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Pork Quality and the Role of Market Organization

Steve W. Martinez
Kelly Zering



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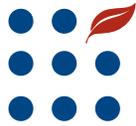
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Steve W. Martinez and Kelly Zering

Abstract

This study addresses changes in the organization of the U.S. pork industry, most notably marketing contracts between packers and producers, by exploring their function in addressing pork quality concerns. A number of developments brought quality concerns to the forefront. These include health concerns and corresponding preferences for lean pork, a decline in other quality attributes, heightened concerns over food safety and related regulatory programs, and expansion into global markets. Organizational arrangements can facilitate industry efforts to address pork quality needs by reducing measuring costs, controlling quality attributes that are difficult to measure, facilitating adaptations to changing quality standards, and reducing transaction costs associated with relationship-specific investments in branding programs.

Keywords: Contracts, transaction costs, measuring technology, measuring costs, pork, quality, leanness, safety, carcass pricing, vertical integration.

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Summary

In the U.S. pork industry, hogs sold through marketing contracts account for approximately 69 percent of total hog sales, compared with 11 percent in 1993. The rapid growth in marketing contracts corresponds to several developments that brought pork quality concerns to the forefront. This suggests possible contract advantages related to changes in quality emphasis.

In the 1990s, several events combined to heighten interest in U.S. pork quality. In response to health concerns related to fat and cholesterol, packer adoption of advanced measuring technology and substitution of live hog grading with carcass pricing grids provided strong incentives for leaner hogs. At the same time, a pork quality condition, referred to as pale, soft, exudative (PSE), was associated with the Porcine Stress Syndrome gene (stress gene), carried by some of the leaner genetic lines. This condition led to pork with poor processing qualities, less attractive appearance to consumers, and a tougher/dryer cooked product. As hogs became leaner, they became more susceptible to producing PSE pork.

Meat safety also gained increasing attention in response to several major meat recalls due to pathogen content. In 1996, mandated use of a new regulatory program for meat and poultry, referred to as Hazard Analysis and Critical Control Point (HACCP), reflected a growing interest in preventing and controlling food hazards before reaching the consumer.

PSE and safety concerns were further ingrained by U.S. efforts to expand globally. In the 1990s, the United States experienced unprecedented growth in pork exports, supported by the passage of free trade agreements. Considerable headway was made into the Japanese market, the leading U.S. export customer, where quality concerns are especially important.

Growing interest in improving pork quality likely increased the importance of measuring and sorting costs associated with hog quality attributes and price determination. Adoption of carcass pricing programs, which vary by packer, may have increased producer costs associated with evaluating alternative packer bids. Carcass grading programs with more narrowly defined quality groupings also likely raised packer costs of sorting and pricing hogs. Efforts to reduce these costs provided impetus for packers and producers to enter into long-term contracts with minimum hog volume delivery requirements. Long-term agreements with packers allow producers to reduce the number of times that alternative packer pricing programs must be evaluated. Also, large numbers of uniform hogs produced under similar production conditions allow packers to reduce the costs of measuring and sorting hogs into narrower quality groupings.

Packer costs of measuring PSE pork and food safety attributes are significant, which provided additional impetus for contract adoption. In particular, a strong link between hog production inputs, PSE, and safety attributes suggests that contracts that specify and monitor production activities can reduce these measuring costs. For example, genetic selection and proper handling procedures to reduce hog stress can reduce the incidence of PSE pork.

Analysis of a small sample of marketing contracts offered in the Midwest between 1996 and 2001 provides some additional insight into recent hog marketing contracts. Most of these contracts rely on formula pricing, adjusted by a carcass pricing grid, and give the packer some control over production inputs. Rather than detailed input requirements, however, many contract provisions express packer expectations for adjusting producer inputs, or plans for working together to determine input specifications. Such “relational” terms likely facilitate adaptations to changing pork quality needs as companies establish branding programs, expand internationally, and respond to changing food safety standards.

To the extent that packers become dissatisfied with the quality and consistency of hogs obtained through carcass pricing programs, they may choose to own or work with genetic companies. Packer branding programs that rely on a particular type of genetics products may lead to further changes in the organization of pork markets. Packers may craft more complex marketing contracts to protect their investments or own and raise their own hogs (i.e., vertical integration). In addition to marketing contracts, a host of other organizational arrangements that blend elements of both spot markets and vertical integration may be used, including packer-owned hogs that are raised using production contracts. Such “hybrid” arrangements may offer advantages in adapting to uncertain market conditions, providing incentives for efficient resource use, and facilitating coordination through control devices, such as monitoring.

Pork Quality and the Role of Market Organization

Introduction

Steve W. Martinez and Kelly Zering

The pace of recent organizational change in the U.S. pork industry has been dramatic. Contracting between pork packers and producers increased considerably in the 1990s. *Marketing contracts* offered by pork processing companies typically specify the quantity of slaughter hogs to be purchased on specified dates and places, and provide hog producers a secure outlet for their hogs and specific pricing terms. Producers are explicitly compensated for hog carcass weight and leanness. Marketing contracts accounted for approximately 69 percent of hogs sold in 2004, compared with less than 2 percent in 1980, and 11 percent in 1993.¹ By contrast, in the beef industry, only 30 percent of steer and heifer slaughter were procured through marketing agreements by the 4 largest beef packers in 2001 (USDA/GIPSA, 2003).

Packer ownership of hogs has also increased in recent years from 6.4 percent in 1994 to over 17 percent in 2004 (R. Smith, 2004; Messenger, 2000). Packers own the hogs from birth and may enter into *production contracts* with producers to raise them. Packers typically provide pigs, feed, veterinary services, and some managerial support, and collect the pigs for marketing. Producers provide housing, labor, water, utilities, and manure management in exchange for a contract fee (Zering and Beals, 1990; Martinez, 2002; Martin, 1997). While on the rise, production contracts between packers and producers remain well below that of the poultry and egg industries, which have relied on such contracts for several decades. In 2001, 81 percent of U.S. poultry and eggs were produced under production contracts (USDA/ERS[c]).

Policymakers have expressed concern about the rapid increase in pork contracting. As marketing contracts replace hog sales on the spot market, spot prices are based on fewer sales. Consequently, prices in these “thin” markets may become highly volatile, subject to manipulation, and less representative of a competitive market equilibrium (Martinez, 1999). In addition, prices in marketing contracts are typically tied to a spot price. Smaller producers also complain that packers prefer to enter into contracts only with large producers and pay the large producers publicly undisclosed premiums.

Past studies of organizational arrangements in the pork industry have focused on the risk-shifting function of contractual arrangements (Martin, 1997) or their effect on farm productivity (Key and McBride, 2003). Relatively little research has focused on their role in addressing pork quality problems (for related research, see Hennessy and Lawrence, 1999; Smith, 1999; and Hobbs, Kerr, and Klein, 1998). Survey evidence suggests that this function could be an important one (Lawrence et al., 2001). In addition, contracting arrangements play a role in addressing quality issues in other

Steve Martinez is an agricultural economist in the Economic Research Service of the United States Department of Agriculture. Kelly Zering is an associate professor in the Department of Agricultural and Resource Economics at North Carolina State University.

¹These figures are based on expert estimates by Economic Research Service/USDA specialists in 1980 (Marion, 1985), a survey of large packers accounting for 86 percent of hog slaughter in 1993 (Hayenga, et al., 1996), and data from USDA's Livestock Mandatory Price Reporting Program accounting for 92 percent of hog slaughter in 2004 (R. Smith, 2004). USDA has a long history of interest in contracting, including broiler contracting, which became an important part of the broiler industry in the 1950s (Martinez, 1999, 2002). Alternative sources of recent and historical contract information are based on USDA farm surveys, including the Census of Agriculture and the Agricultural Resource Management Study (ARMS), formally referred to as the Farm Costs and Returns Survey (Perry). Grain Inspection, Packers and Stockyards Administration (GIPSA) and its predecessors were organized to regulate and oversee the activities of agricultural markets, including contract arrangements.

agricultural industries, including beef (Purcell and Hudson, 2003), fruits and vegetables (Hueth et al., 1999), and tobacco (Dimitri, 2003).

It is important to examine the relationship between changing organizational arrangements and pork quality because policymakers can use the information to facilitate decisionmaking on antitrust issues. Policies that restrict or inhibit changes in markets could reduce social welfare if the changes are in fact efficient responses to market demands. In addition, opportunities for producers to enhance profits and reduce risks may be restricted.

This study's major objective is to examine relationships between changing organizational arrangements and pork quality. For example, do contracts provide a more efficient means of addressing pork quality problems relative to spot markets? In the process, we apply selected theories from the industrial organization literature.

Product Quality and Market Organization: Two Theoretical Perspectives

Transaction cost economics (TCE) offers one perspective on the relationship between market organization and product quality. TCE views organizational arrangements mainly as a means of reducing transaction costs, which include costs of drafting, negotiating, safeguarding an agreement, and haggling and monitoring costs after the agreement has been made. One class of transaction costs are measurement, or information, costs (Hallwood, 1990; Hobbs, 1996).² These include costs of searching for information about buyers or sellers in the market, inspecting goods prior to purchase, and assigning a price. Measuring costs may be especially significant when transactions are heterogeneous (e.g., vary in premiums placed on quality characteristics across transactions and over time), or characterized by asymmetric information (Lafontaine and Masten, 2002; Williamson, 1985). Two types of asymmetric information can be distinguished. The seller may have more information than the buyer about a difficult-to-measure quality attribute, or an individual's contribution to the quality outcome cannot be determined by measuring the finished product (i.e., team organization). Markets may be organized to reduce measuring costs that are associated with assuring a closer correspondence between product value and price, or actions and rewards (Barzel, 1982; Williamson, 1985).

Measuring difficulties associated with overcoming asymmetric quality information may also be viewed as an "exchange hazard" (Williamson, 2000; Poppo and Zenger, 2002). When hog quality attributes are difficult to measure the producer may engage in opportunistic behavior to exploit private information by failing to perform as agreed, such as shirking or cutting corners on quality, also referred to as *moral hazard*. This is expected to lead to contracts with added security features to mitigate the hazard, such as provisions for third party monitoring of sellers, documents to justify activities performed, and other means of increasing information disclosure.

TCE distinguishes transactions primarily by the degree of asset specificity, which refers to investments that have considerably less value in alternative uses and by alternative users. To the extent that addressing quality issues involves such transaction-specific investments, incentives are created to hold up the investing party (e.g., haggling, making false claims of nonperformance, withholding information to create a breach of contract) to gain more favorable terms during contract formation or execution (Masten, 1996). Failure to concede will significantly reduce the value of the specialized assets. As asset specificity increases, more complex contracts are crafted with added protections by specifying required actions, conditions of breach, penalties to deter breach, and procedures such as arbitration for resolving unforeseen disputes (Williamson, 2000; Poppo and Zenger, 2002).

In situations where asset specificity and the associated threat of holdup is especially significant, the costs of protecting against this threat also rise. Examples of the costs would be resources devoted to writing and enforcing contracts. Consequently, vertical integration will become the cheapest

² As defined by Barzel, "measurement is the quantification of information."

alternative. Vertical integration is the ownership of successive vertical stages by a single firm that transfers goods internally. Ownership limits the likelihood of holdup by essentially eliminating the other party.

TCE also gives an important role to uncertainty and the influence of organizational arrangements in facilitating adaptations to changing circumstances (Masten, 1996; Ryall and Sampson, 2003). Matching producers' hogs to the quality needs of packers may require continual revision in light of changing customer demands and quality standards. As market uncertainty increases, it becomes more costly to write enforceable, complete contracts that detail behavior contingent on future outcomes. This leaves opportunities for parties to engage in opportunistic behavior to avoid compliance or increases the likelihood that parties will fail to optimally adapt to changing conditions. Consequently, contracts are likely to become more "relational" in nature. That is, rather than laying out detailed terms of cooperation, contracts are likely to specify the process by which terms will be established. By making contract terms less explicit, transaction costs associated with renegotiating and revising contract terms are reduced in light of uncertain future demand and quality needs.

Another branch of the industrial organization literature, *agency theory*, attempts to determine the optimal contract in a principal/agent relationship, where the principal is the controlling authority and the agent acts for the principal (Eisenhardt, 1985, 1989). Broadly speaking, cooperative behavior between the principal (packer) and agent (hog producer) is viewed as a contracting problem between self-interested individuals with different goals and risk preferences.

In cases where the packer is unaware of how the producer has behaved, two options are available to limit moral hazard (Eisenhardt, 1989). First, contracts may reward producers based, at least partially, on outcomes of their behavior (*outcome-oriented contract*). Second, the packer may invest in information about producer behavior (*behavior-oriented contract*).

The optimal performance evaluation strategy (behavior-oriented versus outcome-oriented) will depend on the ability to measure quality outcomes and related inputs. When quality outcomes are difficult to measure or difficult to measure in a reasonable amount of time, behavior-oriented contracts will become more attractive. Behavior-oriented contracts are also more likely if producer activities can be easily defined and evaluated, which makes it easier to specify appropriate producer behavior in advance. In this case, the production process is referred to as highly *task programmable* (Eisenhardt, 1989).

How can producers be motivated to act in the social interest when they are involved in several valuable activities that affect multiple quality attributes, but the ability to measure these attributes varies? Holmstrom and Milgrom (1991) address this question by formally extending the standard linear principal/agent model to include multiple activities that compete for the agent's time and attention. They demonstrate that explicit incentives for easily measured outcomes of producer effort will be reduced or absent when other unmeasurable performance outcomes are also important. This is because compensation based solely on a measurable outcome, such as volume

supplied, may lead to poor performance in an unmeasurable outcome, such as some dimension of pork quality. Similarly, explicit incentives for a producer's contribution to an easily assessed activity would lead the producer to neglect any team production activities. The presence of incentive clauses for easily measured quality attributes will, therefore, be influenced by the ability to monitor producer activities that affect the unmeasurable attributes.

Changing Emphasis on Pork Quality

Pork quality is the set of characteristics that make meat desirable. Those characteristics might be determined by: aesthetics (taste, smell, texture, and color); nutrition (vitamins, proteins, minerals, energy, type and proportion of fat); safety (absence of pathogens or toxins); intangible qualities (organic, or meat produced under high standards of animal welfare); and qualities such as convenience and reliability. Pork processors identify several other determinants of pork quality: low “drip loss,” or fluid lost from fresh, uncooked pork; color and color consistency; limited external fat; and absence of defects (Morgan et al., 1994).

Pork quality concerns were driven to the forefront by several developments in the 1990s, against the backdrop of fundamental trends driving consumer preferences for food products (Kinsey, 1994, 2000). These developments refocused packer initiatives for improving leanness, safety, and other meat quality attributes.

Renewed Emphasis on Lean and the Switch to Carcass Pricing Programs

Historically, lard was an important product derived from pigs. But after World War II, the demand for lard dropped sharply (Rhodes, 1978, p. 157). To provide incentives for leaner hogs, almost all slaughter hogs were graded and priced live at point of sale using the live hog grades and standards administered by USDA. The standards were based on the expected carcass grades that the live animal would bring (Rhodes, 1978). The highest carcass grade was expected to produce 53 percent or more of the four principal lean cuts (trimmed ham, loin, picnic shoulder, and Boston shoulder), as a percentage of total carcass weight. Live animal evaluation, grading, and pricing was a critical component of most animal science programs and a critical component of the U.S. pig production and marketing system (Boggs and Merkel, 1979).

Problems occurred with live hog grading. The grading remained an estimate of the actual carcass grade and prices were often set for pens of hogs rather than for each individual animal (Rhodes, 1978, p. 157). Resulting errors in attribute measurement implied that producers received only a small reward for producing higher quality hogs and, hence, had weak incentives for improving quality.

The Carcass Grade and Yield Program

The imprecision of the post-WWII live hog grading and pricing system created incentives for a new system of hog selling to emerge. New research-based carcass grades and standards, initially introduced in 1952 and modified slightly in 1968, were intended to reflect differences in value across carcasses and to provide incentives for farmers to “breed and produce the more valuable, leaner hogs.” Rhodes (1978) describes the “carcass grade and yield” pricing system offered by packers. After slaughter, packers would measure the weight, length, and average backfat thickness of the hot carcass

(prior to reaching the chill room or cooler). These measurements would be compared to the carcass grades and standards table to establish a carcass grade. The base hog price per pound would be adjusted up or down to reflect the grade of the carcass.

The carcass grade-and-yield system had two major weak points. First, it relied on people to manually measure, record, and report the dimensions of each carcass. This procedure introduced a significant transaction cost and potential source of error. Second, the system separated the critical grading portion of pricing from the point of sale (e.g., the auction ring or the unloading dock). (This latter feature along with the potential for human error engendered distrust in some farmers, who nicknamed the system “grade and steal.”)

Spurred by rapid advances in electronic computing, other microelectronic devices, and information management in the 1980s and 1990s, some packers shifted their basis for payment to carcass weight instead of live weight. Computerized scales and computer programs recorded weight, calculated payments, and printed reports. Payment based on carcass weight eliminated payment for gut-fill (feed consumed prior to delivery, but not digested by the animal, thus making the animal heavier prior to slaughter).

The carcass grade-and-yield program, however, presented a quality paradox. Almost all market hogs being sold in the late 1980s and early 1990s were in the top two USDA grades, so there was little or no incentive for farmers to produce leaner carcasses. Carcasses with more backfat weighed more (were a greater proportion of liveweight) than lean carcasses. As a result, given two animals of the same liveweight, the animal with more backfat produced a heavier carcass and might generate a greater payment, even though it was not as lean.

New Measurement Technology and the Emergence of Carcass Pricing Grids

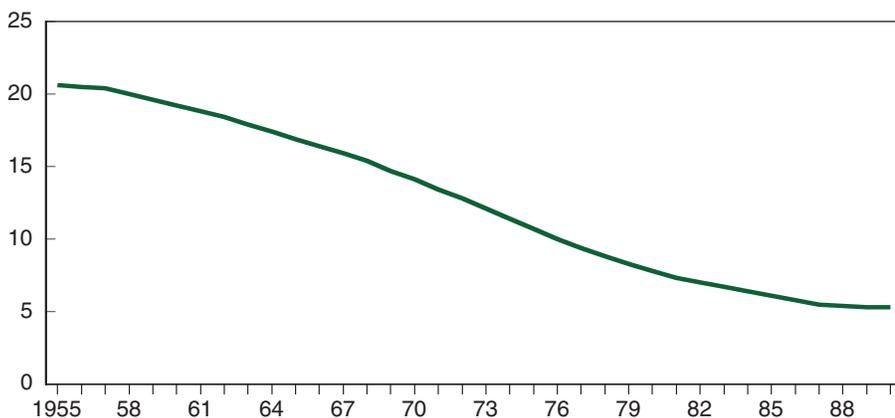
By 1992, live hog grading remained the dominant procurement method, accounting for 83 percent of slaughter hog purchases (USDA/GIPSA, 1998). However, an emphasis on leanness had emerged in the 1980s, with human health research reports linking fat and cholesterol to cardiovascular disease in people (Robenstein and Thurman, 1996). Although live hog grading proved to be effective in encouraging farmers to reduce the fat content of their hogs (fig. 1), further reductions were beginning to slow, while health-conscious consumers were apparently willing to pay for even less fat (Schroeder, 1993; Hayenga et al., 1985; Kenyon and Purcell, 1999).

In 1992, several of the largest pork packing companies adopted a new carcass measurement technology and a new pricing method. The technology was previously adopted and proven by Hatfield Quality Meats in the late 1980s (Marbery[b], 2000). It consists of an optical probe, used to distinguish backfat from lean tissue, combined with a scale and linked to a computer. The optical probe, called the Fat-O-Meater, is inserted through the backfat and loin muscle at a specified point on the carcass. Based on prior research, the backfat thickness and loin muscle depth, combined with the carcass weight, are used to calculate the estimated percent carcass lean.

Figure 1

Fat removed from a typical pork carcass, 1955-90

Pounds per 100 pounds carcass



Note: 1990 is forecast. Series was discontinued after June 1989.

Source: Duewer, Bost, and Futrell, 1991.

The detailed measurements and computing capability allowed packers to introduce their own pricing grids: a schedule of price adjustments to a base price that depend on carcass weight and estimated percent carcass lean (see appendix C). Carcass measurements are reported on a kill sheet and sent to the producer along with payment. Carcass pricing grids (also referred to as carcass merit programs or carcass value pricing programs) and more precise measures of leanness suggest a higher expected price for producing leaner hogs and therefore stronger incentives to do so. Evidence collected from six large meat packers in the Southeast showed that carcass pricing grids were providing significant incentives for producers to raise larger, leaner, and more muscular hogs (Kenyon et al., 1995).

As the popularity of carcass pricing programs grew, leaner hogs became available at more desirable weights. Producers introduced new genetics, improved nutrition, and enhanced management that increased growth rates, feed efficiency, and lean meat composition. A new surge in leanness followed as producers adopted leaner genetic strains from England, Denmark, and elsewhere in Europe. Measurement technology continued to evolve with the introduction of ultrasound devices that make hundreds of measurements of muscle thickness throughout each carcass. Two surveys of large U.S. pork packers, one in 1992 and the other in 2002, found that average hog backfat thickness fell by 36 percent, percent lean muscle increased from 49.5 percent to 55.5 percent, and live weight increased by 10 pounds (Morgan et al., 1994; Miller, 2004). According to Meisinger (2000), more progress was made in the 1990s to reduce carcass fat and increase muscling than in the previous 4 decades combined.

Pale, Soft, Exudative Pork Proves Undesirable

Beginning in the 1950s, when U.S. pork producers attempted to change pork's image of being a fatty meat by instituting breeding programs to reduce fat content, a decline in quality became apparent (Kauffman et al., 1994). This decline was later linked to Porcine Stress Syndrome, a gene carried by some of

the leaner genetic lines of hogs (K.E. Smith, 1999). “Pale, soft, exudative” (PSE) pork, which is fresh pork that has very light color, soft texture, and a high degree of drip loss (“exudative”), quickly became known for its undesirable qualities (Boggs and Merkel, 1979). PSE pork performs poorly in processing (e.g., makes poor precooked hams), is unattractive in the meat case, and has poor eating quality after cooking. Soft, floppy, and watery pork is of little value to processors and wholesalers because it is susceptible to shrinkage—as much as 15 percent—during handling, processing, and storage. Fresh PSE pork turns a very light pinkish gray at retail, which is unattractive to consumers. PSE pork may be directed to low-value uses such as an ingredient for sausage. Economic losses associated with PSE include reduced yield during processing and cooking, drip loss in retail display trays, reduced shelf life, increased quality variation, and reduced consumer appeal.

In the 1990s, as renewed emphasis was placed on producing lean, well-muscled hogs, other pork quality attributes became of greater concern than in earlier decades (see “Pork Quality Audits Document Importance of the PSE Attribute”). PSE-related attributes, associated with the Porcine Stress Syndrome gene (or stress gene), meant that as some hogs became leaner and more heavily muscled, they were also more susceptible to producing pork with the PSE condition.

In Lawrence, Schroeder, and Hayenga’s survey of 11 large U.S. pork packers in 1999, packers reported a need for increased quality control and product consistency in response to greater demand from their pork customers and the ultimate consumer. The survey found that branded programs by packers had been rapidly increasing, accounting for 18 percent of 1999 sales volume, and were expected to represent an even larger share by 2004. According to new product introductions tracked by Marketing Intelligence Service, Ltd. (2003), over 3 times as many branded fresh pork products were introduced in the 8-year period from 1996 to 2003 compared with the previous 8 years. As packers attempt to differentiate their products through branding programs, pork quality standards and consistency become increasingly important.

Meat Safety

A spate of meat safety recalls in the 1990s included Jack-in-the-Box in 1993 for *E. coli* O157:H7 contamination of beef, Hudson Foods in 1997 for *E. coli* O157:H7 in frozen hamburger patties, and Thorn Apple Valley in 1999 for *Listeria* in ready-to-eat deli meat. The recalls heightened media and consumer attention, and raised awareness of the importance of containing microbial hazards (Shane, 1999; Winter, 2002). Product safety problems can have devastating consequences for a company, especially for branded products that place the firm’s reputation at greater risk (Unnevehr and Jensen, 1999). For example, Hudson Foods lost its biggest customer, Burger King, and then was taken over by Tyson Foods. Thorn Apple Valley filed for bankruptcy protection and was later acquired by IBP, which was the Nation’s largest meat packer.³

On the heels of the Jack-in-the-Box recall, new regulatory initiatives in the meat and poultry industries were designed to replace the “poke and sniff” inspection methods for detecting tainted meat. In 1996, USDA’s Food

³ Food safety concerns and concerns over liabilities were apparently important driving forces in the growing retail demand for case-ready meat, which arrives at the store cut and prepackaged (Messenger[b], 2004; Summerour, 2002).

Pork Quality Audits Document Importance of the PSE Attribute

The 1992 Pork Chain Quality Audit, funded by the National Pork Producers Council (NPPC), was the U.S. pork industry's first attempt to gauge the extent of pork quality problems along the supply chain, from consumers to producers. The objective was to provide information to guide industry research programs designed to limit pork quality problems.

Large pork packers were audited to provide the industry with initial benchmarks of the quality status of U.S. pork. Packers, accounting for 68 percent of barrows and gilts slaughtered, completed questionnaires on items affecting pork quality and its value. Results from the packer survey found PSE pork in over 9 million hogs, accounting for 10.2 percent of U.S. commercial slaughter of barrows and gilts.

In 1994, a workshop was held by the NPPC to discuss results from the Pork Chain Quality Audit among representatives from each segment of the pork chain. The most important quality problems were then categorized and listed. Top packer concerns included "reducing fat and PSE," while retailers and food service operators found product inconsistency or lack of uniformity to be major concerns. Important consumer concerns included "inconsistent products, including color."

Subsequent studies, along with several more pork quality and safety summits sponsored by the NPPC, reaffirmed the prevalence and importance of pork muscle quality problems. An updated version of the 1992 Pork Quality Audit (*Benchmarking Value in the Pork Supply Chain*), commissioned by the American Meat Science Association, showed that the incidence of PSE pork had increased to 15.5 percent of slaughter hogs in 2002. Corresponding industry losses amounted to 90 cents/hog (\$90 million) in 2002 compared to 78 cents/hog (\$69 million) in 1992. PSE was also identified as the third leading concern of packers, behind inconsistent weights and thin bellies.

Sources: Morgan, et al.; Miller, 2001; *Pork*, July 2003, p. 17; Kelley, August 2003; and R. Smith, 2003.

Safety and Inspection Service published the final pathogen reduction regulation for the meat and poultry industry (Unnevehr et al., 1998). It set standards for reducing microbial pathogens on meat and poultry products and mandated that meat and poultry plants implement Hazard Analysis and Critical Control Points (HACCP) plans. As part of the HACCP program, companies identify the types of hazards (biological, physical, and chemical) that could affect their products, institute controls to prevent or minimize the hazards, monitor results of these controls, and maintain records of monitoring efforts. In the event that problems are found, the packer is required to take corrective action by locating and eliminating the cause and establishing preventative measures. The government oversees the process and verifies its adequacy. Mandated use of HACCP reflected the growing importance of

preventing and controlling safety problems before products reach the consumer (Unnevehr, 2003).

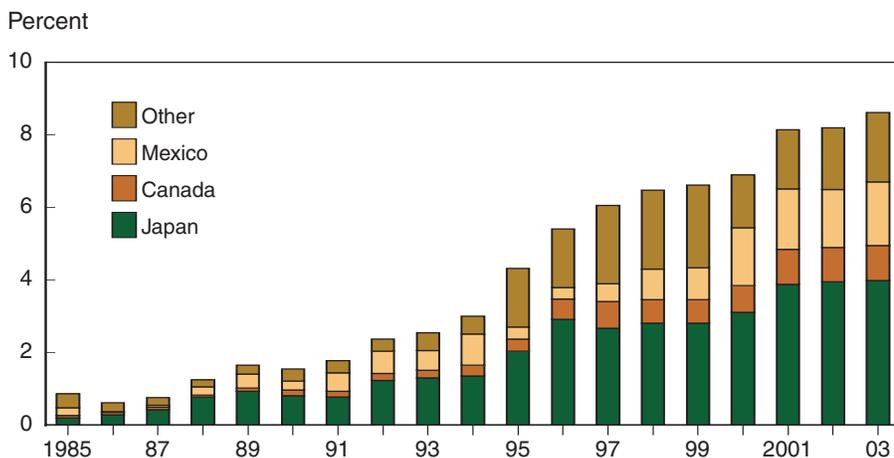
International Markets

The U.S. pork industry experienced unprecedented growth in exports in the 1990s (fig. 2). The North American Free Trade Agreement (NAFTA) in 1994 and the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) in 1995 opened previously protected markets. Technological advances in 1995 allowed U.S. exporters to ship chilled pork products to Japan, which is the largest U.S. export market (fig. 2). In March 1997, Taiwan was forced to close down its pork industry due to an outbreak of foot-and-mouth disease (Pfaff, 1998). At the time, it supplied 41 percent of Japan’s import market with products nearly identical to Japan’s domestic product. This presented opportunities for other exporters to fill the void.

Pork product quality and customized service are major factors affecting global trade of pork products (Cravens, 1997). Hence, as U.S. pork export markets fueled new business opportunities, addressing pork quality problems became increasingly important (see “International Pork Quality Audit Addresses Quality Issues for Exports”). Some countries also have very strict regulations with regard to antimicrobial residues in animal products.

In the 1990s, the U.S. made significant progress toward overtaking Denmark (a major U.S. export competitor) as the leading exporter to Japan, where meat quality issues are especially important (fig. 3). Japanese consumers prefer darker colored meat and more marbling with little variation in lean color (Cravens, 2000). A 1990 survey of Japanese consumers regarding selection of pork products found that health concerns were the primary consideration, including food safety and fat intake (Sapp and Knipe). Other quality characteristics, including taste, freshness, and visible fat, also ranked high.

Figure 2
U.S. pork exports as a percent of total production, 1985-2003



Source: ERS, USDA [a,b].

International Pork Quality Audit Addresses Quality Issues for Exports

The 1994 International Pork Chain Quality Audit, funded by the National Pork Producers Council (NPPC) and the U.S. Meat Export Federation, provided insight into quality issues related to foreign markets. Interviews were conducted with 88 businesses in 16 countries to determine factors that affect demand for pork and how well the United States was conforming. The top three areas identified as needing improvement were:

- Color, firmness, waterholding capacity, and PSE pork.
- Lack of customer service.
- Excessive abscesses/bruises/foreign material in pork.

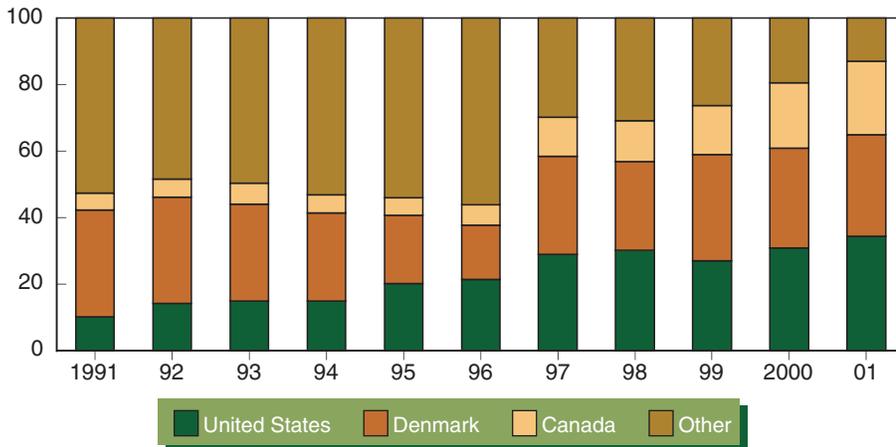
Confidence in product safety was identified as the top reason for favoring U.S. pork. To maintain this perception and increase fresh pork sales abroad, it became more important to extend shelf-life by better controlling microbial growth.

Sources: Cravens, 1997; Smith and Belk, 1998.

Figure 3

Share of Japanese pork imports, 1991-2001

Percent



Source: Miller, February 2003.

Role of Contracts in Reducing Measuring Costs Associated With Carcass Pricing Grids

Growing consumer preferences for lean meat and advances in lean measuring technology likely contributed to changes in measuring costs associated with price determination. In particular, we explore the likely effects of carcass pricing programs on measuring costs, and how this provided an impetus for reliance on marketing contracts.

Measuring Costs Associated With Carcass Pricing Grids

The pork industry experienced significant growth in carcass pricing programs in the 1990s. As reported by the U.S. Department of Agriculture, the percentage of hogs purchased by packers based on carcass evaluation rose from 17 percent of total hog purchases in 1992 to 72 percent in 2001 (USDA/GIPSA, 1998, 2003). As advances in measurement technology (optical probes and computer) enabled more accurate and less expensive measures of meat quality, packers could offer grids with narrower groupings for leanness and carcass weight.

In addition to added packer costs related to recordkeeping and maintaining producer identity, carcass grading programs with more narrow quality groupings likely increase costs of sorting and pricing hogs (McCoy and Sarhan, 1988; Barzel, 1982). Lack of uniformity in the product to be exchanged exacerbates pricing problems (Hallwood, 1990). To purchase hogs without measuring every one, the packer must be convinced that the hogs are uniform in quality and size and will not vary significantly from sample to sample. However, lack of consistency in market hog supplies was a problem. The 1992 Pork Quality Audit of large pork packers found considerable variation in the live weights, and approximately 30 percent of the pigs purchased lacked uniformity (table 1). Lack of uniformity ranked among the top 10 packer quality concerns (Morgan et al., 1994).

The move to carcass pricing programs also likely raised producer costs associated with evaluating alternative packer bids for several reasons. First, packers have different premium and discount schedules, depending on the type of outlet and products sold, and different measuring tools. For example, packers such as Hormel, who process much of their pork, prefer a lighter

Table 1—Consistency and uniformity of live hogs, 1992

Live weight (pounds) ¹		Uniformity of hogs	
Range	Percent of slaughter	Degree	Percent of slaughter
Below 221	8.87	Extremely uniform	17.57
221-240	32.74	Moderately uniform	21.31
241-260	33.12	Adequately uniform	31.27
261-280	17.45	Moderately inconsistent	20.03
Above 280	7.9	Extremely inconsistent	9.90

¹ Average weight = 247 pounds.

Source: Morgan et al., 1994.

carcass. Others, such as Excel, prefer a heavier carcass for boned or boxed products. Marbery (January 24, 2000) writes that restaurants prefer relatively small loins, which come from 215-230 pound hogs compared to the standard 270-pound hog. A packer that exports to Japan prefers leaner pork. Hogs may not only grade differently across packers; the same hog may grade or yield differently at packing plants owned by the same packer.

Instruments used to measure lean also vary across packers (Meisinger, 2000). In 2000, among the Nation's 32 largest plants owned by 13 packers, 7 of these packers used the Fat-O-Meater, which employs light defraction to measure fat and loin depth. Ultrafom and Animal Ultrasound Systems (AUS) ultrasound, which measure fat depth and loin depth by ultrasound rather than light defraction, are used by three companies. Two packers use a low-technology ruler measurement on midline backfat to estimate lean. A more sophisticated measuring device, AutoFom, also uses ultrasound but scans carcasses at 2,000 points and monitors intramuscular fat, pH, which indicates the acidity of the muscle, and color in the cooler. This device is used by Hatfield and became operational in one of Hormel's plants in 2000.

To illustrate resulting grading program disparities, consider hogs from the Newsham and Danbred genetic lines priced on carcass grids of 10 leading U.S. pork packers (Meisinger, undated). The genetic lines differ in lean composition and other quality and performance factors. For Danbred hogs that are sold in Excel's program, carcass value (price X carcass weight) added by feeding to an end weight of 330 pounds compared to 290 pounds equaled \$8.04, compared to -\$3.26 discount applied by Hormel. In the 290-pound category, Danbreds received a \$4.53 premium over the Newsham line in IBP's program, while sales to Indiana Packers Company brought a -\$1.66 discount.

Second, carcass merit matrices may be revised by the packer, which suggests that producers must continually reevaluate alternative packer buying programs. As preferred characteristics of market hogs continue to change, packer carcass matrices also must change (Kelley, 2003). Buying programs have been continually adjusted to increase compensation for leaner hogs. Also, packers have been narrowing their ideal carcass weight ranges to provide more consistent products.⁴

A third factor complicating comparisons is that calculation of the base price also varies by packer, which can lead to important differences in carcass values across packers (Meisinger, undated). The live hog price is used to calculate an equivalent carcass price based on a formula that varies by firm (Kenyon and Purcell, 1999). Some packers use a formula pricing mechanism based on USDA current price reports, while others use an internally derived price.

Marketing Contract Adoption

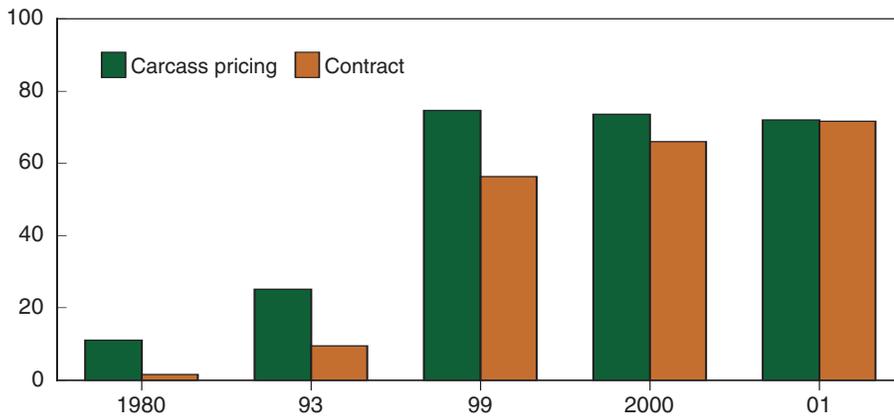
As carcass pricing grids became more important, marketing contracts between packers and producers quickly supplanted much of the spot market trade (fig. 4). The dominant pricing method in these contracts was a formula price adjusted by the packer's carcass pricing grid, with a current live spot market price (e.g., Iowa-Southern Minnesota plant prices) serving as the base price (Lawrence et al., 1997; Hayenga et al., 1996).

⁴ Packer resistance toward making these programs public also complicates producers' ability to evaluate alternative programs. Beginning in April 2001, the U.S. Department of Agriculture implemented the Livestock Mandatory Price Reporting Program to provide all segments of the livestock and meat industries with information on which to base market decisions. USDA now publishes mandatory data on contract arrangements, among other data, while protecting the identity of those reporting and the confidentiality of specific transactions.

Figure 4

U.S. hogs sold under carcass pricing programs and contracts

Percent



Source: USDA/GIPSA, 1998, 2003; Hayenga et al., 1996; Martinez, 2002.

Given changes in the pricing system, two features of marketing contracts could lower packer and producer measuring and sorting costs compared to spot markets. First, long-term agreements may reduce search costs associated with finding suitable trading partners (Hobbs, 1996). The duration of most hog marketing contracts is 4 to 7 years (Hayenga et al., 1996; Kenyon and Purcell, 1999), which can reduce producers’ costs associated with reevaluating packer grids at each sales interval by “stabilizing” the target grid. Similarly, packer costs associated with identifying suitable producers are incurred at long-term intervals.

Second, minimum quantity and quality requirements help to assure packers that hogs are of uniform quality, which allows packers to engage in much less measuring and sorting at the time of exchange. A survey of the largest U.S. pork packers revealed that almost half of the 13 packers involved in formal, written contracts in 1993 had minimum volume requirements, *and* either minimum quality requirements or breeding/genetic stipulations (Hayenga et al., 1996). Feeding programs or approval of facilities were specified by three packers. Large numbers of hogs produced under similar breeding and production conditions would give the packer useful information on the other hogs by measuring a few. Also, because much of the difference in the typical versus ideal hog is related to genetics, stipulations regarding genetics provide further assurances of uniform quality (Kenyon et al., 1995).

According to DiPietre, packing plants that contract for a large number of hogs from uniform supplies have stopped measuring every hog. Quality characteristics are sampled periodically to understand value differences, and producers are paid based on the distribution of quality.⁵

⁵ Packers are expected to offer a higher average price when they are spared some of the costs of measurement (Barzel, 1982). This may explain, in part, premiums paid in some marketing contracts on all hogs sold. Packers justify the premium based on reduced purchasing costs, and reduced hog supply variability that reduces operating costs (Kenyon and Purcell, 1999).

Marketing Contract Design to Reduce Transaction Costs and Control Quality Attributes

Contract advantages related to hog quality and consistency are reflected in two packer surveys.⁶ In their 1994 telephone interviews with 13 large packers, Hayenga et al. (1996) obtained unprompted responses from 10 packers regarding primary contract advantages. The most common reasons for contracting were to improve quality and consistency of supplies, followed by increase volume, and reduce quality risk. Six years later, a survey of 11 of the largest pork packers, representing 77 percent of total hog slaughter, ranked 8 preselected reasons for entering into formal marketing agreements, in order of importance (Lawrence et al., 2001). The top three reasons for using long-term marketing agreements were to obtain a consistent supply of high-quality hogs, to obtain higher quality hogs, and to assure food safety.

Assuming contract advantages over spot markets related to quality, how might contracts be designed to maintain incentives for leanness, while also controlling PSE and safety attributes? Do the properties of observed contracts correspond to predictions from our theoretical framework? To address these questions, we first describe several relevant features of pork quality measures and the pork production process that may affect contract terms. We then examine a small sample of contracts to observe whether they are consistent with the theory.

Measuring Costs and Task Programmability of PSE and Safety Attributes

One factor affecting the choice between outcome-based and behavior-based contracts is the ability of the packer to measure quality attributes. For the PSE condition, packers cannot readily grade hogs based on pH, water loss, and color because they are difficult to measure in high-speed slaughter lines that kill 1,000 hogs per hour (3 seconds per carcass) (Marbery[a], 2000).⁷ In 2000, Forrest, Morgan, and Gerrard noted that predicting color and water holding capacity of pork is one of the most difficult and important challenges facing meat scientists.⁸

PSE pork also presents measurement difficulties because by the time that PSE problems become apparent, the identity of the producer may have been lost (K.E. Smith, 1999). Taking early postmortem measurements of meat quality while the carcass is intact makes it more feasible to link quality to supplier identity. However, PSE-related quality problems do not become apparent until 20-24 hours postmortem.

Responsibility for PSE pork is shared by multiple parties (i.e., team activity), which would further complicate outcome-based measures of producer behavior. The packer may have had a significant influence on quality at the earliest point where measurements can be taken (the warm carcass), based on handling of hogs, design of holding pens and chute, stunning procedures, and post-slaughter chilling (K.E. Smith, 1999; Simmons,

⁶ “Quality” was not defined in either survey.

⁷ PSE indicators include a postmortem pH score (color and water-holding capacity), a Minolta color meter reading, and purge or separated liquid (water holding capacity).

⁸ A 1995 study by the Animal and Plant Health Inspection Service (USDA) found that only 8.8 percent of hog operations, representing 8.4 percent of hogs marketed, received information from slaughter plants regarding the PSE condition.

1998). In addition, some of the most critical handling occurs during transportation of hogs to the packing plant, which is often provided by independent livestock haulers (Miller, 2002; K.E. Smith, 1999; Grandin, 1994).

Food-safety related attributes also present measurement difficulties (Unnevehr and Jensen, 1999, 2001). Testing for pathogen content at different stages is often difficult because rapid tests are not available. Microbiological and chemical residue testing is of limited value because the time required to obtain results does not permit action to be taken while the meat is being processed.⁹

In addition to packers' ability to measure quality attributes, another factor that affects the attractiveness of behavior-oriented contracts is the degree to which desired producer behavior can be specified in advance (i.e., task programmability). While the PSE condition is difficult to measure at the slaughter plant, recent research has improved knowledge about the link between PSE problems and hog production inputs (K.E. Smith, 1999; Marriott and Schilling, 1998; Meisinger, 2001; Goodwin and Christian, 1994). Producers are responsible for 50 percent of PSE problems, mostly through their choice of genetics. As hogs were bred for leanness and muscle development, such breeding led to more stress-prone hogs, which can contribute to PSE muscle.

PSE pork associated with stressed hogs can also be controlled through animal handling and management practices. Producers can reduce hog stress by minimizing the use of electric prods, familiarizing hogs with human activity during finishing, and separating health-stressed from healthy hogs. Finishing facilities can be designed to optimize environmental conditions and minimize resistance during handling and loading, such as the addition of nonslip loading ramps. Feed additives can also reduce the severity and incidence of PSE pork.

With the application of HACCP systems by packers, it may be advantageous for the packer to require producers to assure freedom from a hazard that is controlled by producers, and monitor success (McKean, 2000; Unnevehr and Jensen, 1999, 2001). For chemical residues and physical hazards, it is reasonable to expect that critical control points (i.e., point where a hazard can be prevented, eliminated, or reduced to an acceptable level of risk) be conducted at the production level. Drug residues are clearly the responsibility of the producer. Residues cannot be removed from the carcass, but by properly observing drug withdrawal times, producers ensure that antimicrobial residues in swine tissues are acceptable before the hogs reach the plant.¹⁰ Maintaining animal identification, from drug administration through withdrawal, and education about proper drug use are also important.

On the other hand, addressing biological hazards, such as *Salmonella*, is less clearly defined. Despite ongoing research efforts, there is insufficient information on the feasibility of HACCP-like systems on the farm to provide producers with specific recommendations (Lautner, 1999). Additional research and information is needed to determine the costs of implementing the critical control point at the production stage, and likelihood of success further down the supply chain (McKean, 2000).

⁹ Verification procedures to ensure that hazard controls are working include random sample collection and analysis by companies or Federal inspectors. The Food Safety and Inspection Service operates field laboratories to test for pathogens and drug and chemical residues.

¹⁰ The potential transfer of resistant bacteria to humans has heightened concerns over antibiotics, which are used in animal agriculture to treat or prevent disease or promote growth (Lautner, 1999).

Pork Contract Design to Control PSE and Safety Attributes

Difficult-to-measure, but highly task programmable quality attributes favor the use of behavior-oriented contracts that specify and monitor related production inputs. Such provisions reduce packer costs of measuring these attributes by controlling related producer actions.

To explore recent contracts, the Iowa Attorney General's website lists 19 long-term marketing contracts offered by six leading packers (Farmland, Hormel, IBP, John Morrell, Swift, Excel) over a 6-year span; 1996 to 2001 (see appendix A). Most of the slaughter plants owned by these packers, which accounted for 61 percent of U.S. slaughter capacity in 2002, are located in the Midwest. While the sample is a small set of contracts that are willingly submitted by producers, and may not be fully representative, they provide rather unique observations of actual contracts (Lawrence, 2004). The lack of publicly available packer marketing contracts and dearth of new packer survey information on contracts make the sample especially valuable.¹¹ In addition, the sample is a time series of contracts that provide insight into changing concerns over time during a period of rapid expansion in use of contracts.¹²

The sample contracts range in duration from 34 months to 10 years. Typically, producers are required to deliver a specific number of market hogs at regular intervals. Producer compensation is typically based on the Iowa/Minnesota plant delivered live or carcass price, or Western Cornbelt carcass price, with premiums/discounts based on a carcass pricing grid. Nearly all contracts contain standards for minimum live or carcass weight, and many have minimum quality requirements.¹³

Provisions Related to Production Inputs

Fifteen of the 19 contracts allow us to examine, in some detail, specific contract terms related to monitoring and input specifications (see appendix B).¹⁴ Frequency of contract clauses are summarized in table 2, based on the number of contracts and the number of packers that have these clauses.

All of the contracts contain some type of safety-related provisions. All but one of the packers had provisions that require producers to be certified at Level III PQA or higher, which is a voluntary education program designed to prevent antimicrobial residues and enhance herd health practices.¹⁵ Over half of the contracts, offered by three packers, require producers to be supervised by a licensed veterinarian or comply with any company HACCP programs. These results stand in sharp contrast to the 1993 packer survey that found only 1 of 13 packers with hog health or drug withdrawal program requirements (Hayenga et al., 1996).

Five contracts have specific clauses with minimum PSE standards. Swift's 1998 contract requires each load of hogs to "have a PSE incidence of no greater than the greater of (a) plant average or (b) industry average as determined by the University of Wisconsin Research Department." Swift's 2000 and 2001 contracts specify that the pH for each load of hogs must exceed

¹¹ To our knowledge, the lone packer survey regarding specific non-price terms of long-term hog marketing contracts was conducted by Hayenga et al. (1996) in 1993. Ten years later the United States Department of Agriculture implemented a swine contract library (<http://scl.gipsa.usda.gov/>) of contracts types that are available to producers. The library lists various price and non-price terms, and provides information on most recent contract terms. The contracts themselves cannot be displayed due to confidentiality restrictions.

¹² Contracts reflect the concerns of parties as filtered through their lawyers and conditioned by their beliefs regarding behavior of the opposite party in adjusting to unspecified contingencies (Goldberg and Erickson, 1987).

¹³ Most also have some element of price risk management, such as a price-risk sharing "window" arrangement or minimum price guarantee. In 2001, marketing contracts that contain some type of price risk-management provision accounted for 28.5 percent of all U.S. hogs sold (Kelley, April 2001), compared to 11.3 percent in 1997. The increase in these types of marketing contracts may reflect historic lows in spot hog prices in 1998.

¹⁴ Three of Hormel's contracts (1996-b, 1997-a, and 1997-b) and one of John Morrell's contracts (ND-a) are excluded from further analysis because clauses related to production inputs and monitoring are similar to Hormel's 1996-a contract and John Morrell's 1997-b contract. Minor differences exist in other clauses (see appendix table A).

¹⁵ First introduced in 1989, the Pork Quality Assurance™ (PQA) certification program was revised in 1997, in correspondence to packer HACCP plans, to more clearly define producers' responsibilities (Lautner, 1999). Currently, PQA Level III is the highest level of the PQA program, and can only be completed after discussions with a third-party verifier (veterinarians, agricultural education instructors, USDA extension personnel). In 1998, Farmland, Hormel, Swift, IBP, John Morrell, and others announced they would only purchase hogs from PQA Level III producers because of mandatory implementation of packer HACCP programs (Lautner, 1999).

Table 2—Frequency of contract clauses related to production inputs

Clause	Number of packers with clause (n=6)	Number of contracts with clause (n=15)
Level III PQA or higher	5	13
Packer can observe production operations	5	10
Company-approved or company-specific feeding program	5	9
Company-approved genetics or feeder pig source	4	6
Handling of hogs	3	5
Veterinary supervision	3	8
Producer review of payment records	3	7
Producer can observe packing plant	3	6
Minimum requirements for PSE-related attributes	3	5
Specific genetics or feeder pig source	3	4
Company HACCP program compliance	3	5
Company-approved facilities	2	5
Packer audits of production management records	2	3
Company-approved management programs	1	1

Note: n = sample size.

the plant average. In addition, Swift may establish, from time to time, a “standard” pH level in the carcass-merit matrix that the producer must meet, upon 30 days’ notice. The marketing contract used in Excel’s Pig.Net Alliance program contains the most detailed requirements regarding PSE-related measures, including minimum average pH and minimum Minolta reading requirements.¹⁶

While provisions related to PSE attributes reveal packer concerns, they are not likely to involve regular measurements with consistent feedback to producers. In Swift’s 1998 contract, there is no indication of how PSE would be measured or procedures for verifying compliance. In the 2000 and 2001 contracts, Swift “may, in its discretion, determine pH by testing carcasses on a random basis or by testing each individual carcass.” According to Meisinger (2000), aside from lean composition and trim losses, there were no other pork quality data provided by any packer back to the producer on a consistent basis.¹⁷

Nearly all 15 contracts contain terms related to inputs that affect the PSE condition.¹⁸ Ten contracts had clauses requiring company approval, joint agreement, or a specific type of genetics or source of feeder pigs. Five contracts require producers to handle hogs in a humane manner or in a way that optimizes meat quality. Nine contracts require producers to use company-approved or company-specific feeding programs, and five contracts require company-approved facilities.

Many contract terms governing the use of production inputs are accompanied by monitoring mechanisms. Two-thirds of the contracts give the packer the right to inspect the producer’s hogs and facilities, which is essentially monitoring inputs. Because the link between inputs and output quality is well established (i.e., high task programmability), it is easier to measure inputs when measuring output quality is costly. Monitoring increases the

¹⁶ As part of the Pig.Net Alliance, finishers in the United States raise Canadian weanling pigs, bred using Thames Bend Genetics, that are then sold to Excel.

¹⁷ Minimum PSE standards may serve as a communication device to express PSE concerns to the producer, and perhaps signal packers’ efforts to improve quality to their customers.

¹⁸ Because packers do not typically own the hogs, the provisions related to production inputs are likely related to hog quality outcomes rather than efficiency gains that lower production costs. Furthermore, one may argue that input provisions have less to do with the leanness attribute because of strong explicit incentives for lean in the carcass pricing program (K.E. Smith, 1999).

probability of detecting under-performance and, coupled with penalties for noncompliance, provides a solution to the moral hazard problem.¹⁹

Clauses related to *producer* monitoring of packers are also contained in several contracts. Six contracts offered by three of the packers have clauses that permit producers to visit the packing plant to observe processing and handling of hogs. Seven contracts allow the producer to review packer receipt and payment records. These monitoring clauses may serve as safeguards associated with carcass evaluation “hazards.” Producers cannot withdraw hogs if they are unhappy with the price and may distrust the carcass pricing program because of possible packer bias and grading inaccuracy. Confidentiality of carcass pricing programs and lack of uniformity across packers may also invite skepticism on the part of producers (AP press release, 1999).

Are Strong Incentives for Leanness Optimal?

Are strong incentives for leanness provided by carcass pricing grids optimal? As discussed earlier, increasingly leaner, heavily muscled hogs were often carriers of the stress gene, which was linked to PSE pork. Strong incentives for leanness are expected when the packer can use marketing contracts to specify and monitor producer behavior related to other important, but difficult to measure attributes. Given the highly task programmable nature of PSE pork, this is clearly the case.²⁰

Strong incentives for leaner hogs are also optimal when marginal benefits to the packer are relatively large compared to marginal benefits from reductions in PSE pork (Holmstrom and Milgrom, 1991, p. 32, equation 7). Marginal benefits from producer efforts to control PSE attributes may have been limited by industrywide efforts to breed out the stress syndrome from commercial herds (Casau, 2003; Marbery[a], 2000).

As marginal benefits from increasing leanness become relatively smaller compared to controlling PSE attributes, weaker incentives, or perhaps disincentives, for leaner hogs are expected (Holmstrom and Milgrom, 1991, p. 32, equation 7). There is a positive relationship between increasingly lean hogs and PSE pork (which is disliked by packers/processors, distributors, and consumers). In addition, some researchers believe that fresh pork may have become too lean for consumers (Marbery[b], 2000). Excessive leanness, resulting in thin bellies and insufficient marbling, was one weakness identified in a 2002 pork quality audit of U.S. packers accounting for 64 percent of hogs slaughtered (Messenger[b], 2004).²¹ Disincentives for lean hogs are reflected in a carcass merit matrix recently submitted by a packer to USDA’s swine contract library (“Carcass Weight Lean Percent Schedule J”) (see appendix C). The matrix demonstrates a slight cutoff in lean premiums for hogs exceeding 58.9 lean percent in the industry’s most common weight range, 232 to 292 pounds.

Uncertainty and Contract Design

Many contract clauses related to production inputs tend to be less fully specified. Rather than defining input requirements in detail, many clauses require

¹⁹ The long-term duration of marketing contracts also facilitate the ability of the packer to learn about and assess producer behavior (Eisenhardt, 1989).

²⁰ According to K.E. Smith, controlling production inputs that affect meat quality is more important for leaner hogs because lean hog carcasses have a larger proportion of valuable cuts (e.g., loins and hams). If so, hogs sold through marketing contracts are expected to be leaner than those sold in spot markets. Evidence from USDA’s Livestock Mandatory Price Reporting Program suggests that in January of 2002, 2003, and 2004, hogs sold through marketing contracts were leaner than those sold on the spot market (Grimes and Meyer; Grimes, Plain, and Meyer, 2003, 2004).

²¹ The study found that bacon from thin bellies, while visually appealing to consumers because of less fat, is less palatable (Messenger[a], 2004). It also causes processing problems related to yield losses from slicing and cook shrink. As bacon-topped sandwiches became more popular at restaurants, the belly became an increasingly valuable part of the hog.

packer approval of feeding programs, facilities, or genetics. In Excel’s contract, for example, provisions regarding diet, management, facilities, and handling of hogs specify that these inputs be company approved, meet industry standards, or minimize carcass damage. Other “relational” clauses describe packer expectations or plans for working together (table 3).²²

The less detailed nature of these terms may reflect uncertainty in pork markets that make it difficult for companies to accurately predict future input requirements. In addition to the growth in domestic branding programs, quality standards are dictated by preferences of the importing country in expanding international markets. More accurate measures of pork quality can also lead to corresponding adjustments in input requirements and pricing programs. Recent examples include IBP’s (now Tyson Fresh Meat) adoption of the ultrasound system for measuring lean, and Hormel’s Autofom carcass testing system, which also monitors PSE-related indicators. Adapting to changing input requirements may be facilitated by recognizing potential areas of conflict in advance, and defining expectations or a plan for collaboration.

Uncertainty related to output and input requirements is reflected in several contract “adjustment mechanisms.” Almost all contracts specify that the packer can change the carcass pricing grid, some requiring advance notice to the producer. In the 2000 contract, John Morrell reserves the right to change or add requirements, upon reasonable notice, consistent with evolving industry standards for quality. Two of Swift’s contracts (2000, 2001), require producers to modify nutrition plans if requested (citing the use of non-genetically modified feed as an example). In addition, if requested by the company, producers must implement programs that

²² Nearly all of the contracts contain an arbitration clause or a clause that requires parties to use reasonable or best efforts to resolve disputes (appendix A). These clauses likely reflect the inefficiency of litigation in resolving contract disputes, particularly when contracts are less detailed. Courts have difficulties in inferring the intentions of contracting parties, so legalistic enforcement may be less efficient than private resolution, perhaps by arbitrators with specialized knowledge of the industry (Ryall and Sampson, 2003; Williamson, 1983).

Table 3—Examples of “relational” contract terms*

Contract	Provision
Hormel 1996-a	Producer “must have in place a genetic program capable of producing lean, uniform sorted hogs that consistently meet Hormel Foods requirements.”
Hormel 1997-c	“Both parties will work together to assure the genetics are meeting both the production and carcass meat quality requirements.”
IBP 1997-a	“Producer agrees to use for Market Hog production a nutritional program that will produce carcasses that exceed the average carcass characteristics, as defined by the carcass evaluation program at the time of delivery of all carcasses delivered to IBP by all producers IBP buys from”
IBP 1997-b	“Producer will use genetics to produce Market Hogs that on average will have a meet quality (which includes firmness water holding capacity, marbling and color determined by a Minolta reading 49.4 or less) that equals or exceeds the meat quality of all other hogs delivered to IBP for slaughter.”
John Morrell ND-b	“Producer will consult with John Morrell & Co. in determining which type of genetics will be used in the production of hogs delivered to them.”

*Other examples can be found in USDA’s Swine Contract Library at <http://scl.gipsa.usda.gov/>

improve quality or the company's ability to sell products, citing ISO 9000 and a farm hazard analytical control point program as examples.²³

A Note on Variation in Sample Contract Provisions

Although there are many similarities in input requirements and monitoring clauses across the sample, there are also significant differences, even between contracts offered by the same packer. This may reflect differences in the type of outlet targeted. For example, leanness, consistent color, and water holding capacity are more important for pork destined for grocery store shelves and international markets compared to further processing and food service outlets (Huskey, 2000).

Differences in contract terms may also reflect changes in information and packer goals over time. Ten of the contracts offered by Hormel, Swift, and John Morrell allow us to observe contract terms over time. Splitting the sample into two time periods, 1996-98 and 1999-2001, provides five contracts for each period.

Contract clause frequency related to monitoring and production inputs for the two periods is summarized in table 4. Clauses related to handling of hogs were introduced for the first time in the latter period. This may reflect growing knowledge about the causes of PSE-related attributes, and greater concerns over PSE pork in response to increasingly leaner and stress-prone hogs. While progress has apparently been made in breeding out the stress gene in the hog population, the 2002 pork quality audit revealed an increase in the incidence of PSE pork compared to 1992 (Kelley, August 2003). This suggests handling problems may be an important contributor to PSE-related problems.^{24, 25} All three packers also added clauses that require producers to

Table 4—Contract clause frequency for contracts offered by Swift, John Morrell, and Hormel, 1996-98 and 1999-2001 periods*

Clause	Number of contracts	
	1996-98 (n=5)	1999-2001 (n=5)
Level III PQA or higher	4 (3)	5 (3)
Veterinary supervision	3 (2)	3 (2)
Producer review of payment records	3 (2)	3 (2)
Packer can observe production operations	2 (2)	5 (3)
Company-approved or company-specific feeding program	2 (2)	5 (3)
Company-approved genetics or feeder pig source	2 (2)	2 (1)
Producer can observe packing plants	2 (2)	3 (2)
Company-approved facilities	2 (2)	3 (2)
Minimum requirements for PSE-related attributes	1	2 (1)
Handling of hogs	0	4 (2)
Specific genetics or feeder pig source	0	2 (1)
HACCP program compliance	0	5 (3)
Packer audits of production management records	0	0
Company-approved management programs	0	0

*n = contract sample size. Number of packers using the clause is contained in parentheses.

²³ "ISO 9000 Standards" refers to quality standards first published in 1987 by the International Organization for Standardization to facilitate international commerce by providing a single set of standards recognized worldwide.

²⁴ Recent concerns over handling issues are reflected in the establishment of a Trucker Quality Assurance (TQA) program by the National Pork Board in 2001. TQA is a certification program that educates truckers about proper handling, loading, and transporting of pigs, with emphasis on animal welfare and biosecurity topics (Miller, July 2002). Three contract clauses listed in USDA's swine contract library in May 2004 specified that producers must require truckers to obtain this certification.

²⁵ Recent research also suggests that there may be other genetic causes of PSE pork, besides the stress gene (Casau; *Pork*). Hence, certain genotypes may be more prone to stress than previously thought, which increases the importance of proper hog handling.

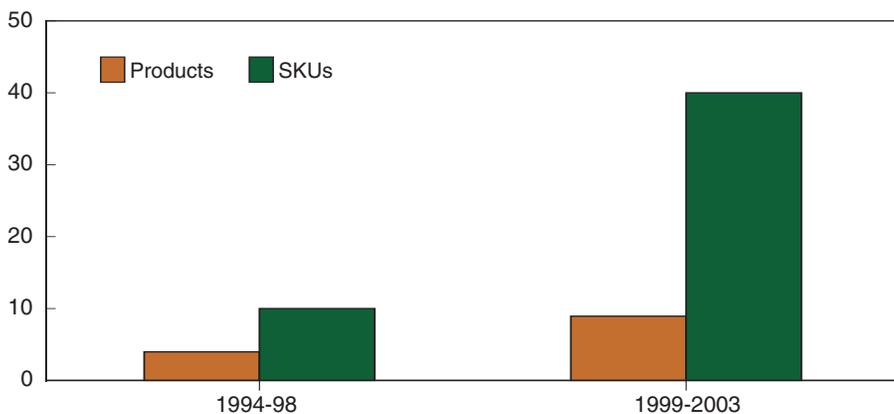
comply with any company HACCP program, perhaps in anticipation of a farm-level HACCP program.

Changes in contract terms over time coincide with attempts by these packers to expand their offerings of branded pork products. Using two 5-year time periods, corresponding to the break in our contract analysis, we compare the number of new fresh pork products introduced by Hormel, John Morrell, and Swift. From 1999 to 2003, the number of new products tracked by Marketing Intelligence Service, Ltd. increased markedly compared to the earlier period (fig. 5).

Figure 5

New branded fresh pork product and associated SKUs* introduced by Swift, John Morrell, and Hormel, 1994-98 and 1999-2003

Number



*Stock Keeping Unit (SKU) is the lowest level that activity can be tracked on an item. For example, each unique size and form combination will be assigned a different SKU number.

Source: Productscan Online, Marketing Intelligence Service, Ltd.

Organization of Packer Branding Programs That Use Specific Genetics

Because many packers do not believe that carcass pricing programs can deliver further improvements in the hog quality and consistency, several packers have purchased or made arrangements with genetics companies (Kenyon and Purcell, 1999). If producers rely on a particular type of genetics (a specific asset) for a packer's branding program, their hogs may have significantly less value to other packers. In this case, the difference between the value of hogs to the packer versus the next-best offer by another packer is subject to appropriation by the packer. One way that the packer may hold up the producer is to lower the initial price offer for the specially produced hogs. As long as the price offer exceeds that of the next-best offer, the producer has few options but to continue selling hogs to the packer.

Similarly, the packer's brand can be considered an intangible asset. Packers may be subject to considerable losses in brand value if a producer withholds the specialized genetics to obtain price concessions. As the value of a packer's branding program and associated holdup hazards increase, packers would be expected to seek added safeguards through complex contracts or vertical integration.

Packer Branding Programs Using Specific Genetics

Several leading packers source genetics for their branded fresh pork programs from a specific breed or breeding company (see appendix D). Smithfield's NPD genetics provides exceptionally lean pork tailored to its Lean Generation brand. Hatfield's branded pork products, tailored to the Japanese market, are produced from Babcock genetics. While the degree to which Farmland and PSF brands are "customized" is not clear, the proprietary nature of the genetics suggests some level of customization.²⁶

These cases provide general support for the relationship between asset specificity (genetics and brand name capital) and safeguards offered through complex contracts and vertical integration. Hogs for Farmland's "America's Best Pork" program are sourced from contracts that contain many safeguard provisions, including those to protect the proprietary nature of the genetics and provide producers with an assured outlet (table 5). Hogs slaughtered in PSF's Missouri plant are sourced from its vertically integrated operations. Hog procurement for Smithfield's Lean Generation pork was initially governed by a joint venture between Smithfield and a large hog producer.²⁷ As the program became more successful, and potential losses from hold up increased, Smithfield purchased the hog producer and restructured genetic development as a subsidiary within the company.²⁸

A Note on "Hybrid" Arrangements

The above cases also demonstrate the myriad of organizational arrangements that exist beyond complex marketing contracts and vertical integration, including joint ventures, production contracts, franchise agreements, and combinations thereof. In addition to long-term purchase agreements, the

²⁶ In 2003, Farmland underwent bankruptcy and sold its pork processing operations to Smithfield Foods.

²⁷ A joint venture is a type of collaboration between parties to share information or resources. Parties create and jointly own a new independent organization.

²⁸ The number of NPD hogs processed by Smithfield increased from 12,700 in 1993 to 4.4 million in 2001 (Smithfield Foods, 1994, 2001).

Table 5—Select safeguard clauses governing the America’s Best Pork brand

Genetic supply agreement:

Monitoring:

- Review of all producer books, business records, and herds permitted.
- Producer must use specific record-keeping procedures
- Producer must report the number of hogs that received Triumph Genetics on a quarterly basis

Penalties—Producer must pay a termination fee for breach

Exclusive dealing—Producers must sell all hogs containing Triumph Genetics to Farmland

Termination clause—Producer must destroy hogs containing Triumph Genetics upon termination

Confidentiality clause—Producers must use “commercially reasonable” efforts to avoid disclosure of confidential information, including after contract termination

“Covenant not-to-compete” clause—For 20 years after current agreement term, producer must refrain from selling hogs for breeding purposes with respect to PIC Genetics that is transferred or licensed to Triumph*

Dispute resolution—Center for Public Resources Mini-Trail for Business Disputes or binding arbitration using members of the American Arbitration Association (AAA)

Market Hog Purchase Agreement:

Purchase requirements—Farmland must purchase all hogs produced under the program.

Termination clause—Specifies advanced notice to Farmland if producer fails to accept changes to pricing program, and a period (90 days) after receiving written notice before Farmland can terminate the agreement.

Monitoring—Farmland permitted to monitor producers’ hogs to ensure all qualifying market hogs are sold to Farmland.

Penalty—Right to terminate for producer noncompliance.

Dispute resolution—arbitration in accordance with Commercial Arbitration Rules of the AAA.

*Triumph Genetics was sourced from the Pig Improvement Company (PIC), the leading provider of swine genetics in the United States.

Source: Iowa Attorney General, 2002.

Smithfield joint venture included production contracts with independent producers and a franchise agreement with a British genetics company. Hogs for most of Hatfield’s Japanese products are supplied through a joint venture with a leading hog producer.

To address the function of diverse organizaional arrangements, Williamson (1991) categorizes organizational forms into three broad categories: spot markets, “hybrids,” and vertical integration. In hybrids arrangements, parties maintain autonomy, but some degree of bilateral dependency exists. Each category is distinguished based on incentive intensity, administrative control, and their ability to adapt to changing circumstances. Incentive intensity refers to the linking of actions and the consequences of those actions. Administrative control refers to coordination through control mechanisms, such as monitoring and career rewards and penalties, as opposed to the laws of supply and demand. Two types of adaptations are further

distinguished: independent responses to changes in product supply and demand, as reflected by prices, and coordinated adaptations between two parties in response to unanticipated disturbances.

Spot markets and vertical integration are polar opposites with respect to each feature (table 6). Markets are most efficient at adapting to price changes. Autonomous parties maintain strong incentives to increase net receipts by reducing costs and adapting efficiently. When parties enter a bilateral relationship and coordinated responses to uncertainty are required, vertical integration has adaptation advantages over markets. At the expense of reduced incentive intensity, vertical integration facilitates cooperation and increases bureaucratic costs as administrative controls are added.

All other organizational arrangements are viewed as hybrid arrangements that lie between spot markets and vertical integration with regard to each of the attributes. Parties maintain distinct ownership of assets, which provides advantages over vertical integration with respect to incentives provided and adaptations to changing prices. For coordinated responses between specific parties, contractual safeguards and administrative devices (dispute settlement procedures, information disclosure) outperform spot markets in facilitating adaptations to uncertainty. However, with added protections, incentive intensity is reduced.

Given the distinguishing features of each generic organizational form, their use can be matched to characteristics of the transaction in a discriminating way. For transactions characterized by high levels of asset specificity, disturbances that require cooperative adaptations between specific parties become more numerous and consequential. Incentives provided through spot markets will be quelled because responses require mutual consent, but parties will disagree and engage in opportunistic behavior. Instead, vertical integration replaces markets, as bureaucratic costs are incurred to increase aggregate gains from adaptation.

Over intermediate levels of asset specificity, however, hybrids may have advantages over spot markets and vertical integration. Hybrid arrangements may outperform markets in adapting to disturbances that require coordinated responses. At the same time, they may provide greater incentive intensity compared to vertical integration. As asset specificity increases, within a specific range, hybrids that offer greater control are expected, *ceteris paribus*. For example, production contracts used by Smithfield fall closer to vertical integration, compared to marketing contracts.²⁹

Table 6—Relationships between organizational arrangements, and performance and control devices

Attribute	Organizational form		
	Spot market	Hybrid	Vertical integration
Autonomous adaptations	++	+	0
Coordinated adaptations	0	+	++
Incentive intensity	++	+	0
Administrative control	0	+	++

++ = Strong, + = Semi-strong, 0 = Weak.

Source: Williamson, 1991.

²⁹ Masten concludes that given the diversity of hybrid forms that exist, factors that lead to their adoption and design are also diverse and, therefore, should be analyzed on a case-by-case basis. If so, this would suggest a more prominent role for case study methodology in the analysis of hybrid arrangements. Furthermore, in a review of several published studies of hybrid arrangements in various industries, Masten finds measurement costs to be more pertinent to the design of hybrids compared to relationship-specific investments. This suggests that measurement costs should also be considered in the analysis of hybrid arrangements.

Conclusions

While there may be other factors driving rapid increases in the use of pork marketing contracts, we conclude that their use is an efficient response to changing emphasis on pork quality. Renewed emphasis on leanness moved to the forefront in the 1990s as improved measures of lean and carcass pricing programs provided strong incentives for leaner hogs. At the same time, pork attributes related to the pale, soft, exudative condition (PSE), such as color, tenderness, and juiciness, became of increasing concern. Greater quality concerns expanded to include meat safety following a series of meat recalls over the decade and regulatory programs designed to limit food borne hazards. Proliferation of branding programs and exports, particularly competition for Japanese consumers, also raised awareness of pork quality issues.

From the 1990s on, as packers placed greater emphasis on further increases in leanness, grading programs based on measures of the carcass rather than the live animal became more common. At the same time, the growing prevalence of marketing contracts could reduce measuring costs associated with the revised grading programs. The long-term nature of these contracts reduces the costs of pricing by limiting the number of times that producers must evaluate alternative grading programs, which vary across packers. Minimum volume requirements allow packers to obtain a large number of more uniform hogs produced under similar conditions, so that measuring a few provides more reliable information about quality of the rest.

Evidence from contract terms suggest that contracts placed increased emphasis on quality issues as they evolved over the 1990s. Effective design of marketing contracts allows packers to maintain strong incentives for lean hogs, while reducing transaction costs and controlling for other quality attributes that are more difficult to measure. This can be accomplished by production input requirements and monitoring provisions. In addition, specifying contract terms in less detail can reduce transaction costs associated with adapting to changing demand and input requirements. Contract terms may communicate packer expectations and plans for collaboration, rather than detailing specific input requirements and expected outputs, which facilitate timely responses to changing quality standards.

To the extent that carcass pricing programs fail to meet the quality needs of the packer, packers may attempt to expand their branding programs by investing in hogs from a specific genetic source. Investments in specific genetics and brand-name capital leave the packer and producer more dependent on each other and more vulnerable to opportunism. Consequently, we would expect these investments to be accompanied by complex marketing contracts, as safeguards are added, or vertical integration, which essentially removes the second party. In addition, a host of other organizational arrangements may have advantages over spot markets and vertical integration by blending elements of both. As investments in genetics and brand name become more specialized, however, organizational arrangements are expected to approach vertical integration in degree of control offered.

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Appendix A—Inventory of Long-Term Contracts: General Contract Provisions¹

Contract ¹	Minimum quality requirements	Volume Requirements	Contract duration	Producer compensation	Penalties	Revisions to carcass pricing program	Dispute resolution procedures
Farmland Market Hog Purchase Agreement 1998	Carcass weight 170 lbs (skinned) or 151 lbs (scalded). 51 % lean.	Quarterly delivery schedule.	34 months	Based on USDA Western Combelt carcass price with adjustments based on carcass merit program	Producer pays \$2 per hog for undelivered hogs. Parties may seek remedies for breaches.	Not specified. Quality adjustments based on carcass merit program in effect at time of delivery.	Arbitration in accordance with the Commercial Arbitration Rules of the American Arbitration Association (AAA).
Hormel Long-Term Hog Procurement Agreement 1996-a	Hog weight 225 lbs.	All hogs from several expansion project facilities with sow capacity specified for each of the facilities.	10 years	Average of previous week's plant delivered spot prices (adjusted by a calculated guaranteed minimum price) with premiums and discounts based on company Grade and Yield program	In the event of producer breach, Company can offset losses against any compensation owed to producer until company has been fully compensated. Company may terminate agreement for default.	Subject to change on 30 days written notice.	None specified.
Hormel Long-Term Hog Procurement Agreement II 1996-b	Same as 1996-a contract.	Weekly delivery schedule, subject to revision based on mutual consent and confirmed in writing.	7 years	Same as 1996-a contract.	Same as 1996-a contract.	Same as 1996-a contract.	None specified.
Hormel Long-Term Hog Procurement Agreement 1997-a	Hog weight 210 lbs.	Same as 1996-b contract.	5-10 years	Same as 1996-a contract.	Same as 1996-a contract, except for termination clause.	Subject to change	None specified.
Hormel Long-Term Hog Procurement Agreement I 1997-b	Same as 1996-a contract.	Same as 1996-b contract.	7 years	Same as 1996-a contract.	Same as 1996-a contract.	Same as 1996-a contract.	None specified.
Hormel Long-Term Hog Procurement Agreement 1997-c	Same as 1997-a contract.	A specified annual number of hogs per sow from 3 expansion phases with a minimum number of sows specified per facility. Weekly hog delivery schedule.	10 years	Same as 1996-a contract.	Material breach by either party allows non-defaulting party to seek all remedies. Defaulting party has 90 days to cure, provided that non-defaulting party may seek relief to prevent recurrence of breaches.	Subject to change	Arbitration in accordance with Minnesota law and the AAA.

Hormel Long-Term Hog Procurement Agreement III 1999	Same as 1996-a contract. Also, free from foreign objects (e.g., needles)	All hogs produced from a producer's sow farrowing operation or production operation, a specified number per month, or other means to be specified.	5 years	Contract price adjusted by company Carcass Buying Program, where contract price is calculated as a direct relationship to feed prices and average of previous week's plant delivered spot prices, with a guaranteed minimum price.	In the event of default, non-defaulting party may terminate agreement, in addition to all other remedies. Hormel may adjust contract price in the event of producer default as long as default continues.	Subject to change at Hormel's discretion	Mediation pursuant to the Minnesota Civil Mediation Act
Hormel Long-Term Hog Procurement Agreement IV 2000	Same as 1999 contract.	All hogs produced from a producer's sow farrowing operation or production operation, or a specified number per month.	Unknown	Same as 1999 contract.	In the event of default, non-defaulting party may terminate agreement and pursue all remedies available.	Same as 1999 contract.	Same as 1999 contract.
IBP Hog Procurement Agreement 1997-a	Carcass merit program evaluation that exceeds average of all producers that IBP buys from. Must meet existing weight specifications. Free from defects (e.g., abscesses, wounds).	Annual number (range) of hogs to be delivered each year. At the beginning of each quarter, producer provides estimated weekly delivery schedule (evenly distributed).	6 years	Window contract with ledger based on the calculated market price. The market price is the base price (average of the USDA Western Cornbelt Lean Value carcass), adjusted by the company's grade premiums and discounts and weight discounts.	In addition to all other rights and remedies under law, IBP or producer may terminate agreement upon default by the other party.	Grade premiums and discounts may change.	IBP and producer will use reasonable efforts to settle disputes.
IBP Hog Procurement Agreement 1997-b	Carcass merit program evaluation and meat quality (e.g., water holding capacity) that meets or exceeds average of all hogs delivered to IBP. Must meet existing weight specifications and a Minolta reading of 49.4 or less (color). Free from defects.	Annual number of hogs to be delivered each year. On November 1, producer provides estimated quarterly or monthly delivery schedule for the year (evenly distributed).	6 years	Same as 1997-a contract.	Same as 1997-a contract.	May be changed on a quarterly basis.	Same as 1997-a contract.

John Morrell Hog Procurement Agreement 1997-a	Hog average per load weight range of 230-270 lbs, 73% average carcass yield, and 48% average lean yield.	Must deliver at least 80% of weekly projected total production (annual production divided by delivery weeks) per week and 90% of annual projected total production per year.	3 years	Window contract with ledger maintained based on market price. Market price is an Iowa/Southern Minnesota plant delivered live hog price as reported by USDA. Payments adjusted based on the company's Grade & Yield program.	In addition to all other rights and remedies under law, Morrell or producer may terminate agreement upon default by the other party.	May be modified as deemed necessary.	Any controversy or claim shall be settled by arbitration based on rules of the AAA.
JohnM orrell Minimum Value Protection Program Participation Agreement 1997-b	None specified.	Must deliver total estimated annual production (minimum 1,500 hogs per year).	3 years	Window contract with ledger maintained, where the market price is the Iowa/Minnesota plant average price. Adjusted by the company's carcass merit program.	Morrell may terminate if producer defaults.	Same as 1997-a contract.	None specified.
JohnM orrell Hog Procurement Agreement 2000	Hog average per load weight range of 230-260 lbs, 74% average carcass yield, and 49% average lean yield.	Must deliver at least 85% of annual projected total production during the year.	3 years, with optional 1 year extensions over 6 years.	Iowa/Minnesota weighted average market price reported by USDA, with premiums and discounts based on percent lean, carcass weight, and yield percentage.	Same as contract 1997-a.	Same as 1997-a contract.	Same as 1997-a contract.
Morrell Ledger Contract Program ND-a	None specified.	Must deliver total estimated annual production (minimum 1,500 hogs per year) evenly distributed throughout the year.	Unknown.	Same as 1997-b contract.	Morrell may terminate if producer fails to deliver 100% of market hogs or fails to perform any material obligation.	Same as 1997-a contract.	None specified.
JohnM orrell Window Pricing Agreement ND-b	Carcass weight range of 176-220 lbs. Backfat level less than 1 inch or at least 51% lean on average.	Specified number per year, with producer option to increase.	Unknown.	Window contract, where the market price is the Iowa/Southern Minnesota plant average price. Adjusted by the company's carcass merit program.	None specified.	After introduction of a new weight and grade program, producer has a 60 day period to end agreement, but must allow 60 days for Morrell to adjust the program or show that the program is not penalizing the hogs.	Any controversy or dispute shall be settled by binding arbitration based on rules of the AAA, with enforcement by the courts of Minnesota.

Swift & Co. Hog Purchase Contract 1998	Hog weight between 240 and 270 lbs. Barrows 50% lean, gilts 52% lean. Average dressing yield per load exceeds 73.5%. PSE per load no greater than the greater of the plant or industry average. Within USDA limit on all residues.	7,000-11,000 per year, delivered on an even weekly basis, plus or minus 10%. Producer must follow procedures for advising Swift of quantities to be delivered.	7 years	Window contract with ledger maintained, where the market price is an Iowa/ Southern Minnesota plant delivered live hog price as reported by USDA. Carcass merit adjustment depending on percent lean, size, and yield.	In addition to all other rights and remedies under law, Swift or producer may terminate agreement upon default by the other party.	May be changed to reflect changes in Swift's carcass program.	Seller and buyer will use their best efforts to settle disputes, claims, questions, and disagreements, or any contract breach.
Swift & Co. Hog Purchase Contract 2000	Meet or exceed plant average pH (or a pH standard if established). Average live weight 240 lbs to 270 lbs per load and live weight per hog 220 to 290 lbs. Lean percent no less than the greatest of 54% lean or the plant average. Average dressing yield of 75% per load.	Specified quantity per fiscal year, delivered on an equal weekly basis with advanced notice of delivery.	Unknown	Fixed price contract tied to soybean meal and corn prices, adjusted by the carcass merit adjustment.	Same as 1998 contract. In addition to all other remedies, Swift may accept or reject non-conforming hogs.	Swift will give producer 30 days written notice prior to change.	Same as 1998 contract.
Swift & Co. Hog Purchase Contract 2001	Same as 2000 contract, except lean percent no less than the greater of 53% lean or the plant average.	Same as 2000 contract.	Unknown	Window contract, where market price is the Iowa/Southern Minnesota weighted average plant delivered carcass price as reported by USDA. Price adjusted based on the carcass merit buying matrix.	Same as 2000 contract.	Same as 2000 contract.	Same as 1998 contract.

Excel Pig, Net Hog Purchase and Supply Agreement 2000	Average pH reading of 6.1 per lot. Minolta reading of 49.4. Average lean percentage of 50%.	Upon advanced notice to Excel, if producer enters into forward contract with Excel to deliver market hogs 23 to 26 weeks thereafter, minimum of 20,000 lbs of market hogs must be sold per forward contract transaction in increments of 1,000 lbs.	Unknown.	Finisher receives a contract price (based on proprietary formula), subject to a minimum and maximum target price, adjusted by the company's carcass merit program (carcass weight and lean percentage).	Excel may terminate agreement upon 30 days notice if producer fails to correct deficiencies in meeting Excel's standards over a 6 month period. Over the 6 month period, producer will not receive carcass merit premiums.	May be changed by Excel at its discretion.	Any controversy or claim shall be settled by binding arbitration based on rules of the AAA.
<p>Note: Swift (formerly Monfort), along with Farmland Foods, were two of the most aggressive packers in signing long-term contracts in the mid-1990s ("New Deals at the Packing Plants," <i>Successful Farming</i>, March 1995).</p> <p>ND= Year Not Disclosed.</p> <p>¹Contract year is our best assessment of the year that the contract was initially available based on dates contained in the contract.</p> <p>Source: Iowa Attorney General's Office (http://www.IowaAttorneyGeneral.org/working_for_farmers/contracts.html).</p>							

Appendix B—Contract Clauses Related to Input Requirements and Monitoring

Contract ¹	Safety and veterinary services	Diet	Genetics	Labor, management, and facilities	Monitoring
Farmland 1998	Farmland will instruct vets to properly administer only USDA-approved medication, vaccines, and other health care products subject to label instructions. Use of these products will be kept to minimum, consistent with good animal husbandry and herd management.	Feed and manage hogs according to Farmland's recommended feeding programs, which may be modified at times.	Genetic strains for breeding stock shall be composed of ____ (number) ____ (type) gilts/sows and appropriate number of ____ (type) boars.	Producer shall supply all necessary management, labor, and utilities to properly operate facilities.	Farmland may inspect facilities and records of producers to assure management of genetic, breeding, health, and feeding programs according to Farmland standards.
Hormel 1996-a	Must adhere to proper drug use and withdrawal procedures. Must be at Level III of PQA program or comply within 6 months. Supervision by a licensed vet.	Company-approved feeding program	Genetic program capable of producing lean, uniform sorted hogs that consistently meet company requirements	Company-approved facilities.	Company can inspect producer's hogs and facilities. Producer can inspect records regarding receipt, weighing, and payment of hogs (scale tickets, P&L's, and checks)
Hormel 1996-b	Same as 1996-a contract	Same as 1996-a contract	Same as 1996-a contract	Same as 1996-a contract.	Same as 1996-a contract.
Hormel 1997-a	Same as 1996-a contract.	Same as 1996-a contract.	Same as 1996-a contract.	Same as 1996-a contract.	Same as 1996-a contract.
Hormel 1997-b	Same as 1996-a contract.	Same as 1996-a contract.	Same as 1996-a contract.	Same as 1996-a contract.	Same as 1996-a contract.
Hormel 1997-c	Quality Assurance Program to assure hogs are drug and residue free, and meet consumer expectations for safe and wholesome pork. Medications and vaccines to properly and competently operate facility.	Feed to properly and competently operate facility.	Select best genotype that is capable of minimizing drug use and providing the type and quality of hog consistent with the companies processing objectives. The company will share carcass cutout and meat quality data and both parties will collaborate to assure that genetics are providing the production and carcass quality requirements. Parties will meet biannually to review long-term projections for carcass weight and quality.	Labor, supervision, and management to properly and competently operate facility.	None specified.
Hormel 1999	Same as 1996-a contract. In addition, must maintain level III PQA certification or the highest level if changed in the future, and comply with any company HACCP program and any future changes within 6 months of establishment or change.	Same as 1996-a contract.	Same as 1996-a contract.	Producer responsible for handling, including that by transporters, to optimize meat quality. Company-approved facilities and/or company-approved sources of weanling and feeder pigs.	Same as 1996-a contract.

Hornel 2000	Same as 1999 contract.	Approval of current and future changes in a genetic program capable of delivering lean, uniform sorted hogs that consistently meet Company requirements.	Approval of current and future changes in feeding program.	Approval of current and future changes in genetic program capable of delivering lean, uniform sorted hogs that consistently meet Company requirements.	Same as 1999 contract. In addition, must approve future changes in facilities and/or sources of weanling and feeder pigs.	Same as 1996-a contract.
IBP 1997-a.	Certified at Level III PQA. Producer shall properly administer drugs and follow appropriate withdrawal procedures. Supervision by a licensed vet.	Nutritional program that produces carcasses that exceed the average carcass characteristics of all hogs that IBP buys.	Parties will agree on genetics to be used and producer must notify Company of changes in genetics and genetic lines, which must be approved by Company.	Producer agrees to provide Company with information related to production management practices upon request.	Company can observe and monitor production and quality. Producer may visit company plants to observe handling and processing of hogs. Producer may inspect receipt, weighing, and payment records of the company.	
IBP 1997-b ²	Same as 1997-a contract. In addition, if a Level PQA is created that exceeds Level III, producer must attain this level within a reasonable period of time.	Same as 1997-a contract.	Producer will use genetics that produces hogs, on average, with meat quality (including firmness, water holding capacity, marbling, and color determined by Minolla reading 49.4 or less) that equals or exceeds the average carcass characteristics of all other hogs delivered to IBP.	Same as 1997-a contract.	Same as 1997-a contract, except that provision allowing producer to observe handling and processing of hogs is omitted.	
John Morrell 1997-a	Certified at Level III PQA or working to get there. Producer shall properly administer drugs and follow appropriate withdrawal procedures. Supervision by a licensed vet.	Company-approved feeding program.	Genetic program capable of delivering lean, uniform sorted hogs that consistently meet Morrell quality standards in existence.	Company-approved facilities.	Producer may inspect receipt, weighing, and payment records of the Company. Producer may visit Morrell's plants to observe handling and processing of hogs. Company can visit producers to observe and monitor production and quality.	
John Morrell 1997-b	Same as 1997-a contract. In addition, licensed vet must be Company-approved.	None specified.	None specified.	None specified.	None specified.	
John Morrell 2000	Same as 1997-a contract. In addition, must be on Morrell's HACCP program.	Same as 1997-a contract.	Same as 1997-a contract.	Same as 1997-a contract.	Same as 1997-a contract.	
John Morrell ND-a	Same as 1997-b contract.	None specified.	None specified.	None specified.	None specified.	
John Morrell ND-b	Certified at Level III PQA.	None specified.	Producer must consult with company to determine type of genetics.	None specified.	None specified.	
Swift 1998 ²	Notify company if hogs treated with Beta Agonist, PST, Ractopamin, or similar substance. Hogs must be within USDA limits on all residues (e.g., sulfa) and be certified at Level III PQA	None specified.	Any change in genetics must be agreed to by both parties.	None specified.	Seller can visit company plant(s) to facilitate and observe the handling and processing of hogs.	

Swift 2000 ²	Same as 1998 contract. In addition, if requested by company, seller will implement programs to improve quality and/or company's ability to sell pork products (e.g., farm hazard analytical control point program, ISO 9000).	Producers must follow nutrition plan provided in contract (not attached), with modifications if requested by company (e.g., non-genetically modified feed)	Genetics shall be of a _____ for sires and _____ for females, and changes must be approved by the company	Sellers must follow humane handling procedures during production and delivery of hogs.	Same as 1998 contract. In addition, seller will allow company in Designated Production Facilities to observe production of hogs and seller adherence to performance obligations.
Swift 2001 ²	Same as 2000 contract.	Same as 2000 contract.	Genetics shall be Cotswold 801 for female lines and Shamrock (HxD) & Cotswold 925 MQ for sire lines, and changes must be approved by the company	Same as 2000 contract.	Same as 2000 contract.
Excel 2000 ²	Maintain the highest Level PQA in effect. Maintain drug withdrawals at levels that allow Excel to export pork products in all current and future export markets. Withdraw all oral tetracycline products a minimum of 2 weeks before slaughter. Maintain highest health standards through proper ventilation prior to delivery, good vermin control, limited access for visitors, and documented immunizations.	Company approved feeding programs.	Hogs must be purchased from farrowers in the Pig.Net Alliance.	Handle market hogs to minimize damage from bruising, improper injections, and other invasive procedures. Facilities that meet current accepted standards for raising improved genetic animals. Company approved management programs.	None specified.
<p>ND=Year Not Disclosed. ¹Contract year is our best assessment of the year that the contract was initially available based on dates contained in the contract. ²These contracts have explicit quality requirements regarding PSE attributes (See appendix A).</p> <p>Source: Iowa Attorney General's Office (http://www.IowaAttorneyGeneral.org/working_for_farmers/contracts.html).</p>					

Appendix C—An Example of Reduced Incentives For Leaner Hogs

In the carcass merit matrix presented in appendix table C, the leanest carcasses (i.e., between 59 and 60.9 lean percent, rows 1 and 2) for live weight ranging between 232 and 292 pounds (i.e., columns 4 and 5) receive a percentage price premium of 105% compared to 106% for the less lean carcasses (i.e., between 57 and 58.9 lean percent, rows 3 and 4).

Appendix table C—A swine carcass merit adjustment schedule submitted to the Swine Contract Library

Carcass Weight Range (lbs)	Live Weight Range (lbs)					
	180-196 133-145	197-216 146-160	217-231 161-171	232-263 172-195	264-292 196-216	293-311 217-230
	<i>Percent</i>					
60-60.9	88	93	101	105	105	100
59-59.9	88	93	101	105	105	100
58-58.9	88	94	101	106	106	97
57-57.9	88	94	101	106	106	97
56-56.9	88	93	101	105	105	97
55-55.9	88	93	101	105	105	96
54-54.9	88	92	101	103	103	96
53-53.9	88	92	101	103	103	96
52-52.9	88	91	101	102	102	94
Lean Percent Range						
51-51.9	88	91	100	102	102	94
50-50.9	88	90	99	100	100	94
49-49.9	88	90	99	100	100	94
48-48.9	88	90	98	98	98	92
47-47.9	88	90	97	97	97	92
46-46.9	88	90	96	96	96	92
45-45.9	88	90	95	95	95	90
44-44.9	88	90	94	94	94	90
43-43.9	88	90	93	93	93	90
42-42.9	88	90	92	92	92	90

Source: U.S. Department of Agriculture, GIPSA. 2003. Review Contract Summary Report - Premiums and Discounts Swine or Pork Market Formula, National. Accessed 30 December 2003.

Appendix D—Packer Branding Programs That Rely on a Specific Type of Genetics

America's Best Pork. “America's Best Pork” (ABP) was Farmland's USDA Process-Verified pork program. The ABP program provided hogs for Farmland's branded, case-ready meat products. Proprietary genetics for the program, referred to as Triumph Genetics, came from Triumph Pork Group, formerly a 56 percent-owned subsidiary of Farmland, which was formed to develop the genetics.

To participate in the ABP program, independent producers were required to enter into a participation agreement with Farmland that summarizes program requirements (Iowa Attorney General, 2002). Producers were required to enter a genetic supply agreement with Triumph Pork Group that covered a range of terms to safeguard the proprietary nature of the genetics, including monitoring, confidentiality, and penalty clauses, and dispute resolution procedures (table 5). Producers were also required to enter a “Market Hog Purchase Agreement” with Farmland, which provided both producers and Farmland with additional safeguards from potential opportunism.

Lean Generation. In 1996, Smithfield Foods launched its line of Lean Generation pork, which was the first branded fresh pork program to receive the American Heart Association's “heart check” certification for superior health qualities. Hogs for the Lean Generation brand were originally supplied through a joint venture between Smithfield and Carroll's Foods, a leading U.S. hog producer. In 1991, Carroll's Foods and Smithfield Foods entered a franchise agreement with the National Pig Development (NPD) Company of Great Britain to obtain exclusive rights for the NPD hog in the United States and Mexico. The NPD hog is the leanest hog in large-scale U.S. commercial production. Through the joint venture, referred to as Smithfield-Carroll's or NPD (USA), NPD breeding stock was provided to Smithfield and its partner-owned farms.

Hogs were produced in operations owned by affiliates of Carroll's Foods. The arrangement involved a partnership between Smithfield and Carroll's *Farms* of Virginia, which owned the hog raising facilities. It also included a long-term purchase contract between Smithfield and Carroll's *Foods* of Virginia, which leased and operated hog production facilities. Under the purchase agreement, Smithfield was obligated to purchase all hogs produced by Carroll's Foods of Virginia at market-equivalent prices.

Smithfield and Carroll's Foods also had production contracts with independent producers to raise NPD hogs.¹ The contractor (a packer or large producer) reduces producer hazards by investing in genetics and other inputs, in exchange for a greater degree of control over production.

As the Lean Generation brand grew increasingly successful, Smithfield gained greater control over the genetics. In 1999, Smithfield acquired Carroll's Foods and its 50 percent interest in the joint venture. Following the purchase of NPD by the Pig Improvement Company (PIC), NPD (USA) terminated its franchise relationship, and now independently operates the NPD genetic development program. In 2000, NPD (USA) was restructured

¹ Note that the same pig may be successively covered by a production and marketing contract. For example, Carroll's Foods may enter into production contracts with producers to raise the pigs, and marketing contracts with a packer to sell the same pigs.

as a separate company within Smithfield, under the name Smithfield Premium Genetics (SPG), to focus on the development of NPD stock. Operating as a subsidiary of Smithfield, SPG provided Smithfield with added safeguards for its Lean Generation brand.

Others. Through its niche marketing program, “Pennsylvania Country Wagon Family Farms Pork Program,” Hatfield meets exact Japanese specifications for quality and safety. Hatfield certifies that its hogs are disease-free and bred under strict genetic, nutritional, and hygienic specifications on “Certified Pennsylvania Family Farms.”

For the Japanese market, Hatfield sources genetics from Babcock Swine (Vigoda), which built a reputation for tender, well-marbled pork with low purge and superior palatability. It was the first U.S. breeding company to eliminate the stress gene, and to receive an official trademark from the U.S. Patent and Trademark Office for their pork products. Hogs for most of Hatfield's Japanese products are supplied through a joint venture with Wenger Feeds (a leading hog producer) (Marbery[b], 2000).

Premium Standard Farms (PSF) has a line of branded fresh pork products and specialty products, such as “Fresh & Tender” and “Premium 97 Heart Healthy.” PSF uses proprietary genetics from the Dalland breed, which is known for its uniform feeder pigs, free from the stress gene. PSF entered an agreement with a leading hog genetics company in the Netherlands to obtain exclusive use of selected male genetic lines in the United States. Production operations that supply PSF's processing plant in Missouri are completely integrated, from genetics to the slaughterhouse (Nunes).