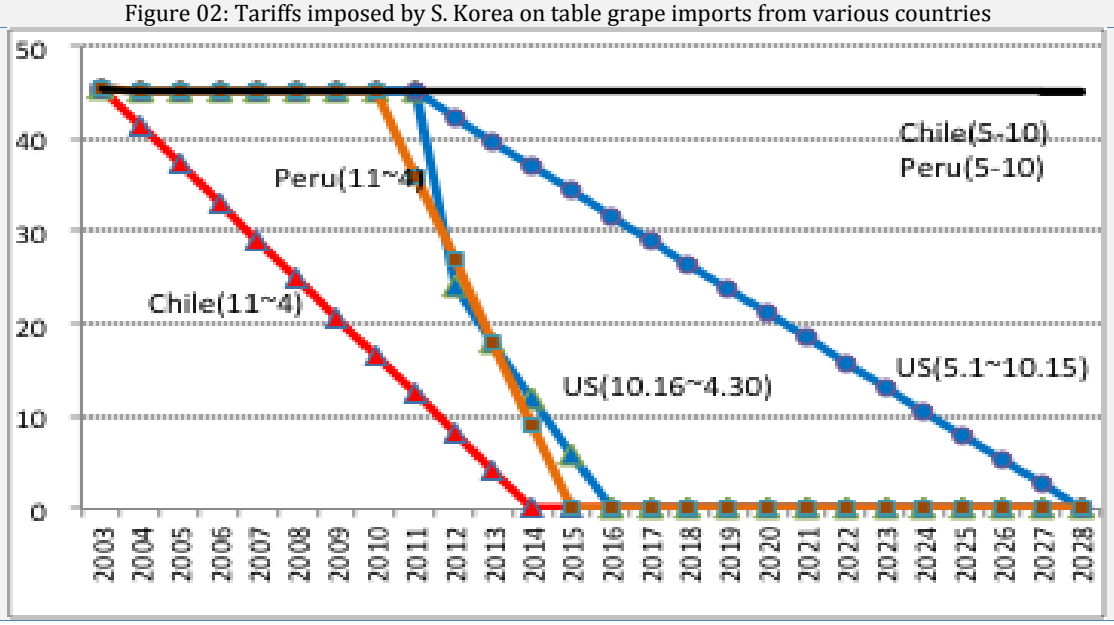
Among all the agricultural products that California exports to S. Korea, table grapes ranks among the top ten. Though it is small in terms of value compared to other major agricultural products, imports in the table grape constitute only a small percent of total consumption in S. Korea. Thus the potential for an increasing role for imports resulting from changes in existing trade barriers should be robust. In 2011, the table grape imports constituted only 16 percent of the domestic consumption (See figure 1). As the size of the domestic table grape sector is quite significant, S. Korea imposed a two-tier tariff structure for table grape imports. The tariff on 'in-season' grapes (May 1- Oct 15) is phased out over a period of 17 years, whereas the tariff on 'off-season' grapes (Oct 16- Apr 30) is phased out in 4 years (USTR Tariff Schedule, 2012). The tariff imposed on off-season grapes from Chile will be phased out completely by 2014 as the FTA with Chile started in 2003. The tariff on off-season grapes from Peru would be phased out by 2015, but the share of Peru is very little compared to that of from Chile and the US. With regard to the US, the tariff on in-season grapes will get phased out in 2028 and that of off-season grapes in 2016.

Figure 01: Domestic production and imports of table grapes in S. Korea (1000 MT)



The graph in figure 2 shows the phasing out of tariffs for both off-season and on-season table grapes.

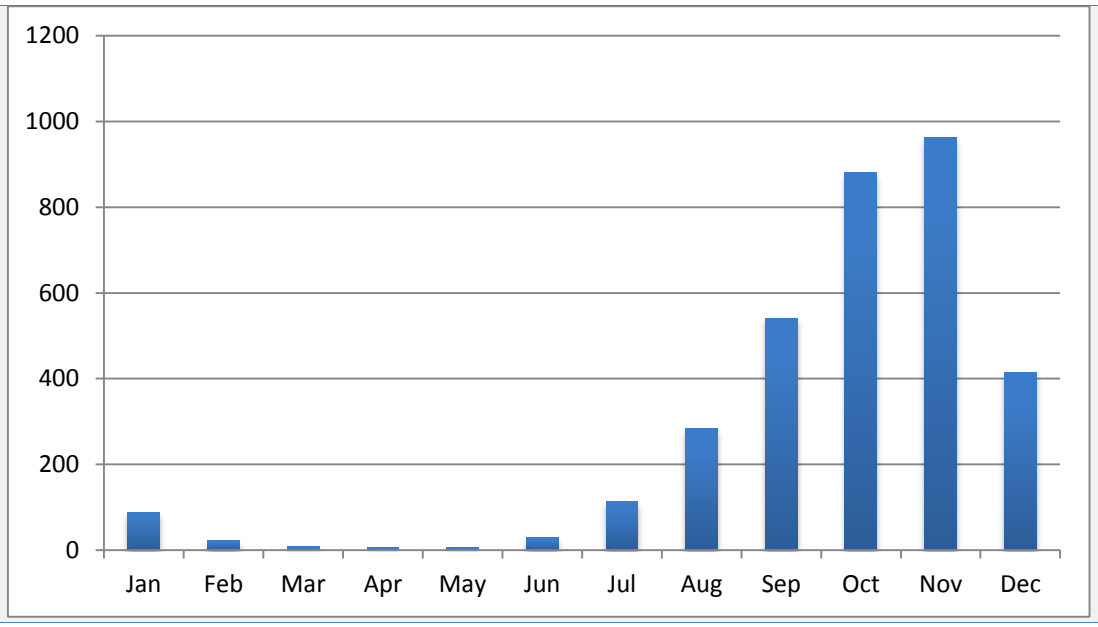
Figure 02: Tariffs imposed by S. Korea on table grape imports from various countries



The tariff on in-season grapes from Chile and Peru will not phased out as the two countries do not export much during the in-season period of S. Korea. As shown in Figure 3, the exports of table grapes from the US peak in the months of September to November. But, that is also the time, when higher amount of tariffs are imposed compared to other months. Taking the advantage of their location in the southern hemisphere, Chile captures the S. Korean market during the off-season period, leading the US in terms of total grape exports to S. Korea. In total, Chile captured 87 percent of the import market compared to only 13 percent by the US in 2011. Peru just started exporting grapes to S. Korea in 2011.

Within this context, this paper analyzes the impact of KORUS FTA on the table grape sectors of both S. Korea and the US. In order to measure the impact of FTA we generally use CGE model, gravity model, and import demand function approach (Heng and Suu, 2009).

Figure 03: Average monthly table grape imports from the US 2003-12 (MT)



Using a CGE model is not appropriate in our case here, as CGE model requires large amount of data due to large number of parameter requirements. On the other hand, the gravity model involves regressing trade flows on a series of explanatory variables, but Heng and Suu (2009) observe that there is not conclusive evidence as to what explanatory variables should be included in the gravity model based on economic theory. The third method and the one that will be used in this paper is the method using import demand functions to study the impact of KORUS FTA. The major advantage of this method is that extensive research has been done to specify the key determinants of import demand. Also, this method is more appropriate for an ex-post analysis as that of our study and also it requires lot less data compared to CGE model (Heng and Suu, 2009). In the case of KORUS FTA, as it is being implemented only in the last one year, there is lack of sufficient number of data points. So, the model of import demand estimation is highly suitable to follow in our study.

In this study the methodology for estimating the impacts of KORUS FTA on table grapes is revised from the approach followed by Choi, et al., (2009) and Kim and Choi (2007). The model assumes that the quantity of imports of the table grapes from the US (Q^f) is a function of price of US table grapes (P^f) price of grapes from rest of the world (P^{rw}), Price of domestic (S. Korea) grapes (P^d), price of substitute products (P^{rd}) and income of the country (M).

$$Q^f = f(P^f, P^{rw}, P^d, P^{rd}, M) \dots\dots\dots\dots\dots Eq.5$$

A detailed theoretical derivation of the demand, supply and cross price elasticity formulas and further derivation of the formulas for estimating price and quantity changes and the associated changes in value of imports are given in Appendix II. The results of the theoretical derivation are given below. The new equilibrium price and equilibrium quantity due to KORUS FTA are as follows

$$\Delta Q^d = \frac{1}{\eta^d}\Delta Q^d + \Delta TP^d = \left(\frac{\varepsilon^d\eta^d}{\eta^d - \varepsilon^d}\right)\frac{1}{\delta_d^f}\left[\delta_f^f\left(\frac{t}{1+t}\right)\Delta t\right] \dots\dots\dots\dots Eq.\ 6$$

$$\Delta P^d = \frac{1}{\varepsilon^d}\Delta Q^d = \frac{1}{\varepsilon^d}\left(\frac{\varepsilon^d\eta^d}{\eta^d - \varepsilon^d}\right)\frac{1}{\delta_d^f}\left[\delta_f^f\left(\frac{t}{1+t}\right)\Delta t\right] \dots\dots\dots\dots Eq.\ 7$$

The data for the estimation of impact of KORUS FTA is obtained from the database of Korea Agricultural Trade Information (KATI, 2013) and all the prices and GDP data were deflated by consumer price index (CPI). Some information on tariff profiles is also obtained from World Trade Organization's database on tariffs. The price elasticity of US imports and cross price elasticity are obtained from our own estimation results. The available estimates of domestic grape demand elasticity and domestic grape supply elasticity were incorporated in the estimation process. The estimation results and all the elasticity values are given in table 4 (a) and 4 (b) respectively.

Table 4(a): Results of the S. Korean Table Grape Import Demand Estimation

	Coeff.	t-value	P>t
Domestic Grape price	0.52	0.28	0.78
US Grape Price	-0.23	-2.69	0.01

Other Grape Price	0.19	2.22	0.03
Domestic other price	5.43	1.46	0.15
GDP	0.01	2.31	0.03
Constant	-2583.91	-1.69	0.1
R square = 0.34; No of observations = 45			

Table 4 (b): Elasticity estimates

	Values
Price elasticity of US imports	-2.11
Cross price elasticity	0.14
Domestic demand elasticity	-0.51
Domestic supply elasticity	0.62

By using the above elasticity values and the formulas obtained from the theoretical derivation, we have estimated the impact of KORUS FTA on grape imports by S. Korea. It is estimated that in 2012, the grape imports have increased by 14 percent and the grape production in S. Korea decreased by 7.8 percent due to KORUS FTA. The results also show that in 2013 as the in-season and off-season tariffs get reduced to around 40 percent and 18 percent respectively, the imports from US may increase by 9.7 percent and production in S. Korea may decrease by 5.3 percent over previous year. The results confirm the expectations of the impact of KORUS FTA on US agricultural exports. As the tariffs get reduced to much lower levels in future, the impact is expected to be much higher than what our results show. Due to reduction in barriers, the table grape sector in S. Korea may initially face a negative impact leading to a reduction in production, but in the long term it is bound to perform well as it will become more efficient due to the global competition it faces.

4.0 Conclusion and policy implications

The results show that the KORUS FTA definitely creates opportunities for exporters of agricultural products from California. The lower barriers and eventual phasing out of tariffs on most products will create a very lucrative market for California agriculture. Along with the reduction of the tariffs, the relaxation of non-tariff barriers by means of simplification of rules and regulations, better and faster administrative procedures will also lead to increased exports from the US. Our analysis has also shown that the S. Korean grape sector will be decreasing its production due to more imports from the US, which may happen with many other agricultural products as well. This may be due to that the S. Korean agriculture is much smaller and much more protected and dependent on government support compared to that of US agriculture. But, by reducing the tariffs and other barriers as well, the S. Korean agriculture may become more competitive and more efficient than before. In order to understand the impact of KORUS FTA more effectively, similar analysis can be done on all major products after few more years of its implementation, as more data will be generated by that time.

The other major finding of this study is the advantage that the U.S. exporters may obtain due to the degree of preference that will be given to them compared to exporters from other countries. But, it difficult to quantify this advantage as it also depends on the marketing strategies of the exporters and not just on trade policies of the exporting countries.

It is expected that the success of KORUS FTA would definitely motivate countries to fast track free trade negotiations between Pacific Rim nations towards a much bigger multilateral free trade agreement called Trans-Pacific Partnership (TPP) and between the US and the European Union towards developing Transatlantic Trade and Investment Partnership (TTIP). Already, the US is pushing forward negotiations on these two free trade agreements, as they will lead to more interdependence between countries and integrated markets around the world.

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Appendix A

Derivation of Preference indices for three countries with different market access

In practice, a tariff is a tax on imports; the price a domestic purchaser pays for imported goods exceeds the amount the foreign exporter receives by the amount of tariff payment. For the simplest case of a specific tariff, the domestic price of importer (Pd) is expressed as Pd=N + T where N is the foreign price of some good (or net price) and T is the specific tariff levied upon it. Assume three exporters serve one import market. Exporter A has tariff free access, exporter B faces a reduced tariff (on a transition path to free access or with a preferential tariff rate) and C faces the MFN tariff levels.

If the domestic price in the importing country is Pd for all three suppliers, and the specific tariffs are Ta, Tb and Tc, then the net price (N) for the exporters is

$$Na = Pd - Ta = Pd$$
$$Nb = Pd - Tb$$
$$Nc = Pd - Tc$$

Thus the preference margins (where Mab is the margin for A relative to B) are

$$Mab = Na - Nb = Tb$$
$$Mac = Na - Nc = Tc$$
$$Mbc = Nb - Nc = (Pd - Tb) - (Pd - Tc) = Tc - Tb$$

As a proportion of net price, these are

$$Mab/Na = Tb/Pd$$
$$Mac/Na = Tc/Pd$$
$$Mbc/Nb = (Tc - Tb)/(Pd - Tb)$$

Alternatively, tariffs are often ad-valorem (TA) – a specified percentage of the price paid to the foreign exporter. In this case domestic price is: Pd = N (1+ TA), thus Pd consists of the payment to the foreigner, N, plus the import tax N*TA. When a tariff is ad-valorem, above expressions are changed to

$$Na = \frac{Pd}{(1+TAa)} = Pd$$
$$Nb = \frac{Pd}{(1+TAb)}$$
$$Nc = \frac{Pd}{(1+TAc)}$$

And the percentage margins are expressed as the following:

$$Mab = Na - Nb = Pd - \frac{Pd}{1+TAb} = Pd\left(1 - \frac{1}{1+TAb}\right)$$

$$Mac = Na - Nc = Pd - \frac{Pd}{1+TAc} = Pd\left(1 - \frac{1}{1+TAc}\right)$$

$$Mbc = Nb - Nc = \frac{Pd}{1+TAb} - \frac{Pd}{1+TAc}$$

As a proportion of net price, these are

$$Mab/Na = \left(1 - \frac{1}{1+TAb}\right)$$

$$Mac/Na = \left(1 - \frac{1}{1+TAc}\right)$$

$$\frac{Mbc}{Nb} = Pd\left(\frac{1}{1+TAb} - \frac{1}{1+TAc}\right) * \frac{1+TAb}{Pd} = 1 - \frac{1+TAb}{1+TAc}$$

These margins can be interpreted either as higher prices (more profits) for the preferred exporter or higher costs that would be offset by the preference (or combination of both). Similarly, a negative preference is the amount by which costs in B have to be less than in A to allow them to be competitive, or lower profit in that market. In this analysis we do not try to distinguish between the cost and profit interpretations. Thus the preference index would be the margin as a proportion (or percent) of the net price. This would vary by commodity and over time, and could in principle be calculated for nay pair of countries.

Let us denote the preference index as Θ then

$$\Theta ab = Mab/Na = \left(1 - \frac{1}{1+TAb}\right)$$

$$\Theta ac = Mac/Na = \left(1 - \frac{1}{1+TAc}\right)$$

$$\Theta bc = \frac{Mbc}{Nb} = Pd\left(\frac{1}{1+TAb} - \frac{1}{1+TAc}\right) * \frac{1+TAb}{Pd} = 1 - \frac{1+TAb}{1+TAc}$$

Let us consider the case of KORUS FTA by considering three countries: A, United States, and Rest of the World (ROW). Country A has a free trade agreement with S. Korea and faces zero tariff rate; the United States faces an MFN rate before the free trade agreement ($TAus^0$) but free trade access after KORUS FTA ($TAus^1$), and the ROW faces the MFN tariff levels. Thus, before the KORUS FTA, preference index for the US relative to country A ($\Theta us^0 a$) and the ROW ($\Theta us^0 row$) is expressed as the following:

$$\Theta us^0 a = \frac{Mus^0 a}{Nus^0} = Pd\left(\frac{1}{1+TAus^0} - 1\right) * \left(\frac{1+TAus^0}{Pd}\right) = -TAus^0 \text{ … … … … … … … … . Eq A 1.1}$$

$$\Theta us^0 row = \frac{Mus^0 row}{Nus^0} = Pd\left(\frac{1}{1+TAus^0} - \frac{1}{1+TArow}\right) * \left(\frac{1+TAus^0}{Pd}\right) = 0 \text{ … … … … … … … … . Eq A 1.2}$$

Since ($TAus^0$=TArow)

After KORUS FTA, they are

$$\Theta us^1 a = \frac{Mus^1 a}{Nus^1} = \left(\frac{Pd - Pd}{Pd}\right) \text{ … … … … … … … . Eq. A1.3}$$

$$\Theta us^1 row = \frac{Mus^1 row}{Nus^1} = \left(1 - \frac{1}{1+TArow}\right) \text{…… … … Eq. A1.4}$$

Appendix B

Theoretical derivation of elasticities and price and quantity changes

In this study, the methodology for estimating impacts of KORUS FTA on table grapes is revised from Choi, et.al.(2009)'s approach. Suppose an import demand function of Korea from the US is denoted as

$$Q^f = f(P^f, P^{rw}, P^d, P^{rd}, M) \text{…… Eq. A2.1}$$

Where Q^f=import quantity from the US, P^f= US price, P^{rw}=other country price, P^d= Korean domestic price, P^{rd}=Korean domestic substitute price, M =income (GDP)

By total derivative, we get

$$dQ^f = \frac{\partial Q^f}{\partial P^f}dP^f + \frac{\partial Q^f}{\partial P^{rw}}dP^{rw} + \frac{\partial Q^f}{\partial P^d}dP^d + \frac{\partial Q^f}{\partial P^{rd}}dP^{rd} + \frac{\partial Q^f}{\partial M}dM \ldots\ldots\ldots \text{Eq. A2.2}$$

It can be re-written in terms of the rate of change as follows

$$\frac{dQ^f}{Q^f} = \frac{\partial Q^f}{\partial P^f}\frac{dP^f}{Q^f} + \frac{\partial Q^f}{\partial P^{rw}}\frac{dP^{rw}}{Q^f} + \frac{\partial Q^f}{\partial P^d}\frac{dP^d}{Q^f} + \frac{\partial Q^f}{\partial P^{rd}}\frac{dP^{rd}}{Q^f} + \frac{\partial Q^f}{\partial M}\frac{dM}{Q^f} \ldots\ldots\ldots \text{Eq. A2.3}$$

$$\Rightarrow \frac{dQ^f}{Q^f} = \frac{\partial Q^f}{\partial P^f}\frac{P^f}{Q^f}\frac{dP^f}{P^f} + \frac{\partial Q^f}{\partial P^{rw}}\frac{P^{rw}}{Q^f}\frac{dP^{rw}}{P^{rw}} + \frac{\partial Q^f}{\partial P^d}\frac{P^d}{Q^f}\frac{dP^d}{P^d} + \frac{\partial Q^f}{\partial P^{rd}}\frac{P^{rd}}{Q^f}\frac{dP^{rd}}{P^{rd}} + \frac{\partial Q^f}{\partial M}\frac{M}{Q^f}\frac{dM}{M} \ldots\ldots\ldots\ldots \text{Eq. A2.4}$$

$$\Rightarrow \Delta Q^f = \delta_f^f \Delta P^f + \delta_{rw}^f \Delta P^{rw} + \delta_d^f \Delta P^d + \delta_{rd}^f \Delta P^{rd} + \delta_M^f \Delta M \ldots\ldots\ldots \text{Eq. A 2.5}$$

Where δ_f^f = own price elasticity of imports from US by a change of import price of the US,
δ_{rw}^f=cross elasticity of imports from US by the change of other country import price,
δ_d^f= cross elasticity of imports from US by the change of Korean domestic price,
δ_{rd}^f=cross elasticity of imports from US by change of Korean domestic substitute price,
δ_M^f=income elasticity of imports from US by the change of Korean domestic income,
Δ = rate of change.
The prices can be expressed with tariff or without tariff

$P_0^f = (1+t)P^f$ with tariff(t) ……. Eq A2.6

$P_1^f = P^f$ without tariff(full elimination of tariff)

When the tariff is fully eliminated, the change in the import price of table grapes from the US in Korea is as follows,

$$\frac{(P_1^f - P_0^f)}{P_0^f} = -\frac{t}{(1+t)} \ldots \text{Eq. A2.7}$$

So, the change in import volume due to change in tariff is

$$\Delta TQ^f = \delta_f^f \left[\left(\frac{t}{1+t}\right)\Delta t\right] \ldots \text{Eq. A2.8}$$

If other things are constant, Korean domestic price will be affected by the change in import volumes from the US. The change can be depicted as

$$\Delta TP^d = \frac{\Delta TQ^f}{\delta_d^f} = \frac{1}{\delta_d^f}\left[\delta_f^f \left(\frac{t}{1+t}\right)\Delta t\right] \quad \because \delta_d^f = \frac{\Delta TQ^f}{\Delta TP^d} \ldots\ldots \text{Eq. A2.9}$$

The change in imports also affects the domestic supply and demand in Korea.

Change in demand: $\Delta P^d = \frac{1}{\eta^d}\Delta Q^d + \Delta TP^d = \frac{1}{\eta^d}\Delta Q^d + \frac{1}{\delta_d^f}\left[\delta_f^f \left(\frac{t}{1+t}\right)\Delta t\right]$

Change in supply: $\Delta P^d = \frac{1}{\varepsilon^d}\Delta Q^d$

Where

η^d= own price elasticity of Korean domestic demand
ε^d=Korean domestic supply elasticity

The change in imports causes a shift in demand curve so that we can get a new equilibrium price and quantity, which are shown as:

$$\frac{1}{\varepsilon^d}\Delta Q^d = \frac{1}{\eta^d}\Delta Q^d + \frac{1}{\delta_d^f}\left[\delta_f^f \left(\frac{t}{1+t}\right)\Delta t\right] \ldots\ldots \text{Eq. A 2.10}$$

$$\Rightarrow \Delta Q^d = \frac{1}{\eta^d}\Delta Q^d + \Delta TP^d = \left(\frac{\varepsilon^d \eta^d}{\eta^d - \varepsilon^d}\right)\frac{1}{\delta_d^f}\left[\delta_f^f \left(\frac{t}{1+t}\right)\Delta t\right] \ldots\ldots \text{Eq. A2.11}$$

$$\Delta P^d = \frac{1}{\varepsilon^d}\Delta Q^d = \frac{1}{\varepsilon^d}\left(\frac{\varepsilon^d \eta^d}{\eta^d - \varepsilon^d}\right)\frac{1}{\delta_d^f}\left[\delta_f^f \left(\frac{t}{1+t}\right)\Delta t\right] = \left(\frac{\eta^d}{\eta^d - \varepsilon^d}\right)\frac{1}{\delta_d^f}\left[\delta_f^f \left(\frac{t}{1+t}\right)\Delta t\right] \ldots\ldots\ldots Eq.\ A2.12$$

From the change in Quantity and Price, we obtain the change in value of production

$$\Delta(Q^d P^d) = \Delta P^d + \Delta Q^d = \left(\frac{\eta^d}{\eta^d - \varepsilon^d}\right)\frac{1}{\delta_d^f}\left[\delta_f^f \left(\frac{t}{1+t}\right)\Delta t\right] + \left(\frac{\varepsilon^d \eta^d}{\eta^d - \varepsilon^d}\right)\frac{1}{\delta_d^f}\left[\delta_f^f \left(\frac{t}{1+t}\right)\Delta t\right] \ldots\ldots Eq\ A2.13 \quad = (1+\varepsilon^d)\left(\frac{\eta^d}{\eta^d - \varepsilon^d}\right)\frac{1}{\delta_d^f}\left[\delta_f^f \left(\frac{t}{1+t}\right)\Delta t\right] = (1+\varepsilon^d)\,\Delta P^d$$

In actual calculation, we directly estimated price elasticity of US imports and cross price elasticity and used Korean domestic demand elasticity and Korean domestic supply elasticity from Choi, et.al. (2009).