

Increasing Vertical Linkages in Agrifood Supply Chains: A Conceptual Model and Some Preliminary Evidence

*Jill E. Hobbs, Assistant Professor
Department of Agricultural Economics
University of Saskatchewan*

and

*Linda M. Young, Agricultural Policy Coordinator
Trade Research Center
Montana State University-Bozeman*

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1. INTRODUCTION

The agri-food sectors of Canada and the United States are witnessing moves towards closer vertical coordination. This is occurring to varying degrees in different industries, taking on a variety of forms, and involving a diversity of supply chain partners. Some industries, notably the United States poultry industry developed tight vertical coordination some time ago. In others it is a relatively recent phenomenon.

It is worth revisiting the definition of “vertical coordination” provided by Mighell and Jones (1963) who explain that the term:

... includes all the ways of harmonizing the vertical stages of production and marketing. The market-price system, vertical integration, contracting, and cooperation singly or in combination are some of the alternative means of coordination (p.1)

Within this succinct definition is the notion that vertical coordination encompasses a continuum of possibilities, from open market spot transactions at the one end, through to full vertical integration at the other but including strategic alliances, joint ventures, contracting, etc.¹ In a sense, there is *always* some form of vertical coordination—be it directed by price signals alone in a spot market or by a combination of pre-determined factors in a contractual situation. Where the interest lies for agricultural economists and the agri-food sector are the implications of the move towards *closer* vertical coordination—i.e. as the sector moves away from commodity spot markets and towards tighter, more closely specified vertical linkages between specific players in the supply chain. In broad terms, this is occurring because of a host of technological, regulatory and financial reasons, in addition to changes in consumer preferences (quality, food safety, etc.).

This paper explores the move toward closer vertical coordination in agri-food sectors, presenting a theoretical framework within which to analyse these changes. The arguments are illustrated with a case study of the U.S. grains industry and implications for producers and policy makers are discussed.

¹ See Hobbs (1996) for a more complete discussion of these elements of vertical coordination.

While recognising that many interesting developments are occurring at all levels of the supply chain: from closer linkages between input suppliers and producers, to specific retailer-processor or retailer-processor-producer alliances, this paper deliberately focuses on the producer-processor interface. This is not to ignore the critical influence of the other parts of the supply chain, indeed, the motivations for closer vertical linkages among producers and processors, in many cases, are deeply rooted in developments elsewhere in the supply chain.

2. THEORETICAL BASIS FOR CLOSER VERTICAL RELATIONS

2.1. *Transaction Cost Economics*

Transaction Cost Economics (TCE) provides useful insights into the development of closer vertical coordination in some agri-food sectors. The approach explicitly recognises that economic transactions do not occur in a frictionless vacuum but that buyer and seller incur costs in conducting a transaction. These costs arise because of information asymmetry, bounded rationality and opportunism when we relax the neoclassical assumption of perfect information. Transaction costs may arise *ex ante*—the expenditure of time and resources identifying suitable trading partners, specifying/identifying product quality, gathering price information etc- these are “information costs.” Costs may arise during the transaction and are called “negotiation costs.” They include the costs of determining contractual terms, paying agent or middlemen fees, retaining the services of a lawyer, etc. Finally, costs occur *ex poste* to a transaction—the ongoing “monitoring and enforcement costs” of ensuring the pre-agreed terms of the transaction are adhered to.

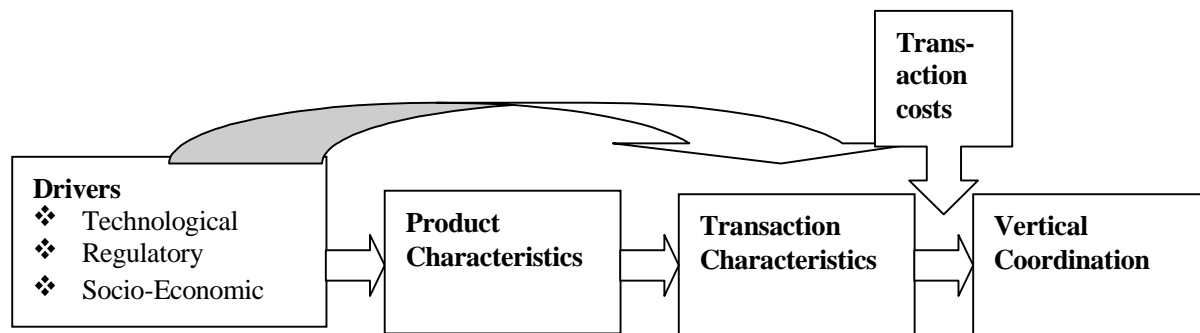
As the transaction costs of using the open market system rise, we expect to see closer vertical coordination, i.e. more transactions carried out under the auspices of a strategic alliance, through contracting or within a vertically integrated firm (Coase, 1937; Williamson, 1979).

2.2. *Factors Affecting the Transaction*

Our model of the forces behind closer vertical relations in agri-food supply chains has four components, as depicted in Figure 1. Following Williamson (1979), we recognise that certain transaction characteristics affect vertical coordination, or the choice of “governance structure.” This is depicted by the relationship between the last two boxes in Figure 1. William-

son discusses frequency, uncertainty and asset specificity as determinants of contractual choice. We argue that these specific transaction characteristics are the result of certain product characteristics (box 2) which themselves are shaped by regulatory, technological and socio-economic “drivers” (box 1). Figure 1 also recognises that some of the drivers can affect transaction characteristics directly by influencing the environment within which those transactions are conducted.

Figure 1. Conceptual Model



2.3. Transaction Characteristics, Costs and Vertical Coordination

Changes in transaction characteristics alter transaction costs, thereby influencing vertical coordination. Table 1 depicts the relationships between generic product features and transaction characteristics, *ceteris paribus*. Uncertainty is broken down into four components. There is uncertainty for the buyer over product quality which imposes sorting costs on the buyer in determining a product’s true quality (Barzel, 1982). Buyer uncertainty also arises with respect to the reliability of supply (timeliness and quantity)—this is a long-run planning problem. For example, a french fry manufacturer must have timely supplies of potatoes to fulfil its own contracts with fast food restaurants on a regular basis. Both buyer and seller face price uncertainty. Again, this is a long-run planning problem. At the time a production decision is made, there is uncertainty over the prices which will be received/paid for agricultural produce. Sellers may face uncertainty in finding a buyer, particularly if their product has idiosyncratic qualities. This raises their information or search costs. As uncertainty increases, we expect closer forms of

Table 1. Generic Model of Relationship Between Product and Transaction Characteristics

Product Characteristics	Transaction Characteristics						
	Uncertainty for buyer: quality	Uncertainty for buyer: reliable supply (timeliness and quantity)	Uncertainty for buyer and seller: price	Uncertainty for seller: finding a buyer	Frequency of transaction	Relationship-specific investment	Complexity of transaction (variety of outcomes)
Perishability	✓	✓		✓	✓		✓
Product differentiation	✓	✓	✓	✓		✓	✓
Quality variable and visible		✓	✓	✓			✓
Quality variable and invisible	✓	✓	✓				✓
New characteristics of importance to consumers	✓		✓	✓		✓	✓
<i>Regulatory Drivers</i>							
Liability	✓			✓		sometimes	✓
Traceability				✓		✓	✓
<i>Technology Drivers</i>							
Company-specific technology						✓	✓

vertical coordination to be selected over open market transactions because of increased information and monitoring costs.

The frequency of the transaction is somewhat self-explanatory. Highly frequent transactions tend to be carried out in the spot market because they induce learning and reputation-effects become important; this mitigates against opportunistic behaviour.

A relationship-specific investment refers to asset specificity when one party has made an investment in a production process specific to one buyer or seller, thereby locking themselves in to that relationship for a period of time. Transactions involving specific assets leave firms vulnerable to opportunistic behaviour and increase the likelihood of contracting or vertical integration as the choice of governance structure due to high monitoring and enforcement costs associated with spot markets. (Williamson, 1979; Douma and Shreuder, 1992; Hobbs, 1996). In addition to uncertainty, frequency and asset specificity, we include an additional transaction characteristic—whether the transaction is complex. As complexity increases, a variety of outcomes become possible. This mitigates against spot market transactions. A more complex contract would be required, with a greater number of contingencies to deal with the added complexities. Alternatively, vertical integration occurs and the transaction is carried out by means of within-firm managerial orders. A strategic alliance which allows sufficient flexibility in the relationship to deal with the complexities is a further possibility.

2.4. The Relationship Between Product Characteristics and Transaction Characteristics

Product perishability creates uncertainty for the buyer with respect to product quality and the reliability (i.e. quantity) of supply. It creates uncertainty for the seller in locating a buyer as perishable products must be moved quickly to the marketplace to avoid deterioration, leaving sellers unable to store the product awaiting favourable market conditions. Perishability adds to the complexity of a transaction because the quality of the product can deteriorate. This imposes sorting/information costs on buyers. It also increases negotiation costs, as procedures are required for establishing which party (buyer or seller) is responsible for product quality at different stages of the transaction (for example, does the processor take ownership of the product upon collec-

tion from the farm, upon delivery to the processing plant, during storage, etc.).² As agricultural products become more differentiated rather than basic commodities, buyers face increased uncertainty over quality and reliability of supply as sellers are less substitutable. Price uncertainty increases, partly because product quality can vary as price will be tied to quality. The transaction becomes more complex—a variety of outcomes are possible and often, the parties to the transaction have made an asset specific investment: sellers in differentiating their product to the specifications of an individual buyer; buyers in tailoring their production practices to the products of specific sellers.

When quality is variable, but variations in quality are clearly visible to, or detectable by, buyers prior to purchase, there is buyer uncertainty over finding sufficient supplies of the good, but not over quality since this can be detected. Price uncertainty exists due to the quality variations—i.e. buyers and sellers cannot be sure of the prices they will receive/pay for a commodity ahead of time because they do not know what the quality will be. The transaction becomes more complex. If quality is variable but those variations cannot be detected prior to purchase, buyers face additional uncertainty over product quality.

Scientific developments, including modern biotechnology, are introducing products with new characteristics of importance (both positively and negatively) to consumers. For example eggs high in essential Omega-3 fatty acids which actively lower blood cholesterol; or the apparent consumer backlash against genetically modified foods in Europe. In other cases, consumers seek reassurance that the product was produced using “acceptable” production practices—e.g. with respect to animal welfare, environmental impacts, child labour practices, etc. Often these characteristics cannot be detected visually prior to purchase. Buyer uncertainty over the quality and availability of supplies, price uncertainty and complexity characterise this transaction.

² See Lang (1980) for a discussion of the effects on product spoilage of different contractual relationships.

2.5. Technological, Regulatory and Socio-economic Drivers

Regulatory Drivers

Technological, regulatory and socio-economic drivers affect some of these product characteristics or influence the transaction environment directly. The table includes two regulatory drivers: liability and traceability. The regulatory environment is important because it can change the priorities or focus of a transaction. For example, the extension or strengthening of product liability laws along the supply chain will likely increase buyer uncertainty over product quality because the consequences of poor product quality are more severe. For this reason, sellers may face greater uncertainty in finding a buyer and the transaction has become more complex and costly. This is likely to lead to closer vertical relations along the supply chain. For example, the 1990 Food Safety Act in the UK increased the legal liability of food firms causing them to seek more information about (and, in some cases, control over) upstream production practices in the food supply chain (Hobbs and Kerr, 1991). In December 1998, the EU endorsed plans to extend product liability laws to farmers (agricultural producers had previously been exempt).

In some cases, the need for traceability could be an outcome of increased legal liability but it need not always be. The ability for full traceback of agricultural products in the event of a break-down in food safety may be a regulatory requirement in itself. Several countries are introducing traceback systems for livestock. Some industry groups have instituted their own traceback systems. Traceability may impact directly on transaction characteristics by increasing the complexity of the transaction, leading to relationship-specific investments such as identity preserved supply chains. This could also create greater seller uncertainty in finding a buyer for producers not part of an identity preserved system. In general, we would expect increased traceability to raise the information and monitoring costs of occasional supply chain relationships, leading to closer vertical relations.

Technological Drivers

Technological drivers affect product characteristics directly, for example, perishability, and product differentiation. Biotechnology can introduce novel product characteristics. Direct impacts on transaction characteristics include technology which limits alternative sources of supply, for example, crop varieties resistant to a specific herbicide. This affects the farmer-input

provider transaction, limiting the alternative sources of input supplies by tying farmers to a specific seed company/herbicide provider. Biotechnology which allows products to be tailored to specific end-users introduces relationship-specific investments. As a result, the risk of opportunistic behaviour creates high monitoring and enforcement costs and an incentive for closer vertical coordination to reduce these transaction costs.

Technology which allows economies of scale from large-scale production/processing units or allows tighter control over product quality through feeding, housing or other management practices may also encourage closer vertical coordination and industry consolidation as it may be less costly for a processor than dealing with larger numbers of small producers.

Socio-Economic Drivers

A variety of socio-economic factors may alter the transaction environment directly or through their effect on the demand for product characteristics. For example, changes in consumer lifestyles and preferences have increased the demand for branded, further processed meals, including home meal replacements. Product quality is extremely important and is signalled by a firm's brand name. In order to differentiate their products, protect the investment in their brand name and reduce the monitoring costs of guaranteeing the quality of their inputs, processors will likely prefer closer vertical relations with their suppliers. Heterogenous consumer preferences in international markets encourage product differentiation, moving the sector away from its traditional commodity orientation. This likely encourages closer vertical coordination, as discussed above.

Table 1 is therefore intended to be predictive. These drivers for change are ongoing and will continue to impact transaction characteristics directly and through their impact on product characteristics. Changes in transaction characteristics alter transaction costs. For the most part, the changes illustrated in the table raise the costs of transacting through spot markets and will therefore lead to closer forms of vertical coordination: strategic alliances, contracting, vertical integration, etc.

3. GROWTH OF VERTICAL LINKAGES IN AGRICULTURE: EVIDENCE

For many agricultural commodities in both Canada and the United States, the trend has been away from spot market transactions and towards closer vertical coordination. In spot markets, goods are exchanged between multiple buyers and sellers in the current time period, and price is often the sole determinant of the sale, e.g. auction markets. In a spot market transaction, vertical coordination incurs entirely in response to price signals. While spot markets are efficient at distributing homogenous commodities, as agricultural products become more differentiated, buyer preferences more heterogeneous and the requirement for improved information flow along the supply chain increases, methods of vertical coordination which allow closer buyer-seller relationships are emerging.

The use of contracting has become increasingly more important in U.S. (and to a lesser extent, Canadian) agriculture.³ In 1997, 31.2 percent of the value of U.S. agriculture production (almost \$60 billion) was grown or sold under contract (Banker and Perry 1999). Under a contract, a farm devolves control over certain aspects of production and/or marketing in return for greater surety over access to markets or inputs and lower risk. Banker and Perry (1999) note that, while farms of all types use contracting, larger family farms (defined as farms with sales of at least \$250,000) and non family farms (non family corporations or cooperatives, and farms run by hired managers) account for 75 percent of the value of products grown and sold under contract.

Following Mighell and Jones (1963), contracts can be classified into three broad groups. *Market-specification contracts* represent an agreement by a buyer to provide a market for a seller's output. The buyer may assume some risk and the right to make decisions over the timing of marketing. The farmer retains control over the production practice. *Production-management contracts* entail more buyer control, allowing the buyer to specify and/or monitor production

³ Data for the United States were obtained from the Economic Research Service through its Agricultural Resource Management Study. Comparative information (to our knowledge) is not available in Canada. Contracting has not been as prevalent in Canadian agriculture largely due to the involvement of regulatory marketing agencies, for example in the poultry, eggs, pork, dairy and grains industries. In some sectors, the role of these agencies is gradually dwindling in importance, thus we might expect to see an increase in contracting or other closer vertical relationships in Canadian agriculture in the future.

practices, input usage, etc. *Resource-providing contracts* represent the greatest level of control for buyers who provide a market outlet, supervise production practices and supply key inputs. In doing so, the buyer usually assumes a greater proportion of the risk and may retain ownership of the product, with the farmer, in effect, paid a management fee. This is close to full vertical integration. It is estimated that, in 1997, eleven percent of U.S. farms engaged in contracting with production contracts (2.2 percent of all farms) being much less prevalent than marketing contracts (9 percent of all farms)⁴ (Banker and Perry 1999).

Data presented in Table 2 indicate that the extent and nature of contracting varies across commodities in the United States. Production contracts are currently more common for livestock. Almost all contracted production for poultry is through production contracts and accounts for 68 percent of the value of production. For hogs, production contracts are dominant, and account for 36 percent of the value of production. A smaller percentage of the value of cattle production is under contract and there is a balance between production and marketing contracts.

A small percentage of U.S. grain is grown or sold under contract (Table 2). Malting barley is the exception, with maltsters accounting for the relatively high percentage of barley under marketing contracts. However, for soybeans (10.2 percent), corn (8.7 percent) and wheat (5.5 percent), a small percentage of the value of production is accounted for by contracts. This is changing quickly for soybeans and corn due to recent developments in the supply chain for these commodities, as discussed in the next section.

Some forms of contracting in agriculture may be more accurately described as quasi-vertical integration. Typically, this is a long-term contractual obligation in which both buyer and seller have invested resources in the relationship. It differs from full vertical integration because the relationship ceases at the end of an agreed period of time; the firms remain independent entities. An example would be a joint venture in which participants share the costs, risks, profits and losses of a venture. Franchises and licenses are other examples but are not common in the agriculture sector.

⁴ The data do not differentiate between production and resource-providing contracts. One suspects that this estimate for “production contracts” includes both.

Table 2. Extent of Contracting in Selected Commodities, United States, 1997

	Value of Production under Contract Total <i>percent</i>	Production Contracts <i>per-</i> <i>cent</i>	Marketing Contracts <i>percent</i>	Value of Produc- tion under Con- tract <i>million U.S. dollars</i>	Farms with Contracts <i>percent</i>
Wheat	5.5	0.1	5.4	448	7.1
Barley	19.3	a	19.3	162	7.3
Soybeans	10.6	a	10.2	1616	14
Corn	8.9	0.2 b	8.7	1674	12.1
Potatoes	41.5	a	36.7	694	25.7
Poultry	70	68.3	a	8937	66.7
Hogs	36.1	32.9	a	3271	11.6
Cattle	28.4	17.5	10.9	6876	2.1

a: Data insufficient for disclosure.

b: The relative standard error of the estimate exceeds 25 percent, but no more than 50 percent.

Note: Totals are not U.S. totals as they exclude low resource, residential and retirement farms. See Banker and Perry (1999) for a detailed classification.

Source: USDA, Economic Research Service, 1997 Agricultural Resource Management Study.

A strategic alliance is centred around a mutually identified objective, in which the parties share the resulting risks and benefits and mutually control the decision-making processes (Amanor-Boadu and Martin, 1992). Typically, it is more flexible than a contract and requires that the parties recognize their mutual goals and work together to achieve them. Trust is implicit in a successful strategic alliance. An example might be an alliance between a pork processor and a group of producers in which the processor receives hogs of a specified quality, with producers having followed agreed-to production practices. The processor may also have a strategic alliance with a food retailer to introduce a high-quality packaged pork product developed jointly with the retailer; of course, the alliance could involve all three parties, spanning the supply chain from producer to retailer (Sporleder, 1992).

Data on products transacted through strategic alliances, through quasi and fully vertically integrated firms are not generally available. In some cases the data is not available in a form which allows us to distinguish between complex production contracts and some other forms of close vertical coordination. In other cases the information is proprietary. This problem notwithstanding, data on the extent of contracting provide a starting-point for analysis.

4. CASE STUDY: DEVELOPMENTS IN U.S. CORN AND SOYBEANS

4.1. Background

This section investigates developments in the U.S. corn and soybeans sectors. Technological developments have been a major driver of change, including developments in genetic engineering and plant breeding, grain testing, information technology. Consumer preferences for grains with enhanced health characteristics, and livestock feeder preferences for grains with enhanced feeding value have contributed to these developments. The rapid increase in highly differentiated grain products has altered the product characteristics described in Section 2.4, with a corresponding change in the transaction characteristics. Contracting is increasing in importance as grain moves from being largely a bulk commodity to a combination of differentiated products with a smaller share as a bulk commodity.

4.2. New Grain Products

Some new varieties of corn and soybeans contain traits that are cost-reducing due to the introduction of resistance to herbicides and insects (Harwood 1997). Other recent corn and soybean varieties have enhanced value by changing product attributes, such as an increase in the oil content in corn, or increasing the healthfulness and digestibility of soybeans. Table 3 contains information on varieties of corn, soybeans and canola that have been introduced in the last few years. Previous discussion of Table 1 indicates that relatively little grain is grown under contract in the United States compared to other commodities. However, as new highly differentiated grain products are introduced, the degree of vertical coordination in the industry is increasing.

Cost-reducing varieties include herbicide and insect resistant varieties. Herbicide resistant crops are genetically improved to tolerate herbicides (such as Roundup Ultra) and result in improved weed control and reduced input usage. Growers using herbicide resistant crops purchase a package of inputs including seed and herbicides from the same company. Of the new herbicide resistant varieties, Roundup Ready soybeans lead in terms of acreage, with 25 million acres planted in the United States in 1998, 34 percent of total U.S. plantings (Sparks Company Inc., 1998). An example of an insect protected variety is YieldGard corn, which provides in-plant protection from the European and Southwestern corn borers. YieldGard corn was planted to 13 million U.S. acres in 1998. In Canada, it is estimated that 60 percent of canola seeded in 1999 will be from genetically modified varieties (Western Producer, 1999).

Table 3. Selected Grain Products in the United States and Canada

Table 1. Selected Grain Products in the United States and Canada						
Product	Characteristics	Development Method	Company	1998 Acreage		Identity Preserved
				million	percent	
<u>Corn</u>						
High Oil corn	oil content 5.8% or more	Ad. breeding	Optimum	1 U.S.	1.2%	Yes
White corn	specific for snack foods	Ad. breeding	DeKalb/Custom	0.65 U.S.	.8%	Yes
High Amylose corn	amylose content > 50%	Ad. breeding	DeKalb/Custom	0.04 U.S.	.04%	Yes
Waxy corn	over 99% amylopectin	Ad. breeding	DeKalb/Custom	0.43 U.S.	.5%	Yes
Liberty Link	herbicide resistant	Transgenic	AgrEvo	4.2 U.S.	5.2%	No
IMI (imidazolinone) tolerant corn	herbicide resistant	Ad. breeding	American Cyanamid	6.6 U.S.	8.2%	No
Roundup Ready corn	herbicide resistant	Transgenic	Monsanto	0.75 U.S.	1%	No
Maximizer and Knockout corn	insect resistant	Transgenic	Novartis	2.0 U.S.	2.5%	No
YieldGard corn	insect protected	Transgenic	Monsanto	13.0 U.S.	16%	No
Roundup Ready and YieldGard corn	herbicide resistant and insect protected	Transgenic	Monsanto	0.03 U.S.	.04%	No
<u>Canola</u>						
Laurate canola (for oil)	high lauric acid—useful in food processing	Transgenic	Monsanto/Calgene	0.08 U.S.		Yes
Roundup Ready canola	herbicide resistant	Transgenic	Monsanto	2.0 Canada	7.4%	No
Liberty Link canola	herbicide resistant	Transgenic	AgrEvo	2.1 Canada	16%	No
Pursuit Smart	IMI tolerant	Ad. breeding	Pioneer Hi-Bred	2.1 Canada	16%	No
<u>Soybeans</u>						
Roundup Ready soybeans	herbicide resistant	Transgenic	Monsanto	25.0 U.S. 0.15 Canada	34% U.S.	No
STS soybeans	(sulfonylurea tolerant)	Ad. breeding	DuPont	10.0 U.S.	14%	No
High Oleic soybeans (for oil)	healthier frying	Transgenic	Optimum	0.03 U.S.	.04%	Yes
Low Linolenic soybeans (for oil)	replace hydrogenated oils	Ad. breeding	Optimum			Yes
Low saturate (for oil)	less saturated fat					Yes
LoSatSoy	low fat	Ad. breeding	Optimum	0.05 U.S.	.07%	Yes
High sucrose soybeans	increased digestibility		Optimum			Yes
High protein soybeans	high protein		Optimum			Yes

Sources: Optimum Quality Grains 1999; Farmsource 1999; and Sparks Company 1998.

New varieties have been developed through both advanced breeding and genetic engineering. Some cost-reducing varieties, for example Imidazolinone (IMI) corn, have been developed through advanced breeding practices. Insect protected crop varieties, such as Yield-Guard corn, have been developed through genetic engineering. These varieties continue a long history of the development of grain varieties with improved attributes over this century.

In general, the use of the cost-reducing varieties has not changed in a significant way the output characteristics of the product or the relationship between producers and other members of the supply chain. The exception to this is a lack of consumer acceptance in Europe and other importing countries of genetically modified organisms, which may result in identity preserved systems for grain that have not been genetically modified.

The enhancement of output traits has very different ramifications for producers and for the supply chain. These products must be identity preserved throughout the marketing system in order to capture the value of their enhanced traits. The rapid development of a tightly integrated supply chain for high-oil corn provides an example of how industry has responded to this technological development. High oil corn has average oil content of 7.45 percent compared to 3.5 to 4.5 percent for common corn (Optimum Quality Grains, 1999). Optimum Quality Grains is a joint venture of the Dupont Company and Pioneers Hi-Bred International Inc. and states that its purpose is to develop and market value-enhanced grains. Optimum licenses its technology, such as its high oil corn, to independent seed companies. Producers can use a system of contracting available through Optimum on the World Wide Web to ascertain the availability, location and terms of contracts for the production of high-oil corn. Optimum Sales Connection and Resource (OSCAR), the on-line contracting system, connects growers with elevators and feeders and processors. Contracts for high oil corn are with Optimum, who partners with a network of elevators. Contracts specify the seed to be used, the point and terms of delivery, premiums for oil content and discounts for failing to meet other quality conditions. Payment is based on the market price for #2 yellow corn plus a premium based on the oil content of the corn. Contracts specify that Optimum and its agents may evaluate and inspect the condition of the crop. The movement of high oil corn from elevators and to domestic and foreign end users is tightly controlled by Optimum.

Contracts are available on OSCAR for a number of Optimum Quality Grains products. Contracts for sulfonylurea tolerant soybeans (STS) also include conditions over the use of both seeds and herbicides and how the grain is to be identity preserved. Other companies are developing their own tightly integrated supply chains for trait-enhanced grain varieties. For example, Dow Agrosiences is developing an identity-preserved channel for a new corn hybrid, Supercede, with contracts to link farmers, elevators and livestock and poultry feeders (Dow AgroSciences, 1999).

Grain varieties with enhanced traits require specific production practices and identity-preserved marketing channels in order to capture the value of the traits in the seed. Contracting is prevalent in value-enhanced corn, with estimates of 70 percent of waxy corn, 60 percent of white corn, and 40 percent of high oil corn produced under contract (U.S. Grains Council, 1999). To date, these enhanced trait varieties account for a small percentage of total grain production. However, substantial investment in research and development of these trait-enhanced varieties, and the number of products in the pipeline, indicate that trait-enhanced varieties may become much more significant as a percentage of total grain crop production in the future.

4.3 Other Industry Responses

Grain companies who are not a part of closely coordinated biotechnology supply chains are looking for ways to remain competitive in the rapidly changing structure of the grains industry. Farmland Industries, a cooperative owned by local producer cooperatives, has responded with new approaches to increasing the value of common grains (Ebbertt, 1998; Ebbertt, 1999). To do this, Farmland Industries has developed an inventory of the grain in its terminal elevators to determine the quality attributes of grains from various geographic locations. Farmland's goal is to be able to source grain from locations based on their quality attributes, segregate the grain throughout their supply chain, and sell it for a premium to customers demanding higher levels of quality or particular quality attributes. In another venture, Farmland Industries, in conjunction with HybriTech, has contracted with growers to provide wheat of a higher uniformity and with specific milling properties for end customers. Farmland's approach

involves identity preservation and contracting, developing a differentiated product from common grains.

4.4 Changes in Product and Transaction Characteristics

The new grain products detailed in Table 3 have different product attributes, resulting in changes in the transaction characteristics presented in Table 1. Buyers must be assured that they are receiving the quality attributes that they desire and pay for, and these attributes largely fall into the category of variable and invisible. This increases uncertainty on the part of the buyer. As growers bear additional costs in producing a grain with highly specific attributes they need to be assured that they will be able to find a buyer who values those characteristics. If livestock feeders or processing plants need to invest in expertise, infrastructure or equipment to use a value-enhanced grain, then they need to be assured of a timely and adequate supply. Stringent quality requirements increase the complexity of the transaction due to the possibility that the producer's crop will meet some, but not all of the requirements. Optimum's contract requirement that its agents are allowed to inspect and monitor high oil corn on contracted acreage is evidence of their need to reduce uncertainty by protecting their investment.

These changes in transaction characteristics have increased transaction costs and resulted in new linkages between producers and grain companies. The increase in contracting is a response to reduce uncertainty and minimize transaction costs.

5. IMPLICATIONS

5.1. Implications for Producers

Growing new or enhanced grain products under identity preserved supply chains offers producers the opportunity to add more value to their crops through product differentiation. This may widen the choice set facing producers if a number of competing supply chains offering different trait-enhanced crops co-exist with the bulk commodity market.

There are also implications for the types of production, marketing and relationship-risks faced by producers. Crops with enhanced traits may call for specific production practices, requiring the farmer to learn new management expertise. However, this would likely be the case with any new enterprise on the farm and has little to do with closer vertical coordination. Changes to the marketing or input supply relationship, however, likely will require new skills in

contract evaluation and negotiation. Producers will need to be more proactive in marketing activities. Rather than simply delivering a bulk commodity to the local elevator, they need to understand the specific quality traits required by the buyer, the contractual obligations of both parties, where the risks lie, who bears these risks, etc. Furthermore, average market price information typically provided by public agencies refers to bulk commodities and will be less relevant for a differentiated, trait-specific crop and therefore less useful to producers.

In a survey of Kansas wheat growers, Duval and Biere (1998) identified a number of reasons why some growers were reluctant to grow hard white wheat under contract. Production management concerns (storage, a requirement to plant on clean ground, extra work) were mentioned frequently (78 percent). Other concerns included the contract (32 percent), the purchase of certified seed (11 percent), and inspections (10 percent). Some farmers were uneasy about the perceived reduction in independence. Often this was a concern among producers with little or no experience of contracting. This suggests a steep learning curve for some producers.

If producers have made an asset-specific investment in the production of trait-enhanced crops, they face higher relationship risks. However, some of the grain contracts appear to be fairly standard and are often with elevators rather than specific end-users, suggesting that producers may still have alternative market outlets for their crops. The degree of relationship risk therefore depends crucially on the extent of asset specificity.

5.2. Implications for Cooperatives and Producer Groups

What are the implications of closer vertical relations for other industry players, namely cooperatives and producer commodity groups? Cooperatives are likely to continue to have a role to play in grain handling and input supply. In fact, they may have an enhanced role as an intermediary, reducing negotiation costs between producers, input providers and processors. In the case of a new crop, this might involve guaranteeing sufficient supplies of a crop to support a processing plant. Producer groups can also play this role. Whereas the producer groups cannot “guarantee” supply, they can still operate as a liaison between producers and processors, encouraging the commitment of acreage.⁵

⁵ Of course, this is not limited to trait-enhanced crops, the Potato Growers of Alberta (a provincial industry association) worked with producers to obtain the potato acreage commitments necessary to attract two large french fry manufacturing plants to southern Alberta in 1999.

Producer groups may have a role to play in establishing and operating quality assurance schemes or in monitoring crop quality, particularly if trait-enhanced varieties require specific production practices that impact an invisible quality characteristic. As Table 1 indicates, this increases buyer uncertainty, leading to higher transaction costs. A credible system of quality assurance or crop monitoring would reduce the buyer's need to monitor and would dilute the incentive for tighter control of the supply chain. Conceivably, this could also be a function of a cooperative, provided that monitoring is seen to be credible; this would probably require independent crop audits. Farmland Industries, referred to earlier, has a quality assurance program concerned with environmental stewardship. Their AG-21 program certifies that grower's production standards meet stringent environmental practices. A traditional function of producer groups has been to lobby governments for price floors to stabilize commodity markets. A move away from these types of markets suggests a re-orientation of lobbying efforts, including improved access to international markets and encouraging the application of anti-trust laws to the input supply and processing sectors should it become necessary.

5.3. Implications for Government

What does the move towards more closely coordinated supply chains bode for the role of government policy? In grains, at this early stage, it is difficult to say. Certainly, as more closely coordinated supply chains, built around identity-preserved products emerge, traditional U.S. commodity-oriented policies will become less relevant—at least for the proportion of agricultural output transacted in this way. Similarly in Canada, much of traditional agricultural policy has focused on providing producers with the best average price for a commodity-type product.⁶

Whether commodity-oriented policies become obsolete depends on the extent to which identity preserved supply chains replace bulk commodity markets for grain. Certainly the trend appears to be a growth in these supply chains, however, the changes are occurring much more slowly in grains than in other U.S. (poultry and hog) sectors. One can expect identity-preserved supply chains and the bulk commodity market for grains to co-exist for at least the next 5 to 10 years, each serving different market needs. Before we can determine the appropriate role for

⁶ Note, Canadian income stabilization policies, such as NISA (Net Income Stabilization Account) are not commodity-specific and therefore would still have a role to play in the case of identity preserved products.

public policy, we must first ascertain the extent to which the bulk commodity grains market will be replaced by closely coordinated supply chains—this requires further research.

Further, the importance of average market price reporting by public agencies will diminish, for three reasons. First, average prices for bulk commodity product will be less relevant for those producers selling trait-enhanced crops into an identity-preserved supply chain. Second, at some point, the “thin market” problem sets in and average prices are no longer representative or reliable. Finally, price information in closely coordinated supply chains is often proprietary and therefore not available for aggregation by public agencies.

In a spot market transaction for a homogeneous commodity, with price the sole determinant of the sale, accurate information about prevailing average prices was critical to the transaction (for both buyer and seller). As products become differentiated and more coordinated supply chains evolve, a host of other factors become important to the transaction. Thus, the information needs of players in the supply chain expand beyond simply requiring average price information. Also important will be information about product quality (quality audits), the availability of contracts, the reliability of buyers/sellers and generally an improved understanding of how the supply chain functions, who are the key players, etc.⁷ It may be appropriate to move these functions from government to the private sector. Precedent exists in the cattle industry in both the U.S. and in Canada. Cattlefax, in the United States, and CANFAX, in Canada, collect data on the cattle industries in their respective industries. This role could be enlarged to include acting as a clearinghouse for information on contract specifications.

6. SUMMARY AND CONCLUSIONS

Closer vertical linkages are emerging in many different agri-food sectors globally. A number of technological, regulatory and socio-economic factors appear to be driving this change. These drivers affect the characteristic of the transaction directly and through their impact on product characteristics. The impact on transaction costs provides one explanation for the observed increase in vertical coordination. Although closer vertical coordination has been

⁷ Of course, price still plays important role in the transaction, however, the transaction has become more complex. The information needs of the producer (and processor) are therefore more complex.

occurring in the U.S. poultry and pork sectors for some time, it is occurring more recently in the U.S. grains industry. Although the case study presented in this paper focuses on the United States, clearly, many of these drivers also affect the Canadian grains and oilseeds industries and similar changes have been observed (see for example, Kennett et al., 1998; Phillips, 1998). Whether the growth of identity preserved supply chains will eventually replace bulk commodity grains is a matter of some debate. Further analysis is required to determine the strength of the drivers for change, their impact on transaction costs and the implications of increased vertical coordination in the future.

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