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## A Comparison of Vertical Coordination in the U.S. Poultry, Egg, and Pork Industries

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### Abstract

Changes in vertical coordination in the U.S. broiler, turkey, and egg industries decades ago may provide useful insight into more recent developments in the U.S. pork industry. The need to protect relationship-specific investments created incentives for contracts and vertical integration. In the presence of relationship-specific investments, market uncertainty from a number of sources helped determine the type of contract/vertical coordination alternative selected.

### Introduction

Vertical coordination refers to the synchronization of the successive stages of a production and marketing system. Methods of vertical coordination include open markets, often referred to as spot markets, contracts, and vertical integration. The U.S. pork industry has undergone significant changes in vertical coordination, as contracting in that market has risen dramatically. From 1993 to 2001, the share of total hogs sold through contractual arrangements increased from 10 to 72 percent. Consequently, sales and purchases through the traditional spot markets have dwindled to 28 percent of total sales.

Changes in vertical coordination that occurred in the U.S. broiler, turkey, and egg industries decades ago may provide insight into the more recent changes in the pork industry, as well as other agricultural industries that are undergoing structural change. In the broiler industry,

production contracts between feed dealers/contractors and growers accounted for over 85 percent of production in 1955, as fewer growers operated independently. These contracts later evolved, giving more control to the contractors. Relationships between the production and processing stages also changed, as feed dealers became more directly involved in both broiler production and processing. In the 1970s, many feed dealers exited the broiler business, leaving processors as the major contractors with growers. In the turkey and egg industries, contracting developed more slowly than in the broiler industry, and vertical integration, in which production and processing are organized by a single firm, was a more common method of coordination. Production contracts, together with vertical integration, now account for over 90 percent of production in each of the three industries.

### Changes in Vertical Coordination of the Poultry and Egg Industries

Vertical coordination refers to the synchronization of successive stages of production and marketing, with respect to quantity, quality, and timing of product flows. Methods of vertical coordination include open production (also referred to as open, or spot, markets), contract production, and vertical integration. In open production, a firm does not commit to selling its output before completing production. Cash (or spot) prices coordinate resource transfer across the stages of production. Contract production is the production of goods and services for future delivery. Contracts can be classified as marketing contracts or production contracts. In marketing contracts, the contractor and producer may agree on delivery schedule, pricing method, and product characteristics, and the contractor engages in few of the producer's decisions. In production contracts, the

contractor engages in many of the producer's decisions and retains ownership of important production inputs. In vertical integration, a single firm controls the administrative operation of two or more successive stages of production (Mighell and Jones). In vertically integrated firms, management directives dictate the transfer of resources across stages of production and marketing.

In the mid-1900s, poultry and egg firms specialized in certain activities, and spot markets were the dominant means of vertical coordination. Feed was produced in commercial feed mills. Poultry and eggs were sold to slaughter plants and egg-handling facilities that performed many of the marketing functions.

During the 1950s, contracting and vertical integration began to play a larger role in these industries (fig. 1). In the broiler industry, production contracts have been the preferred method of vertical coordination since the mid-1950s. The terms of production contracts typically specify that the processor will provide the baby chicks, feed, management, and veterinarian services. The grower provides the labor and chicken houses and is paid for raising the chicks. Today, nearly all broiler production and processing is coordinated through production contracts between growers and processors.

In the turkey industry, production contracts account for 56 percent of turkey production, and vertical integration accounts for 32 percent. Production contracts in the turkey industry are similar to production contracts in the broiler industry: the grower provides the buildings, equipment, and labor, and the processor provides poults, feed, veterinarian services, and managerial assistance. Vertically integrated operations, in which the processor owns all production facilities and hires labor to care for the birds, are more prevalent in the turkey industry than in the broiler industry.

In the table egg industry, changes in vertical coordination were more gradual than in the broiler and turkey industries; however, more than a third of eggs are now produced under production contracts. Under the terms of a typical pro-

duction contract arrangement for table eggs, the contractor provides layers, feed, and other supplies, and the grower provides labor and facilities. All eggs produced under the contract belong to the contractor, and the grower is paid a fee based on the number of eggs produced, with performance incentives.

In large owner-integrated egg operations, integrators produce, pack, and market eggs in their own facilities and may also mix feed, operate hatcheries, and raise pullets (Rogers). Compared with vertical integration in the broiler and turkey industries, vertical integration in the egg industry is more commonly used to coordinate production and processing and accounts for 60 percent of eggs produced.

### Why Production Contracts and Vertical Integration?

This report applies the transaction cost economics (TCE) paradigm to explain the substitution of contracts and vertical integration for spot markets. TCE relies on the existence of transaction costs. Transaction costs are costs associated with reaching and enforcing agreements, including those associated with planning, adapting, and monitoring economic activities. While these functions are not directly productive, they are required to coordinate the activities of buyers and sellers.

The TCE paradigm emphasizes the importance of asset specificity in the

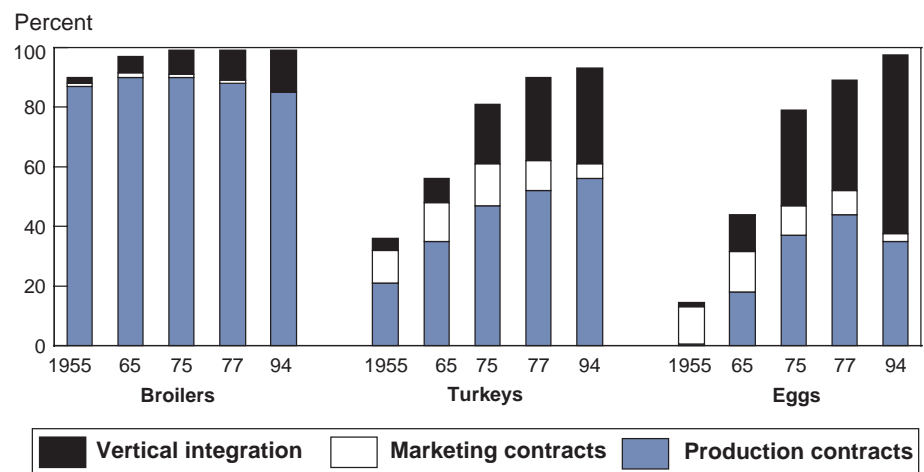
exchange relationship. Asset specificity refers to the extent to which alternative trading relationships can be easily arranged. A party that invests in assets that have few alternative uses and users may be subject to unscrupulous behavior by other parties to the transaction.

Alternatives to spot-market coordination can provide safeguards against unscrupulous behavior and reduce resource expenditures on haggling and bargaining over price. Private actions for breach of contract and public laws protecting contract parties can help enforce contract agreements. Vertical integration, which eliminates the exchange relationship, becomes more important as asset specificity and the costs associated with renege contracts increase (Klein et al.).

Types of asset specificity include physical, site, and temporal. Physical specificities refer to assets that have specialized physical features, such as special-purpose equipment or genetic inputs tied to a specific brand or product. Site specificities develop when buyers and sellers locate their facilities close to each other to reduce transportation costs. Because relocation costs are high, site specificities lock parties into an exchange relationship for the useful life of the asset. Temporal specificities derive from the importance of timely delivery of certain products, such as perishable agricultural products. In most cases of this nature, alternative trading arrangements cannot be easily

Figure 1

#### Poultry and eggs produced under contracts and vertical integration



Note: According to Roy, independent broiler production accounted for 95 percent of total production in 1950. Sources: Rogers; Manchester.

arranged on short notice. When physical, site, or temporal specificities are present to a significant degree, value is placed in continuing the relationship between specific trading partners.

In the broiler, turkey, and egg markets, investments in relationship-specific assets suggested a role for contracts and vertical integration, particularly in geographic regions in which these industries expanded. Following World War II, the poultry industry underwent rapid technological change, which led to specialized production facilities, processing plants, and breeding stock designed for the production of chickens for meat or for eggs. In the broiler industry, most growers invested heavily in production housing with limited alternative uses. In the turkey industry, as confinement and semi-confinement production operations replaced range rearing, increasingly specialized production stages created demand for feeds, equipment, and other products and services designed for each stage (Rogers; Small). By the mid-1980s, large and specialized turkey processing plants replaced plants that slaughtered both broilers and turkeys during the broiler slack season, a common practice in the 1960s (Gallimore and Irvin; Lasley et al.). In the table egg industry, specialized production replaced the general farm flock due to improvements in breeding, feeding, disease control, management, and marketing. Technological innovations in the 1950s and 1960s, including automated egg washers, blood spot detectors, and automated egg cartoners, encouraged large-scale production and mechanized handling and distribution of large numbers of eggs.

Investments in specialized production and processing assets affected the relationship-specific nature of transactions by limiting alternative uses and users of such investments. While the production houses may be specific in a production sense (that is, specialized to broiler production), they may not represent relationship-specific investments unless there are few buyers. Scale economies associated with the adoption of specialized technology resulted in fewer and larger poultry and egg operations, especially in regions of the South undergoing industry expan-

sion. Regions with relatively little output could more readily adapt new technologies because existing capital investments and production methods in these regions had little influence.

Limited procurement distances also created relationship-specific transactions in the poultry and egg industries. Live chickens can lose weight if transported over lengthy distances. Thus, to remain profitable, parties can move chickens only about 30 miles. Consequently, as advances in distribution technology made it more efficient to transport processed poultry products, large processing plants moved closer to the flocks. As processors sought high-production density to reduce the radius of their broiler supply sources, many contract growers had essentially no alternative trading partners. Vertically integrated operations, in which the integrator owns both the production and the processing facilities, were more common with larger-than-average broiler houses located closer to the processing plants.

Timing factors created temporal specificities in the poultry and egg markets. Poultry has a narrow range of time in which it must be sent to processors to prevent the birds' carcasses from being contaminated with foodborne pathogens. Mandatory inspection requirements in the late 1950s, which spurred large investments by poultry processing plants, also increased the importance of timely bird supplies. Table eggs experience weight loss and quality deterioration immediately after lay, so most eggs must reach the supermarkets within a few days of leaving the production house to ensure a fresh and safe product.

### **Marketing Contracts Dominate Hog Sales**

Since the early 1990s, the pork industry has experienced significant changes in vertical coordination. Marketing contracts between large producers and processors have become increasingly common. Contract terms typically specify that the producer will deliver a certain quantity of hogs to the processor at a certain time. The producer may receive a formula-based price, typically a spot-market price (for example, the

Iowa/Southern Minnesota market quote), with premiums or discounts based on size and quality of the hogs.

Production contracts, too, are becoming more common in the pork industry. Under the terms of these contracts, the contractor, typically a large producer or processor, provides management services, feeder pigs, veterinarian services, and other inputs. The grower provides land, facilities, and labor to feed the hogs to market weight. The grower receives a fixed payment, with premiums for efficient production. As in the poultry industry, processors in the pork industry may own feeder pigs and establish production contracts with growers to feed the hogs to market weight. Packer-owned hogs increased from 6.4 percent of U.S. hog production in 1994 to 24 percent in 2000, reflecting Smithfield Foods' (the Nation's largest hog producer and processor) recent purchases of two leading hog producers (Messenger). Most of these hogs are priced using formula-based marketing contracts with the production unit (Grimes and Meyer).

The pork industry has been moving toward more specialized hog production and processing operations for over 60 years, but the trend appeared to accelerate in the 1990s (Hurt). Modern facilities are equipped with state-of-the-art technology dedicated only to pork production (Brewer et al.). These new technologies are more commonly used in the larger hog-production operations.

Expanding hog-production regions (for example, the South Atlantic region, led by North Carolina, and the South Central region, led by Oklahoma) used the newer, specialized technologies nearly a decade before traditional hog-production areas of the North Central region (Brewer et al.; Hurt; Hurt et al.).<sup>1</sup> The North Central region, which had its last major capital-

<sup>1</sup>The North Central region consists of Illinois, Indiana, Ohio, Wisconsin, Michigan, Iowa, Minnesota, Missouri, Kansas, Nebraska, South Dakota, and North Dakota. The South Atlantic region includes North Carolina, South Carolina, Georgia, Virginia, Florida, West Virginia, Maryland, and Delaware. The South Central region consists of Alabama, Mississippi, Oklahoma, Texas, Tennessee, Kentucky, Louisiana, and Arkansas.

ization in the late 1970s and early 1980s, was characterized by smaller, more diversified farming operations and older hog production technology (Foster et al.). Much of the newer technologies could not be fully implemented by these operations given their existing physical and human capital.

Regional differences in the adoption of the newer technologies, and associated scale economies, are reflected by differences in the size of operations. In 1997, units marketing 7,500 or more hogs and pigs accounted for nearly all production in North Carolina and Oklahoma, compared with less than 40 percent of production in Iowa and Illinois (Martinez). Lower production costs for large operations resulted from the application of specialized technology, large capital expenditures, bulk purchasing, and other strategies to achieve economies of scale (Brewer et al.).

Small-number conditions were also apparent in regions of hog-industry expansion. A limited number of processors accounted for a large share of slaughter capacity in the South Atlantic and the South Central, the expanding production regions, compared with the North Central region. This scenario leaves producers with fewer alternative outlets and, hence, makes them more vulnerable to opportunistic behavior by processors. The number of alternative hog suppliers to packing plants also was especially limited in the expanding regions. Traditionally, hog-packing plants were concentrated in the North Central region because of the abundant supply of hogs within a reasonable distance of the packing plants (Zering). More packing capacity generated more hog production, which generated more packing capacity. In 1992, this regional cycle was broken when Smithfield Foods opened the world's largest pork-packing plant in Tar Heel, North Carolina.<sup>2</sup> Smithfield's plant was twice as large as any plant in the North Central region (Hurt et al.). The plant was also built to Japanese and European standards, featur-

ing optical probes to measure backfat and loin eye depth and magnetic resonance imaging to measure fat content in hams (Miller). This plant opened at a time the North Carolina/Virginia region already had excess processing capacity, a limited share of U.S. hog inventory, and few other hogs and processors within reasonable trucking distance.

Investments in specific genetic inputs for producing pork with unique quality attributes have also increased. For example, in the early 1990s, Smithfield Foods introduced Lean Generation Pork in response to diet and health concerns related to fat content of foods. Lean Generation Pork is produced from National Pig Development hogs, the leanest U.S. hogs in large-scale production. In this case, specialized genetics represent a relationship-specific asset, regardless of small-number conditions, because the genetic inputs are tied to a specific brand. Smithfield obtained uniform genetics for the pork through a partnership with a leading hog producer, Carroll Foods, involving long-term marketing agreements and joint ownership of hog-production operations.

Timely delivery of hogs to the processing plant affects processing costs. Modern pork processing plants are designed to operate efficiently at a particular level of use, and operating costs rise rapidly at other levels of production.

## Why Marketing Contracts?

Although processor-owned hogs are becoming more common, marketing contracts remain the prevalent method of vertical coordination in the pork industry, unlike in the poultry and egg industries. The prevalence of relationship-specific investments in the poultry and egg industries likely leads to more vertical integration, which reduces the likelihood of holdup. In hog markets, temporal specificities have less influence because there is greater flexibility in the age at which hogs can be slaughtered. Site specificities also have less influence because hogs have a higher dressing percentage and more value, which enables them to be transported longer distances (*Pork '99 Staff*).

The TCE paradigm provides additional insight into the pork industry's reliance on marketing contracts. The paradigm suggests that uncertainty, coupled with relationship-specific assets, increases the importance of organizing transactions in ways that avoid costly haggling by adapting as conditions change. Uncertainty derives from a number of sources, including (1) technological changes, unpredictable changes in consumer preferences, and random acts of nature; (2) lack of timely communication regarding decisions and plans made by others; and (3) strategic uncertainty related to nondisclosure, disguise, or distortions of information. Because contracts that account for all future contingencies are extremely costly to write, contracts will necessarily be incomplete. In the presence of relationship-specific assets, value is placed in an ongoing relationship between trading partners, so transactions will be organized in ways that adapt to changing market conditions.

Given investments in relationship-specific assets, parties may respond to increasing uncertainty in two ways. First, parties may engage in contracts that are relational in nature. That is, instead of laying out specific details, contracts will specify the process through which future terms of trade will be determined. Contracting parties may also respond to increasing uncertainty by progressing from marketing contracts to vertical integration in the spectrum of control (fig. 2) (Frank and Henderson). When the level of uncertainty becomes particularly high, *ceteris paribus*, vertical integration is expected to become more prevalent.<sup>3</sup> While contracting relies on the ability to anticipate potential problems, vertical integration requires no contract revisions and serves to facilitate adaptation to changing circumstances as they unfold (Masten).

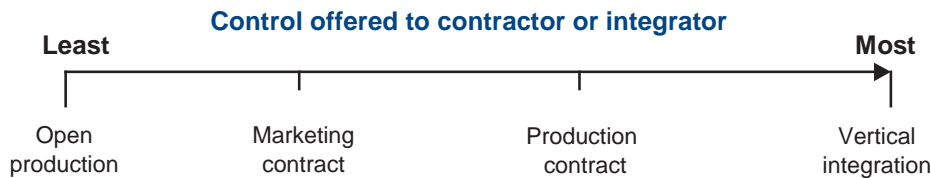
Marketing contracts that are relational in nature provide a compelling incentive for use of these contracts in the pork industry. With formula-priced contracts, which are the most popular type of hog-marketing contract, payments adjust automati-

<sup>2</sup>Later, in 1995, Seaboard opened a large, state-of-the-art processing plant in Guymon, Oklahoma.

<sup>3</sup>Economists use the term "ceteris paribus" to indicate that all variables except those specified are assumed not to change.

Figure 2

### Methods of vertical coordination along the spectrum of control



Source: Mighell and Jones.

cally to changes in market conditions because contract payments are typically linked to a spot-market price. This outcome limits opportunities for producer or processor holdup because it is not necessary for parties to continually renegotiate the base price. In addition, subsequent to significant changes in vertical coordination in the poultry industries, advances in information technology may have reduced some sources of uncertainty for the pork industry in the 1990s. These changes suggest that production contracts and vertical integration, which offer more control to the contractor and integrator, would be less necessary as a means for adapting to uncertainty in the pork industry.

## Conclusions

Lessons from changes in vertical coordination in the poultry and egg industries offer insights into current developments in the pork industry:

- Spot-market trading is less feasible in markets characterized by (1) new and specialized technology in thin markets with few producers and processors, (2) close proximity of producers and processors, and (3) important scheduling and timing factors related to raw product deliveries. These situations expose investors to hazards related to unscrupulous behavior by other parties.
- In the presence of relationship-specific investments, market uncertainty from a number of sources—including technological advances, price and quantity instability, and lack of communication with others in the vertical system—can determine the type of contract/vertical integration alternatives selected. As

uncertainty increases, contracts should provide the integrator with greater control over production. When uncertainty or relationship-specific investments are especially significant, processing and production should be coordinated through vertical integration.

- Based on the way policies are shaped, enacted, and enforced, policymakers can indirectly influence decisions to enter production contracts and vertically integrate. Uncertainties and inconsistencies related to enactment and enforcement of antitrust and environmental policies create incentives for contracting and vertical integration.

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