In the long history of trade in contracts calling for delivery of a commodity at a later date, the livestock futures markets are relatively new. Trade in live cattle futures contracts was initiated on the Chicago Mercantile Exchange (CME) in October 1964, live hog futures were added in 1966, and trade in feeder cattle contracts started in 1971.

Trade in live cattle futures was launched in the face of widespread skepticism. Skadberg and Futrell observed that to have economic merit, futures markets “must offer hedging potential or perform a valid pricing function . . . [and] it is our contention that the futures market in live cattle does not offer significant hedging or pricing potential at this time.”

Much of the skepticism was due to prevailing perceptions of the nature and purpose of trade in futures. Holbrook Working had earlier identified the risk transfer and price discovery functions of futures markets. He had employed the concept of a “carrying charge,” the expected relation between prices for any two months. The idea of a carrying charge was relevant only for storable commodities, however, and analysts had difficulty visualizing trade in futures for nonstorable commodities. Limited trade in potato, onion, and pork belly futures had done little to pave the way for futures trade in a livestock commodity that not only was nonstorable but also was produced throughout the year.

The difficulty in coping with unfamiliar conceptual relationships was apparent in the Skadberg and Futrell article. In discussing basis relationships, the authors observed:

Basis and basis change with respect to time periods, of key
importance in most futures markets, do not appear to be relevant in the live cattle market. There is no storage period and hence no storage cost that is pertinent for the product traded. Further, there is no reason to expect consistent basis patterns, related to time periods, between the cash and futures markets.³

Despite misgivings about the economic viability of trade in livestock futures, the contracts were traded. The live cattle contract started the CME on the path to becoming one of the most important commodity exchanges in the world. But the skepticism about trade in livestock futures that emerged when the contracts were established persists.

**Objectives and Scope.** The overall objective of this chapter is to contribute to the body of knowledge about the economic implications of trade in livestock futures. We are not attempting a complete review of the literature. Substantive reviews of the livestock futures literature have been completed by Leuthold and Tomek and by Kamara.⁴ Here we describe and conceptualize trade in livestock futures with a focus on the controversy that continues to surround the markets, especially the live cattle futures market.

Our coverage is both descriptive and analytical. A review of selected literature and a report of research we have conducted is included when appropriate to clarify important points. At the outset we submit that lack of understanding of the basic economic functions the livestock futures markets are charged with performing is an important reason for the continuing controversy. Other, largely noneconomic issues are widely discussed, but the focus here is on the economic implications of futures trade.

Our specific objectives include the following:

- to identify the sources of, and the reasons for, the controversy surrounding trade in livestock futures
- to describe the workings of livestock futures in risk transfer and price discovery processes
- to describe and discuss an empirical analysis of the direction of causal flows between the live cattle futures and cash cattle and carcass beef prices
- to identify major areas in which questions about the implications of trade in livestock futures persist because of gaps in the existing body of knowledge

The two basic economic functions of trade in commodity futures are to provide a risk transfer mechanism and to contribute to the
process of price discovery. In the livestock futures markets perceptions of how effectively these functions are performed are still being shaped and modified.

**Risk Transfer.** Trade in livestock futures proved viable in spite of a still developing and uncertain conceptual framework because the need for a risk transfer mechanism was increasingly important. Coming out of the 1950s, the consuming public was developing a taste for grain-fed beef, and demand for beef increased significantly. Feedlots with a capacity to feed thousands of head of cattle began to appear. With feeding periods as long as seven to eight months, the entrepreneurs owning the cattle faced a tremendous risk, one not significantly different from the risk of declining prices faced by a firm holding an inventory of a storable product. The conceptual framework within which livestock futures were being traded began to take a more definite shape. The cattle industry needed a way to transfer risk, and hedging procedures to transfer price risk could be adapted from other markets.

The live hog and feeder cattle futures contracts were launched with less uncertainty. Trade in live cattle futures had established a precedent, and the risk exposure facing hog producers was beginning to demand attention as large confinement feeding floors became commonplace. The live hog contract was modified several times to fit the needs of the industry, and trading volume in the early years was low, but some of the conceptual barriers had been overcome when the live cattle contract was initiated. A similar pattern of contract changes and low trading volume occurred in the early years of the feeder cattle contract.

Individual cattle feeders, hog producers, and packers are quick to point to the importance of exposure to price risk and argue that trade in livestock futures is necessary to the economic viability of their operations. Agreement appears to be widespread throughout the industry. The volume data in table 6–1 suggest a broad base of interest and use. Weak demand for red meats, the absence of any major market moves, and the development of futures contracts in other areas (such as foreign currencies and financials) have constrained trading volume in recent years, but live cattle futures alone averaged nearly 5 million contracts from 1978 through 1984. The periodic data on commitments of traders indicate that both hedgers and speculators are active in the markets. Clearly, some industry participants are looking for an opportunity to transfer risk, and some speculators are willing to accept that risk in exchange for a profit opportunity.

Not all cattle feeders and other livestock producers would agree,
TABLE 6-1
TRADING VOLUME IN LIVESTOCK FUTURES, CHICAGO MERCANTILE EXCHANGE, 1964–1984
(1,000 contracts)

<table>
<thead>
<tr>
<th>Year</th>
<th>Live Cattle</th>
<th>Live Hogs</th>
<th>Feeder Cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1965</td>
<td>59</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1966</td>
<td>171</td>
<td>8</td>
<td>—</td>
</tr>
<tr>
<td>1967</td>
<td>300</td>
<td>9</td>
<td>—</td>
</tr>
<tr>
<td>1968</td>
<td>253</td>
<td>9</td>
<td>—</td>
</tr>
<tr>
<td>1969</td>
<td>1,013</td>
<td>64</td>
<td>—</td>
</tr>
<tr>
<td>1970</td>
<td>579</td>
<td>115</td>
<td>—</td>
</tr>
<tr>
<td>1971</td>
<td>746</td>
<td>262</td>
<td>1</td>
</tr>
<tr>
<td>1972</td>
<td>1,372</td>
<td>513</td>
<td>7</td>
</tr>
<tr>
<td>1973</td>
<td>2,558</td>
<td>1,061</td>
<td>23</td>
</tr>
<tr>
<td>1974</td>
<td>2,517</td>
<td>1,084</td>
<td>31</td>
</tr>
<tr>
<td>1975</td>
<td>2,457</td>
<td>1,427</td>
<td>30</td>
</tr>
<tr>
<td>1976</td>
<td>2,648</td>
<td>1,147</td>
<td>63</td>
</tr>
<tr>
<td>1977</td>
<td>2,639</td>
<td>1,308</td>
<td>133</td>
</tr>
<tr>
<td>1978</td>
<td>5,040</td>
<td>1,765</td>
<td>569</td>
</tr>
<tr>
<td>1979</td>
<td>7,214</td>
<td>1,806</td>
<td>981</td>
</tr>
<tr>
<td>1980</td>
<td>5,997</td>
<td>2,154</td>
<td>874</td>
</tr>
<tr>
<td>1981</td>
<td>4,282</td>
<td>2,258</td>
<td>621</td>
</tr>
<tr>
<td>1982</td>
<td>4,441</td>
<td>3,561</td>
<td>604</td>
</tr>
<tr>
<td>1983</td>
<td>4,248</td>
<td>2,791</td>
<td>537</td>
</tr>
<tr>
<td>1984</td>
<td>3,553</td>
<td>2,169</td>
<td>314</td>
</tr>
</tbody>
</table>

Source: Chicago Mercantile Exchange, Yearbook; and CME staff.

however, on the usefulness of livestock futures markets. Many do not use the markets to hedge because they believe that trade in livestock futures is not in the best interests of the industry. The controversy persists for complex reasons that resist being reduced to a single dimension. An argument could be made, however, that the controversy is based at least partly in a failure to understand price discovery, the second major function of trade in livestock futures.

Price Discovery. Price discovery is the process by which a market-clearing price is generated, that is, the process of focusing in on a price in a particular market for a particular period. The literature on livestock futures markets emphasizes the risk transfer function and pays less attention to price discovery; failure to understand price
discovery and the role of livestock futures markets in price discovery continues.\textsuperscript{5}

Price is discovered by employing the available information on supply and demand. Demand for red meats changes slowly and over extended periods. The supply side generates much of the uncertainty in the price picture. For a given herd size, the number of cattle placed on feed can change significantly within a year and generate equally significant changes in supply and price. For hogs there is a marked seasonal pattern in farrowings and slaughter. The hog cycle can be as short as three years, and cyclical expansion or contraction can accentuate price variation. Not all observers understand these facets of the industry, however, and the frustrations that come with declining cash prices are often vented on the futures markets as the presumed cause. The issues can be demonstrated by reviewing the setting within which the cattle placement decision is made.

The decision to place cattle on feed is made in an environment charged with uncertainty, and the manager of the feedlot or the owner of the cattle must form and use some price expectation. Price quotations on distant cattle futures contracts (contracts calling for delivery near the end of the projected feeding period) are a source of expectations.

Evidence on the accuracy of the live cattle futures markets in predicting the cash selling price at the end of the feeding period is mixed. Early studies, such as that by Leuthold, generally concluded that the futures market for cattle is not an accurate predictor.\textsuperscript{6} More recently Just and Rausser found that “predicted” prices from live cattle futures were as accurate in the short term as predictions from sophisticated econometric models.\textsuperscript{7} Kolb and Gay conclude that the performance of the live cattle futures market “appears to be exemplary in all aspects analyzed” and that their results are “fully consistent with the futures price being a good predictor of the subsequent spot price.”\textsuperscript{8}

A great deal of attention is paid to futures prices as cash price predictors, but the question of accuracy is not really important in assessing the performance of the futures markets in the price discovery process. If the cattle feeder uses the futures quotation as a price expectation and makes a decision to increase or decrease placements on the basis of that expectation, then it could be argued that the futures market will be incorrect as a predictor precisely because futures prices are being used as a price expectation.

Placements will tend to vary with changes in the costs of the key inputs in the production program and with changes in price expectations. Conceptually, placements would be expected to increase
if the price expectation offered by the futures market increases. If the response is large, increased supplies in the distant month can drive prices down, and the futures market will be inaccurate as a predictor of the final cash price. Actions that increase placements in response to a higher price expectation are not incorrect, of course. In the price discovery process, the proper role of the futures market is to help motivate increased placements if a high distant futures price is registering the possibility of a relatively short supply of fed cattle in a few months.

Given the possibility of a supply response within the year, analyzing the predictive accuracy of the live cattle futures for a time period long enough to allow a significant change in placements has little conceptual or theoretical merit. Leuthold recognized this point early in his work, and Koppenhaver supports this position when he concludes, "Unless the relationships . . . are continually updated and reestimated using the latest available data, the variable aspects of the pricing bias would make production decisions with futures prices as expectations exceedingly risky."9 Using the futures market as a source of price expectations and then failing to forward price at the prices that are prompting the increased placements is in fact risky and is an incorrect use of the futures market.

Critics also argue that trade in livestock futures accentuates the variability of cash prices. Studies that have compared price variability before and after the advent of futures trade have generally concluded that variability is decreased in the presence of futures trade.10 Recent work by Koontz and Purcell indicates that the live cattle futures market is stabilizing short-run variations in fed cattle supplies and therefore decreasing short-run variations in cattle prices.11 Countering such evidence is the general perception of many observers and critics that movements in futures prices across a few days or a few weeks often far exceed the movement that can be justified by changes in the supply-demand balance. Increased knowledge of the price discovery process in the livestock futures markets would sharpen awareness of the reasons for observed price moves.

Current Situation. The controversy continues to be highly visible. It is often assumed that any undesirable moves or fluctuations in the cash market are prompted by a futures market that is making no contribution to the economic viability of the livestock industry. Much of the criticism comes from producers. Some state cattlemen’s associations have adopted resolutions calling for the abolition of trade in livestock futures. The National Cattlemen’s Association (NCA) became
involved in the discussions in the early 1980s, when it called for study of the effect of trade in cattle futures and for better communication.

The NCA established a committee to investigate the relation between futures and cash prices. The committee examined limited evidence on causal flows. It found that the markets appeared to be functioning as intended and found no evidence that they worked to the disadvantage of the industry. The committee reached no positive conclusions, however, about what trade in futures contributes to the economic well-being of the industry. Its work was hindered by the lack of recent and rigorous research on the nature and magnitude of any causal flows in the cattle-beef complex.

John Helmuth, a staff economist of the House Committee on Small Business, has been a persistent critic of the livestock futures. Helmuth submitted that

- the live cattle futures market seldom offers profitable prices to producers
- a foolproof approach to trading cattle futures exists, and its results demonstrate the existence of a systematic downward bias in live cattle futures
- large traders behave in the livestock futures markets in such a way as to exert an influence on price

Helmuth’s conclusions have been widely reviewed and widely criticized. Critics note that the economic structure of the livestock markets, with many relatively small decision makers, largely precludes the continued offering of prices that exceed the cost of production. Prices above the average total cost of production, where that cost reflects both variable and fixed costs, generate what economists call “excess profits” and would be above the prices needed to keep the resources in production. Both Leuthold and Mokler and Hayenga et al. confirm that forward-pricing opportunities above the average total cost of production are seldom available when the cattle are placed on feed but note that the market typically offers at least a break-even price sometime during the production period. Helmuth’s charge that the live cattle futures market is not effective because it does not consistently offer an opportunity to forward price at a profit suggests he does not understand basic economic attributes of the livestock industry.

Pluhar, Shafer, and Sporleder tested the trading strategy offered by Helmuth and observed that his conclusion was supported for only a relatively brief period, the period for which he reported results.
The authors' criticism of Helmuth's strategy as unrealistic was reaffirmed by Palme and Graham. Kolb and Gay found no evidence of a significant bias in live cattle futures. On the other side of the issue, Koppenhaver concluded that a risk premium exists in cattle futures and suggested that its existence supports Helmuth's findings of a systematic bias.

The Commodity Futures Trading Commission (CFTC) investigated the claim regarding the influence of large traders and concluded that the data do not support Helmuth's conclusion. Lack of access to necessary data has impeded any efforts in the research community to investigate the influence of large traders further.

**Outline of the Chapter.** Clearly we need more information, and we need to address the controversies surrounding trade in livestock futures. If the criticisms are without merit, the industry is being hurt because the futures markets are not being used to their fullest potential. If the criticisms are justified, discussion and analysis are needed to sort out the issues and correct any problems that exist.

In the next section, "Risk Transfer: Procedures, Issues, Basis Considerations," we discuss the concept of basis. Basis performance is critically important to the effectiveness of risk transfer strategies. We examine recent changes designed to improve the performance of the basis and also look at the costs associated with exposure to price risk and how those costs are allocated within the system.

In "Livestock Futures Markets in the Price Discovery Process," we stress price discovery—the area in which problems of perception and understanding are so apparent, problems that become a major obstacle to effective use of existing markets and the possible development of other markets, contracts, or procedures. A second goal of the section is to provide a conceptual basis for discussion of the nature and direction of the causal relations between cash and futures markets.

In "Interactions of Cash and Futures Prices in the Livestock Markets," we turn to discussion of the important issue of causality. The assumed causal flow from futures to cash has been the source of much of the continued criticism of trade in livestock futures. We summarize and discuss the economic implications of the findings of a recent research effort.

In the final section we offer a summary and a look ahead to coming changes in futures trade. We also identify the areas where major questions remain, areas that are gaps in the existing body of knowledge, in an effort to facilitate and guide future discussion and analysis.
Risk Transfer: Procedures, Issues, Basis Considerations

We have suggested that the literature on livestock futures focuses more attention on risk transfer than on the price discovery function. The emphasis on risk transfer is not without merit. Providing a means to permit transfer of price risk is the more visible of the two primary functions of trade in futures, and effectiveness in it is a necessary condition for trade in livestock futures to be judged successful. Given the importance and visibility of the risk transfer function, the performance of the cash-futures basis becomes critically important.

Basis is defined as cash price minus futures price. In discussing basis for nonstorable commodities, Kamara suggests, "Contrary to storage markets, the nonstorage markets exhibit no functional relationship between cash and futures prices so that the cash-futures price relationship has little meaning except during the contract month." The statement is a bit strong. Decision makers considering the placement of cattle might be interested in the basis as a consensus of the expected direction of price movement across the typical four-to six-month feeding period. The basis could also help in analyzing just how much cash price risk the feeder is facing and in decisions on whether and at what price to place a hedge.

Kamara is correct, however, when he implies that the basis in livestock markets is variable and somewhat unpredictable. There is no stable relation, such as a carrying charge, between the cash and futures markets. The possibility of a supply response within the year precludes any stable and consistent relationship, and the lack of stability and consistency can be very important. The effectiveness of hedging as a means of transferring price risk is inversely related to the variability or lack of predictability of the basis.

Table 6–2 provides an illustration. When the hedge was placed on April 1, the expected profit was $4 per hundredweight (cwt). When the program was closed in late September, the realized profit before commission costs was only $1 per cwt. The basis in late September turned out to be $4 instead of the expected $1 per cwt. If the variability in the basis is as large as the variability in the cash market, hedging is ineffective. There is no reason to trade exposure to cash price risk for exposure to basis risk of a similar magnitude.

The basis risk inherent in a hedge in livestock is generally smaller than the price risk facing the speculator in the cash market. Numerous studies have demonstrated that hedging decreases the variability of net income streams during feeding periods. Before the mid-1970s most analyses used some routine form of hedging. Although vari-
TABLE 6–2
BASIS RISK IN A CATTLE-FEEDING PROGRAM

<table>
<thead>
<tr>
<th>Date</th>
<th>Cash</th>
<th>Futures</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 1</td>
<td>Buy feeder cattle and</td>
<td>Observe October live</td>
</tr>
<tr>
<td></td>
<td>estimate cost of feeding;</td>
<td>cattle futures:</td>
</tr>
<tr>
<td></td>
<td>estimate break-even cost:</td>
<td>$70 per hundred weight</td>
</tr>
<tr>
<td></td>
<td>$65 per hundred weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Formulate an estimate of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>basis for late September</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and early October based on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the average basis for that</td>
<td></td>
</tr>
<tr>
<td></td>
<td>period for the past five</td>
<td></td>
</tr>
<tr>
<td></td>
<td>years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Estimated basis: −$1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forward price: futures −</td>
<td></td>
</tr>
<tr>
<td></td>
<td>basis = $69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Profit margin: forward price</td>
<td></td>
</tr>
<tr>
<td></td>
<td>− costs = $4 per hundred</td>
<td></td>
</tr>
<tr>
<td></td>
<td>weight</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sell October futures at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$70</td>
<td></td>
</tr>
<tr>
<td>Sept 28</td>
<td>Sell in cash: $67</td>
<td>Buy futures: $71</td>
</tr>
<tr>
<td></td>
<td>Net: $2</td>
<td>Net: −$1</td>
</tr>
<tr>
<td></td>
<td>Overall net: $1 per hundred</td>
<td></td>
</tr>
<tr>
<td></td>
<td>weight</td>
<td></td>
</tr>
</tbody>
</table>

ability was typically reduced by hedging, the average net income per head was also usually lower. More recently “selective hedging” strategies have emerged, which allow decision makers to choose when they will hedge and when they will be speculators in the cash markets and carry cash price risk. Sophisticated selective hedging strategies, using technical analysis, fundamental analysis, or both, have shown the capacity (across historical data sets) both to decrease the variability of net income streams and to increase the average net income.20

The results of the studies may still, however, underestimate the importance of basis variability to the individual producer. If the producer sells only once or twice a year, the problems arising from a variable basis have no opportunity to average out. If an unexpectedly wide basis at the end of the production program causes a loss instead of an expected profit, producers do not forget the negative experience. Their reaction is especially negative if the basis problems occur when the cash market rallies and substantial losses have been incurred on the futures side of the hedge.

Producers attempting to use the livestock markets to hedge are
aware of the basis problems. They continue to have a strong and consistent interest in changes that might improve basis performance. The discussions have revolved around two separable but related possible adjustments: (1) enactment of measures to improve the performance of the basis for the existing contracts; and (2) changing the specifications or the provisions for delivery in the contracts to improve basis performance.

Improving Existing Contracts. Producers and producer groups have urged the Chicago Mercantile Exchange (CME) to add more months to the futures offerings, arguing that the basis is more variable during months for which no futures are traded. For example, cattle coming out of the feedlot in May, a noncontract month, must be hedged through the June futures contract. Economic forces are at work during the June delivery period to force convergence. In early May delivery is not possible, and the economic forces that bring convergence are less apparent and perhaps less effective.

The empirical evidence supports the implicit hypothesis: the variability of the basis does tend to be greater during the noncontract months. The CME is reluctant to add contracts for more months, however, fearing that the speculator will be driven out of the market or speculative activity will be spread across too many contracts. In either event the liquidity of the market would be reduced, and hedgers would be less confident of being able to fill orders promptly at prices close to those they observe when the orders are placed.

In the late 1970s the CME agreed to add January for live cattle and feeder cattle. The months traded for live cattle had been February, April, June, August, October, and December. Analysis by the CME research staff had revealed that the most variable basis of the noncontract months occurred during January. The January contract was listed but has since been dropped; the industry continued to use the February contract to hedge the cattle to be sold in late December and early January.

The January contract for feeder cattle is still being traded, but volume is light. Contract months for feeder cattle are now January, March, April, May, August, September, October, and November. The long period between November and March may explain the relative success of the January contract. The contract months for hogs—February, April, June, July, August, October, and December—have not changed in recent years.

The issue of the correct number of months is still being discussed. If more months could be added without damaging the liquidity of the markets, logic suggests that contracts should be added; but the
volume data reported in table 6–1 suggest that the CME’s concerns are valid. In recent years volume in the livestock futures markets has leveled off or even declined. The presence of the speculator is unquestionably needed to accept the risk hedgers are trying to transfer and to provide the trading volume necessary to the liquidity of the markets. Adding more contracts would decrease the liquidity in the markets if trading volume did not increase.

Another common request to the CME is to add more delivery points. Producers believe that they will not face reliable basis patterns unless there is a delivery point in their market area. Understanding the reasoning behind the requests for additional delivery points requires examination of the economic forces that act to ensure the convergence of cash and futures and a relatively stable basis pattern.

A hedger or other trader holding a short position in the live cattle market will be motivated to deliver under the provisions of the futures contract when delivery will net more than selling cattle in the cash market and buying back the futures position. Assume that a cattle feeder is facing cash bids of $65 and the futures contract is trading at $70. The basis is therefore $5. If the cattle are near a delivery point, the costs of delivery in the futures market (grading fees, pen rental, commissions) have been estimated by users and CME staff at $1.50 per cwt. The feeder will thus net $3.50 per cwt more if he or she delivers the cattle under the futures contract. Traders looking for arbitrage profits could buy the relatively cheap cash cattle, sell the futures, deliver in the futures market, and earn the $3.50 per cwt profit.

Delivery takes buying power out of the futures market as hedgers holding short positions deliver their cattle instead of buying back the short positions. Delivering the cattle removes selling pressure from the cash market where the cattle are typically sold (but adds to the supply of cattle in and around the delivery point). Traders looking for arbitrage profits must buy the cash cattle they intend to deliver, boosting the demand for cash cattle around the delivery point. Traders holding long positions are motivated to cover their long positions to eliminate the risk that they will be assigned delivery. The long positions are covered or closed out by selling futures, putting selling pressure on the futures. Under pressure from the delivery activities, the cash-futures basis moves toward the cost of delivering the cattle under the futures contract and tends to stabilize around that level (cash about $1.50 below futures). If the basis is too tight or becomes positive during the delivery period, the willingness of longs to accept delivery of cattle instead of closing out their positions sets in motion economic forces to ensure convergence toward the costs of delivery.

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Since the option for delivery rests with the short, the threat of delivery is a powerful force in narrowing a wide basis and bringing convergence between the cash and futures markets. Traders holding long positions, especially speculators, become apprehensive when deliveries are being made anywhere in the system. Nevertheless, producers who are not near a delivery point feel that they cannot use the futures market because they cannot conveniently deliver.

The evidence does not strongly support the producers' concerns. It is not unusual for basis patterns to be more variable at a delivery point than in an outlying market, especially for feeder cattle, for which a larger basis variance has been shown in Omaha, a delivery point, than in the auction markets of Kentucky. It is important that the magnitude of the basis not be confused with its variability. A case can be made that the magnitude does not matter if the basis is stable or can be predicted with accuracy.

To illustrate, assume that prices on any particular day during the delivery period are as follows:

<table>
<thead>
<tr>
<th>Delivery market</th>
<th>Nondelivery market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Futures price = $75</td>
<td>Futures price = $75</td>
</tr>
<tr>
<td>Cash price = $74</td>
<td>Cash price = $70</td>
</tr>
</tbody>
</table>

Assume that the basis in the delivery market has ranged in recent years from −$6 to +$3, with an average of −$1, and that the basis in the nondelivery market, over the same period, has ranged from −$7 to −$4, with an average of −$5. Hedges in the nondelivery market can be much more effective in providing protection against cash price risk because of the smaller basis variation. It is true that the forward price in the nondelivery market will be lower, but that is a function of such matters as location and transportation and has nothing to do with the variability of basis patterns. Feeder cattle in Tennessee are priced lower in the cash market than feeder cattle in Amarillo, Texas, because of location in relation to the concentrated feeding areas of the Southwest. The difference in the cash markets does not mean that cattle in Tennessee cannot be hedged effectively if the producer knows the level of the basis and incorporates it into the hedging program by making a larger basis adjustment.

If the basis starts to widen and threaten the usefulness of a hedge, the producer in the nondelivery market has an option. He or she can sell cash cattle, buy deliverable cattle in a delivery market directly or through a commission agent, and deliver the purchased cattle. If the cash markets maintain a stable relationship over time, the producer in the nondelivery market is disadvantaged only to the extent of any commissions to purchase the deliverable cattle—a small cost. We can conclude, then, that if the producer in the nondelivery
market faces basis behavior substantially more variable than in the delivery markets, the intermarket relations in the cash markets are presenting the difficulty.

A continuing dialogue is needed to improve understanding of the issues and to focus attention on the possible need for better mobility and flexibility between cash markets in different areas. One hypothesis is that better information on intermarket price differences is needed to encourage the arbitrage necessary to keep the relation between cash prices in various market areas relatively stable. Adding delivery points will not necessarily improve the effectiveness of hedges in nondelivery markets, because it will not guarantee a less variable basis.

**Changing the Contract.** Over time the specifications and sizes of the contracts have been changed to match changes in the kind of product being produced, the kind of transportation being used, and so on. Changes in the delivery provisions designed to improve basis performance have been a topic of continuing discussion.

In the live cattle futures, a change to a certificate-of-delivery system was made effective with the December 1983 contract. Before the change major delivery provisions included the following:

- The decision to deliver rested with the short.
- Traders with long positions (including long hedgers) faced the risk of being assigned delivery at any delivery point in the system.
- The decision to deliver was a nonrecourse decision.
- The same cattle were often delivered several times.

A constant barrage of criticism had been directed at the continued lack of participation by long hedgers in the market and the problems associated with delivering the same set of cattle several times. Uncertainty about where they might be assigned cattle kept long hedgers out of the market, and the poor condition of cattle delivered several times added a second barrier to their participation.

The certificate system made these significant changes:

- The short interested in delivery tenders a certificate expressing intent to deliver at a certain point.
- If the assigned long does not want the cattle, the certificate is retendered, and the long is assessed a fee of $1.50 per cwt, which attaches to the certificate and goes to the long who eventually accepts the cattle.
- Longs interested in receiving cattle can issue a demand notice and specify where they are willing to accept cattle, the minimum acceptable certificate value, or both.
The new procedures are clearly designed to get the long hedger into the market and to eliminate the redelivery of cattle.

The certificate-of-delivery procedure that was started with the December 1983 futures contract was not the same procedure originally proposed by the CME staff. During discussions in the Live Cattle Advisory Committee at the CME, several changes were suggested in the original proposal. A limit of $3.00 in certificate value was imposed to decrease what could have been a long delivery process (five days or more before the limit of $3.00). There were concerns that a lengthy delivery process would eliminate the arbitrage activity around the delivery points, activity considered important to the final increments of convergence between the cash and futures markets.

A provision was added to allow the short to reclaim the certificate if the assigned long retenders and there are no demand notices. The reclaim option was motivated by the recognition that a nonrecourse delivery process would continue to force deliveries after the markets had converged to acceptable basis levels. There was also concern that the changes accompanying the move to the certificate system were bringing improvement to the position of the long hedger but erecting barriers to participation by the short hedger and speculator. If the shorts are reluctant to deliver when the basis widens, the effectiveness of the system falters, and the basis tends to be wider and more variable.

As the system now operates, the short who has tendered a certificate is also required to establish a long position in the futures during the day he or she may wish to reclaim. The required long position is another barrier to the short, and so far the reclaiming option appears to be seldom used. Perhaps predictably, the early evidence suggests that the basis is wider under the certificate system, but there is no significant evidence that it is more variable.

While the certificate system continues in use, it will arouse continuing discussion of the costs of retendering the certificate, the restrictions on the reclaiming activities of the short, and other features important to the effectiveness of the system. Analyses will be designed to measure the effects of the system on the level and variability of the basis.

Other changes in procedure are being discussed. Early in the considerations of the change to a certificate system, feeder cattle were included. The discussion and study narrowed to the live cattle contract as conceptual problems and issues emerged. In early 1985 the CME has proposed to the CFTC that the exchange be allowed to institute a cash settlement system for feeder cattle. There would be no deliveries, and the open long and short positions at a certain
date would be settled through a designated cash price. A cash price series is presumably to be collected for the feeder cattle by Cattle Fax, a private concern that collects data and analyzes markets.

Cash settlement is liked by producers and is already being discussed for live cattle and less formally for live hogs. It is no panacea for basis variability. The choice or the generation of a representative price series to be used in settlements is of critical importance.\textsuperscript{24}

**Basis Variability and Predictability.** Regardless of the delivery provisions and settlement processes, basis moves are no problem if they can be accurately predicted. An example using feeder cattle will help to demonstrate this point.

Assume that it is April. A stocker operator will sell 600–700-pound, medium-frame, number 1 steers in early October. The October feeder cattle futures are trading at $72.50. Examination of basis records from past years indicates that the cash-futures basis around October 1 has averaged $-3.50. The forward-pricing opportunity being offered by the futures in this market area is $69, the $72.50 adjusted by the $-3.50 expected basis. Plans can be made using the $69 price. If the $-3.50 is an accurate prediction of the early October basis, the risk transfer function of the market works very well. But if that basis is not predictable and has been seen to vary over a $+2 to $-10 range in recent years, the market is essentially useless to the producer as a risk transfer mechanism. The producer has no reason to exchange exposure to price risk for exposure to basis risk.

A study by Jones indicates that the basis for feeder cattle is difficult to predict.\textsuperscript{25} Jones analyzed feeder cattle basis in five markets (Oklahoma City, Omaha, Montgomery, Kentucky auctions, and Virginia auctions) and set up models designed to predict the basis. Although the study had no obvious conceptual or analytical flaws, the statistical properties of the models were not impressive, and the variance of the forecasts was sufficiently large that the predicted basis levels would be of questionable value to a producer. Perhaps the biggest shortcoming in this area is in the theoretical developments, not the analytic techniques. A more accurate predictive model may have to await more imaginative model specification or further theoretical development. Meanwhile, the problems arising from a variable and largely unpredictable basis support the need for continued investigation of alternatives for feeder cattle.

**The Importance of Risk Transfer.** Concern about basis performance is justified because exposure to price risk has a cost. Significant
exposure to risk at any level in a production-marketing system will result in (1) lower prices for the original producer, (2) higher prices to consumers, (3) a lower return on investment in economic operations in the system, or some combination of the three. If the risk is not transferred to someone outside the system, the typical response of firms is to attempt to pass the risk on to some other firm or entrepreneur in the system. Given this perspective, the importance of effective basis performance to allow and even encourage risk transfer is accentuated.

In the livestock sector the number of firms active at each level in the production-marketing system decreases as one moves toward the retail sector. As the number of firms decreases, each firm gets larger and picks up marketing power—the capacity to influence price or other terms of trade. The path of least resistance when firms attempt to pass on the cost of exposure to price risk is therefore back toward the producer, who, as an individual, has little or no bargaining power.

In the cattle industry, where producers are the most vocal critics of trade in futures, those same producers might therefore have the most to lose if the futures markets did not exist. Sound arguments can be developed that trade in live cattle futures means significantly higher prices for sellers of stocker and feeder cattle than would prevail without a risk transfer mechanism.

The argument starts with a logical and defensible assumption: If anyone in the system is facing significant price risk, operating margins will tend to be expanded to cover that risk, and producers' prices will tend to be lower than they would be if the risk were transferred outside the system. A simple example will illustrate the point.

The price the feedlot operator is willing to pay for feeder steers is a derived price. Some kind of price expectation for finished fed steers must be formulated and an estimate of the cost of feeding generated. With these two pieces of information, a maximum or break-even bid for feeder steers can be derived.

- Price expectation = $72 per cwt.
- Cost of gain = $55 per cwt.
- Value of 1,100-pound steer sold at $72 with a 4 percent shrinkage = $760.32.
- Cost of 400 pounds of gain at $55 per cwt = $220.
- Break-even bid for 700-pound steer = $77.19 per cwt [(760.32 - 220.00)/7].

The derived price for the feeder cattle can be increased if the costs are lowered or the final selling price is higher.
The $72 selling price used in the illustration is an expectation, and it is here that the concept of risk transfer can become important. Assume that two cattle feeders buy these feeder cattle at $77.19 per cwt and that the feeders differ only in the way they price their cattle. Feeder A is a speculator in the cash market, arguing that there is no need to worry about forward pricing because the cattle are bought and sold in the same market. Feeder B hedges or forward-prices each set of cattle that project to make a profit of $30 per head.

Over time feeder B will realize higher average net returns, assuming that the average return per head to the speculator in the cash market is less than $30. In the illustration above, a selling price of about $74.85 would be required to hedge a $30 per head profit. We earlier referred to analyses that confirm the tendency for the market to offer significant profits at some time during the feeding period for a substantial percentage of the sets of cattle placed on feed. If this pattern continues, the $74.85 selling price (or other price that allows a $30 per head profit) will be offered periodically, and the expected value of the profit stream will be greater for feeder B than for feeder A. Given the competition for a sometimes limited supply of feeder cattle, feeder B will be in a financial position to bid more for feeder cattle because the futures market is used to reduce exposure to the risk of variable cash prices. We submit that prices of feeder and stocker cattle would be lower if there were no risk transfer mechanism available to the cattle-feeding complex.

The advocate of speculating in the cash market would argue that the illustration is not valid and would submit that hedging also blocks windfall gains when the cash prices of slaughter cattle increase. In an increasing cash market, the hedger would suffer losses in futures and be limited to the locked-in profit margin less the costs of trading the futures. The speculator would reap the benefits of the occasional sharp price rally.

It is true that there are costs to hedging. The direct costs (commissions plus interest on margin) can be substantial when the market moves sharply higher against a short position. The opportunity costs associated with missing sharp rallies in the cash market can also be substantial. Over time, however, the argument of the cash-market speculator will not hold.

There will be occasional exceptions, but the excess capacity in the cattle-feeding sector and the atomistic nature of the livestock industry guarantee that excess profits will seldom exist when the speculator sells cattle in the cash market. There are no substantial barriers to entry and nothing to stop the quick supply response that emerges when price expectations are favorable. The result is that
acceptable profits over time come from forward prices set by hedging before or during the feeding period, not by taking the cash price at the end of the period after the supply response has been completed. There is another side to the opportunity cost issue. When the cash prices break sharply, the hedger can reap large profits in the futures account, and the cash speculator suffers an opportunity cost.

Risk exposure is also important in other levels of activity in the system. In the processed meats business, frozen boneless beef is widely used. The processor is exposed to two important kinds of risk: (1) the risk of inventory loss while the semistorable product is being held in storage; and (2) the risk of rising costs of raw materials, which cannot be passed on to the buyer because of contractual price commitments or because competition for the materials is too intense.

The first risk is the familiar inventory risk, requiring a short position in the futures market. In this instance, however, there is a major complicating factor. No active futures contract is directly appropriate for frozen boneless beef, lean beef trimmings, or the other raw materials that go into processed meats. During 1984 and 1985 a possible boneless beef contract to be traded in New York has been widely discussed. At a combined meeting of the American Meat Institute and the Meat Importers Association in New Orleans in September 1984, whether a new contract is needed and, if so, what the contract specifications should be were actively discussed. The discussion centered on whether a “margin business” needs a futures market. The debate continues, but it is important to recognize that the opponent of futures trade who would pass on the risk in practicing a margin business could be operating with larger margins than would be required if an effective risk transfer mechanism were available.

The issue of basis performance emerges again at this level of the system. In areas such as boneless beef where no futures market exists, considerable work has been done on “cross hedging” through an existing futures market. If the correlation between the price series for the product to be hedged (such as boneless beef) and the futures contract being used (such as the live cattle contract) is high, hedging procedures can be effective. If the correlation is not strong, the “hedge” will be exposed to high levels of basis risk and is not likely to be effective.

Gaining protection against the rising costs of raw materials requires a “long hedge.” The need is no different from the need of the slaughterer who seeks protection against the rising costs of live cattle or live hogs or the cattle feeder who wants to keep the costs of feeder cattle under control. Again, however, managers of processing firms
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have no futures contract to use and are forced to use cross-hedging techniques.

A similar set of needs exists among firms that buy or produce beef carcasses and break them into boxed beef. They may also face significant price risk. If the carcasses are bought to fill an order for boxed beef, the firms essentially perform a pass-through operation, and their risk exposure is not significant. But the boxes of beef are semistorable, with a shelf life that can range up to sixty days. The firm carries a price risk on any unpriced boxes being held for even a few days. No futures contract exists for boxed beef, however, and breakers are forced to use the live cattle futures market to hedge their programs. The correlation between the two price series is high, but the day-to-day spread between live cattle prices and carcass prices or the boxed beef value series published by the U.S. Department of Agriculture clearly indicates that basis risk will be significant. Hedges to protect inventory values or peg input costs will be less effective to the extent that the cross-product basis is variable.

At every level of economic activity in the livestock production and marketing systems, participants are exposed to price risk. To the extent that they do nothing to transfer that risk, the derived price extended to the original producer will be lower than it would be if effective risk transfer procedures were employed. In addition, the beef and pork industries, characterized by separate ownership at the various levels of economic activity, will be less effective in competing with the largely integrated poultry industry because retail prices will tend to be inflated by the large margins necessary to cover exposure to price risk and to keep resources in production at the live animal level. Where effective futures markets exist but the livestock and red meat industry does not use them, the industry as a whole is the loser. Where no futures market exists but exposure to price risk is significant, the losses are in the form of an opportunity cost but can still be significant.

Concluding Comments. The issue of basis performance will continue to be a lively one. Basis performance is of critical importance to the effectiveness of risk transfer strategies. As users of futures markets and the new options become more sophisticated, they will become more critical observers of basis performance.

The move to a certificate system in the live cattle markets was a progressive step, creating changes that packers’ representatives say will increase the probability of packers’ participating as long hedgers. The redelivery of the same sets of cattle has been essentially eliminated. But the new system should continue to be monitored and
analyzed. The redelivery charge was set arbitrarily at $1.50 per cwt because the costs of delivery under the old system were about $1.50 per cwt. Under the certificate system some other charge might be more relevant, and the possibility of creating a market for the certificates and letting the value of the certificate be determined in a competitive market is worthy of consideration.

The restraints on the reclaiming option will also be discussed at length. We look quite favorably on the move to the certificate system but are also concerned that too many barriers have been placed in front of the short as a willing participant in the delivery process. The delivery process should be as simple as possible and accessible to all potential participants. If barriers exist, the performance of the basis is likely to fall short of its potential.

Alternatively, all the commodities—live cattle, feeder cattle, and live hogs—could shift to cash settlement. We support the need for discussion of such alternatives, for continued dialogue, for analysis, and for a continued search for new and improved procedures. The costs of exposure to price risk are high. Continued attention to this important area is necessary to make the risk transfer processes provided by the futures markets as effective as they can be. The CME, producers, processors, policy makers, speculative traders, regulators, and all other persons involved are correctly interested in basis performance.

Livestock Futures Markets in the Price Discovery Process

In addition to the physical differences between storable and non-storable commodities, important price-related differences merit attention. Tomek and Gray suggest that the ability to store a product across production periods provides a conceptual link that allows futures markets for storable commodities to contribute both to allocating supplies and to stabilizing prices.27 The futures markets for nonstorable commodities, however, have no widely accepted role. Uncertainty about the effect of livestock futures markets on pricing processes has contributed to the negative attitudes toward the markets. Better understanding of the price discovery process would improve the reputation of the livestock futures markets and contribute to more efficient pricing processes throughout the livestock sector.

The Concept of Price Discovery. Prices are “discovered” through a process in which buyers and sellers evaluate available information and arrive at a transaction price that balances the supply and demand for a commodity. Forker characterizes price discovery as a process
by which a market registers available information to arrive at a consensus estimate of the price that will balance the physical supply and demand.\textsuperscript{28} Thus, for a given set of information, price discovery is the process by which price is generated in a specific market.

Consider the following situation. At a given time and for a given set of information, any two traders A and B have different perceptions of the equilibrium, or market-clearing, price. For example, the expected price of cattle five months in the future will be influenced by such economic variables as the number of cattle on feed, the price of corn, the price of competing commodities such as hogs and poultry, and interest rates. Traders A and B will have different perceptions of the available information on the various forces that will influence cattle prices. Each trader will also have different access to information and may evaluate the same information differently. The futures market goes through such a process of evaluating information on expected supply and demand as a consensus expectation for the price five months in the future is generated and made visible in the form of a price quotation for the distant live cattle futures contracts.

When A and B meet in the marketplace and become involved in price discovery, each comes armed with a perception of what the market-clearing or equilibrium price should be. Those perceptions influence their behavior. For simplicity, assume that trader A is a seller and trader B a buyer. Trader A mentally sets an offer price, the price at which he or she expects to be able to sell cattle. The bid price of trader B, the price at which he or she expects to be able to buy cattle, is also set through prior evaluation of the set of information on supply and demand.

The process of price discovery between the two traders in the marketplace is an interactive one through which an equilibrium price is reached in an interval between the highest price B would pay and the lowest price A would accept. The interaction is a convergence of the traders' expectations to a single supply-and-demand intersection that clears the market for the two traders. If there is no price interval common to the expectations of both A and B, no trade will occur until one or both of the traders revise their expectations. Within the framework and discussion presented here, it is clear that relatively equal access to information will be important to efficient price discovery.

The process of price discovery in a market with more than two participants, such as the livestock futures markets at the CME, is similar. As subsequent equilibrium prices are discovered and as supply-and-demand information changes, traders revise their expectations.
The perceptions of supply and demand are adjusted, and the adjustments are then reflected in changed actions in the marketplace and in the discovered price. Price discovery is a dynamic and continuing process as adjustments are made to a constantly changing set of information on supply and demand.

**Price Discovery and Livestock Futures Markets.** The importance of the livestock futures markets in price discovery depends to a large extent on the relative efficiency of the price discovery processes in futures markets and in the cash markets. The market that is more efficient at receiving and interpreting information will discover price before the other.

Producers' awareness of which market reacts most quickly to new information can improve the efficiency of the needed adjustment processes. When making decisions on whether and how many cattle or hogs to place on feed, a producer can look backward to previous prices, examine current cash prices, or employ some form of price expectation. Before futures trading, prices from previous years were widely used as expected prices. The emergence of futures trading provided an alternative by offering prices that reflect the consensus of what traders expect the cash price to be at a particular time in the future, given the currently available information. The use of futures prices as expectations affects the price discovery process in a number of ways, primarily through the supply response.

The relation between futures prices, expectations, and supply response in livestock commodities has been widely studied. Paul and Wesson found a positive relation between placements of cattle on feed and a feeding margin variable. Miller and Kenyon identified a similar relation between futures prices and placements of cattle on feed. Ehrich suggested that placements were a function of feedlot capacity but that price expectations, as measured by fed cattle futures, significantly affected feeder cattle prices. In examining the influence of futures prices on the short-run supply of fed cattle and hogs, Hoffman observed:

One important source of livestock price expectations readily available to all livestock producers is the futures market. The livestock futures market provides a means for dampening short-run price fluctuations through temporal arbitrage where producers have the opportunity to hedge marketings or to plan feeding periods to market animals on the high and avoid the low market.
The possible dampening of short-run price fluctuations to which Hoffman refers results from short-run supply responses based on the use of futures price as expected cash prices.

To illustrate, suppose that live cattle futures prices for delivery in six months increase significantly. Cattle feeders using the distant futures quotation as an expectation of future cash prices will increase placements of cattle on feed. Fed marketings five to six months in the future will increase and exert pressure on cash prices as the finished cattle come out of the lots. Such a short-run supply response has implications for the forecasting performance of livestock futures.

The conceptual framework underlying these largely self-defeating supply responses was discussed by Tomek and Gray for another nonstorable commodity, Maine potatoes. The process for livestock is essentially the same. When expected prices are high at the start of the production period, cattle or hog producers respond by increasing placements or holding back gilts for breeding. Prices at the end of the production period are then lower because of the increase in supply. Conversely, low prices at the start of the production period provide a disincentive, and producers reduce cattle placements or send gilts to slaughter, causing lower output and higher prices in later months. Tomek and Gray note that only when the early price expectation approximates the cost of production will the final realized price approximate the initial expectation.

If the futures markets are efficient in receiving and registering the effect of new information, the supply responses are controlled, and short-run fluctuations are dampened as suggested by Hoffman. Consider the situation above for the cattle feeder when placements are initially increased in response to an increase in a distant futures price. If the futures market registers the effect of the increased placements promptly, futures prices (and therefore price expectations) will be adjusted downward to reflect the expected increase in supply. The downward adjustment curtails the supply response and helps create a stable price.

The relation between live cattle futures prices and placements of cattle on feed has been examined by Koontz, Purcell, and Hudson. Using supply response models and analysis of lead-lag relations between live cattle futures prices and placements of cattle on feed in Cattle Fax member feedlots, the authors concluded that trade in live cattle futures does in fact stabilize short-run supplies of fed cattle. Koontz and Purcell extended the analysis by examining the relation between placements and futures price during periods of increasing and decreasing placements. They found that placements increase in response to changes in the futures price and changes in the prof-
itability of cattle feeding as represented by a profit margin variable. But when placements are decreasing, it is the live cattle futures market that responds. Neither the cash price nor the expected profit margins help cut off the placements and prevent an overreaction.

**Supply Response and Risk Management.** Livestock producers have been vocal critics of trade in cattle and hog futures. Too often producers use futures prices as expectations but fail to forward price to manage the subsequent exposure to price risk. Without appropriate price protection, the producer can suffer the full brunt of the normal and economically rational supply response. The increasing use of futures as expectations suggests a need to clarify the outcomes of the correct and the incorrect use of those expectations.

Consider a hog producer contemplating expansion of a breeding herd. Assume that current corn prices are low and that the outlook for market hogs is bullish nine to ten months in the future. Our producer looks at the distant futures contract, sees a price that suggests a profitable return to increasing herd size, and holds gilts for breeding with the hope of marketing profitable hogs in nine to ten months. If the producer proceeds without hedging, the price realized in later months is likely to be significantly lower than the initial price expectation that prompted the decision to expand. Other producers have responded to the same incentive. The key here is that the futures price reflects a consensus estimate of the expected price based on current information. A producer who uses the price as an expectation and fails to forward price is ignoring the fact that actions of many producers change the information set. The number of slaughter hogs expected to finish nine to ten months in the future increases, and price expectations registered in the futures markets decline. The futures market should not be criticized for registering the effect of the supply response.

The hog producer could have used the futures quotation correctly as an expectation by forward-pricing the expanded production. If he or she had placed a hedge along with the decision to hold back gilts, two things could have been accomplished: (1) the profitable price offered in the distant futures contract would have been locked in (subject to basis risk); and (2) the information regarding increased production would have been reflected in the futures market through the hedging activities. The results might include a higher return to the producer, a quicker curtailing of the expansion, and a reduction in the cyclical fluctuation of hog prices. One of the continuing problems facing the livestock futures markets is that the supply-induced price response (especially the price decrease) is visible to all observers
but the effects of the market's dampening variability and preventing overreactions are less visible.

There is, of course, another side to this topic. The discussion above traces what happens if the producer uses the market correctly. There are at least two less optimistic outcomes. An incorrect use of the price expectations in the futures market—expansion with no forward pricing—can lead to major losses as prices fall under the weight of the supply response.

A second less optimistic outcome will emerge if the futures markets are not efficient and do not quickly register the effect of the emerging positive supply response in the form of lower price expectations. Reduced price expectations are needed to curtail the supply response and keep producers from overreacting. Koontz and Purcell indicate that the live cattle futures market is quick to show, through reduced prices on the distant futures contracts, the effect of increased placements of cattle on feed. The results suggest that the live cattle market is efficient and does contribute to more stable patterns of placements of cattle on feed. But the other livestock futures markets have not been analyzed as extensively as the cattle markets, and there is much we do not know about supply responses prompted by price expectations derived from the livestock futures markets.

Price Discovery, Market Efficiency, and Information. Within the context of price discovery, it becomes clear that the efficiency of the price discovery process has two aspects: (1) the ability of the market to adjust to new information and register its effect in the form of revised prices; and (2) the adequacy of the information used by the market in discovering price. If the information is inadequate, a market may appear inefficient in the process of price discovery when the actual problem is in the information set.

The concept of market efficiency as defined by Fama suggests that a market is efficient if, at any time, all available information has been registered in the price being observed. Although numerous tests of market efficiency have been conducted for grain and livestock, little research has addressed the question of how well agricultural futures markets respond to specific kinds of information. Research dealing with the response of livestock futures prices to new information is essentially limited to the work of Miller, an Agriculture Department study, and studies by Hoffman and by Hudson, Koontz, and Purcell.

Miller developed partial adjustment models to measure the response of live hog futures prices to information contained in Agriculture Department quarterly hog and pig reports. He concluded that futures
prices adjusted quickly to new information, half the response occurring in less than a week. The Agriculture Department studied responses of hog futures prices to hog and pig reports, finding that prices moved up and down about the same number of times after the release of the reports.\(^{40}\) In an extension of the department’s analysis, Hoffman examined the response of live hog futures and live cattle futures prices to the release of reports on hogs and pigs and on cattle on feed.\(^{41}\) Hoffman’s analysis suggested that hog and cattle futures prices tend to increase more often than they decrease after the reports. More recently Hudson, Koontz, and Purcell examined the response of live hog futures prices to the release of quarterly hog and pig reports.\(^{42}\) They concluded that conventional tests of market efficiency may identify what appears to be market inefficiency but is actually a lack of information.

Hudson, Koontz, and Purcell modified the Fama framework of market efficiency by suggesting that two kinds of information fit into Fama’s classification of publicly available information: (1) compiled information, information available in publicly available market reports such as the quarterly hog and pig reports; and (2) available information, information that exists but has not been compiled and made available to the public in any official release. With the periodic release of market reports, available information is transformed into compiled information. If the compiled information released differs from pre-report expectations, a price adjustment will occur, which is likely to be nonrandom as the market moves in the same direction for several consecutive days to catch up to the newly released information. Nonrandom price changes are typically viewed as evidence of market inefficiency, but the difficulty here is more nearly in the adequacy—or inadequacy—of the information available to the market participants. The markets may be operating as efficiently as possible as a price discovery mechanism given the quality and adequacy of the available information.

Summary of Issues. Prices discovered in the futures market provide a readily available consensus estimate of price expectations based on the underlying information. If the markets are efficient in registering the effect of changes in the information set in the discovered price, the supply responses characteristic of the livestock industry might be dampened and prices stabilized.

Criticism of the highly visible price moves in the livestock futures markets often comes from producers who fail to forward price expanded production and then feel the full weight of the price moves coming from the aggregate supply response. The markets must be used
correctly, and better understanding of the price discovery and supply response processes would help.

Dramatic moves in the futures markets after the release of periodic reports appear to be a problem of inadequate information, not inefficient markets. This is especially true for hogs, where the reports are infrequent and do not contain the disaggregated data needed by analysts attempting to track the progress of the hog cycle and estimate future supplies of slaughter hogs accurately.

To repeat a point made earlier: the price discovery process is the element of trade in livestock futures that is still obscure and confusing to many observers, especially producers. In any discussion of livestock futures issues, price discovery should be near the top of the list in priority and importance.

**Interactions of Cash and Futures Prices in the Livestock Markets**

Discussions about trade in livestock futures usually focus on the effect of futures trade on cash prices. The most widely discussed issues are the influence of trade in futures on the variability of cash prices and the nature and direction of causal flows between the futures and cash markets.

Powers analyzed price changes for live cattle and pork bellies during four-year periods preceding and following the initiation of futures trade. The variability of cash prices was reduced for both commodities after the initiation of futures trading. The analysis by Powers was extended by Taylor and Leuthold to cover eight years before and after futures trading for live cattle. The variability of both monthly and weekly cash prices was significantly reduced after the advent of futures trading. In general, analysts have concluded that the variability of cash prices for livestock is lower when an active futures market exists.

Research dealing with the direction of causality between cash and futures prices has been limited. Leuthold and Tomek, writing in 1979, noted: “While considerable interest exists in the influence of futures on cash prices, few ‘causal’ analyses have been tried. Indeed we are not aware of any simple correlation results for different livestock futures prices, nor has the degree of simultaneity between cash and futures prices been rigorously tested.”

Recent developments in the research literature have encouraged increased attention to causality. Causality is being defined rigorously. Analytical techniques to measure temporal relations and the direction of causality between cash and futures prices are being developed. The available literature, however, is still sparse.

Purcell, Flood, and Plaxico examined lead-lag relations between
cash and futures prices for live cattle. They isolated a bidirectional relation between daily cash and futures prices, which suggests that cash and futures prices interact and move together. A statistically significant causal flow from the quotation on day $t$ for distant live cattle futures to the cash price for feeder cattle on day $t + 1$ was also identified.

Miller and Kenyon examined the role of live hog futures prices as expectations in pricing processes for cash hogs. They found evidence of causality running from live hog futures prices to cash hog prices.

Cash-futures interactions for live cattle were examined by Weaver and Banerjee. Although the multivariate framework they employed more closely addresses price determination than price discovery, they concluded that futures prices lead cash prices.

The conclusions of the studies by Purcell, Flood, and Plaxico and by Weaver and Banerjee are questionable because of the data employed. Daily cash prices obtained from the *Wall Street Journal* were closing prices in the Omaha market. Market-determined price quotations are rarely listed for the Omaha market late in the week, and the *Journal* typically repeats the Wednesday quotation for Thursday and Friday. Analyses employing daily observations, especially first differences of daily observations, will give biased results because of the absence of market-determined quotations for Thursday and Friday.

The lack of market-determined price quotations was considered in a recent analysis by Oellerman and Farris. Using truncated data series that allowed examination of lead-lag relations between cash and futures prices on Monday, Tuesday, and Wednesday, the authors concluded that changes in futures price generally lead changes in cash prices.

The literature on causal flows has advanced to the point where rigorous research on them is now possible. Both the conceptual and the analytical frameworks will continue to be refined, but a basic framework can be pulled from the literature and adapted to specific research needs.

**A Framework for Analysis.** We have defined price discovery as the process by which buyers and sellers arrive at the price for a specific quantity and quality of a commodity at a particular place and time. Price discovery can therefore be viewed as a market-specific concept dealing with the ability of a particular market to discover price from the set of available information. When multiple markets exist for the same commodity, the market that is most efficient at incorporating changes in information will discover price and will lead the other markets in registering a change in price.

The definition of causality that is emerging in the literature is based
on the timing of reactions to new information. A is said to cause B if current and past values of A help predict future values of B. Consistent with this definition of causality, live cattle futures prices can be said to cause cash slaughter cattle prices if the futures prices on days $t, t-1, \ldots, t-n$ help predict prices in cash markets for day $t+1$. Granger introduced this concept of causality. His original specification and analytical approach have been modified by other researchers, but the basic approach to defining causality has remained the same. Later in this chapter, the framework used in our analysis of causality in the cattle sector is presented in some detail. As the discussion progresses, it is important to bear in mind just what is meant when the term "causality" is used.

Price discovery processes are at work in both the cash and the futures markets for cattle. If the cash market, for example, is more efficient in registering information, the timing of the flows between the two markets reflects that efficiency. Information is registered in the cash market, price is discovered, and the discovered price is reflected in the set of available information. The futures market reacts to the discovered price with a time lag. Price is being discovered in the cash market, and the futures market is reacting to a price that has already been registered in the cash market. In this case cash prices would be said to cause futures prices.

There are clearly alternative possibilities. If the futures market registers and reacts to new information more quickly, the focus of the price discovery process is in the futures market. Futures prices "cause" cash prices. Alternatively, the two markets can react to the information with equal speed and efficiency. There are no time lags, and the price discovery process is carried out in the two markets simultaneously. When daily prices are used, we would expect interaction within the day or simultaneity between the cash and futures markets.

A more complex pattern emerges when there are interactions between the two markets on day $t$ and lagged flows in both directions from day $t$ to day $t+1, t+2, \ldots, t+n$. At the outset this would be the most likely pattern. What happens in the futures market today would be expected to have some effect on the cash market tomorrow, and what happens in the cash market today would be expected to have some effect on the futures market tomorrow. Such a pattern is the feedback pattern we define more formally below. It leaves open the very real possibility that the cash market is more efficient in registering the effect of certain kinds of information and the futures market in registering the effect of other kinds.

The information flows and price discovery process can be represented algebraically as follows:

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\[ FP(t) = Q[CP(t-1), CP(t-2), CP(t-3), \ldots, CP(t-j)] \] (1)

where \( FP(t) \) is the futures price at time \( t \); \( CP(t-j) \) is the cash price at time \( t-j \), \( j = 1, 2, 3, \ldots \); and \( Q \) is an arbitrary function (assumed linear).

Equation 1 represents the case where the cash market leads the futures market. The case where the futures market leads the cash market is represented by equation 2:

\[ CP(t) = G[FP(t-1), FP(t-2), FP(t-3), \ldots, FP(t-j)] \] (2)

All variables are as defined above for equation 1, and \( G \) is an arbitrary (assumed linear) function.

The case of simultaneous price discovery can be represented as follows:

\[ CP(t) = H[FP(t)] \] (3)

Equation 3 indicates that the cash price at time \( t \) responds to current futures prices as well as to the lagged responses to futures delineated in equation 2. A simultaneous relation between the two series could be modeled equally well with futures price as the dependent variable and cash price as the independent variable.

A more general representation of the information flows between the two markets would allow past cash or futures prices to influence current cash or futures prices. Representation of the relations in this manner operationalizes the test for lead-lag relations between the two series as originally suggested by Granger. In this more general form, equations 1, 2, and 3 become:

\[
\begin{align*}
FP(t) &= Q[FP(t-1), \ldots, FP(t-k), CP(t-1), \ldots, CP(t-j)] \\
CP(t) &= G[CP(t-1), \ldots, CP(t-k), FP(t-1), \ldots, FP(t-j)] \\
CP(t) &= H[CP(t-1), \ldots, CP(t-k), FP(t), FP(t-1), \ldots, FP(t-j)]
\end{align*}
\]

These general representations are direct analogues of the test for causality suggested by Granger and employed by Geweke. The details of the testing procedure are well documented in the literature, including Geweke, Granger, Bessler and Brandt, and Hudson, and are not repeated here. The use of the Granger causality concept to examine lead-lag relations between price series in alternative markets follows Bessler and Schrader. In this presentation, it is sufficient to recognize that the procedure allows testing for four kinds of relations between the cash and futures markets:

- **unidirectional causal** flows, which document the existence of a lagged response in one market to earlier changes in the other market
- **bidirectional** flows, which document the existence of lagged
responses in each of the markets to earlier changes in the other market

* contemporaneous or instantaneous flows, which document the existence of interaction between two markets within the day (assuming the analysis uses daily prices)

* feedback relationships, which document the existence of bidirectional or bidirectional and contemporaneous flows between two markets

If the cash and futures markets are equally efficient, we would expect both bidirectional and contemporaneous flows. Each market would be active in discovering price on any day \( t \) but would also be reacting to developments in both markets on day \( t - 1 \) or earlier days \( (t - 1, t - 2, t - 3, \text{ etc.}) \).

If one market is more efficient in reacting to changes, we would anticipate the existence of unidirectional flows from the more efficient market to the second and less efficient market only. In this case a conclusion that changes in the more efficient market “cause” changes in the other market would be justified. At this point we want to make clear that the existence of contemporaneous and unidirectional flows leaves intact the conclusion that the more efficient market is exerting a causal influence on the second market. Contemporaneous flows will usually be present when daily data are analyzed, and their presence does nothing to invalidate the conclusions on causal flows if unidirectional flows are also present.

**Analysis of the Cattle Complex.** The research literature dealing with the cattle complex has been dominated by pricing issues in recent years. Concerns over thin markets, formula pricing, and the effects of futures markets on cash markets have been frequent topics of discussion.

Questions about the adequacy and accuracy of reporting of carcass beef prices carry the implicit assumption that the carcass beef market is the center of price discovery in the cattle complex. Similarly, concern over the effects of futures trade on cash prices carries the implicit assumption that the futures market is the center of price discovery. The contradiction in these implicit assumptions illustrates the lack of information about the exact nature of the interactions between cash and futures prices in the cattle complex. In discussing these issues, it is useful to consider the relation between the way that price is discovered and the economic structure of various sectors of the livestock industry.

The cattle industry can be described by the economic structure
at each level in the carcass beef, cash cattle, and live cattle futures system. Cash cattle markets, on the sellers' side, approach the conditions of pure competition, with many relatively small producers. The buying side of the cash market is more nearly an oligopoly, with a few relatively large firms. The carcass beef market is an oligopoly or oligopsony, with relatively large firms on both the selling side (packers) and the buying side (retail chains). Much of the concern about thin markets and the related issues of market power and noncompetitive pricing emerges at this level.

Those who argue that carcass markets discover price are concerned with the pricing power such an oligopolistic industry may possess. An analysis by the Meat Pricing Task Force organized by the Agriculture Department illustrates these concerns. According to the report, over 70 percent of all carcasses were priced by a formula using National Provisioner (Yellow Sheet) published prices.

The degree of concentration in the packing industry also contributes to the concern over futures markets. The Agriculture Department study noted that eight packers held positions of fifty or more futures contracts and those holdings accounted for 44 percent of total steer slaughter during 1977. These same eight packers were the source of over 50 percent of the total sales information reported in the Yellow Sheet.

Live cattle futures markets approximate a purely competitive market with a large number of buyers and sellers, none of whom should be able to exert a significant influence on price. In contrast to the cash or carcass markets, the futures market is geographically centralized, providing relatively low-cost access to information. Moreover, the nature of the market encourages the gathering of information by creating a value for that information. Speculators seeking returns on investment capital are motivated to develop or seek information to guide their trading decisions, just as hedgers seek to be well informed in carrying out their strategies for managing price risk.

The economic structure and location of the live cattle futures market suggest a potentially important role in price discovery for the market for two major reasons. First, the large number of well-informed participants creates an evaluation process through which the market-clearing price might be discovered efficiently and effectively. Second, we would expect the time required for information to be registered in the form of a price change or price response to be shorter because of the centralization of the market.

Following the argument above, we hypothesized that the futures market is the primary source of price discovery in the beef sector.
LIVESTOCK FUTURES

Testing this hypothesis required application of the analytic framework described above in identifying and measuring the lead-lag relations or causal flows between live cattle futures, cash cattle markets, and cash carcass markets. The approach is relatively new and is still subject to some uncertainty about the efficiency and accuracy of the test criterion. As a first step, therefore, the performance of the tests for direction of causality was evaluated in three ways.

First, a Monte Carlo investigation was conducted, using data with known (constructed) lead-lag structures to examine the performance of the tests. Second, lead-lag relations between cash and futures prices for grains and oilseeds (corn, wheat, and soybeans), for which the role of futures prices in the price discovery process is more widely accepted, were analyzed. Finally, an investigation measuring the relations between live cattle futures prices and feeder cattle futures prices was conducted. Prices for feeder cattle should reflect the derived demand for feeder cattle as an input, and the strong economic relations between the two markets permitted a test of the effectiveness of the causality tests in identifying the expected lead-lag relations between the two futures markets.

The Monte Carlo results indicated that the tests were capable of identifying a lagged relation, even in the presence of planned complicating factors, with a power of 90 percent or more. Data series were constructed with designed differences and complications (such as differing time trends), but the tests were capable of cutting through the complications and identifying constructed and known unidirectional time lags correctly in more than 90 percent of the trials.

The results of the analysis of cash and futures prices in the grains and oilseeds and of the live cattle and feeder cattle futures were consistent with theoretical expectations. In the grains, there was a strong contemporaneous flow; but there was also a unidirectional lagged flow from futures on day \(t\) to cash on day \(t+1\), suggesting that the cash grain prices react with a time lag to earlier changes in the futures markets. Feeder cattle futures prices for the nearby contract reacted contemporaneously or with a time lag of no more than one day to changes in the prices of the six-month-distant live cattle futures contract. The causality tests were capable of identifying and measuring these expected lead-lag relations.

Given the results of the rather exhaustive analysis of the effectiveness of the causality tests and the underlying methods, the investigations of the interactions between cash cattle and live cattle futures were conducted with confidence in the results. Lead-lag relations between live cattle futures, cash carcass beef, and cash slaughter steer prices (all daily prices) were examined for January 1, 1979, to
Results of Tests for the Presence of Time-related Flows between Live Cattle Futures, Cash Slaughter Cattle, and Carcass Beef Daily Price Series, January 1, 1979, to December 31, 1982

<table>
<thead>
<tr>
<th>Flow</th>
<th>Flow Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>F → C</td>
<td>Yes</td>
</tr>
<tr>
<td>C → F</td>
<td>Yes</td>
</tr>
<tr>
<td>F ← C</td>
<td>Yes</td>
</tr>
<tr>
<td>F → CB</td>
<td>Yes</td>
</tr>
<tr>
<td>CB → F</td>
<td>No</td>
</tr>
<tr>
<td>F ← CB</td>
<td>Yes</td>
</tr>
</tbody>
</table>

a. F refers to the live cattle futures, C to cash slaughter cattle, and CB to carcass beef. The arrows indicate the direction of the flow.

December 31, 1982. The futures price series was a truncated series using the nearby contract. The cash series was the Amarillo series for Choice steers, a series with market-determined prices Monday through Thursday. The carcass quotations were the Yellow Sheet closing prices for each day. The results summarized below follow Hudson and Purcell.57

Results of the analysis. Because cash cattle prices for Friday are not available, the analysis of lead-lag relations used two approaches. First, the missing observations were generated by a procedure that maintained the statistical properties of the cash price series. Second, the framework suggested by Oellerman and Farris, which eliminates the missing days and examines only short time lags, was employed.58 The results, which were identical for the two kinds of analysis, are summarized in table 6–3.

The direction of the flows for which tests were conducted is indicated by the arrows. For example, futures leading cash cattle prices is represented by (F → C), cash cattle leading futures by (C → F), and an instantaneous or contemporaneous relation between cash and futures by (F ← C). The .05 level of statistical significance is used to indicate the presence of the flows and justify the "yes" notation in the table.

The instantaneous relations present in the table suggest interaction across the markets. In the futures and cash cattle complex,
there is very strong evidence of contemporaneous flows (the significance level was less than .001), but that daily interaction was expected. There are also significant unidirectional lagged flows from cash to futures and from futures to cash. The combination of the contemporaneous and lagged unidirectional flows constitutes the feedback pattern, which we earlier indicated would be expected when two efficient markets are pricing the same product. The futures market is not the only source of price discovery in the live cattle market, and prices are not discovered in the futures market and merely reflected with a time lag in the cash market. The futures and cash markets are both involved in price discovery.

The situation is somewhat different in the futures-carcass complex. The contemporaneous flows are very strong, but bidirectional flows are not present. The feedback pattern is therefore not in evidence, because of the lack of a lagged flow from carcass to futures. The lagged unidirectional flow from futures to carcass is strong (significance level below .05), but the flow from carcass to futures is nonexistent (significance level above .5). This set of results shows that futures markets are exerting a causal influence on the carcass markets.

The reactive role of the carcass market was an interesting finding. The contemporaneous flows indicate that the carcass market is involved and important, but the theory of derived demand for a raw material—such as live cattle—suggests that any market that is discovering prices for live slaughter cattle would react with a time lag to prices in the carcass market. The possibility remained that the carcass market was exerting influence within the day, a causal flow that would not be identified through daily prices.

Intraday quotations for live cattle futures and carcass beef were examined. Futures quotations were recorded at 11:30 A.M. and 12:30 P.M. central standard time, before and after the release of the midday carcass beef price quotations. The futures prices were analyzed with both the midday and the closing carcass quotations. The lead-lag relations between these series were identical with those reported for the daily futures and carcass quotations. There was evidence of a strong contemporaneous flow between the carcass and futures series and a causal flow from futures to the carcass market but no causal flow from carcass to futures.

Some industry observers might argue that an intraday flow from carcass to futures exists because the industry "knows" early in the day what the midday carcass quotations will be and the futures prices adjust to that expectation. The absence of any causal flow or any evidence that futures adjust to unexpected carcass quotations around
the midday carcass report and the failure of the tests to isolate any
day-to-day flow from carcass to futures casts doubt on such a presumed
relation.

**Implications.** The live cattle futures market plays an important role
in the day-to-day price discovery process for cash carcass beef and
cash slaughter steers. The results of the causality analysis support
the following conclusions:

- Live cattle futures markets do not exert a dominating influence
  on cash slaughter cattle markets. Cash prices do respond with a time
  lag of one day or more to price changes in the futures market, but
  there is a similar lagged flow from cash to futures. Apparently each
  market has a comparative advantage in registering the effects of
certain kinds of information, setting up the need for lagged flows in
both directions. Combined with the daily interaction between the
cash and futures, the lagged flows constitute precisely the relation
that would be expected between two relatively efficient markets pric­
ing essentially the same product. The hypothesis that the live cattle
futures market is the primary source of price discovery in the cattle
complex is rejected.

- Concerns over the structure of the beef industry at the processing,
  wholesaling, and retailing levels and the related pricing problems
may be overstated or misplaced. The carcass market appears to be
the least important of the three markets analyzed in its contribution
to price discovery. The widespread use of carcass quotations in formula
pricing might well be a reason for concern. But if the price discovery
process or the frequency of change in price direction is the concern,
the fact that the carcass market reacts to previously registered price
changes in the futures market is important. Policies designed to
regulate activity in the carcass market and influence the price
performance of the carcass subsystem may need to be reexamined.
Investigation is needed to clarify why the carcass market cannot make
a greater contribution to the price discovery processes.

- Regulatory efforts intended to influence pricing activities in the
cattle and beef sector must pay increased attention to the live cattle
futures markets given the importance of that market in the price
discovery process. More attention should be paid to the economic
and noneconomic forces that could influence the pricing performance
of live cattle futures, because of the interaction between futures and
cash cattle and carcass beef prices and the causal influence from
futures to carcass prices.

Given the results of this analysis, there is no reason for continued
charges that the live cattle futures market dominates the cash slaughter cattle market. The futures market does not unilaterally cause the periodic price breaks in the cash market. The futures and cash cattle markets are both involved in the discovery of prices for slaughter cattle. There is reason for concern about the ineffectiveness of the carcass beef market as a contributor to the price discovery process. A priori, most analysts would have suggested that the focus of price discovery would be the carcass market, with the live cattle markets—cash and futures—adjusting to the carcass market. This analysis was not designed to answer the question why the carcass market does not perform that role, but the daily prices reported in the Yellow Sheet suggest that prices are too sticky and often do not change for several consecutive days. Price stability does not contribute to efficient response to constantly changing information. We hope to see more research on the broad area of pricing in the livestock and meat markets given the many unanswered questions that remain.

**Summary, Expected Developments, Continuing Issues**

**Summary.** Trade in livestock futures was launched in the face of skepticism that it would be economically viable. Changes in the cattle industry that ushered in large-scale confinement feeding provided the necessary condition for success. Investors in cattle-feeding programs faced tremendous price risk, and a means for transferring risk was needed. Since the beginning in 1964, however, trade in livestock futures has been controversial.

Most of the controversy is due to a failure to understand the workings of livestock futures markets in providing a risk transfer mechanism and in contributing to price discovery and to actual or presumed shortcomings in the performance of the markets. Given this perspective on why a controversy persists, our primary objective was to contribute to the body of knowledge dealing with the economic dimensions and economic implications of trade in livestock futures.

Most analysts have presented positive assessments of the performance of the livestock futures markets in transferring risk. The variability of cash prices has been lower since the advent of trade in futures. Routine hedging strategies decrease the variability of profit streams over time. In recent years selective hedging strategies have been developed that offer both reduced variability of profit streams and higher average profits. Such results suggest that the livestock futures markets have the capacity to transfer exposure to price risk.

Exposure to price risk entails costs, which take the form of lower prices for livestock producers, higher prices to consumers, or some
combination of the two. Firms in the livestock system attempt either to offset the risk through hedging strategies or to transfer the burden to some other firm in the system. Because producers bear the brunt of the attempts to pass on exposure to price risk in the form of lower livestock prices, they should be and are interested in the effectiveness of livestock futures markets as means of transferring risk. Producers and spokesmen for producers' groups have been outspoken critics of the livestock futures markets.

Support for critical assessments is drawn from (1) the failure of the markets to offer consistently profitable hedging opportunities; (2) basis variability, which reduces the effectiveness of risk transfer (hedging) programs; (3) the failure of the futures markets to predict cash prices accurately; (4) the lack of balanced hedging activity on both the long and the short sides of the market; and (5) an assumed causal flow from futures to cash, suggesting that the futures market is the cause of cash price fluctuations. We have discussed each of these.

The criticism that the futures markets do not consistently offer profitable hedges has little support in economic logic. Livestock are produced and sold in an industry characterized by many small producers. In such an economic setting, well-established theory argues against the presence of "excess profits"—prices above the average total cost of production. There is no reason to expect profits to be consistently offered at the time the production decision is being made.

Basis variability has been a problem in the livestock commodities. If the basis is as variable as cash prices, hedging is ineffective. The basis has typically been less variable than the cash price, as shown by studies indicating that hedging reduces the variability of profits compared with speculating in the cash market. But there is room for improvement, and recent innovations in the futures contracts are designed to improve basis performance. The certificate delivery system for live cattle and the cash settlement system now being considered for feeder cattle are attempts to improve the performance of the cattle markets in risk transfer.

The futures markets do not have to be accurate predictors of cash prices to provide effective risk transfer opportunities if the basis is relatively stable or predictable. Much of the criticism of futures markets has come from producers who have used futures quotations as price expectations and then failed to follow through by forward pricing any expanded production. Such a procedure can be self-defeating, since the supply response can lead to final prices below the initial expectation.
The price discovery process is not as visible as the risk transfer function of futures markets, and much of the controversy can be traced to the price discovery function. The issue of a bias due to the lack of long hedging is largely unique to livestock futures and is related to the price discovery issue. Critics argue that prices are lower because most hedging is of the short variety, long hedgers are not active, and only speculators are on the long side.

Such a position has little basis in theory, and the empirical evidence is very limited. The futures market is a price discovery mechanism, which responds to the available set of information on supply and demand. The mixture of traders in the market should not be a determinant of price unless an argument can be made that the participants who would be long hedgers have information not available to others, interpret the existing information differently, or have stronger reasons to be right in their market actions.

Many producers believe that the futures market causes the fluctuations in the cash market and that the cash prices would be higher and less variable if the futures markets did not exist. A recent study found no evidence that the live cattle futures market dominates the cash cattle market. The two markets interact daily, and there are lagged flows of influence from futures to cash and from cash to futures. The analysis did raise questions about the role of the carcass beef market in price discovery. The carcass market interacts with the live cattle futures market within the day but also adjusts with a time lag of one day or more to price changes that have already been registered in the futures market. There is no lagged flow of influence from the carcass market to the futures market. The carcass market may be less important in the price discovery process than most analysts have believed.

An economic argument exists that the prices paid for feeder cattle by feeders are higher because of trade in live cattle futures. More testing of this hypothesis is needed, but it is difficult to deny that buying prices will be discounted by the cattle feeder who faces significant price risk. Disciplined use of the live cattle futures market can increase and stabilize the net return stream to the cattle feeder. In the presence of competition for feeder cattle, at least part of the benefits will be bid into feeder cattle prices.

Research results also suggest that the cash prices of slaughter cattle are more stable because of trade in live cattle futures. Futures prices are used as price expectations in such a way as to reduce the variability in placement of cattle on feed and in short-run fed cattle supplies.

The increasingly important role of the futures markets in price
discovery is bringing some difficulties. A relatively high percentage of producers watch livestock futures price quotations. Many use those quotations as price expectations and are quick to increase output when the prices look favorable, but few follow through by hedging. With no barriers to entry into cattle feeding or hog production, a major supply response and final prices well below those that prompted the expansion are always possible. The live cattle market is quite efficient in this arena and is quick to register the effect of increased placements and try to cut off the price incentive before the expansion goes too far. But not all producers perceive what is happening before the price outlook changes significantly, and sometimes the expansion is excessive. Even the normal supply response can hurt the producer who responds to the initial price incentive without understanding the implications for prices of the aggregate supply response. There is no area in which the lack of understanding we have mentioned many times creates more difficulties.

The discussions of the performance of the livestock markets will and should continue. Increasingly, those discussions should include the possibility that apparent problems of inefficiency in the livestock futures markets may be attributable to inadequacies in the information set available to them. Inadequate information may be an especially acute problem in the live hog markets. Progress toward better information and even more effective futures markets is a worthwhile goal for all involved.

Expected Developments. The question “where to from here” is an interesting one. The twenty-year history of trade in livestock futures has been rocky. It will be interesting to see whether the questions, controversies, research needs, and policy issues will be successfully handled as the livestock futures markets move beyond the infancy stage.

In the next ten years we expect to see the recent decrease in trade in livestock futures arrested and possibly reversed for a number of reasons:

- Economic changes in the livestock industry, including a renewed impetus from the cattle and hog cycles, are likely to bring back high price variability, which will increase interest in risk transfer.
- Tight operating margins, brought on by problems on the demand side and overcapacity, will increase awareness of the exposure to cash price risk at all levels of the production-marketing system.
- Increased understanding of risk transfer procedures will increase the demand for risk transfer mechanisms. Low prices and financial
problems will force more decision makers to be concerned about marketing and pricing.

• Better information and educational programs that clarify the role of futures markets in the price discovery process and the interrelations between cash and futures will remove some of the current apprehensions and increase the use of futures markets.

• Improvements in the existing contracts—such as certificate delivery systems and cash settlement—will remove some of the legitimate concerns about use of the futures markets by hedgers. To the extent that changes improve the stability or predictability of the basis, the markets will be more effective in risk transfer, and potential users who fully understand the basis-related issues will be attracted to (or back to) the markets.

• New contracts in feeder pigs, boxed beef, and boneless beef are expected.

The future holds no guarantee of spectacular growth in the trade of livestock futures, however, even if new contracts are developed. Futures markets provide an effective risk transfer mechanism and contribute to price discovery processes, but many potential users do not agree with that positive assessment and want no part of the futures markets. Moreover, attitudes change slowly, and only with reason to change. A key need is for every decision maker in the system to understand that when any participant in the system faces significant price risk, someone has to pay for that exposure. In the livestock industry much of the economic pain of carrying price risk is passed down through the system to the producer. As understanding of this basic principle spreads, producers will be inclined to look at futures trade differently.

Continuing Issues. Unanswered questions indicate gaps in the available body of knowledge. Among the important areas in need of more discussion and analysis are these:

• The effectiveness of the institutions involved in futures trade. We have not covered noneconomic issues but there are many in the ongoing discussions. Are the efforts of the Chicago Mercantile Exchange to police its own members and activities effective? Does the CFTC have an adequate budget, sufficient power, enough personnel? What about the position limits in the markets? Can one firm exert an influence on price? Without question, periodic sharp price breaks hurt the reputation of the markets. We do not always know whether these breaks are reactions to inadequate information, to legitimate
economic forces, or to noneconomic factors such as large positions, margin liquidation, and position limits.

• The role of the futures market in formulating price expectations. A recent analysis indicates that the futures market plays an important role in guiding changes in placements in the cattle feedlot complex. Given this result, are modifications needed in the live cattle contract to enhance the effectiveness of the markets? How should the futures markets be used in formulating price expectations? The issues surrounding supply responses and the role of futures prices in those responses are not well defined and have not been sufficiently analyzed.

• The relative efficiency of livestock futures markets in the price discovery process. Are the periodic price breaks and price surges due to inadequate information or to the inefficiency of the markets in incorporating the effects of new information? We need more attention to this important area.

• The impact of changes in delivery provisions (certificate system, cash settlement) on the performance of the basis. Information is needed to guide changes so that the opportunities for effective risk transfer will be improved. Changing to cash settlement, for example, could create more basis problems if the cash price series to be used is not widely representative.

• The forces that determine futures prices. Does the mix of traders matter? Would the price really be higher if there were more long hedgers in the markets? What is the effect of the funds being traded by computer routines? New forces are joining traditional economic forces as determinants of futures prices.

• Any impact of the decline in volume and open interest in recent years on the efficiency of the markets in the risk transfer and price discovery processes. If the downward trend in trade is not reversed, we need to understand the implications of the changing levels of participation. Is there a relation between liquidity in the markets and the range or frequency of price moves?

• Changes in industry organization and structure, such as the developing move toward contract feeding of hogs, which could mean changing needs for risk transfer and price discovery mechanisms. We need to look ahead to assess the effects of changes in the way the industry is organized on the kind of risk transfer mechanisms needed.

One thing is guaranteed: there will continue to be controversy surrounding trade in livestock futures. We find many positive things about the livestock futures markets. As risk transfer mechanisms,
they offer immense potential as management tools when used by informed and disciplined decision makers. As contributors to the price discovery process, they offer insight into a complex but tremendously important process. Awareness of just how important these markets are will grow, and we expect to see increased attention from the policy maker, the market analyst, the regulator, and, most important of all, the entrepreneur and business firm in the livestock and meat markets.

There is another side to the story, however. There is a major antifutures sentiment, concentrated among producers, and not all that negativism can be explained away by claiming that “they just don’t understand.” In delivery provisions, in basis performance, in position limits, in management of margin requirements, in periodic price breaks and surges, and in many other areas of the day-to-day issues of futures trade, critics can find reasons for concern and for criticism. To the critic who sees only the difficulties and does not understand the important functions of trade in futures, these issues are more than sufficient for an antagonistic stand. Better understanding and better communication between users and the CME constitute a perpetual issue, and the fact that trade in livestock futures is still shrouded in controversy suggests that progress is yet to be made. The progress will come, in our opinion, on the strength of an expanded base of analysis, discussion, and education.

Notes


5. The works referred to in note 4 by Leuthold and Tomek and by Kamara review much more literature on the risk transfer function than on the price discovery function.


17. Kolb and Gay, "Performance of Live Cattle Futures."
20. For a review of this literature, see Leuthold and Tomek, "Livestock Futures Literature." Additional information can be found in Kamara, "Commodity Futures Markets."
21. Materials presented by Chicago Mercantile Exchange staff to the CME Live Cattle Advisory Committee.
23. The variability of the basis is sometimes smaller in outlying market areas at some distance from the delivery points for feeder cattle (see ibid.). Given these results, the effectiveness of hedging strategies for feeder cattle appears to be largely independent of the location of the cash markets.
25. Jones, "Theoretical and Empirical Considerations."
31. Miller and Kenyon, "Live-Hog Futures Price Use."

34. Tomek and Gray, "Temporal Relationships among Prices."


36. Koontz and Purcell, "Price Discovery in the Live Cattle Futures Market."


38. For a review of this literature, see Kamara, "Commodity Futures Markets."


41. Hoffman, "Effect of Quarterly Livestock Reports."


43. Powers, "Does Futures Trading Reduce Price Fluctuations?"

44. Taylor and Leuthold, "The Influence of Prices."


46. Purcell, Flood, and Plaxico, "Cash-Futures Interrelationships."

47. Miller and Kenyon, "Live-Hog Futures Price Use."


55. The *National Provisioner* publishes a commercial report known in the trade as the Yellow Sheet. It is a daily price quotation sheet for carcass, primal, and subprimal meat prices, primarily beef and pork. The *National Provisioner* is published by Provisioner Publications, Chicago.

56. Michael A. Hudson, "The Impact of Time Trends on the Outcome of Two Tests for Granger Causality: A Monte Carlo Investigation" (Agricultural Economics Department, University of Illinois).


58. Oellerman and Farris, "Price Discovery."