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FURTHER EVIDENCE ON COMPETITION IN U.S. GRAIN EXPORT TRADE

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Abstract

This study analyzes the relationship between export market structure and the pricing behavior of U.S. grain exporting firms. A generalized theoretical model that specifies the Lerner index as a function of the Herfindahl-Hirschman index, market specific own-price elasticities of demand, and other market structure and control variables is used. The hypotheses proposed in the study are tested by OLS regression analysis using pooled cross-sectional, time series data sets for U.S. wheat and corn exports. Strong evidence suggesting that market structure does affect the pricing behavior of U.S. wheat exporting firms was found. Specifically, where export concentration is high, demand is strong, or foreign buyers have less market power, the markup on export price over domestic price is higher. Weaker evidence of systematic export price discrimination was found for corn.

FURTHER EVIDENCE ON COMPETITION IN U.S. GRAIN EXPORT TRADE

Policy makers, economists, and farmers have periodically raised concerns over whether traders in agricultural commodity markets, and especially the grain sector, exercise either monopsonistic or monopolistic market power. In response to these concerns, economists have conducted numerous studies on grain trade and grain merchandising. Most agricultural economists conducted studies on grain trade among nations (McCalla, 1966; Alaouze, Watson, and Sturgess, 1978; Carter and Schmitz, 1979; Sarris and Freebairn, 1983; Karp and McCalla, 1983; Kolstad and Burris, 1986; and Paarlberg and Abbott, 1986), assuming that the structure of world grain trade, characterized by a few large exporting nations and some large importing nations, lends itself to the possibility for imperfect competition among trading nations. It was presumed that market power is exercised through the pricing and trading behavior of the government trading authorities (marketing boards) or through trade policies.

It is also possible for imperfect competition to enter through the behavior of large multinational firms involved in grain trade. Among the large grain exporting nations, the United States is unique in its sole reliance on private firms for the execution of export transactions. In other exporting nations these same multinationals provide international transportation services, but they buy grain from government marketing boards at the border. In the U.S., where there is no marketing board, the firms buy from internal domestic markets, move to the grain to ports, and then on to foreign destinations.

Table 1 lists the leading U.S. wheat and corn exporting firms and their share of total U.S. exports in marketing years 1988 and 1989. These figures suggest that the four firm export sales concentration ratio for wheat ranges between 36 and 46 percent, and ranges between 46 to 47 percent for corn. These levels of concentration fall into the range associated with oligopoly in manufacturing industries (Bradburd and Over, 1982). It is this market structure, where the majority of exports are handled by a small number of firms, that prompted the public debate over the competitiveness of the grain export sector.

Table 1. Leading U.S. Wheat and Corn Exporting Firms' Market Shares for Marketing Years 1988 and 1989.

Year / Market Rank	Wheat Exporting Firms	Market Share	Corn Exporting Firms	Market Share
MY 1988		%		%
1	Continental Grain	15.79	Continental Grain	14.92
2	Order	12.32	Ferruzzi	14.16
3	Louis Dreyfus	12.31	Louis Dreyfus	10.65
4	Ferruzzi	5.59	Order	6.87
5	Order-Portland	5.37	Zen Noh Grain	6.54
6	Bunge Corporation	4.37	Agrex	6.05
7	Order-New York	3.81	Order-Minnetonka	5.38
8	Mitsui Grain	3.47	Alfred C. Toepfer Intl.	4.39
MY 1989				
1	Continental Grain	13.87	Continental Grain	15.90
2	Louis Dreyfus	9.95	Cargill Corporation	14.32
3	Cargill Corporation	7.40	Louis Dreyfus	8.93
4	Mitsui Grain	5.22	Agrex	6.46
5	Order	4.09	Zen Noh Grain	5.94
6	Order-New York	4.07	Ferruzzi	5.01
7	Mitsubishi	3.37	Peavey Grain	3.89
8	Union Equity Coop. Exch.	3.29	Mitsui Grain	3.79

Source: Port Import/Export Reporting Service, *Journal of Commerce*.
Note: Not all firm names are revealed in this data source. Some firms are identified as "Order" or as "Order" in combination with a city name where the firm is headquartered or has some other significant facility. This data source is further discussed later in this paper.

> "The five companies [Cargill, Continental, Bunge, Dreyfus, and Cook] maintain a strangle hold over the world's grain supply and constitute a food cartel unprecedented in world history. The grain companies are not at the mercy of the free market.
>
> On the contrary, they use their enormous size to manipulate the free marketplace and to maximize profits at the expense of farmer and consumer alike." (Burbach, 1976, p. 25)

Views such as this and those expressed by others (Morgan, 1979), including policy makers, prompted economists to analyze the U.S. export grain trading system. In comparison to the number of studies on grain trade among nations, this literature is not nearly as extensive, due in part to the difficulty of obtaining data on the conduct of private firms. One valuable, early descriptive analysis prepared by Juillerate and Farris (1971), described the export system, including the ownership of facilities, and traced grain movements to export facilities. Another descriptive analysis was prepared by McCalla and Schmitz (1979a), where a comparison of the U.S. and Canadian marketing systems was made. However, these authors were unable to come to precise conclusions on the relative performance of these two systems. Later studies placed greater emphasis on evaluating the performance of the U.S. export grain marketing system. Studies by Thompson and Dahl (1979) and Conklin (1981) focused on pricing efficiency within the export system. These authors argue that the system displays evidence of pricing efficiency. These results are largely attributable to the market institutions, such as the futures market and government reports, which help to insure efficient price discovery. Still, these studies provided little insight into the structure of the industry nor how it may affect performance.

Caves (1977) developed an analytical framework for explaining the structure and performance of the grain export sector. The corollaries he developed were later tested using survey data collected from a small number of member firms of the North American Export Grain Association (Caves and Pugel, 1982). In their analysis of wheat, corn, and soybean exports, they argue that the high level of concentration observed in the export sector is attributable to economies of scale in information handling and to risk spreading. It is further argued that the grain export sector is a competitive market and that there is an "absence of focal points for parallel noncompetitive behavior" (Caves and Pugel,

p. 274). However, Caves and Pugel offered no direct test of the relationship between pricing behavior and market structure.

A more recent study by Pick and Park (1991) explored the pricing behavior of export firms, specifically examining the possibility that U.S. exporting firms may employ discriminatory pricing policies towards specific destinations, either in a systematic fashion across time or in response to changes in bilateral exchange rates. In their analysis of cotton, corn, soybean, soybean oil, and wheat exports, they found some evidence of discriminatory pricing, in the wheat export market only.

Whether large multinational firms executing U.S. grain export transactions exercise market power, and whether the structure of the market contributes to that outcome, remains an open question. It is hypothesized here that the export market structure has a significant impact on the pricing behavior of U.S. wheat and corn exporting firms. The purpose of this study is, therefore, to determine if the sales concentration of U.S. exporting firms, the total U.S. market share in foreign markets, and the proportion of U.S. exports purchased by foreign buyers have an impact on the discriminatory pricing behavior of U.S. firms in foreign markets.

This paper will extend and synthesize the works by Caves and Pugel and Pick and Park, by offering new evidence on how grain export pricing is affected by market structure. It will also use a more recent and comprehensive firm-level data set on U.S. grain exports, not used in other studies.

This study should be useful to policy makers, commodity analysts, and researchers, as it provides new evidence on the structure and conduct of firms in the grain export market. To date, the information on the structure of grain export trade is still fairly limited. Also, administrators of export programs, such as the Export Enhancement Program (EEP), may benefit from a new view of export competition in the grain sector. Finally, it is believed that a better understanding of the behavior of firms in international markets should assist researchers in developing new modeling approaches for international trade problems where market power matters.

A generalized theoretical model that specifies the price-cost margin, or Lerner index (Lerner, 1934), as a function of the Herfindahl-Hirschman index (HHI; Hirschman, 1964), market specific own-

price elasticities of demand, and other market structure and control variables is used in the analysis. The hypotheses put forth in this study are tested by ordinary least squares regression analysis using pooled cross-sectional, time series data sets for U.S. wheat and corn exports. The model employed in the analysis is first developed, then the alternative data sources are discussed. This is followed by a discussion of empirical results.

Methodology

If it may be assumed that the goods (and services) supplied by grain merchandising firms are viewed as homogenous goods by the buying agents in a particular country, then the model proposed by Cowling and Waterson (1976) may be employed to specify the theoretical model. These authors suggest that the first order conditions derived from the profit maximization problem for Cournot firms provides an appropriate specification for cross-sectional studies analyzing the relationship between market structure and the price-cost margin, or Lerner index. This familiar relationship is given as follows,

$$(1) \qquad \frac{(P - \overline{MC})}{P} = \frac{HHI}{\epsilon}$$

The term on the left is equal to the Lerner index, where P is the observed market price and $\overline{MC}$ is an average of the marginal costs incurred by the firms in the market. This index measures the proportion by which price exceeds marginal costs - the price markup. The terms on the right are the Herfindahl-Hirschman index (HHI)[1], which measure concentration, and the market specific own-price elasticity of demand (ϵ). The Lerner index is hypothesized to be positively related to concentration and negatively related to the elasticity of demand.

While this model is appealing, in that it is derived from neoclassical economic theory, it is likely that other variables have an important impact on the price markup firms apply to particular destinations. Indeed, Cowling and Waterson mention the need to introduce other important variables to account for "real world" phenomena.

In this study it was postulated that the share of a foreign market held by U.S. exporters is important in determining the price markup applied. This is due to the observed relationship in industrial organization that the extent to which cartel firms may price above marginal costs is limited by the presence of non-cartel firms. Also, U.S. export firms act as a cartel only if there are few foreign competitors. The greater the number of non-cartel firms (the lower the U.S. market share) the lower the markup. Therefore, a positive relationship is expected between the Lerner index and the variable measuring U.S. market share.

While large sellers may succeed in exercising market power, it has been suggested that large grain buyers may succeed in exercising countervailing market power, as well (Carter and Schmitz). The structure of many international import markets, where imports are purchased by state trading agencies, further facilitates this possible outcome. It has been suggested that 95 percent of the transactions in the world wheat market involve state traders on one or both sides of the transaction (McCalla and Schmitz, 1979b). Therefore, a variable measuring the proportion of U.S. exports accounted for by an individual importer was also included to measure the size of foreign buyers. Here, a negative relation is expected between the Lerner index and this variable.

Pick and Park tested the pricing-to-market hypothesis advanced by Krugman (1987), whereby export prices to particular destinations denominated in the exporter's currency vary in response to changes in bilateral exchange rates. Krugman proposes that an increase in the bilateral exchange rate (FCU/$U.S.) will bring about a decrease in the export price ($U.S./ton) for the corresponding country. The nominal exchange rate is included in the general model employed in this study to determine the affect of exchange rate changes on price markups. Given the hypothesized decrease in export price following a foreign currency depreciation, a negative relationship between the Lerner index and the exchange rate would be expected, provided there is no concurrent change in marginal costs.

The data period used in this study, marketing years 1979 through 1989, covers a period of strong export growth, extending through 1981, and then a period of declining exports. It was hypothesized that firms enjoy larger markups during periods of strong demand and slimmer margins

during recessionary periods. To test this hypothesis, the total volume of U.S. exports during each marketing year was introduced as an additional explanatory variable. A positive relationship is expected between the Lerner index and U.S. export volume. It should be noted that since this analysis was conducted using a pooled data set, this variable enters in a manner similar to an annual dummy variable.

Finally, in reduced form, forecasting models for commodity prices, the stocks-to-use ratio is a frequently included variable. This variable is useful for measuring the relative scarcity of a commodity in a market and is expected, here, to indicate the strength of foreign demand. Therefore, both U.S. and importer stocks-to-use ratios were included in the model. These variables were included partly to reduce the unexplained variability in the dependent variable and thereby increase the power of the significance tests. These variables also proved to provide some additional insights into the behavior of firms in these export markets. Large stocks in the U.S. could depress the export price and reduce marginal costs for a grain merchandising firm. The extent to which price and marginal costs are depressed may not be equiproportional. Larger declines in marginal costs are expected, since it is assumed that exporters exercise some control over price and are likely to limit its downward movement. Although the relationship between the Lerner index and the U.S. stocks-to-use variable may be positive or negative, a positive relationship is expected here. The relation between the Lerner index and the foreign stocks-to-use ratio depends largely on the import and production policies in the foreign country.

Incorporating these additional variables in the model yields an equation that can be represented in a general form as follows,

$$(2) \quad L_{jt} = f\left(\frac{HHI_{jt}}{\epsilon_{jt}},\ USSHR_{jt},\ FMS_{jt},\ NEXR_{jt},\ USEXP_{t},\ USSTU_{t},\ FSTU_{jt}\right)$$

L_{jt} is the Lerner index, expressed as a percent, for country j in marketing year t and is defined as $[\ (P_{jt} - \overline{MC_t})\ /\ P_{jt}\ ] \times 100$;

HHI_{jt} is the Herfindahl-Hirschman index defined for shipments by U.S. exporters to country j in marketing year t and measures the extent of firm concentration by trade route;

ϵ_j is the specific own-price elasticity of demand in market j;

$USSHR_{jt}$ is the U.S. percentage market share in country j during year t and is defined as [$(Imports\ from\ U.S.)_{jt}$ / $(Total\ Imports)_{jt}$] x 100;

FMS_{jt} is the percentage of U.S. exports accounted for by country j in year t and is defined as [$(Imports\ from\ U.S.)_{jt}$ / $(Total\ U.S.\ Exports)_{jt}$] x 100;

$NEXR_{jt}$ is the nominal bilateral (U.S. and country j) exchange rate during year t;

$USSTU_t$ is the U.S. stocks-to-use ratio, defined as ending stocks divided by domestic consumption, in period t ;

$FSTU_{jt}$ is the stocks-to-use ratio in import country j for period t.

Before proceeding with a discussion on the data, a few additional comments on methodology are in order. The primary objective of this study was to test hypotheses on the relationship between export market structure and pricing behavior. The development of a model for predictive purposes was not necessarily an essential criteria. The results are intended to be used in developing more refined models of firm-level behavior in export markets. While some may question the model specification and testing procedures, it is felt that the approach utilized here is appropriate, given the limited goals of this study. Several empirical regularities were found using this approach.

Data

The data used in this study were assembled from six sources to form a cross-sectional, time series data set covering marketing years 1979 through 1989.[2] Cross-sectional components correspond to the country destinations to which the U.S. shipped grain. For wheat, the sample included 93 countries; the corn sample included 82 countries. It is assumed that each country defines an appropriate geographic market and that a year is the appropriate time horizon for the decision making agents in these markets.

The Lerner index was calculated directly from price data available from two sources. The export price to destination j (P_{jt}) was estimated using the U.S. Department of Commerce Schedule B export value and quantity data to calculate the unit value of exports for each country destination during each marketing year.[3] The value data used in this calculation are FAS (free alongside ship) values,

which exclude the cost of loading and other charges associated with delivering the product from the U.S. border to the destination. The average U.S. domestic farm price for wheat and corn, as given by *Agricultural Statistics*, was used as a proxy for marginal cost (MC_t). It might be argued that if the costs of moving grain from interior locations to export facilities are low relative to the value of the grain and remain fixed within a given year, then an average domestic price may approximately measure marginal costs for grain merchandising firms.

The index, as calculated here, then measures the extent to which the price of grain sold to particular destinations exceeds an average price at which grain may have been acquired at some interior location. It is recognized that domestic transport costs from various interior markets to various port facilities differ. To account for differences in domestic transport costs to West coast and East or Gulf coast ports, a dummy variable was introduced in the model in equation (2). Destination countries lying between 90 degrees longitude west and 60 degrees east (South America, Europe, Africa, and the Middle East) were designated as east supplied countries, under the assumption that these countries would most likely be serviced by shipments from either East coast or Gulf ports. In these situations the dummy value was set to 1. All other countries were denoted as west supplied destinations, under the assumption that they were most likely serviced by West coast ports, and the dummy was set to zero.[4]

Provided these arguments are accepted, a reasonable estimate of the Lerner index may be calculated directly from price data. Price data have been used in other studies to calculate the Lerner index, including those by Parker and Connor (1979), Nickell and Metcalf (1978), and Connor and Peterson (1991).

Net trade elasticities, obtained from Patterson (1987), served as the market specific own-price elasticities of demand. Net trade elasticities measure the price responsiveness of importers (and exporters) over the short to medium run, taking into account price transmission, stock adjustment, and demand elasticities. In an analysis involving importers, this is the appropriate measure of price responsiveness, as stocks and trade policies play an important role in determining import volumes.

Also, when exporting firms are setting specific export prices and determining markups, these same factors are likely to play an important role in this short run decision making process. The elasticities obtained from Patterson, presented in Table 2, are based on the 1986 USDA study, *Embargoes, Surplus Disposal, and U.S. Agriculture*. For some destinations, which were modeled as net exporters in Patterson, it was necessary to assume an elasticity measure. In those instances, the elasticity was set to 0.1 under the assumption that these were specialized import purchases that would not be very price responsive. It was also assumed that these elasticities remained constant over the entire period of observation. The domestic own-price elasticities of demand used in the USDA SWOPSIM (Sullivan, et al, 1989) model were also employed in this analysis.

The U.S. share variable ($USSHR_{jt}$), U.S. stocks-to-use variable ($USSTU_t$), and foreign stocks-to-use variable ($FSTU_{jt}$) were calculated using data obtained from *Production, Supply, and Demand View* (Gundsman and Webb, 1991). The U.S. share variable was calculated by dividing U.S. shipments to individual markets by total market imports. However, due to transshipments and shipment delays, this approach yielded U.S. shares exceeding 100 percent in some markets. When this occurred, the share was limited to 100.

Nominal exchange rate data for International Monetary Fund members were obtained from *International Financial Statistics*. Official exchange rate data for the Soviet Union, a non-IMF-member, were obtained from *Ekonomicheskaya Gazeta*. All exchange rates are expressed in terms of foreign currency units per U.S. dollar (FCU/$U.S.) and represent the average rate for the calendar year.[5] All other variables in the model are measured on a marketing year basis, thereby presenting a slight mismatch in time periods. As close a match as possible was made in joining these data.[6] The exchange rate is important because of its potential affect on individual importers over time. Therefore, to reduce possible, spurious cross-sectional effects, due to the large variation in the magnitude of this variable across countries, each country's exchange rate was normalized on the 1989 rate.

The new data set used in this study is the Port Import/Export Reporting Service (PIERS) data, available from the *Journal of Commerce*. This data set is composed of the individual export

Table 2. Estimated Net Trade Elasticities for Wheat and Corn.

Country or Region	Wheat	Corn
Canada	0.100 a[1]	0.100 a
EEC	0.100 a	0.144
Western Europe	0.612	3.155
Japan	0.041	0.588
Oceania	0.100 a	0.100 a
Eastern Europe	0.539	0.587
China	0.568	0.001
Mexico	1.071	0.929
Central America	0.247	0.777
Brazil	0.142	0.744
Argentina	0.100 a	0.100 a
Venezuela	0.392	0.785
South America	0.309	1.119
Subsaharan Africa	0.325	2.394
Nigeria	0.042	6.634
Egypt	0.300	0.759
North Africa	0.419	10.025
India	6.642	0.001 b[2]
South Asia	0.868	0.001 b
Indonesia	0.279	0.001 b
Thailand	0.310	0.100 a
Southeast Asia	0.451	3.057
East Asia	0.374	1.344
Middle East	0.591	1.402

[1] An "a" denotes a value that was assumed in this study since these countries or regions appeared as net exporters in the study by Patterson.
[2] A "b" denotes values that were 0.000 in the study by Patterson and are set to 0.001 in the current study.

transactions of U.S. exporting firms. It specifies the commodity, quantity, exporter, date and port of departure, and destination country and port for each shipment recorded in U.S. Customs Service documents. These data have proven to be very useful in providing detailed information on the structure of U.S. exports. It has also been shown to be very accurate if handled properly by the researcher, in that commodity export volumes correspond closely with Census Department data (Patterson and Abbott, 1991). These data were used to calculate the HHI for each destination during each marketing year and the foreign market share variable (FMS_{jt}).

The PIERS data set does not include the value of export shipments, as the Journal of Commerce is forbidden by law from doing so. Therefore, unit values were calculated from the Commerce Department data. Also, U.S. exporters may elect to periodically file documents to prevent the disclosure of their company name in this data set. In such situations, the company name is designated as "ORDER". However, the city in which the company is headquartered or some other significant facilities location is identified in the data set. Thus, in situations where the company name is denoted as "ORDER", an alias for the company name was formed using the city location as an identifier for the firm. For the entire data period for wheat, records with "ORDER" in the company name data field accounted for about 28 percent of the records and 37 percent of total shipment volume. For corn, 31 percent of the records and 37 percent of shipment volume occurred under the "ORDER" moniker. These values for the percent of records and the percent of total shipment volume gradually declined over the data period, falling to as low as 11 and 15 percent for wheat in 1989, and 15 and 16 percent for corn in 1988. Concentration measures for individual foreign markets were generally found to be similar when the observations with firms denoted as "ORDER" were included and excluded from the sample. Even though it is felt that the firms were uniquely identified by using the city name alias, the discussion of the results presents estimates obtained from samples both including and excluding the "ORDER" observations.

Tables 3 and 4 show the concentration measures, market structure variables, and Lerner index for selected countries in selected years. The two samples used to calculate the four-firm concentration

ratio (CR4) and the HHI are denoted as A and B. Sample A contains firm names represented by the "ORDER" city name descriptor. Sample B excludes all observations containing "ORDER" in the firm name data field. These tables are intended to provided some casual evidence of the hypothesized relationships between market structure and export pricing. It is seen that the markup (Lerner index) reaches a maximum value in most markets in 1981 and falls in later years. This reflects the proposed hypothesis that the markup is greater during years of strong export demand. The substantially smaller values for this index in 1985 and 1988, as in the case of Egyptian wheat shipments, may reflect actions under the EEP. Also, some of the negative index values may be attributable to this program. The Lerner index also appears to be positively correlated with U.S. market share. In making comparisons across some markets, there appears to be a negative relationship between the share of U.S. exports purchased by individual buyers and the Lerner index. For instance, Brazil, a fairly small buyer of U.S. corn, faces a larger markup than does Japan, a large buyer of U.S. corn. The relationship between concentration and the Lerner index is not as easily discernable by casually reviewing the data. However, the similarity of the concentration measures obtained from the different samples can be seen. Tests of the relationship between concentration and the other market structure variables and the Lerner index are presented in the next section.

Empirical Results

Table 5 presents the ordinary least squares estimates of the general form model specified in equation (2), with the addition of the East-West dummy variable for wheat exports. This model is labeled Equation 2.1 in the table. There are two additional models labeled as Equation 2.2 and Equation 2.3. Each of these is a minor variant of equation 2.1. The specification of these latter models is discussed later in this section with the results for each. Also, for each model, both samples were used in the estimation. The results for equation 2.1 for wheat indicate that the export market structure does have a significant impact on the markup firms apply to the average domestic price when setting the export border price for each destination. The coefficient on the concentration measure

Table 3. Wheat: Lerner Index, Concentration Measures, Share of U.S. Exports, and U.S. Market Share in Selected Markets and Years

Country and Year	Lerner Index	CR4 A	CR4 B	HHI A	HHI B	Share of U.S. Exports	U.S. Market Share
		Percent				*Percent*	
USSR							
1979	13.95	90.7	100.0	3012.5	3790.8	12.58	32.17
1981	27.23	85.1	98.8	2212.1	4637.4	10.53	32.93
1985	7.10	100.0	100.0	3159.9	3159.9	0.69	0.98
1988	6.81	66.2	71.7	1249.5	1563.8	12.65	27.83
China							
1979	5.36	100.0	100.0	5112.9	5870.9	4.22	23.46
1981	16.95	72.3	88.8	1683.0	2939.0	16.34	62.46
1985	8.22	81.5	100.0	2173.9	5520.9	2.29	7.73
1988	-5.61	60.3	70.4	1155.0	1566.3	21.25	46.82
Brazil							
1979	18.85	63.5	49.8	1612.2	1088.3	11.21	46.59
1981	22.89	60.8	58.1	1229.8	1361.2	6.93	67.39
1985	17.02	55.3	61.2	1139.1	1269.2	3.21	33.41
Netherlands							
1979	19.28	78.8	84.0	2403.3	2396.7	1.51	42.35
1981	21.25	96.9	100.0	2754.9	5908.9	0.90	35.34
1985	18.45	99.8	100.0	2897.1	6502.1	0.31	24.21
1988	-0.19	100.0	100.0	4952.5	4952.5	0.01	0.17
Italy							
1979	21.26	100.0	100.0	7847.1	7847.1	0.79	14.55
1981	29.12	90.6	99.9	2562.3	4868.4	1.04	31.12
1985	26.67	100.0	100.0	3955.5	5328.5	0.22	7.94
1988	17.02	100.0	100.0	5751.4	5751.4	0.14	6.36
Israel							
1979	19.49	86.0	100.0	2739.1	4053.4	2.37	100.00
1981	25.40	97.6	99.5	4425.2	5850.6	0.77	83.94
1985	15.55	81.1	100.0	1938.2	6009.7	2.31	72.41
1988	14.34	100.0	100.0	4340.6	7168.7	1.19	67.00
India							
1981	22.21	73.5	76.0	2167.2	1813.9	4.07	75.75
1985	20.09	100.0	100.0	3476.6	3529.2	0.61	100.00
1988	-12.50	52.7	62.2	1106.1	1424.6	5.85	78.48
Indonesia							
1979	21.72	100.0	100.0	5159.5	5159.5	0.02	59.14
1981	20.59	92.2	97.6	3959.0	3670.2	1.92	62.69
1985	21.53	76.2	92.8	1877.5	2676.1	1.25	19.36
1988	14.13	82.0	97.7	2013.5	2998.7	0.50	12.47
South Korea							
1985	17.76	77.7	88.1	1839.9	2956.8	8.80	38.67
1988	17.00	72.9	82.5	1690.1	2036.5	4.95	8.00
Japan							
1979	20.54	100.0	100.0	2883.9	3987.5	0.57	56.47
1981	22.76	55.6	61.6	1050.1	1230.8	8.28	59.98
1985	21.40	45.3	57.2	829.2	1149.0	14.95	58.35
1988	17.93	48.8	55.4	943.1	1119.8	8.02	48.75
Egypt							
1979	15.77	73.5	78.4	1720.2	2006.7	5.26	35.43
1981	14.03	71.6	67.3	1855.3	1593.9	5.34	44.47
1985	6.78	74.9	85.7	1840.9	3835.7	7.06	36.61
1988	9.93	66.3	80.8	1319.5	1997.6	8.03	52.84
Nigeria							
1979	19.78	91.3	94.2	3256.2	5269.6	4.62	72.96
1981	25.30	93.9	97.8	6265.6	7039.5	2.71	80.32
1985	21.80	90.8	96.2	4068.1	5125.9	4.26	62.00

Table 4. Corn: Lerner Index, Concentration Measures, Share of U.S. Exports, and U.S. Market Share in Selected Markets and Years

Country and Year	Lerner Index	CR4		HHI		Share of U.S. Exports	U.S. Market Share
		A	B	A	B		
USSR	-------	*Percent*	-------			--- *Percent* ---	
1979	26.11	67.7	73.0	1542.6	1699.9	8.45	39.64
1981	22.76	67.3	78.9	1598.7	3098.8	10.37	43.91
1985	11.02	51.9	59.2	901.2	1230.3	17.81	65.39
1988	17.15	73.6	85.5	2055.3	2894.9	29.13	87.80
China							
1979	24.72	85.6	87.9	2554.7	3392.3	2.37	90.95
1981	20.44	67.2	61.6	1412.1	1629.4	2.16	100.00
Brazil							
1979	26.70	64.9	71.2	1618.4	2302.2	2.85	85.75
1985	16.35	77.5	75.9	2167.6	1780.5	3.77	53.25
1988	22.79	100.0	100.0	6765.3	6765.3	0.05	20.00
Netherlands							
1979	22.65	69.8	68.0	1386.4	1511.9	4.65	71.02
1981	19.31	55.2	57.9	982.6	1168.7	4.61	43.46
1985	10.43	93.5	99.9	3527.0	3939.5	0.56	2.34
Italy							
1979	22.83	70.9	78.9	2127.2	2810.9	3.66	78.35
1981	18.80	97.9	100.0	4298.7	7952.3	1.55	31.16
1985	11.38	100.0	100.0	3031.4	4227.2	0.12	9.57
Israel							
1979	19.66	85.7	100.0	2317.5	4342.8	0.86	95.19
1981	22.63	66.5	100.0	1413.2	3142.4	0.71	72.66
1985	1.01	87.3	100.0	2356.3	3681.3	1.13	100.00
1988	-1.08	93.7	100.0	2644.6	4213.3	0.58	70.59
India							
1979	59.86	100.0	100.0	5179.4	5179.4	0.02	93.75
1988	16.17	100.0	100.0	5322.0	9442.4	0.32	100.00
Indonesia							
1981	36.65	100.0	100.0	9702.8	9702.8	0.01	100.00
South Korea							
1981	20.04	44.8	47.5	800.3	857.2	5.27	60.00
1985	-3.16	47.2	54.1	903.4	1128.9	4.16	48.78
Japan							
1979	25.09	59.0	62.3	1197.5	1203.3	13.99	89.69
1981	19.30	61.0	76.0	1190.7	2021.2	20.29	80.85
1985	4.65	62.1	80.5	1469.9	2252.2	30.43	65.02
1988	12.79	55.6	62.1	1138.4	1370.5	25.80	84.87
Egypt							
1979	24.40	73.1	83.2	1663.5	2092.8	1.04	100.00
1981	18.99	48.9	59.3	838.3	1130.3	2.85	100.00
1985	4.05	51.7	64.1	960.2	1402.5	5.00	79.64
1988	10.44	68.0	70.8	1377.5	1710.1	2.21	69.69
Nigeria							
1979	35.16	81.3	93.4	1856.8	2235.0	0.18	80.00
1981	21.55	72.6	80.3	1575.8	1888.9	0.65	80.50
1985	16.95	100.0	100.0	7387.7	9854.9	0.03	10.00

(HHI/ϵ) is positive and significantly different from zero at the one percent significance level for both samples. Next, the larger the share of the market held by U.S. exporters, the greater the markup. Conversely, the greater the proportion of U.S. exports accounted for by an individual importer (the larger the importer), the lower the markup. The hypothesis that the markup is positively related to export volume is also supported. Again, this suggests that exporters appear to enjoy larger markups during strong demand periods. The coefficients on both the U.S. and foreign stocks-to-use ratios are positive and significantly different from zero. This suggests that U.S. domestic prices may fall more than export prices during periods of large stocks, thereby producing a larger markup, and that the markup appears to be larger when foreign demand is strong. No significant relationship between the Lerner index and the nominal exchange rate was found. This suggests that movements in the bilateral exchange rate do not systematically affect the markup firms apply to specific destinations.

In summary, the coefficient estimates for equation 2.1 suggest that export market structure does affect the pricing behavior of U.S. wheat exporting firms. Where concentration is high, demand is strong, or foreign buyers have less market power, the markup on export price over domestic price is higher. While the predictive power of this model would be considered poor, as measured by the corrected coefficient of variation, the null hypothesis that all coefficients equal zero is rejected at the 1 percent significance level (F-value). This adds some confidence to the observed relationships, despite the low adjusted R-square. Attempts to model the concentration measure in a nonlinear form and as an interactive variable with U.S. export volume yielded no additional significant results. A subsample for the period prior to the initiation of the EEP, marketing years 1979 through 1985, yielded results that were qualitatively similar. Also, use of the SWOPSIM elasticities produced similar results. Since stocks and price transmission elasticities are important in short run analyses and since the SWOPSIM elasticities are more appropriate for medium to long term analyses (3-5 years; Gardiner, et al, 1989, p. 6), the net trade elasticities obtained from Patterson were deemed more appropriate for this study.

Equation 2.2 is a variant of equation 2.1. Here, the traditional four-firm concentration ratio (CR4) is used instead of the ratio of the HHI to the elasticity of demand (HHI/ϵ). This model, follows in the Bainsian cross-sectional analysis tradition. This modeling approach has been criticized by many economists (Carlton and Perloff, 1990). The strongest critique of this approach is that it must be assumed that demand elasticities are the same across all industries or markets. Given the set of elasticities used in this study (Table 2) this is hardly a plausible assumption. Also, some have questioned the exogeneity of the independent variables used in this type of model. Indeed, this criticism can be leveled against equation 2.1, as well. Nevertheless, industrial organization economists have used similar models in efforts to establish some of the empirical regularities that continue to be accepted. The model is utilized here as a means of comparing the empirical findings obtained from equation 2.1. Here, it is observed that concentration, as measured by CR4, is positive and significantly related to the price markup. With the exception of the variable measuring countervailing import market power, the same relationships between market structure and the Lerner index are obtained here as in equation 2.1.

Equation 2.3 is another variant of equation 2.1. The independent variables are the same, but now the dependent variable (performance variable) is the wheat export price for individual markets (P_{jt}). This model is a generalized extension of the model used by Pick and Park, and is consistent with other cross-sectional studies where price is used as a performance variable (Weiss). Generally, the observed structure-price relationships are as expected: a larger U.S. market share and higher concentration increases the export price; and, larger import markets receive lower export prices. Two of the other observed relationships deserve special comment.

First, a negative, significant relationship between export price and the nominal exchange rate (FCU/$U.S.) is observed. Thus, as a foreign currency depreciates relative to the dollar (an increase in the exchange rate), exporters may lower the export price of wheat to offset the loss in purchasing power realized by foreign buyers. This is consistent with Krugman's pricing-to-market hypothesis. Recall, no significant relationship between the Lerner index and the exchange rate was observed. This

suggests, that as the export price is lowered for a significant volume of exports, the internal domestic price falls, as well. The fall in the domestic price could be the result of domestic monopsonistic market power exercised by leading exporting firms.

The other relationship to be noted is that between the wheat export price and the U.S. stocks-to-use ratio. Here, a significant negative relationship is observed, compared to a significant, positive relationship between the Lerner index and the stocks-to-use ratio. This suggests that large U.S. stocks tend to depress the average domestic price proportionally more than the export price. Thus, a significant, positive relationship may exist between stocks and the Lerner index, even in the presence of large domestic stocks.

Taken together, these last two relationships would suggest that price changes are transmitted more completely backwards through the export system, than forward. That is, changes in the border price, due to exchange rate movements, are more likely to affect internal domestic prices, than are changes in the internal domestic price, due to the stock situation, likely to affect the export price. Measurement of the asymmetric margin adjustment suggested here may be possible using a margin model, like the retail-wholesale margin model used by Carman and Pick (1990).

Table 6 presents similar estimates for corn. The same equations are estimated for each of the two corn samples (with and without "ORDER" observations). Using equation 2.1 for corn, weak evidence relating the destination specific price markup to concentration is found. In sample A, the coefficient for this variable (HHI/ϵ) is significantly different from zero at the 5 percent level. Using sample B, the level of significance falls to the 10 percent level. So, evidence supporting the hypothesis that the markup is linked to the export sales concentration and the elasticity of demand is not as strong for corn, as compared to wheat. It is also observed that neither the market share held by the U.S. nor the proportion of U.S. exports purchased by an individual importer are significantly related to the price markup. For wheat, these variables were found to be significant. These results probably reflect differences in the nature of competition in these international markets. The U.S. is a clear leader in international corn trade and faces less competition in this specific product market. However, in

countries where corn is used primarily as a feed grain, the U.S. faces considerable competition from other coarse grains from other exporting nations, which can be easily substituted for corn in feed rations. Given this additional competition and the relatively large elasticities of demand for corn, it is unlikely all U.S. exporters can achieve appreciable markups in foreign markets, even when a large share of the market is held by a small number of U.S. exporters. Also, there are not large foreign buyers of corn, as in the wheat export market. Therefore, the likelihood of countervailing market power being exercised is reduced.

In equation 2.2 a stronger relationship between the Lerner index and concentration, as measured by CR4, is measured. Equation 2.3 shows that the corn export price tends to increase, as export sales concentration increases or the elasticity of demand decreases. Equations 2.1 and 2.3 also show that large U.S. stocks may depress the average domestic corn price by more than the export price. No significant relationship between the exchange rate and the price markup nor export price is observed. This suggests that the exchange rate has no systematic affect on either the domestic or export corn price.[7]

Conclusions

This study evaluated the relationship between export market structure and pricing behavior by U.S. grain exporting firms. A generalized theoretical model, which specified the Lerner index as a function of the Herfindahl-Hirschman index and the elasticity of demand, was estimated using ordinary least squares. Additional explanatory variables related to market structure and market conditions were introduced. New data from the PIERS data set was employed in estimating this model. This data set was used to calculate the HHI for each country to which the U.S. exported grain. A model which specified export price as a function of export market structure was also estimated.

In the wheat export market, it was found that the export sales concentration of U.S. firms in foreign market was positively and significantly related to the export price markup over domestic price that export firms applied. It was also found that the larger the share of the market held by all U.S.

Table 5. Effect of Export Market Structure on Price Markup and Export Price for Wheat

Dependent Variable:	Equation 2.1 Lerner Index		Equation 2.2 Lerner Index		Equation 2.3 Export Price	
Sample :	A	B	A	B	A	B
Intercept	-0.123	-1.431	-10.475**	-10.189***	109.046*	105.378*
	(-0.035)	(-0.408)	(-2.076)	(-1.669)	(11.309)	(11.187)
HHI/ϵ	0.0000854*	0.0000669*	--	--	0.000159*	0.000103**
	(4.252)	(3.455)			(2.889)	(1.981)
CR4	--	--	0.125*	0.0967***	--	--
			(3.282)	(1.870)		
U.S. Share of Market	0.0755*	0.0707*	0.0721*	0.0645*	0.155*	0.158*
	(5.374)	(5.047)	(5.111)	(4.650)	(4.008)	(4.201)
Proportion of U.S. Exports	-0.563*	-0.440*	-0.269	-0.227	-1.091**	-0.870**
	(-3.562)	(-2.837)	(-1.388)	(-1.120)	(-2.509)	(-2.094)
Foreign Stock-to-Use Ratio	10.437*	11.031*	10.297*	10.800*	32.339*	34.614*
	(4.650)	(4.895)	(4.562)	(4.757)	(5.241)	(5.725)
U.S. Stock-to-Use Ratio	6.208*	6.011*	6.417*	6.268*	-10.531*	-10.845*
	(4.865)	(4.701)	(5.000)	(4.884)	(-3.002)	(-3.161)
U.S. Export Volume	0.000164**	0.000199*	0.000160**	0.000208*	0.00126*	0.00135*
	(2.407)	(2.915)	(2.349)	(3.022)	(6.767)	(7.334)
Nominal Exch. Rate	-0.000124	-0.000121	-0.000137	-0.000130	-0.000590***	-0.000577***
	(-1.090)	(-1.082)	(-1.195)	(-1.163)	(-1.885)	(-1.931)
East-West Dummy	-2.689**	-2.532**	-2.204***	-1.879	-2.437	-2.347
	(-2.306)	(-2.175)	(-1.902)	(-1.636)	(-0.760)	(0.751)
Adj. R^2	0.122	0.118	0.113	0.107	0.142	0.159
F-Value	13.598*	12.676*	12.572*	11.486*	16.137*	17.486*
No. Obs.	729	697	729	697	729	697

Notes: The values in parentheses are t-values. One , two, and three asterisks denotes significance at the 1, 5, and 10 percent levels, respectively. Adj. R^2 is the corrected coefficient of determination. F-value corresponds to the test of the null hypothesis that all coefficients equal zero.

Table 6. Effect of Export Market Structure on Price Markup and Export Price for Corn

	Equation 2.1		Equation 2.2		Equation 2.3	
Dependent Variable:	*Lerner Index*		*Lerner Index*		*Export Price*	
Sample :	*A*	*B*	*A*	*B*	*A*	*B*
Intercept	-30.601*	-30.387*	-40.986*	-38.654*	133.302*	134.612*
	(-4.814)	(-4.644)	(-5.451)	(-4.624)	(12.382)	(12.142)
HHI/ϵ	0.0000019**	0.0000013***			0.0000035**	0.0000022***
	(2.178)	(1.766)			(2.325)	(1.715)
CR4			0.120*	0.098***		
			(2.908)	(1.859)		
U.S. Share of Market	-0.00943	-0.00479	0.00134	0.00408	-0.0192	-0.00707
	(-0.514)	(-0.256)	(0.074)	(0.219)	(-0.618)	(-0.223)
Proportion of U.S. Exports	-0.106	-0.0971	0.0479	-0.034	-0.341	-0.349
	(-0.760)	(-0.732)	(0.309)	(-0.236)	(-1.445)	(-1.552)
Foreign Stock-to-Use Ratio	-5.167	-5.465	-4.847	-5.113	-8.278	-6.187
	(-1.057)	(-1.077)	(-0.995)	(-1.009)	(-1.000)	(-0.720)
U.S. Stocks-to-Use Ratio	20.155*	19.961*	20.857*	20.182*	-74.910*	-74.980*
	(5.249)	(5.069)	(5.452)	(5.127)	(-11.520)	(-11.239)
U.S. Export Volume	0.000758*	0.000756*	0.000765*	0.000762*	0.000558*	0.000538*
	(8.239)	(8.071)	(8.346)	(8.128)	(3.580)	(3.367)
Nominal Exch. Rate	0.00314	0.00538	0.00301	0.00598	-0.00301	-0.00318
	(0.058)	(0.099)	(0.056)	(0.110)	(-0.033)	(-0.034)
East-West Dummy	2.620	2.081	0.668	0.148	1.568	0.153
	(1.141)	(0.878)	(0.327)	(0.071)	(0.403)	(0.038)
Adj. R^2	0.124	0.121	0.131	0.122	0.459	0.451
F-Value	9.867*	9.338*	10.400*	9.386*	54.221*	50.798*
No. Obs.	501	485	501	485	501	485

Notes: The values in parentheses are t-values. One , two, and three asterisks denotes significance at the 1, 5, and 10 percent levels, respectively. Adj. R^2 is the corrected coefficient of determination. F-value corresponds to the test of the null hypothesis that all coefficients equal zero.

firms, the larger the markup. However, large importers received wheat at a smaller markup, indicating evidence of countervailing market power. It was revealed that U.S. wheat exporting firms appear to enjoy larger markups during periods of strong demand. Finally, it appears that markets with either a high U.S. export sales concentration or a low elasticity of demand, face higher wheat export prices at the U.S. border.

In the corn export market, weaker evidence was found suggesting that higher concentration by trade route among the U.S. exporting firms led to higher price markups and higher export prices. However, no significant relationship was found between the Lerner index and either the U.S. market share or the size of the foreign buyer.

For both commodities it was found that the nominal exchange rate had no impact on the price markup applied by firms. Yet, it was significantly related to the wheat export price. It appears that U.S. exporting firms may lower the wheat export price in the face of a foreign currency depreciation. Both commodities also showed that large U.S. stocks tended to increase the markup applied by firms, while at the same time they tended depress the export price. Large U.S. stocks apparently depress domestic prices proportionately more than export prices.

These results provide evidence that the pricing behavior of U.S. exporting firms does not reflect pure competition, as there is evidence of systematic price discrimination by destination which is related to the export market structure. In nearly all the estimated models, the theoretical expectations were satisfied in that no estimated coefficients had the wrong sign. Further, high levels of statistical significance were obtained on the coefficients of many of the structural variables.

These findings on discriminatory price behavior by exporting firms are consistent with those by Pick and Park. Like these authors, the strongest evidence was found in the wheat export market. The conclusions drawn here contradict those by Caves and Pugel. However, Caves and Pugel largely develop their conclusions from institutional evidence, and use only a limited data sample for the export market.

What welfare implications do the findings of this study have and how should U.S. policy makers respond? Some might argue that U.S. policy makers need not respond at all (Helpman and Krugman, 1989). To the extent that U.S. exporting firms are extracting rents from the importing nations which are then transferred to U.S. residents, then U.S. welfare is increased. Indeed, some have argue that there exist situations where exporting firms, who fail to exercise their market power, should be taxed at rates dependent on the structure of the markets they supply (Rodrik, 1989). The difficulty with this argument is that many of the firms involved in U.S. export grain trade are private multinational firms. In this case, the rents may very well accrue to residents in other countries. Given this structure of ownership, the policy prescription is not clear. Also, policy action may be called for if the welfare of farmers is considered. The successful exercise of monopoly power by exporting firms requires them to reduce the quantity exported. This action could increase domestic supplies, depress domestic prices, and lower farmer welfare.

Endnotes

[1] HHI is defined as the sum of the squared firm market shares in the appropriately defined market;

$$HHI = \sum_{i}^{n} \left[\frac{X_{ij}}{X_j}\right]^2 \text{ , for each market j.}$$

[2] The marketing year for wheat begins on June 1; the marketing year for corn begins on September 1.

[3] Wheat corresponds to the following seven and ten digit Schedule B codes: B1314090, B0410020, B0410010, B1306540, B1306520, X1008900040, X1001902000, X1001100000;
Corn corresponds to the following codes: B0440060, B0440050, B0440020, B0440010, B1303475, B1303465, B1303200, X1005904060, X1005902000.

[4] A preferable approach would have involved using export data based on a U.S. port-foreign destination pairings. Then, a weighted average markup for each destination could be calculated based on the volume of shipments through specific ports. However, export data for this type of pairing is not available.

[5] The IMF exchange rates are based on market average rates.

[6] The temporal matches employed between the calendar year exchange rate data and the other marketing year data are best described through an example: For wheat, MY 1980/81 was matched with CY 1980; for corn, MY 1980/81 was matched with CY 1981. Exchange rate data were only obtained for the years 1979 through 1989. Therefore, due to the matching scheme for corn, the analysis only applies to marketing years 1979 through 1988, as MY 88/89 was matched with CY 89.

[7] An alternative match in the exchange rate and other data was tried. In this case, for example, MY 1980/81 was matched with CY 1980. This too failed to produce any significant relationships between the exchange rate and either the export price or price markup.

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