Quality Pricing in U.S. Soybean Exports

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Abstract: *This paper examines quality-price relationship in U.S. soybean exports. Implicit prices for quality characteristics of U.S. soybean exports were estimated using a hedonic price function from a rich transaction-specific data set to major destination markets to test the efficiency of the market in transmitting preferences for quality. The results of this analysis suggest that the price of soybean export shipments was not affected by the oil and protein content of the soybeans. Moisture content was surprisingly found to positively affect price while foreign material reduced price after the 1989-1990 marketing year. These results are discussed for their implications for existing, and proposed changes to existing, soybean market regulation.*

Key Words and Phrases: *Soybeans, Quality, Hedonic price analysis.*

This study estimates the implicit price of oil, protein, foreign material, damaged kernels, moisture and other soybean quality characteristics using an econometric model. The goal of the study is to learn whether buyers in major foreign markets pay more for higher quality U.S. soybeans. An extensive literature search revealed no previous hedonic analysis for soybeans, though several studies exist for wheat and other commodities.[1]

Most of the previous studies on the relationship between prices and grain quality have concentrated on wheat trade, since that market exhibits both strong competition between rival exporters and diverse end uses for the commodity (Wilson and Preszler; Veeman; Larue and Lapan). In addition, the broad dividing of wheat into classes for different end uses permits analysts to focus on a subset of wheat price-quality relationships. The major shortcoming of previous studies is inadequate data. The data are either highly aggregated or cover a relatively narrow chronological period. In this study, the unit value of the shipment represents the negotiated f.o.b. price between the foreign buyer and U.S. exporter for the contractually specified characteristics in the shipment.

Recent proposals for changes in the marketing system have included tightening specifications on No. 2 soybeans by reducing the maximum level of foreign material as well as incorporating the inherent characteristics of oil and protein in the price of soybeans or in the grades. Another regulatory issue in grains is the problem of using water as a dust suppressant in grain storage (Miller). Hill (1993b) suggests that current market incentives encourage adding moisture to grain and advocates a system that would remove the incentive to add water to grain.

Economics of Grain Characteristics

Hedonic price methodology is one method used to determine the value of components or characteristics of heterogenous goods. The general theory was developed by Lancaster and Rosen and was adapted by Ladd and Martin to focus on agricultural products that are used as inputs in a production process. More recently, Wilson; Bowman and Ethridge; Unnevehr and Bard; and Mercier et al. (1994) have also used hedonic analysis to determine the value of component characteristics of agricultural and food products such as wheat, cotton, beef cuts and corn.

This model assumes that profit-maximizing processing firms operating in a perfectly competitive market require the inputs for their effect upon output. For example, soybean processors evaluate soybeans in terms of their intrinsic characteristics of soybean oil and protein content. These characteristics affect the yields of soybean oil and meal that the processor receives from the production process. The characteristics of economic importance are thus included in the production function. For a single firm, the production function is:

$$q_h = F_h(z_{1h}, z_{2h}, \ldots, z_{nh}) \tag{1}$$

where q_h is the quantity of the output h (h=1,2,...,H); and z_{jh} is the quantity of input characteristic j (j=1,2,...,n).

The firm's objective function is assumed to be profit maximization:

$$\pi = \sum_{h=1}^{H} p_h \; F_h(z_{1h}, z_{2h}, \ldots, z_{mh}) - \sum_{h=1}^{H} \sum_{i=1}^{m} p_i x_{ih} \tag{2}$$

where x_{ih} is the quantity of the ith input (I=1,2,...m) used in the production of output h; p_i is the price paid for the ith input; and p_h is the price received for the output h.

The first-order condition with respect to input I used to produce output h is:

$$\frac{\partial \pi}{\partial x_{ih}} = p_h \sum_{j=1}^{m} \left(\frac{\partial F_h}{\partial z_{jh}}\right)\left(\frac{\partial z_{jh}}{\partial x_{ih}}\right) - p_i = 0 \tag{3}$$

Solving for p_i results in the following demand equation for the firm:

$$p_i = p_h \sum_j (\frac{\partial F_h}{\partial z_{jh}})(\frac{\partial z_{jh}}{\partial x_{ih}}) \tag{4}$$

The partial terms in Equation 4 represent the marginal physical product of characteristics of characteristic *j* in the production of the output *h* and the marginal yield of characteristic *j* from the *i*th output. $p_h \partial F_h / \partial z_{jh}$ can be interpreted as the marginal or implicit price of the *j*th characteristic and is defined as β_j. For simplicity define the marginal yield to be Z_{ji}. This results in:

$$p_i = \sum_j \beta_j Z_{ji} \tag{5}$$

which is the usual hedonic regression estimated for valuing input characteristics. This hedonic regression is conducted with observed market prices as dependent variables and observed quality variables as explanatory variables.

An issue in estimating hedonic price functions with time series data is controlling for general shifts in supply and demand. Price, the dependent variable in hedonic functions, is influenced by a number of factors other than quality characteristics, including variation in total supply and macroeconomic events such as changing exchange rates. These events cause the general price level of the commodity to vary. To account for these general shifts in supply and demand, we follow Bowman and Ethridge by using a reference price. In this method, a base grade is identified and quality factors for the base grade (which are constants) are subtracted from the measured value for the quality factors in each shipment. Quality differentials are used to explain price deviations from the reference price. With this modification the estimated equation becomes:

$$P_{it} - P_t = B(Z_{it} - Z) \tag{6}$$

where P_{it} is the observed price and P_t is the reference price. Z_{it} is the vector of quality characteristics while Z is the similar vector of quality characteristics associated with the quality of the reference grade.

Data and Variables

The shipment-level data used for estimating the hedonic price model is a subset of all U.S. soybean exports shipped between January, 1990, and November, 1991, (U.S.

Department of Commerce; U.S. Department of Agriculture). The data analyzed represent 198 shipments from U.S. Gulf ports to three major destination markets, namely the European Union, Japan and Korea, for which a complete set of quality variables was available.[2,3] Table 1 shows the number of shipments to each destination while Table 2 provides summary statistics for the data. The data cover portions of three separate marketing years for soybeans since the soybean marketing year begins on September 1. The shipment-specific quality and price portion of the data set was constructed by matching Federal Grain Inspection Service (FGIS) export inspection data with U.S. Department of Commerce Bureau of Census export data on quantity and value collected. The data set was constructed by matching individual shipment observations based on the import destination, U.S. port of exit, month and year of shipment, and shipment size. The price was derived by dividing shipment value by shipment size and represents a transaction price for each particular shipment. These transaction prices reflect the price as recorded at export, so they are effective f.o.b. prices.

Prices at Gulf ports are usually quoted for No. 2 soybeans only and No. 2 U.S. soybeans represent the vast majority of all soybean shipments.[4] Therefore, the No. 2 soybean price was selected as the reference grade as a proxy for changes in the general price level. The price one week prior to when the ship was actually loaded was used because discussions with soybean exporters suggest this is an appropriate proxy for supply and demand shifts.[5]

The quality variables used as independent variables were foreign material, protein content, oil content, damaged kernels and moisture content, which are all measured as percentage content. The variables used in the regression were differences from the base grade or from their mean value in the sample, if not in the base grade. The data set reports actual levels of these factors measured in the shipments, serving as proxies for contractual limits that reflect the buyers' expectations. The quality information is derived from the FGIS export data set. The expected sign of the coefficient can be drawn from knowledge of whether higher amounts of a variable detract from or enhance the value of the final product. It is also possible for processors' demands to vary by time. To account for temporal shifts, we included time dummy variables representing marketing years which measure fixed marketing year effects that are not captured by the reference price. The following section describes the quality variables and expectations about their relationship with price.

Protein and oil content are considered primary determinants of value in soybeans, as they are the major determinants of the amount of soybean oil and meal that a processor can obtain from the beans. Higher oil and protein content are hypothesized to be positively related with the value of the shipment if the market is effective in transmitting preferences for higher oil and protein content. There has been some question about the effectiveness of the marketing system in transmitting preferences for soybeans containing higher levels of oil and/or protein.

Table 1.
Countries and Observations in the Data Set

Country[a]	Shipments
Japan	59
Korea	24
Netherlands	67
Germany	3
Italy	1
England	8
Portugal	5
Belgium	10
Spain	19
France	2

[a] Includes only observations used in the analysis. The Netherlands, Germany, Italy, Britain, Portugal, Belgium, Spain and France are all part of the European Union.

Table 2.
Summary Statistics for the Data Set

Variable[a]	Mean	Standard Deviation	Minimum	Maximum
Price ($/bu)	0.04	0.16	-0.39	0.48
QUANTITY	0.01	0.70	-2.97	1.16
Damaged Kernel (%)	-0.03	0.35	-0.70	1.50
Foreign Material (%)	-0.23	0.40	-1.20	1.00
Splits (%)	-1.12	0.26	-1.70	0.00
Protein Content (%)	0.01	0.42	-1.10	0.90
Oil Content (%)	0.10	0.40	-0.90	1.00
Moisture Content (%)	-0.01	0.60	-1.50	1.70

[a] All the variables indicated are the differences as discussed earlier. The variables described above were the variables actually used as variables in the regression.

Foreign material is the percentage of material, which may be small pieces of soybean or non-soybean material in the shipment, that passes through a sieve. It is generally expected that foreign material will decrease the value of the soybean shipment because it has substantially less value than the rest of the shipment. Foreign material must be removed through cleaning before the soybeans can be processed; however, the foreign material is often blended back into soybean meal. To some extent, foreign material increases the cost of shipping a unit of usable soybeans and increases the cost of processing. After the 1989-1990 marketing year, a change was made in the way FGIS measured foreign material, making it more difficult for foreign material to be undeclared on the official inspection certificate. To incorporate this institutional change, an interaction term of foreign material by marketing year 1989-1990 was added to the regression.[6]

Splits are soybeans with more than one-fourth of the bean removed but not otherwise damaged. Splits that account for more than the 10 to 15 percent of the total shipment affect oil yield and quality (Bender and Hill). Further, splits are associated with growing, harvesting and storage conditions which in themselves may negatively affect quality. A high number of splits may indicate poor handling or harvesting conditions and are also often used as a proxy for high free fatty acids. Thus splits should have a negative relationship with price.

Damaged kernels is a grade determining factor. Damaged kernels measures damage arising from mold and a number of other factors that can reduce the value of the soybean shipment.

The expectation is that higher levels of moisture lead to a lower price since increased moisture leads to lower levels of usable soybean oil and protein. Higher levels of water are also associated with a higher probability of mold damage. Further, since water does not contribute to the processing value of a shipment, its presence is costly because its weight must be shipped along with the useful protein and oil. However, moisture may reduce breakage in soybeans so that higher levels of moisture could lead to reduced levels of damage while shipping.

Quantity is the volume of the total shipment. It is expected that it would be cheaper per unit to load a large volume of soybeans as compared to a shipment of a smaller volume. This effect would be expected to decline as the quantity increases, so a log specification is given for this variable.

This yields the following equation:

$$P_{it} P_{t-1} = \beta (Z_{it} - Z) + \vartheta QUANTITY + \delta MY + \theta FM89/90 \qquad (7)$$

where P_{it} is the observed per bushel price of the shipment[7]; P_{t-1} is the price of No. 2 U.S. soybeans one week prior to shipment; Z_{it} is the vector of quality characteristics which in this case are moisture content, oil content, protein content, splits, foreign material, and damaged kernels; QUANTITY is the natural log of the ratio of individual shipment size to average shipment size[8]; FM89/90 is the amount of foreign material multiplied by the dummy variable for the 1989-1990 marketing year; and Z is the vector of quality characteristics associated with the reference grade. If these qualities are not included in the reference grade, then the average quality for the entire period is used.[9] MY is a set of marketing year dummy variables for the marketing years 1989-1990 and 1990-1991. This is the equation that was estimated.

Empirical Results

The specific functional form of the relationship between price and quality is not determined theoretically (Rosen). There are a number of potential relationships that could be used including linear, logarithmic, semi-logarithmic and higher order relationships.[10] Each of these types of forms were examined and discarded in favor of the linear model, except for the QUANTITY variable, due to a superior statistical fit of the linear model.

Equation 4 was estimated, pooling observations covering the three marketing years and the results are shown in Table 3.[11] The coefficient estimates are interesting in that all the coefficients for the quality characteristics, except protein and moisture, had the expected signs in the regression.[12] Furthermore, the coefficients for moisture, damaged kernels, foreign material, marketing year and quantity were all significant at the 10 percent level.

The Breusch-Pagan-Godfrey Test[13] and the Harvey Test[14] were utilized to check for heteroskedasticity. These tests did not reject the null hypotheses of homoskedastic variance. The Belsley, Kuh and Welsch diagnostic for multicollinearity yielded a condition number of 14, indicating that multicollinearity was not a problem.

The coefficient for foreign material was found to be significant at the 10 percent level and marketing year dependent. At the beginning of the 1990-1991 marketing year, inspection procedures for foreign material were changed. This change resulted in a reduction in the possibility that undetected foreign material would occur. This institutional change evidently had a large impact on pricing efficiency as foreign material had the expected negative sign after the institutional change.

Protein and oil content coefficients were not statistically significant at the 10 percent level. This supports the claim that while buyers may attach a positive value to the protein and oil yields of soybeans, the current marketing system does not value protein and oil content. Hence, U.S. farmers may not have a clear price incentive to produce soybeans with higher quantities of oil and protein. Shippers, furthermore, do not generally segregate loads containing higher or lower protein and oil content (Stitzlein).

The coefficient for moisture was significant and positive. The results suggest an incentive for handlers to re-wet, or at least maintain moisture levels of, grain in the marketing system. Alternatively, the positive sign may be more related to the

Table 3.
Hedonic Soybean Price Regression for 1990-1991

Variable	Coefficient
QUANTITY	-0.041* (-2.51)[a]
Damaged Kernels	-0.058* (-1.81)
Foreign Material	-0.097* (-2.79)
-Foreign Material and Marketing Year 1989/90	0.194* (2.99)
Splits	-0.009 (0.28)
Protein Content	-0.007 (-0.21)
Oil Content	0.008 (0.20)
Moisture Content	0.051* (2.04)
Marketing Year 1989/90	0.079* (1.80)
Marketing Year 1990/91	0.086* (2.88)
R^2	0.23
No. of Observations	198

[a] Represents t-statistics, * denotes significance at the 10% level.

Table 4.
Effect of Quality on Price Using Statistics Generated by the Model

Average Price of No. 2 Soybeans	$6.21/bushel
Reducing Foreign Material from 2% to 1%	+ $0.10/bushel
Reducing Damaged Kernels from 3% to 2%	+ $0.05/bushel
Reducing Moisture from 12% to 11%	- $0.05/bushel

available moisture content in the marketplace as exporters are often forced to load 13 percent moisture soybeans on a 14 percent moisture contract because there are inadequate supplies of 15 percent moisture to blend. Overall, this is surprising in that increased moisture was expected to decrease the unit value of the shipment. The results may be partially explained by the fact that contracts specify minimum quality standards which provide no incentives for actually providing lower moisture soybeans to the market. Further, increasing levels of moisture decrease breakage susceptibility which is a positive quality, but breakage susceptibility is unobserved in the data set.[15]

The coefficients for the QUANTITY and damaged kernels variables were significant and had a negative relationship with price. This means that as the size of the overall shipment increases, the price of the individual unit within the shipment declines.

Table 4 shows the effect of changes in foreign material, damaged kernels and moisture upon the price of soybeans, using the estimates generated in the equation. This may be of interest to those looking at the possible price or value effects of quality changes. These results should be interpreted carefully as the implicit prices generated reflect pricing situations that existed during the time of the shipments used in estimation, i.e., the 1989-1990, 1990-1991, and 1991-1992 soybean marketing years. Overall, the effect of quality on price over the ranges indicated appears to be relatively modest.

Implications for the Marketing System

Information on the values of quality characteristics could be of use to producers, merchandisers and elevators as they make decisions about what quality to provide to buyers. The results of this study will contribute information to the current debate over possible changes in the existing soybean grades and standards. As mentioned earlier, some have proposed that the United States should lower the level of foreign material in No. 2 soybeans from 2 percent to 1 percent. There has also been concern that importers' valuation for protein and oil is not transmitted clearly through the existing marketing system.

It has long been argued that decreasing the level of foreign material in soybean exports will increase the value of the shipment. The implicit price of foreign material from this study suggests that buyers will discount for higher foreign material, or, conversely, buyers will pay more for grain with lower foreign material, especially after the institutional changes at the end of the 1989-1990 marketing year. The implicit price of foreign material therefore provides information about the potential benefits of cleaner soybeans.

The results of this study suggest little (or no) premium for higher protein and oil content in the current marketing system. Over the time period studied, there is no evidence that importers were assessed explicit discounts or premiums for higher or lower oil and protein.[16] One way to increase the effectiveness of the U.S. soybean marketing system may be to include protein and oil explicitly in the market transactions. This could provide clearer signals about buyers' preferences for higher protein and oil content.

The results of the study indicate an incentive for high moisture content in soybeans over the range studied. Increasing amounts of moisture actually seem to increase the value of the shipment.[17] Hill (1993a) proposed a marketing system wherein the weight of water is subtracted from the weight of the total shipment to adjust quantity to the equivalent at a base moisture level. This removes the incentive to "re-wet" grain; however this proposal does not take into account the potential benefit that moisture provides in reducing breakage susceptibility. More study of the relationship between moisture and value to processors in the export market is needed before such a system is implemented in soybeans.

In general, the potential problem with providing the quality needs of buyers is the multidimensional nature of quality. Transactions costs of negotiating on the basis of individual quality characteristics and shipping segregated lots may be greater than the perceived benefit.

Conclusion

In this era of increasing competitiveness, the United States faces the challenge of developing innovative methods to compete effectively. The provision of higher quality beans could be one such source of competitive advantage (Heien and Pick). However, as the results of this study indicate, the current marketing system could possibly be improved through developing incentives for soybeans with higher protein and oil content. This study provides some evidence on current performance of the market and price system in effectively transmitting the quality requirements of buyers to U.S. producers and exporters. Further study would be useful to explore the effects of possible changes to improve the competitiveness of U.S. soybeans in export markets.[18]

Notes

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Hill, James Guinn and three anonymous reviewers for their helpful comments. The views expressed are the authors' and do not necessarily represent the policies of the organizations with which they are affiliated.

1. While the study in this paper was being completed, a parallel study of soybeans using hedonic price theory was also developed (Hyberg et al.).
2. Twenty-four observations were dropped from the sample because they were judged to represent soybeans to be used for direct processing into food products such as tofu and tempé.
3. The quality loaded on board a vessel is sometimes determined by available supplies of various qualities rather than by an economic decision by the buyer or seller. The data set indicates the quality which was actually delivered.
4. The data set is made up of No. 2 soybeans primarily; however, there are a few shipments of No. 1 and No. 3 soybeans. The No. 1 and No. 3 soybean shipments in the data had no appreciable quality or price differences with the exception of foreign material. Considering this uniformity, these observations were left in the data set.
5. There is also a better statistical fit between using a one-week lag as a proxy for supply and demand shifts compared to other lag lengths or a distribution of earlier prices. The use of an inappropriate reference price could be considered an additional error in the dependent variable which could reduce R^2. The coefficients of the independent variables are not affected as the model still conforms to the classical regression model (Green, p. 295).
6. *Federal Register* (June 13, 1990) records that inspection procedures for foreign material changed just prior to the 1990-1991 marketing year. These changes may have affected the coefficient for foreign material in the 1989-1990 marketing year.
7. The t subscript refers to the week of the shipment.
8. The average quantity is 2,100 metric tons.
9. The average observed values for moisture, oil content and protein content are 12 percent, 18.8 percent and 35.5 percent respectively.
10. Some authors (Cropper et al.; and Craig et al.) have recommended the use of the linear and/or quadratic Box-Cox forms to determine the functional form of the relationship. This regression procedure is not appropriate in this case because both the dependent and independent variables can take on values of zero since they are deviations from the base grade. This makes it impossible to apply the Box-Cox form.
11. An alternate possibility would be that quality demand was differentiated by destination markets. This possibility would preclude the unique estimation of demand parameters in an aggregate regression as has been discussed by Epple. A Chow test was used to determine if separate regressions for Japan, Korea and the European Community were significantly different from the aggregate

regression. The generated F (12,174) statistic of 1.25 failed to reject the aggregate model hypothesis at the 5 percent level. This result is consistent with earlier research (Pick and Park) which also did not find appreciable product differentiation by country for soybeans.

12. Protein and oil content are inversely related in soybeans, so having them listed as separate independent variables might not be appropriate. A separate functional specification for protein and oil content was tried with the explanatory variable being the sum of protein and oil content. This variable had a similar, insignificant coefficient to the individual coefficients of protein and oil content.
13. See Judge et al., Equation 11.3.4.
14. See Judge et al., Equation 11.2.60.
15. There may be an optimal moisture that balances the trade-off between breakage for overly dry beans and mold growth and weight loss from excessively wet soybeans. This could be a good area for future research.
16. There are some indications that this may be changing. In the fall of 1992, the Japanese offered premiums for soybeans with a higher content of oil and received an average of 0.4 percent more of oil.
17. This is similar to the Gillmeister et al. study which found that water in milk increased it value.
18. Some investigation has recently been completed in Mercier and Gohlke.

References

Belsley, D.A., E. Kuh, and R.E. Welsch. *Regression Diagnostic: Identifying Influential Data and Sources of Collinearity.* New York, NY: John Wiley & Sons, 1980.

Bender, K., and L. Hill. "Quality Preferences of Soybean Processors." Urbana-Champaign, IL: University of Illinois Rep. 89 E-430, July 1989.

Bowman, K., and D. Ethridge. "Characteristics Supply and Demand in an Hedonic Framework: U.S. Market for Cotton Fiber Attributes." *Amer. J. Agr. Econ.* 74(1992):991-1002.

Craig, S., J. Kohlhase, and D. Papell. "Chaos Theory and Microeconomics: An Application to Model Specification and Hedonic Estimation." *Rev. Econ. and Stat.* 63(1991):208-215.

Cropper, M., L. Deck, and K. McConnell. "On the Choice of Functional Form for Hedonic Price Functions." *Rev. Econ. and Stat.* 60(1988):668-675.

Epple, D. "Hedonic Prices and Implicit Markets: Estimating Demand and Supply Functions for Differentiated Products." *J. Polit. Econ.* 95(1987):59-80.

Federal Register. "Shiplot Inspection Plan (Cu-Sum)." Office of the Federal Register, National Archives and Records, General Services Administration, Washington, DC: GPO, June 13, 1990, p. 24030.

Heien, D., and D. Pick. "The Structure of International Demand for Soybean Products." *South. J. Agr. Econ.* July, 1991, pp. 137-143.

Hill, L. Statement Before the Subcommittee on General Farm Commodities, U.S. House of Representatives Committee on Agriculture, Washington, DC, Oct. 1993a.

__________. "Hidden Discounts in Grain and the Incentive for Rewetting." *Farm Economics Facts and Opinions*, Issue 93-11. University of Illinois at Urbana-Champaign, Nov. 1993b

Hyberg, B., N. Uri, S. Mercier, and C. Lyford. "The Market Valuation of Soybean Quality Characteristics." *Oxford Agrarian Studies* 22(1994):65-81.

Gillmeister, W., R. Yonkers, J. Dunn, and J. Sleper. "Hedonic Pricing of Milk Components." Paper presented at the 1992 AAEA meetings, Baltimore, MD, August 9-12, 1992.

Green, W. *Econometric Analysis*. New York, NY: MacMillan Publishing Company, 1990.

Judge, G., W. Griffiths, H. Lutkepohl, and T. Lee. *The Theory and Practice of Econometrics*, second ed. New York, NY: John Wiley & Sons, 1985.

Kohn, F. "Controversy Continues Over Cleaner Beans." *Soybean Digest*, May/June, 1992, pp. 10-12.

Ladd, G., and M. Martin. "Prices and Demands for Input Characteristics." *Amer. J. Agr. Econ.* 58(1976):21-38.

Lancaster, K. "The New Approach to Consumer Theory." *J. Polit. Econ.* 58(1966): 21-38.

Larue, B. And H. Lapan. "Market Structure, Quality and World Wheat Markets." *Canadian J. Agr. Econ.* 40(1992):311-328.

Mercier, S., and B. Gohlke. *The Role of Quality in Soybean Import Decisionmaking*. Washington, DC: USDA Agr. Econ. Rep. 722, Sept. 1995.

Mercier, S., C. Lyford, and V. Oliviera. "The Effect of Quality on Corn Export Price Determination." *Rev. Agr. Econ.* 16(1994):165-173.

Miller, D. Letter to the Federal Grain Inspection Service. Park Ridge, IL: American Farm Bureau Federation, Nov. 23, 1993.

Pick, D., and T. Park. "The Competitive Structure of U.S. Agricultural Exports." *Amer. J. Agr. Econ.* 73(1991):133-141.

Rosen, S. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *J. Polit. Econ.* 82(1974):34-55.

Stitzlein, J. "Component Pricing in the Export Market Channel." *Component Pricing in the Soybean Industry*, ed. L. Hill, pp. 46-48. Urbana-Champaign: Illinois Agr. Exp. Sta. AE-4702, Jan. 1994.

Veeman, M. "Hedonic Price Functions for Wheat in the World Wheat Market: Implications for Canadian Wheat Export Strategy." *Canadian J. Agr. Econ.* 35(1987):535-552.

Wilson, W. "Differentiation and Implicit Prices in Export Wheat Markets." *West. J. Agr. Econ.* 14(1989):67-77.

Wilson, W., and T. Preszler. "End-Use Performance Uncertainty and Competition in International Wheat Markets." *Amer. J. Agr. Econ.* 74(1992):556-563.

U.S. Department of Agriculture. *Export Grain Inspection System Data.* Computer database. Washington, DC: Federal Grain Inspection Service, 1986-1991.

U.S. Department of Commerce. *U.S. Agricultural Exports.* Computer database. Washington, DC: Bureau of Census, Oct. 1992.

Unnevehr, L., and S. Bard. "Beef Quality: Will Consumers Pay for Less Fat?" *J. Agr. and Res. Econ.* 18(1993):288-295.