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in Meat Product Markets**

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Vertical Integration Incentives in Meat Product Markets

Frances Antonovitz, Brian Buhr, and Donald J. Liu¹

Since Tom Urban popularized the phrase "the Industrialization of Agriculture" nearly five years ago, numerous studies of this phenomena have been conducted (e.g., Boehlje; Drabenstott; and Hurt). The industrialization of agriculture refers to the trend toward larger production units (to capture economies of scale) and the increasing occurrence of vertical integration and coordination among the various stages of the food and fiber system. Barkema; Drabenstott; and Kinsey as well as others have suggested that it is today's discriminating consumers who are the driving force behind this industrialization because of their demands for extremely detailed product specifications which have overwhelmed the traditional market system. This paper will focus on the increased vertical integration and coordination occurring in meat product markets.

To initially focus our comments, it is worthwhile to

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establish a stereotypical representation of the food production system. At the primary supply end of the chain is the farmer who employs the four major factors of production (land, labor, capital and equipment) to produce raw commodities such as corn grain, live animals for slaughter, fruits, vegetables and intermediate foods. Next in line is the more heterogeneous (in terms of inputs used and outputs produced) processing segment. One important characteristic of the processing sector is that while always closer to the consumer than the producer, firms within the industry may be relatively closer or farther from the consumer. For example, further cutting of meat products may be done at the grocery store which is in direct contact with consumers, while hamburgers used by McDonald's must clearly be shipped to the restaurant. Finally, there are the retail outlets or more precisely the point of interface with the final consumer who is the source of primary demand. Along the way of course, there are multiple suppliers involved in one sector and not another and there are multiple leakages from one sector (e.g. exports of chilled beef) and not another. In between each sector are marketing inputs and infrastructure including transportation, grading systems, warehouses (perhaps rapidly becoming an unnecessary storage factor) and price discovery institutions.

Each country possesses an agricultural and food sector which fits this loosely defined structure. However, each country's conditions such as national policies (monetary, fiscal and trade), and most importantly in our context endowments of various

factors of production. From a trade perspective, it is this country specific portion of market conditions which may lead to a firm seeking international vertical integration while eschewing the same thing within its own country.

Historically, open spot markets for commodities have linked together input suppliers, producers, processors, retailers, and consumers. Now, however, these open markets have been increasingly replaced by vertical coordination, contractual relationships, and vertical integration of two or more of these stages. Many of these arrangements even extend into international markets. Dairy production, seeds, commercial fruits and vegetables, turkeys, eggs, and particularly broilers have experienced some type of vertical coordination for quite a long time. However, contracting and integration are relatively uncommon for grains, oilseeds, and cotton. Relative newcomers to the movement toward coordination include the beef and pork industries.

More specifically, this study will attempt to apply some of the relevant theories in industrial organization to the vertical integration and coordination occurring in the livestock and meat subsectors highlighted by domestic and international examples of processed and fresh meats. These subsectors are particularly interesting because their "industrialization" has been rapidly evolving (Hurt; Rhodes) and the markets have been moving quickly toward coordinated agreements (Boehlje) and developing further processed products at a remarkable rate. Furthermore, for

several reasons these subsectors represent some of the fastest growing export markets in agriculture. Improved technologies allow perishable products to be transported abroad quickly and easily. Also, as incomes continue to rise in the newly industrialized and emerging economies, we have seen and are likely to continue to observe a significant increase in the demand for meat in these countries with the U.S. having the potential and motivation to fulfill these demands. Hence, the industries studied in this paper will provide a rich case history for further studies assessing the hypotheses of vertical integration for other domestic agricultural subsectors and for vertical linkages in other international food markets as well.

Theory and Relevance

This section presents an overview of the relevant theories of vertical integration and coordination and how these theories can be used to examine the trend toward industrialization of the meat sector, with particular focus on its international dimension. The discussion will include technological economies arguments for vertical integration, neoclassical theories of vertical integration, transaction cost economics viewpoints of vertical integration, and theories of vertical contractual relations.

Before proceeding with the overview, more precise definitions of vertical integration and coordination are given.

Vertical integration is the consolidation of two successive production processes in which the output of the upstream stage is used as one intermediate input in the downstream stage. The consolidation is such that contractual and open market exchanges between the upstream and downstream firms are eliminated and replaced by internal exchanges within the consolidated firm. As such, vertical integration implies ownership and complete control over neighboring stages of production or distribution. Somewhere in between the extremes of vertical integration and open market exchange lie the various degrees of vertical coordination arising from contractual arrangements between firms at the successive stages. A vertical coordination transfers some (but not all) of the production or distribution decisions of one firm to another.

Also, a general comment on the theory of vertical integration is in order. In reality the prevalent pattern of agricultural industrialization is vertical coordination rather than vertical integration. Indeed, with few exceptions, vertical integrations in agriculture are rare, and sometimes are not even allowed by the law.² However, given that there are clear examples in U.S. agriculture and that there are fewer legal

² The Packer Consent Decree of 1920 forbade the "Big Five" meat packers of that era from ownership of livestock and subsequent meat products. Current Midwestern corporate farm laws often present explicit barriers to vertical integration (e.g., must be classified as a "family farm corporation"). An often cited successful example of vertical integration in agriculture is, of course, Tyson Foods.

barriers in international vertical integration this seems like a reasonable way to proceed with the discussion. By studying a firm's motivation for vertical integration, one gains insights into the implication of existing vertical integration policies (or lack thereof) on the conduct and performance of the industry. The investigation also places researchers in a better position to predict the future of the industry if legal and economic restrictions on vertical integration change.

Technological Economies Arguments

One reason given for the occurrence of vertical integration is that there may be technological economies associated with the integration because it takes less of the other intermediate inputs to produce the same output in the downstream process (Perry, 1989). In processed meats a clear example is the relationship between meat processors (defined as either fabricating final cuts such as pork chops or processed meats such as Johnsonville Brats) and grocery store butcher shops. For all practical purposes the technologies involved in the cutting and packaging are identical. Therefore, meat cutting personnel and equipment would seem to be redundant inputs for one or the other stage. The primary practical reason for the lack of integration is that individual grocery stores may attempt to satisfy their particular customer's demands for specific cut specifications (essentially a product differentiation argument). Inventory

control and product distribution may also be limiting factors in further integration. However, as meat products become more homogeneous (due to producer and processor technologies) and inventory control and information systems technologies improve, it is likely that greater levels of integration will occur, most likely with processors developing case ready products and the retailer removing their redundant butcher shops.

Very intriguing cases arise when considering the international dimensions of technological economies. It is readily apparent that technical efficiencies arise when livestock and crop production can occur in the same place (linking production to idiosyncratic country factor endowments) because it is then possible to use the manure to improve crop yields and at the same time reduce inputs associated with pollution abatement. This crop-livestock complementarity explains why it may be more efficient for Japanese and Taiwanese packers and processors to integrate backwardly into the livestock production stage in the U.S., rather than importing feed grains from the U.S. and raising the animals there.

Neoclassical Theories of Vertical Integration

In addition to technological economies, there are other motivations for which firms integrate. In the neoclassical theory of vertical integration the focus has been on market imperfections, including imperfect competition and imperfect

information.

Imperfect Competition

Focusing on the case of imperfect competition, we will examine three different motivations for vertical integration: internalization of market distortions arising from imperfect competition, price discrimination, and entry blocking.

Internalization of Efficiency Losses

Consider a vertical situation in which the upstream firm is a monopoly which provides one of the intermediate inputs used by the downstream competitive firms. Due to monopoly pricing, there exists a distortion in the usage of intermediate inputs by the downstream industry as firms shift away from the monopoly input in favor of other intermediate inputs which are competitively supplied. The size of this distortion depends on the elasticity of substitution among the inputs of downstream production. The monopoly would have the incentive to capture the efficiency loss from the distortion by integrating forward into the downstream stage (i.e., purchasing as many of the downstream firms as possible), thus, expanding the usage of its own intermediate good. This suggests that one possible incentive for vertical integration is to internalize efficiency losses arising from imperfectly competitive pricing (e.g., McKenzie; and Vernon and Graham).³

³ Subsequent researchers have raised the question of whether vertical integration by the monopolistic manufacturer

Just as monopoly pricing may cause inefficiencies, there are clear distortions created at the international level by trade policies such as non-tariff barriers. Similar in concept to avoiding monopoly distortions by vertically integrating, it may be possible to capture or avoid some of the non-tariff trade barrier distortions with international vertical integration. An example for incentives to integrate occurs within the context of the European Community's ban on beef imports from countries who use certain anabolic hormones in production. After processing, it is not possible to tell which beef products are from treated animals without expensive tests. Therefore, all the beef from countries which have approved use of the banned hormones is effectively excluded from the E.C. whether it is treated or not. The only way to assure no use is for a firm in the E.C. to be directly involved in raising the cattle itself and certify them as hormone-free. The U.S. firm IBP (a major beef packer) is actively pursuing integrated marketing in the E.C. to ensure hormone free beef, and personal contacts suggest they are stepping up efforts in response to the recent BSE (mad cow disease) incidents in Great Britain.

Another example that international vertical integration can be used to circumvent non-tariff barriers is the following.

into the retail stage will in turn create a monopoly distortion in that stage thus increasing consumer prices to such an extent that it actually reduces overall welfare compared to the pre-integration situation (see the review in Perry, 1989).

Brazilian soybean producers may wish to capture value-added production activity by feeding and exporting beef or pork to beef or pork-deficit countries. However, the export potential is restricted because of foot-and-mouth disease in Brazil. Hence, there is an incentive for Brazilian soybean producers to ship the beans to a disease-free country and vertically integrate into the livestock production sector in that country.

Price Discrimination Motivations

As pointed out in the literature (e.g., Stigler; and Perry, 1978a), another incentive for vertical integration under imperfect competition is to separate downstream markets for the purposes of price discrimination. For example, consider the case where an upstream monopoly is able to classify its downstream competitive industries into two groups: one with an elastic intermediate input demand for the monopoly product and the other with an inelastic derived demand. The Robinson-Patman Act prohibits the monopoly from engaging in explicit price discrimination, that is, charging a different price to each downstream group. Yet, through forwardly integrating into the stages with elastic derived demand, the monopoly can expand input usage for its product in those stages, meanwhile raising the open market price to the inelastic group by charging the monopoly price.⁴

⁴ Notice that the above scheme will not work if the monopoly's forward integration is with respect to the inelastic

Perry (1978b) gives an interesting backward-integration story to illustrate the incentive for price discrimination by a downstream monopsony. To integrate back into the competitive upstream industry, the monopsony needs to acquire the assets of the competitive firms at the price which equals the rents that the assets generate. Instead of acquiring all of the upstream firms outright, the monopsony can extract some of the initial rents by buying one at a time. More specifically, the partially integrated monopsony then expands the production of its subsidiaries, hence, buying even less from the remaining independent firms. In turn, this has the effect of lowering the rents of the assets of the remaining independent suppliers which makes it possible for the monopsonist to acquire those firms at a lower price as it chooses to further integrate.

A good domestic market example of the above price-discrimination theory is given by the meat packing and processing industries. As illustrated in Figure 1, after the slaughter process, the carcass may move on to several alternative stages which require different amounts of further processing (e.g., further cutting for consumption in the fresh market vs.

group. The optimal pricing strategy for the monopoly in this case would appear, on the surface, to be to reduce the usage of its product by the inelastic subsidiaries while lower the open market price for the elastic independent firms. But this cannot be optimal because the resulting higher retail prices in the inelastic stages would certainly be undercut by new entrants who can obtain the monopoly input at the lower open market price.

additional processing such as canned hams, luncheon meats, etc.). If the demand elasticities are different for the fresh and the more extensively processed meat products, then the theory can be used to suggest which of the two processing stages the packer is likely to choose for integration. For example, Kesavan and Buhr estimate that the retail demand for fresh cuts of pork (hams, pork chops, and sirloin roasts) is less elastic than the demand for pork sausage. Based on the criteria of price discrimination, if a packer chooses to integrate into one of these two processing stages, it would pick the sausage. This may be evidenced by the fact that further processed sausages and canned hams in a typical grocery store meat counter are branded by the packer or processor, while most of the fresh cuts (pork chops, loins, etc.) are typically store label. One can make similar arguments at the international level. For example, if Country A's demand for pork sausage is less elastic than Country B's, then the U.S. packing firm would choose to integrate into the sausage processing stage in Country B, *ceteris paribus*.

Entry Blocking Motivations

Bain proposes a third incentive for vertical integration under imperfect competition. He argues that vertical integration has the effect of creating entry barriers by forcing potential entrants to contemplate entry at two stages of production rather than just one. Salop and Scheffman discuss a situation where a

dominant firm may engage in backward integration into the input

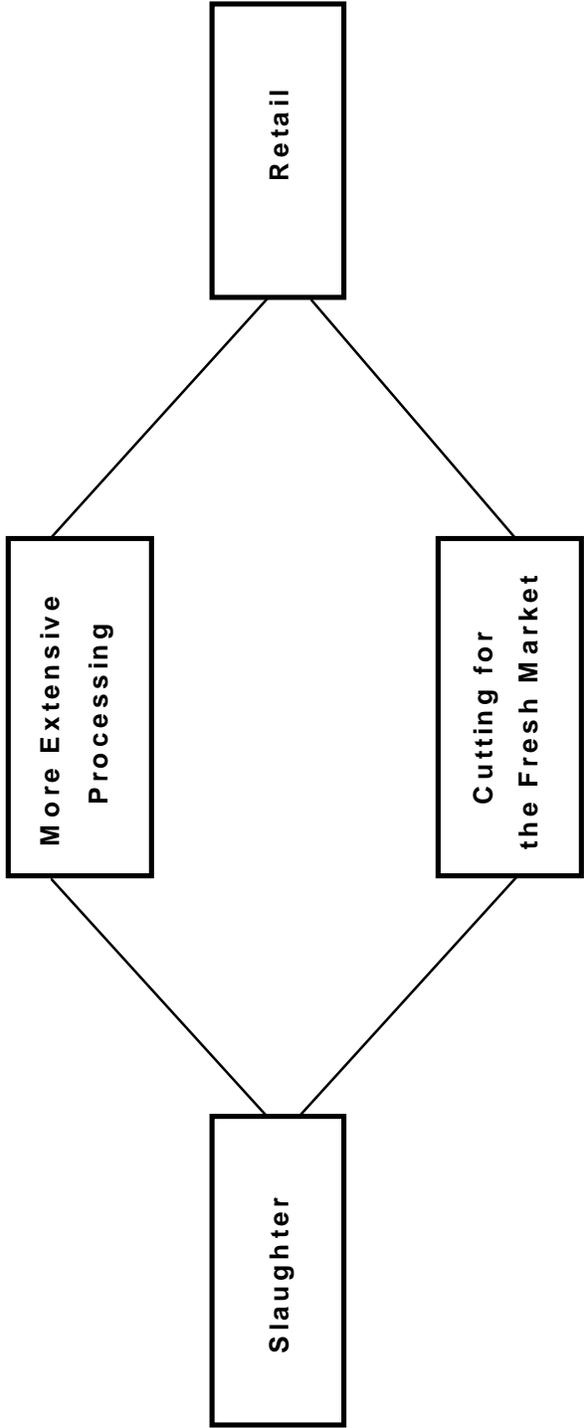


Figure 1. Example of Processing Stage in the Meat Industry

production stage so as to raise the costs of its downstream competitors in the final good market. More specifically, by sufficiently integrating into the upstream stage and consequently leaving the upstream open market thin, the final-good competitors (existing or potential) are forced into a situation where they find themselves not being able to expand without driving up the input price significantly.

In a survey of U.S. pork packing industry (Hayenga et al.), packers predict that their hog slaughter volume under vertical integration or contracting with hog producers will increase from 13.4% of the total in 1993 to 33.9% in 1998. The prediction of increasing reliance on vertical integration and coordination can be due to reasons other than entry blocking motives. In any case, the thinning of the open market leads economists to hypothesize that fewer firms will be involved in pork packing in the future.

We can also discuss the issue of entry barriers in the context of resolving them. Vertical integration can be used to overcome barriers to entry into international markets. For example, Japanese meat wholesale companies have had a difficult time acquiring particular pork products for their markets due to different cultural preferences and the fact that the still largely commodity mentality of U.S. meatpacking prevents U.S. packers from meeting the Japanese demands. To overcome this factor, three Japanese firms (Mitsubishi, Central Soya and

Ferruzzi) have purchased and operate IPC (a pork packing plant) in Indiana with the explicit objective of procuring hogs and processing them in a manner consistent with their meat sales in Japan. Hence, backward vertical integration in this case has eliminated an institutional/cultural barrier of entry for Japanese firms procuring pork products from the U.S. market.

The previous discussion centers on vertical integration between a monopolistic stage and a neighboring competitive stage. Of course, vertical integration could also happen between two successive stages each with a different degree of competition among firms in the stage. Many of the insights discussed above remain valid.

Imperfect Information

Now, turn to the case of imperfect information. We will discuss several incentives for vertical integration under this category including: supply assurance, diversification, and information acquisition.

Supply Assurance Motivations

First, consider the notion of "supply assurance." As pointed out by Perry (1989), this concept entails the possibility of a rationing disequilibrium in the sense that the firm may not be able to procure the desired quantity of input at the prevailing open market price. The salient feature of this concept can be explained by Carlton's model in which the upstream

manufacturers endogenously choose to ration the supply of the necessary intermediate input to downstream retailers. To ensure adequate supplies of the input, the retailers have an incentive to integrate back into the manufacturing stage, but only to the extent that it guarantees the satisfaction of the portion of consumer demand which will arise with high probability. The retailers then resort to the open market to buy additional quantity of input called for by any greater consumer demand which arises with low probability.

An example of this phenomena is the so-called captive-supply of cattle. Captive-supply refers to packers using contract cattle, packer-owned cattle, or cattle procured via some type of business arrangement (such as forward contracting) as a strategic attempt to offset expected shortages during the year due to the seasonality in the supply of cattle.⁵ Clearly, captive-supply may work to the benefit of packers by insuring a given supply of cattle. However, to the detriment of cattle producers, markets may become thin (as pointed out earlier in the section on imperfect competition and barriers to entry) and prices received for fed cattle may be lower and/or market information is reduced due to fewer reported price transactions established in the open market (Barkley and Schroeder; and Ward et al.).

⁵ In this example the supply is "rationed" by Mother Nature. That is, supply at any given point in time is fixed due to biological lags in animal production.

We can also discuss the analogous concept of demand assurance as it relates to international vertical integration. Interesting examples occur in the markets for red meat as well as the market for broilers. Animal anatomy dictates that specific animal parts or cuts are produced in relatively fixed proportions even though consumers may prefer one part or cut over another. In this country for example, consumers have an aversion toward many of the offals or by-products of meat animals such as livers, brains, kidneys, hearts, blood, and tongues. However, the tastes and preferences of consumers in the former Soviet Union and some Asian countries are quite different; many of these offals and by-products are as highly valued as the red meat itself (e.g., see Hayes et al.; and Wong and Khan). As to the broiler example, U.S. consumers have a strong preference for breast meat while this is not observed in many other countries. Clearly, it is optimal for the U.S. livestock and broiler industries to expand their international markets into countries with stronger demand for the parts or cuts not demanded in the U.S. market. Foreign captive demands for these parts or cuts can be established by vertical integration into their retail distribution systems.⁶ For example, Purdue and Cargill (U.S. broiler firms) have made extensive in-roads towards integration in Russia and other former

⁶ One can think of situations in which the foreign distribution systems might choose to "ration" their net import demand for the U.S. products.

Soviet countries. Recently (March 1996), Russia tried to restrict chicken imports from the U.S. because it had argued that U.S. imports did not meet its phytosanitary requirements. However, most market analysts agreed that this was an attempt to protect their chicken producers and processors from the intense competition from U.S. integrated firms.

Diversification Motivations

Can vertical integration be used as a tool to deal with uncertainty arising from demand and supply shocks? To provide a partial answer, consider the model by Perry (1982). Consumers purchase the final good from retailers who in turn purchase the good from an intermediate market supplied by manufacturers who in turn obtain from the factor markets the inputs needed for the production of the good. There is also a foreign demand for the good at the intermediate market level. Through market linkages, retail profits can be affected by shocks in consumer demand, foreign demand and factor supply. Now, suppose Retailer X and Manufacturer Y are to be consolidated. The integrated firm will still be affected by economic elements affecting consumer demand and factor supply. Moreover, even though it may no longer be involved in the intermediate input market, the integrated firm is not immune to shocks in foreign demand, as those shocks will eventually affect factor and final output prices. This suggests that vertical integration will not inherently insulate firms from economic shocks within the system.

Although vertical integration cannot insulate firms from price fluctuations, it may provide the benefit of diversification. For example, when the shocks are mainly fluctuations in foreign demand in the intermediate market (increasing demand for the manufacturing stage, but reducing supply and raising price for the retail stage), the returns from retail and manufacturing stages are negatively correlated,⁷ which would present a diversification incentive for vertical integration. On the other hand, if the shocks are mainly fluctuations in domestic demand (raising the demand in the same direction of both stages), the returns from retail and manufacturing operations are positively correlated and, hence, the diversification incentive would favor disintegration!

A possible example of this phenomena occurred in the Fall of 1994 in the U.S. pork industry when packing plants had reached their capacities near the peak of the hog cycle. While the capacity of the slaughter industry had been reached, the number of market weight hogs continued to increase. In this instance, producers could not sell all of their hogs because of the unanticipated oversupply of hogs relative to the capacity of the

⁷ The negative correlation result requires that the elasticity of the retail demand for the final good exceeds the elasticity of substitution among intermediate inputs used in production of the final good.

slaughter facilities.⁸ Hence, while returns to hog producers fell, the returns at the packer and retail levels did not. In particular, the retail level viewed supply as unchanging when capacity of the packers had been reached and retailers had no incentive to lower prices as quantities were fixed at any rate. After this incident, many producers, and logically so, expressed a desire to integrate or own packing plants themselves so as to diversify their operations. Even so, it's not clear there would be extensive diversification benefits over the long run.

Information Acquisition Motivations

Given that firms operate under uncertainty, is it possible that the reason they engage in vertical integrations is because they want to acquire information relevant to the resolution of the uncertainty? Consider Arrow's model in which there is a group of competitive manufacturers supplying intermediate inputs to a group of competitive retailers. The intermediate input price is stochastic because of production shocks associated with the manufacturing stage. While the production shocks are observable by the upstream firms prior to the marketing of the intermediate good, this information is not revealed to the retailers until aggregated into the equilibrium price. As such,

⁸ Unlike seasonality of cattle production (discussed in the context of captive supplies) which is easy to predict and reflects more of a variation in supply rather than an uncertainty, hog cycles (anywhere from 3 to 6 years) are difficult to predict both in terms of timing and magnitude.

the retailers have to make business decisions without knowing the intermediate input price. Obviously, if a retailer is to integrate back into the manufacturing stage, he will be able to observe the production shock of his subsidiary. Assuming production shocks are generally positively correlated across the manufacturers, Arrow argues that backward integration facilitates decision making as it enables the retailer to obtain a better forecast of the intermediate input price.⁹

Additional insights on the information acquisition motivation for vertical integration can be found in Rioran and Sappington. There are three vertical stages: R&D determining output quality, manufacturing, and retailing. The developer has private information about the cost of R&D, while the manufacturer (whose identity is to be determined) has private information about the cost of producing the final good. The retailer sells the product at a known price. Now, both the retailer and developer can do the manufacturing and are equally proficient in doing it. The retailer's problem is to decide whether to manufacture the product himself or let the developer do it. It turns out that when R&D cost shock and production cost shock are

⁹ While being simple, as pointed out in Perry (1989), Arrow's model suffers a degeneracy problem of a sort. That is, since the manufacturers are competitive, they cannot benefit from withholding their private information on production shocks and, hence, the retailers could easily purchase the information from them. As such, vertical integration is not needed in the model. See Crocker for a model illustrating the acquisition of private information while avoiding Arrow's degeneracy.

positively correlated, the developer has an added incentive to overstate the cost of R&D if he is also manufacturing. Thus, it is beneficial for the retailer in this case to vertically integrate into the manufacturing stage. On the other hand, when the cost shocks are negatively correlated, the developer's incentive to overstate the cost of R&D is restrained if he is also manufacturing. Hence, it may be best for the retailer to let the developer do the manufacturing.

Consider the following application and a slight variation of Rioran and Sappington's model in the area of export promotion. There are three vertical stages: Excel exporting beef to Japan, advertising and promotion activities at the Japanese retail level, and the Japanese retail stage. The Japanese retailers have private information about the cost of retailing, while the promoter (whose identity is to be determined) has private information about the cost of promotion. Either Excel or the Japanese retailers can perform the promotion activities. Perhaps the theory can be used to predict where the vertical integration may occur. If the retail cost shock and promotion cost shock are positively correlated, the Japanese retailers have an added incentive to overstate the cost of retailing if they are also doing the promotion. Thus, it is beneficial for Excel in this case to vertically integrate into the export promotion stage. On the other hand, when the cost shocks are negatively correlated, the retailers' incentive to overstate the cost of retailing is

restrained if they are also doing the promotion. Hence, it may be best for Excel to let the Japanese retailers do the promotion.

Finally, we would like to discuss an issue related to information acquisition incentives to vertically integrate when there is inaccuracy in the transmission process. For example, the production/processing/marketing system wants to produce meat with characteristics that are highly valued by consumers. However, knowledge and understanding of consumers' preferences for individual characteristics must be accurately transmitted through many disintegrated stages in the system to the genetics and production management stages where most of the final product characteristics are determined. Hence, there may be some incentive to shorten this information chain through vertical integration so as to improve the accuracy and speed of information transmission. This also raises the issue of non-identifiable product attributes which consumers may deem important. Organically produced meat and produce, rbST free milk, and animal welfare friendly production methods are all developments directly related to meeting specific consumer preferences. Many disintegrated sectors makes it difficult and expensive to track these attributes which are only identifiable by the labels placed on them once they leave their point of production origin. To ensure differentiation they must remain outside the marketing channel of other products which could easily make the same claim. In addition, many of these products

command market premiums providing incentives for intermediaries to misrepresent the products. These cases may in fact require consumer cooperative ownership or integration of the production process to "vouch for" the attendance of the desired attributes.

Transaction Cost Economics Viewpoints

Having discussed the neoclassical theories of vertical integration, consideration now turns to the transaction cost economics literature which focuses on vertical bilateral monopoly exchanges (Coase; Williamson). A bilateral monopoly between a buyer and a seller of successive stages occurs because of ownership of exchange-specific assets; a concept Williamson referred to as "asset specificity". According to this theory, vertical integration is merely one method of carrying out the bilateral monopoly exchange, and there are other ways such as contracting. As the environment becomes more complex, however, the probability of a contract failing to specify the terms of performance for particular states of nature increases. In such states, due to asset specificity, a firm may find itself held hostage by the other firm's threat to relinquish the relationship unless certain concessions are granted. A solution to this opportunistic behavior is vertical integration. Obviously, the stronger the asset specificity, the more opportunistic the other party can be and, hence, the more preferable is the vertical integration solution. For a given degree of asset specificity,

the relative costs of governance between vertical integration and contractual arrangement then dictates the choice of the governance structure.

It is important to emphasize that transaction costs in livestock industries has many applications such as grading, quality of inputs, food safety, etc. For example, consider PSE syndrome in hogs.¹⁰ PSE could be eradicated from the U.S. swine herd as it has in Denmark. However, at least in this country, the costs of doing so would outweigh the benefits at the present time because only a small proportion of hogs have this genetic defect. Since the Japanese have a strong preference for PSE-free pork, they must carefully inspect each carcass imported from the U.S. to insure that it does not have PSE. Apparently, there are significant transaction costs, to the Japanese, associated with this type of nonintegrated bilateral arrangement. Alternatively, the Japanese could vertically integrate into the U.S. hog production sector, produce PSE-free pork themselves, and ship it back to Japan.

Theory of Vertical Coordination

It is clear that vertical integration gives the tightest control among all the different types of vertical relationships.

¹⁰ PSE is a genetically-transmitted condition in which the muscle tissue of the hog will react to stress before slaughter diminishing its palatability. Many foreign consumers have a much stronger aversion to these characteristics (pale, soft, exudative i.e., PSE) than the average U.S. consumer.

However, the transaction cost economics literature suggests that there are situations in which a vertical coordination is preferred depending on the relative cost of governance. This section provides a brief overview of the theory of vertical coordination.

The literature here is mainly concerned with the contractual relationship between two firms at successive stages of a vertical chain. While the actions of one firm affect the payoffs of the other firm in the successive stage, each firm chooses its decisions based solely on its own payoffs. Hence, the thrust of contract design problem is to overcome the externality between the firms so that their joint payoffs are maximized and distributed. As such, the study of vertical contractual relationships can be cast with the framework of principal-agent problems. One way to achieve this joint maximization is to solve the principal-agent problem for the optimal actions and then draw the contract accordingly. The information needed for the prescription and enforcement of such a contract, however, can be so demanding that the contract is, in practice, either infeasible or suboptimal. In such a situation there are incentives to utilize the various schemes of nonlinear pricing methods and direct vertical restraints.

To illustrate the point, consider the simple example of Katz, where there is only one principal with a single agent. The

principal is the manufacturer of an intermediate good which is used with other inputs by the downstream agent to produce the final retail good. Assume that the manufacturer has all the bargaining power in that he is in a position to implement a contract that induces the retailer to (i) behave in a manner consistent with joint-profit maximization and (ii) submit all the profits to the manufacturer. Given the needed information, such a contract can be drawn based on solutions to a corresponding principal-agent problem. But, is there an easier way?

Nonlinear Pricing

A two-part tariff is a simple pricing rule that enables the manufacturer to accomplish the above two goals without getting into a relationship requiring excessive post-contract monitoring. Under this contract, the retailer pays a franchise fee to the manufacturer and then buys the intermediate good at its marginal costs. The franchise fee transfers rents to the manufacturer, while marginal cost pricing for the intermediate good induces the retailer to act as a joint-profit maximizer. Note that the two-part tariff scheme is a type of quantity-dependent pricing as the average per-unit price falls with the purchase volume.

If a franchise fee is not allowed, the manufacturer would have to set the price of the intermediate good above its marginal costs to extract rents from the retailer. However, a divergence between marginal price and marginal costs distorts the retailer's

incentive for joint profit maximization. Katz discusses other situations in which the manufacturer would find it optimal to set the marginal price above marginal costs (e.g., under various situations of incomplete information). The upshot is that when the wholesale price of the intermediate good exceeds the marginal cost, the retailer purchases too little of the intermediate good because of (a) factor substitution in favor other inputs, and (b) output contraction in response to higher costs.

Direct Vertical Restraints

To ameliorate distortions from above-marginal-cost pricing, the manufacturer may wish to impose contract provisions for such direct vertical restraints as ties, royalty, and resale price maintenances. For example, the manufacturer may mandate the use of inputs in efficient proportions through the use of a tying arrangement, which occurs when a seller agrees to sell input A to a buyer only if the buyer also purchases input B from that seller (and no other). A tying arrangement works perfectly to overcome input mix distortions only when it can be applied to all inputs, and additional distortions may be induced if this is not the case. As pointed out by Katz, however, these distortions can be minimized by increasing the prices of the tied inputs that are the least substitutable for untied inputs. Alternatively, the manufacturer may adopt a royalty scheme where the retailer's payment for the intermediate input depends on his sales quantity

or revenues in the final good market. Similar to a tying arrangement, a royalty can be thought of as a form of multi-product pricing because it is equivalent to a proportional markup on all inputs.¹¹ However, a royalty has the advantage over a tie in that the manufacturer does not have to monitor the levels of other intermediate inputs in order to limit input distortions. Finally, as to the distortion arising from output contraction, a resale price maintenance can be employed. Specifically, since output contraction increases retail price, the manufacturer can impose a resale price ceiling so as to constrain the extent to which the retailer can reduce the output. A potential problem with this scheme is that the retailer may respond to the price ceiling by reducing the quality of his output.

For pragmatic reasons, we have restricted ourselves in the above discussion on vertical contractual relationship to the simplified case where there is only one principal with one agent. The basic issue is how to deal with the externalities between the two parties so that they will behave in a joint maximizing manner. We have found that the simple rule of marginal cost pricing is conducive for inducing the agent to behave in a joint-profit maximizing manner, while the taxation of a suitable franchise fee can be used to distribute the joint profits in a

¹¹ A tying arrangement is a multi-product pricing scheme because the seller's price for A is infinite if the quantity of B purchased from another firm is positive.

manner consistent with the relative bargaining position of the two parties. In cases where there is a need for above-marginal-cost pricing, direct vertical restraints can be used to alleviate the resulting distortions on the agent's incentive for joint maximization. Katz also discusses the more realistic situations where there are multiple agents and/or multiple principals. Though the problems of externalities become much more involved in those cases, the basic spirit of the solutions, in large part, remains the same.

As indicated earlier, vertical contractual arrangements are more common in most facets of agriculture and food than are vertical integrations. Current examples domestically include contracting between hog producers and packers. An interesting characteristic of these contracts is that they do not allow producers to market hogs outside the contract. This ensures that the potential externalities indicated by the previous literature will not arise. Feed companies are aggressively seeking coordination with independent growers to capture markets for their feed products. They likely would not do so without regulatory barriers (specifically corporate farm laws) to ownership.

Summary and Implications for Future Research

Will the study of vertical integration and coordination in agricultural markets be just a short-lived fad, like mini-skirts

and tie-died tee shirts? We think not. Consumers here and abroad are becoming more discriminating in their tastes and demanding that more services be included in the food products that they purchase. Hence, this necessitates more precise coordination among the stages of production and marketing. Furthermore, as production, processing, and transportation technologies continue to evolve, international trade will increase in perishable foods and lead to additional opportunities and need for vertical integration across international boundaries. As incomes increase in the newly industrialized countries and other emerging economies, the demand for meat will increase at a greater rate than for many other foods. All of these factors point to more trade in fresh and processed meat and more international vertical integration and coordination in the markets for these products.

This paper presents an overview of the theories of vertical integration and coordination and examines the relevancy of these theories to the study of industrialization in the meat sector. Several broader research issues evolve from the paper. As discussed earlier, vertical integration and coordination can allow an economy to recapture inefficiencies in the system while at the same time creating additional distortions. The question is whether there is an overall gain or loss to the society. Furthermore, one must question whether the change in resulting welfare distribution is an improvement over the previous state.

Obviously, the result of this evaluation depends on the welfare criteria used. In addition, we must put all of these debates in a global context when international vertical integration arises. Clearly, issues of global welfare and distribution must be examined as well as impacts on national food security, trade patterns, and future direction of multinational trade negotiations.

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