DIFFERENTIATION WITHTIN THE GRAIN AND OILSEEDS SECTORS: THE EVOLUTION AND REENGENERING OF SUPPLY CHAINS

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ABSTRACT

Dynamics in the global food system along with a cascade of technologies drive demands for capturing information and sharing information vertically within the supply chain. Food safety, genetic engineering, and animal welfare all have contributed to the need for enhanced information flow within the supply chain. Identity preservation in grains and oilseeds is an emerging issue that may influence the structure of agriculture longer-term. Firms within the food supply chain must decide what information to provide and how to provide it. This applies to collecting information from upstream suppliers as well as to supplying information for downstream customers. Components of this vertical information situation include farmer-supplier identity preservation to capture value and the buyer information needs concerning geographic location of production or seller identity in order to manage risk. One implication is that demand for identity preservation (IP) in the United States grains and oilseeds sector may be weak as long as vertical information is an expensive product attribute that seller and buyer value differently. A second implication is that vertical information plays a significant role in influencing industry structure and market governance in the grains and oilseeds sector.

Keywords: Identity preservation, contracts, signaling strategies, farm structure, food system
JEL codes: L21, L14, L66, and L50

INTRODUCTION AND BACKGROUND

Numerous events have developed rapidly within the global food system that conspires to build demand for increased vertical information flow. The events influencing the grains and oilseeds sector center primarily on differentiation and food safety. To illustrate with regard to food safety, the StarLink™ situation has challenged the global supply chain to exorcise all StarLink™ contamination in terms of human food supply channels. Sold by Aventis CropScience, StarLink™ corn is engineered to contain the Cry9C protein obtained from *Bacillus thuringiensis* (Bt), a genetically engineered variety. StarLink™ corn, because of questions about the allergenic potential of the Cry9C protein, was not approved for use in foods intended for human consumption. The StarLink™ incident raises some important questions concerning the incentives and strategies of various economic agents in

the agrifood supply chain. The incident challenges analysts to understand under what conditions certain economic agents are incentivized to engage in identity preservation and when they may view anonymity as a superior strategy.

Sporleder and Goldsmith (2001) recently defined and analyzed a fundamental signaling problem within the contemporary agrifood supply chain. The signaling problem involves both the provision of the proper amounts of positive and negative product attributes. The authors describe the informational role of branding, a defacto form of identity preservation, as a trust mechanism for delivering safe and consistent quality food. While branding is a powerful force in vertical information flows, it is generally absent from commodity markets for grains and oilseeds. This is the point of departure for this analysis by elaborating on when and why vertical information markets form and understanding the role of various economic agents relative to IP strategy.

Genetic engineering and other events such as the emergence of organic production necessitate enhanced vertical information flow, specifically the increasing need for identity preservation within the grains and oilseeds sector. Identity preservation implies differentiation, a situation distinct from commingled mass marketed grains and oilseeds that are handled and stored in bulk for efficiency reasons. There are two extremes of a continuum that represents the conceptual basis for an identity preservation (IP) system, Figure 1. One end is no identity preservation where agricultural commodities are commingled and mass marketed at the producer first-handler level in the agrifood supply chain. This end is illustrated by the marketing of #2 yellow corn. The other extreme of the IP continuum is where products are branded and therefore include all of the information components of an IP system. This end is illustrated by any branded commodity or further processed food product. Somewhere in between the ends of the continuum is a space of agricultural commodities that are differentiated but not branded, such as the production of organics.

There are five possible information components to an IP system, defined in the first column of Table 1, and some of these are lacking at the mass marketed end of the continuum. However, at least some and perhaps all five information components are known to the seller of the branded product, even if the complete set of information is transparent and not made available to the final consumer. The portion of the continuum between the end points represents increasing complexity and additivity of the five components of an IP system.

As the identity preservation and other forms of differentiation emerge in the supply chain for agricultural commodities, the chain may need to be reengineered to accommodate the demands for increased vertical information flow of differentiated product-service bundles. The reengineering also may influence farm structure and farmer investment, the emphasis of this manuscript. Managers of firms within the food supply chain must decide how to respond to the situation. Critical for the farmer-supplier is what and how to provide information to downstream customers. On the buy-side end users assess how much information they need from their upstream suppliers.

For example, when buy-side demand requires minimal information and needs maximum flexibility and substitutability, commodity spot markets dominate. Vertical information flows are minimal. Farm supply (sector structure) tends to evolve in a competitive manner. Alternatively, if information needs on the buy-side are significant, more information is necessary, spot markets fail in terms of this provision, and explication through contracts dominates. Farm supply becomes less competitive, premiums emerge, and farm structure becomes more heterogeneous.

PERSPECTIVES ON VERTICAL INFORMATION FLOWS

The dynamics surrounding genetic engineering capabilities for both grain and livestock along with food safety and animal welfare concerns combine to increase the need for information, communicated vertically within the supply chain. The information requirements to satisfy the need may not be customarily disseminated or even collected in the current supply chain. For example, dissemination of information regarding the slaughter conditions for meat animals or whether corn seed was genetically modified is typically not collected or disseminated within the conventional supply chain.

In Europe the concept of traceability has been applied to the meat supply chain. Due to problems such as "mad cow disease" (BSE) and foot-and-mouth disease (FMD), enhanced vertical information flows were needed to assure the safety of the livestock-meat supply chain (Sporleder and Goldsmith, 2002; Fischler). For example the United Kingdom's animal passport system, when fully implemented, may allow consumers' knowledge about their meat products all the way upstream to the farm gate. Alternatively in grains and oilseeds, the term identity preservation suggests the grain has not been commingled and supplier identity also is known.

Information Components

Within the vertical market for information there are five basic components that can comprise an IP system, degree of segregation, knowledge of the supplier's identity, knowledge about the geographic origin, knowledge as to quality metric, and knowledge of the production protocols, Table 1. Each component can define a program or can be assembled with other components for a more complete IP system. As more components are added, information quantity increases and, ceteris paribus, the costs of implementing and maintaining the system rise.

Information Needs

The valuation of the above components and the underlying incentives of the sell side agent can differ significantly from those of the buy-side agent. Four underlying transaction features appear to be central to the concept of vertical information need. The first is the incentive for sellers to want to maintain their identity as their products go forward as differentiated or even branded. This would afford them a premium in the market. The second is for the buyer to demand information from upstream suppliers to mitigate risk, such as in the StarLink™ example above. Third is for either the seller or buyer to maintain segregated commodities without identity information on the supplier or

other information items such as the geographic origin or production protocols. Finally, when the need for vertical information flow is minimal, products are commingled or blended so anonymity prevails and simply may be preferred to IP. Ceteris paribus, preserving the identity downstream or knowing the origin or identity of the upstream suppliers is costly. This cost can arise from third-party verification systems, system complexity, asset specific investments to accommodate monitoring, and the bureaucracy (Sporleder and Goldsmith, 2001). Segregation without identity preservation is less intense in terms of vertical information flow and therefore less expensive on a per unit basis. Full flexibility for commingling entails the lowest vertical information costs and is the "benchmark" from a cost viewpoint.

Preference for information flows may differ between buyers and sellers. For example, sellers may feel that their differentiated product warrants a premium in the marketplace as compensation for additional costs incurred in production and handling. The buyer may not be willing to pay for the product because the added information is insufficient to afford the necessary market price premium (or uplift) or to mitigate significant risks, Figure 2.

Stylistically imagine a farmer producing a high quality white corn for an end-user, such as a snack food manufacturer. Does preserving the identity of the supplier of white corn make the snack food more valuable in the end-user's market? Can the end-user exercise more pricing control because of the source of white corn; the notion of market uplift? If so the vertical information has currency and price premiums will prevail. Ingredient branding is an example of the presence of market uplift. IBM is willing to pay the premium to Intel and share their brand with Intel (Intel Inside™) because it affords IBM pricing power in the marketplace. While going on the spot market for computer chips is possible, the branded or identity preserved chip has currency and captures value in the marketplace for IBM. A similar example for a food product is the ingredient branding of NutraSweet™ in a cake mix.

Similarly the demand for vertical information may be high to attenuate buyers' risk, even if the corn were unbranded (common). For example, Gerber Foods invests in its supply chain by developing IP systems to ensure that no GMOs are present.

Alternatively market uplift and risk may both be trivial, making intensive vertical information flows unnecessary (low on the half-pipe, Figure 2). For example a seller of corn may produce several corn varieties, channeling each to a different destination. Segregation is important for value creation and capture but the supplier's identity is valueless. The product in this case may command a premium rather than the supplier/product bundle.

Incentives for Vertical Information Flows: The Buyer's Problem[1]

[1] This discussion is the result of a three-year research project conducted at the University of Illinois. Thirty Needs Assessments (for a discussion of need assessment techniques see Johnson et al, 1987; Soriano, 1995; Goldsmith et al, 2002) were conducted of over 30 meat, grain, and oilseed end-users. In detailed interviews end-users described their procurement process and the various needs that were either met or left unmet.

Vertical information flows are costly for buyers in numerous ways. Undifferentiated commodity purchases afford great flexibility through substitutability, common understanding of grades and standards, and the ability to commingle. Buying from a competitive commodity market also affords buyers the opportunity to manage price risks through buffer stocks and futures markets. Commodity purchasing is quick, low cost, and repeatable, with supply chains that exhibit well-established trade customs. Investment in vertical information capture and analysis adds new and uncertain costs and perhaps sunk investments to facilitate procurement. Because of this trade-off between information quantity/quality and cost, buy-side firms are selective as to which inputs warrant investment, i.e. investments become strategic. Economic agents in the supply chain prefer to avoid asset specific investments.

Analysis of commodity-retail price spreads demonstrates the declining role of the commodity input in the consumption experience. One value of commodities to end-users is that they are low cost. The buyer creates and captures value by taking a low cost input and converting it into a higher valued product. Higher cost or premium inputs have to be justified in terms of their market uplift or risk mitigation features. This makes incentives antithetical between the buyer and the seller. The buyer then constantly scans for alternatives to reduce costs, either through engaging substitutes (high oil corn and oil substitutes) or promoting greater supply (e. g. food-grade grains).

Finally, production agriculture is fraught with risk. Endemic to grain and oilseed production is variability due to weather, seasonality, and hemispheric differences. Ceteris paribus, buyers have scant incentive to directly engage sellers so as to avoid incorporating upstream risk into their operations. Buyers prefer, when possible, to shift risk to the farmer-producer. The thirty study firms from organic buyers to livestock feeders reveal a thick market of farmers eager to supply their needs. Also, as agro-industrial capital becomes more global the commodity supply is enhanced[2].

Vertical Information Needs and Transaction Governance

The majority of U.S. grains and oilseeds markets require minimal vertical information flows and the spot market is the primary form of governance (Martinez and Reed, 1996; Martinez and Davis, 2002). Contracting though has become a common governance mechanism for segregated grains and oilseeds (Martinez and Davis, 2002). The U.S., as opposed to Europe, continues to struggle though to develop markets and pay significant premiums (>5% of the commodity price) where identity is preserved. More common are segregated markets utilizing annual contracts and modest premiums (<5% of the commodity price), e.g. Frito Lay and white corn.[3]

Risk mitigation or risk shifting results from moving away from spot transactions to contract transactions. Another key factor that may influence the prevalence of contracting at the producer first-handler level is perishability. Perishability, in a supply chain context, is analyzed as sequential versus reciprocal dependency. For less-perishable

[2] This is especially relevant to non-perishable commodities and in light of the rapid increase in on-farm storage in both the US and South America.
[3] Recently, premiums have doubled to 10% of the commodity price in Illinois for non-GM soybeans.

commodities, storage is the fundamental means of achieving vertical coordination in the supply chain. Buffer stocks are held by private firms in upstream and downstream markets in an effort to mitigate quantity and quality risk and generally deal with unexpected events. Vertically dependent firms at successive stages in the supply chain are referred to as sequentially dependent because buffer stocks play a major role.

In commodity markets characterized by perishable commodities, reciprocal dependency is the relationship among vertically allied firms in the supply chain. Buffer stocks as a hedge against uncertainty and to achieve vertical coordination are not practical or cost effective. One consequence of this is that the coordination problem is more severe and alternative exchange mechanisms emerge beyond simple spot market transactions. The most important mechanism that substitutes, in terms of economic function for buffer stocks, is contracting. Contracting can be a means of enhancing coordination and substitute for the buffer stocks prevalent among agents in the sequentially dependent supply chain.

The sequential-reciprocal dependency aspects of commodities may be combined with the extent to which agricultural commodities are special use or are differentiated. This "dependency/differentiation" space may be used to draw a relative "map," Figure 3.

Research at the University of Illinois has identified three important classes of contracts that pertain to the identity preservation proposition: hard contracts, soft contracts, and simple contracts. Hard contracts are tight specification (either process or outcome) contracts that entail penalties for compliance failure or even indemnification of the buyer. An example of a hard contract is how Burger King® governs its transactions with its perishable food suppliers. Burger King® specifies and offers for bid its perishable food needs. The seller, in accepting the contract, agrees to not only supply the specified product but is liable for breech (Barrier, 2002). In the case of the Hudson meat recall (see Martin, 1999) Burger King® as the buyer was immediately relieved of all its purchase obligations. Hudson Foods was liable for the added costs of procurement, and brand damage and damage control, i.e. additional advertising (Barrier, 2002). Such hard contracts are not uncommon between processors and food manufacturers or retailers.
This research has been unable to document a case where litigation ensued because a producer failed to meet a supply contract[4]. Anecdotally, a branded food company that was part of the needs assessment study reported that a major US cooperative failed to meet its obligation to supply a high quality food-grade grain contract. The reason the co-op failed to fulfill its obligation is because commodity prices rose and the membership opted to market their crop in the spot market. The most notable aspect of the anecdote was that the food manufacturer was not compromised by the behavior of it supplier. Company procurement norms, even in quality markets, dictate that the company should not become over-committed because of supply risk.

Because supply has been and continues to be variable, either in terms of quality or quantity, the buy-side is hedged, perhaps through buffer stocks, and maintains alternative supply sources. One difficulty for farmers in their attempt to capture more value in the supply chain

[4] Other than the hedge-to-arrive situations in Minnesota and Ohio in the late 1990's.

is supply variability. This inherent problem forces buyers to engage numerous strategies to protect themselves from being caught in a short supply situation. Farmers sometimes attempt to mitigate supply risk by building new business models, such as the new generation cooperative, but may lack the delivery capability or other resources to fully protect buyers.

Soft contracts involve process and quantity specification but compliance failure involves no legal liability. Organic contracts in Illinois are highly specific, third-party verified, but involve no legal liability for failure to deliver. In the case of poor performance producers forego the premium and drop off of the select-supplier list. The market for suppliers, even for organic, is contestable with numerous suppliers globally willing to supply. Procurement executives report that information technologies make monitoring disparate supply sources easier every year. One buyer was even exploring web-based bin monitoring software that would allow remote quantity and quality assessment of a buyer's potential inventory, even while it resided in a supplier's storage facilities.

The most common contracts are unspecified soft contracts. These specify minimal management processes (i.e. simply variety/hybrid and quantity) and third-party verification is not employed. Often these are proprietary programs designed and maintained by handlers and processors to divert grain through their own channels. Premiums are moderate (~5% of the commodity price) and failure to comply is met without significant penalty.

End-users also describe an even less intrusive procurement program. Common in food grain supply chains is the strategy of "pump priming" without contractual obligation. End-users do not work directly with farmers but directly with a region by improving the local supply base. This is done by distributing specific varieties or hybrids and supporting management and training education in terms of best management practices and the varieties/hybrids used. This raises the modal quality level in the region and the farmers then can sell into a proprietary price grid. No farmer is excluded ex-ante from delivering through the program. This allows the buyer the best of both worlds, higher quality without substantively reducing the competitiveness of supply through contracting. End-users do run the risk of other buyers free-riding. This occurs when a firm attempts to raise the quality of grain in a region through pump priming and more than one buyer is present in the market. When the model grain quality is raised all buyers in the market benefit. In actuality though, free-riding is limited because demand for food grain is narrow.

In summary, the demand for vertical information is reflected in the continuum of transaction governance structures, Figure 2. Information is costly so buyers do not want asset specific investments in their supply chains. Second to spot market transactions, the most common governance structure are soft contracts and involve segregated commodities. Though end-user benefits are on the horizon for the next generation biotechnologies, currently market uplift cannot be realized to compensate the buyer in terms of improved margins, added risk, and reduced flexibility.

Similarly in terms of risk mitigation, when the Grocery Manufacturers Association explored how to address pharma farming in the Midwest (see Schuff, 2002; the case of Prodigene) to serve their European clients, their response was simple. They would not invest in high cost

procurement systems with traceback in the U.S. Instead they would simply move off-shore with their soft contract and commodity procurement model. To understand identity preservation business opportunities requires an understanding of the buy-side proposition. While more vertical information agrifood supply chain is seemingly better, no entity, from 1st handler through to the final customer, (organic and pharma being two exceptions) seems willing to pay the price. Given this outcome what are the strategic investment alternatives for producers to create and capture more value?

SUMMARY AND IMPLICATIONS

The fundamental question for farmers is how their role may change or morph over time as the agrifood supply chain increasingly is asked to differentiate. Can value be captured upstream in the modern agrifood supply chain? We conceptualize two primary forces driving the reengineering of the supply chain. One is the desire for more differentiation. Life sciences along with food processors and manufacturers continue to innovate with the expectation of creating significant end-user value, perhaps in a specialized market. Final consumers want more variety and less risk. At the same time, pushing back against forces for greater differentiation is the acute and celebrated efficiency of the agricultural commodity procurement system represented by the current infrastructure.

Agriculture is different from other industries because supply risk, either through weather or perishability, challenges vertical coordination between independent farmer suppliers and commodity buyers. Strategically for farmers, new and novel business models must be developed that directly address buyers' needs. This challenges farmer-owned existing firms and start-ups to be concerned about differentiation and branding

The previously cited research at the University of Illinois revealed that while end-users do prefer more quality to less quality, quality sometimes is not the issue. Sometimes the buyer doesn't simply buy a commodity but rather buys an input that possesses a set of attributes. While farmer groups may believe they are selling an undifferentiated commodity, the buyer looks upstream for a bundle of attributes. Some may be related to the grain, some related to price, and some related procurement efficiency. This buy-side set of Lancasterian attributes reflects buyers' needs and underlies making markets in the grains and oilseeds sector. The buyer's problem balances grain quality uplift and risk mitigation with procurement or transaction cost efficiency. The most effective strategy for producers looking to create and capture more value through differentiation is to understand buy-side needs and build supply models that address them.

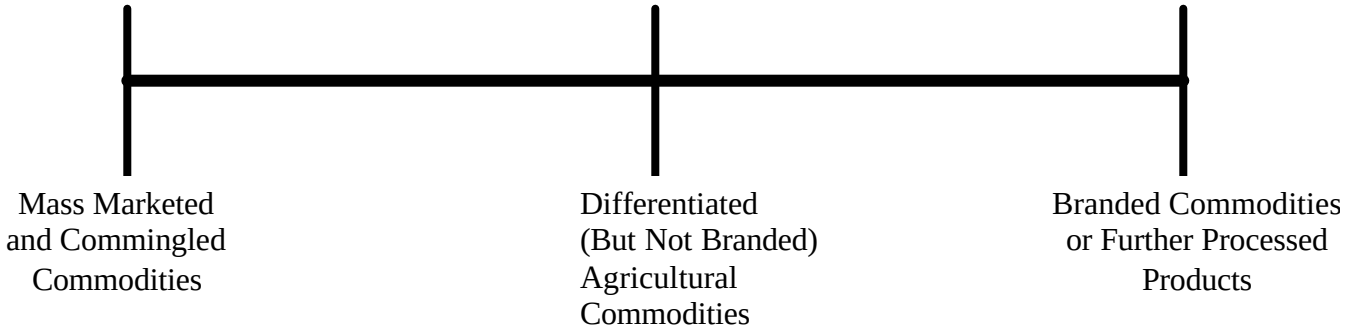

Figure 1. A Continuum Depicting Value Added and Differentiation in the Food Supply Chain.

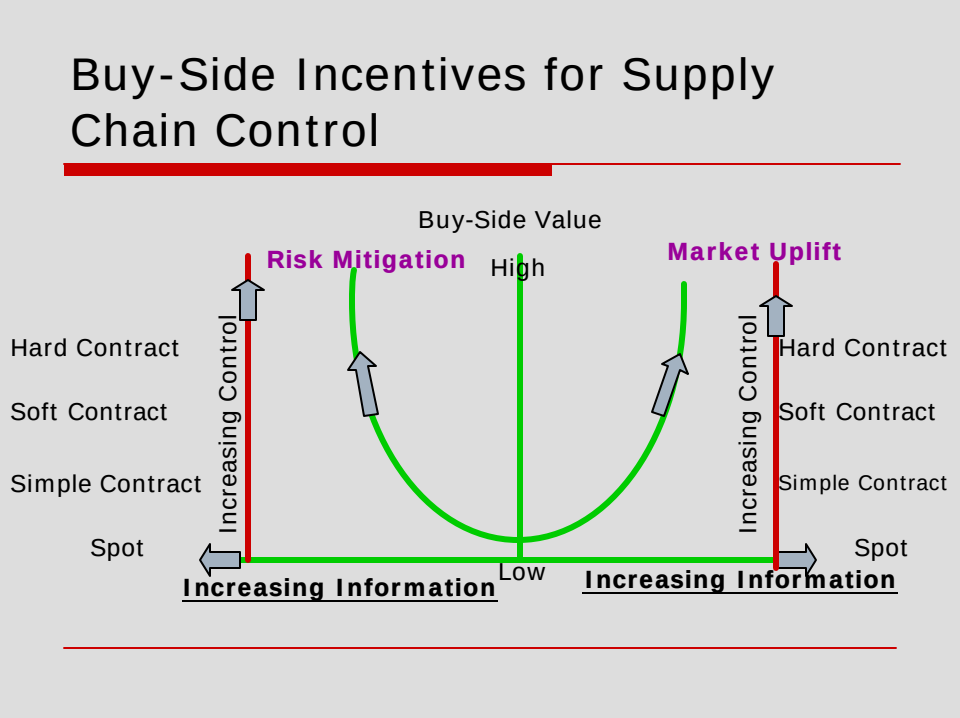

Figure 2. Incentives for Supply Chain Control by Buyers in Relation to Likely Governance Structures

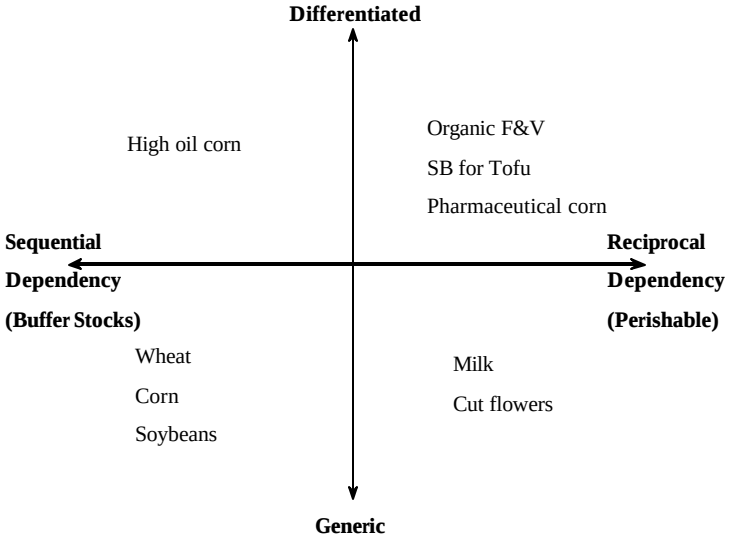

Figure 3. Examples of Commodities in Relation to Perishability and Product Differentiation

Table 1. Key Information Components of an Identity Preservation System and the Economic Incentives of Buyers and Sellers within an Agrifood Supply Chain.

Information Components of Identity Preservation		**Incentives of Economic Agents**	
		Sell Side	**Buy Side**
Segregation	**Benefits**	Allows efficient channeling	Allows efficient channeling
	Drawbacks	Premiums unlikely to reflect true costs	Limits efficiencies from scale economies
Knowledge or information on the identity of the economic agent	**Benefits**	Allows rent capture	• Provides market uplift if consumers value the source • Reduces risk by sharing risk
	Drawbacks	Can focus product liability	Adds costs through reduced substitutability, flexibility, and increased procurement complexity
Knowledge or information about the geographic origin	**Benefits**	Rent capture through geographic inimitability	Provides market uplift if consumers value the source
	Drawbacks	May not be relevant	Reduces competition
Knowledge or information about quality metrics	**Benefits**	Know what you are selling	Know what you are buying
	Drawbacks	Inhibits free-riding	Eliminates quality asymmetric information
Knowledge or information about production protocols	**Benefits**	• Allows for rent capture • Demonstrates due diligence • May contain spillovers to improved quality management	• Reduces risk by attending to critical control points • Demonstrates due diligence
	Drawbacks	Costly	• May not have market uplift • Underlying stochastic risk properties may be unaffected • Adoption of broad-based QC systems may negate firm's competitive advantage

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