processor may vertically integrate "upstream" (backwards in the marketing channel) to exercise greater control over the quality and timing of deliveries and the quality of inputs used in the production process. Again, reduced risk and/or greater profits may result.

The risk-reducing benefits associated with vertical integration depend to a great extent on the nature of the industry. Typically, the benefits associated with integration increase as production and marketing interrelationships become more complex and when breakdowns in marketplace competition are most likely (such as opportunistic behavior by contracting parties). For perfectly competitive industries, all firms are subject to price fluctuations caused by supply and demand shifts—whether or not they are vertically integrated—and integration cannot provide protection from such risks. In such industries, the benefits to integration may be small. When imperfect markets exist, in contrast, firms can benefit by some combination of improved information access, internalized transactions costs, and efficiencies in market exchange (Perry, 1989). As a result, firms tend to integrate when the costs incurred in using the market price mechanism exceed the costs of organizing those activities within the management control of a single operation (Scherer).

The benefits associated with integration typically increase as production and marketing relationships become more complex and when breakdowns in marketplace competition are most likely.

While vertical integration can lead to reduced risks and/or enhanced profits for some firms or growers, others may find such a strategy unattractive. Depending on the size of the firm and the extent of the proposed integration, the benefits associated with specialization and scale economies can be greatly reduced or lost, particularly in perfectly competitive markets. For growers in such markets who choose to vertically integrate, the gain may be primarily through enterprise (or business) diversification (Perry, 1989). In addition, the size and scope of the operation can have a major impact on integration choice.

Empirical applications have examined the linkage between vertical integration and farm-level risk. One such study, focusing on cattle production in the Texas rolling plains, illustrates the importance of size of firm and income growth on integration choice (Whitson, Barry, and Lacewell). This study, responding to concerns about price uncertainty and the changing structure of the livestock industry, evaluated the risk-return effects of selling fed calves or holding them through subsequent stages in the production process. It included a weaned calf stage, a stocker phase (grazing on wheat pasture), a custom feeding phase (bypassing the stocker phase and custom feeding), and other options.

The authors found that, at low-income levels, the preferred sequence involved production of weaned calves with subsequent placement in a feedlot, a result consistent with negative covariances. As growth in ranch income increased, however, a wheat pasture activity was included in the vertical sequence to increase income and meet increased cash flow requirements over a 5-year horizon. The manager's willingness to accept risk and constraints to his or her ability to borrow were critical in determining the final integration choice.

Production Contracts

Production contracts typically give the contractor (the buyer of the commodity) considerable control over the production process (Perry, 1997). These contracts usually specify in detail the production inputs supplied by the contractor, the quality and quantity of a particular commodity that is to be

delivered, and the compensation that is to be paid to the grower. As an example, a broiler integrator (contractor) usually retains control over the chicks as they are raised by the producer, as well as prescribes specific inputs and special management practices throughout the production cycle. In return for relinquishing control over decision-making, growers—particularly hog and broiler growers—are typically compensated with an incentive-based fee. According to USDA's Agricultural Resource Management Study, commodities valued at approximately $18 billion were produced under production contracts in 1997.

Firms commonly enter into production contracts with farmers to ensure timeliness and quality of commodity deliveries, and to gain control over the methods used in the production process. Production contracting is particularly favored when specialized inputs and complex production technologies are used, and the end product must meet rigid quality levels and possess uniform characteristics. Production contracting is also favored when oversupply and undersupply have been problems, the risk-return tradeoffs are advantageous to both the producer and the contracting firm, production technologies are specific, uniform, and knowledge-based, centralized management is feasible, and the commodity is highly perishable (Kliebenstein and Lawrence; Barry, Sonka, and Lajili; Farrell; Harris). In addition, integrators may prefer to keep fixed capital assets (such as buildings) off of their balance sheets for liquidity purposes (Barry).

Because the broiler industry possesses many of these attributes, production contracting in this industry is particularly common. Indeed, about 99 percent of the value of broiler output was produced under production contracts in 1997 (table 5). Such contracting is also commonly used in the egg and hog industries. For hogs, the use of production contracts has increased rapidly in the past 5 years, as the number of large, specialized operations has accelerated and size economies and new health technologies have encouraged greater concentration of animals. These contracts ensure that packers receive a consistent supply of high-quality hogs, allow processing firms to operate at close to optimal capacity, and allow the marketing system to be more responsive than in the past to changes in consumer preferences (Martinez, Smith, and Zering).

Two basic types of production contracts are used, which differ in the amount of control, risk, and uncertainty the buyer and seller assume: production management

Production contracting is most commonly found in the broiler, egg, and hog industries.

Table 5—Value of selected commodities produced under production contracts, 1997

Commodity	Value of production under production contracts	
	Percent	*Million dollars*
Broilers	99	6,664
Cattle	14	4,280
Eggs	37	773
Hogs	33	3,097
Vegetables	8	1,145
Total value of production under production contracts, all commodities[1]	12	18,215

[1]Includes $1,627 million in the crop category and $16,588 million in the livestock category. The total value of agricultural production is $191,724 million.

Source: USDA, ERS, 1997 Agricultural Resource Management Study, special analysis.

Two basic types of production contracts are used: production management contracts and resource-providing contracts.

contracts and resource-providing contracts. The production management contract is commonly used for processing vegetables (sweet corn, snap beans, and green peas). With these contracts, the buyer gains additional control over decisions that would be made solely by the grower in the absence of a contract, including planting schedules and seed varieties (Powers). By assuming this degree of control, the contractor increases the likelihood of receiving a commodity that has specifically desired characteristics, and nearly all price risk is shifted to the contractor through the establishment of an agreed-upon price upon entry into the contract. Some price risk remains with the farmer, however, due to quality considerations, which may result in either a discount or a premium relative to the established contract price (Lucier). When crops fail, growers receive no payment under these contracts and, hence, bear the production risk associated with crop shortfalls.

The second type of contract is the resource-providing contract, which usually offers contractors a greater degree of control than do production management contracts. These contracts are often used when specialized inputs and management are required to ensure final-product attributes, and are particularly common in the broiler industry. Under such an arrangement, the broiler producer generally provides land, housing facilities, utilities, and labor, and covers operating expenses (repairs, maintenance, and manure disposal). The contractor usually provides the chicks, feed, veterinary services, management, and transportation. Significant production decisions—such as the size and rotation of flocks, the flock's genetic characteristics, and the capacity of chicken houses—are made by the integrator (Perry, 1997). Thus, the grower is essentially a custodian of the production operation for the integrator.

Much attention in recent years has been focused on contracting in the broiler industry and the implications for producers' risks and returns. In this industry, payments are based on a grower's performance efficiency relative to all growers in his or her group or "round," and involve two components. The first component is the "base payment," which is a fixed amount per pound of live meat produced. The second component is the "incentive payment," which depends on the grower's efficiency in feed conversion, the poultry mortality rate for that grower, and the weight of that grower's finished birds relative to all growers in the round. These factors are weighted in a calculation that determines the grower's "settlement cost." If the settlement cost for all contractor flocks harvested within a specified period in the round is greater than the individual grower's cost, he or she receives a bonus. In contrast, a penalty is incurred if the grower's settlement cost is high relative to all other farmers in the round.

Several important risk-related features are associated with these "relative performance" contracts. Because grower payments depend largely on production outcomes—and not feed or broiler prices—growers do not explicitly bear any price risk. Furthermore, the relative nature of the contracts means that, in the presence of favorable growing conditions (like ideal weather), the costs of all growers in the round are lower and, hence, no single grower receives a larger per pound payment. Although growers do not bear this type of "common" production risk faced by all growers in their round, they do bear the "idiosyncratic" risk specific to their operation. For example, an operation that experienced an unusual disease outbreak and a higher mortality rate would have a

higher settlement cost—and a penalizing incentive payment—relative to other growers in the round. Because of these factors, this type of production contract shifts price and common output risk from individual growers to integrators, with growers retaining the idiosyncratic risk specific to the efficiency of their own operation (Knoeber and Thurman).

The risk implications associated with production contracts are highly conditional on the specific contract terms. One recent study of the broiler industry examined the risk-shifting associated with the type of relative-performance contract (a "contract with rounds") discussed previously, comparing the results to a "contracts without rounds" situation and to an "independent grower" situation (Knoeber and Thurman). They defined the payment in the contract-without-rounds case as a fixed payment plus the amount by which the grower's feed conversion performance varies from a fixed standard that did not change over time. The "independent" case assumed that the grower purchased inputs and sold broilers at market prices, and had not contracted with an integrator.

In that analysis, 89 percent of the growers realized risk reduction that was significantly greater in the relative performance contract situation than in the contract-without-rounds case. This is because relative production contracts eliminate the risk common to all growers in the round as well as price risk, leaving only the idiosyncratic risk specific to production on a given operation. In contrast, the without-rounds contracts—where payments are made on a fixed standard representing the average settlement cost for all growers for the entire sample—eliminate only price risk. Knoeber and Thurman also concluded that relative and without-rounds contracts reduced risk by 97 and 94 percent, respectively, compared with the independent grower case. In both situations, the reduction in price risk accounted for the major risk-shifting component.

More recently, Martin analyzed the risk reduction associated with production contracts in the North Carolina pork industry. Martin's research found that the risk-shifting capacity of relative production contracts was significantly greater for 36-70 percent of contract growers compared with without-rounds contract growers. This is weaker evidence than realized by Knoeber and Thurman, and may partly be explained by the greater homogeneity associated with broiler production. Broilers usually are both placed on farms and marketed at uniform weights, while hogs may be placed on farms at 30-60 pounds and marketed at weights varying from 220-280 pounds. Because there is less output variation common to all growers in the hog industry, relative contracts have less of an impact on grower risk when compared with without-rounds contracts. Martin also found that without-rounds contracts shifted 90 percent of the grower's income risk to the integrator when compared with the independent-grower situation, with 93.5 percent of income risk shifted in the case of relative production contracts.

In addition to risk-shifting capacity, production contracts have other advantages for growers, as well as for contractors. For contractors, the use of production contracts can result in sufficient input supply control (without the need for vertical integration), as well as improved response to consumer demand. Evidence suggests that farmers enter production contracts to guarantee market access, improve efficiency, and ensure access to capital (Perry, 1997). Most production contracts lower farmers'

One study of the broiler industry concluded that "relative-performance" production contracts reduced income risk by 97 percent, compared with the independent grower case.

One distinguishing difference between marketing contracts and production contracts is that producers using marketing contracts take greater responsibility for management decisions.

price risks when compared with risks on the open market. The combination of lower market risks and less variable incomes was a major reason cited by farmers for using production contracting in at least one survey (Rhodes and Grimes). This suggests that farmers are well aware of the risk-shifting capacity just illustrated. In addition, depending on contract terms, farmers can benefit from technical advice, managerial expertise, and access to technical advances (such as high-quality breeding stock) that may not otherwise be readily available (Perry, 1997).

Despite such advantages, however, production contracting has been criticized. Some observers argue that production contracting can limit the entrepreneurial capacity of growers, and others cite the risks of contract termination on short notice (Hamilton; Charlier; Harris). Contractors may require upgrades to buildings and other infrastructure that are unexpected by the grower, resulting in an investment risk. In addition, some growers under a relative performance system believe that they are at an unfair disadvantage, arguing that companies may not have the incentives to maintain strict accuracy in the accounting and allocation of inputs among growers, and that absolute standards (as in the "contracts-without-rounds" case) may be most equitable and transparent (Jenner). Issues between growers and integrators have led to lawsuits on various occasions, and Iowa, Kansas, and Minnesota have adopted some form of legislation regulating production contracting in agriculture (Johnson and Foster; Plain; Hamilton and Andrews).

Marketing Contracts

Marketing contracts are either verbal or written agreements between a buyer and a producer that set a price and/or an outlet for a commodity before harvest or before the commodity is ready to be marketed (Perry, 1997). Since ownership of the commodity is generally retained by the grower while the commodity is produced, management decisions (such as varieties or breeds, or input use and timing) typically remain with the producer. This latter characteristic—responsibility for management decisions—is critical in distinguishing marketing contracts from production contracts (table 6).

Marketing contracts can take many forms. They are at times used by grain farmers to forward price a growing crop with a country elevator, where they are referred to as cash forward contracts. The contract terms vary across contracts, but typically establish a price (or contain provisions for setting a price at a later date) and provide for delivery of a given quality (or grade) within a specified time period. A "flat price" (or fixed price) forward contract may, for example, state that a farmer will deliver 10,000 bushels of No. 2 yellow corn to the local elevator at harvest for a price of $3.25 per bushel. Premiums and discounts may be established for grain that does not meet specified quality standards. Flat price contracts are one of the most common types of forward contracts. The price typically is the elevator's "bid price" for all farmer-delivered grain. This "bid price" is based on a current futures quote, less a "basis" adjustment that reflects marketing costs between the local elevator and the futures exchange location.[9]

[9]Country elevators entering into such marketing contracts generally hedge their positions using futures markets. Hedging provides an offset to any price-level changes associated with the marketing contracts that elevators negotiate with producers, and transfers price-level risk to basis risk (uncertainty in the relationship between futures and cash prices). See later discussion of price-level and basis considerations in the "hedging" section.