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Product Differentiation and Segregation in Agricultural Systems: Non-Genetically Modified and Specialty Corn and Soybean Crops in Iowa

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Abstract

An important dimension of product differentiation and segregation for specialty crops is the added handling and transaction costs incurred. Some forms of business organization may realize lower costs of providing such services, and if specialty crop production is growing relative to commodity production, these two factors may have implications for industry structure. We use data from an Iowa grain handling survey to test hypotheses developed in the non-empirical transaction-costs literature with respect to organizational and financial governance of cooperatives and private and corporate firms. Preliminary results are discussed with respect to business organizations, added costs, investments, crops, and contracting.

Keywords: contracting, cooperatives, corporations, grain handling, industry structure, segregation, specialty crops, transaction costs.

PRODUCT DIFFERENTIATION AND SEGREGATION IN AGRICULTURAL SYSTEMS: NON-GENETICALLY MODIFIED AND SPECIALTY CORN AND SOYBEAN CROPS IN IOWA

Introduction

Providing consumers with choices through the use of specialty products has the potential to enhance welfare, as long as identity is preserved in food and feed products for consumers and intermediate product users. If choice is denied to the consumer of the product, such as through mixing undifferentiated genetically modified (GM) and non-GM commodity products, the welfare-enhancing gains of product differentiation may not be fully realized, although the consumer may still benefit through lower-cost products. Therefore, systems for identity preservation and product segregation hold value in product markets.

An important issue when considering segregation of specialty crops is the added segregation costs incurred by the grain handling system for segregating differentiated products. Speculation on and estimates of such costs range from a few cents to dollars per bushel, depending on the assumptions made and the data used (Miranowski et al. 1999; Good and Bender 2001). Differences in these costs may have important implications for the structure of the grain handling industry.

But, to date, this issue has received little attention. If specialty grain production is growing relative to commodity corn and soybean production, this shift in relative importance could have significant structural implications. More specifically, if one form of business organization—the private firm (including a corporation) versus the cooperative—has cost advantages over other forms in providing product segregation services, then that form of business organization will control an increasing share of the food and feed markets over time.

In addition, potential efficiency gains in product differentiation and segregation may be realized by extending organizational control: replacing markets with contracts and

vertically integrating components of the food system (e.g., input supply, production, marketing, processing, and distribution). The implications of such actions can be extensive and can have significant impacts on rural producers, consumers, and communities. Further, concerns over the safety and global acceptance of GM products will create even greater pressure for development and enforcement of product segregation systems and provide incentives for further integration in the food system.

In this paper, we use a transaction-costs framework based on the new industrial organization literature and provide a rationale for decreasing transaction costs as the business organization of grain handlers moves from cooperatives to hybrid forms of organization to private (and corporate) ownership. The decreasing-cost hypothesis is tied to both the business organization form and the financial governance structure and helps to explain how the business structure may change with increasing asset specificity. The transaction-costs framework motivates our detailed look at the costs of grain handling in Iowa.

In order to compare costs of alternative product segregation systems operating within different market structures, we survey Iowa grain handlers. The added costs of product segregation for corn and soybeans, including testing, handling, and storage, are collected from grain handlers identified by their form of business organization. These data are disaggregated by form of business organization (private and corporate ownership and cooperative), size of firm or enterprise, degree of market system integration, and product value added through product differentiation and segregation. The results allow detailed analyses of transaction costs for alternative business organizations and market structures and identification of incentives for food system integration and evolution to alternative forms of business organization.

This paper provides the conceptual basis for the study and results from a 2003 survey of Iowa grain handlers. The next section presents the conceptual framework for tying changing industry structure to changing transaction costs. The data survey and collection from the 2003 survey of Iowa grain handlers are then described. The analytical results section presents statistics from the survey and identifies some implications.

Conceptual Framework

The modern transaction-costs literature provides a partial analysis framework for explaining economic phenomena. Organizational structures evolve to minimize transaction costs. Likewise, industry structure evolves to minimize overall transaction costs. Firms rely on input markets until the market-purchased inputs cost them more than does vertically integrating with suppliers. All components of the economic system are driven by the need to minimize transaction costs or to adjust in other ways.

Obviously, the transaction-costs model is more successful in explaining evolution within the economic system during periods of changing transaction costs than during periods of relatively stable transaction costs (Williamson 1991). For example, the information revolution of the 1990s would be expected to have created major adjustments in marketing practices, prevalent forms of business organization, contracting, and industry structure, including vertical and lateral integration, as transaction costs changed with new information technology.

Transaction-costs proponents (e.g., Williamson 1985) argue that contracts are incomplete because it is too costly to include all relevant contingencies in an *ex ante* exchange. Contract incompleteness puts investors in a weak *ex post* bargaining position when specific and irreversible investments are required *ex ante*. Thus, the investor may not invest in the highest surplus-generating project, creating an inefficient hold-up problem. Suitable governance structures, characterized by who has the decision authority and who is the residual claimant, may reduce or alleviate the hold-up problem.

Organizational Governance

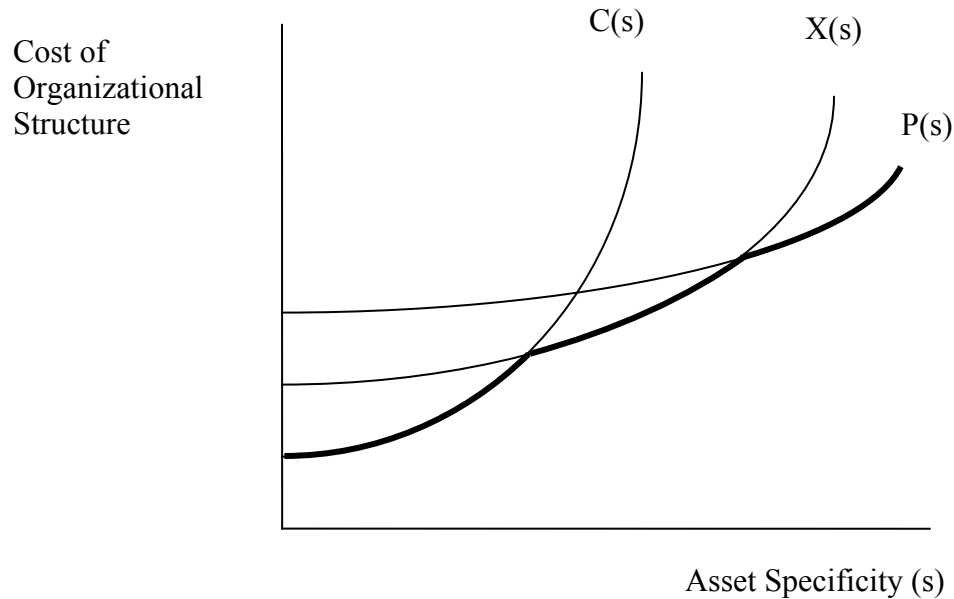
There are two dimensions of governance that are important from a transaction-costs perspective: organizational governance (Williamson 1991) and financial governance (Williamson 1988). The first, organizational governance, concerns who controls the firm and dominates the firm's governance decisions. In this regard, cooperatives differ from private or corporate ownership. Input suppliers or farmers control agricultural marketing cooperatives. Farmers supply the raw commodities or inputs and provide capital for the cooperative's investments. Private firms and corporations are owned and controlled by individuals and shareholders, who are the residual claimants but who do not supply inputs

to the firm. Thus, the *ex post* bargaining position of the supplier and purchaser will depend on the organizational structure being considered.

Hendrikse and Veerman (2001) articulated a conceptual framework of evolving business organization from agricultural marketing cooperatives through integrated, corporate marketing systems. Control through markets or through vertically integrated enterprises relates to the nature and structure of costs. Market governance is generally preferred when asset specificity is low and the incidence of hold-up problems is low. Vertical integration becomes more attractive as asset specificity and, associated with it, the incidence of hold-up problems increases. Hybrids of the two organizational forms may succeed with intermediate levels of asset specificity. Cooperatives are better suited to competitive markets and situations of low asset specificity, at least lower than that required by their members in supplying inputs to the cooperative. Cooperatives generally have lower costs at lower levels of asset specificity than do private firms. Private firms and, especially, corporations are better suited to situations demanding higher asset specificity and generally have lower costs than do cooperatives with increasing asset specificity. More vertically integrated systems are typically characterized by higher asset specificity.

Following Williamson (1991), the costs of different organizational forms are assumed to increase with asset specificity but at different rates. For cooperatives, the organizational costs are assumed to be lower for low levels of asset specificity but to increase more rapidly at higher levels of asset specificity. Private and corporate ownership organizational costs are higher at lower levels of asset specificity but increase less rapidly with increasing asset specificity. The organizational costs of hybrid forms are in between those of cooperatives and private firms as asset specificity increases. These trade-offs are depicted in Figure 1, where costs vary by asset specificity (*s*) for three organizational structures: cooperatives and market governance (C); private, corporate, and vertically integrated systems (P); and hybrid forms of governance (X).

How would the organizational form influence the costs of specialty crop segregation and identity preservation, or why would we hypothesize that private firms should have cost advantages over cooperatives in handling specialty grains and oilseeds? With increasing asset specificity required for identity preservation and product segregation, the



Source: Williamson 1991.

FIGURE 1. Organizational structure and asset specificity

organizational costs of cooperatives increase more rapidly than do those of private firms. Farmer members provide the necessary equity for marketing cooperatives. As long as asset specificity is low for the marketing cooperative and lower than the level of asset specificity for its members' own production operation, the opportunity cost of the equity remains low to members. As asset specificity of the marketing cooperative increases, the median farmer member may not vote for a more asset specific or specialized investment.

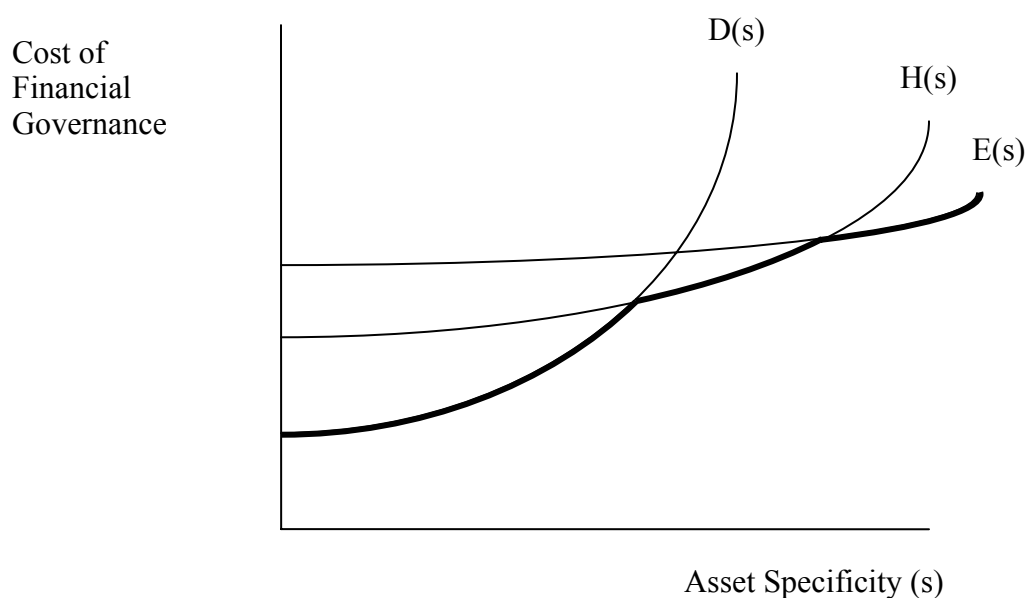
Financial Governance

The second dimension of governance relates to financial governance. Financial governance addresses debt and equity as financial governance instruments in transaction-costs economics. Financial instruments are important because they specify control rights and how returns depend on outcomes (Williamson 1988). Debt instruments have rigid contracts, and the creditor has prior claim in the case of bankruptcy. Because debt instruments are characterized by standard contract rules, design costs are low. Debt is not designed to deal with unforeseen contingencies, nor does it permit efficient adjustments

ex post. Because debt contracts are restricted to a few standard rules, the cost of debt rises sharply when the level of asset specificity increases.

In contrast, equity gives financiers the rights of control and the role of residual claimants (Williamson 1988; Hendrikse and Veerman 2001). The appointed board of directors has the power to control management and adjust decisions. With increasing asset specificity, equity capital costs are lower than debt costs. Because equity is more complex than debt when control mechanisms are built in, the start-up costs of equity are initially greater than the debt costs. Thus, debt will be used for projects with low asset specificity and equity will be used for high-specificity projects with hybrid financial forms at intermediate levels of asset specificity. Figure 2 illustrates the hypothesized relationship between the cost of financial governance and asset specificity developed by Williamson (1988) and diagrammed by Hendrikse and Veerman (2001) for the case of agricultural marketing cooperatives.

Debt costs (D) are lower at low levels of asset specificity (s) but increase more rapidly than equity costs (E) with increasing asset specificity. With increasing asset specificity, hybrid financial costs (H) fall between debt and equity costs.



Source: Hendrikse and Veerman 2001.

FIGURE 2. Financial governance and asset specificity

Why are these financial forms of governance important? Farmer members control marketing cooperatives, each with one vote. The cost of debt financing increases with increasing asset specificity, such as occurs with added segregation costs and investment in identity preservation. Because their organizational form does not allow them to cede control to the suppliers of equity capital, cooperatives cannot obtain equity financing except from their members as asset specificity increases. On the other hand, corporations and private firms can relinquish control rights in the firm to the financier in exchange for more favorable financing terms. Thus, as asset specificity increases, the costs of financing the more specific investment increases more slowly for a private firm than for a cooperative.

Application to Product Segregation in Grain Handling

The transaction-costs framework is based on a partial analysis of firm decisions and behavior. Industry structure evolves to minimize transaction costs. Firms with more costly processes have to either become more efficient or go bankrupt. The predictive power of the transaction-costs framework should improve during periods of significant change in costs of marketing or supplying products or in the nature of products marketed, such as has happened in the last decade.

In the Midwest, large numbers of farmers grow grains and oilseeds. Most of the grains and oilseeds are commodities that are co-mingled on their way from the farmer to the processor or exporter. Farmers compete with each other on a perfectly competitive basis, but processors and other grain and oilseed handlers frequently have some degree of market power. Co-mingling makes it costly for the processor to sort for specific product characteristics. The additional costs make it more difficult for the processor to pay for quality traits, and the farmer usually receives the commodity market price. To minimize the cost of production, farmers have an incentive to meet just the minimum quality standards specified for the commodity grade.

Segregated product markets, in contrast, allow for purchase of quality-differentiated inputs or products from identified suppliers. Suppliers may be “identified” through contractual arrangements, certification, testing, and open market transactions of differentiated products. Such quality differentiated and segregated products are designed to satisfy specific processor, end-user, and consumer preferences,

much like the purchase or acquisition of branded inputs or products. Relative to commodities, which are co-mingled in the grain and oilseed handling process, segregated inputs and products will have additional transaction costs associated with preserving their identity and marketed qualities.

Two important changes are transforming corn and soybeans, as well as numerous other food and pharmaceutical product markets today: the information and biotechnology “revolutions.” Biotechnology has reduced the cost and time of developing important new traits and characteristics demanded by intermediate users and consumers. The information revolution, likewise, has reduced the costs of identifying suppliers, contracting production, tracking products, and preserving (e.g., testing, certifying) the qualities of inputs and products as they move through the food system. Thus, the combined forces of biotechnology and information technology are leading to the rapid introduction of new quality-differentiated inputs in the food system.

Traits that add value to corn and soybeans are being introduced into several feed and food markets. The markets that handle these products are having to adjust to differentiate products containing these valued traits and to segregate these products from commodity corn and soybeans that are typically handled in the same marketing channels.

In the Midwest, private firms, corporations, and cooperatives have had important roles in the commodity corn and oilseed handling system. The implications of new, value-added product introductions in the industry have important policy and strategic dimensions. Will the growing relative importance of product differentiation and segregation favor one form of business organization over another form (i.e., private firms versus cooperatives)? Will the nature and organization of markets change through increased contracting, vertical integration, and lateral coordination? Will the introduction of additional differentiated products lead to important adjustments in the structure of the industry? What can the new institutional economics and the transaction-costs framework tell us about the possible evolution of the grain and oilseed market, business organization, and industry structure? We begin to address these questions with data from the survey of Iowa grain handling practices and costs.

Survey and Data

The Iowa Specialty Crop Survey was conducted in April 2003. The survey instrument designed for the Iowa survey draws on an earlier survey conducted in Illinois (Good and Bender 2001). The National Agricultural Statistics Service (NASS) conducted the survey, based on their list of 460 grain-handling firms with operations in the state of Iowa. NASS used a mail questionnaire and followed up with a telephone interview for those firms that had not responded after two weeks. In total, NASS received mail or telephone responses from 380 grain-handling firms in Iowa, an 82 percent response rate.

Of the 380 firms responding, 68 firms handled one or more corn and soybean specialty crops. The highest number of specialty crops reported for a single firm was seven. Data were collected for all firms on the organizational structure of the firm, size, number of satellite operations, and type of firm. For those firms handling specialty corn and soybean crops, data were collected on specialty crops handled in 2002, bushels of specialty crop handled, added transaction costs per bushel of specialty crops, investment necessary to handle each specialty crop, source of investment capital, nature of the transaction (e.g., contract, open market, premiums) to acquire the specialty crop, quality and purity testing of the specialty crop, and future plans for specialty crop handling.

The summary results of the survey are reported in the next section. The results provide a useful overview of the product differentiation and segregation systems currently practiced in Iowa and are related to organizational and financial governance and control.

Survey Results

Table 1 provides background information on the number of firms by business organization in our sample, the number of each type of firm handling specialty crops in 2002, and the number planning to handle specialty crops in 2003.¹ A few observations on Table 1 may be appropriate. Even though cooperatives accounted for 30 percent of firms sampled in 2002, cooperatives accounted for 44 percent of firms handling specialty crops and 47 percent of firms planning to handle specialty crops in 2003. Private firms and corporations by contrast, accounted for 70 percent of firms in the sample and only 56 percent of firms handling and 53 percent of firms planning to handle specialty crops.²

Among firms handling specialty grains reported in Table 2, specialty crops accounted for 9 percent of the total volume of cooperatives handling specialty crops and 28

TABLE 1. Number of firms included in the Iowa specialty crop survey, by firms' organization type, 2002

Organization Type	Number Surveyed	Percent	Number Handling Specialty Crop			
			2002		Planned 2003	
			Number	Percent	Number	Percent
Cooperative	113	30	30	44	34	47
Private and corporate	265	70	38	56	39	53
Refused	2	1	0	0	0	0
Total	380	100	68	100	73	100

TABLE 2. Importance of specialty crops in Iowa, by firms' organization type, 2002

Firm Organization	Number of Respondents	Percent	Volume of Specialty Crops Handled as % of Total Volume		Average Number of Specialty Crops Reported (n=68)
			Average	Range	Number
Cooperative	28	45	9	1-100	1.70
Private and corporate	34	55	28	1-100	1.71
All	62	100	19	1-100	1.71

percent of the volume in privately owned firms and corporations. Yet, as indicated in Table 3, bushels of specialty grains handled by cooperatives averaged 645,000 bushels, compared to 289,000 bushels of specialty crops handled by corporations and privately owned firms. Comparing the results with those in Tables 1 and 2, cooperatives tend to have a relatively higher probability of handling specialty crops and, on average, of handling a larger number of bushels of the specialty products. However, despite the greater number of bushels of specialty crops in total for cooperatives (Table 3), the volume of specialty crops handled by cooperatives represents a smaller share of total volume compared to the share of total volume handled by privately held firms and corporations (Table 2). As can be seen from the range statistics in Table 2, some firms in all three categories handled specialty crops exclusively. Somewhat surprising is the fact that there is no difference between the average number of specialty crops reported by

TABLE 3. Average bushels, average added cost, and average investment for specialty crops handled, by type of organization, 2002

	Cooperative	Private and Corporate	All
Volume			
Number of respondents	28	36	64
Average bushels (1,000)	645	289	445
Average additional cost			
Number of respondents	26	30	56
Average \$/bu/crop	0.34	0.31	0.32
Average investment			
Number of respondents	10	10	20
Average \$000/crop	36	123	80
Average \$/bushel	0.63	1.01	0.82

firm organization type; firms reporting that they handled specialty crops handle slightly less than two specialty crops (1.7 crops) on average.

Table 3 also provides information on average added cost per bushel of specialty crop handled. Cooperatives reflect the higher average cost of \$0.34/bu, compared to the average costs reported by privately owned and corporate firms of \$0.31/bu, although these average costs are not statistically different. While private and corporate entities do have an operating cost advantage, the cooperatives have a lower investment cost per bushel of specialty crop at \$0.63 compared with the privately owned and corporate firms' investment per bushel at \$1.01. Again, these averages are not statistically different. Obviously, further analysis is needed to determine the source of the apparent differences.

Table 4 indicates the types of investments that firms made to segregate specialty crops in Iowa. Interestingly, 50 percent of the 68 firms that handled specialty crops indicated that they made no additional investment to handle specialty crops. Presumably, the reported increase in operating costs covered all additional costs incurred, including investment flows.

In Table 5, we break out added costs and investment per bushel of specialty crop handled for the three most frequently reported specialty crops: high-oil corn, non-GM corn, and non-GM soybeans. Private and corporate handling costs are lower than those

TABLE 4. Type of investment made to handle specialty crops in Iowa, 2002

Type of Investment	Percentage of Firms	Percentage of Cooperatives ^a	Percentage of Private and Corporate Firms ^b
None	50	25	25
Invest added storage	13	4	9
Invest modify storage	16	4	12
Invest added dump pits	12	4	7
Invest added air equip	9	1	7
Invest modify air equip	12	4	7
Invest buy testing equip	25	9	16
Invest add transportation	3	1	1
Invest personal training	24	10	13
Invest other	1	-	1

^a Based on cooperatives only (n=30).^b Based on private and corporate firms only (n=38)**TABLE 5. Average added costs and investment incurred for specialty crops by type of organization, 2002**

	Added Costs (\$/bu)			Investment (\$/bu)	
	Average	Minimum	Maximum	Firms Investing Average	All Firms Average
High oil corn				(n=7)	(n=20)
Cooperative	0.29	0.16	0.90	0.32	0.15
Private and corporate	0.25	0.15	0.43	0.25	0.04
All	0.28	0.15	0.90	0.31	0.11
Non-GMO corn					(n=10)
Cooperative	0.28	0.09	0.65	n.r.	<0.01
Private and corporate	0.26	0.04	0.74	n.r.	<0.01
All	0.27	0.04	0.74	n.r.	<0.01
Non-GMO soybean				(n=5)	(n=41)
Cooperative	0.30	0.05	0.45	2.14	0.38
Private and corporate	0.37	0.02	1.79	2.75	0.23
All	0.34	0.02	1.79	2.38	0.29

Note: n.r. denotes not reported due to a small number of observations in the cells.

reported by cooperatives for specialty corn but are significantly higher than cooperatives' handling costs for soybeans. A possible explanation is the large investments that corporate firms are making in product segregation of non-GM soybeans.

Summary information on grain handling firms' contracting activities with sellers (farmers) and buyers (processors/feed mills) for the three most frequently reported specialty crops in our sample—high-oil corn, non-GM corn, and non-GM soybeans—are reported in Table 6. In total, over 90 percent of high-oil corn is produced under contracts with farmers. Only 45 percent of the non-GM corn and 66 percent of the non-GM soybeans are produced under contract with farmers. At the same time, grain handlers have about 70 percent of the high-oil corn forward contracted with buyers and over 80 percent of the non-GM corn and non-GM soybeans forward contracted. For corn, the private and corporate firms did relatively more contracting with farmers and relatively less contracting on the open market. In contrast, cooperatives had relatively more of the non-GM soybeans purchased under contract with farmers.

TABLE 6. Marketing practices for high-oil corn, non-GM corn, and non-GM soybeans in Iowa, all firms, 2002

	Number of Observations	Overall Mean	Cooperative Mean	Private/ Corporate Mean
High-oil corn handled (1,000 bu)	19	206	266	103
Volume purchased on:				
Contract with farmers (%)	20	91	88	96
Contract with open market (%)	20	10	12	4
Volume contracted with buyer (%)	15	69	61	84
Non-GM corn handled (1,000 bu)	10	1,176	2,363	384
Volume purchased on:				
Contract with farmers (%)	10	45	25	58
Contract with open market (%)	10	35	50	25
Volume contracted with buyer (%)	7	89	73	100
Non-GM soybeans (1,000 bu)	37	84	110	65
Volume purchased on:				
Contract with farmers (%)	39	66	74	60
Contract with open market (%)	39	34	26	40
Volume contracted with buyer (%)	30	83	81	85

Summary and Implications

Historically, cooperative, private, and corporate forms of business organization have played an important role in the commodity grain and oilseed handling industry in the Midwest. Factors such as the revolutions in information and biotechnology are poised to bring about significant adjustments in the industry during the coming decades. We are moving toward more demand for product differentiation and segregation in grain and oilseed specialty crops and gradually away from a commodity-based industry. With these adjustments, we can anticipate that some forms of business organization are better positioned to benefit from these changes while other forms, such as marketing cooperatives, may become more vulnerable.

This paper provides a preliminary look at a 2003 survey of specialty crop handling practices for the state of Iowa. At this time, the results that we report are preliminary and at best can be described as casual empiricism. We are in the process of estimating multiple regression models to explain differences in the added costs and investments of segregated grain handling systems by form of business organization, differences in contracting behavior by form of business organization and implications for integration, differences in financing of product segregation and identity-preserving investments, and differences in willingness to handle segregated specialty crops by form of business organization. In addition, given the objective function of cooperative firms, are they offering a broader range of member services (i.e., more specialty crops handled) but with a higher average cost of segregation? This avenue needs to be explored. Other factors, such as the volume or capacity of firm, the number of satellite elevators, and the relative share of specialty crops in the total volume of grains and oilseeds handled, are also being considered.

Although we have not formally tested any of the transaction-costs hypotheses, the preliminary discussion of the data points leads to some interesting developments. First, significant differences in added specialty crop handling costs and investment exist between cooperatives and privately held firms and corporations. Second, these differences may lead to cooperatives having a competitive advantage in handling specialty soybeans and private and corporate firms having an advantage in handling specialty corn. Third, it is unclear if the transaction-costs framework is a useful tool for studying the evolution of the agricultural marketing system and industry structure. Only a more thorough analysis of the survey data will make it possible for us to draw definitive conclusions.

Endnotes

1. It is important to note that the survey was conducted in April 2003 and should reflect quite certain plans.
2. In terms of capacity by form of business organization, there are several small elevators in both the privately owned and corporation categories. Among the largest firms are three regional cooperatives and two corporations.

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