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Market Power of The Japanese Non-GM Soybean Import Market: The U.S. Exporters vs. Japanese Importers

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Abstract

Genetically modified (GM) soybean acreage has rapidly increased in the world in the past decade and globally the majority of countries now use GM soybeans to produce oil and meal for livestock and human consumption. Japan, however, uses only Non-GM soybeans as widely recognized high quality goods in vertically differentiated import soybeans in Japan, for direct human consumption of which more than 80% are imported from the U.S., Canada, and China. This research used the inverse residual demand model to estimate a U.S.-Japan partial equilibrium trade model to test the existence of market power in the Japanese Non-GM soybean import market. The U.S.-Japan partial equilibrium trade model incorporated the U.S. residual Non-GM soybean supply for Japan, the Japanese residual demand for U.S. Non-GM soybeans, and the equilibrium condition, where the U.S. residual Non-GM soybean supply equals the Japanese residual Non-GM soybean demand. Monthly data from January 2003 to December 2007 were used for the analysis. Empirical results indicated that U.S. Non-GM soybean exporters have stronger market power than Japanese Non-GM soybean importers. The results are different from other countries empirical studies and indicate that Japanese consumers are willing to pay higher prices for soybeans, tofu, natto, miso, and other all soy food products using Non-GM soybeans.

Introduction

In the past 100 years, Japan has changed from being a self-sufficient country to an industrially-advanced country that relies heavily on trade. As a result, Japanese citizens enjoy a high standard of living. But except for rice, Japan must import food commodities from all over the world. At present, the country's food self-sufficiency ratio is 39% (calorie base), which means that Japan depends on imports for 61% of its food supply. The self-sufficiency ratio in grains is 27% (MAFF 2003). For food grade soybeans, the self-sufficiency ratio, which has declined year by year, was only 15 percent in 2004. Some studies suggest that the decreasing Japanese self-sufficiency ratio may result in future problems (MAFF 2006a).The United States is the leading soybean producer in the world. In the past decade, genetically modified (GM) soybean acreage has rapidly increased. Most of the major soybean importing countries, including China, Mexico, and South Korea, reading accept imports of GM soybeans for all uses. On the other hand, Japan, the world's third largest soybean importer, has insisted on importing only Non-GM soybeans for direct human consumption. Japan's major suppliers are the U.S., Canada, and China. Japan will likely continue to be the world's largest importer of Non-GM soybeans.

Figure 1 shows the U.S. Non-GM soybeans share of the total U.S. soybean acreage. In 1997, U.S. Non-GM soybeans were planted on over 95% of the total U.S. soybean acres. But GM soybean technology has been adopted rapidly by U.S. soybean farmers. As a result, Non-GM soybeans share decreased to less than 50% of the total soybean acreage by 1999. Non-GM soybean share has continued to fill in the new century to only 9% of total U.S. soybean acreage.

Japanese Soy-Foods

There are many food soybean products consumed around the world. For instance, tofu, soy milk, and soy sauce are popular in many countries.

Consumption of other soybean foods, however, tend to be limited primarily to specific regions. For example, soy cheese, soy yogurt, and soy ice cream are popular products in the U.S., but only specialty soybean stores sell these soybean foods in Eastern Asia.

In the 1930's, Japan was self-sufficient in food-grade soybean production. Japan started to import soybeans, primarily for oil in the 1940's. By the 1950's, the amount of soybeans produced in Japan was approximately equal to soybean imports. During the 1960's, the amount of imported soybeans surpassed the amount of domestically produced soybeans. In 1972, the tariff on soybean imports was eliminated. In a short time, approximately eighty percent of all soybeans consumed in Japan were imported. United States produced soybeans made up 90% of soybeans imported into Japan. In the 1990's, consumption of GM soybeans became an increasingly important issue in Japan. Japanese consumers drove the debate by increasingly choosing to purchase Non-GMO products. In 2000, all soy products manufacturers fully shifted to Non-GM soybeans for tofu and natto production in Japan. Tofu has a long history in the Eastern Asian countries including in China, Japan, North and South Korea, and Taiwan. Tofu has been accepted as a health food in the U.S. and European Union (EU). Natto is an ethnic Japanese food of fermented whole soybeans. Natto soybeans are characterized by small seed size, which can be a maximum of only 5.5 mm diameter. Natto soybeans must also have a clear hilum, thin seedcoat, and high carbohydrate content. For centuries, natto has been popular in parts of Japan as a flavoring, especially as topping on rice for breakfast (Norris 2006). Natto is packaged in small white plastic packages with soy sauce and mustard. Miso is fermented and salted soybean paste. Although it is used primarily as a seasoning, miso soup is one of the most popular foods made from miso. It is usually served with rice at breakfast and supper meals in Japan.

Given the above facts, the Japanese Non-GM soybean import market can be characterized as a monopsony if all Japanese Non-GM soybean importers are viewed as one buyer. If all exporters in each country are aggregated, U.S., Canada, and China can be viewed as an oligopoly. The question then becomes who has more market power: the monopsony or the oligopoly? The party to a trade negotiation with the strongest market power can negotiate a more favorable price or other terms of trade than a trading partner with relatively weak market power. Estimating who has stronger market power should be of interest to both Non-GM soybean exporting countries and a Non-GM soybean importing country.

There are U.S., Canadian, and Chinese Non-GM soybean exporters in the Japanese Non-GM soybean market but U.S. Non-GM soybeans share over 70% in the Japanese Non-GM soybean market. Thus it is important to know the market power relationship of the United States compared to Japan: Japanese buyer vs. U.S. seller. U.S. policymakers would be in better position trade policies that could expand the U.S. market share in the Japanese Non-GM soybean import market. Japanese policy makers may be able to change trade policies to forestall future problems of relying on a powerful trade partner, such as the United States.

To determine relative Non-GM soybean market power relationships, this research will employ a two-country partial equilibrium trade model to test market power relationships for the Japanese Non-GM soybean import market between Japanese Non-GM soybean importers and U.S. Non-GM soybean exporters.

Literature Review and Overview of the Food Soybean Trade between the U.S. and Japan

Konduru et al. (2009) focused on "separation of GM and non-GM crops is generally difficult within a commodity system that has been built for scale, speed and efficiency achieved through aggregation." Identity preserved (IP) systems are used to separate GM and non-GM crops through relevant supply chains and export markets. Analysis of GMO testing is widely used for significant adjustments in supply chain operations which are required for IP systems analysis. GMO testing is used in the field to detect the presence or confirm the absence of certain GM crops (Konduru et al. 2009). The authors examined the implications of measurement uncertainty in GMO testing on the behavior of importers and exporters in IP non-GM and in commodity markets using a game theoretic framework. They conclude direct impacts on the behavior of importers and exporters from 1) relative size of IP costs, testing and rejection costs, 2) premium prices offered in the non-GM markets, and 3) measurement uncertainty.

Goldberg and Knetter (1999) measured market power of German beer and U.S. linearboard in specific destination markets based on Baker and Bresnahan (1988). They estimated residual demand elasticity as a measure of market power of German beer exporters and U.S. linearboard exporters in each destination country without collecting firm specific data. They

approached to measure a market power using exchange rate as an ideal cost shifter that one can investigate the market power of an exporting country in a specific foreign market without detailed cost shifters of competitors. Although one cannot recover structural parameters, it is easy to estimate the degree of market power in a specific destination market.

Carter et al. (1999) estimated the world wheat market by using the residual-demand model based on Goldberg and Knetter (1999) model. Carter et al. (1999) assumed that each country was a single firm, and those parameters could be interpreted as the share-weighted industry averages for all firms within one country. Using the double-log form of inverse residual demand function, Carter et al. (1999) estimated the price flexibility for the U.S. wheat exports to Japan directly. They applied the likelihood ratio (LR) tests for model selection. There were three alternative market structure models: the competitive model, the monopsony model and the U.S. price leadership model, based on Love and Murniningtyas (1992) Cournot or Bertrand competition in international wheat markets. Carter et al. (1999) find that the Japanese wheat market is imperfectly competition for the exporters by the first approach and the LR tests suggest that they could not rule out the competitive model in the Japanese wheat market.

Song (2006) examined the Chinese soybean market using two-country partial equilibrium trade model which was developed of residual-demand model and residual-supply model, and compared who has more market power: US exporters versus Chinese importers, in the Chinese soybean import market. This approach measures the market profits of both soybean importers and exporters in the Chinese soybean market and has more restricted comparing with the inverse residual models because it includes an equilibrium condition. Song (2006) shows there are complement relationship between U.S. and South American countries (Argentina and Brazil) through their monthly stock and export data. Song (2006) focused on oligopoly (U.S., Brazil and Argentina) verses monopsony (China). However, Song (2006) did not cover South American soybean imports which are approximately 40% of total Chinese soybean imports. U.S. soybean imports in China are approximately 56% of total Chinese soybean imports. Thus, this is not enough to mention Chinese importer market power. The author examines only U.S-China case and finds that "the market power of Chinese soybean importers is stronger than that of U.S. soybean exporters."

The Non-GM Soybean Trade

Japanese trading companies import Non-GM soybeans into Japan. Japanese trading companies do not deal exclusively in one specific product or product group, but rather deal in many products. A typical leading trading company will buy or sell almost anything, including industrial goods, textile goods, raw materials including agricultural products and mineral resources among other products. There are eight Japanese trading companies in that import food soybeans. On the other side of the trades are U.S. grain exporters that sell the soybeans to Japanese trading companies.

There are two principle ways to ship U.S. soybeans to Japan. One is bulk shipment, and the other is container shipment. Bulk shipment is typically used for large-volume sales of commodity soybeans. The most common bulk shipment size is 40000 metric tons. Not all soybean trading companies can finance the large quantity required to fill a vessel of that size. Only the four largest Japanese trading companies have the capability to charter vessels (Fukunaga, 2003). There are many advantages of using containers, such as to reduce shipping risks, theft, handling damage, adverse temperatures, or risk of accidental mixing. Specialty soybeans may even be purchased directly from a farmer. U.S. soybeans shipped in containers usually maintain in high quality because there is less damage to the soybeans in transit and foreign material levels are lower. Also demurrage on containers is much lower than for vessels, thus there is less financial risk (USSEC).

Model Estimation

As shown by most previous research in international agricultural trade, people believe that importers have more market power than exporters, both in competitive and non-perfect competitive markets. This research is focused on the food soybean market in Japan. As discussed in Chapter 2, Japan has a unique food soybean market. Japanese people consume only Non-GM soybeans, therefore Japan imports only Non-GM soybeans from the U.S., Canada, and China. In order to use the two-country partial equilibrium trade model, Japan is considered a monopsony by aggregating all Japanese Non-GM soybean importers. On the other side are the U.S., Canada, and China which makes up a three-country oligopoly of soybean sellers. If Japan as a country is a monopsonistic Non-GM soybean importer, it may

have more market power than any one of the Non-GM soybean exporting countries. This research seeks to test who has the stronger market power in the Japanese Non-GM soybean import, buyer or seller.

To measure the market power of Japan as a Non-GM soybean buyer, the inverse residual Non-GM soybean demand and the inverse residual Non-GM soybean supply were estimated. In the two-country partial equilibrium Non-GM soybean trade model, the inverse residual Non-GM soybean demand and the inverse residual Non-GM supply were combined to estimate relative market power.

This research focuses on the U.S.-Japan partial equilibrium Non-GM soybean trade model since over seventy percent of the Non-GM soybeans consumed in Japan come from the U.S. Other Non-GM soybean exporting countries, Canada and China, are treated as other Non-GM soybean exporters to Japan, IMP_{JPN}^{OTH}. Likewise, some European countries that import Non-GM soybeans from the U.S. are treated as other Non-GM soybean importers from the U.S., EXP_{US}^{OTH}. Based on Song (2006) model, the U.S.-Japan partial equilibrium Non-GM soybean trade model is written as eq 1 to 4.

where, $P_{JPN}^{US,IMP}$ is Japanese Non-GM soybean import price from U.S. (￥/MT); RD_{JPN}^{US} is Japanese residual demand for U.S. Non-GM soybean (MT); INC_{JPN} is Japanese personal disposable income ($); IMP_{JPN}^{OTH} is Japanese Non-GM soybean imports from countries other than U.S. (MT); *FT* is the food time trend variable, measuring Americanization of Japanese dishes; ε_{JPN} is the error term, assumed identically and independently distributed. P_{US}^{EXP} is U.S. Non-GM soybean export price to Japan ($/MT); RS_{US}^{JPN} is U.S. residual Non-GM soybean supply for Japan (MT); INC_{US} is U.S. personal disposable income ($); EXP_{US}^{OTH} is Non-GM soybean exports from U.S. to countries other than Japan (MT); STK_{US} is the U.S. beginning Non-GM soybean stocks (MT); and ε_{US} is the error term.

Data Description

For estimating the U.S.-Japan partial equilibrium Non-GM soybean trade model, monthly data from January 2003 to December 2007, 60 observations in all, were used. See Table 3.1 for all variables used in this analysis and sources.

Data for the Japanese inverse residual Non-GM soybean demand, RD_{JPN}^{US}, and the U.S. inverse residual Non-GM soybean supply, RS_{US}^{JPN}, were obtained from the Ministry of Finance Japan (2008) and *Daily Soybean and Oil Seeds* published by Shokuhin Sangyou Shinbunsha Co., Ltd. (Food Industry Newsweek Co., Ltd.). The amount of monthly Non-GM soybean in Japan imported from the U.S. for each month, $SB_{JPN,M}^{US,NGM}$, is the amount of monthly soybean imported by Japan from the U.S., $SB_{JPN,M}^{US}$, divided by the amount of soybeans Japan imported yearly from the U.S., $SB_{JPN,Y}^{US}$, multiplied by the Non-GM soybeans imported by Japan yearly from the U.S., $SB_{JPN,Y}^{US,NGM}$. It can be written as:

$$SB_{JPN,M}^{US,NGM} = \frac{SB_{JPN,M}^{US}}{SB_{JPN,Y}^{US}} * SB_{JPN,Y}^{US,NGM} \qquad (5)$$

Japanese personal disposable income, INC_{JPN}, is from the U.S. Department of Agriculture, Economics Research Service (USDA-ERS) International Macroeconomic Data Set (USDA-ERS, 2008b). According to Song (2006), the U.S. personal disposable income and Japanese personal disposable income are annual data. In this research, however, monthly data is required. Personal disposable income for the U.S. and Japan were transformed into monthly format, as described below. First, the annual growth rate of Japanese personal disposable income was calculated. Second, the initial value was set as the January disposable income. Then, the calculated annual growth rate and the initial value were used to estimate disposable income for the remaining months of the year. The last step was to use the trial-and-error method to adjust the January income so that the sum of the estimated monthly disposable incomes equaled the actual annual disposable income. The estimated monthly income was used to approximate the actual monthly disposable income in the empirical estimation (Song 2006).

$$\begin{cases} LnP_{JPN}^{US,IMP} = \alpha_0 + \theta_{JPN}^{US} LnRD_{JPN}^{US} + \alpha_1 LnINC_{JPN} + \alpha_2 LnIMP_{JPN}^{OTH} + \alpha_3 FT + \varepsilon_{JPN} & (1) \\ LnP_{US}^{EXP} = \beta_0 + \theta_{US}^{JPN} RS_{US}^{JPN} + \beta_1 LnINC_{US} + \beta_2 LnEXP_{US}^{OTH} + \beta_3 LnSTK_{USi} + \varepsilon_{US} & (2) \\ LnRD_{JPN}^{US} = LnRS_{US}^{JPN} & (3) \\ LnP_{JPN}^{US,IMP} = \phi_0 + \phi_1 LnP_{US}^{EXP} & (4) \end{cases}$$

The variable, Japanese Non-GM soybean imports from other countries, IMP_{JPN}^{OTH}, was calculated from data obtained from the Ministry of Finance Japan (2008) and *Daily Soybean and Oil Seeds*, published by Shokuhin Sangyou Shinbunsha Co., Ltd. The variable IMP_{JPN}^{OTH} is the sum of the monthly Japanese soybean imports from Canada and China multiplied by the amount of yearly Japanese Non-GM soybean imports from Canada and China, $SB_{JPN,Y}^{OTH,NGM}$. The amount of monthly Japanese soybean imports from Canada where the sum of the amount of Japanese soybean imports from Canada and China equals 100, is the amount of monthly Japanese soybean imports from Canada, $SB_{JPN,M}^{CA}$; divided by the amount of yearly Japanese soybean imports from Canada, $SB_{JPN,Y}^{CA}$; multiplied by the yearly Canada to China soybean import to Japan ratio, $\left(\frac{SB_{JPN,Y}^{CA}}{SB_{JPN,Y}^{CA} + SB_{JPN,Y}^{CH}} * 100\right)$.

The monthly Japanese soybean imports from Canada can be written as:

$$\frac{SB_{JPN,M}^{CA}}{SB_{JPN,Y}^{CA}} * \left(\frac{SB_{JPN,Y}^{CA}}{SB_{JPN,Y}^{CA} + SB_{JPN,Y}^{CH}} * 100\right) \quad (6)$$

Similarly, the amount of monthly Japanese soybean imports from China when the sum of the amount of Japanese soybean imports from Canada and China equals 100, is the amount of monthly Japanese soybean imports from China, $SB_{JPN,M}^{CH}$; divided by the amount of yearly Japanese soybean imports from China, $SB_{JPN,Y}^{CH}$; multiplied by the yearly Chinese soybean ratio in Japan, which is 100 minus the yearly Canada to China soybean import to Japan ratio. The monthly Japanese soybean imports from China can be written as:

$$\frac{SB_{JPN,M}^{CH}}{SB_{JPN,Y}^{CH}} * \left[100 - \left(\frac{SB_{JPN,Y}^{CA}}{SB_{JPN,Y}^{CA} + SB_{JPN,Y}^{CH}} * 100\right)\right] \quad (7)$$

Thus, Japanese Non-GM soybean imports from Canada and China can be written as:

$$IMP_{JPN}^{OTH} = \left\{\left[\frac{SB_{JPN,M}^{CA}}{SB_{JPN,Y}^{CA}} * \left(\frac{SB_{JPN,Y}^{CA}}{SB_{JPN,Y}^{CA} + SB_{JPN,Y}^{CH}} * 100\right)\right] + \left[\frac{SB_{JPN,M}^{CH}}{SB_{JPN,Y}^{CH}} * \left(100 - \left(\frac{SB_{JPN,Y}^{CA}}{SB_{JPN,Y}^{CA} + SB_{JPN,Y}^{CH}} * 100\right)\right)\right]\right\} * SB_{JPN,Y}^{OTH,NGM} \quad (8)$$

For the U.S. inverse residual Non-GM soybean supply to Japan model, the U.S. Non-GM soybean export price to Japan, P_{US}^{EXP}, is the FOB price reported by the U.S. Department of Agriculture, Foreign Agriculture Service (USDA-FAS, 2008). The

U.S. personal disposable income, INC_{US}, is from USDA-ERS, International Macroeconomic Data Set (USDA-ERS, 2008c). Similar to the Japanese personal disposable income, the reported data for U.S. personal disposable income is annual data. Using the same method as used for the Japanese personal disposable income, U.S. monthly personal disposable income is estimated from the actual annual income. The variable U.S. Non-GM soybean beginning stocks, STK_{US}, was obtained from the USDA-ERS, Oil Crops Yearbook (USDA-ERS, 2008d). The variable U.S. Non-GM soybean exports to countries other than Japan, EXP_{US}^{OTH}, is calculated using data obtained from USDA-FAS. The variable EXP_{US}^{OTH}, is the amount of monthly U.S. Non-GM soybean exports, EXP_{US}^{NGM}; minus the amount of monthly U.S. Non-GM soybean exports to Japan, EXP_{US}^{JPN}. The amount of monthly U.S. Non-GM soybean exports, EXP_{US}^{NGM}; is the amount of monthly U.S. soybean exports, $EXP_{US,M}$; multiplied by the Non-GM soybean to GM soybean cropping ratio in the U.S. which is 1 minus the percentage of GM soybean cropping ratio in the U.S., $\left(1-\%SB_{area}^{GM}\right)$; divided by twelve.

$$EXP_{US}^{OTH} = EXP_{US}^{NGM} - EXP_{US}^{JPN} \quad (9)$$

$$EXP_{US}^{NGM} = \frac{EXP_{US,M}}{12} * \left(1-\%SB_{area}^{GM}\right) \quad (10)$$

Before estimation, a heteroscedasticity test and an autocorrelation test were conducted for the model. Test results indicate that the null hypothesis for equation (1) and (2) fail to reject for either model. These test results imply that neither the Japanese inverse residual demand function nor the U.S. inverse residual supply function have a heteroscedasticity problem and an autocorrelation problem.

Estimation

The Non-GM soybean trade model was simultaneously estimated by using Three-Stage Least Squares (3SLS) method. Table 2 is estimated results that for equation (1), Japanese residual Non-GM soybean demand is statistically significant at the 1% level. The sign of the estimated coefficient is negative as expected that indicates a downward sloping Japanese residual demand curve for U.S. Non-GM soybeans. By equation (1), the estimated coefficient is also the price flexibility of the Japanese residual demand function for U.S. Non-GM soybeans as shown by Appendix equation (A3). The estimated price flexibility of the Japanese inverse residual demand for the U.S. Non-GM soybeans is -0.219 and the market profits of the U.S. Non-GM soybean exporters are about 22% of the export price.

For equation 2, the U.S. residual Non-GM soybean supply is statistically significant at the 1% level and the sign is positive as expected, indicating an upward sloping U.S. residual Non-GM soybean supply curve. By equation (2), the estimated coefficient is the price flexibility of the U.S. inverse residual Non-GM soybean supply function for Japan as shown by Appendix equation (A4). The estimated price flexibility of the U.S. inverse residual Non-GM soybean supply to Japan is 0.04 and the market profits of Japanese Non-GM soybean importers are about 4% of the Non-GM soybean import price. Comparing these two coefficients, U.S. Non-GM soybean exporters have greater market power than Japanese Non-GM soybean importers.

Conclusion

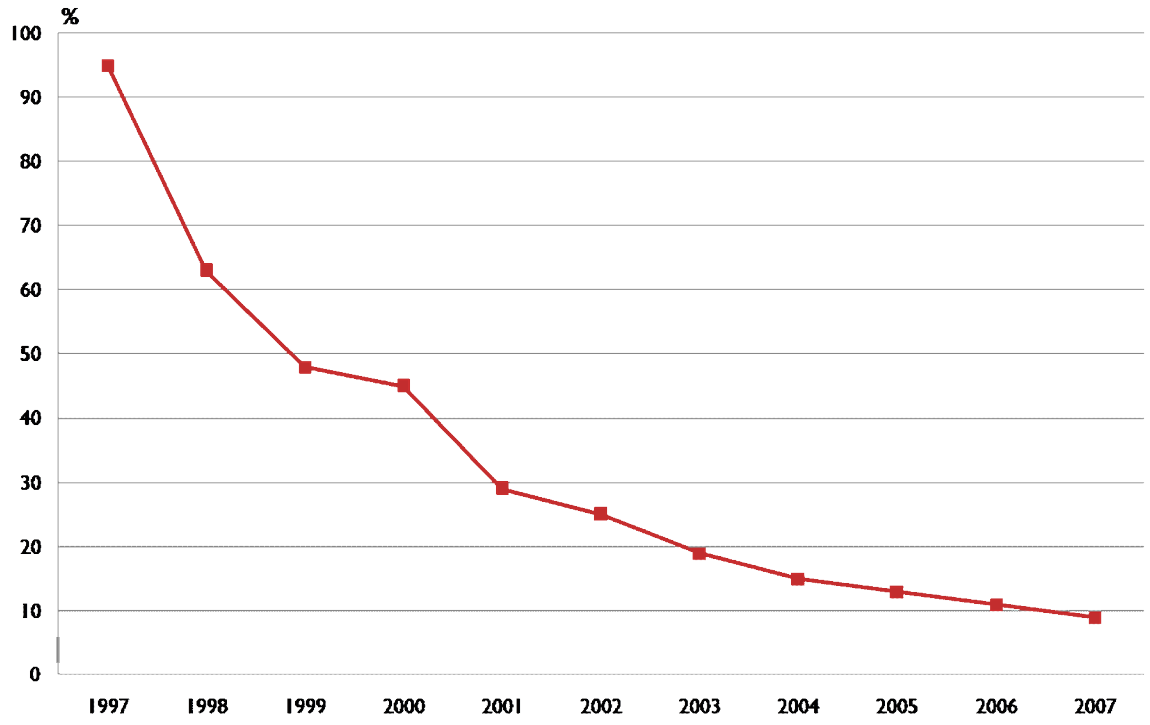
The Japanese people have long been concerned about healthy food. One of the most popular Japanese health foods is tofu produced from soybeans. However, Japan grows only about 10% of the soybeans consumed in the country each year. Japan imports about 70% of its food soybean needs from the U.S. In recent years, the U.S. soybean farmers have switched from producing all Non-GM soybeans to producing almost all GM soybeans. At present, only nine percent of the U.S. soybean crop remains Non-GM soybeans. Soybean producers in other countries are following the U.S. example and are switching to GM soybeans. GM soybeans have lowered production costs while raising yields for soybean producers. In the future, differential incentives for farmers to grow Non-GM soybeans will have to increase to offset lower yields, higher production costs, and the costs associated with segregating Non-GM soybeans from GM soybeans. By the late 1990's, Japanese people had developed widespread apprehension about the safety of consuming GM soybeans. Since then, they have insisted on eating only Non-GM soybeans. In response to consumer desires, Japanese soybean importers only import Non-GM soybeans for food soybeans in Japan. This makes the Japanese food soybean market unique in the world.

With the decline in Non-GM soybean production in the U.S. Canada, and China, it appears that market power in the Japanese food soybean market has shifted to the sellers of Non-GM soybeans. A two-country partial equilibrium trade model was constructed to test the hypothesis that market power has shifted to the sellers of Non-GM soybeans. The results showed that U.S. Non-GM soybean exporters have relatively stronger market power than Japanese Non-GM soybean importers. The market margin for U.S. Non-GM soybean exporters was estimated at 22% of the export price while the market margin for the Japanese Non-GM soybean importers was only about 4% of the Non-GM soybean import price. These results are different from other countries previous studies which showed importers have more market power, and show that the Japanese importers may have to pay a higher price to purchase Non-GM soybeans in the future. It also indicates that Japanese consumers will have to pay higher prices for tofu, natto, miso, and other soy foods using Non-GM soybeans. Eventually, Japanese consumers will have to make a decision to keep paying a higher price for Non-GM soybeans or accept lower priced GM soybeans.

Acknowledgement

I would like to thank Michael Woolverton for helpful comments. However, all errors are mine only.

Figure 1. Non-GM Soybean Share in the Total Soybean Acreage of the U.S. (1997-2007)



Source: USDA-ERS, 2008a

Table 1. The U.S.-Japan Partial Equilibrium Non-GM Soybean Trade Model's Variables and Sources

Variable	Meaning	Source
$P_{JPN}^{US,IMP}$	Japanese Non-GM soybean import price from US (¥/MT)	USDA-FAS
RD_{JPN}^{US}	Japanese residual demand for U.S. Non-GM soybean (MT)	Ministry of Finance Japan Shokuhin Sangyou Shinbunsha Co., Ltd.
INC_{JPN}	Japanese personal disposable income ($)	USDA-ERS
IMP_{JPN}^{OTH}	Japanese Non-GM soybean imports from Canada and China (MT)	Ministry of Finance Japan Shokuhin Sangyou Shinbunsha Co., Ltd.
P_{US}^{EXP}	U.S. Non-GM soybean export price to Japan ($/MT)	USDA-FAS
RS_{US}^{JPN}	U.S. Non-GM soybean residual supply for Japan (MT)	Ministry of Finance Japan Shokuhin Sangyou Shinbunsha Co., Ltd.
INC_{US}	U.S. personal disposable income ($)	USDA-ERS
EXP_{US}^{OTH}	U.S. Non-GM soybean exports to other countries (MT)	USDA-FAS
STK_{US}	U.S. Non-GM soybean beginning stocks (MT)	USDA-ERS

Table 2. Estimated Results of the U.S.-Japan Partial Equilibrium Trade Model

	Variable	Coefficient	Standard Error	t Value	Pr > |t|
	Intercept	18.60854*	4.591843	4.05	0.0002
Japan Inverse	RD_{JPN}^{US}	-0.21955*	0.091787	-2.39	0.0102
Residual Non-GM	INC_{JPN}	-0.57598	0.405074	-1.42	0.1607
Soybean Demand:	IMP_{JPN}^{OTH}	0.008464	0.031475	0.27	0.7890
$P_{JPN}^{IMP} = P(RD_{JPN}^{US}, \ldots)$	PT	0.036404	0.039466	0.92	0.3603
	Intercept	3.148397*	3.516505	0.90	0.0045
U.S. Inverse	RS_{US}^{JPN}	0.040696*	0.21506	0.19	0.0068
Residual Non-GM	INC_{US}	0.662107	0.439792	1.51	0.1379
Soybean Supply:	EXP_{US}^{OTH}	-0.06222	0.051102	-1.22	0.2286
$P_{US}^{EXP} = P(RS_{US}^{JPN}, \ldots)$	STK_{US}	-0.03522**	0.018298	-1.92	0.0594
Price Relationship	*Intercept*	5.624331*	0.392903	14.31	<.0001
$P_{JPN}^{IMP} = P(P_{US}^{EXP})$	P_{US}^{EXP}	0.846458*	0.067456	12.55	<.0001

Note: * 1% significant level, ** 10% significant level.

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Appendix

Similar steps for achieving adjusted Lerner Index for Song (2006), U.S. Non-GM soybean exporters choose export quantity to Japan, Q_{US}^{EXP}, to maximize their profits, $\prod_{US}$.

$$\max_{Q_{US}^{EXP}} \prod_{US} = P_{US}^{EXP}(Q_{US}^{EXP}) * Q_{US}^{EXP} - (P_{US}^{Farm} + C_{US}) * Q_{US}^{EXP} \quad \text{(A1)}$$

where $\prod_{US}$ represents profits obtained by U.S. Non-GM soybean exporters. The variable P_{US}^{EXP} is U.S. Non-GM soybean export price, which is a function of the export quantity, Q_{US}^{EXP}. The variable P_{US}^{Farm} is U.S. Non-GM soybean farm level price that is equal to the exporter's purchase cost from U.S. Non-GM soybean farmers. The variable C_{US} is U.S. Non-GM soybean exporter's transaction costs. The first order condition of equation (A1) and arrange it then,

$$\frac{P_{US}^{EXP} - \left(P_{US}^{Farm} + C_{US}\right)}{P_{US}^{EXP}} = -\frac{\partial P_{US}^{EXP}}{\partial Q_{US}^{EXP}} * \frac{Q_{US}^{EXP}}{P_{US}^{EXP}} \quad \text{(A2)}$$

The left side of equation (A2) represents the market power for U.S. Non-GM soybean exporters over the Japanese Non-GM soybean importers. The right side of equation (A2) is the price flexibility of the Japanese inverse residual Non-GM soybean demand from U.S. The market power for U.S. Non-GM soybean over the Japanese Non-GM soybean importers as the Adjusted Lerner Index for U.S., ALI_{US}. It can be written as:

$$\frac{P_{US}^{EXP} - \left(P_{US}^{Farm} + C_{US}\right)}{P_{US}^{EXP}} = ALI_{US} \quad \text{(A3)}$$

Therefore, the price flexibility of the Japanese inverse residual demand for Non-GM soybeans from U.S. can be used as an indirect measure to evaluate the market power of U.S. Non-GM soybean exporters. Similarly, the price flexibility of U.S. inverse residual Non-GM soybean supply for Japan can be used as an indirect measure to evaluate the market price of Non-GM soybean importers in Japan.

$$\frac{\left(P_{JPN}^{R} / E_{JPN}\right) - C_{JPN} - P_{JPN}^{US,IMP}}{P_{JPN}^{US,IMP}} = ALI_{JPN} \quad \text{(A4)}$$