

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.

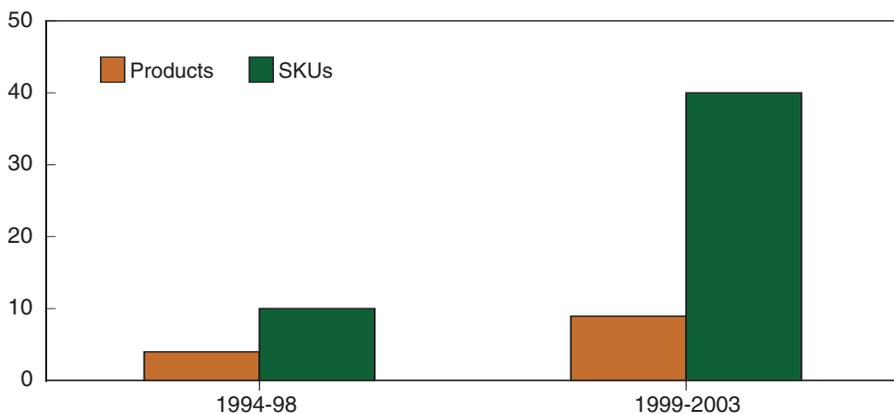
comply with any company HACCP program, perhaps in anticipation of a farm-level HACCP program.

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.