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Contracting and Vertical Coordination in the United States Pork Industry

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Abstract

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Disciplines

Agribusiness | Agricultural Economics | Industrial Organization | Meat Science

**Contracting and Vertical Coordination
in the United States Pork Industry**

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Introduction

Coordination activities in the pork production industry are growing rapidly. These range from the totally integrated system through ownership, to that which bridges the input supply, production, processing and merchandising segments through various informal or formal forms of coordination. For example, some arrangements involve contract for production or delivery of products of a specified amount, quality, etc. Still others may involve agreements or linkages between independent participants in the industry. All are aimed at improving the participants' competitive position in the industry over what it would be without the linkages. Industry development or adjustment is not uniform across regions in the United States. This manuscript documents those differences, outlining some reasons for the differences. Additionally, competitive relationships along with contract growth and a comparison of returns and risks of selected contracts are presented.

Pork Industry Trends

The pork industry, like many industries, is witnessing a movement towards a greater level of coordination and specialization. The typical farrow to finish type operation which has dominated the industry and was traditionally viewed as a single enterprise in the past, is now being viewed as two or more different enterprises in the specialization movement. These include the gestation and farrowing phase, the nursery or what is termed the off-site nursery phase, and the grow-finishing phase. The coordinated systems (networking) approach allows the individual producers who are participants in the system to specialize in one or more of these areas of production. Increased coordination is also occurring in the input providing and processing, and merchandising segments of the industry. Research suggests that the producers who are members of coordinated systems tend to adopt technologies more rapidly. They are more likely to have cost of production records, gain a lean premium, and use price risk management tools and scales to sort hogs and weigh feed. Along with this specialization has come some regional shifts in the pork production industry. One of these shifts is the dramatic increase in hog production that has occurred in North Carolina. Another pork industry growth area is the southwestern fringe of the cornbelt. This area will likely represent the largest pork industry growth in the next ten to fifteen years.

Development of the North Carolina industry has also been accompanied by marked gains in productivity, which has helped offset the advantages of lower feed cost enjoyed by Midwestern hog producers. There have been dramatic improvements in hogs produced per litter, number of litters produced per year per sow and market hog efficiency. Additionally, the ability to provide packers with leaner high quality hogs in volume has led to improved price premiums.

Within a coordinated system those participants which have access to the most current and best information will be positioned to extract the most from the industry. A recent article by Boehlje and Schrader points out the importance of knowledge or information base in the adjustments occurring in the industry. They very effectively point out that there are two key locations for accurate and reliable information. One location is information on the end user or consumer, about attributes which influence consumer purchases. This would also involve the consumer willingness to pay for those attributes (also see Hurt). The second location is

information on or access to the genetic base that fits into producing those products that meet consumer preferences. In many cases, this would be aligned with the owner of the genetics. Thus, in the evolution of the industry, the coordinated systems that have the best consumer information and respond to this information, along with information on genetics, and have access to these genetics at competitive rates, will be the systems that dominate the industry.

The pork industry has also seen a movement toward specialization within regions. For example, the Midwestern Region, and in particular Iowa, appears to be moving toward specialization in the grow-finishing phase of swine production. The cornbelt (southeastern, southern, and southwestern fringe) states are increasing their share of the gestation, farrowing, and in some cases the nursery phase of the swine production operation. The feeder pigs are transported to the cheaper corn cost areas in western, north central and central Iowa and other locations within the cornbelt for finishing. Iowa has relatively cheap corn and the highest market hog prices in the country, due to the excess packer capacity. Cheap corn is very attractive to grow-finishing hogs, as the majority of the corn costs in a farrow to finish operation occurs during the grow-finishing phase of the animal. Therefore, there are competitive advantages for finishing out feeder pigs as near as possible to the low cost corn supply. A large percentage of a farrow to finish operation's non-feed variable costs and fixed costs are involved in the production of feeder pigs. Thus, there is not the pressure to be located near a low cost corn supply.

Information from recent *Hog and Pig Reports* bears this out. For example, while the U.S. breeding herd inventory declined by 1.5 percent from December 1993 to December 1994, Iowa experienced a 12% decline in breeding herd numbers over this same time period. The breeding herd numbers actually rose during this time period in states such as Oklahoma, Missouri and North Carolina. Iowa's share of the breeding herd decreased from 23.7% of the U.S. breeding herd to 21.2% of the U.S. breeding herd during this time (Lawrence). Inventory numbers for the Iowa pork production industry indicate two things are occurring. One is that there is a movement to feeding-only types of operations, and the second is that producers are exiting the industry. Producers exiting the industry is occurring nationwide, as the industry moves to fewer and larger sized producers. However, examination of the types of operations in Iowa during the 1992-1993 time period shows that the finishing-only operations were the only type of system to show an increase in numbers. Some of this change may be due to the shifting of operations to finishing feeder pigs only.

Due to crop production advantages, the heart of the cornbelt will consistently have the low cost corn price. However, the current price advantage that cornbelt hog producers are experiencing is driven by excess packer capacity and will not likely continue into the future. About one in every five hogs that are processed by hog packers in Iowa is produced in another state and shipped in for processing. This excess packing capacity will not be in existence into the future if higher cost packers exit the industry due to increased procurement cost and low margins.

The December 1994 *Hog and Pig Report* showed continued structural change in the industry as the number of operations in the U.S. continued to decline, and those remaining become larger. The majority of the firms exiting the industry have come from the smaller sized producer groups. Additionally, the shift is not consistent by region. For example, while

the U.S. decline represented a 7.3% drop in number of operations from the year before, Iowa experienced a 12% decline, while other states, such as the Nebraska saw a stable trend in the number of hog producers during this time. For those operations which have 1,000 head or more of inventory, which represents about 2,000 head marketed per year, the percent of the share in the U.S. increased from 39% in 1989 to 55% at the end of 1994. The average sizes of these operations vary by area of the country. For example, the average inventory of farms with over 1,000 head in inventory for Iowa was 1,804 at the end of 1994. This compares to an average of 2,416 for the Midwest Region, and 5,624, or approximately 11,000 head marketed per year, for North Carolina.

The growth of the large operations in North Carolina in the last four to five years has been phenomenal. For example, the growth in the average number of hogs per farm has grown by a multiple of five from 1989 to 1994 in North Carolina. This compares to a 50% rise in the remaining part of the U.S. Even more telling is that 86% of the hogs raised in North Carolina come from units of 2,000 head or more in inventory, as compared 30% of the hogs coming from similar sized operations when all other states are considered.

A recent report by Grimes indicated that the 57 largest hog producers in the U.S. marketed 12,365,000 hogs in 1993, or 13 percent of the total U.S. slaughter. These marketings had increased by 25 percent in the one year period from 1992 and these operations planned on doubling their size by 1996. The recent decline in market hog price has had a dampening impact on these growth plans. However, growth remains at a brisk pace.

Regional Industry Comparison

A comparison of swine industry development between the Southeast, particularly North Carolina, and the Midwest provides some interesting contrasts. First, North Carolina has grown, on average, more than 20% annually for the last five years. This exceptional growth has moved the state from producing five percent of the nation's pork and a seventh place ranking in 1989, to currently producing 12% of the nation's pork and ranking number two. This growth in North Carolina has been fostered by the development of what has been commonly referred to as the mega-sized producers. For the most part, these mega-sized producers represent a highly coordinated hog production industry. It is characterized by a highly coordinated system of contractual arrangements which cover such items as feed formulation or mixing standards, specified production facilities, genetic pool for breeding livestock, internal veterinary care, and management strategies which are to be utilized in the pork production process. The industry is coordinated from the input supply side, on through pig production, packer processing, and is currently expanding to the consumer level, where the development of branded pork products is on the horizon.

This development of the North Carolina industry was built around the need to find additional sources of economic activity for the state, which was experiencing declines in industries such as tobacco. The state had large amounts of under-employed labor, and was looking for an alternative for increasing the family income base. A conscious effort was made by the industry stakeholders to focus on pork production as one area for evaluation and growth. The industry lacked an infrastructure for rapid growth which would revolve around a large number of small producers. Thus, the model of mega-sized producers contracting with

many farmers came to the forefront as the alternative for industry development. The model was more or less a prototype of the poultry production industry that was already in existence in North Carolina. With this model, the industry infrastructure needed for a cost competitive and longer term economically viable industry could be developed internally. Development of contractual activity is a necessary component for an infant industry lacking a competitive infrastructure. Contracts represent a key component of the infrastructure. Moreover, the movement into pork production represented diversification for some of the producers. North Carolina was quite familiar with contractual production, as this was already widely used in poultry production. Tobacco was produced under a quota system or highly regulated and controlled, as well.

In contrast, the pork production industry of the Midwest was highly developed and had an extensive infrastructure in place to service the industry. It was dominated by large numbers of medium to smaller sized family farm producers. The industry would be characterized as a fully developed or mature industry. Given this, the development of coordinated efforts for the use of instruments such as contracts was slow initially. Thus, the slow pace at which the Midwest has responded to the changes in the pork production industry is not surprising, as this is characteristic of firms or regions which enjoy dominance in an industry

More recently, the Midwest is becoming more acutely aware of its eroding competitive position and is taking actions for improvement. Coordinated efforts are expanding. However, in many cases, these coordinated efforts differ from those of the mega-operations of North Carolina. The Midwest has a pork production infrastructure that is already in place. Thus, it faces the aspect of adjusting the infrastructure to meet the needs of the industry to face the competitive pressures from around the world. The array of options available is more diversified in an area with these attributes. For example, some of the coordinated efforts involve independent producers entering into networks that provide many of the same competitive advantages gained by the highly integrated systems or mega operations located on the fringe of the cornbelt. These coordinated efforts can encompass access to high quality and uniform genetics, use of consistent production technologies, uniform management strategies, and other production practices which lead to uniform, lean and high quality hogs. These systems, too, are highly coordinated and in some cases involve agreements which span from the input supplier on through to the packer. In many cases, these coordinated efforts also allow the individual producer to begin specializing in their respective production operations. For example, members of the coordinated effort may involve breeding stock producers, the sow gestation and farrowing producers, the nursery pig producers, and grow-finish producers. These systems are linked through contractual arrangements in many cases.

This type of evaluation is not unusual within a development setting. While the dominant regions may be slower to adjust and adopt competitive strategies, it is continually observing activity ongoing in the rapidly developing regions. It then picks and chooses those activities which are useful and incorporates them within its own development scheme. However, it must be recognized that the pace at which this observation and adoption takes place is all-important to the dominant region in maintaining its dominance within the industry. While it may enjoy advantages such as low cost feed input, a key ingredient to livestock production, if the adoption process is too slow, the industry dominance can be lost.

Competitive Relationships

Recent studies are showing some economic or cost advantages to coordinated efforts in the swine industry. Coordinated pork production systems tend to show higher efficiencies than independent operations. A recent feeder pig finishing study by McBride showed that feed and labor efficiency were significantly greater for hogs produced under contractual arrangements, while death losses were lower. An Illinois study showed that volume purchasing and selling can lead to discounts on items purchased, as well as premiums paid for the hogs that sold on a volume basis (Polson and Hudson). A recent Purdue study has shown production cost differences by size of operation. The study compared four different types of hog farrow to finish production systems: a 1200 sow, 600 sow, 300 sow, and 150 sow operation. Total production costs were as follows: \$34.18/cwt for the 1200 sow operation; \$35.63/cwt for the 600 sow operation; \$38.53 for the 300 sow operation and \$40.55/cwt for the 150 sow operation. This is a cost difference of \$6.37/cwt between the 150 and 1200 sow operation, or a difference of about \$16.00 for a 250 lb. pig (Boehlje, Clark et al.). A Minnesota study has shown that, in general, the difference in return to management and risk is about \$4-\$5/cwt lower for a 120 sow operation as compared to a 500 sow operation with similar technology (Lazarus et al.). These cost differences create competitive advantages and also create an environment where the smaller sized producers are looking for ways of coordinating their efforts to gain some of the advantages that the larger sized operators have internalized into their operation.

Duffy has shown that swine production can effectively improve the earnings for a diversified crop/livestock operation. He showed that adding a 120 sow operation to 400 acres of continuous corn increased return to management from \$6,711 to \$31,532 annually. A well managed, diversified livestock crop production system can capture some synergistic-competitive advantages. These are production systems where the by-products of one segment, in this case manure from livestock production, can be used as a resource in crop production. Similarly, crops produced can be utilized directly in livestock production.

Variability of production also impacts the competitive position. Swine production variability impacts producer risk, as well as survival capabilities. An Iowa study showed substantial between year variability for individual producers over a six year period (Bruns, Kliebenstein, Lawrence, Stevermer). The study grouped producers into the top, middle, and lower one-third by selected items for each year. Results showed that producers moved among the three groups. Over the six year study period only three percent of the producers (one of 40) were in the top one-third for annual percent return to capital for all six years. Seventy percent were in the top third for at least one of the six years. A Minnesota (Lazarus) and an Indiana study (Boland and Patrick) showed similar results. Coordinated systems that are intensively and effectively managed reduce the level of production and return variability.

Industry Contract Growth

Information provided in a 1992 study by Rhodes and Grimes projected that about 15-16% of the U.S. domestic slaughter was from contractors in their own facilities or contract facilities (Rhodes and Grimes 1992a). A similar study showed that in 1989 about 11-12% of the market hogs were produced under similar arrangements. This represents about a 40% increase over

the 1989-1992 time period. Further analysis showed that the percentage growth from 1991-1992 in hogs produced by contractors was about 30% in the East Coast Region of the United States. This compared to a 20% increase in Iowa (Wind-Norton and Kliebenstein 1994b), a 12% increase in the East North Central states, and an 11% increase in the West North Central states. The growth in contract production is dramatic, but the rate of growth differs by region of the U.S., as well as states within regions. The East Coast Region has shown the most dramatic increase over the past few years with North Carolina representing the largest increase within that region.

Information in Table 1 shows the distribution of contract market hogs produced by operation size. There are some interesting differences between regions. For example, in the East Coast Region almost all contract hogs were produced in operations of 10,000 head or more; 21% produced in the 10,000-49,999 head sized operations, while 77% was produced in the 50,000+ head sized operations. In contrast, in Iowa, 5% of the contract hogs were produced in operations of 1,000-1,999 head, 42% in the 10,000 to 49,999 head size operation and about one fourth, or 24% in the 50,000+ head operation. The East North Central as well as West North Central Regions showed a distribution similar to Iowa except that there were fewer hogs produced in the smaller sized operations, while a larger percent were produced in the 50,000+ head sized operations.

Table 1. Percentage of Contract Market Hogs Marketed by Size of Contractor

Number of Hogs Annually	United States	Iowa	East Coast	East North Central	West North Central
1,000-1,999	1%	5%	..	<1%	2%
2,000-2,999	3%	9%	..	11%	<1%
3,000-4,999	3%	6%	..	7%	14%
5,000-9,999	7%	15%	2%	21%	12%
10,000-49,999	24%	42%	21%	21%	35%
50,000+	61%	24%	77%	39%	37%
Total	100%	100%	100%	100%	100%

Types of contract producers also vary across regions of the country. As shown in Table 2 about 30% of the contract producers in the East Coast Region produce feeder pigs; while 46% finish out feeder pigs (Rhodes and Grimes 1992b). The North Central states, and in particular Iowa, have a heavier concentration of feeder pig finishers as compared to feeder pig producers. In Iowa 81% of the contract producers finish out feeder pigs, as compared to only 10% who

produce feeder pigs. Feeder pigs are produced in other regions and transported closer to the corn supply for finishing. These trends have differing economic impacts on rural communities, as well as the state. The labor intensive, as well as management intensive areas of swine production are in feeder pig production, as compared to feeder pig finishing.

Table 2. Percentage of Growers in Given Hog Operation Types by Region

Type of operation	United States	Iowa	East Coast	East North Central	West North Central
Finish feeders	56%	81%	46%	81%	63%
Farrow to finish	3%	0%	8%	2%	1%
Produce feeders	29%	10%	30%	15%	17%
Breeding stock	1%	0%	2%	0%	3%

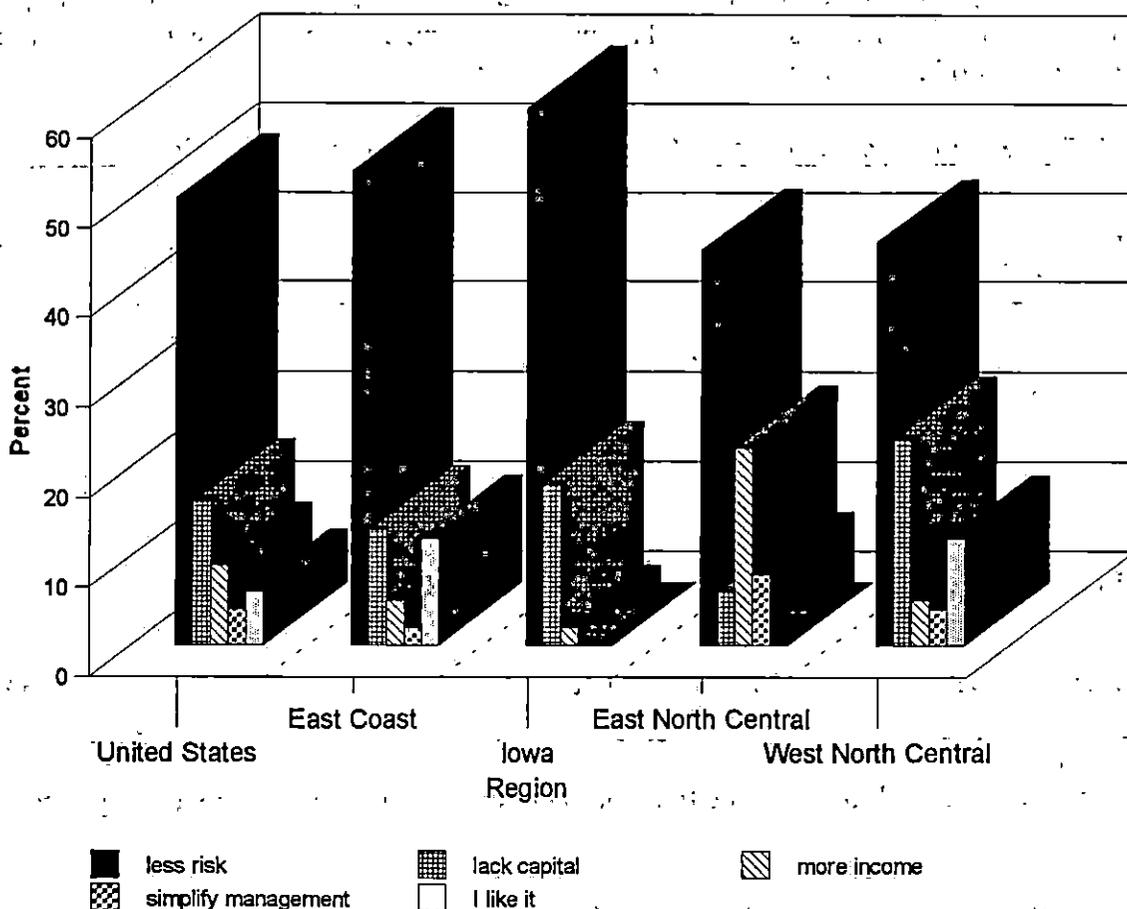
*Columns do not total to 100% due to reporting of combinations of the above categories.

Motivation, Attitudes and Contract Lengths

Growers enter contractual arrangements for various reasons. The primary reason is that of risk reduction (Figure 1). This ranged from 44% in the East North Central Region to a high of 60% in Iowa (Wind-Norton and Kliebenstein 1994a). In general, lack of capital was the next most important reason for entering contractual arrangements. Twenty-three percent of the West North Central Region responses indicated they had entered contractual arrangements because of a lack of capital. This was 16% for the U.S. and ranged to a low of 6% for the East North Central Region. The response of the need for more income, while showing a high level of variability between regions, was the third most important reason for entering contractual arrangements; 22% of the respondents in the East North Central Region compared to a low of 5% for the West North Central Region and only 2% for Iowa.

When comparing the above information with results from an earlier survey conducted by Rhodes and Grimes in 1989, there appear to be trends developing on reasons why growers are entering into contractual arrangements (Rhodes and Grimes 1990). One of the trends is that risk aversion tends to have become a more important reason, while the financial reasons for contracting have declined. For example, in the 1992 study, reasons for Iowa respondents to enter contractual arrangements were 60% for risk reduction while 20% were financial. In comparison, Iowa respondents in the 1989 survey showed 48% were financial and 22% were for risk aversion.

Figure 1. Reasons Growers Contract



This appears to be a dramatic swing in the reasons for contracting, but is likely a further movement in a trend following the farm crisis of the 1980s. The financial difficulties of the farm crisis encouraged contracting. More recently, interest rates have declined, balance sheets have improved and options for financing have become more available. With this, reasons for contracting have shifted to risk reduction. Producers are choosing to remain in contract production after they have become financially capable of production as an independent. They are choosing to use their equity to expand the size of their contractual operation in lieu of moving into independent production. About half of the Iowa contract growers and three-fourths of the East Coast contract producers indicated that they did not wish to become independent producers. About one-third of the Iowa contract producers wish to become independent producers. The percentage of contract producers wishing to become independent producers appears to be declining over time. This suggests that more growers may be looking to contract production as a viable method of long-term participation in the pork industry and not necessarily as an entry point or method of survival through tough financial times and then gravitating towards independent production in better times.

Information on length of time contract growers have been in the contracting business in the U.S. shows hog contracting beginning in the East Coast area and moving in a westerly-northwesterly direction. For example, in the East Coast Region, 10% of the contract growers entered contract production before 1980; another 21% entered contract production during the 1980-1984 time period; or about one-third of the contract producers in the East Coast Region had entered contract production prior to 1985. In comparison, only one-fourth of the contract producers in the East North Central Region had entered contract production prior to 1985. This compares to 10% of those producers in Iowa and the West North Central Region.

The pork contract production industry also shows differing patterns when evaluated on growers employment in activities outside of contract production. As seen in Table 3, contract production is viewed as an additional income generating alternative in the West North Central and Iowa areas; about half of the contract growers in these regions (48% West North Central; 45% Iowa) had sizeable enterprises in addition to the contracting activity (Wind-Norton and Kliebenstein 1994c). This compared to only 20% for producers in the East Coast and East North Central Regions. Contract growers in the East Coast Region viewed contracting as the primary source of income; this was the sole income-generating alternative for 39% of these producers who had no other employment. For producers in the East North Central Region, contract production activity was an income-expanding alternative to supplement a full-time off-farm job. This is shown by 67% of the contract producers in the East North Central Region with a full-time off-farm job. These attributes will have an impact on how the industry develops and the different types of contractual arrangements that will be in effect.

Table 3. Growers' Employment Outside of Contract Production by Region

	United States	East Coast	Iowa	East North Central	West North Central
Full time off-farm job	26%	21%	22%	67%	16%
Part time off-farm job	7%	5%	12%	0%	11%
Sizeable enterprises other than contracting	31%	20%	45%	20%	48%
No other employment	27%	39%	11%	8%	22%
Partially retired	1%	3%	0%	0%	0%
Investor only	3%	7%	2%	0%	1%

* Columns may not total to 100% due to combination responses given.

Length of grower contracts also varies by type of contract as well as by region of the U.S. For example, contract lengths tend to be longer in the East Coast than in the East North Central or West North Central Region. As demands for specific types of remodeling or new facilities as a part of the contractual arrangement have increased over time, contractual lengths have also increased. This is in an effort to match the loan repayment time that would go along with the increased investments accompanying the contractual arrangement.

Hog Marketing Agreements

The exact terms of risk-sharing marketing contracts differ between packers, but the concept is the same. In general, the producer gives up the opportunity for high prices in return for protection from low prices. There are two basic types of risk-sharing agreements offered by Midwest packers: cost-plus and price-window. Some packers offer long-term agreements that do not share risk, but that pay premiums for characteristics of value to the packer, i.e., scheduled plant delivery and early morning delivery. These contracts typically are for 5-10 years in length.

The cost-plus contract ties the price received by the producer to the cost of producing hogs via a production budget and feed prices. For example, the contract may use the Iowa State University Swine Enterprise Records high profit one-third cost of production as the "cost" and add a profit margin of, say, \$5.00/cwt as the "plus." If the high profit one-third cost is \$36/cwt and \$5/cwt is added, the resulting price is \$41/cwt. The contract may have a provision where the producer and packer share the difference in the price above the base. These contracts typically have a feed price adjustment factor based on a rolling-average corn price (usually Omaha) and soybean meal price (usually Decatur). As feed prices increase, so does the price received for hogs and vice-versa. The cost-plus price is independent of the current open-market price of hogs. When hogs are \$30/cwt, this contract looks great to the producer, but not so great to the packer. When hogs are \$50/cwt, however, the same contract may not seem like such a great idea to the producer. It protects producers from variables beyond their control—hog and feed prices. Cost-plus contracts require that producers be efficient in production factors that they do control to succeed with the price received.

The price-window contract has an upper and a lower price boundary that establishes a price range or "window." When market prices are inside the boundaries, the producer receives the prevailing market price. When prices are outside the window, the producer and packer share the risk. While some contracts guarantee upper and lower boundaries, the more common arrangement is that the difference between the open market price and the boundary price is split equally between the producer and the packer. For example, if the window is \$40 to \$48/cwt, the producer would receive the market price when it is between \$40 and \$48. If the price is \$30 the producer would receive \$35, half of the difference between \$30 and \$40. If the price is \$54 the producer would receive \$51, half the difference between \$48 and \$54. Price window contracts may have a feed price adjustment factor to raise or lower the "window" but typically, the producer stands that risk.

Other important terms are included in these contracts. They require carcass merit pricing and may require that hogs be of a minimum quality grade to qualify for the contract. Repeated delivery of sub-standard hogs is grounds for canceling the contract. Scheduled deliveries are

also required. While some contracts allow the producer to commit only a portion of his or her production to the packer, others require that producers commit all production and the packer has first rights on any expansion. The contract may also require that genetic stock, nutritional practices, facilities and other production practices be approved. They typically also require the highest level of Pork Quality Assurance. Contract lengths also differ, but are typically in the 5 to 10 year range to assure that prices have time to pass through both a high and a low range. The contract may have a "no net gain" clause that keeps track of the price gains or losses under the risk-sharing provisions, and the contract must either continue or be bought out if either party has made a net gain. This assures that the producer and packer have the same long-run average price as in the open market, but without the highs and lows.

Provisions and price levels of long-term packer contracts are usually offered similarly to various producers at one time. However, the terms appear to have changed over time. Just as hog prices have declined in recent months, so have the attractiveness and availability of long-term contracts as the packer's bargaining position improved. Contracts signed two to three years ago typically have higher price levels than the contracts offered today.

Comparison of Pork Production Contracts

Within a coordinated pork production system contracts are commonly used to enhance the organization within the system. Contracts can be used for organizing such items as genetic or feed purchases, designation and time of delivery, type of hogs to be delivered, designation of production system, and spelling out the terms for delivery of hogs to packing plants. There can be a number of participants in the coordinated system. King points out that one of the managerial problems in contractual arrangements is designing incentive structures that motivate the stakeholders in the coordinated system to make decisions that will maximize the overall performance of the system. Participants need to act as a group rather than as individuals. Barry, Sonka and Lajili point out that in the analysis of coordinated industries the evaluation becomes one of principal agent relationships. These principal agent relationships can effect the economic performance of each of the players in the coordinated effort. The agent (for example, the pig grower) is expected to operate in a manner consistent with the principal's objectives. In this case, the principal may be the processor or packer, the supplier of genetics or breeding stock, or possibly the lender for the purchase of the building or facility. They point out that due to problems such as asymmetry of information by the industry stakeholders and other reasons, it is virtually impossible to write a contract that will cover all future contingencies.

Hillburn, along with Martin, have shown that returns and risks can vary dramatically between contracts. Thus, it is very important that before entering contractual arrangements, all parties of the arrangement evaluate their expected returns and risks around those returns (Kliebenstein et al.). In the study, Hillburn examined three different contractual arrangements, as well as sole proprietorship. Two contracts were a fixed payment type of contract, while the third contract was a profit sharing agreement. Comparison of the contractual arrangements is shown in Table 4. Return levels are shown for a group of 300 feeder pigs being finished out. Comparison of the two fixed contracts shows that for Contract A the expected returns per group was \$346 with a standard deviation of \$359. In contrast, the

expected returns for Contract B was \$443 per group with a standard deviation of \$201, or a substantially lower relative level of risk. Comparison of the maximum returns versus the minimum returns shows similar results; where the maximum returns are about the same, between the two contracts, while minimum returns are dramatically less, in fact, negative for Contract A. In addition, the probability of the returns being greater than zero was 100% for Contract B as compared to 82% for Contract A. The profit sharing contractual arrangement

Table 4. Grower risk and returns per group

Item	Contract				
	A Fixed Payment with Bonus ¹	B Fixed Payment with Bonus ²	C Profit Sharing	D Fixed Payment with Bonus ³	Sole Proprietor
Expected Return	\$346	\$443	\$1679	\$419	\$3724
Standard Deviation	\$359	\$201	\$2654	\$268	\$6469
Maximum Return	\$1204	\$1219	\$10314	\$1204	\$21730
Minimum Return	(\$1206)	\$56	(\$1934)	(\$378)	(\$18305)
P (Return > 0)	82%	100%	65%	94%	72%

- (1) Also has death loss deduction
- (2) Fixed payment is greater and bonus less than example A
- (3) Represents example A without death loss deduction

provided a higher level of expected returns, while the standard deviation was also greater. The probability of the expected returns being greater than zero was 65% for this contract. The sole proprietor production scenario showed dramatically higher expected returns in addition to the standard deviation being greater, as well. The probability of expected returns being greater than zero was 72% for this scenario. A comparison of the standard deviation relative to the expected returns shows the relative level of risk between the different scenarios. This comparison shows that the lowest relative level of risk is exhibited with Contract B, followed by Contract D, then Contract A followed by Contract C, and with the sole proprietor showing the highest level of risk relative to expected returns. Thus, the contracts evaluated did reduce the level of risk for the contract grower. However, as pointed out by Hayenga, Boehlje and Hook, a better understanding of the equity of risks/rewards for each participant in the coordinated system is needed, as inequitable systems will not survive.

Summary

Coordination activities in the pork industry are expanding rapidly, further accelerating industry concentration. Many forms of coordination are occurring, ranging from those controlled through asset ownership to those involving less formal arrangements between two or more independent participants. The coordinated systems approach can allow individual participants to further improve their competitive position, enhancing their long-term success. Additionally, access to information and genetics are two important characteristics for future industry success.

The industry has seen dramatic growth in North Carolina the past five years, exceeding 20 percent annually. This growth came primarily from the highly coordinated mega-sized producers through horizontal expansion of contract production. Coordination activities have been slower to develop in the Midwest and have taken a more diverse approach. The array of options used is more diversified, ranging from independent producer relationships, to marketing contracts, to franchise type arrangements.

Currently, the primary reason for contractual arrangements is risk reduction. Studies have shown that the level of risk can vary dramatically between contracts. Thus, all participants must evaluate their expected returns and risks carefully. Studies have shown that contracts reduce expected returns and risks over the sole proprietorship alternative.

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