Marketing Contracts, Production Contracts, or Vertical Integration?

While characteristics of poultry, egg, and pork market transactions and associated transaction costs suggest that spot-market trading will be inefficient, the significance of alternative vertical coordination arrangements varies across industries. Vertical integration of the production and processing stages is more prevalent in the turkey and egg industries, while marketing contracts are more common in the pork industry. Reasons for these differences are explored in the following section.

Uncertainty and Vertical Acquisitions

In markets with significant asset specificity, increasing levels of uncertainty are expected to lead to methods of coordination that transfer more control over functions to the integrator. During periods of extensive changes in structure and vertical coordination in the poultry and egg industries, uncertainty originated from a variety of sources.[30] Disease and heavy mortality rates were found among birds (Black). Significant technological advances were made within a short period of time (technological uncertainty) (Tobin and Arthur; Martinez, 1999).[31] Poor coordination of sales between producers and buyers led to wide market swings. Sharp industry losses in 1959 and 1961, characterized by overproduction and depressed live-bird prices, led many hatching-egg producers, hatcheries, and feed companies to exit the broiler and turkey industries. Extensive changes in competitive conditions, mergers, and acquisitions at all stages in the 1960s (National Commission on Food Marketing) and rapid inflation fueled by OPEC (Organization of the Petroleum Exporting Countries) in the early 1970s created further uncertainties.

In the late 1950s and early 1960s, uncertainty in the broiler industry led management centers to become involved in stages further downstream in the vertical chain (Tobin and Arthur). At the time, rapidly increasing broiler sales complicated coordination of vertical stages. Advances in technology at all stages led to excess production and depressed prices. Greater demand for research and new product development increased demand for capital through periods of erratic price movement. Retailers who offered chicken breasts and thighs at one price and drumsticks at another complicated inventory control (Strausberg). Lack of communication with buyers of dressed broilers and overemphasis on broiler shortages and surplus led to the demise of open markets further upstream. Feed companies began to deal directly with wholesalers or retailers by acquiring or merging with processors and by building their own processing facilities. Consequently, production-related decisionmaking was enhanced by the retailers' superior knowledge of consumer preferences and buying habits.

In the pork industry, sources of uncertainty include government regulations (for example, environmental regulations, family farm ordinances) and hog prices (table 2). In recent years, hog prices have become more sensitive to changes in hog production (fig. 13). Hog demand has become more inelastic, which has led

[30]Proxies for technological uncertainty in the empirical literature include years to technological obsolescence, frequency of changes in product specification, and probability of technological improvements (Mahoney).

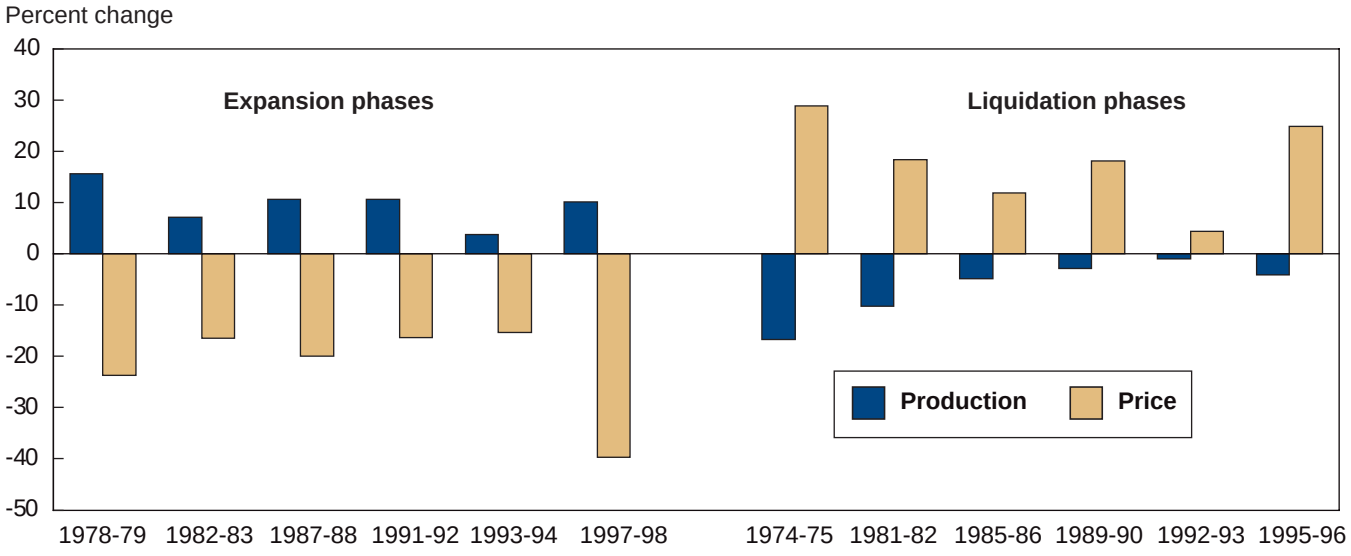
[31]In the United States, shell egg production accounts for over 70 percent of total table egg production.

Table 2—Types of uncertainty faced by selected pork companies

Firm	Type
Hormel	Hog prices and availability, government regulations, consumer acceptance of products, and interest rate debt.
Smithfield Foods	Availability and prices of live hogs and raw materials, product pricing, competitive environment and market conditions, and failure or inability to comply with government regulations, including environmental and health regulations.
Seaboard Farms	Hog and raw material prices, third-party hogs, and pork prices.
Farmland Industries	Federal, State, and local environmental laws and regulations, disease, genetic changes, market prices for hogs, strength of competition, and regulatory delays that affect growth strategies, joint ventures, and operational alliances. Note: Includes uncertainty that may cause a company's actual results to differ substantially from forward-looking statements.

Sources: Smithfield Foods, Form 10Q, March 14, 2000; Hormel, Form 10-K405, January 28, 2000; Farmland Industries, Form 10-Q, January 14, 2000 and Form S-1, January 19, 2000; and Seaboard Farms, Form 10-Q, April 28, 2000. Filings with the Securities and Exchange Commission.

Figure 13
Hog price and production changes over selected periods



Source: Compiled by ERS/USDA from Meyer.

to more volatile prices and revenues. The demand elasticity for a factor of production will be smaller in absolute value as its share of total production cost becomes smaller (Thurman). Hence, an increase in the proportion of pork that is consumed in further-processed form is expected to result in a smaller (in absolute value) own-price demand elasticity. As pork is bundled with other goods and services, the percentage of the pork price accounted for by marketing services increased 14 percentage points between 1990 and 2000, from 55 to 69 percent, compared with only a 5-percentage point increase from 1980 to 1990.

Another source of uncertainty in the pork industry is the competitive environment in which firms operate. Processors compete in an environment in which strategy and pricing by one company can dramatically affect the competitive outcome of another firm, which also has consequences for the company's suppliers (Di Pietre).

As in the poultry industry in the 1960s, vertical acquisitions and coordination of production and processing through production contracts, led by Smithfield Foods, has become more common in the pork industry. Following 50-year lows in hog prices in fall 1998, Smithfield purchased two leading hog producers with which it had marketing contracts. In 2000, Premium Standard Farms (PSF), the 2nd-largest hog producer and 13th-largest hog slaughter firm, acquired Lundy Packing, a hog slaughter firm based in North Carolina, which more than doubled PSF's processing capacity.

Vertical Integration in the Turkey and Egg Industries

While uncertainty in the poultry, egg, and pork markets has been associated with increases in production contracts and vertical integration, vertical integration is much more prevalent in the turkey and egg industries. One possible contributing factor to the prevalence of vertical integration is that uncertainty is more significant in the turkey and egg industries. In turkey production, both disease susceptibility and longer growing periods increase uncertainty (National Commission on Food Marketing; Gallimore; Strausberg; Roy, 1972). With longer growing periods, more time elapses between a change in buyers' plans and corresponding changes in production, so it takes longer to react to price changes resulting from demand shocks. Consequently, efficient transfer of information between parties becomes more important, which, ceteris paribus, increases the likelihood of vertical integration (Caves and Bradburd). Turkeys are marketed at 4-7 months of age, compared with 5-6 weeks for broilers, so adjustments in broiler production can be made more quickly. The table egg production cycle is also longer than the broiler cycle (Strausberg).

Income uncertainty from shell egg sales may be especially significant to vertical integration.[32] Differences in procurement methods of two of the top three U.S. egg producers support this statement. Cal-Maine Foods produces 78 percent of its eggs in vertically integrated facilities, in which feed is manufactured, chicks are hatched, pullets are grown, and eggs are produced, packed, and distributed (Cal-Maine Foods, Form 10-K, filed with Securities and Exchange Commission August 21, 2000). Cal-Maine procures the remaining eggs through production contracts with growers who own their own egg-production facilities. On the other hand, Michael Foods procures only 35-40 percent of its eggs from company-owned hens and purchases the remainder through marketing contracts and the open market (Michael Foods, Form 10-K, filed with Securities and Exchange Commission March 31, 1999). Cal-Maine sells nearly all of its eggs in the shell egg form, whereas Michael Foods sells 94 percent as further-processed eggs, such as reduced-cholesterol products, liquid eggs, and precooked omelets. Greater uncertainty in shell egg sales makes vertical integration by Cal-Maine a more efficient means of coordination. Income from shell egg sales is sensitive to the highly variable market-based wholesale price of shell eggs (Urner Barry Price Quotation).[33] The production of value-added products can help limit uncertainty related to price changes in commodity shell eggs. Gross margins from sales of value-added egg products are generally less sensitive to commodity price fluctuations.[34]

Changing consumer tastes and preferences for table eggs provided an important source of demand uncertainty. Beginning in the 1950s, faster paced lifestyles led consumers to favor lighter breakfasts and less fresh egg consumption. In the 1970s and 1980s, health concerns raised by nutritional studies linking cholesterol and fat to heart disease contributed further to the downward trend in egg consumption (Brown and Schrader).

The inefficiency of tournament contracts, commonly used in broiler production, could also contribute to more vertical integration in the turkey and egg industries. In tournament contracts, grower payments adjust automatically to production influences common to all growers because payments are based on *relative* performance of growers, which is not affected (Knoeber). Hence, these contracts do not require costly renegotiation of contract terms in response to shared production influences, such as rapid advances in production technology. However, tournaments require a large number of contestants (growers) to effectively reduce risk-bearing costs.[35] Tournament contracts perform more efficiently in the broiler industry than in the turkey and egg industries because there are more broiler growers relative to processors (Knoeber). The design of tournament contracts for turkey and egg production was less feasible.

Transaction costs associated with significant site specificities in the egg industry also suggest that vertical integration is a more efficient means of organizing transactions than other methods of vertical coordination. Technological breakthroughs in the 1960s led to high-speed, in-line grading, in which eggs are conveyed directly from laying cages to grading and packing machines. Soon after 1961, on-farm egg processing became the norm (Jasper). These packing and processing operations may be considered an extreme form of site specificity because they are located at the same site as the farms.

Temporal specificities in markets associated with shell egg production also may be significant to vertical integration. For example, Cal-Maine produces mostly shell eggs, which are highly perishable as indicated by the company's low shell egg inventory, consisting of 4 days of production (Cal-Maine Foods, Form 10-K, filed with Securities and Exchange Commission August 21, 2000). On the other hand, Michael Foods produces mostly egg products. Furthermore, over periods of important changes in vertical coordination, reductions in the number of alternative egg producers with which to bargain were more severe than in the broiler indus-

[32] In the United States, shell egg production accounts for over 70 percent of total table egg production.

[33]Variance of prices makes it easier for firms to cheat by raising their price (Klein, Crawford, and Alchian). Evidence from the petrochemical industry suggests that input price uncertainty in the 1970s led to more vertical integration into input stages (Fan).

[34]Michael Foods recently sold shell egg production facilities to reduce exposure to the commodity egg market and to focus on production of value-added products (Smith, 2000).

[35]In the transaction cost economics literature, the risk-shifting role of coordinating methods is ignored. This has been justified based on several factors, including (i) the ability of owners to diversify their business to limit the effects of risk, (ii) the inability to directly observe risk preferences, and (iii) the lack of attention to other explanations for business arrangements by focusing on risk aversion (Masten, 1996).

try. From 1959 to 1978, the number of egg farms fell 72 percent, compared with an 18-percent reduction in the number of broiler farms over the same period (Lasley). This finding suggests that thin markets increased the severity of temporal specificities.[36]

Less dense production areas in the egg industry, compared with the poultry and pork industries, suggest that vertical integration may be especially prevalent in egg markets. Geographically concentrated regions may provide a check on opportunism associated with specific assets, which suggests that motives for vertical integration would be more pronounced in geographically dispersed industries, as firms vertically integrate to protect against opportunism. The egg industry is more widely dispersed than the poultry and pork industries (app. C). News of opportunistic behavior also may spread more rapidly in concentrated regions, which would reduce the likelihood of holdup and lessen the need for vertical integration (Enright). For example, in the pre-1960s U.S. tuna industry, small boats and frequent deliveries to port served to constrain processor opportunism because of the potential for losing the trust of current and potential trading partners (Masten, 1996). That is, the high density of trading partners that could observe and communicate instances of opportunism put the processors' reputation at stake.

Marketing Contracts in the Pork Industry

While processor-owned hogs are becoming more common in the pork industry, marketing contracts remain the prevalent method of vertical coordination in the pork industry, particularly in comparison with the poultry and egg industries. The prevalence of asset specificities in the poultry and egg industries possibly leads to more vertical integration, which reduces the likelihood of holdup. In hog markets, temporal specificities have less influence on vertical coordination because there is greater flexibility in the age at which hogs can be slaughtered (*Pork' 99* Staff). 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).

Greater uncertainty, coupled with investments in relationship-specific assets, typically results in fewer marketing contracts and greater reliance on production contracts and vertical integration. However, marketing contracts that are relational in nature provide a compelling incentive for reliance on these contracts in the pork industry. With formula-priced contracts, which are the most popular type of hog marketing contract, payments adjust automatically to changes in market conditions because contract payments are typically linked to a spot-market price.[37] This feature limits opportunities for producer or processor holdup because it is not necessary for parties to continually renegotiate the base price.[38] In addition, following significant changes in vertical coordination in the poultry and egg industries, advances in information technology may have reduced some sources of uncertainty for the pork industry in the 1990s. These advances would lessen the need for production contracts and vertical integration, which offer more control to the contractor and integrator.[39]

Another factor that may influence the pork industry's reliance on marketing contracts is that processors contract with fewer and larger hog producers using a uniform set of inputs. By establishing marketing contracts with large hog producers, coordination occurs across fewer firms, which can substitute, albeit imperfectly, for greater control offered to processors through production contracts and vertical integration. Marketing contracts also may give the processor some control over hog quality and uniformity by stipulating inputs to be used by the producer. A survey of 19 of the largest hog processors found that half of the packers with marketing contracts required a minimum volume to be supplied, and either the minimum quality of hog to be supplied or their genetics (Hayenga et al., 1996).

[36] The decline in the number of turkey farms also was quite severe, falling 92 percent from 1959 to 1978.

[37] These contracts provide no shifting of price risk because the contract price varies directly with the spot-market price.

[38] Spot-market prices are often adjusted based on quality premiums and discounts, which may provide an area of contention. However, changes in private grading programs occur less often than changes in spot prices.

[39] In their empirical analyses using transaction cost economics, Levy and Frank and Henderson construct a measure of unanticipated demand uncertainty. Their analysis is accomplished by calculating the variance of the residuals from a regression of logged food industry, or firm, sales on a time trend. Similarly, in this report, annual logged pork, broiler, turkey, and egg expenditures were regressed on a time trend to construct a measure of demand uncertainty. Poultry and egg uncertainty was calculated over two periods of extensive changes in vertical coordination, 1955-64 and 1965-74. To compare, recent demand uncertainty in the pork industry was calculated for the period 1990-99. Statistically, the variance of residuals for poultry and eggs was significantly larger in the 1965-74 period than the variance for pork. However, in the 1955-64 period, only broiler demand uncertainty exceeded recent pork uncertainty.

Processors that contract for large numbers of hogs from uniform supplies have stopped measuring every hog, basing payments instead on periodic samples and the distribution of quality (Di Pietre). In 1999, Smithfield Foods had marketing contracts with 3 of the top 10 hog producers (Murphy Farms, Maxwell Foods (also known as Goldsboro Hog Farm), and Prestage Farms), accounting for 29 percent of slaughter. These producers, in turn, established production contracts with growers, which provided substantial control over production. After acquiring two large hog producers, Murphy Farms and Carroll Foods, Smithfield currently has production contracts with 1,200 growers, representing about 70 percent of hog production in North Carolina (Marbery, December 18, 2000). On the other hand, Tyson Foods has contracts with 7,402 broiler growers (Tyson Foods).