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Title: **Measuring the Market Power of the U.S. Wheat Exporters in Asian countries: An Issue about Adjustment of Nominal Exchange Rate When Using as A Cost Shifter.**

Running Title: **The Competitive Structure of U.S. Grain Exports in Asian Countries.**

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Abstract: The objective of this article is to measure the market power of U.S. grain exporters in the Asian countries. This study revisits the issue of the market power with the Goldberg and Knetter (1999) model, addressing an issue about using nominal exchange rate as a cost shifter. This study proposes an adjusted nominal exchange rate deflated by inflation rates of exporting countries and exchange rate risk as another possible risk shifter. The results of the preliminary estimation show that using the adjusted exchange rate provides better results. The results also show that U.S. wheat exporters have market power in Philippine, Korea, Malaysia, and Singapore, while no market power in Indonesia and Japan. Australia plays a significant role in constraining the market power of U.S. wheat exporters in the Asian market, suggesting that a proper economic model in the Asian country might be U.S.-Australia duopoly model.

Keywords: International Grain Trade, Imperfect Competition, and Exchange Rate

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Introduction

Measuring market power of U.S. grain exporters in foreign markets is necessary as the first step for the study of *imperfect competition* and its policy implications in the international grain trade. Two popular methods have been used to examine the competitiveness in international trade: the first is to consider the price adjustment behavior of exporters in response to exchange rate movement, called *partial passing-through* (PPT), and the second is to consider *pricing-to-market* (PTM) behavior of exporting countries.

There are some limits on the two methods, such as product differentiation across destination markets and difference on the demand schedules exporters face. In order to cope with the problems, one needs to collect specific firm level data. Data limitations are serious in the context of international markets, implying that balancing between data limitation and specific inference about the nature of international market competition is an important task for economists.

The recently brewed method of Goldberg and Knetter (1999), hereafter GK, has an advantage that detailed inferences about market power can be captured without collecting firm specific data. Using exchange rate as a cost shifter, market power can be estimated without depending on detailed cost shifters of competitors, which is an important contribution of the GK model. However, they neglect the fact that nominal exchange rate changes may not be a good proxy to reflect the changes of competitors' costs. Nominal exchange rates under the floating system represent exchange ratios of paper monies between countries. Since monetary authority of each country determines money supply independently, a country could experience higher inflation rate than other countries, which cause depreciation (or appreciation) in the real value of nominal exchange rate. Therefore, the nominal exchange rate adjustment may not affect relative

costs between competitors. Thus, reconsideration of nominal exchange rate is important in an empirical study for competitiveness in the international trade, because without a proper adjustment on nominal exchange rate under a situation of substantial differences in exporters' inflation rates, interpretation of empirical results and derivation of policy implications would be biased.

The objective of this article is to measure the market power of U.S. grain exporters, mainly focused on the Asian countries for three grains – wheat, corn, and rice. This study revisits the issue of the market power of U.S. grain exporters with the GK model. This study is timely because analysis of imperfect competition in the international grain trade is one of the hottest current issues in the international economics, and question about the competitive impacts of state trading enterprise, such as the Japanese Food Agency (JFA), the Australian wheat Board (AWB), and the Canadian Wheat Board (CWB), is an important issue in agricultural trade.

This article has the following distinguished features from previous studies for imperfect competition in the international trade. First, the GK model is adopted with an adjusted nominal exchange rate which is deflated by inflation rates of exporters. Second, we use the data of floating system period of exchange rates after the year 1973. The exclusion of the pegged-rate period precludes the possibility of specification bias stemming from the change in the exchange-rate regime.

A preliminary estimation was completed for wheat. The results show that empirical estimators from the estimations with nominal exchange rate are not significant and have unexpected signs. This may be due to substantial difference of inflation rates between exporters. The results of the estimation with the adjusted exchange rate show that the elasticity of residual demand of each Asian country has negative sign and four of them are statistically significant at the

1% level. This implies that the U.S. wheat exporters have market power in Philippine, Korea, Malaysia, and Singapore, while they have no market power in Indonesia and Japan. The results do not deviate from results of earlier studies by Pick and Park (1991) and Love and Murningtyas (1992) and Carter, MacLaren, and Yilmaz (1999). A noticeable result is that Australia plays a significant role in constraining the market power of U.S. wheat exporters in the Asian market, suggesting that a proper economic model in the Asian country might be U.S.-Australia duopoly model.

Theoretical Consideration

Measures of Market Power

Since the influential paper by Brander and Spencer (1982), strategic trade policy has become one of the most important subjects in the international economics. Under the assumption of imperfect competition, many authors have presented variety of strategic firm behaviors and government policies¹. Among them, Helpman and Krugman (1989) offered a new trade theory based on the presence of imperfect competition. The theorem implies that allowance for imperfect competition leads to non-standard impacts of trade policy and that in order to analyze policy implications of the theorem in the real world, knowledge about true market condition is indispensable. Therefore, measuring the market power of U.S. grain exporters in foreign markets is important as the first step for the analysis of imperfect competition and derivation of policy implications.

A popular method examining competitiveness in international trade is to consider the price adjustment behavior of exporters in response to exchange rate movements, called the PPT. This has become popular because nominal exchange rates substantially deviate from market fundamentals during the post-Bretton Woods era, which cause exchange rate shocks to U.S.

exporters. Under the assumption of perfect competition defined by the condition that price equals to marginal cost, we expect that exchange rate shocks cause dramatic variations of market shares of U.S. exporters. Many empirical studies have found evidences that the exporters strategically decide their export prices over exchange rate movements [e.g., Mann (1988) and Yang (1995)]. For instance, it has been generally observed that, when there was substantial overvaluation of an exporter's currency, the exporter would not fully increase his export price denominated in the destination country's currency. In contrast, if there was a substantial undervaluation, the exporter would not fully decrease his export price. Because price adjustment behavior might not be observed under assumption of the perfect competition, it is considered as an evidence of imperfect competition of international commodity markets.

Another popular way to examine competitiveness in international trade is to consider the PTM behavior of exporters. Krugman (1987) labeled the PTM after the phenomenon that exchange rate difference induces price discrimination in international markets. The PTM behavior is a different concept from the PPT, because the PTM is generally involved in multiple markets and is more directly connected to the notion of markup - pricing over marginal cost - and imperfect competition. Knetter (1989, 1993) suggested a method to measure potential markup of exporters in specific destination markets with firm's PTM behaviors in response to exchange rate movements. Using his idea, after separating time varying marginal cost of an exporting firm, one can easily estimate destination specific markup of the firm. His method is intuitively plausible and easy to apply to empirical works so that the model has become popular to estimate potential markup and imperfect competition of the international market. In agricultural economics, Pick and Park (1991, 1996) and Pick and Carter (1994) used the Knetter's model to investigate competitiveness of the U.S. agricultural commodity exports.

However, there are several limits for the two methods so that we cannot accept the PPT or PTM behavior of exporters as a proper indicator of market condition. First, an evidence of discriminatory pricing behavior may be due to product differences across destination markets rather than strategic firm behaviors [Abbott, Patterson, and Reca (1993)]. Second, the adjustment of mark-ups to marginal cost shocks, which determines the PPT and PTM, depends on the convexity of demand schedule exporters face. Consequently, in some situations, there is no direct relationship between the PPT (or PTM) and the level of mark-up [Goldberg and Knetter (1999)]. To cope with the problems, one needs to collect specific firm level data on marginal costs, prices, and product differentiation of exporters and data on demand system the exporters face. However, as Pick (1993) pointed out, data limitations are serious in the study for international trade. Therefore, from a practical point of view, balancing between data limitation and specific-inference about the nature of international market competitiveness is a challenging task for economists.

Recently, GK (1999) proposed a simpler approach to measure market power in a specific destination market, based on the empirical model of Baker and Bresnahan (1988). The main advantage of their approach is that one can make a proper inference about market power in international trade without collecting firm specific data. Using exchange rate as an ideal cost shifter, one can investigate the market power of an exporting country in a specific foreign market without detailed cost shifters of competitors. Although, in the model, one cannot recover structural parameters, it is easy to estimate the degree of market power in a specific destination market. Carter, MacLaren, and Yilmaz (1999) applied the GK model to Japanese wheat market to investigate the market powers of three exporting countries – the United States, Canada, and Australia. They concluded that there coexist the price-leadership by the United States and the

monopsony power by the Japanese Food Agency (JFA) and that the monopsony model is closer to the true data generating process than the U.S. price leadership model.

In the GK model, exchange rate is a key factor as a cost shifter of competitors. However, they neglect that nominal exchange rate changes may not be a good proxy to reflect the changes of competitors' costs. Basically, nominal exchange rates between countries under the floating system represent exchange ratios of paper monies of countries. Because monetary authority of each country determines money supply independently, a country could experience a higher inflation rate than the other, which causes appreciation (or depreciation) of the values of exchange rates. Therefore, the nominal exchange rate adjustment may not affect relative cost between competitors. For example, although the U.S. dollar has been appreciated with compared to Italian Lira during the last two decades, one cannot conclude that U.S. exporters have faced higher export costs than those of Italian exporters during the period. The nominal appreciation of U.S. dollar is simply due to the relatively higher inflation rate of Italy than the United States. Therefore, consideration of inflation rate is important in empirical studies because, without a proper deflation on nominal exchange rates, derivation of policy implications from empirical results would be distorted.

A Residual Inverse Demand Model

In the context of international wheat market, the idea of GK (1999) bears out that if a destination market is perfectly competitive, export price changes by the U.S. wheat exporters are completely explained by the supply curve of foreign competitors in the destination markets. The reason is that only destination market clearing price can explain the U.S. wheat prices by the definition of perfect competition. Therefore, if changes in U.S. wheat exports do not have any predictive

power for its export prices at a specific destination market, we can conclude that the United States has no market power in the market.

The wheat prices of each exporting country in a destination market can be written as an inverse function of the quantity of own wheat exports, wheat prices of other competitors, and demand shifters in the destination market. Each exporting country simultaneously solves its profit maximization problem with respect to quantity exported, in which the total revenue is the product of wheat price and quantity of an exporting country and the total cost is multiplied by the exchange rate between destination countries and the exporting country. The first order condition for each exporting country implies that marginal cost equals the perceived marginal revenue if destination is perfectly competitive. The marginal cost for competitors is a function of the quantity produced and a vector of cost shifters. Substituting the first order conditions to the inverse demand function of the U.S. exporters produces the residual demand curve for the U.S. exports, in which the prices of competitors are eliminated. Finally, a residual inverse demand for the U.S. wheat has three observable arguments: the quantity exported by U.S. exporters, demand shifters in a destination market, and cost shifters of other competitors.

An explicit expression of the inverse demand curve for the U.S. wheat exporters can be written as follows:

$$(1) \quad \ln p_{mt}^{ex} = \lambda_m + \eta_m \ln Q_{mt}^{ex} + \alpha'_m \ln Z_{mt} + \beta'_m \ln W_{mt}^N + \varepsilon_{mt},$$

where p^{ex} denotes the U.S. wheat price in a destination market, Q^{ex} represents the quantity exported by the U.S. wheat exporters, Z denotes the demand shifters of the destination country, W^N represents the cost shifters of other exporting countries, ε_{mt} is an error term which is assumed to be independently identically distributed (i.i.d.), the Greek letters denote parameters to be estimated, the subscript m indexes a specific destination market, and t indexes time.

The parameter of interest is η , which is interpreted as the residual demand elasticity. An estimate of zero indicates that the U.S. exporters do not have market power in a destination market. In this case, the exporters face a perfectly elastic demand curve; the export prices do not depend on the quantity exported by United States, but is completely determined by the competitors' costs. The larger η in absolute value (particularly negative), the larger the deviation from marginal cost pricing, and the more power the exporters have over the prices.

One of the ideal cost shifters of competitors suggested by GK is nominal exchange rate against a destination country. The advantages of using exchange rate as a cost shifter are (1) we can easily obtain the data and (2) nominal exchange rate changes can represent exporting countries' specific cost shifter in each destination market. Therefore, it is ideal that the currency value of a destination market fluctuates against the exporting countries.

However, if destination countries pegged their nominal exchange rate to exporting countries' currencies, nominal exchange rate alone might not be an enough exogenous variable to construct an instrument variable. Therefore, we need to include other potential cost shifters in order to obtain a better instrument variable in the second stage in addition to nominal exchange rates.

On the other hand, GK (1999) and Carter, MacLaren, and Yilmaz (1999) used nominal exchange rate as the cost shifter for all exporters in destination markets. They implicitly assume that there are no substantial differences of inflation rates between exporters. However, if an exporting country experiences a rapid domestic inflation, real cost of the country can be increased although the country's nominal exchange rate is depreciated compared to destination market currency. Therefore, in order to mitigate the inflation effect, we need to deflate the nominal exchange rate using exporters inflation rate and then use it as a cost shifter.

Empirical Application

The United States faces competition with Australia and Canada in Asian wheat markets. Thus, our empirical model include the two countries as competitors against the United States² and the inverse demand equation (1) becomes

$$(2) \quad \ln p_{mt}^{us} = \lambda_m + \eta_m \ln Q_{mt}^{us} + \beta_{1m} \ln y_{mt} + \beta_{2m} \ln exaut_{mt} + \beta_{3m} \ln excan_{mt} + \varepsilon_{mt},$$

where $\ln p_{mt}^{us}$ represents the logarithm of the U.S. wheat prices in destination country m and is denominated by the destination country m , $\ln Q_{mt}^{us}$ denotes the logarithm of quantity of U.S. wheat exports to destination country m , $\ln y_{mt}$ represents the logarithm of real GDP of destination country m which is denominated by destination country currency, $\ln exaut_{mt}$ represents the exchange rate between destination country m and Australia and the rate is deflated by the inflation rate of Australia, $\ln excan_{mt}$ denotes the exchange rate between destination country m and Canada and the rate is deflated by the inflation rate of Canada, and ε_{mt} is an error term with i.i.d.

The quantity Q_{mt}^{us} would be endogenous which is determined under the assumption of the imperfect competition and has to be instrumented if statistical test indicates potential simultaneity between Q_{mt}^{us} and p_{mt}^{us} . y_{mt} is used as a demand shifter of destination market m and $exaut_{mt}$ and $excan_{mt}$ are used as cost shifters of Canadian and Australia respectively.

Data

The data used in this study consist of the values and quantities of annual U.S. wheat exports to six Asian countries - Indonesia, Japan, Korea, Malaysia, Philippine, and Singapore - from 1973 to 1994. The values and quantities together are used to construct unit value of export prices.

Quantity and value data were available from the OECD bilateral trade data set, named *Trade in Commodities*. The exchange rates are based on the annual average nominal exchange rates, published in *International Financial Statistics* by IMF. Consumer price indices which are used to measure inflation rates for each country and real GDP data are taken from *International Financial Statistics* by IMF, and they are annual average. The series were already deflated on the base year 1990. As the instrument variables, the fertilizer and electricity price indices are used and they are obtained from the USDA web-site³.

Test for Simultaneity

Own quantity Q_{mt}^{us} in the equation (2) is potentially endogenous because of the presence of simultaneous relationship with own price p_{mt}^{us} . Therefore, as the first stage of empirical estimation, we estimated a following reduced form equation to obtain an instrument variable for each destination market equation.

$$(3) \quad \ln Q_{mt}^{us} = \beta_m' \ln IV_{mt} + \xi_{mt},$$

where IV denotes instrument variables - a vector of exogenous or predetermined variables - which are strongly correlated with Q_{mt}^{us} , but not correlated with the error term ε_{mt} in equation (2), β_m' represents vector of coefficients to be estimated, and ξ_{mt} is an error term with i.i.d.

The IV includes all the exogenous variables in each residual demand equation. For instance, the exchange rate of United States via each destination market, fertilizer and electricity price indices of the United States, and their lagged values are all potential exogenous variables. Because the choice of instrumental variables would affect the final estimation results and there are so many potential instruments, the instruments were chosen based on a statistical test; we

included all potential instrument variables into each regression equation at first and then eliminate statistically insignificant variables at 5% level.

With chosen instrument variables in each equation, we implemented a simultaneity test suggested by Spencer and Berk (1983), which is a modified version of the Hausman (1978) specification test. An important advantage of the method is that one can test simultaneity in a single equation system, while the Hausman test need to estimate whole system of equations. Since our empirical model in the equation (2) is basically single equation system for each destination Asian market, the test procedure of Spencer and Berk is preferred.

The simultaneity test was completed with a simple two-stage procedure. First, we ran a regression in the equation (3) to obtain the residual $\hat{\xi}_{mt}$. Second, the equation (2) was estimated with $\hat{\xi}_{mt}$ as an additional independent variable. Under the null hypothesis of no simultaneity, the coefficient on $\hat{\xi}_{mt}$ should equal to zero. Therefore, a t test on the coefficient of the variable $\hat{\xi}_{mt}$ provides an appropriate specification test. If there is simultaneity between p_{mt}^{US} and Q_{mt}^{US} , we need to use the instrument variable. Table 1 presents results of the simultaneity test. The null of no simultaneity was rejected in the case of Philippine and Singapore. Therefore, the IV estimation was completed for these two countries.

On the other hand, the U.S. wheat export prices in each destination market may have been correlated each other, i.e., contemporaneous correlations, because unobservable shocks of U.S. specific costs and macroeconomic variables may affect export price in each destination market simultaneously. To remedy problems which may arise from the contemporaneous correlations in the error terms across six destination market equations, a system of Seemingly

Unrelated Regression (SUR) was used. Therefore, final estimation method is a system of SUR equation with IV in the case of Philippine and Singapore.

Preliminary Estimation Results for Wheat

A preliminary estimation was completed for wheat. The results show that empirical estimators from the estimations with nominal exchange rate are not significant and have unexpected signs than economic theory suggests. This may be due to substantial difference of inflation rates between exporters. The estimation results with the adjusted exchange rate are displayed in Table 2. The coefficient estimator on export quantity denotes the elasticity of residual demand of each Asian country. All of them have negative signs, expected as the residual demand elasticity, and four of them are statistically significant at 1% level. The corresponding residual demand elasticities in Korea, Malaysia, Philippine, and Singapore are -0.61, -0.12, -0.84, and -0.16 respectively. The results imply that the U.S. wheat exporters have higher market power in Philippine and Korea than in Malaysia and Singapore, while they have no market power in Indonesia and Japan.

The results are consistent in spirit with earlier studies by Pick and Park (1991) and Love and Murningtyas (1992) and Carter, MacLaren, and Yilmaz (1999). For instance, Pick and Park (1991) examined the market power of U.S. wheat exports using the Knetter's method. They found no PTM behavior of U.S. exporters in Japan, while statistically significant PTM behavior in Korea and Philippine. Love and Murningtyas (1992) also found that Japan exerts a high degree of monopsony power in the world wheat market, which implicitly implies no market power of U.S. wheat exporters in Japan. Higher market power of U.S. wheat exporter in the case of Korea and Philippine is also intuitive. Because these countries do not have diversity in wheat imports with compared to the other Asian countries, the United States can exert market power in the countries.

In the case of Philippine, the estimated coefficient on Austria exchange rate is not significant resulting in highest market power of the United States.

In all destination markets, the estimated coefficients on Canada-destination country exchange rates are not statistically significant, while those of Australia-destination country exchange rates are positive and statistically significant in five of six cases at 5% level. The positive sign of the Australia-destination country exchange rate coefficient is intuitive. As a competitor's currency is appreciated, the competitor's cost in exports increases and the U.S. exporters can charge a higher price. The results indicate that Australia plays a significant role in constraining the market power of the U.S. wheat exporters in the Asian market. These results also imply that the proper economic model in the simulation study in the Asian country might be U.S.-Australia duopoly model. The results are also related to the issue of impacts of state trading enterprise in grain trades and indicate that the AWB seems to exert market power in the Asian country. In Japan, the United States does not have its market power, possible related to the activity of the JFA.

Implications and Conclusions

The GK method has an advantage that using exchange rate as an ideal cost shifter, market power can be estimated without depending on detailed cost shifters of competitors. However, their implicit assumption of no substantial difference at exporters' inflation rates is too strong to apply in the real world. Therefore, a proper adjustment on nominal exchange rates should be completed.

In the preliminary estimation, we applied the GK method with an adjusted exchange rate as a cost shifter to measure the market power of U.S. wheat exports in six Asian countries. The results indicate that the U.S. wheat exporters have market power in Philippine, Korea, Malaysia,

and Singapore, while they have no market power in Indonesia and Japan. The results run together with the results of earlier studies. A noticeable result is that Australia plays a significant role in constraining the market power of the United States in the Asian markets, suggesting that a proper economic model in the Asian country might be U.S.-Australia duopoly model.

This study has some limits. One of them is using exchange rate alone as a cost shifter. An important reason of using exchange rate is easy access to the data in the international trade. However, the exchange rate alone cannot fully explain exporters' costs. Therefore, the interpretation of empirical results and policy implications should be mentioned with caution. This suggests that finding additional factors which can be used as a cost shifter and are easy to access remains to future researches.

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Table 1.
Results of Simultaneity Test.

Destination Country	Test Statistics	Simultaneity
Indonesia	0.126	No
Japan	1.019	No
Korea	-0.815	No
Malaysia	-0.730	No
Philippine	1.751 ^{***}	Yes
Singapore	2.190 ^{**}	Yes

Note: The null hypothesis of the Spencer and Berk test is no simultaneity between p^{US} and Q^{US} . ** and *** denote that the null is rejected at 5% and 10% significance level respectively.

Table 2.
Estimation Results of The Market Power of U.S. Wheat Exporters.

	Indonesia	Japan	Korea	Malaysia	Philippine	Singapore
Constant	-0.551 (-0.264)	-18.011** (-2.265)	12.291* (3.193)	-5.943* (-3.822)	5.403*** (1.825)	0.362 (0.191)
$\ln Q_{mt}^{us}$	-0.004 (-0.159)	-0.112 (-0.353)	-0.614* (-4.485)	-0.121* (-3.267)	-0.838* (-3.042)	-0.160* (-3.141)
$\ln y_{mt}$	-0.033 (-0.214)	1.398** (2.359)	-0.347 (-1.509)	0.199 (1.287)	0.449 (0.472)	-0.354*** (-1.650)
$\ln exaut_{mt}$	0.516** (2.121)	0.998* (3.759)	0.434** (1.995)	0.516* (2.875)	0.119 (0.460)	0.321** (1.962)
$\ln excan_{mt}$	0.210 (0.898)	-0.229 (-0.789)		-0.383 (-1.573)		-0.176 (-0.929)
R^2	0.553	0.935	0.920	0.743	0.842	0.882

Note: *, **, and *** denote that the null is rejected at 1%, 5%, and 10% significance level respectively. The values in the parenthesis are *t*-statistics values.

Endnotes

¹ More detailed survey about strategic trade policy under the different underlying assumptions is presented in Brander (1995).

² In the cases of Korea and Philippine, import volumes from Canada are negligible. Therefore, we assume that Australia is only competitor in these markets.

³ For details, please visit <http://www.ers.usda.gov/data/sdp/view.asp?f=inputs/98003>. or <http://usda.mannlib.cornell.edu/data-sets/inputs/98003>.