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## Price and Quality of Pork and Broiler Products What's the Role of Vertical Coordination?

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### Abstract

*Significant changes in vertical coordination of the U.S. broiler industry many years ago may provide useful insight into the rapid changes occurring in today's pork industry. Under production contracts and vertical integration, the broiler industry developed and grew into the leader in U.S. meat production—outpacing beef and pork. Production efficiencies, quality assurances, and convenience in product offerings have led to falling chicken prices and rising per capita consumption. Incentives for contracting in the pork industry are similar to those in the broiler industry in many ways. The similarities suggest that consumers may also expect plentiful supplies of high-quality pork products at economical prices.*

### Introduction

The industrialization of the U.S. pork industry currently under way is characterized by major changes in structure and organization, including changes in vertical coordination. Methods of vertical coordination, or the synchronizing of product transfer from one stage of production to the next, include open-market coordination through spot prices, contractual arrangements, and vertical integration. Contracts and vertical integration are replacing open-market coordination.

Past developments in vertical coordination of the broiler industry may offer some insight into the developments in today's pork industry. Growth of the U.S. broiler (young chicken produced for meat instead of eggs) industry was achieved largely through production con-

tracts and vertical integration, whereby production at consecutive stages of the food system (such as production and processing) occurs with inputs (such as facilities and broilers) owned by a single firm. Today, integrators—typically processors—produce nearly all broilers under contract with growers or in the company's own facilities. The broiler industry experienced substantial gains in production efficiency, which has lowered chicken prices (adjusted for inflation). The industry has also established a variety of brand-name and convenience-type retail products.

New methods of vertical coordination can lower production costs and improve product quality. Replacement of open-market coordination with contracts and vertical integration are notable examples. They can facilitate the rapid and thorough adoption of new technology; reduce

costs of measuring and sorting for quality attributes; shift price and production risk; and facilitate financing, thereby allowing rapid growth in production and scale economies.

This report summarizes and updates an ERS analysis that compared vertical coordination in the pork and broiler industries. First, a description of productivity gains and quality improvements in both industries is provided, followed by a description of changes in vertical coordination. The final section discusses the relationship between productivity gains and quality improvements, and new methods of vertical coordination.

### Growth and Development of the Broiler Industry

Adoption of technological advances in the 10-year period following World War

It was substantial. Vitamins added to feed enabled birds to be raised in confinement, which led to year-round production. Mechanical innovations significantly improved production efficiency by reducing labor requirements and improving the broiler-growing environment. Broiler production developed independently from the other poultry enterprises, as chickens were bred for their meat quality rather than their egg-laying ability.

With the decline of the cotton industry, broiler production and slaughter capacity expanded into the South. Through vertical contracting arrangements, the use of excess labor at wage rates lower than in traditional production regions kept down production costs in the new production regions. Processors benefited by shorter hauling distances from fewer and larger growers.

The rapid adoption of new technology had an unprecedented impact on broiler production efficiency, output, and prices. Since 1955, the deflated retail price of whole broilers has fallen by 61 percent.

Processors focused increasingly on product differentiation, through further processing and brand labeling. In 1995, 63 percent of broiler volume was cut-up and sold as parts, and 11 percent was sold as further processed products, such as chicken franks, patties, nuggets, and marinated products (National Broiler Council).<sup>1</sup> In 1988, brand names accounted for half of all supermarket sales of broilers, and brand-name broilers commanded a 14-percent premium over supermarket brands (Bugos).

Lower prices and response to consumer preferences for convenient, nutritious, high-quality broiler products have led to continued increases in consumption. Per capita consumption of broilers in the United States has increased more than 100-fold, from 0.7 pound in 1935 to 74 pounds in 1998, exceeding pork consumption for the first time in 1986. In 1993, per capita consumption of broilers surpassed that of beef, until then the leading meat product.

<sup>1</sup>See References section for full citations.

## The Pork Industry: An Industry in Transition

New technology, typically incorporated into the newer production facilities, is an important driving force for structural and organizational changes in the pork industry. Examples include high-density, fat-added diets; high-speed, single-species feed mills; artificial insemination; centralized management that quickly implements changes; and employment of consultants and specialists in all areas of production (Hurt). Specialization in phases of production reduces the risk of disease outbreaks and results in improved utilization of labor and facilities.

As with the broiler industry, production of hogs is expanding rapidly in nontraditional areas, particularly in the Southeast and, to a lesser extent, in the West and Southwest. Hog producers in nontraditional, corn-deficit areas of production can compete with the traditional areas in the Midwest because of lower land and labor costs, bulk grain purchases, high-speed feed mills, newer and technologically advanced production systems, and less strict environmental regulations (Hayenga and others, 1998; Rhodes; Iowa State University). Large-scale hog producers more readily adopt current technology (Good; Hayenga and others, 1998) and are proportionately more important in areas outside of the Midwest. For example, according to the 1997 Census of Agriculture, units marketing 7,500 or more hogs and pigs accounted for 92 percent of total production in

North Carolina and 93 percent of the total in Oklahoma. These compare with 36 percent of the total in Iowa and 38 percent in Illinois. Large hog farms have higher reproductive efficiency, as indicated by the number of pigs weaned per litter (fig. 1).

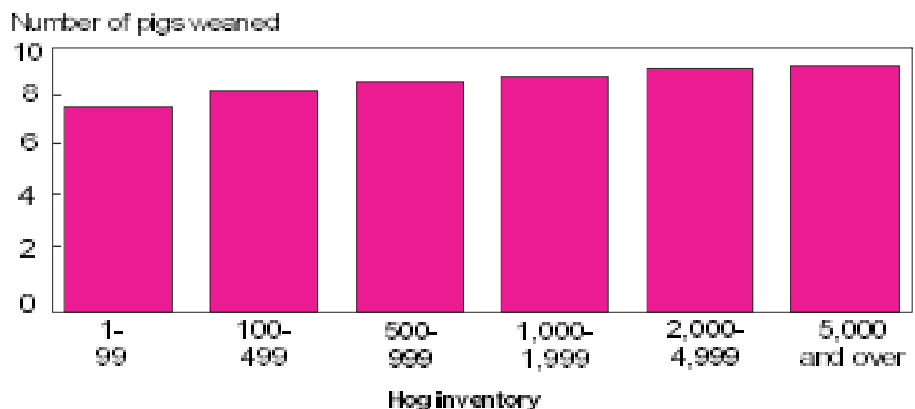
Slaughter capacity has followed the growth of hog production in nontraditional areas. For example, the Virginia/North Carolina region accounted for 14 percent of U.S. commercial hog slaughter in 1998, compared with 9 percent in 1990 (USDA[b]).

Productivity gains in the pork industry have contributed to lower retail prices and higher per capita consumption. From 1990 to 1998, the average retail pork price fell 8 percent and per capita consumption of pork increased 6 percent.

Some companies have made great strides in improving the quality of pork products. Smithfield Foods' Lean Generation pork was the first to be certified by the American Heart Association (AHA) as "heart healthy." Foods displaying the heart-check mark are evaluated to ensure that they meet the criteria of AHA's Food Certification Program. To become eligible for the heart-check mark, foods must satisfy nutritional guidelines regarding fat, saturated fat, cholesterol, sodium, and other nutrients (American Heart Association).

Increases in exports also indicate improvements in pork quality. In the

Figure 1  
Larger operations weaned more pigs per litter in 1998



Source: USDA[a].

1990's, U.S. pork exports have increased five-fold. Japan, the leading importer of U.S. pork, imports higher quality pork products as indicated by its per-unit value of U.S. pork exports. In 1997, the average value of U.S. pork exports to Japan was \$1.47 per pound, compared with \$0.85 per pound for Canada and \$0.80 per pound for Mexico (*Pork '98*).

## Important Changes in Vertical Coordination

Contracting in the broiler industry grew quickly. In 1950, 95 percent of broiler growers operated independently. By 1955, independent producers accounted for only 10 percent of total broiler production, whereas 88 percent were produced under a contract arrangement, mostly with feed dealers, and 2 percent were produced in integrator-owned broiler facilities.

Feed companies became even more directly involved in the broiler business by adding hatcheries, acquiring processors, and building their own processing facilities. In the 1970's, processors replaced feed companies as the integrators of the broiler marketing system.

Today, most major processor-integrators control the vertical stages of the broiler industry through vertical integration and production contracts. Integrators, such as Tyson, breed the parent stock, produce hatching eggs (often under contract), hatch the eggs, and contract with growers to raise the chicks.

In the pork industry, hogs produced under production contracts grew from 18 percent of the total in 1994 to 30 percent in 1997 (Miller). Production contracts between growers and large hog producers, also referred to as *integrators* or *contractors*, have been used in nontraditional regions of production. Integrators in the pork business typically establish production contracts with smaller growers to feed the hogs to market weight. The integrator provides management services, feeder pigs, medicine, and other inputs, while the grower provides the labor, facilities, and land. In return, the grower receives a fixed payment, adjusted for production efficiency.

Market-specification contracts, commonly referred to as marketing contracts or agreements, between the large hog-producer-integrators and large packers are replacing open-market transactions at a rapid pace. In early 1999, packers obtained nearly 60 percent of hogs through contracts or integration (University of Missouri and National Pork Producers Council) compared with less than 2 percent in 1980. Typically, these contracts specify that the producer deliver a certain quantity of hogs, to a certain location, at a specific time. In return, the producer usually receives a market-based price that is adjusted for quality premiums.

## Incentives for Vertical Coordination

Changing methods of vertical coordination support the industrialization process in a number of ways.

First, the use of specific assets—those with a much greater value in a particular use compared with the next-best alternative—may serve as an incentive to vertically contract. As assets become more specific, parties become more susceptible to opportunistic behavior when there are few traders. This is because they have few alternative uses or users for their specific investments and, hence, are subject to concessions (for example, reduced price offerings) by a trading partner in an exchange relationship. Some protection may be provided by entering into contracts, where limits are placed on acceptable behavior. The legal system provides an explicit set of rules and procedures for resolving disputes, assesses penalties for breach, and limits the likelihood of obtaining concessions in instances of failure to perform. Broiler housing facilities, hatcheries, processing plants, and breeding stock have a low value outside of their intended purpose. Growers tend to locate their broiler houses close to feed mills and processing facilities, because broilers are perishable commodities and transportation costs of feed and market-ready broilers are high. Delays by processors may be effective in eliciting price concessions because it is difficult for producers to find alternative markets for broilers on short notice. Spa-

tial concentration of processor-integrators may reduce the number of alternative trading partners for the broiler growers. Production contracts between the grower and integrator reduce the likelihood of opportunistic behavior on the part of the integrators.

Marketing contracts can also lower the incidence of opportunistic behavior associated with investments in specific assets that are designed to improve hog quality. Breeding stock that produces exceptionally lean hogs can be considered a specific asset. Take the case of NPD hogs, for example. Before its recent purchase of Carroll's Foods, Smithfield Foods had an arrangement with affiliates of Carroll's Foods to raise and purchase hogs through long-term contracts. In 1991, this arrangement, referred to as Smithfield-Carroll's, acquired the exclusive franchise rights from the National Pig Development Company, a British firm, to develop and market the exceptionally lean NPD breed of hog in the United States.

Second, the inability to foresee all future possibilities when formulating decision plans, together with uncertainty in market conditions, provides motivation for new methods of vertical coordination. Limited foresight and uncertain market conditions complicate the writing and enforcement of contractual arrangements, because it becomes increasingly costly to account for all possible contingencies (Williamson). When unplanned events occur, parties to the arrangement must find ways to adapt. This creates possibilities for opportunistic behavior by trading partners. Contractual arrangements attempt to solve the opportunism problem through court enforcement. However, the courts must be able to distinguish whether contract renegotiations are motivated by opportunism or are efficient responses to changing market conditions, which is a difficult task in the presence of uncertainty. Under highly uncertain conditions, contractual arrangements are less conducive to court enforcement. Uncertainty provides the impetus for vertical integration, where both parties share a common interest, thereby alleviating adversarial relationships. Hence, as the degree of uncer-

tainty increases, vertical integration becomes more likely. By mitigating the effects of uncertainty, vertical integration facilitates effective decisionmaking and efficient allocation of resources.

Consider a comparison of broiler volume uncertainty in the 10 years from 1955 to 1965 to the recent volume uncertainty in the pork industry (table 1). These two periods are compared because they represent periods of significant changes in vertical coordination. In the broiler industry, extensive vertical integration occurred between feed dealers and processors between 1955 and 1965. Recently, extensive increases in marketing contracts occurred between producers and packers in the pork industry. Supply volume uncertainty is indicated by variations in monthly production levels (USDA[c]). While the standard error of monthly production is larger for the pork industry, a direct comparison is not appropriate because pork production is nearly four times greater. A comparison of the coefficient of variation, a unitless measure of variability, indicates that broiler volume in the early 1960's was more than twice as variable as more recent pork volume. Vertical integration between feed companies and broiler processors in the early 1960's represented a greater degree of control than did more recent marketing contracts between pork packers and producers.

Third, measuring and sorting costs that are associated with quality attributes of the raw product (such as leanness, PSE (which leads to pale, soft, exudative (or watery) meat),<sup>2</sup> size, uniformity, and meat yield) can be reduced by contracting between the producer and processor, or by vertically integrating. The raw or processed product requires measuring to determine its value. If products are heterogeneous with respect to quality attributes, then costly sorting also may be required to determine its value. When the quality of an input is easier to measure than the quality of the output, and input quality is strongly related to output quality, then the purchaser of the output may

<sup>2</sup>PSE pork is susceptible to moisture loss because of the watery condition and is tough, dry, and lean after cooking.

**Table 1. Past volume uncertainty in the broiler industry exceeds recent uncertainty in the pork industry**

Item	Broilers (ready-to-cook), 1955-65	Pork, 1990-98
Average annual production (million pounds)	4,586.7	17,139.1
Standard error <sup>1</sup>	679.8	999.0
Coefficient of variation <sup>2</sup>	15	6

<sup>1</sup>The standard error is the square root of the variance. <sup>2</sup>The coefficient of variation is calculated by dividing the standard error by the average and multiplying by 100. Source: ERS/USDA.

choose to measure input quality to assure output quality (Lazear). This can be accomplished through direct control in the form of vertical integration or through contracts that specify inputs in farm production or quality attributes of the farm product.

In the broiler industry, production contracts have specific requirements that lower measuring and sorting costs by controlling size, aesthetics, and uniformity for meeting the quality requirements of slaughter plants. Inputs—such as management services, feed from processor-owned feed mills, equipment, and genetics—are standardized across growers.

Brand-name products and cost-lowering mechanization in processing and handling have been made possible by the uniformity of broilers. For example, in 1961, Holly Farms added hatcheries, feed mills, a breeder flock, and a processing plant, and contracted for broiler growing. By 1964, Holly Farms was the first to market broilers that were pre-packaged at the processing plant. These broilers were distributed as fresh (not frozen) products and marketed under the Holly-Pak label.

Because the value of pork is largely determined by genetics and weight, the use of multi-year contracts between producers and packers that specify quality characteristics may reduce measuring and sorting costs. A survey of large packers found that half of them required minimum quantity and quality specifications, or specific genetic requirements (Hayenga and others, 1996).

Fourth, production contracts shift price and production risk from growers to integrators. Growers do not have to worry about prices of inputs (for example) rising, because the integrator provides the animals, feed, and other key inputs. Under absolute performance payment schemes, most common in the hog industry, the risk of falling output prices also is shifted from the grower to the integrator, because grower payments are independent of market prices. Under relative performance payment schemes, most common in the broiler industry, grower receipts depend on the grower's performance relative to that of other growers. In the case of common production shocks, such as weather conditions, grower payments are not altered because relative performance does not change. This effectively shifts common production risk to the integrator. However, growers are still responsible for production risks that affect the performance of their flock, such as equipment problems. This provision limits grower shirking or failure to perform.

Reductions in the cost of managing risk can contribute to increases in chicken and pork supplies. Income uncertainty entails a cost to producers that would reduce the supply of animals, assuming that producers are risk-averse. For broiler contracts examined by Knoeber and Thurman, 84 percent of price risk was transferred from growers to integrators. Therefore, while actual price variability may be quite high, it is effectively mitigated. For a North Carolina hog integrator, absolute performance contracts were found to shift 90 percent of income risk



from the grower to the integrator during 1985-92 (Martin).

Finally, contracting can assist producers in obtaining financing and in reducing capital constraints. Through production contracts, financially stronger feed companies reduced broiler growers' capital requirements by providing most of the variable inputs (such as chicks, feed, and medicine). In the pork industry, production contracts allow integrators to grow rapidly and capture economies of size. For example, instead of investing in all buildings and equipment required for a farrow-to-finish operation, the integrator can invest in specialized facilities, such as farrowing units, while the grower can invest in the remaining facilities, such as the nurseries and finishing facilities. This arrangement allows the integrator to build more farrowing units, for example, because the integrator does not have to invest in nurseries and finishing facilities.

## Conclusions

Comparisons of vertical coordination in the pork and broilers industries suggest the following:

- Production contracts facilitate rapid growth in new geographical areas by shifting price and production risk to firms better able to manage risk, and by sharing input costs between integrators and growers. Production contracts between growers and integrators reduce capital constraints and improve production practices. These contracts facilitate the rapid and thorough adoption of cost-reducing technology.
- Increased control over production through contract arrangements results in the uniform, high-quality broilers and hogs necessary for further processing, branding, and large-scale specification buying by restaurants and supermarket chains. By raising the quality of the animals produced, contracting and integration can lower the costs of measuring and sorting

broilers and hogs when they are marketed.

- While contracting and vertical integration are controversial developments in the pork industry, these arrangements can result in lower production and slaughter costs, lower consumer prices, and improved product quality—especially if the pork industry continues to follow the trend set by the broiler industry. The broiler industry has emphasized quality, variety, convenience, uniformity, and affordability in its product offerings. Consequently, retail chicken prices have fallen, and per capita consumption has increased.

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