Segregation of Non-biotech Corn and Soybeans: Who Bears the Cost?*

by

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April 2003

*Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting in Montreal, Canada, July 27-30, 2003. Comments or suggestions from Gregory K. Price, Carol Goodloe, Amy Burdett, Elizabeth Jones, and Marianne Plaus are gratefully acknowledged. The authors are agricultural economists of the Economic Research Service, U.S. Department of Agriculture. The views expressed herein are those of the authors, which do not necessarily reflect official USDA policy.

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Markets for non-biotech corn and soybeans have emerged in recent years, extending a trend of increased product differentiation in the U.S. grain sector.[1] Product differentiation has also been a steady trend in U.S. export markets. Between 1990 and 2002, the share of vessels carrying one lot of grain (averaging about 25,000 metric tons for U.S. No. 2 corn) fell from 70 percent to 54 percent. During the same period, the number of vessels carrying two lots increased from 19 percent to 26 percent, and the number carrying 5 or more lots increased from 0.7 percent to 4.0 percent (Plaus).

Demand for non-biotech grain is driven by several factors. First, changing preferences toward biotech products by consumers in some parts of the world, notably the European Union (EU) and Japan, have led to an increase in the use of non-biotech ingredients by food manufacturers in those countries. Second, consumers' perceptions about safety and health effects of biotech foods (which are not science-based) and foreign governments' willingness to give consumers the right to choose between biotech and non-biotech foods, have led to the adoption of mandatory biotech food labeling and government regulations in the EU and Japan, as well as South Korea, Australia, New Zealand, and China. Food manufacturers in some of those countries, such as the

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[1] Value-enhanced varieties of corn and soybeans have been an important part of the longer-term trend toward product differentiation. Acreage devoted to traditional value-enhanced corn (such as high oil corn) increased from 3 percent of total corn acreage in 1996 to about 8 percent in 2000 (U.S. Grains Council). Traditional value-enhanced corn does not include non-biotech corn, which accounted for another 2.6 percent of total corn production in 2000.

EU and Japan, often opt for procuring non-biotech ingredients so that their products do not have to carry a label: "may contain GMOs."

These developments present both an opportunity and a challenge for the grains and oilseeds sector. The U.S. industry perspective is that market-based programs (including identity preservation (IP) and third-party process verification) are more efficient means of marketing value-enhanced commodities in general and non-biotech products in particular than government regulation, including U.S. grain grades and standards.[2] Because the U.S. grain marketing system is characterized by high-volume, high-speed operations for bulk commodities, relatively high purity levels (e.g., 95%) of non-biotech corn and soybeans can only be sustained through IP systems, which will likely create additional costs.

Despite their importance, little is understood about price premiums that buyers are willing to pay for non-biotech corn and soybeans in domestic and foreign markets, or how premiums respond to changes in IP systems or other factors (such as the exchange rate for the dollar) over time. Whether or not buyers are willing to pay premiums for non-biotech crops appears to depend critically on the share of non-biotech supply relative to the share of non-biotech demand. The next question of concern is: would the price premium be large enough to cover the cost of IP and

[2] IP, for purposes of this study, is broadly defined as a production-handling-distribution process by which crops are required to be kept separate to avoid commingling during planting, harvesting, loading and unloading, storage, and transportation throughout the entire supply chain so as to preserve the crops' identities in terms of end-use quality, genetic makeup, or unique production process (such as organic farming). In contrast, segregation entails many of the above activities at any stage of the marketing chain, but does not necessarily preserve the crops' identities. Segregation to meet a stringent threshold level of biotech material in grain shipments, such as 1-percent in the EU or lower, is generally regarded as difficult and prohibitively expensive if not impossible.

to entice producers to grow non-biotech crops? If the U.S. grain marketing system is efficient, knowledge about potential price premiums can be supplemented by inferences about the distribution of costs.

This study focuses on the economics of segregating U.S. non-biotech corn and soybeans for shipments to Japan, the primary export market for U.S. non-biotech grains and oilseeds, as a case study. The purposes of this paper are two-fold: 1) to estimate price premiums that buyers in both the U.S. domestic and Japanese export markets were willing to pay for non-biotech corn and soybeans for the 2000-2002 crops; and 2) to examine who bears the cost of segregation. The IP systems used to segregate non-biotech corn and soybeans are intended to meet a less stringent, 5-percent tolerance level, not zero tolerance. In addition to shipments to Japan, these IP systems can be employed for shipments to other export markets.

Non-biotech Corn and Soybean Markets

At present, non-biotech corn and soybeans grown and marketed under IP systems remain a niche market. Non-biotech, IP corn and soybeans each account for about 2 percent of U.S. production (Lin, 2002). Non-biotech corn and soybeans are basically an extension of value-enhanced crops, such as high-oil and white corn, which are typically grown by producers under contract with grain companies.

Japan is the primary export market for both U.S. non-biotech corn and soybeans, according to grain trade sources (table 1).[3] In the marketing year of 2001/02, U.S. exports of non-biotech corn totaled about 2.1-2.6 million metric tons (mmt), 95 percent of which were shipped to Japan for food manufacturing (primarily starch). The StarLink incident in late 2000 triggered a significant increase in non-biotech corn exports to Japan in 2001/02. Similarly, U.S. exports of non-biotech soybeans totaled about 0.8-1.2 mmt, predominantly exported to Japan for the production of processed foods (such as tofu, miso, and soy sauce). The 0.7-1.0 mmt exports to Japan include non-biotech soybeans shipped as a bulk commodity (but intended to meet a 5% threshold level of biotech content) or by containers, as well as organic soybeans (table 1). Changing sentiment towards biotech products among some consumers and the decision of food manufacturers to avoid using biotech ingredients in the production of 26 food items governed by the Japanese labeling regulations are the two major driving forces behind the importation of non-biotech corn and soybeans into Japan.[4] In 2001/02, non-biotech exports accounted for 14-17 percent of U.S. corn exports to Japan and 19-27 percent of U.S. soybean exports to that country. Small volumes were exported to South Korea and the EU in the case of non-biotech soybeans and to South Korea in the case of non-biotech corn.[5]

In addition to meeting the needs of export markets, U.S. grain handlers also separate non-biotech from biotech crops through IP for meeting the needs of some domestic food processors. Over the past few years, a few food manufacturers have decided to end the use of biotech crops in

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[3] Many grain companies choose not to ship to countries with very low threshold levels of biotech content, such as Australia, New Zealand, and Saudi Arabia, because of high risk of liability, which makes the cost of IP prohibitively expensive.

[4] Japan began implementing its mandatory labeling regulations for biotech foods in April 2001.

[5] According to Toepfer International, market demand for non-biotech, IP food soybeans in the EU totaled about 100,000 metric tons in 2000/01, mostly imported from the United States for making tofu.

Table 1--U.S. exports of non-biotech corn and soybeans: 1999/00 - 2001/02

Commodity	**Importing country**	**Volume exported (million metric tons)**		
		1999/00	2000/01	2001/02
Non-biotech corn				
	Japan	0.5-1.0	0.7-1.0	2.0-2.5
	South Korea	--	0.1	0.1
	EU	--	--	--
		0.5-1.0	0.8-1.1	2.1-2.6
Non-biotech soybeans				
	Japan	0.5-0.6	0.5-0.8	0.7-1.0
	South Korea	0.1	0.1	0.1
	EU	0-0.1	0-0.1	0-0.1
		0.6-0.8	0.6-1.0	0.8-1.2

Sources: U.S. grain trade associations; Japanese grain trading houses; Toepfer International; and Japan Ministry of Agriculture, Forestry and Fisheries.

their operations. In July 1999, the Gerber and Heinz companies announced that their baby food processing facilities would immediately stop using biotech ingredients. In January 2000, Bestfoods, Inc. decided to reformulate its food products destined for the EU by not using biotech ingredients in order to avoid the biotech labeling requirement (Howie). Then, in February 2000, Frito-Lay Inc. announced that it would replace biotech corn in its snack food manufacturing with non-biotech corn. The volume of non-biotech corn used annually by these food manufacturers is estimated to lie between 0.5 mmt and 1.0 mmt. Frito-Lay alone used about 21.4 million bushels (0.5 mmt) of corn in producing processed foods in 1999 (Koenig).

Identity Preservation Systems and Costs

Because of limited demand for non-biotech corn and soybeans and the additional expense of maintaining separate handling and storage facilities or cleaning the existing infrastructure, only a small to modest percentage of grain elevators segregate and market non-biotech products based on IP systems.

Modern biotechnology has and will continue to challenge the U.S. grain marketing system, particularly in terms of increased need for product differentiation. In September 1999, Sparks Companies, Inc. conducted a survey of 100 Midwestern grain elevators and found that 11 percent were segregating for non-biotech corn and 8 percent for non-biotech soybeans. In February 2000, the Farm Progress Company surveyed 1,200 U.S. grain elevators with regard to their segregation intentions. The results indicated that 24 percent planned to segregate non-biotech corn and 20 percent planned to segregate non-biotech soybeans in fall 2000. Elevators were probably anticipating food labeling regulations to be implemented in 2001 in countries other than the EU, such as Japan and South Korea. However, even fewer elevators in both surveys were reportedly willing to offer premiums for non-biotech grains--5 percent in the 1999 Sparks survey and 10 percent in the Farm Progress survey. Another survey conducted by the American Corn Growers Foundation in fall 2000 suggested a higher level of potential segregation. The survey polled 1,107 grain elevators in 9 states and found that 30.5 percent were either requiring or suggesting segregation at their elevator facilities.

The non-biotech niche market is defined by IP systems with contracts that specify the purity of non-biotech content in corn or soybean shipments so as to meet particular needs. Some U.S. grain handlers are already segregating grain for certain export markets. For example, Cargill segregates non-biotech corn under *Innovasure*, a so-called process-based IP system, for Japan, although without guaranteeing a specific tolerance level for biotech material. The company provides its own verification process for the IP program in many cases, similar to that used for high oil corn (HOC). Patterning corn segregation after handling procedures for HOC can usually meet the 95-percent purity requirement of Japanese buyers (Lin, Chambers and Harwood). Thus, the process has remained the core procedure for segregating non-biotech corn in recent years. Other IP systems, such as the one designed by the Association of Official Seed Certifying Agencies (AOSCA) aim to achieve a certain purity level of non-biotech content, such as a 99-percent purity level for non-biotech corn. This is generally referred to as content-based (or standards-based) IP.

To ensure the achievement of a given purity, grain companies often contract with producers to plant certain varieties (e.g., non-biotech and EU-approved) for non-biotech corn IP programs. In addition, the programs require that equipment--such as planters, combines, dump pits, grain conveyers, dryers, and storage bins--be cleaned between crops. Contract producers are also required to adopt specific production and harvesting practices. For example, a distance of 660 feet from any biotech corn field is required to isolate a non-biotech corn field and avoid inadvertent cross-pollination from neighboring biotech corn. In addition, the programs involve testing the purity level of seed purchased by producers and biotech content of corn shipments as well as auditing and certification. Moreover, the programs often require detailed record keeping and retention of samples from the purchased seed, harvested crops, and corn shipments.

The IP system for non-biotech soybeans has changed more drastically in recent years. In the 2000 crop year, the Synchrony-treated soybeans (STS) IP system was a common segregation process with rigid requirements. STS are herbicide-tolerant, but non-biotech varieties developed by DuPont and marketed by ADM, Protein Technologies International, and other grain companies. Under this IP system, growers agree to purchase certified STS seed varieties from an authorized dealer, retain receipts for verification, and purchase Synchrony-- DuPont's herbicide ingredient that kills weeds but does not cause damage to STS soybeans upon spraying. This IP system requires a purity level of non-biotech content, ranging from 98 percent (not to exceed a 2% biotech content) under a variation of the IP system adopted by Consolidated Grain & Barge to more than 99.99 percent (not to exceed a 0.01% biotech content) under another IP system implemented by DuPont's own Protein Technologies International. In addition, in the latter case, there are a set of quality specifications (e.g., a maximum of 1% for foreign material and a maximum of 13% for moisture) that must be met. In the former case, contracted STS production for export must have no corn commingled --a zero tolerance. Contract producers received $0.15 per bushel premium at harvest time with the Consolidated Grain and Barge IP system and $0.30 per bushel premium under the Protein Technologies International IP system if all requirements are met. Producers received no premium if the requirements were not met.

The STS IP system lost favor with farmers in the 2001 crop year because of 1) its very rigid requirements for maximum allowable biotech content and other quality attributes, and 2) Japanese buyers' unwillingness to pay premiums at the previous level due to STS' very low level of protein content.[6] Many soybean producers did not receive the premiums promised in the contracts because their shipments failed to meet the IP requirements. As a result, they changed

[6] According to Kim Nill of the American Soybeans Association, the sign up for the STS IP system was negligible for the 2001 crop. This statement was reaffirmed by analysts of the Protein Technologies International in April 2002.

to non-STS IP systems, typically resembling the HOC IP system, which is less rigid than the STS system.

Costs of Segregation

The cost of segregation depends on the requirements of the IP system that is designed to preserve the identity of the product, including the purity level of non-biotech content. Hence, the cost of segregation is particular to a specific IP system. If an IP system is changed, such as when the HOC system is applied to 2001 non-biotech soybeans rather than the STS system, then the cost will change accordingly to reflect the new set of requirements.

An earlier ERS study examines the cost of segregation for non-biotech crops based on a survey of U.S. grain elevators and specialty grain firms conducted by the University of Illinois (Bender *et al.*). The ERS study indicates that, on average, segregation could add about $0.22 per bushel (12% of the average corn farm price) to the cost of handling non-biotech corn from country elevators to export elevators if segregation follows the HOC system (Lin, 2002). The ERS cost estimate is comparable to that reported by other researchers or the grain handling industry, which is typically around $0.20/bu. (Miranowski, *et al.*; Lence and Hayes; Moss, Schmitz, and Schmitz; and Krejci). The ERS study also estimated that, on average, segregation could add about $0.54 per bushel (12% of the average soybean farm price) to the cost of handling non-biotech soybeans from country elevators to export elevators if segregation follows the STS system. In contrast, the cost of segregation could decline to $0.18 per bushel (4% of the soybean farm price) if segregation follows the same handling process used for HOC.

The above segregation costs were reaffirmed by analysts of the U.S. grain industry, Japanese grain trading houses, and companies directly involved in implementing non-biotech IP programs. For example, Protein Technologies International estimated the cost of segregation for 2001 non-biotech soybeans at \$0.18 per bushel from country elevators to export elevators. Of the total \$0.18/bu along that marketing chain, \$0.01 arose at country elevators, another \$0.10 was assessed between country elevators and river elevators, and \$0.07 was incurred between river elevators and port elevators (Schmalz). In terms of the nature of the segregation costs, about one-third is hidden cost (e.g., the opportunity cost of leaving storage bins partially filled or interest expense due to the delay of loading non-biotech soybeans onto vessels) and the remaining two-thirds are real, additional costs of segregation.

In most cases, shipping non-biotech soybeans from U.S. export ports to final destinations in Japan would not add extra ocean freight expenses. Non-biotech soybeans accounted for 19-27 percent of total U.S. soybean exports to Japan, making it likely to be shipped in larger volumes. A volume greater than 8,000-9,000 tons does not require separate holds on the vessel and thus does not lead to additional ocean freight expenses (Nishiyi). In addition, testing would be simpler than that for corn because herbicide-tolerant soybeans are the only approved biotech trait. In contrast, shipments of less than 8,000 tons are more common for non-biotech corn and testing for biotech content is more complicated for corn due to different biotech events and the existence of varieties that have not been approved by some importing countries (Sato; Martin). Shipments of non-biotech corn are thus more likely to have delays in loading onto the vessel, which adds extra opportunity costs (interest expense). Therefore, non-biotech corn shipments would typically add an extra \$5 per ton (\$0.13 per bushel) of ocean freight expenses from U.S.

export ports to Japan, compared with no such additional expense for non-biotech soybeans (Sato).

The costs of IP also consist of all segregation costs (including hidden costs) at the farm level and incentives offered to producers to grow non-biotech crops. According to USDA's Value Enhanced Grain Survey conducted by NASS' Illinois Market News, non-biotech corn price premiums paid to producers by grain companies averaged about $0.08 to $0.10 per bushel for the 2000 crop, mostly $0.10 for the 2001 crop, and $0.06 to $0.15 for the 2002 crop. In the case of non-biotech soybeans, the price premiums averaged about $0.10 to $0.30 per bushel for the 2002 crop and $0.20 to $0.25 for the 2001 crop, up from $0.05 to $.10 for the 2000 crop. The price premiums largely represent incentives offered to producers to grow non-biotech crops.

The costs of IP vary, depending upon the requirements of the system. In the case of non-biotech corn, the costs totaled around $0.45 per bushel (22% of the average corn farm price) for the 2000-2002 crops from U.S. farm gates to final destinations in Japan. The costs for non-biotech soybeans totaled around $0.62 per bushel (14% of the average soybean farm price) for the 2000 crop and around $0.40 (8% of the average farm price) for the 2001-2002 crops.

Price Premiums for Non-biotech Crops

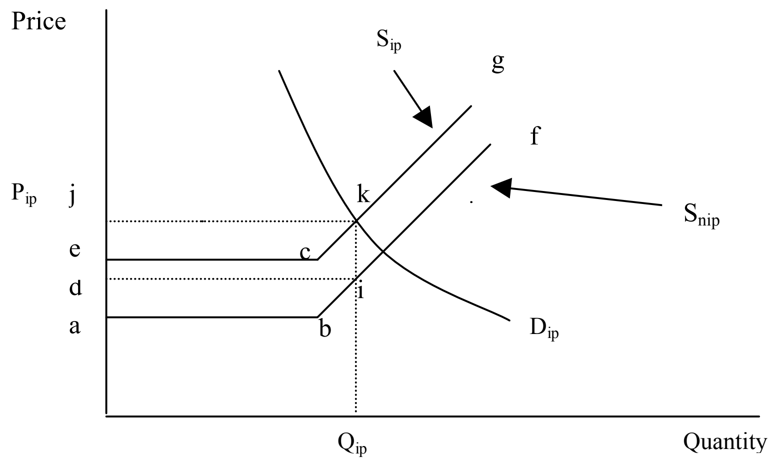
If consumers in some segments of export markets (primarily the EU and Japan) show a preference for non-biotech food products, are they willing to pay premiums for them? This cannot be determined from retail data, because food manufacturers opt to use non-biotech ingredients to avoid labeling. However, it is possible to determine whether Japanese buyers are willing to pay premiums for non-biotech corn and soybeans. In addition, it is feasible to determine if the price premiums are large enough to cover the costs of segregation and to provide incentives to producers for entering into contracts with grain companies to grow non-biotech corn and soybeans.

Theoretical Considerations

Prior to the investigation of price premiums that Japanese buyers are willing to pay for non-biotech corn and soybeans, it is appropriate to consider related conceptual issues. How does the market equilibrium condition for non-biotech corn or soybeans differ from that for biotech and biotech-commingled varieties? Under what market conditions would buyers pay price premiums for non-biotech corn or soybeans, or even discount biotech products?

The conceptual framework divides U.S. corn or soybean market into two separate, segmented markets: 1) the non-IP market, including biotech products and conventional varieties that are not segregated and thus are commingled with the biotech products; and 2) the IP market, which is reserved exclusively for non-biotech products grown under IP systems. As shown in figure 1, the supply curve for the unsegregated non-biotech product prior to the cost of IP being added is a "kinked" supply curve abf (S_{nip}), with the flat segment of line ab representing the fact that farmers always have the option of selling their products at the non-IP market for a price (point a). After adding the cost of IP (distance of line ik) to the supply curve S_{nip}, the supply curve of the non-biotech, IP product becomes another "kinked" supply curve ecg (S_{ip}).

Figure 1. Market equilibrium for non-biotech products in the IP market



If the demand curve (D_{ip}) for the non-biotech product intersects the supply curves at their diagonal segments, it means that some farmers would be induced to supply some quantity (Q_{ip}) of the non-biotech, IP product instead of selling the product in the non-IP market. The market for the non-biotech product is cleared at the equilibrium price (P_{ip}), which is the vertical sum of the marginal cost of the non-biotech product production (point i) plus the cost of IP (distance of line ik, which is equal to the distance of line ae, or line dj). In other words, the non-biotech product IP market is in equilibrium when the market clearing price, which exceeds that in the non-IP market, is just sufficient to cover the cost of IP and marginal cost of production for the non-biotech product (including incentives offered to producers to grow non-biotech, IP crops). The equilibrium quantity for the non-biotech product that corresponds to the equilibrium price is Q_{ip} (fig. 1).

At the above equilibrium quantity and price, producers of non-biotech, IP commodities gain no excess returns beyond covering the marginal cost of production and the cost of IP. In other

words, the price premium (P_{ip} - a) for the non-biotech product is sufficient just to cover the cost of IP and marginal cost of production. Given the assumption that producers always have the fall-back option to sell in the non-IP market at a price (point a), the "producer premium" for IP production, defined as the difference between the incentive price for IP production and the price received for unsegregated production, has a lower bound of zero. The incentive price for IP production refers to the effective price received by producers after subtracting the cost of IP (distance of line ea) from the price of IP commodities (point e) received by producers. Because the price premium (P_{ip} - a) can also exceed the IP cost, the "producer premium" for IP production, in equilibrium, reflects differences in marginal cost between non-biotech, IP commodities and conventional (but unsegregated) ones, not pure profit for the producer.
The above "producer premium" for the production of non-biotech, IP commodities, will disappear if the demand curve intersects the horizontal section of the supply curve ecg (inclusive of IP costs). The market clearing price for non-biotech, IP commodities is at point e, where producers have no more incentive for IP production than that for conventional (but unsegregated) commodities. Thus, the price premium for non-biotech, IP commodities, in equilibrium, is just sufficient to cover the cost of IP, leaving no "producer premium" for IP production.

Changes in the cost associated with IP (the vertical distance between supply curves) have different impacts, depending on whether the intersection with demand curve occurs on the "flat" or "diagonal" segment. If it occurs on the flat segment, an increase in IP costs will be borne by consumers. In contrast, if it occurs on the diagonal segment, there will be price changes for both consumers and producers.

The above graphic analysis has a limitation in that it assumes that IP cost can be represented as a fixed parameter. Related to this limitation is that the graph cannot show the incidence of IP costs for grain handlers or shippers. In addition, it assumes uniform cost structures for all producers of non-biotech, IP commodities. Individual producers may have higher or lower costs, depending on farm-specific characteristics and locational factors.

Whether price premiums paid for non-biotech crops exceed the costs of segregation depends on the relative size of the supply of and demand for biotech and non-biotech crops. The market condition under which buyers are more prone to pay price premiums that are just sufficient to cover the costs of segregation is when the supply share of the non-biotech product is larger than the corresponding demand share (Lence and Hayes). At present, the supply share of non-biotech products grown in the United States exceeds their demand share, which is still a niche market, accounting for about 2 percent of domestic corn or soybean production. Hence, price premiums paid for non-biotech crops tend to cover just the costs of segregation. Non-biotech corn or soybeans, if exported, are primarily destined for Japan for food production, which is highly inelastic.[7] The inelastic demand for food corn and soybeans makes it easier for U.S. exporters to pass on the costs of segregation to Japanese buyers as well.

Foreign Non-biotech Premiums

Interviews with a few Japanese grain trading houses, trade associations, and the Japan Ministry of Agriculture, Forestry and Fisheries indicated that typical price premiums Japanese buyers

[7] According to Pekaric-Falak, Meilke and Huff, the price elasticity of demand for corn in food processing would likely be very inelastic, around -0.10 for the Western Hemisphere. Similarly, the demand price elasticity for food soybeans in Japan would likely be highly inelastic, around the same general magnitude.

were willing to pay for non-biotech corn ranged between $0.40 and $0.50 per bushel, or $15.7 to $19.7 per metric ton (CIF price with average corn quality), for the 2000-2001 crops. The price premiums (in Japanese yen per metric ton) for the 2001 crop rose in part because the StarLink incident made Japanese buyers more cautious about biotech corn. However, a stronger dollar (the exchange rates averaged 121.6 yen per dollar in 2001, up from 107.8 yen per dollar in 2000) caused the premiums for non-biotech corn to remain largely unchanged when converted into dollars per ton. Non-biotech corn price premiums remained steady for the 2002 crop, ranging from $0.43 to $0.48 per bushel.

In the case of non-biotech soybeans, interviews with Japanese grain trading houses, a grain company, and a trade association indicated that typical price premiums for non-biotech soybeans (CIF price with average soybean quality) for the 2001 crop ranged between ¥1,200 to ¥1,500 per ton, or between $0.27 and $0.33 per bushel ($9.90 to $12.10 per ton).[8] This premium range was a sizable decrease from the $0.50 to $0.60 bushel for the 2000 crop. Clearly, the use of more rigid STS IP system raised the cost of segregation, pushing up the price premiums for non-biotech soybeans for that crop year. In contrast, the use of an IP system patterned after HOC handling process is less stringent in its requirements, leading to lower segregation costs for the 2001 crop.

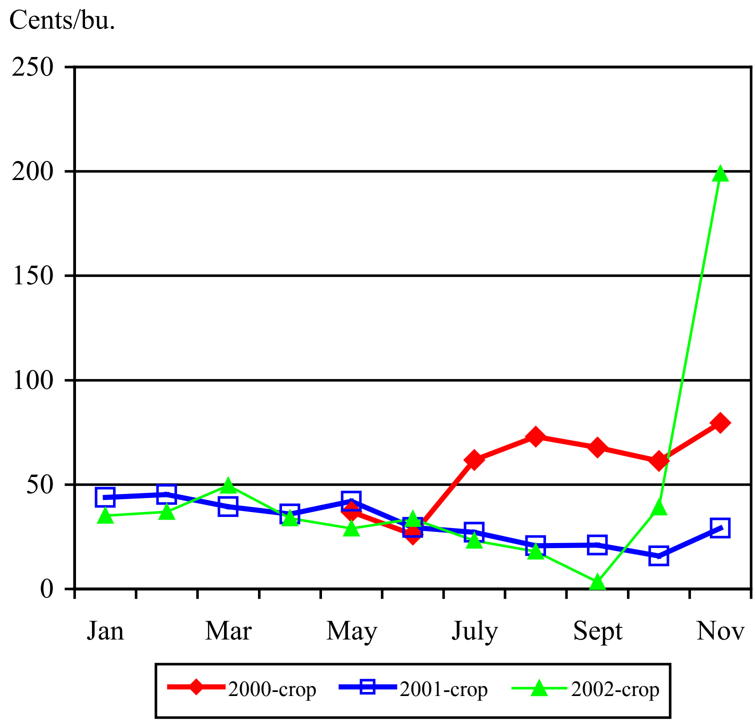
[8] This range of premiums for non-biotech soybeans with average quality, which generally meet a 5-percent tolerance, is comparable with the $0.35-per-bushel price premium for the 2001 crop reported by the Clarkson Grain Company for shipment to Japan (Clarkson) and the $0.30-per-bushel price premium estimated by the trade association (Nill). In contrast, premiums for food-grade, non-biotech soybeans shipped by containers to the Japanese tofu market and organic soybeans for making tofu there were much higher--$1.75/bu. ($64/ton) for the former and $11.5/bu. ($423/ton) for the latter. The premium for food-grade soybeans is attributed to quality attributes of the bean (such as higher protein, clear hilum), in addition to non-biotech trait.

The above price premiums for non-biotech soybeans are very comparable with those obtained from the Tokyo Grain Exchange.[9] Biotech soybeans are specified in the contract as U.S. No. 2 yellow soybeans of Indiana, Ohio and Michigan origin produced in the United States. Non-biotech soybeans refer to identity-preserved U.S. No. 2 yellow soybeans of Iowa, Illinois and Wisconsin origin. Monthly settlement prices of futures contracts expiring in December for biotech and non-biotech soybeans reflect the weighted average prices (in yen per ton) of daily settlement prices for the contract expiring month. The monthly settlement prices were converted to dollars per ton or cents per bushel based on the mid-month exchange rate of the dollar. The December contract month is chosen for the analysis because it reflects new crop futures prices, which are more compatible with price premiums paid by grain companies to U.S. non-biotech producers based on seasonal sales patterns for soybeans. The weighted average price premiums for the 2000 and 2001 crops are computed by using monthly trading volume as the weighting factor, excluding December due to thin trading in that month.

Price premiums for non-biotech soybeans averaged $0.31 per bushel for the 2001 crop, down from $0.54 per bushel for the 2000 crop (fig. 2). In contrast, the weighted average price premiums ranged from $0.33 to $0.52 per bushel for the 2002 crop, depending on whether September and November 2002 futures prices--two outliers--are included in the computation of non-biotech premiums. Price premiums became volatile toward the end of the futures contracts and reached an average of $1.99 per bushel in November 2002. Japanese futures traders adjusted

[9] Non-biotech soybean futures were launched at Tokyo Grain Exchange (TGE) in May 2000. These futures prices and those for conventional, unsegregated soybeans permit the calculation of non-biotech premiums. Price premiums at TGE could be influenced by the supply of non-biotech soybeans by grain companies in the real market, which could bias the price discovery process, especially in a short timespan (such as a month or so). However, the premiums at TGE match closely with those obtained from other data sources for the 2000 and 2001 crops. For details of contract specification for non-biotech soybeans at TGE, the reader is referred to a study by Parcell and TGE's web site: http://www.tge.or.jp/cgi-bin/monthly.

Figure 2. Price premiums Japanese buyers were willing to pay for non-biotech soybeans



non-biotech premiums they were willing to pay amidst indications that the 2002 non-biotech soybean supply was tight, and that U.S. farmers would plant even more herbicide-tolerant soybeans for the 2003 soybean crop.[10] In addition, the hike in non-biotech premiums reflects that U.S. producers and handlers have learned from previous lessons that some IP systems, such as the STS, can be very costly.

Can the Incidence of Segregation Costs be Transferred?

Given the price premiums that Japanese buyers were willing to pay for non-biotech corn and

[10] Subsequent to the peak in November 2002, per-bushel price premiums for non-biotech soybeans for the 2003 crop declined to $0.93 in January 2003, $0.72 in February 2003, and $0.44 in March 2003. These price premiums are consistent with the 1.0-1.5 dollars per bushel average premium reported by media, which are two to three times higher than the previous year (Nikkei English News Service).

soybeans, are the premiums large enough to cover the costs of IP? In other words, who bears the cost? Is it Japanese buyers, or U.S. producers, grain handlers, or some combination of the three?

Demand price elasticity of the commodity plays a key role in affecting the distribution of the costs of segregation. If the commodity is less price elastic, either because of strong consumer preference for non-biotech products, a lack of substitutes, or the nature of the commodity's market demand, then suppliers are in a better position to pass on the costs of segregation to consumers. The demands for both food-grade corn and soybeans in Japan are highly inelastic, leading to Japanese consumers' willingness to pay price premiums for non-biotech corn and soybeans. In addition, Japanese consumers regard soybeans from Brazil and Argentina, which have a reddish tint, to be inferior in making tofu. This (somewhat) distaste for South American soybeans makes it easier for U.S. non-biotech soybean suppliers to pass on the costs of segregation in the form of higher prices to consumers without incurring revenue losses.

Based on available evidence, it is clear that in the case of non-biotech corn, Japanese buyers have been willing to pay price premiums ranging from \$0.40/bu. to \$0.50/bu. in recent years. This level of non-biotech premiums is large enough to cover virtually all IP costs, including additional ocean freight expenses (due to the small shipment volumes that were commonly less than 8,000-9,000 tons), segregation costs from country elevators to export elevators, and price premiums paid to producers (table 2). Price premiums paid by Japanese buyers were able to cover 93-111 percent of the cost of segregation and producers' non-biotech premium for the 2000 crop. Similarly, about 89-111 percent and 96-105 percent of the IP costs were covered by premiums paid by Japanese buyers for the 2001 and 2002 crops, respectively. In other words, the incidence

Table 2—Price premiums paid by Japanese buyers for non-biotech corn and soybeans and the costs of IP, 2000-2002 crops

		Non-biotech corn			Non-biotech soybeans		
Premium or IP Cost	Unit	2000-crop	2001-crop	2002-crop	2000-crop	2001-crop	2002-crop
(a) Premium paid by Japanese buyers	$/bu.	0.40 – 0.50	0.40 – 0.50	0.43-0.48	0.50 – 0.60 (0.54)*	0.27 – 0.33 (0.31) *	(0.33-0.52) *
IP costs:							
Ocean freight exp.	$/bu.	0.13	0.13	0.13	--	--	--
Segregating cost from country elevators to export elevators	$/bu.	0.22	0.22	0.22	0.54	0.18	0.18
Price premium paid to producers**	$/bu.	0.08 – 0.10	0.10	0.06-0.15	0.05 – 0.10	0.20 – 0.25	0.10-0.30
(b) Subtotal	$/bu.	0.43 - 0.45	0.45	0.41-0.50	0.59 - 0.64	0.38 - 0.43	0.28-0.48
(a)/(b) % of IP costs covered by Japanese buyers' premium***	%	93 - 111	89 - 111	96-105	85 - 94	71 - 77	108-118

*Price premiums for non-GM soybeans based on Tokyo Grain Exchange futures prices for contracts expiring in December.

**Source: USDA-NASS, "Value Enhanced Grain Survey," Illinois Market News. Feb. 8, 2000 and Feb. 6, 2001.

***The percentage of IP costs covered by Japanese buyers' premium for non-biotech corn or soybeans is calculated by matching lower end (or upper end) of the price premium range with lower end (or upper end) of the IP costs. Different ranges of the percentages could follow if one mixes the comparison between lower end of one with upper end of the other.

of the costs of segregating non-biotech corn ultimately falls on Japanese buyers. U.S. producers, grain handlers and exporters were able to pass on all the costs to Japanese buyers.

Price premiums paid by Japanese buyers for non-biotech soybeans also covered the bulk of the cost of segregation and incentives offered to producers for growing 2000 and 2001 non-biotech soybean crops. For the 2000 crop, price premiums that Japanese buyers were willing to pay for non-biotech soybeans ranged from $0.50/bu. to $0.60/bu., which covered 85-94 percent of the cost of IP. Producers apparently would not accept the added expense of segregation under the STS IP system as the costs of segregation were not passed on to Japanese buyers. Lower price premiums for 2001 non-biotech soybeans, due to the implementation of a less stringent IP system, resulted in a lower coverage range. However, even with the lower price premiums, they covered about three-fourths of the cost of IP (table 2).

This lower coverage range might be attributed to three potential factors. First, in the event that NASS' Illinois Market News overstated producers' non-biotech premiums, the range of IP costs covered by Japanese buyers' premiums would be understated. However, this scenario is regarded as unlikely because the Value Enhanced Grain Survey covered about 75-80 percent of the non-biotech soybean, IP market in Illinois (English). Second, while the -0.10 demand price elasticity for food soybeans contributes to the transfer of segregation costs to Japanese buyers, it is less than perfectly inelastic. Hence, the transfer of segregation costs to Japanese buyers would likely be less than 100 percent. Third, although price premiums paid by buyers are reported for a specific crop year, sales are spread over several months after harvest instead of at a specific time. In the event that market prices for non-biotech products decline due to unforeseen market forces, price premiums paid by Japanese buyers could be lower than U.S. producers and grain handlers were expecting at new crop harvest-time. Given limitations of the available data (which include a number of industry cost estimates and price averages but not data for a complete set of actual transaction within a supply chain), these results should be viewed with some caution.

In contrast, futures trading for the 2002 non-biotech soybean crop at Tokyo Grain Exchange appeared to have adjusted the non-biotech premiums significantly upward toward the end of the futures contracts. As most of the soybean cropland was planted to the herbicide-tolerant soybean variety, non-biotech soybean buyers in Japan had to offer larger premiums to entice U.S. producers to give up the opportunity of growing the biotech variety and to cover costly IP systems. As a result, non-biotech premiums paid by Japanese buyers for the 2002 crop more than adequately covered the costs of IP.

Conclusions

The IP system used to segregate non-biotech corn and soybeans from biotech varieties or biotech-commingled crops is an extension of the handling process that has been employed for value-enhanced commodities. The system evolves over time as the U.S. grain and oilseed industries adapt to the needs of foreign buyers for these niche products. The IP systems discussed in this paper are intended to meet a less stringent, 5-percent tolerance level, not zero tolerance. In addition, these IP systems can be employed for shipments to other export markets besides Japan.

The cost of IP varies, depending upon the requirements of the system. As the grain and oilseed industries adapt to the needs of foreign buyers, more cost-effective IP systems will be adopted by

U.S. producers and handlers. In addition, the costs of IP might vary over time, such as in the case of non-biotech soybeans, resulting from the adoption of a less costly IP system.

At present, non-biotech corn and soybeans grown and marketed under IP systems remain a niche market--the share of non-biotech corn or soybean demand is small relative to their share of the supply. This market condition implies that the price premium for non-biotech corn or soybeans would tend to equal the cost of IP. The inelastic demand for food corn and soybeans in Japan, which is the sole use of U.S. non-biotech corn and soybeans destined for that country, together with a lack of viable substitutes, make it easier for U.S. grain handlers and exporters to pass on the costs of IP to Japanese buyers.

Evidence available to date suggests that price premiums that Japanese buyers were willing to pay for non-biotech corn and soybeans imported from the United States, by and large, can cover the costs of IP systems. In other words, the incidence of the segregation costs largely falls on Japanese buyers. This is especially true for non-biotech corn in the 2000-2002 crops and for non-biotech soybeans in the 2002 crop. Even in the case of 2000 and 2001 non-biotech soybean crops, where the premiums did not cover the costs of IP as fully as in other cases, the premiums still covered about three-fourths of the IP costs. The remaining one-fourth were borne by U.S. non-biotech, IP producers, grain handlers, exporters, or some combination of the three. However, these results have to be interpreted in an *ex post* context. In an *ex ante* sense, farmers can always sell their products at the conventional (but unsegregated) price instead of growing non-biotech, IP crops. In addition, price premium data have their limitations. Although the range of price premiums appears to be convergent from various sources, the number of observations is limited in the absence of a comprehensive survey. The supply of non-biotech soybeans by grain companies in the real market could bias the price discovery process at TGE, especially in a short timespan (such as a month or so).

Current IP systems are not designed to meet a 1-percent threshold level of biotech content. Instead, they are designed primarily to meet a much lenient threshold level, such as the 5-percent level for exports going to Japan. While these IP systems appear to adapt well to the needs of Japanese buyers, their cost-effectiveness in the EU is uncertain. A key question is: will EU buyers be willing and able to pay sufficient premiums to compensate for much more stringent IP requirements for non-biotech products, such as traceability and labeling regulations the EU is proposing?

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