

# The Role of Changing Vertical Coordination in the Broiler and Pork Industries

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Although the term “industrialization” is used to describe current changes occurring in agriculture (Urban), it was also used to describe major structural changes in the broiler industry nearly half a century ago. As the broiler industry grew, contracts and vertical integration played an important role in the adoption of new technology and the coordination of production with consumer preferences. The industrialization of the broiler industry yielded gains in production and marketing efficiencies that lowered the costs of chicken products. At the same time, the industry achieved a level of control over production and processing that has enabled it to respond to consumer preferences for high-quality, uniform, value-added products.

The U.S. pork industry in the 1990’s resembles, with some differences, the broiler industry in its industrialization process (Rhodes; Hurt; Barkema and Cook). These points are discussed below.<sup>1</sup>

## **Growth of the Broiler Industry<sup>2</sup>**

Since the 1930’s, relationships between vertical stages of the broiler industry (see box, “Vertical Stages of the Broiler Industry”) have changed significantly.

Coordination of vertical stages through production contracts and integrated operations facilitated the adoption of new technology and gains in production and marketing efficiency. Contractual arrangements between feed companies and broiler growers encouraged rapid adoption of new production technology. As the broiler industry grew, these contracts evolved in response to the changing needs of both the feed company and the

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<sup>1</sup>The discussion is patterned after the four-step structural change model developed by Reimund, Martin, and Moore, and recently applied to the Quebec pork industry (Gillespie, Karantininis, and Storey). These steps include (1) development of new technology, (2) production in new geographic areas, (3) growth and development, and (4) new methods of vertical coordination.

<sup>2</sup>This section is based on information contained in Sawyer; Knoeber and Thurman; Martin; Roy; Tobin and Arthur; G.B. Rogers; R.T. Rogers; National Commission on Food Marketing (NCFM); Bugos; Marion and Arthur; Hyk; and Mighell and Jones.

grower. Vertical integration between production and processing activities resulted in further gains in coordination between chicken production and demand.

## *Background*

Before the 1930’s, nearly every farm had a small flock of chickens for egg production; chicken meat was a byproduct of these laying flocks. Most frying chickens were fowl, laying hens that had outlived their fertility. Young roosters (cockerels) that were superfluous to the egg-laying flocks were also sold as frying chickens as a spring delicacy.

At the time, opportunities existed to raise birds for their meat on a year-round basis. The genetics of the cockerels, however, were for desirable laying characteristics rather than for meat. Hen meat was tough, dry, and strongly flavored, while the quality of the cockerel meat was only fair. The popularity of spring chicken suggested that a market existed for establishing a year-round supply of chicken meat. In an effort to extend the seasonal consumption pattern, substantial quantities of chickens were stored and sold in the frozen New York dressed form.<sup>3</sup> Upon thawing, however, the meat was watery and of poor quality.

The profit potential inherent in broiler production became evident during World War II. Unlike the red meats, poultry was not rationed during the war, encouraging its consumption. Broiler price ceilings in place at the time were profitable to the farmer, but were commonly evaded so that actual broiler prices exceeded the ceiling price. Broiler production nearly tripled between 1940 and 1945, despite poor feed quality and heavy disease losses.

These developments likely played a role in the postwar allocation of capital to facilities and research. Adoption of technological advances in genetics, disease control,

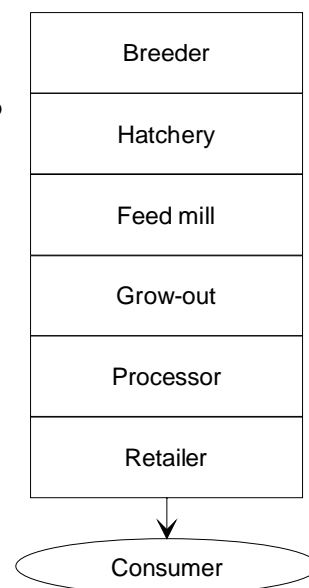
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<sup>3</sup>“New York dressed” form refers to killing, bleeding, and plucking the chicken without removing the head, feet, and inedible viscera.

## Vertical Stages of the Broiler Industry

Vertical stages of the broiler industry include the breeder farm, hatchery, feed mill, grow-out farm, processing plant, and retail market. Feed is provided to both the breeder farm and grow-out farm. Eggs from the breeder farm are sent to the hatchery. At the hatchery, the eggs are hatched, and the chicks are sent to the grow-out farm, where the birds are grown to market weight, in about 6 to 8 weeks. The birds are then sent to the processing plant, where they are slaughtered and dressed. The dressed birds are ice-packed or chill-packed (air-chilled) as whole birds or cut into parts. Other birds are quick-frozen, either in whole form or as individual pieces, or are shipped to another company-owned plant for further processing into value-added products, such as frozen nuggets and dinners. Processors sell their output to further processors, distributors, or to retail outlets, composed of the food service segment (institutions and restaurants) and retail grocery stores.

Source: Rogers, 1992



nutrition, housing, and materials handling in the 10-year period following the war were substantial (see box, “New Technology in the Broiler Industry in the 1940’s and 1950’s”). These innovations increased the size of production units to achieve economies of size and resulted in substitution of capital for labor. In 1954, for example, no farms sold 100,000 or more broilers; by 1964, 12.5 percent of farms sold 100,000 or more broilers (Reimund, Martin, and Moore). With the development of chickens bred for meat quality, broiler production could develop independently from the other poultry enterprises.

### *Developments in Contracting*

Although technological advances set the stage for growth and development of the broiler industry, most broiler growers operated independently at the time. The grower would buy feed from a dealer, chicks from a hatchery, and other supplies from another dealer. When the birds were ready for market, the grower would sell them to the processor who offered the highest price.

Financial resource requirements increased as production expanded and growers began operating broiler houses on a scale amenable to the new technology. Large capital requirements, coupled with declining, highly variable live broiler prices, made broiler pro-

duction a risky business. Many broiler growers, especially those in the rural areas of the South, were either financially unable to operate or unwilling to assume the price risk.

Large feed companies recognized the broiler industry’s potential for growth and the larger market that represented for their feed.<sup>4</sup> Consequently, they established production contracts with growers. These contracts later evolved to assure a market outlet for feed supplies, to reduce growers’ financial and income risks, and to create incentives for growers to produce efficiently. Risk and management responsibilities were increasingly transferred to the feed companies, also referred to as integrators (see box, “How Contracts Evolved in the Broiler Industry”).

Use of production contracts increased quickly. The first recorded broiler contract, signed in 1933, involved a joint sharing of risk and profit between a feed dealer and grower. In 1950, 95 percent of broiler producers remained independent (Roy). By 1955, however, after the large national feed companies moved into broiler-producing areas of the South, independent producers

<sup>4</sup>Feed is an important component of the grow-out stage, representing about 70 to 75 percent of grow-out costs.

accounted for only 10 percent of total broiler production, whereas 88 percent were produced under a contract arrangement and 2 percent were produced in company-owned broiler facilities (fig. 1). Nearly all broilers are grown under contract or in integrator-owned facilities.<sup>5</sup>

With the decline of the cotton industry in the South, the broiler industry's shift to the use of contracts encouraged an expansion of broiler production there (Roy). In 1950, Georgia, North Carolina, Arkansas, Alabama, and Mississippi accounted for 27 percent of U.S. broiler production; by 1965, they had become the top five broiler-producing States in the Nation, accounting for 60 percent of U.S. production (National Commission on Food Marketing). Through vertical contracting arrangements, the use of excess labor at lower wage rates reduced production costs in the new production regions.<sup>6</sup> Hatchery efficiency gains also contributed to lower chick prices. In 1961, the cost of producing broilers in the Southeast was about 15 percent lower than on the Delmarva Peninsula (Delaware, Maryland, Virginia) (Roy).

### Developments in Vertical Integration

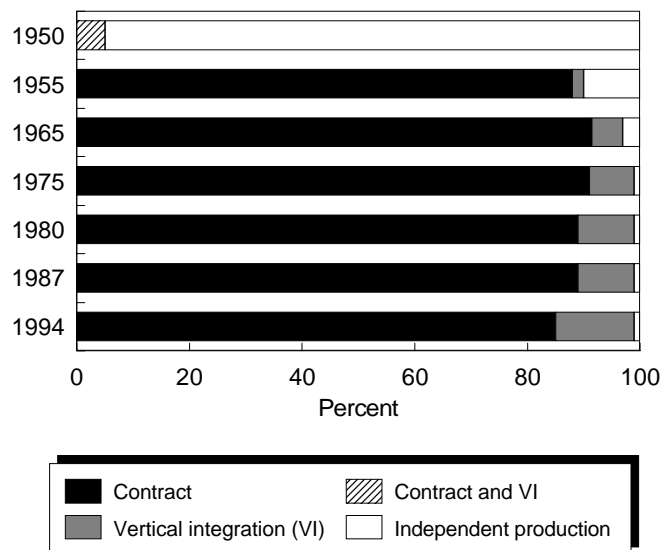
As broiler production and consumption expanded at a rapid pace in the 1950's, supplies and prices became more unstable (Tobin and Arthur). Shortrun profitability considerations led to production decisions that did not account for longer range considerations affecting the industry.<sup>7</sup> Feed companies often did not communicate with buyers of dressed broilers, who provided market information. The feed companies were likely to be overly influenced by fluctuations in the markets for baby chicks and feed, and out of touch with day-to-day markets for dressed broilers. This situation created an imbalance between supplies and demand.

<sup>5</sup>Contracts can vary according to the degree of control offered to the integrator. While most broilers were grown under contract by 1955, contracts continued to evolve.

<sup>6</sup>Contracting was familiar to southern farmers who had been sharecroppers (Bugos).

<sup>7</sup>Operating efficiently within a particular stage of a marketing system does not guarantee efficiency of the entire system. The goals of a single stage may not coincide with the goals of the other stages.

Figure 1  
**Proportion of broilers produced under contracts, vertical integration, and independent production**  
*Production contracts increased rapidly after 1950*



Note: Roy does not distinguish contracting and vertical integration in 1950.

Source: Compiled by ERS, USDA from Roy; Knutson, Penn, and Boehm; Marion; and Manchester.

The Poultry Products Inspection Act (PPIA) of 1957, which required USDA inspection of all broilers traded across State lines by January 1, 1959, placed additional pressure on the industry to increase production. Before 1959, USDA offered voluntary inspections of broilers for wholesomeness, the results of which were used as a competitive selling device. The PPIA was designed to instill consumer confidence and to protect against substandard health practices following a spate of deaths from bacterial disease traced to contaminated poultry meat. Many processors needed to make major capital investments to comply with the new sanitary requirements. Consequently, they built new plants to meet the inspection requirements. From 1958 to 1959, the percentage of broilers inspected increased from 25 percent to 75 percent. At the same time, capacity was increased and automated processing equipment was updated. Some increase in capacity, which would have occurred sooner or later, was squeezed into the 12 to 14 months before 1959 (Tobin and Arthur). Increased capacity allowed plants to cover the cost of capital investments only by operating at greater volumes of production.

## New Technology in the Broiler Industry in the 1940's and 1950's

Many important technological advances occurred in nutrition, medicine, buildings and equipment, and genetics in the 1940's and 1950's. Research on feed formulations led to substantial improvements in feed efficiency. In the process of studying vitamin B<sub>12</sub>, researchers discovered that growth was being stimulated by properties that were unexplainable by vitamin B<sub>12</sub> itself. This led to the discovery of the antibiotic Aureomycin (chlortetracycline), which led to a completely new era of nutrition research. Not only did antibiotics serve as growth stimulants, they had great value in disease control. This enabled flocks to be grown in confinement. In the early 1950's, antioxidants were introduced, which prevented rancidity in fat used in high-energy poultry rations.

To overcome the cost and tedium of feeding birds by hand, automatic feeding was introduced in the late 1940's, using a specially designed chain to carry feed along troughs throughout the house. Other equip-

ment innovations included waterers, ventilation equipment, chick sorters, and feed cleaners.

Around 1950, advances in feed medications allowed poultry to receive medication through the feed. In addition, vaccination through drinking water was developed. These advances were also compatible with the larger commercial-sized flocks because the entire flock could be treated at once, which reduced labor costs.

Substantial investments were also made to develop strains of chicken that were bred strictly for their meat qualities. The "Chicken-of-Tomorrow Program," initiated in 1945, was an annual contest sponsored by the Great Atlantic and Pacific Tea Company that became instrumental in encouraging leading breeders to breed broilers for their meat qualities, particularly the yield of meat from breasts, thighs, and drumsticks.

Sources: Hyk; Tobin and Arthur; Sawyer.

In the spring of 1958, integrators placed additional orders to breeders for more pullets (young hens) to be placed in the hatchery supply flocks in response to higher broiler chick prices. This response to current chick prices was apparently made without regard to prospective demand for broilers several months in the future (Tobin and Arthur). At the same time, integrators were building their own hatcheries. The buildup in the hatchery supply flock in 1958 led to a 13-percent drop in live broiler prices from 1958 to 1959. Many hatcheries and feed companies experienced major losses because of overproduction and depressed broiler prices. By 1961, live broiler prices had dipped an additional 14 percent from the depressed 1959 levels.

Following these drops in broiler prices, further changes in organization occurred. To coordinate production capacity at each stage, feed companies became more directly involved in the broiler business. The feed and hatchery stages became integrated as many feed companies added hatcheries and expanded growing operations, possibly due to the volatility of hatching-egg prices faced by inde-

pendent hatchery operators (Sawyer). Feed companies also developed closer ties with processors by acquiring or merging with processors and by building their own processing facilities (Sawyer). Processors' day-to-day exposure to the dressed broiler market gave them more market information than producers, so processors seemed in the best position to coordinate the hatching-egg operation. By integrating with the processing stage, feed companies came in closer contact with the market for dressed broilers and could therefore more closely coordinate broiler supplies with the consumer market for chicken.

As feed companies increased their processing operations, independent processors and independent producers found themselves with fewer markets for buying and selling broilers. Consequently, independent processors established their own contracts with feed companies to obtain birds or with growers to produce the birds (National Commission on Food Marketing). Many smaller independent producers were forced out of the broiler business, while others purchased their own processing facilities.

## How Contracts Evolved in the Broiler Industry

Six basic types of contracts were used in the broiler industry, including (1) open account, (2) guaranteed price, (3) flat-fee, (4) sharing, (5) feed conversion, and (6) combination.

The first contracts between the integrator (usually a feed company) and growers were open *account contracts*. Under these arrangements, credit was extended that eased the grower's capital constraint. The growers provided housing, equipment, labor, fuel, and other inputs. When the broilers were sold, the grower repaid the debt. Profit to the feed company came from markups on inputs or a flat service charge. All profits and losses were sustained by the grower. As growers began to specialize in broiler production and rely on the business as a source of income, price and production risk became more critical.

*Guaranteed price contracts* lowered grower price and output risk and reduced financial constraints. Under these contracts, the feed company furnished supplies for a fee. Because the grower was guaranteed a certain price when the birds were sold, price risk was shifted to the integrator. When the contract price exceeded the cost of inputs, the grower received the difference. If the guaranteed price did not cover the cost of supplies advanced to the grower, the loss was canceled. Hence, some production risk was shifted to the integrator as well. Growers were still subject to input price risk and excessive capital requirements. Also, a guaranteed price encouraged shirking by the growers, resulting in poor-quality birds.

*Flat-fee contracts* became the most widely used arrangements in the 1950's and 1960's. The integrator provided feed, medicine, and chicks and retained title to the broilers. The integrator sent advisors to improve farm production practices. The grower was no longer indebted to the integrator for inputs. When the birds were sold, the grower received a "flat fee" per bird, pound, or week as compensation for labor and some inputs. Because growers were no longer indebted to the integrator for inputs, their capital requirements and output risk were reduced. In addition, input and output

price risks were transferred to the integrator. Because grower payments were not based on feed efficiency, and growers' effort was not easily monitored, these contracts encouraged shirking.

To deter shirking, integrators developed variations of the flat-fee contract. Under *share contracts*, the integrator provided the chicks, feed, medicine, and fuel, while the farmer provided the house, equipment, and labor. Bird receipts in excess of integrator costs were shared by the integrator and farmer, thereby giving each a partial interest in the other's objectives. Losses were absorbed by the integrator. However, input price markups by the integrator were encouraged, so that profits to be shared were lower. In addition, growers were still subject to burdensome capital requirements and output price risk and had some incentive to shirk.

*Feed-conversion contracts* were designed to provide an incentive for improved production practices. A feed-conversion bonus was paid to the grower, along with the flat fee payment, based on pounds of feed per pound of bird. The farmer had less incentive to shirk because income was directly related to performance level. However, the grower was still subject to production risk and capital constraints.

*Combination contracts* combined the desirable attributes of the previously discussed contracts. These contracts usually involved a flat fee payment to the grower adjusted by some bonus payment to discourage shirking. A bonus was added to the flat fee, depending on profit-sharing, feed efficiency, mortality, or some other basis. In addition, the integrator commonly bases the bonus payment on the grower's performance relative to other similar growers, rather than on an absolute standard. For instance, a grower may receive payment based on an average cost of production, which is then adjusted up or down depending on the individual grower's cost compared with the average.

Source: Martin.

In the 1970's, many feed companies left the broiler industry because of depressed broiler prices and high input costs (Hyk). Processors took over ownership of almost all stages to gain efficiencies from improved coordination (Rogers, 1992). The processors' role as integrator was influenced by the significant economies of size in poultry processing and the large proportion of value added in processing (George Morris Centre).<sup>8</sup>

The major integrators recently expanded into the basic breeding of the broiler stock as well (Rogers, 1992). In 1985, a British subsidiary of the Cobb Company, a primary breeder owned by Upjohn, introduced the Cobb 500 female line into the United States. The Cobb 500 resulted in a large, easily deboned breast that provided 2 percent more breast meat. The new bird appealed to Tyson Foods, a large integrator that served most of the institutional market, where frozen, deboned breasts were sold. To prevent competitors from monopolizing the breed, Tyson initially purchased half ownership in the Cobb Company (Bugos). In 1994, Tyson increased its ownership interest to 100 percent by acquiring Upjohn's remaining 50-percent interest. The Cobb Company continued to improve the bird to produce larger and more uniform breast yields that Tyson demanded.

### *Productivity Gains*

Rapid adoption of new technology had an unprecedented impact on production efficiency, costs, and output in the broiler industry. By 1990, a ton of feed could produce 43 percent more broiler meat than in 1955. More automated equipment, larger houses, and more productive birds increased the productivity of farm labor. In the late 1940's, approximately 5.1 hours were required to produce 100 pounds of broilers; that had declined to about 0.1 hour by the late 1970's (fig. 2). Production costs fell by approximately half in the two decades following World War II. Over the same period, deflated costs fell by 65 percent. In the early 1970's, deflated production costs continued to fall, despite rapidly increasing input prices (for example, feed and energy). Production efficiency gains generated a five-fold increase in broiler supplies from 1946 to 1957, and another five-fold increase from 1957 to 1997.

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<sup>8</sup>Processors are now commonly referred to as "integrators" because of their involvement in the entire broiler subsector.

Developments in the retail sector also influenced the broiler industry. Following World War II, supermarkets, relying on price and advertising, replaced specialty meat markets to the benefit of the broiler industry. Supermarkets often used broilers as price leaders because they sold at lower prices than other meats. This practice reinforced consumers' perceptions of broilers as a good buy and played a role in the tremendous expansion in broiler consumption and broadening of the broiler market without direct promotional expense by the producer (Tobin and Arthur). In addition, selling eviscerated (cleaned and disemboweled) chicken appealed to the retailer because it saved butchers' time and to the consumer because it was convenient.

### *Current Status of the Broiler Industry*

Most major processors control the vertical stages in the broiler industry, from breeders to market-ready products, through vertical integration and *resource-providing contracts*, typically referred to as *production contracts*. These processor-integrators, such as Tyson, breed the parent stock, produce hatching eggs, and hatch the eggs. Providing baby chicks, feed, veterinary services, and advice, they contract with growers to raise the chicks. Growers provide the chicken houses and labor. The production contracts specify a payment per pound of live broiler produced, depending on the grower's relative performance. The grown broilers are then slaughtered and dressed for market. Further processing may be accomplished in company-owned plants or by other processors who do not slaughter the birds. Plants are typically specially designed for the primary product form (for example, cut up, deboning, or product preparation for food service companies).

In such an integrated marketing system, the only point where basic supply and demand conditions generate a publicly visible price is at the interface between the processor and retailer (or distributor). As products become more processed, even this price information becomes less available. Many restaurants have entered long-term contracts with processors or distributors to avoid volatile broiler prices and offer stable menu prices for consumers (Rogers, 1992). While some con-

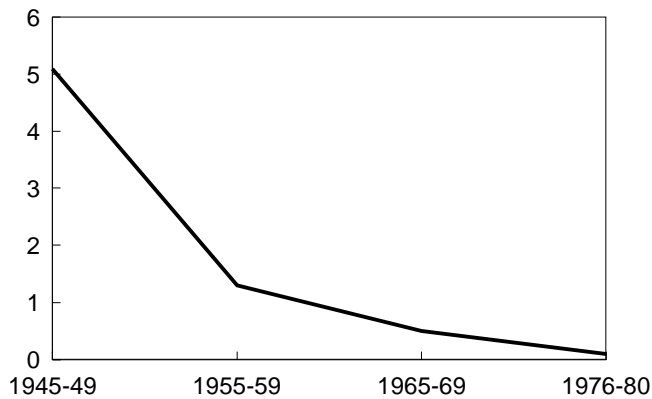
Figure 2

### Broiler production efficiency indicators

Production efficiency has increased dramatically since the 1940's

#### Labor use

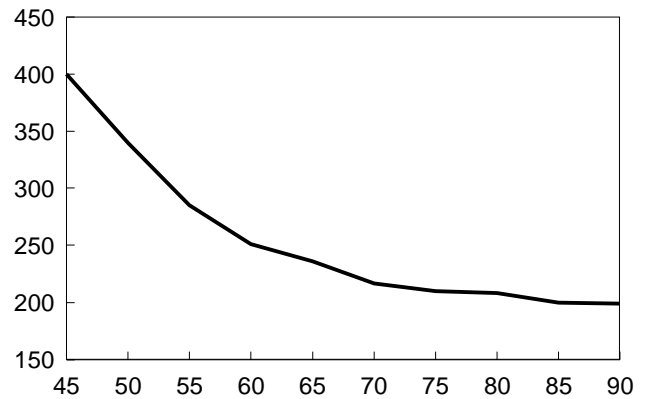
Hours of labor per 100 pounds of broilers



Source: ERS, USDA.

#### Feed efficiency

Pounds of feed per 100 pounds of broilers



Source: Compiled by ERS/USDA from Lasley; Lasley, Jones, Easterling, and Christensen; and Rogers, 1992.

tracts are based on cost-plus formulas, the terms are not disclosed.

### Recent Developments in Vertical Coordination of the Pork Industry

Many of the current structural changes in the pork industry resemble past changes in the broiler industry.<sup>9</sup> In both industries, new methods of vertical coordination are associated with new technology, geographical shifts in production, growth in firm size, and improved production efficiency. There are also differences between the industrialization process in the pork and broiler industries.

#### *Technological and Organizational Innovations*

New technological innovations and increased specialization in hog production are encouraging a larger number of animals at a given production site (Hurt). Advances have occurred in genetics, nutrition, housing and handling equipment, veterinary medicine, and management that improve the health of the hogs and reduce risks associated with hog production. This technology is applied to large production units to reduce

fixed costs per hog. In the 1970's and 1980's, hogs were typically produced on farrow-to-finish farms, that is, farms with a breeding herd where the pigs are raised from birth to market. More recently, hog production has shifted to specialized farms at three different sites, separated by location. The first site is used for breeding, gestation, and farrowing. After weaning, the pigs are moved to a second site, a nursery facility, where they receive special diets and care. Once they reach 8-10 weeks of age and 40-60 pounds, they are transported to the finishing facility, the third site, where they are fed to market weight. This system reduces the risk of disease outbreaks and results in improved use of labor and facilities.

Paralleling the broiler industry, new methods of organizing hog production are contributing to industrialization. Large hog producers, typically referred to as integrators, or contractors, establish production contracts with smaller growers to feed the hogs to market weight. The producer-integrator provides management services, feeder pigs, medicine, and other inputs, while a grower provides the labor and facilities. In return, the grower receives a fixed payment, adjusted for production efficiency. These arrangements allow integrators to grow rapidly by leveraging their capital. For example, instead of investing in all buildings and equipment required for a farrow-to-finish operation, the integrator can invest in

<sup>9</sup>Stages of the pork system include the breeding stock sector, hog production sector, the packing/processing sector, and retail markets for pork products.

specialized facilities, such as farrowing units, while the grower may own 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. By building more farrowing units with a given investment, more hogs can be produced. Integrators can also apply their management expertise in finance, genetics, nutrition, engineering, veterinary medicine, and animal husbandry to a greater number of pigs. Because the integrator provides many of the variable inputs and guarantees a payment to the grower, risk associated with input and output price variability is shifted from the grower to the integrator (Martin).

### *Growth in Nontraditional Regions*

Like the broiler industry, the hog industry is growing most rapidly in areas that had not earlier produced many hogs, including the Southeast and, to a lesser extent, the West and Southwest. Growth in the Southeast is dominated by expansion in North Carolina, where hog inventories have more than tripled since 1989, compared with a 5-percent increase nationwide. North Carolina is now the second leading State, after Iowa, in hog inventories, and the leader in number of pigs born (pig crop). Slaughter capacity has followed hog production to nontraditional areas (Boehlje and others). Smithfield Foods, for example, recently opened the world's largest packing plant in North Carolina.

The dramatic increase in hog production in the Southeast is due in part to the increase in contracting in hog production and the decline in the tobacco industry. North Carolina farmers quickly accepted contracting because of the State's familiarity with production contracts in poultry. Lenders see contracting operations as a way to stabilize farm income in the face of potential losses in tobacco revenue (Hurt).

Hog producers in nontraditional areas of production can compete with the traditional areas because they can realize efficiency gains through improved managerial and production techniques. Large, environmentally controlled facilities, which spread costs over a larger number of animals and improve production efficiency,

gave producers in emerging areas distinct cost advantages (McBride).

### *Structural Changes*

Innovations in production have lowered costs for firms operating at higher levels of output. Most of the rapidly expanding large hog production operations are operating at costs that are \$3 to \$5 per hundredweight (cwt) below the costs of most more traditional operators (Rhodes). Large specialized farms have total costs of production that are 10.6 percent lower than smaller farrow-to-finish operations, excluding advantages in input prices (Good). Feed produced at large centralized mills and hauled to farms is replacing feed from small, onfarm feed mills. Larger feed mills may be able to manufacture feed with more precise ration formulation and more uniform nutrient content. They can usually buy ingredients in large volume at lower cost and quickly change ingredients in response to relative price changes. These factors may outweigh the cost of hauling corn to the mill and feed to the farm. The mill may be owned by a large-scale hog producer or by a producer cooperative, or it may contract to manufacture feed (Martinez, Smith, and Zering).

While declining real hog and pork prices have forced many small hog producers out of business, others have expanded production to reduce unit costs. Consequently, the number of hog farms has fallen, while average size has increased. Growth in the size of hog farms, led by the nontraditional areas of production, is indicated by the percentage of hogs on farms with 1,000 hogs or more. The percentage of hogs raised on operations with inventories greater than 1,000 head increased from 37 percent of the U.S. swine population in 1987 to 47 percent in 1992 and 71 percent in 1997. In North Carolina, nearly 98 percent of hogs resided on these large farms in 1997, compared with 63 percent in Iowa (the leading hog-producing State).

As new packing plants have increased in size in the 1990's, the number of federally inspected plants has fallen (USDA[f]).<sup>10</sup> The rapid shift to much larger plant sizes over the past decade reflects an effort to capture

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<sup>10</sup>Packing firms tend to engage in further processing, but they may also sell their output to processors engaged only in further processing.



apparent economies of size. In 1986, 19 plants, accounting for 50 percent of total slaughter at federally inspected plants, had annual processing capacity that exceeded 1.5 million head. By 1997, 29 plants with 1.5 million head of capacity accounted for 84 percent of hogs processed. Six plants had annual capacity exceeding 3.5 million head per year in 1997 and accounted for 29 percent of all hogs processed in the United States.

### *New Methods of Vertical Coordination*

Hog production and packing have traditionally been coordinated through open market exchange, where sales are made after production is completed. In other words, the producer's position remains "open" until the product is ready for sale. Coordination is accomplished through price signals that provide incentives to adjust the quantity and quality of production. Higher prices for a particular product or quality bring additional resources into production. A grading system distinguishes demand for various quality attributes.

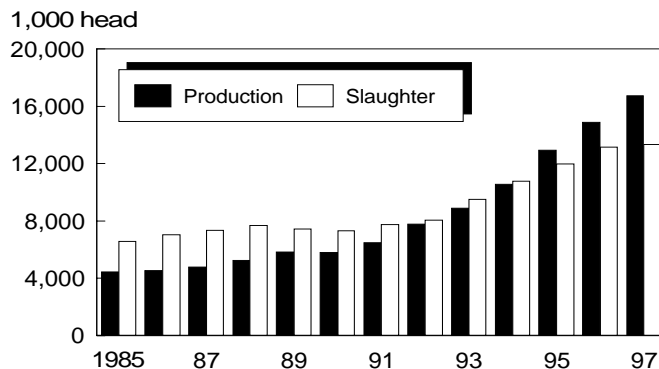
*Market-specification contracts*, commonly referred to as marketing contracts, between the large hog producer-integrators and large packers, are an important factor in the phenomenal growth of hog production in nontraditional areas. These contracts typically specify that the producer deliver a certain quantity of hogs, to a certain location, at a specified time. In return, the producer receives a market-based price that is adjusted for quality premiums. The contract assures large producers an outlet for their hogs and compensation for quality improvements. With a large, stable flow of high-quality, uniform hogs, the packer can reduce costs associated with variable supply flows, poor-quality hogs, and product losses due to condemnations and quality problems (such as excess fat or abscesses). In the North Carolina/Virginia region, hogs were imported until the mid-1990's, when production levels reached and surpassed slaughter quantities (fig. 3). Multiyear marketing contracts facilitated the coordinated growth in hog production and slaughter.

Multiyear marketing contracts between large packers and large hog producer-integrators are rapidly replacing open market transactions (fig. 4). In 1970 and 1980, less than 2 percent of hogs were obtained by packers through contracts or integrated operations. Hayenga

Figure 3

### **Hog production and slaughter in North Carolina/Virginia region, 1985-97**

*Slaughter growth has been coordinated with production growth in the 1990's*



Source: Compiled by ERS, USDA from USDA [f.g].

and others (1996) surveyed 19 large packers in 1994, accounting for 86 percent of U.S. hog slaughter in 1993. Assuming that packers excluded from the survey do not contract or vertically integrate, the percentage of hogs obtained by packers from contracts and vertical integration in the United States was approximately 11 percent in 1993. The remainder was purchased on the open market using "spot" prices at the packing plant or company buying stations, or spot prices from dealers, order buyers, terminals, and auctions. In 1999, 59 percent of hogs in the United States were obtained through multiyear contracting or integration.

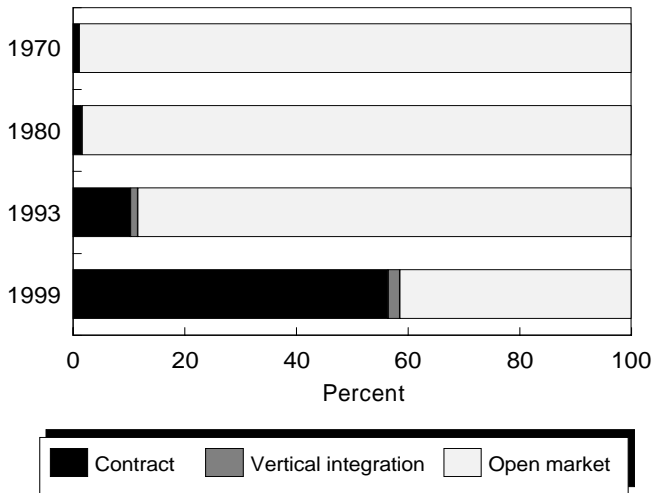
Changes in coordinating arrangements are also reflected at the breeder-producer interface. Small family farm purebred breeders are being replaced by large, highly sophisticated breeder companies who will often develop specific genetic lines for a large producer's own breeding herd (Schrader). A large breeding stock company can supply large producers with sufficient volume at one time. Smaller producers often buy replacement boars and gilts (young females) for the breeding herd by negotiation in an open market. Large producers, however, who tend to be on a schedule that requires specific timing and supplies of closely specified products, often use long-term arrangements to obtain gilts or boars (or semen) at formula prices.

Productivity gains in pork production have added significantly to U.S. pork supplies since the late 1970's. Technological advances have yielded more litters per

Figure 4

**Share of hogs delivered for processing via long-term contracts and vertical integration**

*Substantial increases in marketing contracts have occurred in the 1990's*



Sources: Compiled by ERS, USDA from Hayenga, Lawrence, Rhodes, and Grimes; Marion; and University of Missouri and National Pork Producers Council.

sow, more pigs weaned per litter, and improved feed efficiency. The average number of pigs weaned per litter reached 8.64 in 1997, compared with 7.04 in 1978 (fig. 5). Heavier hogs and greater dressing yields at the packing plant have led to increased meat production per hog. A given quantity of pork meat can now be produced with fewer hogs, less labor, and less feed. Because of these productivity gains, pork production per head of breeding stock rose from 1,400 pounds in 1978 to 2,500 pounds in 1997 (fig. 5). Industrialization of the pork industry has been especially apparent since the 1990's, which heralded the arrival of the "mega producers" (operations with inventories of at least 2,000 head). The percentage of the U.S. swine population raised by the mega producers nearly doubled from 28.8 percent in 1992 to 55 percent in 1997 (USDA[e]). Since 1990, total pork production has increased by an annual average of 1.8 percent per year. In the 1980's, the annual average increase in pork production was 0.5 percent.

***Differences Between the Broiler and Pork Industries***

Although significant changes in organization are occurring in the pork industry, there are some differences between the pork and broiler industries. The broiler marketing system remains more highly inte-

grated. Breeding, feeding, hatching, and processing are vertically integrated functions, while production contracts are used to coordinate production with processing (fig. 6). Marketing contracts are relatively unimportant for the broiler industry. On the other hand, marketing contracts between the hog producer-integrators and packers (processors) are becoming increasingly important. Marketing contracts give the packer less control over production than do the production contracts used by the broiler processor-integrators. Production contracts between large hog producer-integrators and growers also are becoming more important. These contracts are similar to those between broiler growers and processors. Distinguishing between production and marketing contracts in the pork industry is especially important because they serve different functions.

The pork industry is faced with several obstacles to a continuation of recent trends in organization. Unlike the broiler industry, the pork industry has a large core of independent hog producers selling on the open market. These producers will likely resist further moves toward contracting and integration in the hog industry, despite the competitive pressures placed on them to find a market for their hogs.

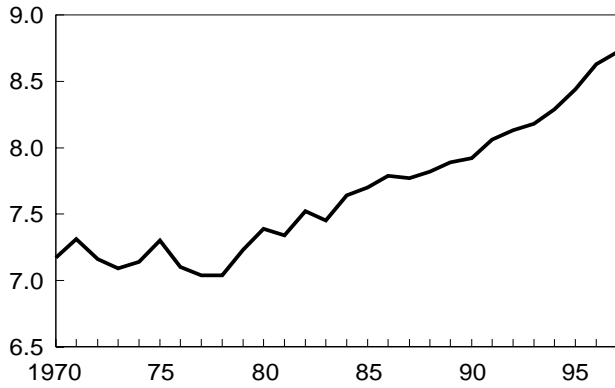
As consumers have become more concerned about the effects of their food choices on the environment (Kinsey), potential air and water pollution associated with manure from large hog operations may also create obstacles to further expansion. The pork industry mastered a method of organizing production that could be quickly replicated, which enabled rapid growth of hog operations. This seriously taxed existing environmental regulations and has led some States, North Carolina for instance, to impose moratoriums on new large hog production units. In addition, some localities have attempted to enact strict local ordinances that supersede existing State laws. Local residents often fear that unchecked expansion of hog operations will lower the quality of life and land values by contaminating water and air. On the other hand, large producers are concerned that stricter environmental regulations will limit their ability to reap the benefits of size economies associated with new technology. In addition, some legislative leaders claim that the large hog operations are important to their State's economy.

Figure 5

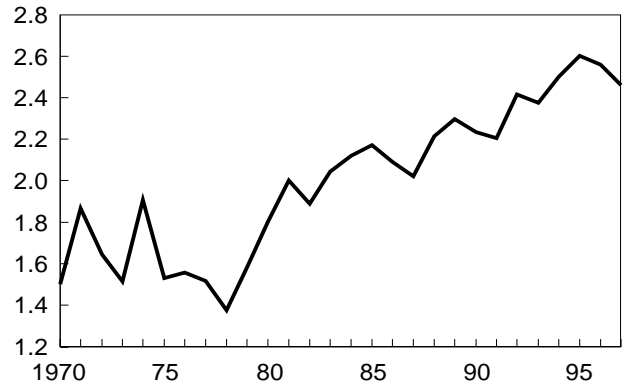
**Efficiency gains in hog production**

*The pork industry has experienced substantial gains in productivity in the 1980's and 1990's*

Pigs per litter  
Numbers



Pork per sow (breeding inventory)  
Thousand pounds



Source: ERS, USDA.

Figure 6

**Production contracts and marketing contracts in the pork and broiler industries**

*Marketing contracts in the pork industry offer the processor less control over production than production contracts in the broiler industry*

