How Will We Know the Price of Hogs?

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▪ Introduction

While the consolidation and re-structuring of the U.S. and global hog and pork sectors has been underway for over a decade, the current hog price depression is magnifying the pressure. Historical trends reflect the consolidation in farm numbers. As recently as 1994, the greatest share of hog inventories (40%) were within the farm size range of 100-999 head. By 1998, 42 percent of hog inventories were held on farms with greater than 5,000 head. These farms represented less than 2 percent of all farms with hog inventories.

Similar trends are occurring in the meat packing industry, but to an even greater extent. As of 1998, it was estimated that the top two-meatpacking firms controlled 38 percent of the total U.S. hog slaughter capacity. The top 5 firms accounted for 68 percent of the hog slaughter capacity.

However, the essence of the change is not necessarily related to size, but the underlying change in the business organization and management of the swine industry. These structural changes have an impact on how the industry will organize to acquire resources in a rational fashion. The price of output is a key factor in determining the optimal amount of production to undertake. This information, in concert with the firm's cost of production is critical to determining the right investment in production activity.

As we have seen traditional means of price discovery begin to collapse under the weight of emerging complexity in a rapidly evolving agricultural structure, the question arises, "How will we know and use the price of hogs?" This question cannot be answered without an understanding of the forces creating change in the industry.

▪ Historic Profit Centers Become Cost Centers

Competitive market conditions are defined by four circumstances: (1) there are many buyers and sellers in the market, (2) there is equal access to information (3) there are few barriers to entry or exit from the industry (e.g., low capital costs) and (4) the product being traded is uniform. With these conditions in place, it is expected that firms will be highly specialized in their activities when there are positive economies of size in production. In other words, hog production, packing, processing and distribution would likely be independent activities. This allows greater capital intensity in any phase of the operation so those participants can capture optimal economies of size and scale. In the competitive market, prices serve to transfer products through the vertically adjacent firms until the products reach the final consumer. Prices contain all the necessary information that is simply the quantity of pork produced and consumed in the market. Prices originate with the consumer's willingness to pay for a particular product or its refined attributes.

▪ Operational Effectiveness is Not Enough

As we look to the future, some are predicting a supply chain that is optimized around scale and by "driving the cost out". Scale will certainly be a powerful factor re-shaping the market channel. Firms that focus one-dimensionally on cost reduction or value innovation rarely succeed in the long-run. The path of the most successful firms takes them through cycles of value innovation followed by rapid cost reduction through operational efficiency in new product processes.

The market is gearing up to continuously monitor consumer preference information, interpret this and respond with the unique quality bundles demanded by a diverse set of domestic and global consumers. To achieve this, communication of information and coordination and control of product is required. Control of both product and flow must be possible from the production of inputs used in the production processes through each intermediate product all the way to the final offering to consumers.

This coordination and control which leads to the effective differentiation of products requires chain-wide organization, control, management and a focus on continuous improvement. It is not efficient to achieve this through a diverse set of individual profit centers focused on their own cost functions instead of the real goal: satisfaction of the tastes and preferences of the final consumer.

Due to the persistence of demand for special characteristics, the availability of the technology and methods necessary to produce those demands and the willingness to pay by consumers, an incentive develops for firms. This

incentive is to vertically integrate or coordinate other functions in the chain to realize the opportunity. The fundamental change which occurs is each intermediate level (or a set of levels) in the channel comes under the organization, management and control of a single firm or joint venture.

Implications for Pricing

What are the implications for pricing as this occurs? Historically, each level of the market channel for pork could be considered a profit center. A profit center is a set of related functions or activities such as pig production, packing, boning, warehousing or distribution that results in the creation of revenue by a sale. Each profit center in the market channel generates a product or service sold to another level of the channel or to final consumers. A profit center is sufficiently distinct from other sets of functions to warrant it own management, control, sometimes its own culture and market. Because product innovation does not characterize commodity markets, functionality and cost reduction are the dominant strategies of these profit centers.

Another way to say this is, there is no strategy in commodity markets. The only imperative in commodity markets is cost reduction within the boundaries of the conditions listed above. Cost reduction is a management function based in operations. Strategy is only required in markets which exhibit “imperfect competition”, sometimes referred to by economists as monopolistic competition. This market model emerges when differentiation of products makes sense because of branding and therefore the homogenous product requirement fails. Branding is made possible in a system that can respond to segmented consumer preferences, expressed by willingness to pay, by assembling a bundle of attributes in a product which uniquely satisfy those preferences. It is not the purpose of this paper to discuss branding, which is a complex area of study in its own right, rather to examine the implications on price discovery where perfect market models no longer exists.

When integration or coordination of production and marketing segments emerges to support branding, transfers of products normally occurring through exchanges (markets) begin to disappear. Management, guided by the final price/value of the end product, instead of intermediate prices (for hogs), coordinates both the level of production and the characteristics of production. The sale of intermediate products through markets between levels of the channel is likely to decrease and a transfer of product will occur instead. Instead of a sale, a reimbursement of costs takes place.

Each of the separate processes that were organized as profit centers historically become cost centers. Cost centers are a set of related activities that accrue costs but do not generate a cash sale. The profit center relocates to the interface between the coordinated channel and the consumer. In this

way, consumer satisfaction with the final product is signaled through the purchase quantity and price.

▪ Essence is Underlying Change in Business Process

The essence of these changes is not necessarily related to size, but the underlying change in the business organization and management of the swine industry. There can be no doubt that size offers certain cost savings. However, several large, multi-state swine companies do not realize these economies due to less than adequate information and management systems. In this sense, size and productivity do not necessarily convey automatic advantage, although the potential is there.

What is emerging from a largely independent structure with specialized segments (e.g., feed manufacturing, hog production, packing--all mostly distinct entities) is a spectrum of organizational structures ranging from the traditional independent structure to the completely vertically integrated structure. In the middle of the spectrum lies an array of contracting alternatives (e.g., Cargill systems or Murphy Family Farms) and coordinated alliances (e.g., Farmland's Triumph System and most cooperative efforts such as Land O' Lakes).

▪ Chain and Firm Organization

Currently, the swine industry violates nearly all assumptions of a perfectly competitive market. Four packers account for 67 percent of total market hog slaughter. The essential meaning of this is there are fewer buyers and they are more geographically dispersed. Access to critical information such as net prices paid and the quality distribution of carcasses is limited or differentially available.

Barriers to entry and exit are high, because improved animal health is allowing greater concentrations of confined animal production using capital-intensive all-in-all-out/multiple site systems. These systems provide cost lowering economies of scale and lower the shutdown point (where variable costs of production per unit of output equal the sale price of output). Similar observations can be made in the packing industry where plants slaughtering less than 12,000 head per day are generally considered cost inefficient.

Finally, responding to increasingly diverse consumer demands (now export markets, but soon segmented domestic markets) requires the ability to alter and measure pork quality attributes and to differentiate pork products either through further processing or through manipulating attributes originating at the farm or genetics level. When perfect market conditions fail to exist, prices are

increasingly ineffective at conveying all relevant market information. As this occurs, there are positive benefits to directly passing information beyond prices through the market chain. The benefits to chain alignment may, in some systems, exceed the costs of decreased economies of size while increasing economies of scope (taking on or aligning activities in the chain through information systems).

As the swine market moves further from competitive market conditions, there will be greater incentives to align segments of the chain to achieve the coordination necessary to meet consumer preferences.

▪ Consolidation and Integration

The trends toward integration will continue due to several factors:

1) There are complimentary and redundant inputs that can be coordinated or removed from the system.

This is best illustrated by the growth in case ready pork products. Although there are technical benefits (longer shelf life, better inventory control, etc.) packer/processors have moved towards case ready meats partly because the saws, knives and employees formerly employed by grocery stores were redundant inputs to necessary inputs in meat packing and processing. Hence, packing firms can integrate the grocery store retail fabrication functions, thus reducing total chain investment while increasing uniformity, safety of products and reducing labor, inventory management and product wastage costs.

2) Market imperfections and price distorting effects create incentives to integrate.

Recent growth in using formula contracts or long term contracts for pricing market hogs has both been caused by and resulted in market price distortions. As these pricing inefficiencies become greater, firms have greater incentives to integrate in an attempt to avoid price discovery between segments of the chain. The only necessary point of price discovery is at the consumer level where products can be priced based on perceived value. All other prices are technically derived from consumer price and can be internalized in an integrated system.

3) Increasing demands for specific and narrowly focused information creates incentives for integration.

This category may include measurement problems and moral hazard. Pork quality traits such as meat color, pH, water holding capacity, tenderness and others are only measurable AFTER the animal has moved from production into packing. At that point it is difficult for an independent producer firm to verify that the carcass was properly handled (for example pre-slaughter animal

treatment, slaughter techniques and cooler management as well as measurement methods can all have significant effects on actual and reported pH levels) in the plant. Because producer handling and feeding of pigs can also affect pH levels in meats and the handling and feeding is unobservable by the packer, there will remain the problem of two-way mis-payment and therefore distorted incentives for pork production. Integration, where both firms will have technical aspects fully revealed, improves information and hence is an incentive for integration.

On another level this may be as simple as a firm seeking to gain access to patent technologies or proprietary information of a vertically linked firm.

4) Vertical diversification may be an alternative reason for integration.

By taking on additional production stages, firms may gain a diversification advantage that reduces risk exposure. This is only the case when one of the firms has additional activities not directly related to the primary vertical activity. Otherwise, they are both equally subject to the same set of risks (unsystematic risks) - namely shocks to primary supply and primary demand.

▪ Methods of Integration

Strictly speaking, vertical integration is ownership of at least two vertically related stages of production. Vertical coordination does not imply ownership but may be contractual. Which method improves competitiveness the most is an empirical question. It will depend greatly on managerial execution and strategic vision.

Relative merits of coordination and integration assuming common quality of execution:

- Integration requires greater capital costs and may compromise economies of size with economies of scope. Integrated firms must own cost-center assets that drag down return on capital. Concentrated focus on improving value added to the final consumer is frequently lost as management attention is diverted to fixing problems associated with cost-center assets in the integrated chain. Outsourcing these functions is a solution but essentially results in a coordinated system rather and an integrated one.
- Integration improves the probability of achieving desired information flows. Contracts must be carefully crafted to assure proper performance and moral hazard and imperfect information are more likely still present. The virtually integrated firm, which involves coordinating existing and new assets via an information system, may approximate the advantage of full integration.

- High quality information systems are more difficult to manage for coordinated chains than integrated chains because of command and control issues.
- Integration usually increases barriers to entry for other firms that must also incur all integrated capital costs to enter the market. This is good from the integrated firm's perspective but can lead to further reduced market competition, at which point government intervention may occur. Coordinated chains may also achieve this.

▪ Industrial Management Issues

Managerial efficiencies will also affect the structure of firms in the industry. In general, integrated firms with a hierarchical decision structure will be more efficient at implementing decisions, but run the risk of making more bad decisions because there is only one "filter" for a decision to pass through. Vertically coordinated enterprises are likely to be less efficient in making decisions as two or more decision filters must be passed through. Hence, one of the entities can likely still choose not to implement a particular strategy even though the other sees it as necessary. However, vertically coordinated firms will tend to reduce the number of both good and bad decisions.

Management knowledge and business information structure will be critical in executing vertically coordinated or integrated chains. Currently, integrated chains have the advantage because in the rapidly changing environment of swine production they are most able to respond quickly and decisively.

▪ Technology and Information

Technology has enabled firms to respond to consumer preferences, which fosters the continuing incentives for firms to integrate. Biotechnology, specifically molecular biology and genome mapping, will only enhance the ability to adapt biological products to user demands. Biotechnology will also require greater information sharing as the number of modified attributes increases and must be passed up the chain to capture value.

Information is critical in determining the structure of vertical alliances. An inability to transfer information across firm boundaries provides great incentives to integrate to internalize the information. At the same time, the improved ability to communicate offered by Internet e-commerce and specialized information systems can overcome many of the incentives to fully integrate, allow firms to focus on their core competencies (economies of scale), and

reduce barriers to entry implied by integration while increasing the benefits associated with competition.

▪ What Are Market Contract Pricing Mechanisms?

Market contracts inherently provide for forward delivery of hogs and pigs at some time in the future. Therefore, perhaps the most critical component of a market contract will be the establishment of a pricing mechanism to transfer or exchange the pigs at that future date. This mechanism must be set before hand to avoid potential "hold-up" problems. Hold up problems are defined as the circumstances where the alternative options for one of the parties are limited so that the other may effectively hold them up for a higher or lower price than would otherwise be determined in the market. ***The following challenge is crucial to the satisfactory performance of marketing contracts: establish a price that does not create sustained economic disadvantage (relative to their competitors) for the parties involved.***

▪ Common Types of Pricing Mechanisms

Futures Contracts

Futures contracts are standardized and well defined commitments to deliver lean hogs at a specified price on or before a specified date. Futures contracts are legally binding commitments to deliver or accept delivery, just as forward contracts to packers would be. A key difference between futures contracts and forward contracts is that futures contracts are highly liquid (frequently traded and always available) and they are specifically defined whereas forward contracts will vary from packer to packer or producer to producer. Futures contracts require a much higher level of marketing management and knowledge than forward contracts because appropriate strategies must be executed by the producer.

Currently, the futures contracts in the pork complex are the Lean Hog Futures contract, which is a carcass weight based and cash settled contract; the Frozen and Fresh Pork Belly Contracts and the Pork Cutout contract. The Lean Hog Futures Contract is most appropriate for producers selling hogs as its behavior is most closely tied with the actual live hogs being traded. Meat based contracts can be used but require more sophisticated analysis to determine appropriate usage. This point is raised because many producers are using the Lean Hog Futures Contract as a proxy for pricing weaned pigs in all-in-all-out production systems (see the publication: Pricing Early-Weaned Pigs, NPPC).

Use of a futures hedge does not require the involvement of a packer. In a simple hedge, a hog producer would simply sell the lean hog futures contract nearest the date the hogs are expected to be delivered. This does not eliminate all future price risk as there is still basis risk. Basis is the difference between the cash price and the futures price. In general, the net price received by the producer will be lower if the basis widens (the difference between the cash and the futures price increases). Using futures hedges does not address market access issues, since it does not involve the packer. In addition, producers must be aware of the potential for margin calls if the futures price moves against their position (in this case if the futures price rises). In such a situation, the hedge is likely also locking the producer out of profitable price increases. Another drawback of using futures contracts is that they are pre-defined contracts which cannot be adjusted to suit specific circumstances. For example, there are only seven delivery months for the Lean Hog contract and only one day of price convergence between the cash and futures for each delivery month. Futures hedges should only be undertaken with the aid of a broker and with support of your lender.

Options on Futures Contracts

The options hedge again involves the use of the futures market. However, in this case instead of selling the actual futures contract, the producer would buy the right but not the obligation to sell the futures contract (lean hogs) at a certain price. This would be a put option and the purchase price of the put option is the premium. Put options can be expensive, but the main advantage is that they protect against price declines but do not limit the upside potential if prices rise in the future. In addition, the premium (plus brokerage commissions) is all the put option will ever cost - there are no margin calls or other financial requirements. Again, market access to a specified plant is not addressed.

Forward Price Agreements

Forward price agreements are defined between two parties, both of which are actively engaged in a production process; for example, market agreements between a hog producer and a packing plant or between two stages of hog production. The terms of forward contracts are highly variable, depending potentially on specific agreements between individual parties. This is in contrast to the standardized futures market contract. The specificity of forward contracts reduces the liquidity of the contracts so they are unlikely to be directly transferable among different parties. It also requires that each contract's payment provisions be carefully analyzed as they are likely to change. One other difference is that it is not clear how risk can be directly transferred to the futures market under multi-year agreements, although it is possible under some circumstances.

1. Fixed Price Agreements

These agreements determine the actual price of hogs which will be delivered in the future. Typically, these will be very short term (e.g., < 1-2 months) because as the length of time to delivery increases the risk of establishing a fixed price becomes greater. In other words, the market price levels may change relative to the fixed price creating a disadvantage for one or the other parties. The exchange price offered is likely related to the futures market which allows the packer or producer to hedge the risk of fixing a price. The contract will assure access for the term of the contract, but is not likely to assure access beyond that date. Fixed pricing agreements are also common in weaned pig contracts – particularly when ending profits of the final market hog sale are transferred back through related production stages.

2. Fixed Basis

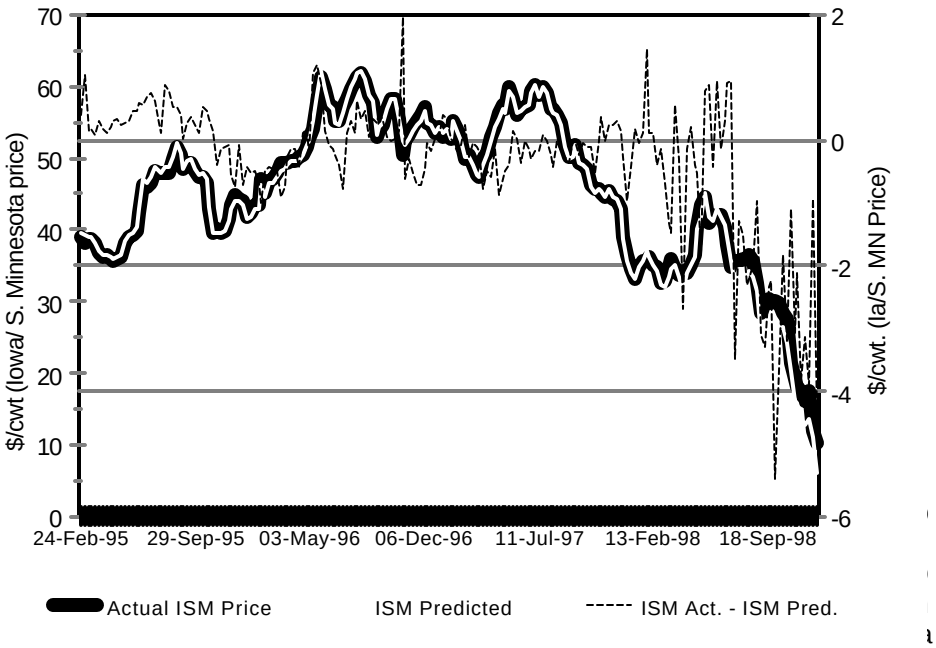
As the name implies, the basis price is offered rather than the actual exchange price. The expectation is that the producer can then fix a delivery price relative to the futures market plus or minus the basis difference. The producer may be given the option of never establishing the price if delivery at the going market price is advantageous. To utilize these agreements, producers should have access to basis data to determine if the basis figures offered are reasonable and acceptable. Fixed basis contracts may be offered over the life of futures contracts so they may extend slightly over a year. Plant access is assured only over the life of the agreement.

3. Formula Price

Formula prices are used as a mechanism to establish prices over extended time periods or when multiple sales of hogs are forward contracted with a packer or another producer and there is some concern about the ability to establish a price. The formula price is based off a "price determining market" (one where there are enough buyers and sellers to effectively establish a price). Formula prices, for example, could be calculated as Iowa/S. Minnesota weighted average of 49-51% lean hogs which are plant delivered, plus or minus a price differential or premium based on market differences such as location or overall quality of hogs. Formula prices do not necessarily provide price protection because they will fluctuate along with the market they're based on. This is the distinguishing difference between formula prices and the two prior pricing mechanisms. Formula pricing may or may not provide market access, however, in most cases the formula price mechanism is a result of contracting for quantities.

An additional consideration in formula prices is the possibility that the market upon which the formula price is based may change relative to other markets over time. Figure 1 provides an illustration of these changes.

In Figure 1, the price of 47-49% lean hogs on an Iowa/Southern Minnesota basis were regressed against the same percent lean for the weekly Western Cornbelt price series over the period 1995 through August 1998. The chart compares the actual Iowa/S. Minnesota price to the price predicted by creating a formula based on the regression and using only the Western Cornbelt price. The dashed line, marked "ISM Act. – ISM Pred.", shows the difference between the two or the error in formula pricing using the Western Cornbelt series. For most of the period the error was zero which means the predicted and the actual Iowa/S. Minnesota series were nearly the same and the formula pricing method worked very well. However, near the end of the period, the formula based on Western Cornbelt prices consistently under-predicted the Iowa/S. Minnesota actual price. Therefore, a producer with a formula price incorporating only the Western Cornbelt price would have been significantly under-priced relative to the actual Iowa/S. Minnesota market. Without an adjustment mechanism, this relationship would likely not be acceptable to a grower for a long period of time. This illustrates how market price behavior can change even in closely related markets and the danger of relying on formula prices.



margin above costs of production. These contracts may have a balancing clause (ledger) where payments made to producers when market prices are below the contract floor price must be paid back when the contract base price exceeds the cost-plus formula price of the contract. Terms of these contracts

range from 4 to 7 years. One of the greatest risks of these contracts is that technology or other external market conditions may change; this will alters the performance of the contract relative to the market, again placing one of the contracting parties at an economic disadvantage relative to their competitors. In general, as the length of time the contract is in effect increases, the risk of unexpected or detrimental price behavior also increases.

5. Price Window

These contracts are very similar to the cost-plus contract other than the pricing mechanism. In general, a ceiling and floor price are set. When a predetermined market hog price falls within the ceiling and the floor, the hogs are exchanged at the market price. When the market price falls above the ceiling or below the floor price, the packer and producer split the difference between the two prices. Other terms are fairly similar. A key determinant of the performance of the contract will be setting the levels of the floor and ceiling price. Some window contracts will also utilize moving averages of prices to further smooth the payout of the contracts. Window contracts do not directly reduce the risk of input costs such as feed, labor, interest, fuel and others rising substantially over the life of the contract. However, the expectation is that as input prices increase, production would decrease and market prices would move higher in general.

6. Price Floor

As implied by the terminology, a price floor contract sets a minimum price. To compensate the packer for this protection, when the hog price above predetermined ceiling levels, the producer places a portion of the price in an account to carry through the low price periods. The producer draws on this account during low price periods. A loose analogy can be drawn between these price floor contracts and a futures option contract. As with other mechanisms, changes in the underlying fundamental market conditions can place one of the parties at an economic disadvantage.

Checklist for Evaluation of Contract Prices

- Is the Contract Price representative of my current market?
- Does the Contract Price include quality premiums?
- With a Cost-Plus agreement, is there adequate bench marking to the market to account for the possibility of demand influences?
- Are the bounds on a Price Window skewed high or low relative to historic price patterns?
- Is the “primary” market upon which the contract is based a competitive market (i.e., large volume, many buyers and sellers, observable)? Is there

a method to change the "primary" market if it becomes less or non-competitive over the life of the contract?

- Is the contracted price somewhat responsive to major market changes (e.g., new technologies) or is it likely to severely disadvantage one or the other party if there are sustained market changes?
- Are specific renegotiation parameters stated or is the contract open ended?
- Is the contract price risk reducing, or does it simply assure quantities with prices that are closely correlated to general market fluctuations?

▪ What is the Relationship between Base Prices and Packer Quality Grids?

The contracted price is often stated relative to the base price. This is important for two reasons: (1) it may directly affect the level of payoff if the contract has a split between the contract price and the base price and (2) in those cases when the ledger account is in affect, it will affect the accounting balance of the ledger. A higher base price relative to the contract price will reduce the level of the ledger in the case when market prices are lower than the contracted price. Conversely, it will increase the amount of the ledger owed to producers when the market price exceeds the contracted price.

Generally, a contract is specified so that the net payment to the producer is determined by adding the packer's standard quality grid to the contracted base price, just as it would be to a market determined price. However, packer grids frequently change in response to changing distributions of carcass quality. In general, as the carcass quality of the swine population has improved, quality premiums have declined. While an uncontracted producer might find it advantageous to investigate alternative packers, a long-term contract will bind the producer to the contracted packer. So, while changes to the grid price will not change the base payment of the contract, it can dramatically affect the total payment.

▪ Summary

Structural changes in the swine industry will both cause and require new methods of pricing. As the segments of the chain begin to coordinate and integrate to more perfectly respond to consumer demand, the transfer of products, normally facilitated by open markets, may simply become transfers coordinated by information systems. Because the consumer cannot be integrated, a market or exchange will not be eliminated between the final seller and the final consumer. All other markets and their associated prices are

subject to evolution and potential elimination. At the beginning of the pork chain, it seems likely that investment capital will reward good decision making and fund coordinated or integrated production systems which can accomplish through good decision-making, the functions which were previously carried out by open markets.

Coordinating and making resource allocation decisions by command versus through the market mechanism is a complicated and heroic task. Asset fixity and biological constraints (e.g. the inability to shorten gestation lengths) further complicate the task and will punish, over an extended period, wrong decisions.

Equity markets that are very liquid and meet the criteria of competitive markets will be the final judges, along with the consumer, of the structure of the swine industry. The only relevant prices for the swine industry in the future may be the price of the stock (equities) in companies trying to accomplish these activities, and the prices of the final goods, as determined by consumers.

▪ Other References and Readings

Buhr, Brian and Dennis DiPietre, 1997. Front End Guidance for Value Added Networks: Marketing Pork to the Mexican Consumer in the U.S., National Pork Producer's Council.

DiPietre, Morehead and Duffy, Strategies for Controlling Product from Production to Consumption: The Swine and Co. Plant at St. Joseph, Missouri, University Extension Commercial

Dixit, Avinash K. and Barry J. Nalebuff. 1991. Thinking Strategically, W. W. Norton and Company, New York.

Drucker, Peter F.. 1993. Post Capitalist Society, Harper Business, New York

National Pork Producer's Council, Pork Chain Quality Audit, Progress Report, Des Moines, Iowa, April 1994

National Pork Producer's Council, Pork and the U.S. Consumer Conference, Proceedings, Des Moines, Iowa, March 28-29, 1995

National Pork Producer's Council, Quality Summit, Proceedings, Des Moines, Iowa, July, 8-9, 1997.

Leonard-Barton, Dorothy. 1995. Wellsprings of Knowledge, Harvard Business School Press.

Poirier, Charles and Stephen E. Reiter. 1996. Supply Chain Optimization, Berret-Koehler Publishers, San Francisco, California.

Porter, Michael. Strategy, Harvard Business Review, Nov-Dec 1996

Price Pritchett, Pritchett and Associates, Inc., New Work Habits for a Radically Changing World, Dallas, Texas

U.S. Meat Export Federation and Colorado State University. 1995. International Pork Quality Audit: A Foreign Market Audit of U.S. Pork, December 1994