Exporters' Market Power

in Agricultural Import Markets in Korea

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ABSTRACT

Korea relies more than 70 percent of food supply on a limited number of exporting counties. If the suppliers possess market power, the food security matters. This study tested whether the major exporting countries of corn and wheat have power of determining market prices and enjoy oligopolistic profit in Korea.

The empirical results indicate that Korea shows a high degree of import loyalty toward U.S. products. It is evident that the U.S. and Australia have market power in the wheat market, while no distinct power is detected in the corn market. The result for the corn market seems to reflect the severe price competition between the two major exporters, the U.S. and China. It is also shown that the launch of the WTO does not significantly change the structure of market power in the markets considered.

Key Words: market power, food security, import loyalty,
residual demand elasticity

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Introduction

Korea is one of the most important importing countries in the international

agricultural trade. Korea imported more than 15 million tons of grain in the year 2000.

The self-sufficiency rate is less than one percent for corn and wheat and less than ten

percent for soybeans. This high level of food dependency on foreign suppliers may

result in fragile food security in Korea.

Food security can be defined as a situation in which all households have

both physical and economic access to adequate food for all members and are not at

risk of loosing such access (Ohga 1998). If the domestic agricultural import markets

are dominated by a limited number of exporters and these exporters possess

monopolistic or oligopolistic power in the price determination process, the economic

accessibility would be fragile. If this is the case, the food security matters and it is

important to increase the portion of domestic supply and to adopt more efficient

import practices.

The objective of this paper is to determine if the U.S. and other major

exporters of agricultural products have market power in the agricultural import

markets in Korea. Specifically, this study conducts two analyses. First, Korea's import

loyalty to an exporter is estimated, which can be defined as a probability of repeated

import from a specific export source. The import loyalty is estimated using the Markov model based on market shares (Telser 1962; Wilson, Koo, and Carter 1990).

Second, the market power of each exporter is estimated. In the industrial organization theory, Lerner's index, defined as the ratio of the difference between price and marginal cost to price, is used to measure the degree of market power (Lerner 1934). But, as the marginal cost in a specific industry or country is usually not measurable, the marginal cost is often replaced by the average cost. However, this requires a strong assumption that the technology in the industry is linearly homogeneous.

This paper uses two methods to estimate exporters' market power. First, Goldberg and Knetter (1999) proposed an econometric method of estimating the market power using the residual demand elasticity. Instead of estimating the market power directly, this method tests the hypothesis of no monopolistic power in the residual demand that is faced solely by the underlying exporter. This method requires relatively less data and is easy to use.

Second, Nevo (1996) presents a method of estimating market power, in which the price-cost mark-up is directly estimated. In this model the market power can be estimated without requiring information about the cost.

This study adopts the three complementary methods above, which can lead to more reliable conclusions. In addition, the effect of the institutional shock from the UR agricultural negotiations is also analyzed. It is likely that the world trade patterns change with the launch of the World Trade Organization (WTO). Thus, we test if there is any significant change in the market power after 1995.

The results of this study will provide important implications to policy alternatives for food security. If the major exporters possess market power in the pricing mechanism, it is suggested to maintain a minimum level of domestic production capacity, to diversify import sources, and to use futures markets and long-term contracts to reduce risk involved in imports. If the exporters' market power changes after the WTO era, the result will have important implication to the next round WTO negotiations.

The Model

Import Loyalty and the Markov Process

The Markov process provides a transition probability matrix that measures a tendency of repeated behavior or, equivalently, a chance to switch. In import analyses, it measures how loyal an importing country is toward a specific exporting country. The Markov process is specified as follows:

$$(1) \quad Y_{j,t} = \sum_{i=1}^{n} Y_{j,t-1} PROB_{i,j} + e_{j,t}, \, j = 1, \, 2, \, ..., \, n$$

where $Y_{i,t-1}$ = market share of exporter i at time t

$PROB_{i,j}$ = transition probability

$e_{j,t}$ = error term, $E(e) = 0$, $E(ee') = I\sigma^2$

The transition probability matrix is the matrix of conditional probabilities that a specific brand (or product) is to be repurchased (diagonal elements) or switched to some other brand (off-diagonal elements) at time t given the brand (or product) was purchased at time t-1. If a diagonal element is large, it is said that the probability of repeated purchase is large and the consumer is loyal to the specific brand (or product). If, on the other hand, the probability of repeated purchase is low, the consumer is apt to switch brands. Since the rows of the matrix sum to unity, small numbers of diagonal elements imply relatively large numbers of off-diagonal elements, which indicate large chances of purchasing different brands from the previous purchase.

The magnitude of import loyalty depends on many factors. Consumers' attitude to buy would be the key factor. Some consumers may frequently switch brands, while others simply stick to specific brands. In addition, quality or product characteristics would also be an important factor. Trade policies (importing or exporting) and/or marketing practices also significantly affect the switching probabilities. However, the model specified above is not able to identify factors

determining the transition probability. It only tells the overall tendency. More complicated econometric models are needed for complete identification of the reasons. But this is beyond the scope of this study.

The Markov model can be estimated by minimizing the sum of squared errors given two constraints for probability:

$$(2) \quad \underset{PROB_{i,j}}{Minimize} \quad SSE = \sum_{t=1}^{T}\sum_{j=1}^{n}\left[Y_{j,t} - \sum_{i-1}^{n}Y_{i,t-1}PROB_{i,j}\right]^{2}$$

$$\text{subject to} \quad \sum_{j=1}^{n}PROB_{i,j} = 1 \text{ for all } i$$

$$0 \le PROB_{i,j} \le 1.$$

The transition probabilities are estimated under two assumptions. First, the process is a first order process. In other words, the purchase at time t depends only on the purchase at time t-1 (not on the history before t-1). Second, The process is stationary. This implies that the moments of the process are time-invariant. Given the assumptions, the steady-state market share of each brand can be calculated by multiplying the transition probability matrix until the columns of the outcome become identical. These are long-run equilibrium market shares under the current condition of consumer taste, technology, marketing strategies and so on.

Residual Demand Elasticity Model

The Lerner index is defined as the ratio of the difference between price and marginal cost to price. This indicates how much the price deviates from the optimal pricing under perfect competition. However, use of this index involves several problems. First, it is very difficult to measure the marginal cost using the accounting data available. The data usually are aggregated, and it is costly and time-consuming to disaggregate, if not impossible. In most cases, the data are confidential because they are critically important for competitors. Tax is another reason to keep the data from leaking out.

An alternative to the Lerner index is the elasticity of the residual demand faced by the exporter under consideration. The residual demand is the demand faced by an exporting country after taking into account the supply response of the competing countries in the import market.

Figure 1 depicts the residual demand for an exporter. The left panel of the figure depicts the market in which the import demand curve interacts with the supply curve of all other exporters except the exporter considered. The right panel shows the situation in which the residual demand schedule interacts with the exporting country's supply schedule. Since the exporter faces the residual demand alone, it will be a

monopolistic supplier. If the residual demand curve is flat, there is no room for the exporter to exercise the monopolistic power and the exporter faces the price determined by the left panel. If, on the other hand, the residual demand curve is steep, a monopolistic profit is possible by pricing the marginal cost equal to the marginal revenue. The steeper the curve is, the higher the excess profit is, and vise versa. This is a one-to-one mapping to the market power implied by the Lerner index. Thus, the market power can be deduced from the residual demand elasticity (strictly speaking, price flexibility).

Since the residual demand is determined by the difference between the import demand and the supply of competitors in the market, the demand shifters in the importing country and the supply shifters of competing countries are key factors determining the price. Goldberg and Knetter (1999) suggest an inverse demand model to estimate the residual demand elasticity. Following them, we specify the residual demand model as follows:

$$(3) \quad \ln P^{ex} = \beta_0 + \eta \ln Q^{ex} + \beta_1 \ln RGDP + \beta_2 \ln E^1 + \beta_3 \ln WPI^1 + \beta_4 \ln LCI^1$$
$$+ \beta_5 \ln E^2 + \beta_6 \ln WPI^2 + \beta_7 \ln LCI^2 + e^{ex}$$

where P^{ex} = export price
Q^{ex} = export volume
$RGDP$ = real GDP in the importing country
E = exchange rate
WPI = wholesale price index

LCI = wage index

superscript ex = the exporting country

superscript 1 and 2 = competing country 1 and 2.

Since the model in equation 3 is the inverse demand in double logarithmic form, the coefficient of the quantity η is the price flexibility. The residual demand would be flat if the price flexibility is zero (or equivalently infinite demand elasticity), implying no market power. If the exporter enjoys market power, the coefficient will be negatively significant.

The effect of freer trade with the launch of the WTO on the market power is analyzed with intercept and slope dummy variables. The null hypothesis of no WTO effect is tested with zero coefficient of the slope dummy.

Multinomial Logit Model

Nevo(1996) suggests a market share model to estimate the price-marginal cost mark-up (MU). The markup, which is the numerator of the Lerner index, can be derived from the profit maximization function for the exporting country. The profit function for the representative exporter is defined as

(4) $\prod_i = (P_i - mc_i)S_i M - C_i^f$

      where $mc_i =$ marginal cost

             $S_i = S_i(P_i, P_j) =$ market share as a function of export prices

             $P_i =$ export price

             $M =$ import market size

             $C_i^f =$ fixed cost

The first order condition for profit maximization is

(5) $S_i(P_i, P_j) + (P_i - mc_i)\dfrac{\partial S_i}{\partial P_i} = 0, \forall i$

which can be rewritten for the mark-up as

(6) $P_i - mc_i = -S_i(P_i, P_j)(\dfrac{\partial S_i}{\partial P_i})^{-1}, \forall i$

To estimate the markup in equation 6, the marginal effect of price on the market share

should be estimated. The marginal effects for all exporters can be estimated using a

system of multinomial logit model as follows:

(7) $S_i = \dfrac{\exp(-\alpha_i p_i)}{1 + \sum\limits_{\kappa=1}^{I} \exp(-\alpha_k p_k)}$

The null hypothesis of no market power of the ith exporter is H_o: $\alpha_i = 0$. As for the
residual demand approach, the WTO effect is tested using dummy variable.

Data

This study determines the market power of major exporting countries in the wheat and corn markets. The data needed for this study are import quantity and price, exchange rate, wholesale price index, and wage index by exporting country, and Korea's GDP for a demand shifter. Major exporters of wheat include the U.S., Canada, and Australia. In the corn market, the U.S. and China are dominant exporters.

The quarterly data for import quantity and price are from *Monthly Report of Trade Statistics* by National Statistics Office. Other data are from IMF's *International Financial Statistics*. Considering data availability, the sample period covers the first quarter of 1993 through the third quarter of 1999 for wheat, and from the first quarter of 1991 to the third quarter of 1999 for corn.

Figures 2 and 3 show historical market shares for the two crops. The wheat import market shows significant changes in the market share. In 1993 and 1994, Canada was the largest exporter after which the U.S. took the position. However, the U.S. share consistently decreases over time, while the share for the rest of the world (ROW) soars since 1998. Canada's share fades out recently, while Australia has a stable market share at around 20% throughout the sample period.

The market structure for the corn import market looks much simpler with

only two major exporters, the U.S. and China. However, the competition between the two players is evidently more severe. The trade pattern shows that the market is dominated by China whenever China has stock to export. Until 1994 when the Chinese production dropped significantly due to severe drought, the U.S. dominated the market. But, China resumed her seat soon with a good harvest in 1997.

Imports from China have several advantages over the U.S. Since China locates closer than the U.S., the transportation takes a shorter time with a lower cost. In addition, the order size can be much smaller for the Chinese crop due to the distance, which should be at least 50 thousand tons from the U.S. The Korean importers tend to prefer importing from China unless the U.S. price is low enough to compensate differences in quality and procurement costs.

Empirical Results

Wheat Market

Table 1 shows the estimated transition probability matrix. The U.S. enjoys the highest import loyalty with 0.86, while that for Canada is 0.69 and 0.51 for Australia. The probability of switching import sources from the U.S. to Canada is zero, and that to Australia is 0.142. However, the switching probability from Australia to the U.S. is

zero, implying that Australia would take the market share from the U.S. over time.

This is evident in Table 2. The steady-state market share for the U.S. lowers while that for Australia gains. In the long run, the market growth for ROW is distinct. Under the current trade and marketing strategies, the wheat import market in Korea seems to allow no dominant exporter.

Table 3 shows the estimated price flexibilities from the residual demand models. The estimates are statistically significant for all three exporters, implying these exporters enjoy market power in the wheat import market. The number for the U.S. is –0.38 and the largest among the three. The t-test results indicate that the launch of the WTO does not show any significant (statistically) change in the market power, even though the U.S. and Canada gain power while Australia looses.

The multinomial logit model provides similar results to the residual demand model (Table 4). The U.S. and Australia show significant mark-ups, while that for Canada fails to reject the null hypothesis of zero mark-up. The Lerner index is 0.75 for the U.S. implying a distinct market power. As in the previous model, the t-test confirms that the WTO does not affect the magnitude of market power.

Corn Market

The transition probability matrix for the corn market is shown in Table 5. The diagonal element is estimated 0.90 for the U.S. and 0.93 for China, indicating a high degree of import loyalty to both countries. China enjoys higher loyalty as expected. The switching probability from the U.S. to China is 0.028 while that from China to the U.S. is 0.064. These low switching probabilities imply the importance of being the dominant exporter. For the remnant exporter, aggressive marketing strategies are essential to regain the market. China is shown to gain the long run equilibrium market shares at the cost of the U.S. (Table 6).

The price flexibility measuring the market power is shown in Table 7. Differently from the wheat market, the exporters do not seem to have significant market power in the corn market. In addition, the launch of the WTO does not cause any change in the market power.

The multinomial logit model also confirms the insignificant market power (Table 8). The same inference can be made for the WTO effect on market power.

Conclusions

Korea meets most of domestic demand for wheat and corn with imports. This high dependency of the products on foreign supply endangers food security especially when the international market is noncompetitive or the exporters have market power. Many economists in Korea, however, do not agree with the existence of market power suggesting severe competition in the world markets of the products as evidence.

This study tests whether major exporters of wheat and corn possess power of determining market price and enjoys oligopolistic profit in Korea. The empirical results indicate that Korea shows a high degree of import loyalty toward U.S. products. It is evident that the U.S. and Australia have market power in the wheat market, while no distinct power is detected in the corn market. The result for the corn market seems to reflect the severe price competition between the U.S. and China. These results suggest that market structure does not necessarily determine market performance. It is also shown that the launch of the WTO does not significantly change the structure of market power in the markets considered.

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Table 1.   Transition Probability Matrix for Wheat Imports

		Time t			
		USA	CAN	AUS	ROE
Time t-1	USA	0.858	0	0.142	0
	CAN	0.175	0.690	0.135	0
	AUS	0	0.250	0.514	0.236
	ROE	0.075	0.031	0.137	0.757

Table 2.   Steady-state Market Share in the Wheat Import Market

	USA	CAN	AUS	ROE
Import Loyalty	0.858	0.690	0.514	0.757
Average Market Share	0.397	0.228	0.221	0.154
LR Market Share	0.361( )	0.201( )	0.222( )	0.216( )

Table 3.   Estimated Price Flexibility in the Wheat Market

	USA	CAN	AUS
Flexibility	-0.384*	-0.146**	-0.142*
	(-2.287)	(-8.028)	(-2.412)
T-value for WTO effect	-0.524	-0.095	0.458

Numbers in the parentheses are t-values.
**: indicates significance at the 1% level.
* :indicates significance at the 5% level.

Table 4.   Estimated Mark-up for Wheat Exporting Countries

	USA	CAN	AUS	ROE
Mark-Up(MU)	0.143	0.037	0.055	0.059
t-value	3.990**	0.471	1.838	2.575*
Average Price	0.188	0.156	0.174	0.108
Lerner Index	0.758	0.236	0.317	0.549
t-value for WTO effect	-0.051	0.035	-0.134	-0.032

** indicates significance at the 1 % level
 * indicates significance at the 5 % level

Table 5. Transition Probability Matrix for Corn Imports

		Time t		
		USA	CHI	ROE
Time t-1	USA	0.900	0.028	0.071
	CHI	0.064	0.934	0.001
	ROE	0.517	0.346	0.137

Table 6. Steady-state Market Share in the Corn Import Market

	USA	CHI	ROE
Import Loyalty	0.900	0.934	0.137
Average Market Share	0.523	0.439	0.038
LR Market Share	0.509( )	0.448( )	0.043( )

Table 7. Estimated Price Flexibility in the Corn Market

	USA	CHI
Flexibility	-0.054	-0.032
	(-1.742)	(-0.436)
T-value for WTO effect	-1.347	0.434

Numbers in the parentheses are t-values.

Table 8. Estimated Mark-up for Corn Exporting Countries

	USA	CHI	ROE
Mark-Up(MU)	0.017	0.014	-0.060
t-value	0.559	0.583	-4.075*
Average Price	0.140	0.131	0.142
Lerner Index	0.121	0.110	-0.426
t-value for WTO effect	0.003	0.205	-0.057

* indicates significance at the 1% level.

Figure 1. The concept of Residual Demand and Market Power

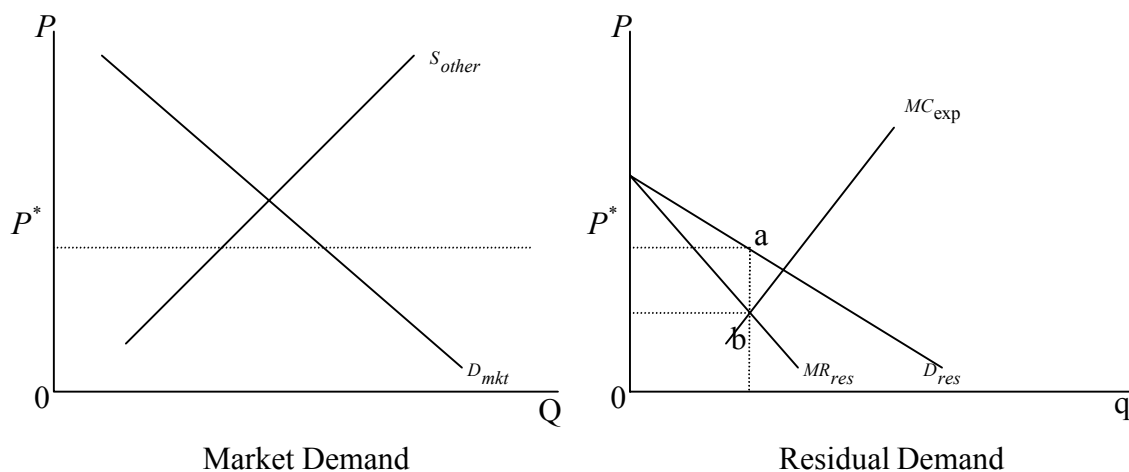Market Demand   Residual Demand

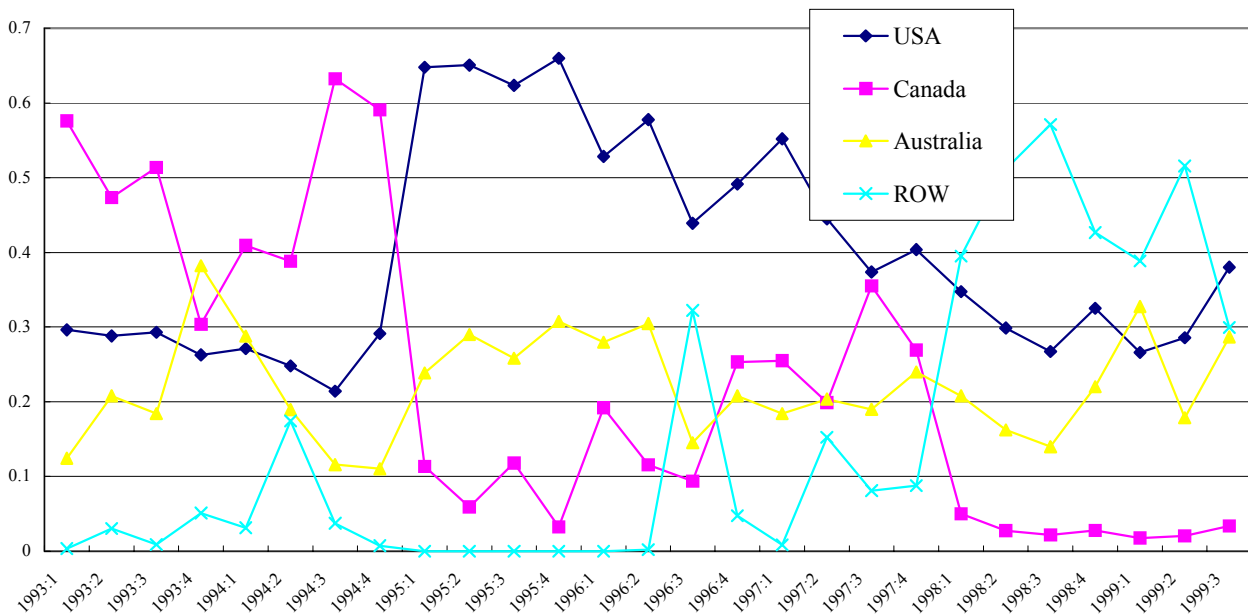Figure 2. Historical Shares of wheat exporting countries in Korea

Figure 3. Historical Shares of corn exporting countries in Korea