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Analysis of U.S. Wheat Market Shares in East Asia

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Abstract

The effects of U.S. wheat prices, dollar values, and their volatilities on U.S. wheat market shares in 10 Asian countries are analyzed. The variables are converted to a relative form comparing the U.S. against Australian and Canadian variables in order to incorporate the effects of competition among these countries. The effects of the increased loan rates and target prices in the early 1980s and the U.S. export enhancement program (EEP) are also analyzed. Estimation results show that higher U.S. wheat prices and U.S. dollar appreciation have detrimental effects, while increases in competitors' wheat prices and currency values have cross positive effects on U.S. market shares. The importers are not sensitive to volatility in annual price and exchange rate changes. Dummy variables representing the domestic farm and trade policies are not statistically significant, implying that the two variables do not have a substantial effect on U.S. wheat export performance in the markets.

Keywords: international wheat trade, market share, panel unit-root test, panel estimation

Highlights

The objective of this study is to analyze U.S. wheat market shares in Asian countries. This study is timely and important because U.S. wheat market shares in Asia have decreased since the 1980s and because the effects of U.S. dollar valuation on U.S. export performance is an important issue.

We examine four main factors determining market shares in the Asian countries: 1) U.S. wheat prices and their volatility, 2) U.S. dollar values and their volatility, 3) U.S. farm and agricultural trade policy, and 4) competition between the wheat exporting countries.

In order to incorporate the effects of competition between exporting countries, wheat prices, exchange rates, and their volatilities are formatted as relative values: the U.S. variables are divided by Australian and Canadian variables. Using the relative form helps to incorporate, in a parsimonious way, the third country effect into an import demand model.

Empirical results show that relative wheat export prices and exchange rates are important factors determining the U.S. market shares, while relative volatilities of prices and currency values are not statistically significant. This suggests that the Asian importers are sensitive to changes in wheat prices and currency values, but not sensitive to volatility in annual price and exchange rate changes.

Increased U.S. wheat prices and appreciation of the U.S. dollar had negative, significant effects on the U.S. wheat export performances in the markets, suggesting that Australia and Canada had an advantage when U.S. wheat prices were relatively higher or when the U.S. dollar appreciated against the currencies of its competitors. Dummy variables for U.S. domestic farm and trade policies – increased loan rates and target prices in the early 1980s, and the U.S. export enhancement program (EEP) – are not statistically significant, implying that they are not important factors in the wheat trade between the United States and Asian countries. The overall results suggest that wheat importers in the Asian countries are sensitive to an exporting country's wheat prices and dollar values.

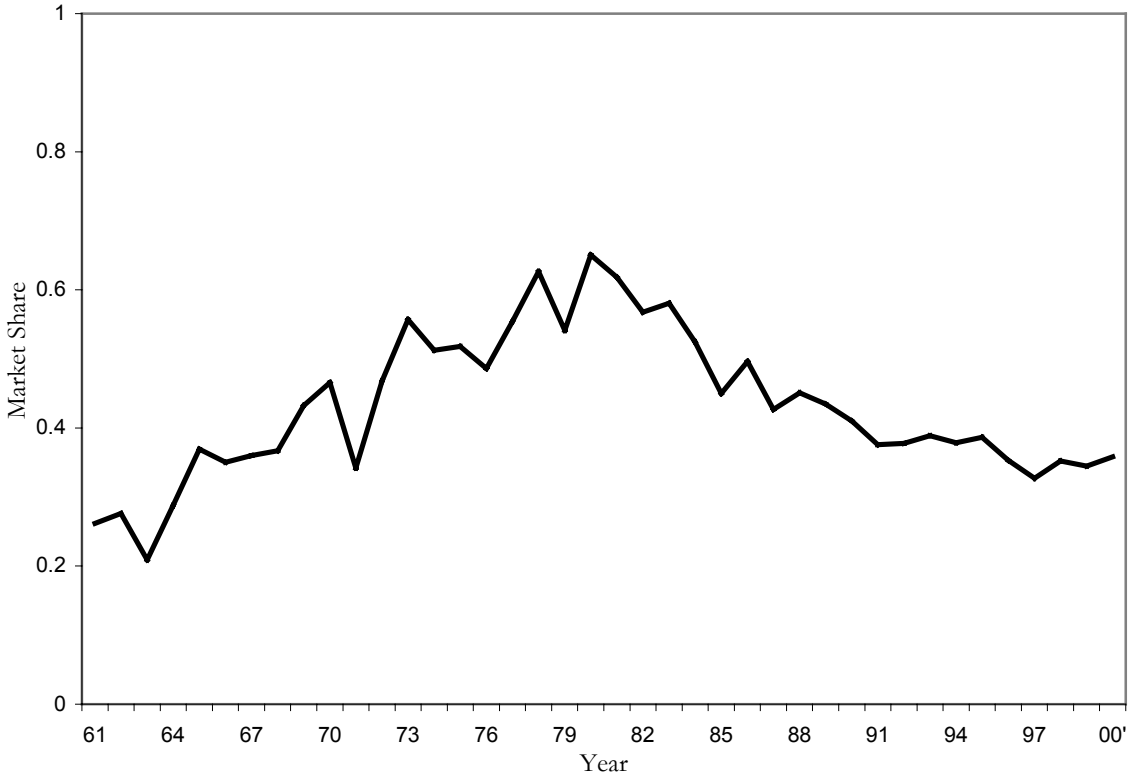
Analysis of U.S. Wheat Market Shares in East Asia

Hyun J. Jin and Won W. Koo*

INTRODUCTION

The market shares of U.S. wheat in Asian countries – China, Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Singapore, S. Korea, Taiwan, and Thailand – have decreased since the early 1980s. During the last two decades, the average market share of U.S. wheat in the region has decreased from 65 percent in the year 1980 to 35 percent in the year 2000, as shown in Figure 1.

Figure 1. Average Market Share of U.S. Wheat in Ten Asian Countries



Note: The data range from 1961 to 2000 by fiscal year. The data consist of the market shares of U.S. wheat exporters in the following Asian countries: China, Hong-Kong, Indonesia, Thailand, Taiwan, Singapore, Philippines, Malaysia, S. Korea, and Japan.

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Market shares in individual Asian countries have more dynamic features. South Korea, the Philippines, and Taiwan had been loyal to U.S. wheat, with only small variations. However, in recent years, this loyalty has been deteriorating in the Philippines. Malaysia and Indonesia significantly increased their imports from the United States during the period from 1973 through the early 1980s, but they have reduced imports from the United States since the mid-1980s. Thailand and Hong Kong increased their imports of U.S. wheat until the late 1980s, but they have decreased their imports since the early 1990s. In Indonesia and Hong Kong, the United States has been losing its market share by a large percentage. U.S. market share has been unstable in China and Singapore, with large variations. On the other hand, U.S. wheat market share has remained stable at around 50 percent in Japan. The market shares of U.S. wheat in individual Asian countries are plotted in Figures 2 through 4.

Figure 2. U.S. Wheat Market Shares in China, Japan, the Philippines, and South Korea

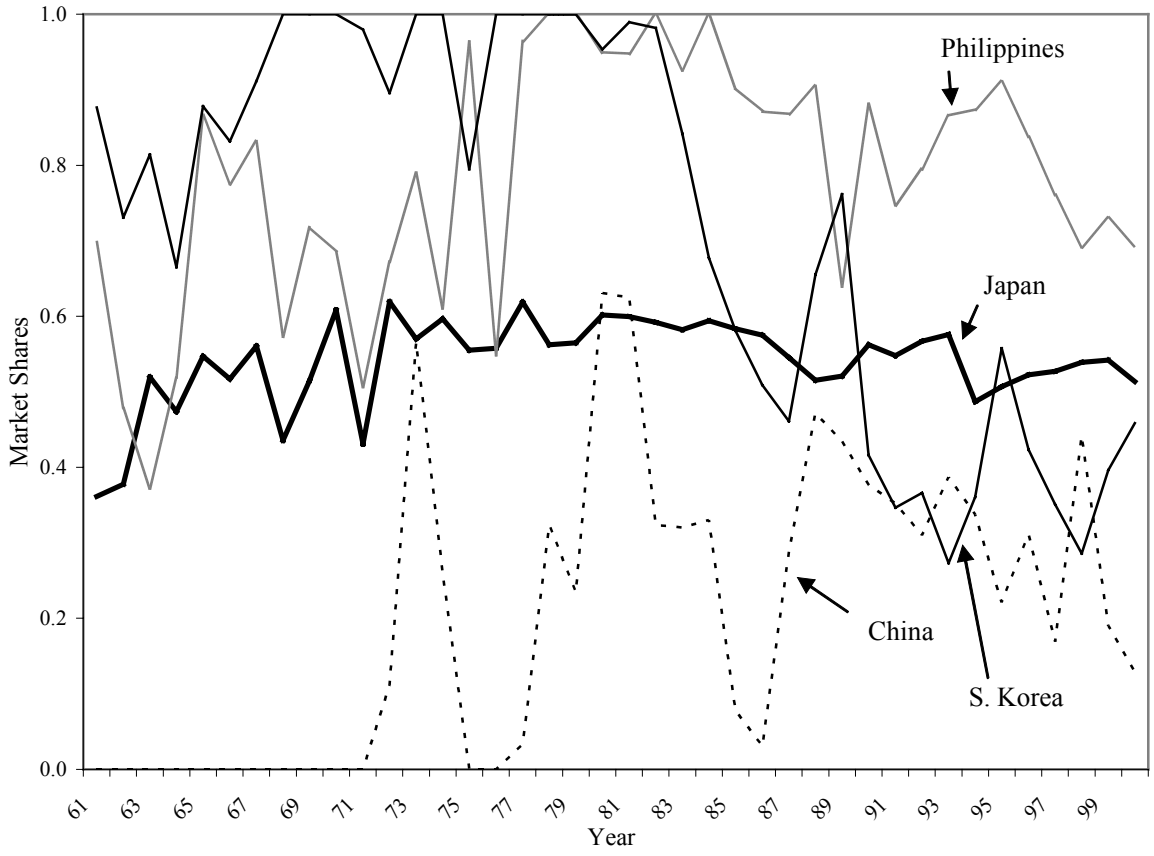


Figure 3. U.S. Wheat Market Shares in Hong Kong, Taiwan, and Thailand

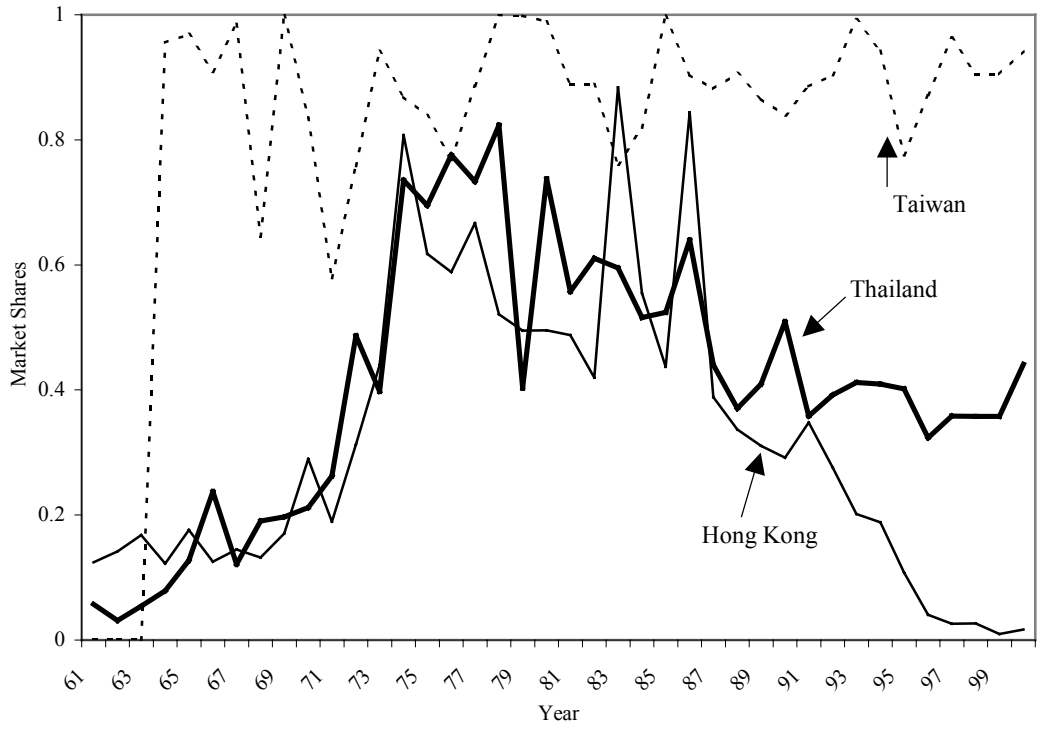
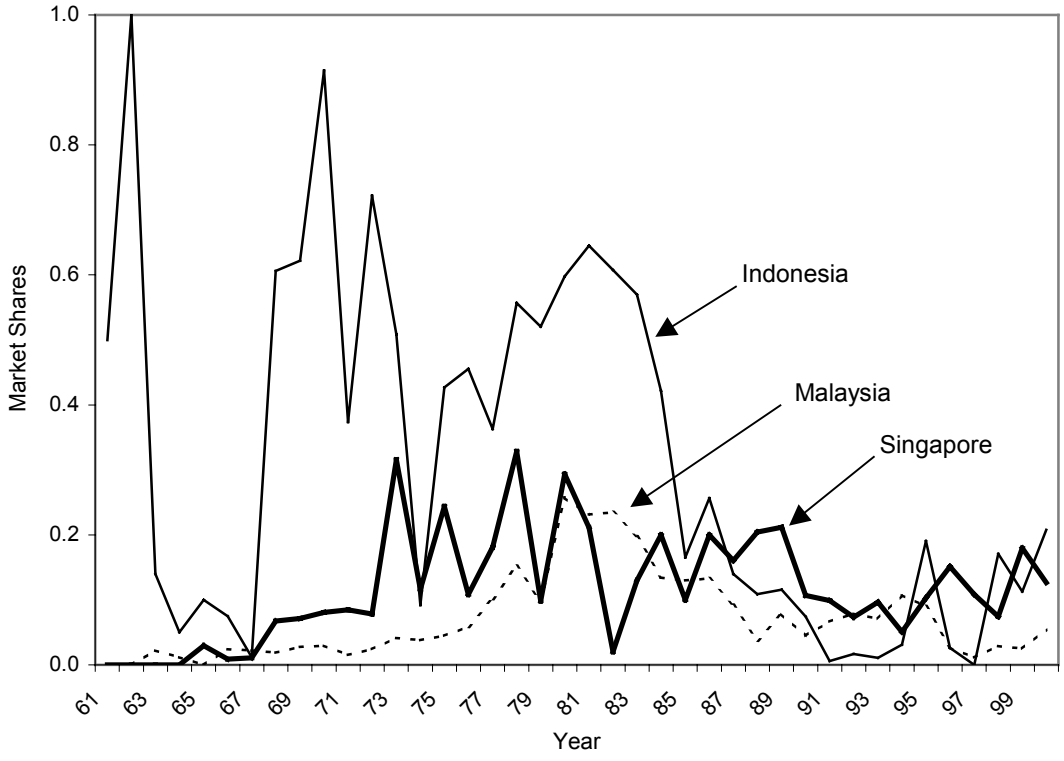


Figure 4. U.S. Wheat Market Shares in Indonesia, Malaysia, and Singapore



The major wheat exporting countries to Asia are the United States, Australia, and Canada. The market shares of the three exporting countries in the region range from 86 to 96 percent for the period from 1973 to 2000, according to *World Agricultural Trade Flows* by the Foreign Agricultural Service (FAS) of the U.S. Department of Agriculture (USDA).

Decreased U.S. market shares may be associated with increased sales by the competing suppliers, Australia and Canada. Since the early 1980s, the foreign competitors have significantly increased their market shares in Asia; Australia's wheat export has increased by 100 percent and Canada's by 40 percent.[1]

This study examines the main factors in the U.S. decline in market shares within the Asian countries. Specifically, we analyze the effects of the following variables: 1) U.S. wheat prices and their volatility, 2) U.S. dollar values and their volatility, 3) U.S. farm and agricultural trade policy, and 4) competition between the wheat exporting countries.

In order to incorporate the effects of competition between exporting countries, wheat prices, exchange rates, and their volatilities are formatted as relative values: the U.S. variables are divided by corresponding Australian and Canadian variables. Using the relative form helps to incorporate, in a parsimonious way, the third country effect into an import demand model. This helps to minimize specification errors that arise from the fact that trade flows depend on the costs of purchasing grain not only from an exporting country but also from competitors of the exporting country.

Our analysis focuses exclusively on the floating-rate period, running from 1973 through 2000. Excluding the pegged-rate period precludes the possibility of specification bias stemming from the change in the exchange rate regime. In the estimation procedure, a panel unit-root test, developed by Maddala and Wu (1999), is performed to check whether the panel data are characterized by nonstationarity and whether there is a cointegration problem caused by interactions of nonstationary variables. Empirical estimation is performed using a panel estimation method: a two-way random effect model with moving-average error components.

Estimation results show that relative wheat export prices and exchange rates are important factors affecting the U.S. market shares, while the relative volatilities of prices and currency values are not statistically significant. This suggests that Asian importers are sensitive to changes in wheat prices and currency values, but not sensitive to volatility in annual price and exchange rate changes. Increased U.S. wheat prices and appreciation of the U.S. dollar had negative, significant effects on the U.S. wheat export performances in the markets, suggesting that Australia and Canada could take advantage of a situation when U.S. wheat prices were relatively higher or when the U.S. dollar appreciated against the currencies of its competitors. Dummy variables for U.S. domestic farm and trade policies – increased loan rates and target prices in early 1980s, and the U.S. export enhancement program (EEP) – are not statistically significant, implying that they are not important factors in the wheat trade between the United States and Asian countries.

[1] Refer to *Wheat Yearbooks* by the Foreign Agricultural Trade of the United States (FATUS), Economic Research Service (ERS), the U.S. Department of Agriculture.

The remainder of the paper is organized as follows. A model for U.S. market share analysis is specified in the second section. The third section details data used in the study. The fourth section presents the procedure of empirical analysis and shows estimation results. A summary and conclusion follows in the last section.

MODEL SPECIFICATION

A standard long-run relationship model is specified, following Cushman (1983); Kenen and Rodrik (1986); Asseery and Peel (1991); and Chowdhury (1993). The relationship can be derived as a long-run solution of behavioral demand and supply functions for a grain trade (Gotur, 1985). The dependent variable is the level of market shares held by U.S. wheat in the 10 Asian countries. The explanatory variables are U.S. wheat prices relative to Australian and Canadian wheat prices; relative volatility of the wheat prices; U.S. dollars values relative to Australian and Canadian dollars in the 10 Asian destination markets; and relative volatility of the dollar values. The equation is written as follows:

$$x_{it} = \alpha_0 + \beta_1 \cdot p_{at} + \beta_2 \cdot p_{ct} + \beta_3 \cdot \mathrm{V}(p_a)_t + \beta_4 \cdot \mathrm{V}(p_c)_t + \beta_5 \cdot r_{ait} + \beta_6 \cdot r_{cit} + \beta_7 \cdot \mathrm{V}(r_a)_{it} + \beta_8 \cdot \mathrm{V}(r_c)_{it} + e_{it}, \quad (1)$$

where x denotes U.S. market shares in the Asian countries; p_a and p_c are U.S. wheat prices divided by Australian and Canadian wheat prices, respectively; r_a and r_c represent U.S. dollar values (R_u) divided by Australian and Canadian dollar values (R_a and R_c), respectively, in the 10 Asian markets; V(·) denotes the volatility of U.S. wheat prices or currency values relative to the volatility of Australian or Canadian wheat prices or currency values; e is an error term; and α_0 and β_i are unknown parameters. Price variables are time-variant but cross-sectional invariant. All other variables are both time and cross-sectional variant. The subscript i denotes cross-sectional changes for the 10 Asian importing countries. The subscript t represents time changes from 1973/1974 to 1999/2000 by fiscal year.

A rise in U.S. wheat prices would reduce the demand for U.S. wheat, thus reducing its market share, while an increase in competitors' wheat prices might encourage the importers to purchase more from the United States. Thus, expected signs of the coefficients of p_a and p_c are negative. If the U.S. dollar value rises, holding Australian and Canadian dollar values constant, then wheat import prices from the United States increase, resulting in comparatively higher purchasing costs for U.S. wheat and, therefore, reduced demand. The opposite would be true if competitors' currency values increased while holding the U.S. dollar value constant. Thus, expected signs of the coefficients of r_a and r_c are negative. If the volatility of an exporting country's wheat price or currency value increases, the importers would reduce wheat purchase from the country and switch to other exporters to avoid the risk. Higher volatility implies greater risk for the importers. Expected signs of relative risk variables of prices and exchange rates are also negative.

An import demand model usually includes a variable that captures the effects of the importing country's income level changes, if the dependent variable is the quantity imported. However, since the dependent variable is market share rather than quantity imported, a variable representing importing countries' income level is not included in Equation (1), under the assumption that changes in income level in an importing country will not affect the market shares of an exporting country unless consumers' preferences for wheat in the importing

countries significantly change in favor of an exporting country's wheat over other competitive countries' wheat as the income levels change.

Trade policies of importing countries and destination-specific transportation costs can influence trade flows. It is assumed that the trade policies of importing countries do not discriminate in favor of one country against other exporting countries. It is also assumed that the freight rates for heavy grain en route from the United States to the Asian countries have not changed significantly compared to the freight rates for foreign competitors. According to *World Grain Statistics*, published by the International Grain Council (IGC), the annual averages of freight rates for heavy grain traveling major ocean routes have moved together. Therefore, transportation costs may not significantly affect the U.S. market shares; albeit, it may affect the quantity imported.

Gehlhar and Vollrath (1997) analyzed U.S. market shares of agricultural commodities in the world market to determine whether a drop in the U.S. agricultural market share is associated with U.S. sales being displaced by competing suppliers. They developed a method, called trade share accounting (TSA), which establishes the relationship between trade structure and market share. From their empirical results, they identified four distinct trends from 1962-1994. The time period lasting from 1981 to 1987 was termed the contraction period.

For the contraction period, Gehlhar and Vollrath argued that the two farm policies – increased loan rates and target prices in early 1980s – are responsible for lost market shares. These farm policies effectively priced U.S. bulk commodities above the world market price[2], which encouraged competitors to increase production and gain market shares. The overall U.S. agricultural market share halted its precipitous decline in 1987 and then began to increase. It rose modestly, gaining 1.3 percent between 1987 and 1994. The researchers attributed the growth to the EEP as one of the main boosters for U.S. agricultural exports during the period.

The EEP was initiated under the Food Security Act of 1985. The purpose of the program was to offset the adverse effects on U.S. exports due to unfair trade practices or subsidies by competing exporters, particularly the European Union (EU), and also to support U.S. prices. This program allows exporters to sell U.S. products in targeted markets at prices below their costs by providing cash bonuses. According to the data set of *Foreign Agricultural Trade of the United States* (FATUS) provided by FAS/USDA, among the commodities, wheat accounts for more than 80 percent of the total value of all EEP-assisted sales. Until 1994, EEP was applied to an average of 50 to 70 percent of U.S. wheat exports. The impacts of EEP in terms of additional exports and cost effectiveness have been analyzed in several studies. The results of these studies have varied widely, with the level of additional exports ranging from 5 to 70 percent (e.g., Seitzinger and Paarlberg, 1989, and Goldberg and Knetter, 1997).

To capture the effects from the U.S. domestic farm policies and EEP, two dummy variables, D_t^1 and D_t^2, are included in Equation (1). The first dummy denotes increased loan rates and target prices in the early 1980s. The value of D_t^1 is set to be one if *t* is from 1980 to 1984, otherwise

[2] The policies increased both loan rates and target prices because of concern about the potentially negative impact the Soviet grain embargo would have on domestic farm income. The loan rate for wheat increased 36 percent in a single year, rising from $2.35 in 1979 to $3.20 per bushel in 1980. Shortly thereafter, the 1981 Agricultural and Food Act legislated yearly increases in support prices.

zero. The second dummy represents the EEP. The value of D_t^2 is set to be one if t is from 1985 to 1995, otherwise zero.

DATA

The data consist of U.S. wheat market shares in 10 Asian countries – China, Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Singapore, S. Korea, Taiwan, and Thailand. Data also includes average wheat export prices of the United States, Australia, and Canada, and real exchange rates between the 10 Asian importing and three exporting countries. The data are annual and range from 1973/1974 to 1999/2000 by fiscal year.

The data of wheat imported by the Asian countries are acquired from FATUS, published by FAS/USDA. Summary statistics of total wheat imports and specific imports from the United States by the 10 Asian importing countries are presented in Table 1. The data on wheat export prices were provided by *World Grain Statistics*, published by the IGC. The wheat prices are freight-on-board measures and are expressed in U.S., Canadian, and Australian dollars, respectively, per ton. Wheat price quotations and summary statistics of average wheat export prices of the United States, Australia, and Canada are presented in Table 2. From the 10 series, the average prices of U.S., Australian, and Canadian wheat were calculated, under the implicit assumption that these different types of wheat are substitutable for the importers.

Table 1. Summary Statistics of Total Wheat Imports and Imports from the United States by the Ten Asian Countries

Country	Mean	Std. Dev.	Max	Min
China	8008	4781	15863	500
	(2686)	(2531)	(8698)	(0)
Hong Kong	337	181	707	124
	(90)	(42)	(172)	(7)
Indonesia	2102	1085	4201	576
	(402)	(293)	(902)	(0)
Japan	5756	291	6310	5111
	(3209)	(200)	(3567)	(2633)
Malaysia	783	350	1340	336
	(64)	(37)	(127)	(13)
Philippines	1359	727	2982	503
	(1117)	(537)	(2177)	(307)
Singapore	281	91	513	150
	(40)	(19)	(88)	(4)
South Korea	3000	1159	5647	1584
	(1690)	(229)	(2107)	(1340)
Taiwan	815	169	1125	527
	(731)	(160)	(1018)	(442)
Thailand	380	273	830	68
	(165)	(93)	(353)	(37)

Notes: The wheat imports are denoted by quantity (1,000 metric tons). Data run from 1973/1974 through 1999/2000 by fiscal year. The first values are for total wheat imports of the countries, and the values in the parentheses are for wheat imports from the United States by the countries.

Table 2. Summary Statistics of Wheat Prices of the United States, Australia, and Canada

	U.S. Wheat Prices	Australian Wheat Prices	Canadian Wheat Prices
Wheat Price Quotations	No.2 DNS 14% in Gulf and Pacific Ports No.2 HRWO in Gulf Port No.2 Soft Red Winter in Gulf Port No.2 Western White in Pacific Prot No.2 Hard Winter 13% in Pacific Port	Prime Hard Australian Standard White	Canada Western Red Spring 13.5% in St. Lawrence and Pacific ports
Mean	154.67	224.68	231.85
Std. Dev.	24.26	47.87	44.73
Maximum	215.50	328.90	341.03
Minimum	117.00	138.95	149.76

Notes: The wheat prices are freight-on-board (FOB) and they are expressed in U.S., Canadian, and Australian dollars per ton, respectively. Data run from 1973/1974 through 1999/2000 by fiscal year. DNS denotes Dark Northern Spring, and HRWO denotes Hard Red Winter Ordinary.

There are three sets of real exchange rate data: the Asian countries' currency values against the U.S. dollar (R_u); the Asian countries' currency values against the Australian dollar (R_a); and the Asian countries' currency values against the Canadian dollar (R_c). Real exchange rate data were obtained from *Exchange Rates and Agricultural Trade* data set published by the Economic Research Service (ERS) of USDA. The average and standard deviation of the exchange rates are displayed in Table 3.

Table 3. Summary Statistics of Exchange Rates of Asian Importing Countries against U.S., Australian, and Canadian Currencies

Country	vs. United States		vs. Australia		vs. Canada	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
China	5.9	2.2	4.4	1.4	4.7	1.7
Hong Kong	9.2	2.4	7.0	1.6	7.4	2.0
Indonesia	2038.7	1056.6	1492.9	618.8	1594.9	687.4
Japan	144.8	32.8	112.6	34.8	118.4	34.0
Malaysia	903.0	120.0	686.8	79.4	727.2	88.5
Philippines	2.5	0.5	1.8	0.3	2.0	0.3
Singapore	28.0	3.9	21.3	2.4	22.6	3.6
South Korea	1.7	0.2	1.3	0.1	1.3	0.2
Taiwan	31.9	4.0	24.6	4.6	25.9	4.3
Thailand	26.1	4.0	19.8	1.7	21.0	2.4

Notes: The exchange rates are average annual real rates. Data run from 1973/1974 through 1999/2000 by fiscal year. Because of limited space, other statistics such as maximum or minimum are not presented in the table.

Presence of a unit-root process makes the panel data nonstationary, which has the potential to lead to serious errors in inferences and cointegration between nonstationary variables. Therefore, we performed a panel unit-root test devised by Maddala and Wu (1999). Test results, presented in Table 4, indicate that observations follow stationary processes with a linear trend. Therefore, a variable representing a linear time trend is included in the empirical estimation to reduce any erroneous inference from the existence of time trends in the panel data.

Table 4. Results of Panel and Univariate Unit-Root Tests

Test	Variables	Drift	Trend
Maddala-Wu Fisher Test	U.S. Wheat Market Shares	31.990**	59.947**
		(0.043)	(0.000)
	U.S. $ Values in the Asian Countries	22.842	51.971**
		(0.297)	(0.000)
	Australian $ Values in the Asian Countries	12.976	37.719**
		(0.878)	(0.010)
	Canadian $ Values in the Asian Countries	17.881	43.984**
		(0.595)	(0.002)
Augmented Dickey-Fuller Test	U.S. Wheat Export Price	-3.7530**	-3.6651**
		(0.009)	(0.048)
	Canada Wheat Export Price	-2.2561	-2.7594*
		(0.234)	(0.086)
	Australia Wheat Export Price	-1.2214	-3.2241*
		(0.258)	(0.074)

Notes: Since the price variables are univariate, ADF *t*-statistics are reported instead of MWF χ^2-statistics. The symbols * and ** denote rejection of the null hypothesis of unit-root at 10 percent and 5 percent significance level, respectively. The values in parentheses represent *p*-values.

PROCEDURE OF EMPIRICAL ANALYSIS

Each set of real exchange rate panel data is normalized to make each time series equivalent in magnitude. Note that there are three panel exchange rate data, i.e., R_u, R_a, and R_c, and that in each data there are 10 time series. A sample average was calculated for each time series and each observation is divided by the sample average and multiplied by 100 to rescale the observation. The variances of wheat prices and exchange rates were obtained using the moving sample standard deviation of changes that has been used extensively in literature (e.g., Koray and Lastrapes, 1989, and Chowdhury, 1993).

The volatility measure is calculated as follows:

$$V_t = \sqrt{k^{-1}\sum_{i=1}^{k}(R_{t+i-1} - R_{t+i-2})^2}\ , \qquad (2)$$

where V_t is the volatility and k is the order of moving average. In this study, k is specified to be one.

Empirical estimation for Equation (1) is performed using a two-way panel model. To account for any country and time-specific effects that cannot be captured by the explanatory variables in the model, variables for both effects are included in the panel analysis. Statistical justification of

the inclusion of both effects is based on a Lagrange multiplier (LM) test (Breusch and Pagan, 1980). The test statistic was 29.34, which is larger than the critical value of χ^2 distribution with two degrees of freedom at the 5 percent level (5.99). Therefore, the null hypothesis of no country and time effects is rejected. Inclusion of the two effects is appropriate in the estimation, and it helps to avoid bias and inconsistency problems caused by omitting relevant variables.

In the time processes of wheat trade between the United States and the Asian importing countries, a big shock may not die out promptly. Instead, it could have possible lag effects, implying that the first few serial correlations could be substantial and statistically significant. To account for the lag effects, a moving-average (MA) model is used in the residual effect of the two-way panel model. Further, based on a Hausman m-statistic, the country and time effects are treated as random.[3]

The U.S. wheat price is potentially endogenous if there is a simultaneous relationship with the U.S. market shares. If the importers account for the U.S. market shares when purchasing wheat or if the U.S. exporters exert their market power in a destination Asian market based on their market shares, an endogeneity problem might exist in the model. In such cases, values of price variables may be determined inside or by the model. This could cause price variables to be correlated with the error term, resulting in inconsistent estimates.

The endogeneity problem is checked using a test suggested by Spencer and Berk (1981). As the first step, we selected instrument variables which are exogenous or predetermined and are strongly correlated with the U.S. wheat prices but not correlated with the error term e_{it} in Equation (1).[4]

The second step is to run an OLS regression with the chosen instrument variables[5] on the following equation:

$$p_{ust} = \boldsymbol{\delta} \boldsymbol{IV}_t + \upsilon_t, \tag{3}$$

[3] The Hausman (1978) test was performed, and the result showed that the test statistic is 4.11, which is smaller than the critical value of χ^2 distribution with four degrees of freedom at the 5 percent level (9.48). The degrees of freedom are equal to the number of slope parameters. The null hypothesis of no correlation between the effect variables and the regressors was not rejected at the 5 percent significance level. This suggests that the random effects model is more appropriate than the fixed effects model.

[4] The instrument variables include operating and opportunity costs in the production of wheat in the United States: costs of fertilizer, chemicals, seed, fuel-lube-electricity, hired labor, and interest rates. In addition to these six factors, there are more potential instruments, such as opportunity cost of unpaid labor, taxes and insurances, or costs of repairs. Because including too many variables might cause multicollinearity between instrument variables, the instruments were chosen based on *t*-value of each variable and the adjusted R^2. All potential instrument variables were, at first, included in Equation (3) and then statistically insignificant variables were removed. If the *t*-value of a variable is not statistically significant at the 5 percent level and omitting the variable does not significantly reduce the value of the adjusted R^2, then the variable is removed from the estimation equation for both parsimonious specification and reducing the possibility of a multicollinearity problem.

[5] The data of the operating and opportunity costs of producing wheat in the United States were obtained from the *Commodity Costs and Returns* published by ERS/USDA.

where p_{us} denotes U.S. wheat prices; $\boldsymbol{IV}$ is the vector of instrument variables; δ represents the vector of coefficients to be estimated; and υ is an error term with i.i.d. Finally, Equation (1) is estimated with the residual υ_t as an additional independent variable. Under the null hypothesis of no endogeneity, the coefficient of υ_t should be equal to zero. If the test result indicates endogeneity of the U.S. wheat prices, one needs to use the instrument variables instead of the U.S. wheat prices. Estimation results show that the *t*-value of υ_t is 1.18 and its *p*-value is 0.237 when we use the model of two-way random effect with variance-component MA process. The null hypothesis of no endogeneity cannot be rejected. Therefore, any potential endogeneity problem of the U.S. price variable would be insignificant in the estimation.

TRADE SHARE ACCOUNTING

Before the panel estimation, it is necessary to test whether decreased aggregate market share of U.S. wheat in the Asian countries is associated with losses in its market share in individual destination markets or if it is due to any change in the structure of the markets. If markets where an exporting country holds higher market shares grow slower than other markets where the exporting country has lower market shares, the aggregate market share of the country decreases while it maintains constant market shares in individual markets. In this case, the aggregate market share does not correctly reflect the country's export performance.

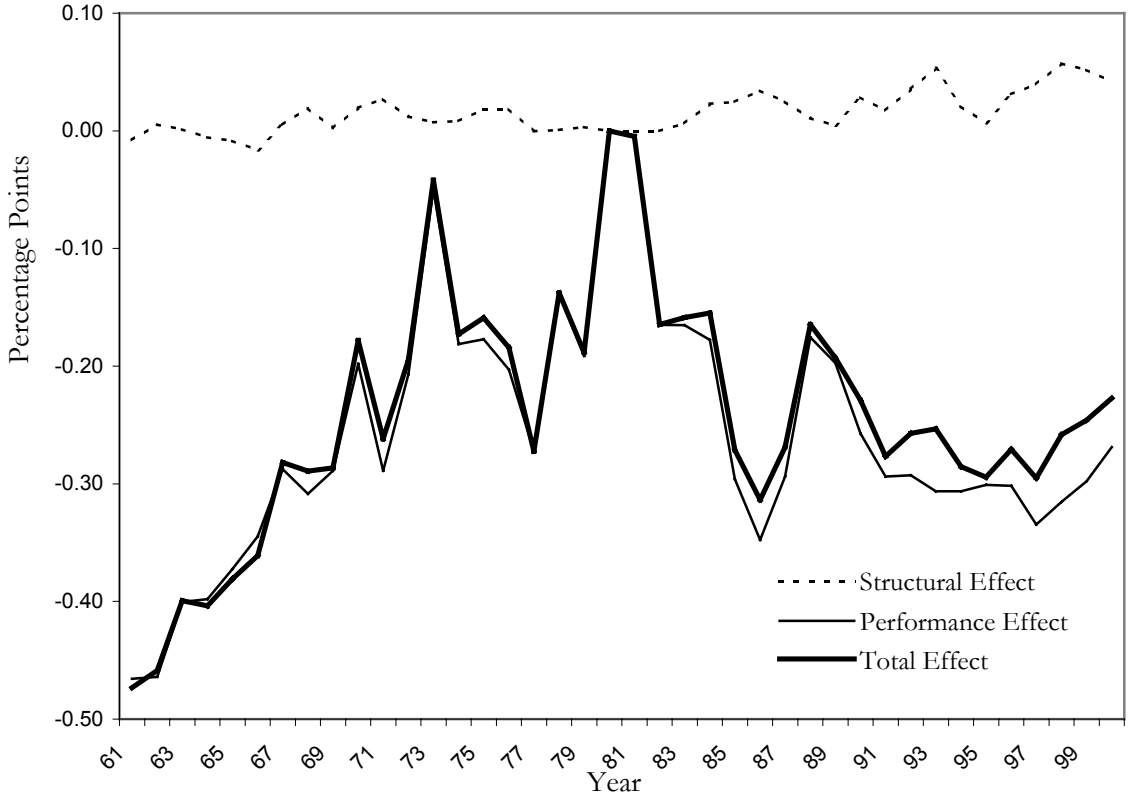
To test whether the decrease in the aggregate market share was necessarily associated with weakened performance of U.S. sales in individual markets or if it was caused by a changed structure in the markets, structural effect and performance effect were derived using the trade share accounting (TSA) method developed by Gehlhar and Vollrath (1997).

Following this process, three trade accountings were established: 1) the individual market share for U.S. wheat in the Asian countries, 2) the relative size of the individual Asian markets, and 3) the aggregate market share of U.S. wheat in the Asian markets. From the three accountings, the observed market share, the fixed-performance market share, and the base-period market share were estimated using 1980 as the base year. Structural effect and performance effect were then calculated using the three market shares.[6]

The results of this calculation are presented in Figure 5, which shows that changes in the aggregate market shares are mainly due to the performance effect. This clearly indicates that decreased U.S. market share is associated with losses in its market share within individual countries, but not related to changes in structure of the Asian markets.

[6] Refer to Gehlhar and Vollrath (1997) for details of the TSA procedure.

Figure 5. Trade Share Accounting for U.S. Wheat in the Asian Countries



Note: Base year for the accounting is 1980.

EMPIRICAL RESULTS

The results from the panel estimation of Equation (1) are presented in Table 5. The panel estimation was performed using the two-way random effect model with variance-component MA process. For the purpose of comparison, the panel estimation was performed again using the other two popular error component models, an autoregressive error component model (Parks, 1967) and a two-way random effect error component model (Fuller and Battese, 1974). The variance-component MA model performs best among the three error component models when we consider economic signs and statistical significance of the estimates. Therefore, economic interpretations are based on the results from the two-way random variance-component MA method.

Table 5. Panel Estimation Results

Variables	Variable Definition	Expected Sign	Variance-Component MA Method	Park's Method	***Fuller and Battese's Method***
α_0	Intercept	.	5.5462** (4.70)	-0.3019 (-0.14)	0.4730 (0.60)
p_a	U.S. Wheat Price/Australian Wheat Price	*Negative*	-1.6835** (-3.11)	-0.0206 (-0.15)	-0.0854 (-0.22)
p_c	U.S. Wheat Price/Canadian Wheat Price	*Negative*	-1.4962** (-2.47)	0.4997** (3.34)	-0.0274 (-0.07)
$V(p_a)$	Volatility of p_a	*Negative*	0.0023 (0.86)	-0.0013** (-1.99)	-0.0019 (-0.98)
$V(p_c)$	Volatility of p_c	*Negative*	0.0048 (0.66)	-0.0045** (-2.58)	-0.0007 (-0.14)
r_a	U.S. $ /Australian $ Values (vs. Asian Countries)	*Negative*	-1.2267** (-2.45)	0.4133** (2.62)	0.3762 (1.15)
r_c	U.S. $ /Canadian $ Values (vs. Asian Countries)	*Negative*	-1.3617** (-3.07)	0.1358 (1.14)	-0.1516 (-0.54)
$V(r_a)$	Volatility of r_a	*Negative*	-0.0008** (-42.77)	-0.0001 (-1.78)	-0.00009 (-0.49)
$V(r_c)$	Volatility of r_c	*Negative*	-0.00001 (-0.29)	0.00002 (0.16)	0.0003 (0.87)
D_1	Dummy for U.S. Domestic Policies in Early 1980's	*Negative*	-0.0590 (-1.12)	-0.0595** (-3.52)	-0.0880** (3.24)
D_2	Dummy for EEP	*Positive*	0.0105 (0.19)	0.0272 (1.56)	0.0421 (1.37)
t	Time Trend	.	-0.0217** (-2.63)	-0.0084** (-3.29)	-0.0137 (-2.79)
	Number of Cross Section		10	10	10
	Length of Time Series		26	26	26
	F test		196.21**	2.58**	6.60**
	R^2		0.79	0.52	0.67

Notes: The values in the parentheses denote *t*-statistics. The null hypothesis of the F-test is that all variables are insignificant, and the values in parentheses are *p*-values. The symbol ** denotes statistical significance at the 5 percent level.

The price variables have negative signs, as expected in the model specification, and they are statistically significant at the 5 percent level. The results imply that relative wheat prices are important variables affecting U.S. market shares in the Asian importing countries. Surprisingly, the price volatility variables have a positive sign, but they are not statistically significant at any conventional level. This implies that the importers are not concerned about price volatility. Note that the data are annual so that the volatility represents annual change. If one uses quarterly or monthly data, qualitatively different results for price volatility variables may be obtained.

The exchange rate variables have negative signs and are statistically significant at the 5 percent level. This suggests that a strong U.S. dollar has a negative effect on U.S. wheat market shares, while strong competitors' exchange rates have favorable effects on U.S. market shares. An appreciation of the U.S. dollar against importing countries' currencies makes U.S. agricultural commodities more expensive, inducing the countries to reduce their imports from the United States. The currency volatility variables have negative signs. The variable for the U.S. dollar volatility relative to the Australian dollar volatility, $V(r_a)$, is statistically significant at the 5 percent level, but the U.S. dollar volatility relative to the Canadian dollar volatility, $V(r_c)$, is not statistically significant at any conventional level. This suggests that the volatility of the Canadian dollar is not as important as the volatility of the Australian dollar in affecting U.S. market shares.

The two dummy variables have the signs which are expected in the model specification, but they are not statistically significant at any conventional level. This indicates that the two farm policies in the early 1980s, which increased loan rates and target prices, did not significantly affect U.S. market shares in Asia and that the EEP was not an effective export policy to reverse the downward trend of U.S. wheat exports after the early 1980s in the Asian markets. The published works which find results most similar to ours for the effects of EEP are those of Seitzinger and Paarlberg (1989) and Goldberg and Knetter (1997). Seitzinger and Paarlberg analyzed the effect of the EEP on U.S. wheat exports. Their study indicates that the program raised volume, prices, and gross export revenues, but that net export revenues rose only slightly. It is important to note that they used sample data from only a portion (1985 through 1988) of the entire EEP period, so comparing our results to theirs may not provide reliable economic meaning. Goldberg and Knetter also analyzed the impacts of EEP for wheat, with a sample period coinciding somewhat with that of our data. The study shows that overall export shares did not rebound in spite of the implementation of the EEP in the post-1985 period.

Within this study, the main explanatory variables, wheat export prices, exchange rates, and volatility of the prices and exchange rates, are formatted as relative values to analyze the effects of competition between the United States and the two other exporting countries, Australia and Canada. The U.S. variables are divided by the two competitive countries' variables. Statistical significances of the variables for relative prices and exchange rates indicate that competition between the wheat exporting countries is another important factor in the Asian markets, in addition to the U.S. wheat prices and currency values. This suggests that decreased U.S. market shares may be associated with increased sales by competing suppliers.

SUMMARY AND CONCLUSION

The objective of this study is to examine factors affecting the U.S. wheat market shares in 10 Asian markets. We included competition effects between wheat exporting countries in the markets and variables representing U.S. farm and trade policies in addition to prices, exchange rates, and their volatilities.

The results show that relative wheat export prices and exchange rates are important factors affecting U.S. market shares. The variables have negative signs and are statistically significant, implying that higher U.S. wheat prices and appreciated U.S. dollar values have detrimental effects on U.S. wheat market shares, while competitors' higher wheat prices and currency appreciation have cross positive effects on U.S. market shares.

The variables of relative volatility of wheat prices and exchange rates are not statistically significant at any conventional level, with the exception of the U.S. dollar volatility relative to the Australian dollar volatility. This implies that importers are not sensitive to volatility in annual price and exchange rate changes. However, they are sensitive to relative changes in U.S. dollar values relative to Australian dollar values, implying that Australia may be a more important third country than Canada for U.S. wheat export in the Asian markets.

The dummy for increased loan rates and target prices in the early 1980s has a negative sign, and the dummy for EEP has a positive sign. However, they are not statistically significant at any conventional level. This implies that the effects of the U.S. farm and trade policies were not substantial enough to cause changes in U.S. wheat export performance in the Asian market. In addition, this study shows that competition among the wheat exporting countries in the Asian markets was another important factor. This implies that decreased U.S. shares are related to increased competitors' shares.

The overall results suggest that wheat importers in the Asian countries are sensitive to the traditional variables: U.S. wheat prices and dollar values of exporting countries. When we consider annual decision making processes by the importers, based on our data frequency, the results imply that U.S. wheat exporters and policy makers need to give additional consideration to relative prices and currency values compared to the competing suppliers.

References

Asseery, A. and D. A. Peel. "The Effect of Exchange Rate Volatility on Exports." *Economics Letters* 37 (1991): 173-77.

Breusch, T. S. and A. R. Pagan. "The Lagrange Multiplier Test and its Application to Model Specification in Econometrics." *The Review of Economic Studies* 47-1 (1980): 239-53.

Buse, A. "Goodness of Fit in Generalized Least Squares Estimation." *American Statistician* 27 (1973): 106-08.

Chowdhury, A. R. "Does Exchange Rate Volatility Depress Trade Flows? Evidence from Error-Correction Models." *Review of Economics and Statistics* 75-4 (1993): 700-06.

Cushman, D. O. "The Effects of Real Exchange Rate Risk on International Trade." *Journal of International Economics* 15 (1983): 45-63.

Fisher, R. A. *Statistical Methods for Research Workers*. 4th ed., Edinburgh: Oliver & Boyd, 1932.

Frankel, J. A. and A. K. Rose. "A Panel Project on Purchasing Power Parity: Mean Reversion Within and Between Countries." *Journal of International Economics* 40 (1996): 209-24.

Fuller, W. A. and Battese, G. E. "Estimation of Linear Models with Crosses-Error Structure." *Journal of Econometrics* 2 (1974): 67-8.

Gehlhar, M. J. and T. L. Vollrath. "U.S. Export Performance In Agricultural Markets." Technical Bulletin No. 1854, Economic Research Service of U.S. Department of Agriculture, Washington D.C., 1997.

Goldberg, P. and M. M. Knetter. "Causes and Consequences of the Export Enhancement Program for Wheat." *The Effects of US Trade Protection and Promotion Policies*. R. Feenstra ed., pp 273-96. University of Chicago Press, Chicago, 1997.

Gotur, P. "Effects of Exchange Rate Volatility on Trade: Some Further Evidence." *IMF Staff Papers* 32 (1985): 475-512.

Harris, R. D. F. and E. Tzavalis. "Inference for Unit Roots in Dynamic Panels Where the Time Dimension is Fixed." *Journal of Econometrics* 91 (1999): 201-226.

Hausman, J. A. "Specification Tests in Econometrics." *Econometrica* 46-6 (1978): 1251-71.

Im, K. S., M. H. Pesaran, and Y. Shin. "Testing for Unit Roots In Heterogeneous Panels." Mimeo, Department of Applied Economics, University of Cambridge, 1997.

International Grains Council. *World Grain Statistics*. London, U.K. 1973/74 through 2000/01.

Kenen, P. B. and D. Rodrik. "Measuring and Analyzing the Effects of Short-Term Volatility in Real Exchange Rates." *The Review of Economics and Statistics* 68 (1986): 311-15.

Koray, F. and W. D. Lastrapes. "Real Exchange Rate Volatility and U.S. Bilateral Trade: A VAR Approach." *The Review of Economics and Statistics* 71 (1989): 708-12.

Langley, S. V., M. Giugale, W. H. Meyers, and C. Hallahan. "International Financial Volatility and Agricultural Commodity Trade: A Primer." *American Journal of Agricultural Economics* 82 (2000): 695-700.

Levin, A. and C. F. Lin. "Unit Root Test in Panel Data: Asymptotic and Finite Sample Properties." Discussion Paper No. 92-93, University of California at San Diego, 1992.

MacDonald, R. "Panel unit root tests and real exchange rates." *Economics Letters* 50 (1996): 7-11.

Maddala, G. S. and S. Wu. "A Comparative Study of Unit Root Tests with Panel Data and A New Simple Test." *Oxford Bulletin of Economics and Statistics* Special Issue (1999): 631-52.

Parks, R. W. "Efficient Estimation of a System of Regression Equations when Distributions Are Both Serially and Contemporaneously Correlated." *Journal of the American Statistical Association* 62 (1967): 500-09.

Pick, D. H. "Exchange Rate Risk and U.S. Agricultural Trade Flows." *American Journal of Agricultural Economics* 72 (1990): 694-700.

Pozo, S. "Conditional Exchange-Rate Volatility and the Volume of International Trade: Evidence from the Early 1900s." *The Review of Economics and Statistics* 74-2 (1992): 325-29.

Seitzinger, A. H. and P. L. Paarlberg. "The Export Enhancement Program: How Has it Affected Wheat Exports." Economic Research Service Publication No. ERSAIB575, U.S. Department of Agriculture, 1989.

Spencer, D. E. and K. N. Berk. "A Limited Information Specification Test." Econometrica, 49 (1981): 1079-85.

U.S. Department of Agriculture, Economic Research Service (ERS). *Commodity Costs and Returns*. Washington, D.C. 2002.

U.S. Department of Agriculture, Economic Research Service (ERS). *Exchange Rates and U.S. Agricultural Trade*. Washington, D.C. 1990.

U.S. Department of Agriculture, Economic Research Service. *Wheat Yearbooks*. Washington D.C., 2002.

U.S. Department of Agriculture, Foreign Agricultural Service (FAS). *Foreign Agricultural Trade of the United States (FATUS)*. http://www.ers.usda.gov/Data/FATUS.

U.S. Department of Agriculture, Foreign Agricultural Service. *World Agricultural Trade Flows*. Washington D.C., 2001.

Wu, Y. "Are Real Exchange Rates Nonstationary? Evidence from a Panel-Data Test," *Journal of Money, Credit, and Banking* 28-1 (1996): 54-63.