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POLICY CHOICES IN THE GRAIN QUALITY DEBATE

Congress and the U.S. Department of Agriculture (USDA) have repeatedly used legislative and regulatory tools in an attempt to improve the quality of grain delivered to our customers overseas. They have documented complaints, funded research, sent investigative teams overseas, and held innumerable congressional hearings on issues ranging from inspection fees to adulteration. Despite all these efforts, there has been no significant improvement in quality. Complaints from foreign buyers about poor quality grain and threats that they will seek other sources of supply have changed very little in more than one hundred years. The Chicago Board of Trade received complaints from European importers about the poor quality of grain from U.S. exporters as early as 1857. President Theodore Roosevelt in his 1908 message to both houses called for action on grain grades, saying, "Complaints...have continued for years, ...not only in this country but abroad." The prophet Amos gives an even longer historical perspective, as he berates the grain merchants in 750 B.C. for "giving short measure in the bushel...and selling the dust of the wheat."

In 1916 Congress passed the U.S. Grain Standards Act (GSA), expecting dramatic improvement in grain quality. However, the continuing complaints prompted congressional hearings nearly every year in the first two decades following promulgation of grades for wheat and corn. In 1975 a major scandal over grades and weights at the ports led to a major revision in the GSA, including the requirement that all grain exports must be inspected and graded by federal employees, but the complaints only increased following the 1976 amendments to the GSA, reaching a peak in 1985 (figure 1), accompanied by a declining share of the world grain

market (figure 2). This encouraged additional changes in the GSA and regulations. The 1986 Grain Quality Improvement Act prohibited reintroduction of foreign material once it had been removed from the grain. The Federal Grain Inspection Service, created by the 1976 amendment, introduced many grade changes such as statistical principles for determining quality based on improved mechanical sampling devices, changing the limits on grade-determining quality attributes, and including soybean oil and protein contents as part of the information that could be requested by buyers.

None of these changes resolved complaints of buyers, nor was there any marked improvement in the quality of grain delivered to the foreign buyer. During the 1990 congressional hearings, the representative of the American Soybean Association testified that the quality of soybeans from U.S. ori-

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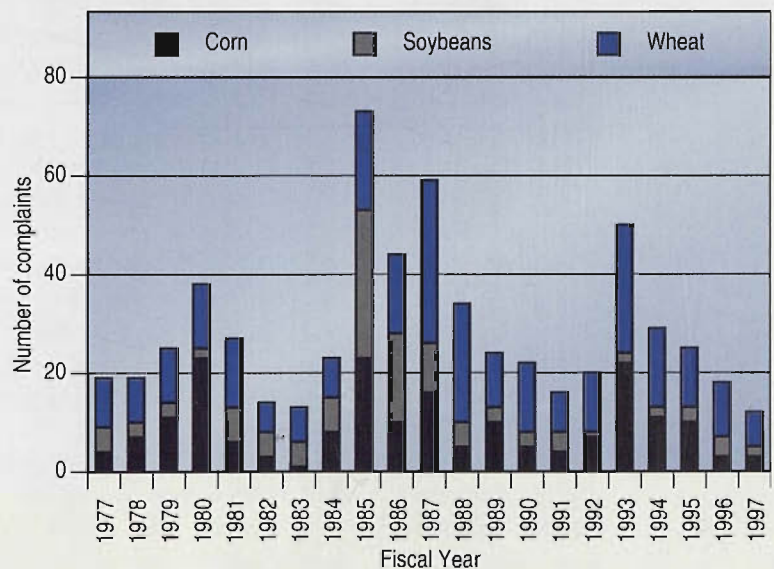


Figure 1. The number of formal complaints about quality peaked in 1985

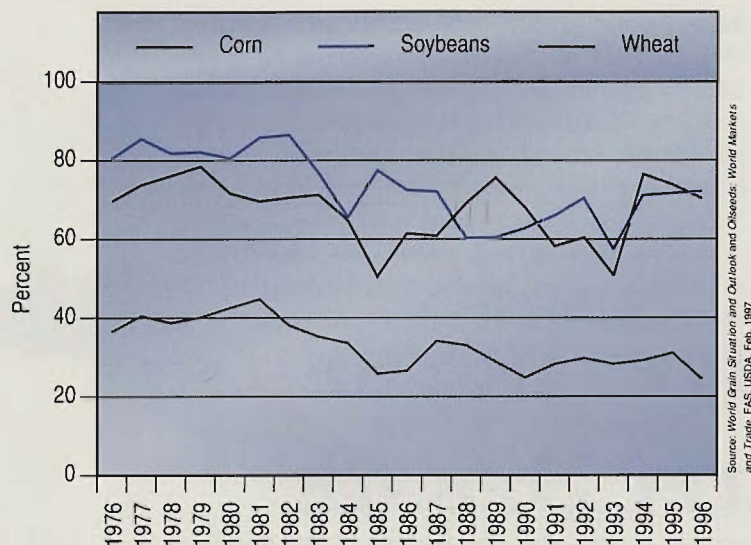


Figure 2. U.S. export market share

gins was inferior to that of soybeans from Brazil, and he warned Congress that "Quality is a major reason for market erosion in this the largest single market for soybeans" (Riedel, p. 117). European buyers threatened to take their business elsewhere (Brandon) and the Japanese Oilseed Processors Association repeatedly documented that Brazilian soybeans contained a higher percentage of oil. The Office of Technology Assessment identified differences in grading and marketing policies of the major competing countries and recommended changes for the United States government and grain producers and handlers. However, the study did not provide conclusive evidence that these changes would influence market share (U.S. Congress, Office of Technology Assessment). Although foreign buyers, commodity organizations, and Congress continued to argue that quality problems have reduced the U.S. market share, the complexity of international trade, trade policies, and inadequate data on quality at destination make it impossible to demonstrate any significant correlation between quality and market share. Over the past twenty years the number of formal complaints has ranged from less than twenty in 1982 to more than seventy in 1985. The years of decreased number of complaints do not follow congressional actions. There was an increase following the 1986 Grain Quality Improvement Act, and, again, complaints increased in 1993 following another series of legislative and regulatory actions. There are no significant correlations with export volume, prices, or low-quality crop years (Hill 1990).

Economic logic suggests that better quality (that is, higher value) at equal prices will increase market share of the supplier with better quality. However, despite this logic, legislative and regulatory efforts to improve quality have had little effect on the

number and type of complaints or on recovery of lost market share in world grain trade. Regulators and legislators will not succeed in making the United States the origin of choice with respect to quality until they understand two important principles: (a) changes in grades will not automatically change quality and the value of exported grain; and (b) the quality on the origin grade certificate will always be better than the average quality at destination due to deterioration during loading, transport, and unloading. Legislative efforts have been focused on origin certificates while foreign importers focus on destination quality.

Grades do not determine quality

Producers, legislators, and regulators often have failed to differentiate between the function of grades (to describe quality) and the function of the market (to price quality). Grades do not alter quality, although they provide the standardization, description, and uniformity that allow market incentives to stimulate actions that alter quality. Changes in the limits for the individual factors that classify grain into one of the numerical grades may change the proportion of grain falling in each of the numerical classifications, but these changes do not change the value of a given crop—they only redistribute the qualities already produced among the numerical grade classifications. The quality and value of the crop will change only when producers or handlers are motivated to change their practices. There is no evidence that all of the bills and congressional hearings, and the more than 350 regulatory changes in the grades, definitions, and limits on individual factors used to classify quality into a numerical grade, have had any direct effect on market share, frequency of complaints, or quality of grain reaching the processing plants in world markets.

Quality changes between origin and destination of U.S. exports

Foreign buyers and many congressmen have assumed that if the corn is certified as grade No. 2 at origin, the buyer should receive No. 2 at the destination processing plant. Most buyers select an export contract that specifies "origin certificate final," meaning that grades and weights will be determined in the export elevator prior to the final drop into the ocean vessel. Foreign buyers often fail to recognize the sources of quality deterioration between the export inspection and the processing plant when they complain that "I bought No. 2 and I expect to receive No. 2." U.S. legislators and regulators also have been frustrated when the changes they introduced in grades and loading specifications failed to improve destination quality or lessen the complaints of foreign buyers.

When the legislative and regulatory changes failed to achieve the desired results, USDA officials began to question the validity of the complaints and the motives of the importers. Research was needed to determine if importers had a basis for their continued complaints about destination quality. Specifically, were the problems the fault of the shipper loading inferior grain, or did quality change between the time the quality certificate was issued and the time the grain was delivered to the final user? Very few studies provided information about destination quality as a basis for answering this question.

Previous studies

Between February of 1906 and May of 1908, USDA conducted three separate studies to “determine how far these reports were founded on fact and how far they were colored in the interest of the purchaser on the other side” (Phillips). Samples were taken from 175 vessels carrying a total of 15,077,987 bushels of corn. The quality of the corn in each vessel was compared with the certificates issued when the ships were loaded at U.S. ports—primarily Baltimore and New Orleans. The analysis showed that 100 of the 175 vessels contained some hot or heating grain—some so “badly damaged as

to be entirely unfit for feeding purposes.” Nearly 13 percent of the fifteen million bushels were found to be damaged when the vessels arrived in Europe (Shannon, Leighty, and Boerner). These investigations identified some cases of false grading, but the majority of the quality problems were caused by loading grain at moisture levels too high for maintaining quality in the hold of the vessel, given the temperature at the time of loading and the time required to reach the foreign port.

Nicholas analyzed fourteen selected soybean shipments from the United States to Japan, and compared destination quality of soybeans shipped from U.S. origins with that of soybeans received from Brazil and China. The percentage of foreign material in U.S. origin soybeans was higher than that of the soybean shipments from either Brazil or China. In addition, Brazilian soybeans had a higher oil, and a lower protein level than U.S. and Chinese sources.

Nicholas and Whitten compared the results from seventeen soybean shipments sampled at their U.S. origins and at the overseas destinations. Both foreign material and splits increased during movement from the U.S. port to the destination and there was a loss of oil quality on two of the shipments. In addition the data showed a slight increase in

Members of Congress Terry Bruce, Berkely Bedell, Pat Roberts, Edward Madigan, and Cooper Evans during hearings on the 1986 Grain Quality Improvement Act. Representative Thomas Foley also attended the hearings.



Description of the Data and Methods

Data were collected from three major soybean processors in Europe and nine in Japan for the four-year period 1990 through 1995. Individual processors in Europe and the Japan Oilseed Processors Association (JOPA) provided data on moisture content, foreign material, oil content, protein content, and percentage free fatty acid (FFA). In addition, JOPA provided information on percentage of splits. The destination data from both countries included the name of the vessel, origin port, quantity received, and arrival date. This information allowed researchers to match FGIS origin certificate records containing quantity and quality information with destination analyses on each vessel. The matched data set was used to test the hypothesis that destination quality was equal to origin quality.

For the period under study we matched destination quality data from the cooperating processors with origin data for 383 vessels unloaded in Japan and 229 vessels unloaded in Europe. For those vessels which unloaded only a portion of the cargo at the participating plants we assumed that the analyses represented the entire vessel.

The search for statistically significant differences between origin and destination were based on a paired t-test, comparing origin and destination values of each quality factor (oil, protein, etc.) for each vessel.

The results for Japan and Europe were analyzed separately to identify differences due to country of destination (for example, different contract specifications or different sampling methodology). Also, Japanese data permitted analysis of foreign material and splits in addition to oil, protein, and moisture contents. European processors did not provide data on splits, and although they provided sporadic data on foreign material, the methodology was not consistent among processors nor with USDA procedures and therefore was not included in the analysis.

average oil and protein contents (0.1%). Hill et al. (1981) sampled four U.S. soybean shipments upon arrival in England and documented quality losses, including deterioration of oil quality as indicated by increased levels of free fatty acid, iron, peroxide value, and phosphorus, resulting in decreased oil yield and oil quality.

The most extensive monitoring of quality changes between origin and destination was conducted between 1975 and 1985 by University of Illinois researchers (Hill 1990, p. 221). Corn destined for a foreign processing plant was identified prior to leaving the country elevator. Samples were taken at each point in the market channel from loading the unit train or barge to final processing plants in Japan, Europe, and Mexico. (Hill, Paulsen, and Early; Hill et al. 1985; Hill et al. 1990). Temperature and humidity equipment, installed in the hold of the vessel, recorded hourly conditions throughout the ocean journey. The results showed the following.

- Quality at the time of loading the ocean vessel conformed to the certificate and to the contract specifications. Origin quality was often better than

the quality of individual grade factors specified in the buyer's contract, especially on the factors of damage and test weight, measures of bacterial deterioration, and density.

- Quality is usually specified by requesting a numerical grade (grade 1 through 5 for corn, 1 through 4 for soybeans, etc.). Numerical grade is determined by the factor with the lowest quality; for example, if foreign material is too high to allow the sample to be classified as grade No. 2, the lot will be graded as No. 3, even if the quality of all other factors would have qualified for No. 2 or even No. 1. Numerical grade fell as much as two grade levels between origin and destination as a result of quality losses, such as heating, mold damage, and broken kernels.
- The quality losses observed in the commercial shipments were consistent with results found in laboratory research. Over many years, controlled experiments with corn have demonstrated that the increase in broken kernels is directly related to drying conditions, moisture content, and drop height. Research has also established a direct relationship among temperature, moisture, time, and biological activity leading to mold growth and quality deterioration.

Impacts during loading and unloading resulted in an increase in broken kernels between origin and destination, especially if the corn had been dried at high temperatures. Since quality certification is based on samples taken before the corn is loaded, destination quality will always be less than origin quality. Moisture content (which is specified by the buyer) and temperature of the grain at loading were the primary factors that influenced heating and biological activity during transport.

- Most cargoes are divided among several users at destination with a portion of the cargo in the hold or vessel going to different buyers. Segregation in the hold during loading can result in a wide range of quality (especially on the grade factor of broken corn and foreign material) in different locations within a hold. When only a portion of a hold is unloaded to a barge or railcar or truck, there can be a wide range in the quality received by different buyers. For example in one of the vessels monitored from Toledo to Rotterdam, the percentage of broken corn and foreign material on individual barges received by processors ranged from 5.3 percent to 20.3 percent (Hill, Paulsen, and Early).
- Most importers use a certificate final contract, in which the responsibility for quality transfers from the seller to the buyer and the ship's captain at the end of the loading spout. However, certificate final contracts are lower priced than contracts which guarantee quality at destination, and

most importers specify the contract that only guarantees quality at the export elevator, despite the high probability that delivered quality will be less than that recorded on the USDA certificate. The use of certificate final contracts reduces the legal responsibility of the exporter with respect to the destination quality. Consequently, foreign buyers must prove error at the point of sampling prior to loading for their complaint to be judged "valid" by USDA employees investigating complaints about quality. However, that does not resolve the problem for the final user when the grain arrives in poor condition. Number 1 grade at the time of loading can still be moldy, hot, and badly broken when it arrives at the foreign port (Hill et al. 1990).

New evidence

In spite of the consistent findings from the studies from 1906 to 1985, Congress, producer groups, and foreign buyers continued to question how much of the lower quality at destination was the result of losses during transport and handling, and whether there were problems with the quality at origin. All of the previous studies were limited to case studies of a single vessel or a few vessels over a short period of time. Conditions surrounding individual shipments often differed from one vessel to another. Also, soybeans received little attention in these studies, even though the Japan Oilseed Processors Association and processors in Europe originated many of the complaints about quality. Our research using data from the four-year period of 1990 through 1993 quantified the quality losses during shipment of soybeans from U.S. ports to processing destinations in Europe and Japan. (See box for a description of data and methods of analysis.)

The data indicated that grain quality changed between the origin (per origin certificate) and the destinations (table 1). For Japanese destinations, moisture content at destination was 0.52 percentage points lower than the origin certificates. In the European data, average moisture at destination was 0.72 percentage points lower than at origin. The moisture loss may have happened because of handling practices which exposed grain to dry air during loading, unloading, and sampling. Handling of samples at destination, prior to testing, could also reduce moisture content. Reference methods for calibrating moisture meters also differ among countries; however, the difference in reference methods should have resulted in an increase in moisture content rather than the observed decrease between origin and destination (Hill and Bender).

Oil and protein contents are the two most important factors that determine the value of soybeans for crushing, and any change in these con-

stituents has an economic impact on processor's profits. Oil content showed a small but significant increase during transit and handling in both the Japanese and European data sets (table 1). Protein content was 0.1 percentage point higher at destination than at origin in the Japanese data, but 0.08 percentage point lower in the European data. Both values were significantly different from zero at the 99 percent level. Although these average values are quite small, they contain a very wide range among individual vessels. Those vessels where quality appeared to be better than origin obviously generated no comment from the buyer; those with large loss of quality could mean significant economic losses to the individual processor. Processors do not look at annual quality averages for all vessels arriving at their port; they only look at quality for each vessel that arrives at their plant. An increase of 0.4 percentage points in foreign material represents a loss of 200 tons of millable soybeans in a 50,000 ton panamax vessel. At a price of \$200 per ton this quality deterioration represents a loss of \$40,000.

Only the Japanese data included information about foreign material and splits. As expected, the levels of both of these factors increased between origin and destination. Quality at origin was measured prior to loading of the vessel, and samples at Japan were taken after the grain was removed by pneumatic unloading devices. There are several impacts during loading and unloading that create split and broken beans. Pieces of soybeans smaller than 8/64 inch are included in the grade factor of Foreign Material (FM). These impacts increased FM by 0.38 and splits by 2.06 percentage points in shipments to Japan, lowering quality by one grade or more on 64 percent of the vessels. Broken beans and splits reduce the value of soybeans because they increase the rate of deterioration and oxidation during shipment and storage and reduce the yield and quality of the oil that can be recovered. The percentage of oil increased between origin and desti-

Table 1. Origin and destination values of selected quality characteristics, U.S. soybean samples, 1990-93

Quality Factors	No. of Observations	Origin Value (%)	Destination Value (%)	Destination Minus Origin
U.S. to Japan				
Moisture	375	11.99	11.47	-0.52**
Foreign material	377	1.85	2.23	-0.38**
Splits	373	8.45	10.50	-2.06**
Protein ^a	260	35.42	35.52	-0.10**
Oil ^a	263	18.85	18.97	-0.12**
U.S. to Europe				
Moisture	229	12.26	11.54	-0.72**
Protein ^a	223	35.34	35.26	-0.08**
Oil ^a	223	18.77	19.00	0.23**

Note: ** denotes statistically significant at the $\alpha = 0.01$ level.

^aThe destination values for protein and oil contents were reported without regard to moisture content and were adjusted to a 13% moisture basis. JOPA reported total nitrogen which was converted to protein content.

nation with no apparent explanation. Although statistically significant, the results for protein were inconclusive. Results were contradictory for the two destination countries, and the absolute differences were quite small.

Implications for business and government

The results from our recent study can help importers and exporters establish contract specifications and develop more realistic expectations about delivered quality. Quality at destination will almost always be less than that shown on the origin certificate. Legislators and regulators sometimes fail to recognize that most quality factors are specified by the buyers. For example, the buyer may specify a lower moisture content, knowing the trade-off between more tons of oil and meal per ton of soybeans and higher levels of splits and foreign material at destination. Higher moisture levels reduce breakage but will increase biological activity and the level of free fatty acid, which in turn reduces the quality of the oil.

This study also has policy implications for regulatory agencies and legislators.

- Legislative and regulatory changes in grades will have little impact on destination quality. Grades describe quality; they do not determine it, except as the market creates incentives for change through price differentials.
- Legislation and regulation should provide the mar-

ket participants with more accurate information about economically important attributes. The two most important attributes in determining value, oil and protein contents, are not part of current grades. Since these factors are not affected by handling and transport, they would provide a measure of value that would show little change between origin and destination.

- As shown in this study, changes in quality between the export certificate and the final destination are inevitable. The buyer may choose to purchase on the basis of destination quality, but most buyers consider the cost of that guarantee to be too high.
- Marketing efficiency can be increased by reducing transactions costs through more accurate information about value. Many of the changes in the past have changed grade limits without increasing the information about quality. For example, the grade limit for foreign matter has been changed several times during the history of soybean grades (Hill 1990). The quality of the crop was unchanged although there was a redistribution of quantities among the grades. On the other hand, including oil and protein contents in soybean grades would reduce marketing and transactions costs because they would increase the information that buyers use to estimate value (Hill 1988). Currently this information is being made available to buyers only after the vessel has been loaded. Individual processors in the domestic market often seek information about composition by

The research team conducted intensive sampling in each barge and vessel hold at origin and destination.



sampling in many geographical regions. The sum of the costs of collecting this information by each firm probably exceeds the cost of providing this quality information through uniform grades and standards.

- Regulatory and legislative actions will not solve the problem of quality losses between origin and destination. Destination quality is largely a function of the quality specifications in the buyer's contract and the inevitable loss of quality during handling and shipping. Mandating cleaner grain will not reduce breakage during handling. Contracts that specify "origin grades and weights" will continue to generate complaints by processors dissatisfied with the quality received at their plant, because it will always be less than quality at origin. Policy changes should be directed toward increasing the amount and accuracy of information provided by objective third party agencies (government inspectors or independent agencies under government supervision), not at mandating the level of quality loaded.
- The choice of quality, contractual arrangement, loading procedures, and price should be left to buyer and seller negotiations in a market where all participants have equal access to information about value. ■

■ For more information

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