



---

## Economic Issues with Vertical Coordination

*by Michael Boland, Associate Professor, Agricultural Economics, Kansas State University*

*David Barton, Arthur Capper Cooperative Center, Kansas State University*

*Matthew Domine, District Sales Manager, Krone North America*

[mboland@agecon.ksu.edu](mailto:mboland@agecon.ksu.edu)

Much has been said about the economic forces affecting agriculture and what they might mean for producers, agribusinesses, and consumers in the 21<sup>st</sup> century. The term mass customization has been used to describe how firms might be able to produce customized products for different market segments. Firms using such a competitive strategy will need to be as cost efficient as possible by operating at the lowest average cost, if they are to succeed in marketing products to these customized market segments. This competitive strategy requires firms to focus on particular market niches and provide differentiated products. This strategy also requires tremendous coordination, from identification of end-user needs to selection of genetic traits that may satisfy these needs most profitably.

Vertical coordination is an important part of a competitive strategy and is defined broadly as various methods used to manage vertical stages in a marketing channel. There are three basic types of vertical coordination between stages: open marketing; contract production and marketing; and integration through cooperatives or public companies. Open marketing is the traditional method used by many producers to sell their commodities as price takers. The focus of this publication is on contract production and marketing, and integration through cooperatives and public companies. The objective is to provide an overview of contracting and integration and discuss risk factors associated with these two methods of vertical coordination.

### **Contract Production and Marketing**

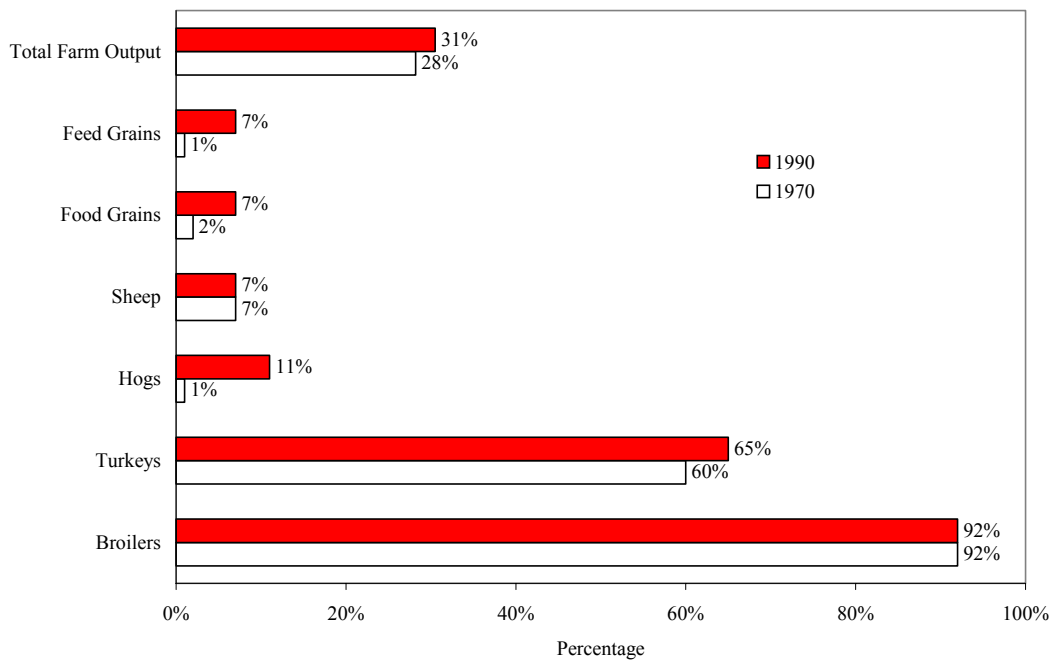
Contract production and marketing refers to a firm committing to purchase a commodity from a producer at a price formula established in advance of the purchase. A contractual relationship between producers and processors is a form of vertical coordination. Various contracts involve different levels of producer and processor responsibility.

Contracting has increased between 1970 and 1990 as seen in Figure 1 (Martinez and Reed). In 1990, an estimated 30.5 percent of total U.S. farm output was contracted compared to 34 percent in 1997 (USDA ERS). Although these may not seem like significant changes, the 3.5 percent increase between 1990 and 1997 is almost equal to the entire value of Kansas farm production in 1997. The most dramatic increase occurred in hogs, feed grains, and food grains. Since 1990, a reduction in government involvement in agricultural markets (e.g., the 1996 FAIR Act) has

increased the risk exposure of producers to price variation from supply and demand conditions. Increased exposure to risk has likely led producers to further increase the use of contracts.

What has led producers and processors to increase contractual arrangements? Under some contracts, producers also realize cash flow and tax advantages, as well as the ability to expand their operation. In principle, contracts are beneficial to both producers and processors (e.g., risk reduction). Most often, processors are *contractors*: they formulate terms and offer those terms to producers, who become *contractees*. Contracts offer producers an opportunity to reduce revenue risk by guaranteeing price. Processors exchange risk exposure or crop premiums for control over their inputs. Contracts add stability to market transactions through commitment and serve to minimize risks associated with unfavorable changes in market conditions. However, contracts also limit profit potential from favorable changes.

Figure 1. U.S. Production Coordinated by Contract, 1970 and 1990 (USDA ERS)



There are at least five parties that may be affected by a farm production contract agreement. These parties include the producer, processor, landlord, suppliers, and lenders. Contracts may affect associated parties through changes in crop ownership, eligibility for crop insurance and farm programs, rights if contract fails, liabilities and constraints of some parties (e.g., banking regulations), assumption of risk, security interests (e.g., liens), and changes in existing agreements (e.g., share cropping). Contracts vary considerably by contractor and crop, and should be evaluated on an individual basis.

There are two basic types of contracts: marketing contracts and production contracts. Differences in the two types include management responsibility, crop ownership, and provision

of crop inputs. Within these basic types there are a number of possible arrangements. Possible alterations within the contract types include pricing, storage, transportation, and quality determination. The most appropriate contract for a given situation depends on the market structure. In general, more complex, differentiated product markets benefit from higher levels of coordination. Examples of such markets are those that require extensive technology or capital investment for production, involve perishable products, require special management skills, require specific quality attributes, or emphasize product uniformity. Conversely, non-differentiated commodity markets often function in nearly perfect competitive conditions. Firms in these markets are impacted by supply/demand conditions and will benefit little from higher levels of vertical coordination.

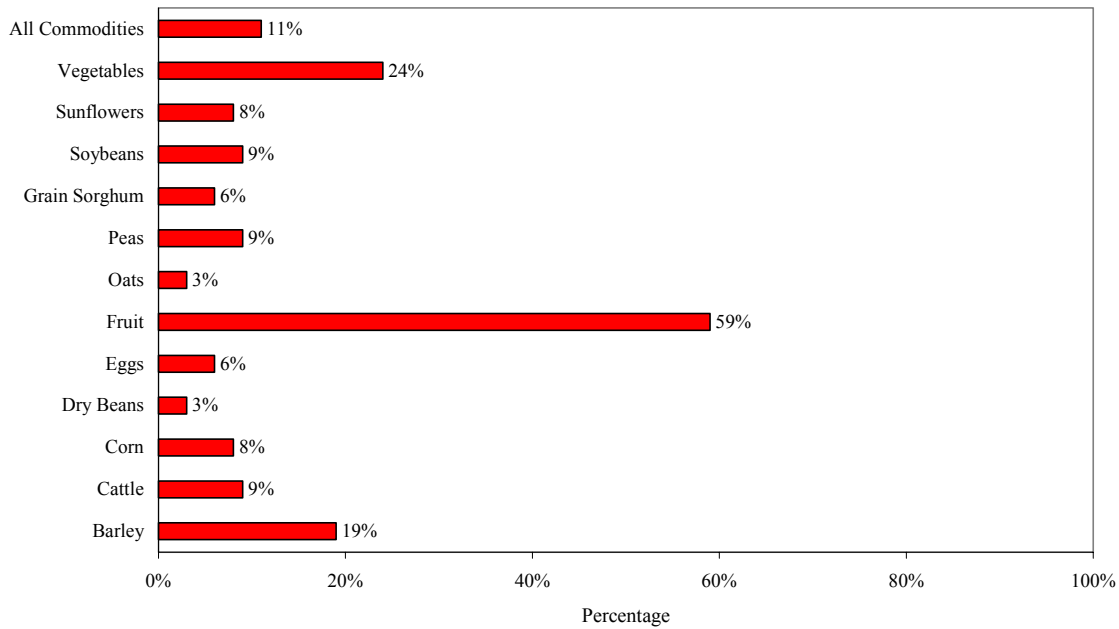
### **Marketing Contracts**

Marketing contracts identify a buyer, seller, and product, and have two main provisions: 1) quantity and 2) price. Marketing contracts are used to set a price and market for a crop to be sold at a future date. Producers have a guaranteed buyer and price for their production, but supply most or all crop inputs, retain ownership until time of sale, and have sole management responsibility. Price is determined by current supply and demand conditions.

Quality is also becoming more important in marketing contracts. Quality may be a specified provision of the contract or part of a pricing mechanism. Terms for quality in marketing contracts may include minimum amount of crop component (e.g., oil, protein, crop grade), specified physical properties (e.g., color, hardness), grown under specific conditions (e.g., organic, pesticide-free), or grown from a specified seed variety. There are a number of pricing mechanisms used in marketing contracts. Some contracts use a flat price, which is a single, specific price set at time of contract. This is the only type of marketing contract that alleviates price risk. Many marketing contracts use a base price, often determined from a cash market or futures exchange, plus or minus economic incentives for quality attributes, basis (storage and transportation), or a specific price spread.

Crop ownership may transfer at varying times. For instance, a delayed pricing contract may transfer ownership immediately while price is set at a later date. In contrast, a flat-price contract may set a price at planting time for a product to be sold at harvest. Since the producer maintains ownership of the crop, the producer is most often responsible for transportation and storage costs. Examples of marketing contracts are delayed or advance-pricing mechanisms, futures market strategies, and contracts to deliver to a processor or closed cooperative. Figure 2 describes the percentage of commodities grown under marketing contracts in 1997 (USDA ERS).

Figure 2. U.S. Production Coordinated by Marketing Contracts, 1997 (USDA ERS)



### Production Contracts

Production contracts have three main provisions: 1) production inputs supplied by the contractor, 2) quality and quantity, and 3) type of compensation to contractee for services rendered. In addition to price risk, production contracts address crop loss and sometimes management efficiency. Relative to marketing contracts, production contracts include increased processor (buyer) control. In exchange for more control, processors address crop loss and management risk in addition to price risk. To compensate for risk sharing, the producer portion of crop value is often lower than in marketing contracts. There are two types of production contracts: production-management contracts and resource-providing contracts.

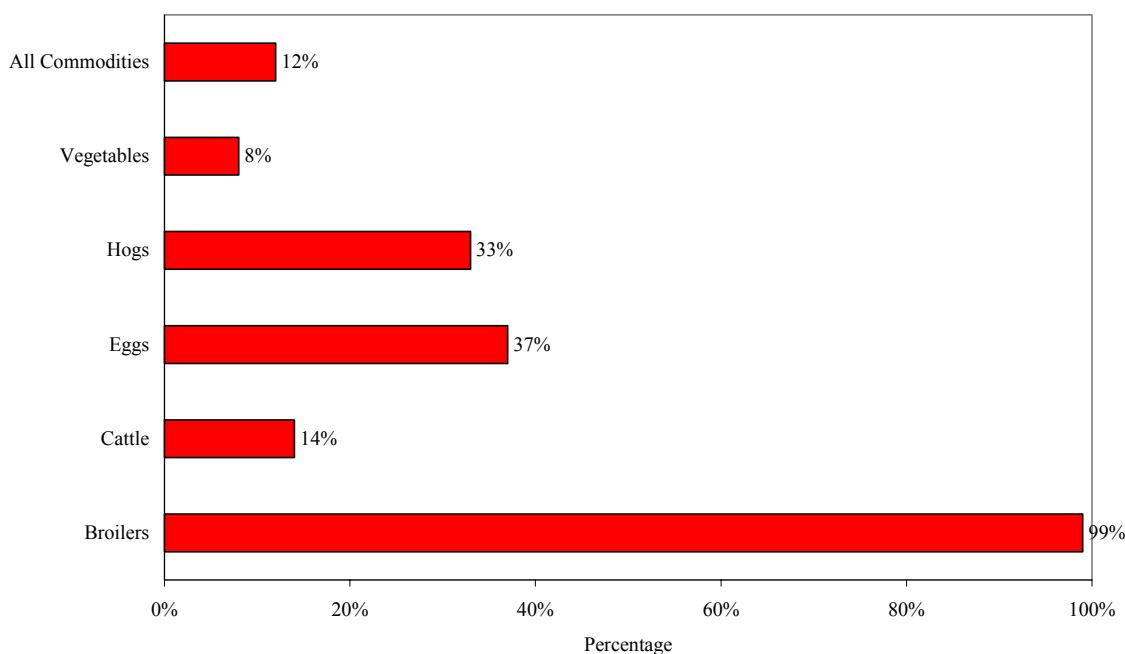
In production-management contracts, processors participate in crop management. Producers provide most inputs and retain title. However, contractors may provide some inputs, such as seed, and provide management assistance. In exchange, a processor agrees to purchase the entire crop and provide economic incentives for quality and quantity. These contracts are popular in specialty field crops such as fruits, and vegetables. Bailment contracts are an example of production-management contracting.

Resource-providing contracts are the highest vertical coordination level contracts. They involve the processor supplying most inputs for production and having increased involvement in management practices. Producers often provide only land and labor, and are compensated for their services more than their entrepreneurial abilities. Personal service contracts are an example of resource-providing contracts. The poultry industry is a market that extensively uses resource-providing contracting, where processors supply chicks, feed, and management. Figure 3 describes the production of commodities grown under production contracts (USDA ERS).

### Integration

Integration is a method of vertical coordination representing the greatest degree of control that a firm can gain over the output from another stage of production. Coordination of two or more stages occurs under common ownership and management. There are many examples of integration in agriculture. Farmers who produce corn and hay as feed for their dairy operations are vertically integrated across the crop and livestock production stages. Similarly, cattle producers who have a cow-calf herd, background the weaned calves or stockers to feeders, and feed the cattle to finished or slaughter weights through a retained ownership program are

Figure 3. U.S. Production Coordinated by Production Contracts, 1997 (USDA ERS)



vertically integrated.

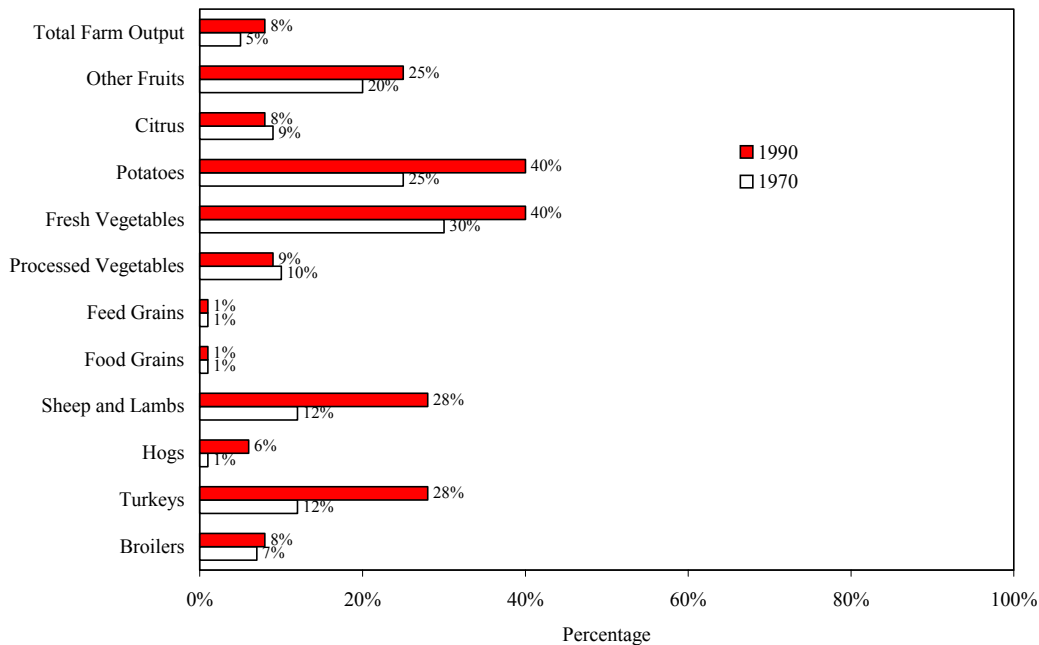
Producers also engage in integration through group action. The most common form is a producer-owned cooperative. There are two basic types of cooperatives in terms of marketing coordination, open-membership and closed-membership. The more popular terms are traditional and new generation cooperatives, respectively. Closed or new generation cooperatives have very tightly coordinated marketing between the farm production stage and the next stage, such as assembly, storage, or processing.

In a new generation cooperative, a producer invests directly by purchasing stock and signing a

uniform marketing agreement. This investment and agreement creates a right and an obligation to deliver a certain number of units of production to the cooperative. In most cooperatives, there are a limited number of shares issued. Boland, Katz, and Barton have written several case studies on closed membership cooperatives.

Figure 4 describes the change in U.S. farm production coordinated by integration between 1970 and 1990 (Martinez and Reed). Note that potatoes and vegetables, both perishable crops, have had the greatest increase in integration. Approximately 8 percent of total U.S. agriculture output was vertically integrated in 1990.

Figure 4. U.S. Farm Production Coordinated by Vertical Integration, 1970 and 1990 (USDA ERS)



There are two principal methods of integration. The first method is to invest in public food processing company stock for those companies that process the commodities grown by a producer. The second method is to invest in cooperative stock for a cooperative that processes the commodities grown by a producer.

### Investment in Public Company Stock

Purchasing stock in a food processing company is an obvious method to manage risk associated with integration. Direct investment allows producers to share in the potential returns from processing commodities into industrial products or food products. One tool that is useful in determining the appropriate level of investment is the VEST model (Siebert, Jones, and Sporleder). The VEST model uses the processing firm's value of shares outstanding (equity value), cost of goods sold, and total farm sales of a particular commodity to determine the required investment capital by a producer.

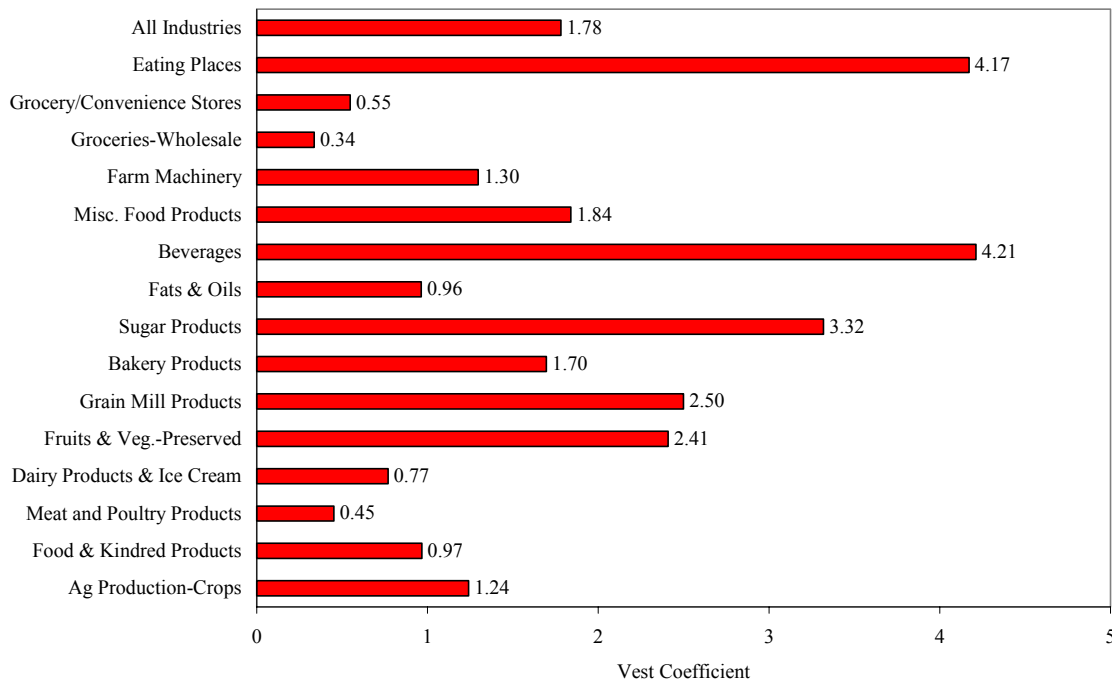
The first step is to calculate the VEST coefficient, which is the ratio of **Value of Shares Outstanding to Cost of Goods Sold**. A higher VEST coefficient implies more risk and higher

potential returns; a lower VEST coefficient implies less risk and lower potential returns. Figure 5 has the VEST coefficients in Boland, Freberg, and Barton's (unpublished data) study of 168 food and agribusiness firms from 1980 to 1997 by U.S. Department of Commerce SIC industry classification. Note that generally the greater the number of marketing functions performed (such as grading, processing, storage, wholesaling, other services, transportation, promotion), the higher the VEST coefficient.

When a VEST coefficient is greater than one, a producer would need to invest more than the total sum of farm sales. This greater investment is due to the large number and cost (value-added) associated with the functions performed by that industry relative to the value of the farm commodity. However for firms with fewer marketing functions, less investment is needed.

The next step is to determine how much capital a producer should invest in stock. The VEST coefficient for a particular commodity is multiplied by total farm sales for that commodity

Figure 5. Vest Coefficients By Industry for Investor-Owned Firms, 1980-1997 (Boland, Freberg, Barton)



assuming a producer desires to invest 100 percent of farm sales. However, depending on each producer's aversion to risk and the amount of capital available for investment, producers may choose to be fully vested or invest a smaller percentage of total farm sales (e.g., multiply the percentage by the VEST coefficient to obtain total investment needed).

Cole, Featherstone, and Kastens found that for some agricultural firms, the VEST model may enhance profits, but not reduce risk due to positive correlation between stock prices and farm sales. Thus, it is important that to consider a producer's objective when using the VEST model. The choice of agricultural industries is important for a reduction in risk, improvement in profit potential, or combination of risk reduction and profit potential.

### **Investment in Cooperative Stock**

A similar process can be used to determine the level of investment in a cooperative. However because stock is not publicly traded, some care should be used when evaluating the return on investment or equity. Diversified cooperatives with open membership and operating in geographically disperse regions are likely to use pricing strategies comparable to public companies. Consequently, return on investment or equity should be comparable to public companies. However, this may not always be the case for vertically integrated cooperatives that are able to transfer income between various stages of marketing. In those circumstances, return on equity or investment may reflect the membership's desire to return a higher price for the inputs which are supplied to the processing cooperative. Consequently, return on equity or investment may be lower than public companies.

### **Risk Factors**

Obviously, there are risk factors associated with vertical coordination. As producers commit a higher percentage of their production to vertical coordination, they reduce the liquidity associated with crop ownership. In the open market, processors reflect their risks in price offerings. If pricing becomes quality-based, quality risk is transferred from processors back to producers. This leads to questions as to whether or not producers realize more total value when contracting. Higher levels of vertical coordination may also cause long-term changes in price discovery mechanisms and concentration in agriculture.

### **Contracts**

It is important to have information on the risk and return factors in vertical coordination. Harwood et al. describe some risk and return tradeoffs from contracting. Marketing contracts focus on controlling market and price risk. The producer owns and manages the crop, and is therefore responsible for delivering the quantity and quality specified. This means the producer is still exposed to risk of crop production loss. Marketing contracts are closest to open market transactions and therefore have the least effect on parties outside the producer and processor. Cash flow timing and associated tax effects are the main changes associated with marketing contracts. There is often little or no impact on crop insurance, farm program qualification, or other commitments. The exception to this would be specialty crops with special provisions regardless of contracting. Farm program and crop insurance provisions were designed to protect producers from risk.

Increased processor control through production contracts also increases the probability of changes in the rights and responsibilities of associated parties. Price, market, and management risk are significantly decreased, but the management role of a producer is essentially changed. Closer relationships may create long-term commitment to the processor.

### **Integration**

The relationship between integration and risk involves an evaluation of the expected returns, and the correlation of the farmer's return on investment for the current activity and the integration alternative. If the correlation is positive and large across activities, the gains in risk efficiency from integration may be relatively low. In contrast, a negative correlation across activities implies that integrating vertically may substantially reduce market price risk. Large capital requirements and difficulty of exit, nature of the commodity, and the ability to secure input or output markets are three major risk factors associated with integration.

A great deal of capital is needed to vertically integrate because typically physical assets are purchased or built. Thus, producers provide equity through incurring debt or converting existing equity into cash to purchase the assets. Furthermore, these investments may be difficult to exit should financial difficulties occur. Thus, it is important to recognize what effect such an investment might have on a producer's financial portfolio.

The nature of the commodity and its industry is also an important risk factor. The risk-reducing benefits associated with 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. For perfectly competitive industries, all firms are subject to price fluctuations caused by supply and demand shifts, whether or not they are integrated, and integration cannot provide protection from such risks. In such industries, the benefits to integration may be small. It is important to note that while an industry may have small numbers of buyers and sellers in one geographic region (e.g., North America), global competition still affects supply and demand.

The incentives for integration may arise either from producers or from buyers further down the marketing chain who realize an opportunity to enhance potential returns or reduce their risk. For example, a producer (or group of producers) may vertically integrate *downstream* (forward in the marketing channel) to ensure a market for commodities and to have an opportunity for a greater return on equity. By doing so, producers may enhance returns by lowering transaction costs and by using management and other resources more efficiently. Risk also may be reduced by guaranteeing a market outlet and by avoiding the uncertainties of selling and purchasing intermediate commodities in imperfect markets. Conversely, a 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 returns may result.

Thus, the ability to secure dominant share in these input or output markets is critical for the success of integration. For example, securing a large volume of a commodity such as pinto beans is critical for success if integration is contemplated by producers. Given production in various regions, this may mean working with other firms in those regions (e.g., marketing agency-in-common) to secure dominant share. On the other hand, clearly differentiated products require producers to secure input markets to ensure that the products can be processed.

A study of 56 investor-oriented agribusiness firms from 1984 to 1993 found an average return on investment (investment equals total assets minus current liabilities) of 17.6 percent, which is greater than the 16.1 percent obtained by investing in the S&P 500 over the same time period (Forster). Boland, Freberg, and Barton (unpublished data) found a 18.3 percent average annual return on equity and a 11.0 percent return on investment from 1980 to 1997. Figures 6 and 7 present the mean annual return on investment and equity for various SIC industry classifications. For example, firms that were involved in activities with more marketing functions had greater returns than firms involved in only one or two functions such as retailing or slaughtering meat. It is important to note that the range of returns is quite large and generalizations about the average return must be considered with great care. Return on equity compared to return on investment varies between industries because different industries use different combinations of

debt and equity.

One measure of risk is the coefficient of variation (CV). It is the standard deviation divided by the mean return. A higher CV (due to a higher standard deviation or a lower mean) implies more risk while a lower CV suggests less risk. Figures 8 and 9 present the CV for return on investment and return on equity. Different industries have seen different levels of variability in returns and return on investment and equity over 1980 to 1997. Return on investment had

Figure 6. Return on Investment by SIC Industry Classification, 1980 - 1997 (Boland, Freberg, Barton)

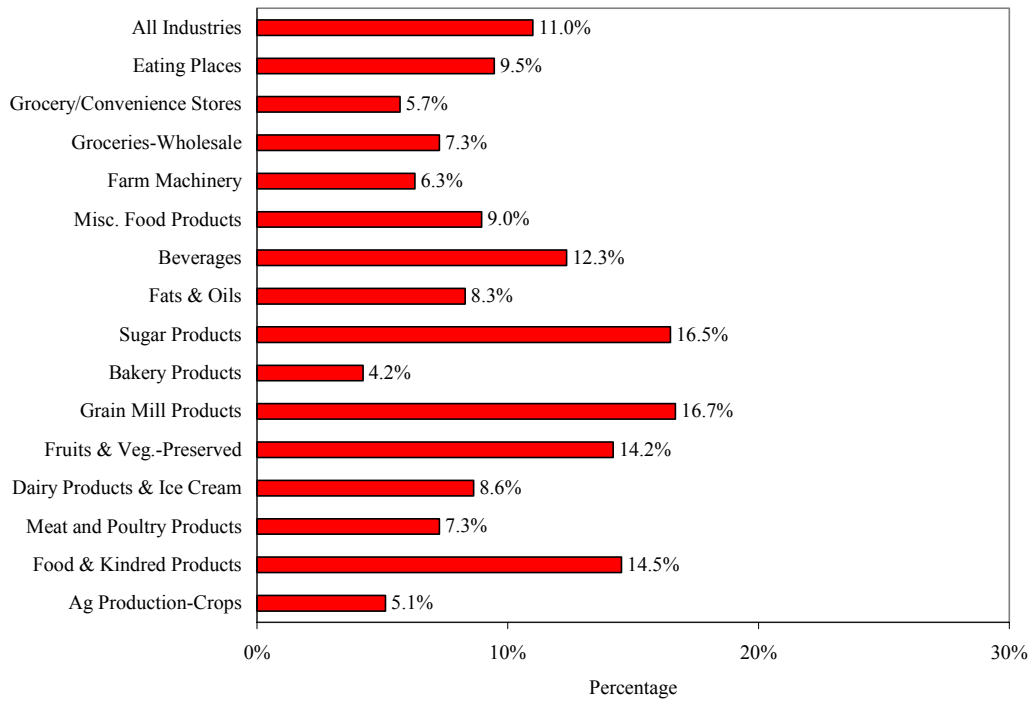


Figure 7. Return on Equity by SIC Industry Classification, 1980 - 1997 (Boland, Freberg, Barton)

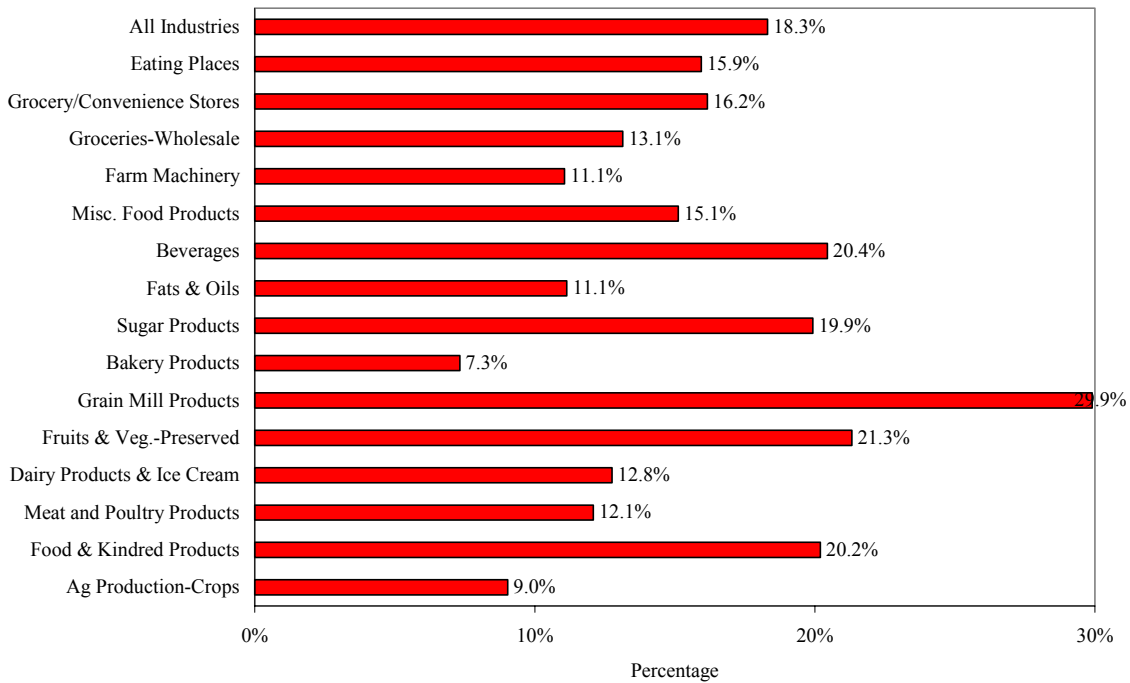


Figure 8. Coefficient of Variation for Return on Investment by SIC Industry Classification, 1980 - 1997  
(Boland, Freberg, Barton)

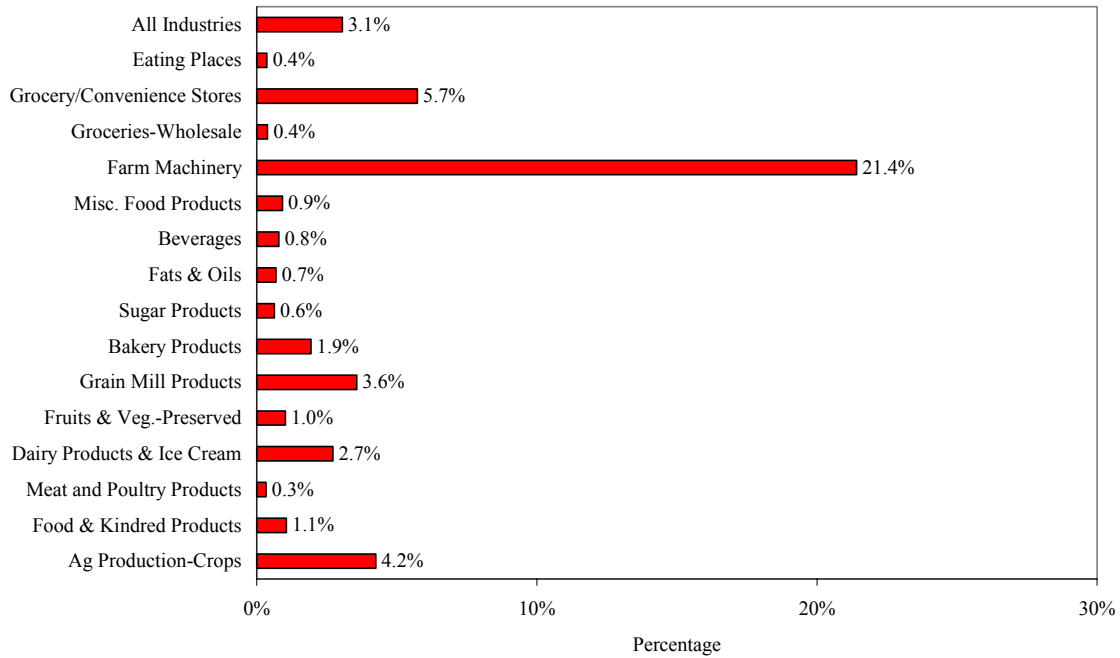
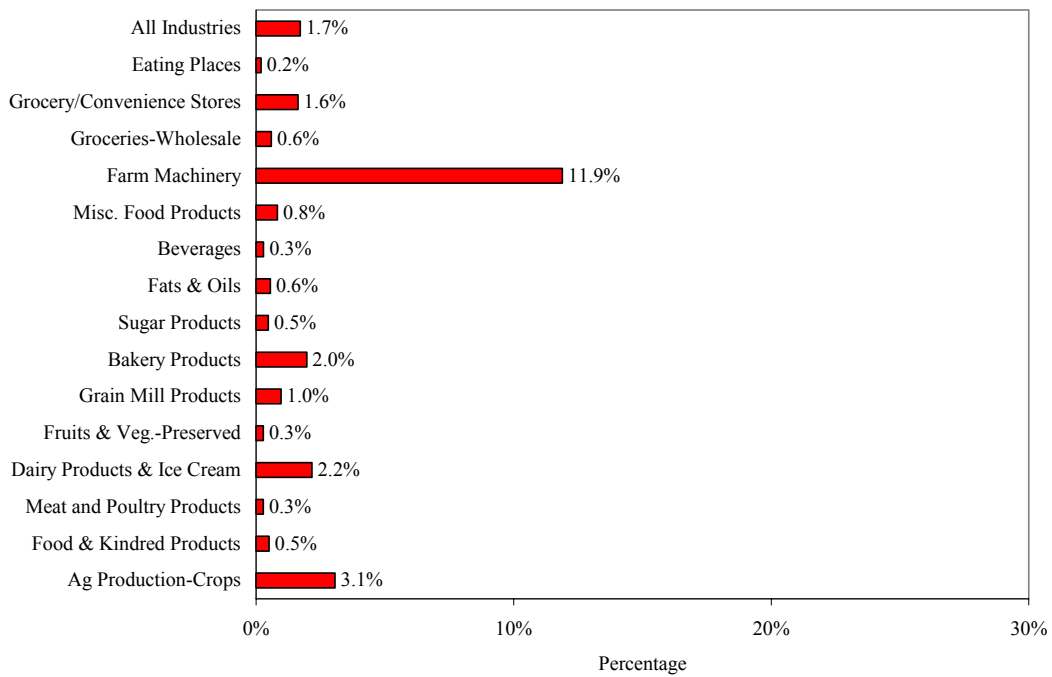


Figure 9. Coefficient of Variation for Return on Equity by SIC Industry Classification, 1980 - 1997 (Boland, Freberg, Barton)



almost twice as much variability as return on equity, which reflects the risk premium for equity vis-a-vis long-term debt and equity. A greater discussion of these figures is presented in Boland, Freberg, and Barton.

### **Managing Integration Risk**

Integration is becoming a more popular alternative vertical coordination method among some producers given the risk and returns shown in figures 6 to 9. It is important to note that the level of integration may vary among producers. One common question often asked by producers is “How much should I consider investing in vertical integration?”

A study was conducted to help provide information about investments in new generation cooperatives by other producers (Boland, Lusk, and Barton). The objective was to determine the factors underlying a producer’s decision to invest a percentage of their production in a closed membership food processing cooperative. The study was based on a sample of 38 Midwestern food processing cooperatives. Participants were asked questions regarding the average percentage of a producer member’s total production being marketed through the cooperative, the number of producers that had purchased stock, the number of shares, the price of shares issued, and whether the product was considered perishable or storable. A product was considered storable if the product could be held for longer than six months to take advantage of fluctuations in price as a result of changes in supply.

The products marketed by the storable cooperatives included oilseeds, edible beans, alfalfa hay, corn, ethanol, wheat, fructose corn syrup, soybeans, and specialty grains such as buckwheat. In contrast, the cooperatives that marketed perishable products processed carrots, cattle, beet sugar, hogs, bison, peas, sweet corn, turkeys, ostrich, potatoes, and fish. On average, producers of storable products marketed 25.5 percent of their total production through the cooperative compared to 70.1 percent for perishable products.

Regression analysis was used to determine significant determinants of storable and perishable commodities. If the commodity or food product was considered perishable, the average percentage of a producer’s production invested in the cooperative increased while the number of producers investing in the cooperative was much smaller relative to storable commodities. For example, producers in the study who marketed a perishable commodity would contribute 22.9 percent more production to the cooperative relative to producers marketing storable products with storable crops. Thus, the degree of perishability and number of producers are inversely correlated (e.g., perishable commodities had fewer numbers of producers investing in the cooperative). The opposite was true for storable commodities; these had greater numbers of producers investing and the percentage of farm production investment was lower relative to perishable commodities.

The study suggests that the relative perishability of a commodity or food product has a significant impact not only on the size, but also on the percentage of production for the individual members in the cooperative. Producers with perishable commodities invest in food processing cooperatives, in part, to improve market access because it may be more difficult to find timely buyers within their geographic region. Some commodities may never have been produced in their region on a large basis and the only processor is the cooperative. Thus, the ability to sell the product outside the cooperative may be limited or nonexistent. Consequently,

producers will commit all or a large percentage of their output to the cooperative.

However, a new risk is incurred by placing a larger percentage of the producer's production in the cooperative. Porter (1985) suggested that firms marketing perishable commodities should use a differentiation strategy to offset possible price disadvantages from not being able to store the commodity. Such a strategy requires greater investment as noted from the VEST coefficients. It may be difficult to locate enough producers to invest in a processing cooperative because it requires a greater percentage of the producer's total production. These producers are likely to be more reluctant or risk averse to producing a perishable product.

Deciding between producing perishable and nonperishable crops is an important decision producers must make when considering risk associated with the nature of industry and ability to secure markets. Perishable crops are often marketed directly to one processor. Perishable products will have a smaller number of producers who will likely commit a higher percentage of their production to the cooperative, relative to easily stored commodities.

### **Implications**

Vertical coordination is a mechanism for enhancing farm income. Producers contemplating investing in vertical coordination methods should evaluate the return from that investment relative to the entire risk within their farming operation. It may be that investments in technologies that could reduce average production costs (e.g., precision agriculture, etc.) would lead to greater returns and less risk relative to vertical coordination, particularly integration. Lack of major processors for corn and soybeans in some geographic regions may lead to fewer contractual arrangements.

### **Questions and Answers on Vertical Coordination**

**What are the different types of vertical coordination?** There are three basic types of vertical coordination: open marketing, contract production and marketing, and integration through investments in food and agribusiness firm's stock or new generation cooperatives and purchases of a delivery right. The food industry has traditionally operated in an open marketing system in which a firm purchases a commodity from a producer at a market price determined at the time of purchase. Using contract production, a firm commits to purchase a commodity from a producer at a price formula established in advance of the purchase. Integration is a method of vertical coordination representing the greatest degree of control that a firm can gain over another stage of production.

**What are the major methods of contracting?** The two major types of contracts are marketing contracts and production contracts. These contracts vary in crop ownership, management responsibility, and provision of crop inputs. In marketing contracts, producers own the crop, manage it, and provide most or all crop inputs. Marketing contracts control market access and price risk, but do not address crop loss or management risks. Production contracts involve increased processor provision of inputs, crop ownership, and participation in management. In exchange, crop loss and management risks are reduced for producers.

**What are the main risks associated with vertical coordination?** Marketing contracts control price risk to some extent. However, there may be risk associated with price spreads, basis, and base price movements in pricing mechanisms of marketing contracts. A flat-price contract, where a specific price is set at the time of the agreement, is the only marketing contract that totally alleviates revenue risk. Marketing contracts do not address risks associated with crop loss and personal management abilities. Production contracts address price risk, crop loss risk, and management risk to varying degrees. However, there are still risks of contract breach, as well as the possibility of altered eligibility for crop insurance, farm programs, and financing. In addition, relationships with landlords, custom operators, and any other associated parties may be affected. Capital and management requirements, the nature of the industry, the ability to secure input supply and output markets, and the perishability of the product are risk factors associated with vertical coordination.

**What are the methods to achieve integration?** Producers can manage risk through ownership using the VEST model to invest in food and agribusiness firms, or purchasing stock in a new generation cooperative and signing a uniform marketing agreement.

**How much of U.S. agricultural production is marketed through vertical coordination methods?** According to USDA's most recent numbers, approximately 42 percent of agricultural products are marketed through vertical coordination. This is broken out into 34.5 (contracts) and 8 percent through integration.

## References

Boland, M. A., J. Lusk, and D. Barton. 1998. Factors underlying producer investments in processing cooperatives. Research Report #31, Department of Agricultural Economics, Kansas State University, Manhattan.

Boland, M. A., C. Freberg, and D. Barton. Unpublished data for forthcoming publication Economic issues with food and agribusiness firm profitability, Department of Agricultural Economics, Kansas State University, Manhattan.

Boland, M.A., J. Katz, and D. Barton. 1999. Case studies on food and agribusiness closed membership cooperatives. MF-2448, Kansas State University, Manhattan.

Cole, C. A. Featherstone, and T. Kastens. 1999. Alternatives to value added coops. In *Proceedings of the 1999 Risk and Profit Conference*. Department of Agricultural Economics, Kansas State University, Manhattan, KS, August 20-21.

Forster, D.L. 1996. Capital structure, business risk, and investor returns for agribusiness. *Agribusiness: An International Journal* 12: 429-442.

Harwood, J., R. Heifner, K. Coble, J. Perry, and A. Somwaru. 1999. Managing risk in farming: concepts, research, and analysis. Economic Research Service, U.S. Department of Agriculture, Agricultural Economics Report No. 774.

Johnson, J., M. Morehart, J. Perry, and D. Banker. 1996. Farmers' use of marketing and production contracts. Economic Research Service. U.S. Department of Agriculture.

December 1996.

Martinez, S. and A. Reed. 1996. From farmers to consumers: vertical coordination in the food industry. AIB-720, Economic Research Service, U.S. Department of Agriculture.

Porter, M. 1985. *Competitive Advantage*. The Free Press, New York NY.

Siebert, J. W., R. Jones, and T. L. Sporleder. 1997. The VEST model: an alternative approach to value added. *Agribusiness: An International Journal* 13: 561-568.

USDA ERS. 1997. Agricultural resource management study, special analysis. Economic Research Service, U.S. Department of Agriculture.