THE USE OF LIVE STEER FUTURES CONTRACTS AND THEIR EFFECT ON CATTLE FEEDING PROFITS

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THIS BOOK CONTAINS NUMEROUS PAGES WITH DIAGRAMS THAT ARE CROOKED COMPARED TO THE REST OF THE INFORMATION ON THE PAGE.

THIS IS AS RECEIVED FROM CUSTOMER.

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CHAPTER I

INTRODUCTION

The problem

In economic activities involving a span of time, such as storage or production, there is the possibility that price changes in the period could cause unforeseen losses. This occurrence is most probable for those products which typically experience fluctuating prices. Live steers have been such a commodity. Because of the related uncertainty of income expectations, price fluctuations of finished cattle have been a major concern of producers.

In certain storable commodities, e.g., grains, futures markets have offered a means of counteracting price fluctuations through the technique of hedging. This consists of taking a position in the futures market opposite to that in the cash market.[1] Since prices in the two markets are assumed to advance or decline by the same amount, a gain or loss resulting from price movements in one market would be offset by a corresponding loss or gain in the other market. The hypothesized benefit to be derived from the hedge is that one could, while storing or merchandizing a commodity, eliminate or reduce the possibility of a loss from a price decrease.

Although a production process such as cattle feeding differs from storage activities, they are similar in that price fluctuations can cause adverse effects. Thus, on November 30, 1964, trading was initiated in futures contracts for live steers,[2] thereby providing a hedging mechanism for cattle

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[1]For example, if one were to purchase a quantity of a cash commodity (the actual physical product), he would sell a futures contract for the equivalent amount. Later when the cash commodity were to be sold, an offsetting futures contract would be purchased.

[2]No separate discussion will be given of the specifications of a futures contract; for those interested in this, see Chicago Mercantile Exchange, "Futures Trading in Beef Cattle," pp. 2-8.

feeders. Previous experience from other futures markets led some to the contention that hedging would act to eliminate the effects of wide price swings and the resultant income instability.[3]

Objectives

The futures market for live steers had been in existence for five years when this study was started so that empirical data was available for analysis. In addition, a body of literature concerning cattle hedging has come into existence, primarily covering theoretical considerations of the decision of whether or not to hedge.

This study was undertaken to provide a comprehensive analysis of available data on hedging using live steer futures. As such, previous hedging concepts were tested for their validity, and new concepts were added if they were found meaningful. Specific objectives were:

1. To compare the results from a policy of consistent hedging versus one of never hedging.
2. To test the selective hedging method currently advocated.
3. To test concepts about futures-cash price relationships for live steers which have stemmed from storable commodities.
4. To develop new selective hedging criteria.
5. To measure the effects of hedging on "risks."
6. To analyze possible interactions between hedging and direct contracting.

Procedure

To measure the impact of hedging on cattle feeding profits, it was

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[3]R. Wayne Robinson and Gerald Marousek, "Beef Cattle Futures Market," Agricultural Extension Service, University of Idaho, Idaho Current Information Series, Number 8, April, 1965, p. 3.

necessary to develop pertinent data. To accomplish this, a simulated feeding program was established covering the period from December 5, 1964 (near the date of the initiation of futures trading) until December 20, 1969.[4] It was assumed that feeder steers were purchased each week, fed 17 weeks, then sold as slaughter steers. Thus, in the time span studied, the analysis simulated the feeding of 247 separate lots of cattle. Costs and revenues were calculated for each of these lots from quoted market prices and secondary sources (see Appendix I). The data generated provided the information necessary to determine profits under situations of differing hedging decisions.

In the development of certain concepts relating to hedging, hypothetical price data are used rather than actual figures. The data created, however, are consistent with the assumptions made. Where applicable, concepts developed from hypothetical data are affirmed with information from the simulated feeding program.

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[4]This date was the time at which the last simulated lot of slaughter steers was sold; the final date for purchasing feeder steers was August 23, 1969.

CHAPTER II

THE EFFECTS OF HEDGING ON CATTLE FEEDING PROFITS

Routinely hedged compared to unhedged operations

The first effort, after development of the simulated data, was to compare a practice of routinely hedging versus one of never hedging. The underlying goal of this analysis was to provide information which would aid a producer in making a hedging decision as well as indicating areas requiring further study. A graphic comparison of the two alternatives is presented in Figure 1; a statistical summary is given in Table 1.

A cursory study of Figure 1 indicates that profits from the routinely hedged operations displayed less fluctuation than unhedged operations; this is further substantiated by the lower variance for the former (Table 1).[5] The higher degree of income stability was attained at a lower average income, i.e., routinely hedged operations resulted in an average loss of fifty-six cents per steer while never hedging gave an average profit of $7.29 per steer. In addition, a policy of routinely hedging would have resulted in a larger number of feeding operations which returned a net loss (138 as compared to 89 for the unhedged lots).

Table 1.--Simulated data obtained on profits from 247 routinely hedged and unhedged operations

Type of operation	Average profit per head	Variance of profits	Number of lots which returned negative profits
Routinely hedged	$-0.56	$184.33	138
Unhedged	7.29	555.73	89

[5]Income variance has often been utilized as a measure of risk, i.e., the smaller the variance, the less the risk. See, for example, Ronald I. McKinnon, "Futures Markets, Buffer Stocks, and Income Stability for Primary Producers,"

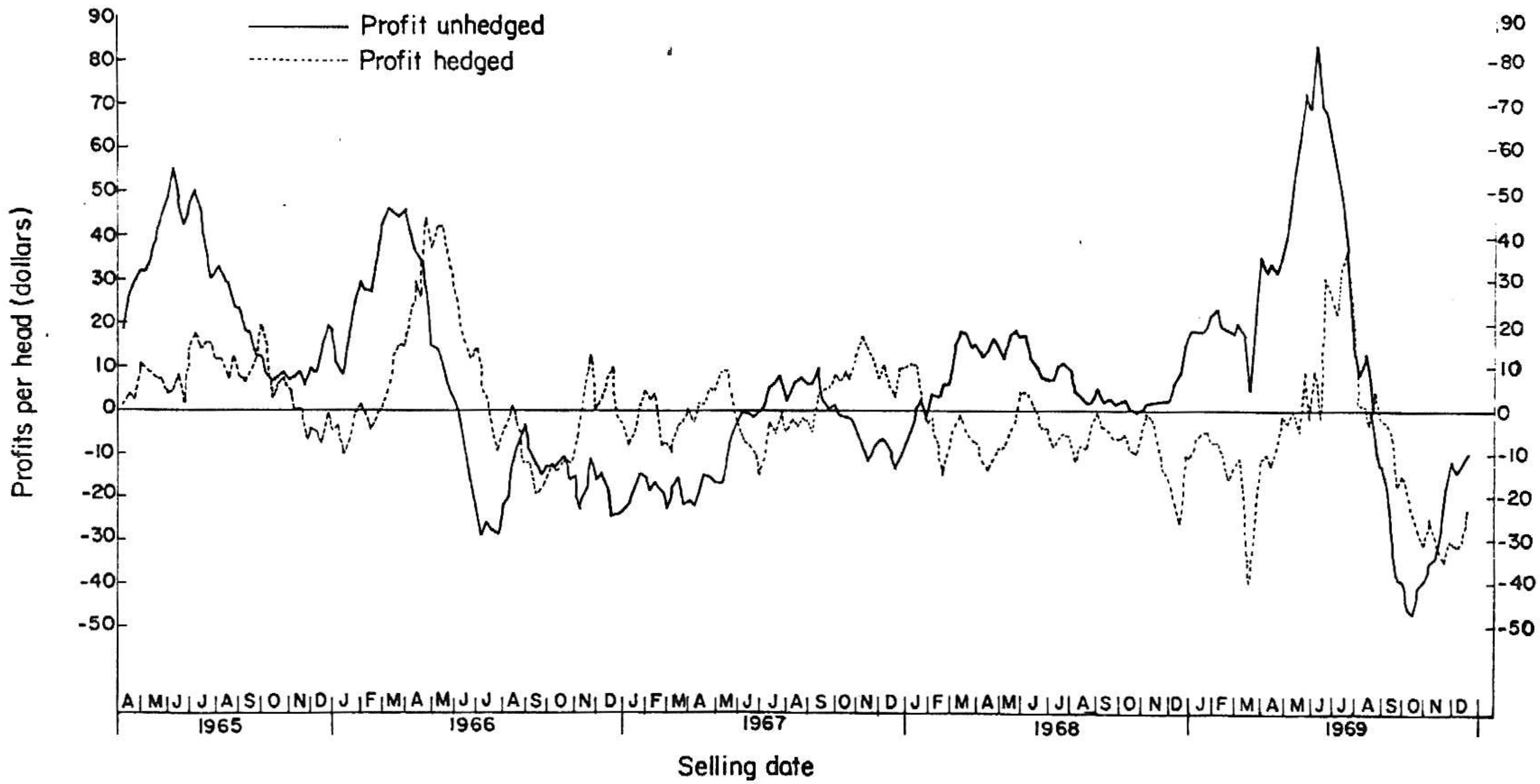

Fig. I. A comparison of profits per steer between hedged and unhedged feeding operations, 247 simulated lots.

Table 2.--The effect of hedging upon profits from cattle feeding

Unhedged		Routinely hedged	
Financial outcome	Number of lots	Effect of hedging	Number of lots
Profit	158	Profits increased	14[a]
		Profits reduced	56[b]
		Profits turned into a loss	88[b]
		Subtotal	158
Loss	89	Losses reduced	31[a]
		Losses increased	19[b]
		Losses turned into a profit	39[a]
		Subtotal	89
Total	247	Total	247

[a]Hedging would have increased returns relative to not hedging.

[b]Hedging would have decreased returns relative to not hedging.

More detailed information is given in Table 2, which is essentially a condensation of Figure 1. The table depicts the effect that transactions in the futures market had on the net revenue from the cash market operations. One observation is that rarely did the two transactions supplement one another, i.e., if a profit or a loss were forthcoming from feeding without the benefit of hedging, then seldom did hedging increase the profit or loss. More specifically, a profit from unhedged cattle feeding was indicated on 158 lots; hedging would have increased profits on only 14 of these lots, reducing or eliminating profits on the other 144 operations. On the 89 lots for which a loss would have occurred on unhedged cattle feeding, hedging would have aggravated the situation in only 19 lots. For the other 70 feeding programs, hedging would have either reduced or eliminated losses. Thus, hedging was shown to be effective when losses on cattle feeding were experienced; however the technique was indicated to be detrimental when cattle feeding was profitable, particularily since hedging under these circumstances would have turned profits on 88 lots into losses.

The time period studied was one of generally rising cash prices so that it might be expected that a policy of routinely hedging would return a lower average income. However, the length of the time period (about 5 years) and the available data suggest two observations. First, the existence of an average loss per steer for the routinely hedged operations, an obvious difference from the results of the unhedged transactions, indicates that a cattle feeder could not depend upon the former method to assure a normal return[6] over an extended time period. Secondly, an obvious question arises that possibly neither policy was always the more beneficial. This would suggest that, rather than following one practice exclusively, one might desire to alternate between hedging and not hedging, i.e., selectively hedging.

Use of the breakeven price

If the preceding observations are accepted, the next step would be the development and testing of a selective hedging method. This is defined as a system whereby the decision of whether or not to hedge is based upon some selected criterion. The goal of this program would be an improvement of the

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[6]In the terms of the theory of the firm, a normal return is considered as one such that firms are neither encouraged to enter or depart from an activity.

financial outcome over routine hedging and never hedging. That is to say, a method which would reduce the instability of and/or increase the level of cattle feeding profits relative to the other selling procedures.

A selective hedging system commonly advanced has been based upon the relationship between the futures price and the estimated breakeven price.[7] Utilizing this method, one would hedge his feeding operation whenever a futures contract (adjusted for location, quality, and weight) could be sold for more than the breakeven price (as determined from an estimate of costs).[8] The rationale is that by establishing a selling price (through the hedge) above costs, one could essentially be assured of a profit.

To test the effectiveness of this method, the analysis was divided into two phases. First it was necessary to ascertain if an indicated hedged profit could be maintained, i.e., if a futures contract could be sold for more than the estimated breakeven price, would a profit be forthcoming. Comparisons utilizing the simulated data suggested that a futures contract could have been sold for more than the breakeven price on 95 of the 247 feeding operations. If these 95 operations had been hedged, a profit would have been obtained on 80 (or 84 per cent) of the lots; this would imply that hypothesized results could be expected with some degree of certainty.

The second phase was to measure the effect of this method on profits for all 247 transactions. Hedging was utilized whenever a comparison of the futures and breakeven prices indicated that a hedged profit could be obtained; if not, the lots were assumed to be produced unhedged. A summary of

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[7]G. A. Futrell and J. M. Skadberg, "The Futures Market in Live Beef Cattle," Cooperative Extension Service, Iowa State University, M-1021, January, 1966, pp. 3, 15-18, provides examples of this technique.

[8]The breakeven price is found by dividing all costs of production by the number of hundredweights sold.

results is given in Table 3.

A tentative conclusion from the table is that the selective hedging method eliminated some of the adverse effects of a policy of never hedging. With no appreciable decrease in average income per steer, the selective hedge had a lower variance. This would indicate a tendency for the larger profits and losses to be eliminated, while still allowing the same return to be received. This, plus a smaller number of lots returning a negative profit (63), suggests that the chances for incurring a loss, particularily a large one, would be lesser for the selective hedge as compared to never hedging.

Table 3.--Simulated data obtained on profits from three different selling methods, 247 lots

Selling method	Average profit per head	Variance of profits	Number of lots which returned negative profits
Routinely hedged	$-0.56	$184.33	138
Unhedged	7.29	555.73	89
Selectively hedged based on the breakeven price[a]	7.14	359.91	63

[a]A lot was calculated as being produced unhedged if a futures contract could not be sold for more than the breakeven price. A total of 152 lots would not have been hedged.

In comparison to routinely hedging, the selective method had a higher variance. If this statistic is accepted as a measure of risk, then one would conclude that the latter involved more risk. However, a higher average profit for the selective hedging program, along with less than half as many lots returning a negative profit, create doubt as to the validity of this conclusion.

The preceding material has provided information to illustrate the need for a selective hedge. Another method will be proposed in a later chapter. Before doing so, attention will be shifted to the discussion of a concept basic to the idea of hedging. This diversion was taken to make the development of the other selective hedge more meaningful as well as to provide a better understanding of the futures market for live steers.

CHAPTER III

CASH-FUTURES PRICE RELATIONSHIPS

Storable commodities

One of the most basic and enduring assumptions relating to hedging is that its effectiveness is dependent upon a consistent relationship between the cash and futures prices.[9] Under ideal conditions, it is assumed that the futures price will exceed the cash price by the carrying charge (or storage costs), and that movements of the two prices for any one commodity will generally parallel one another. Thus, when hedging a long cash position, a loss from a cash price decrease would be offset by a corresponding gain resulting from an equal (or almost equal) drop in the futures price. A hedge would be considered perfectly effective if any gain or loss in the cash market were exactly offset by a corresponding loss or gain in the futures market. Blau expressed this as follows:

> The system of futures trading is based on the fact that cash and futures prices move together. Clearly the effectiveness of hedging (i.e., the effectiveness of neutralizing price risks in the cash market by assuming opposite risks in the futures market) must be impaired to the extent to which the movements of cash and futures prices diverge.[10]

Similar ideas persist in the more current literature.[11] Of course, it has been widely accepted that actual cash and futures prices do not always parallel one another. Moreover, it has been shown that profits can be enhanced through a consideration of these deviations.[12] Under ideal conditions, however,

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[9]The difference between the cash and futures prices is termed the basis.

[10]Gerda Blau, "Some Aspects of the Theory of Futures Trading," The Review of Economic Studies, XII, (1944-45), p. 7.

[11]Robinson and Marousek, "Beef Cattle Futures Market," p. 3.

[12]Holbrook Working, "Futures Trading and Hedging," American Economic Review, XLIII (June, 1953), pp. 320-27, illustrates trading on the basis.

parallel movements would be expected.

To measure the validity of this assumption and its implications for hedging, price relationships for any point in time will first be developed. The next step will then be to derive a relationship over time. Attention will first be centered on storable commodities, primarily to show that generalizations arising from these futures do not necessarily apply to the live steer market. To facilitate the discussion, the following symbols will be used:

T_1: usually the beginning of a time period considered, i.e., the start of the storage or production period.

C_1: the cash price of the commodity at T_1.

F_1: the price at T_1 of a futures contract which will mature at T_2.

T_2: usually the end of a time period, i.e., the end of the storage or production period.

C_2: the cash price of the commodity at T_2.

F_2: the price of the futures contract at T_2.

It is further assumed that the cash and futures prices refer to the same grade of the commodity at the same trading location, or that appropriate adjustments have been made.

Using the statistical term, expected value (E), it will be shown that the expected value of the difference between the futures and cash price at any given time is storage costs. This is given by:

(1) $E\ (F_1 - C_1) = S$ where S = storage costs from T_1 to T_2.[13]

[13]The concept of storage costs presents a matter of differing opinions, as some include a risk premium and a convenience yield (i.e., benefits other than monetary gain from holding a product) in addition to physical storage costs. It will be assumed that storage costs refer to an amount which, if exactly covered, would cause one to be indifferent as to whether he would store the commodity or perform some other activity. In reality, the gains depicted from arbitrage are dependent only upon an individual's concept of storage cost, with the exception of arbitrage between futures contracts. A consensus of opinion as to storage costs is not thus generally required to receive the gains shown.

or

(2) $E\ (F_1 - C_1^*) = 0$ where $C_1^* = C_1 + S$

In essence, this indicates that the basis at any given time will equal storage costs. A deviation from this would suggest arbitrage transactions to a trader such that the expected equality would be restored.

If F_1 were greater than C_1^*, this would indicate to a trader that he could sell a futures contract for later delivery for more than the cost of making the product available. Thus, at T_1, a trader could assure himself of a profit equal to the difference between F_1 and C_1^* by selling the futures contract and buying an equivalent quantity of the cash commodity to store for later delivery. This action, along with others so motivated, would lower the futures price and raise the cash price. This would continue until there were no further prospects of any gain, i.e., F_1 equalling C_1^*.

If a futures price above the cash price plus storage expenses indicates the feasibility of storage, then the converse, (F_1 less than C_1^*), would indicate that storage might not be profitable. This relationship would mean that the present price of a futures contract (F_1) would be less than the cost of making the commodity available (C_1^*). Holders of the cash product would then face the following alternatives: (1) to sell the commodity on the current cash market or (2) hold the commodity unhedged for sale on a later cash market. It would be reasonable to exclude a normal hedging transaction[14] since this would assure the trader of a loss in relation to proceeds available at the current cash price; it would therefore <u>always</u> be a less profitable plan than alternative (1). If a trader were not desirous of holding for a sale at a

[14]Exceptions to this will be discussed later when fixed storage costs and a convenience yield are considered. For the present, it is assumed that all storage costs are variable.

later, uncertain price, he would sell the product at the current cash price. This action in conjunction with those of other traders with similar desires would cause a decrease in C_1^*. Since no direct reasons would exist for this to cause a decrease in F_1, it would be possible for the basis to be restored to the equilibrium.

If, however, a holder of the commodity felt that prices in the cash market were likely to rise by an amount equal to or greater than storage costs, he would be willing to hold the product without hedging. With the acceptance of this alternative, a trader could assure himself of a gain relative to a cash storage position by selling on the current cash market and buying a futures contract. As a relative gain is entailed, an absolute loss would be possible. Hypothetical data to illustrate this point are presented in Table 4.

Table 4 illustrates gains from T_1 to T_2 under two different selling strategies.[15] Abstracting from the table, the gains from cash storage were \$-0.01 during the period of rising prices and \$-0.08 during the period of falling prices. Initially selling the cash commodity and converting to a position in the futures market would have resulted in gains of \$0.01 and \$-0.06, respectively, on these transactions. Therefore, no matter the direction of price trends, a position in the futures market would have resulted in a net gain of \$0.02 relative to that available from cash storage. This relative gain would be equal to the difference between C_1^* and F_1 (\$1.30 - \$1.28).

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[15]Total proceeds are not shown as no consideration was given to the cost, previously entailed, of acquiring the inventory of the product. It might be instructive to note that hedged storage would have resulted in a loss of \$0.02 (\$1.28 - \$1.30), which would have been assured at T_1.

Table 4.--A hypothetical example illustrating a relative gain from the selling of the cash commodity, and the purchasing of a futures, when F_1 is less than C_1*

4a - Hypothetical prices

Time	Period of rising prices		Period of falling prices	
	Cash prices	Futures prices	Cash prices	Futures prices
T_1[a]	C_1 = $1.25	F_1 = $1.28	C_1 = $1.25	F_1 = $1.28
T_2[b]	C_2 = $1.29	F_2 = $1.29	C_2 = $1.22	F_2 = $1.22

4b - Gains from cash storage[c]

Period	Final cash value →	Less initial value →	Less storage =	Net proceeds from storage
Rising prices	C_2 = $1.29	C_1 = $1.25	$0.05	$-0.01
Falling prices	C_2 = $1.22	C_1 = $1.25	$0.05	$-0.08

4c - Gains from the purchase of futures[d]

Period	Selling price of the futures →	Less buying price of the futures =	Net proceeds from the futures transaction[e]
Rising prices	F_2 = $1.29	F_1 = $1.28	$ 0.01
Falling prices	F_2 = $1.22	F_1 = $1.28	$-0.06

[a]Storage costs are assumed to be $0.05, therefore C_1* equals $1.30 (i.e., $1.25 + 0.05 = $1.30).

[b]It is assumed that at T_2, which is contract maturity, the basis is zero so that $F_2 = C_2$.

[c]Gains are computed by subtracting storage costs from price changes in the cash market, i.e., the final cash value less the initial value. Total proceeds from the handling of the product would depend upon the cost of obtaining the initial holdings, which has not been depicted.

[d]Utilizing these transactions, one would initially sell his inventory of the product and purchase a futures contract for an equivalent amount. Later an offsetting futures contract would be sold or delivery accepted. Total proceeds would depend upon the amount at which the cash commodity was sold in relation to the cost of obtaining it.

[e]This ignores commission charges and interest on the margin.

The data for a period of falling prices depicts that an absolute loss is possible; however, as pointed out previously, this method would be undertaken only if one felt that cash prices would rise sufficiently to warrant storage. The use of this arbitrage procedure would act to raise the futures price and lower the cash price, thereby aiding in restoring the expected basis.

Blau has depicted arbitrage transactions similar to those shown in the previous text. She concluded that arbitrage would always be effective in preventing F_1 from rising above C_1^*, but not always effective in eliminating the converse. Limitations were the element of speculation involved and the amount of the initial quantities of cash stocks held by arbitragers, i.e., this method would not be possible if one did not possess an inventory of the product.[16]

The point is that anyone who initially holds unhedged cash stocks when F_1 is less than C_1^* would be expected to transact in such a matter as to restore the basis. No matter one's expectations as to price trends, his optimum action would be to sell the cash product. Doing nothing, i.e., continuing to hold stocks, would incur a greater chance of loss than arbitrage. The existence of F_1 less than C_1^* might then be construed as a signal to sell on the cash market, and, if favorably disposed towards storage, to buy futures instead. In any event, actions are suggested which would aid in restoring the expected basis.

Just as the existence of F_1 less than C_1^* is a "signal" to sell unhedged quantities of the cash product, it also indicates the profitability of selling amounts previously stored with hedging utilized. This price relationship provides a more opportune time to terminate the storage period than by holding until contract maturity. (Table 5.)

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[16]Blau, "Some Aspects of the Theory of Futures Trading," p. 7.

Table 5.--A hypothetical example illustrating a profit obtained by offsetting a storage hedge when F_1 falls below C_1^*

	Period of rising prices		Period of falling prices	
	Cash market	Futures market	Cash market	Futures market
T_0[a]	Buy at $1.25	Sell at $1.32	Buy at $1.25	Sell at $1.32
T_1[b]	Sell at $1.27	Buy at $1.30	Sell at $1.22	Buy at $1.25
Gain in each market	$0.02	$0.02	$-0.03	$0.07
Storage costs T_0 to T_1	$-0.02	- 0 -	$-0.02	- 0 -
Net gain in each market	- 0 -	$0.02	$-0.05	$0.07
Total gain[c]	$0.02		$0.02	

[a]T_0 is assumed to be some time previous to the present, T_1; storage costs are assumed to be $0.07 so that C_1^* equals $1.32.

[b]At T_1, it is assumed that storage costs are $0.05, but the actual basis is only $0.03; therefore, F_1 is less than C_1^*.

[c]It might be instructive to note that if one had initially entered the storage position with an indicated profit, e.g., if a futures could have been sold for $1.33 instead of $1.32, that this profit of $0.01 would have been obtained as well as the one on the offsetting transactions.

In Table 5, it is assumed that a trader initially entered a storage position with only a normal return indicated, i.e., F_0 ($1.32) exactly covered C_0^* ($1.25 + 0.07 = $1.32). By delivering the product against the futures contract, he would be assured that all costs would just be met. If before the maturity of the contract, the futures price would fall below the cash price plus storage, a profit equal to this difference ($C_1^* - F_1$) could be obtained if the storage position were liquidated. The gain arises from being able to purchase a futures contract at a value relatively lower than the equivalent cash figure (C_1^*). The transactions necessary to reap this profit, i.e., selling cash and buying futures, would cause the futures price to rise and the cash price to decline. It could be expected that traders would continue these transactions until no further gains were possible, i.e., F_1 equalling C_1^*. The only theoretical limitations would be the amount of hedged quantities in existence.

If conditions were made even more restrictive by assuming that no unhedged quantities exist and further that none were hedged in the futures for which the basis is less than expected, it still would not necessarily follow that arbitrage would be precluded and that the futures price would exist indefinitely at a lower value than expected. For by admitting the existence of more than one futures contract, it would follow that those contracts utilized for hedging would have to presently meet or exceed their expected bases. To state otherwise would be to maintain that traders would not respond to those gains which were depicted in Table 5. Thus, an arbitrager could sell the futures meeting its basis and buy the one which would be priced low in comparison to its expected value. The buying of the low priced futures would cause it to increase relative to the cash price; thus when the proper basis were obtained, the arbitrager could reap his gain (again equal to C_1^* minus F_1) by offsetting his previous futures transactions.

To be certain of gains, a trader would initially only sell a futures contract if it had a maturity date beyond that of the contract he would intend to purchase. The reason for this is that, at contract maturity, one could expect the futures and cash prices to be equal;[17] if not, one could

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[17]Arbitrage, at contract maturity, would involve certain and immediate gains no matter the inequality. This will be covered in more detail when live

accept delivery on the futures contract and then sell the cash commodity if the cash price were above the futures price. This would eliminate the possibility of incurring a loss on the offsetting of the futures initially purchased. Then the only way in which a loss could occur on the offsetting of the futures initially sold would be if the actual basis were to exceed the expected, i.e., the futures price would be greater than the cash price plus storage costs. It could be assumed that arbitrage would eliminate this possibility. An example of an arbitrage between two futures contracts is given in Table 6.

Table 6.--A hypothetical example illustrating arbitrage between two different futures contracts when one (Futures A) has F_1^* less then C_1

	Price trends					
	Period of rising prices			Period of falling prices		
	Cash market	Futures market: Futures A	Futures market: Futures B	Cash market	Futures market: Futures A	Futures market: Futures B
T_1[a]	$1.25	buy at $1.28	sell at $1.35	$1.25	buy at $1.28	sell at $1.35
T_2	1.28	sell at 1.28	buy at 1.33	1.22	sell at 1.22	buy at 1.27
Gain per contract	--	-0-	+0.02	--	-0.06	+0.08
Total gain	$+0.02			$+0.02		

[a]A maturity date of T_3 is assumed for Futures B as it has the later delivery date. Assumed storage costs are:

T_1 to T_2: $0.05

T_1 to T_3: 0.10

T_2 to T_3: 0.05

In Table 6, Futures A did not meet its expected basis as F_1 (\$1.28) was less than C_1^* (\$1.30). Since Futures B met its basis as well as having a later maturity date, it would be sold while Futures A would be purchased. At maturity date of Futures A, offsetting transactions would be made resulting in a gain (\$0.02) equal to the difference between C_1^* and F_1 for Futures A.

Normally, it would be expected that arbitrage would be effective in restoring the basis before contract maturity. The stipulation that one sell a futures contract with a later maturity than the one he is purchasing tends to eliminate the possibility that the indicated gain would not be received.

If conditions were such that previously depicted arbitrage transactions could not be utilized, then it might be that processors would transact in such a manner as to help restore the basis. If they presently were to have a known future need for the commodity, and were concerned about a price increase, they would have two options: (1) to buy the commodity and store it or (2) buy a futures contract calling for acceptance of delivery at some future date.[18] Under conditions of F_1 less than C_1^*, alternative (2) would provide the lower procurement cost. Of course, the purchasing of futures contracts would cause F_1 to rise relative to C_1^*.

A theory for an inverse carrying charge (futures price below the cash price) has been developed by Working.[19] The basic premise is that the supply of storage is directly related to the price and is forthcoming even at a negative return. That is, some traders undertake storage for other than a

[18]Normally an offsetting futures would be sold as the delivered grade might not meet processor specifications. This would still establish a procurement cost lower than the initial cash cost plus storage fees.

[19]Holbrook Working, "Theory of the Inverse Carrying Charge in Futures Markets," Journal of Farm Economics, XXX (February, 1948), pp. 18-23.

monetary return, being willing to hedge even when a loss would be assured.

One class of individuals who might be willing to do this would consist of those who have fixed storage costs, e.g., storage facilities. Economic theory states that, in the short run, one can engage in an activity as long as the variable costs are covered. This would involve a smaller loss than discontinuing operations and absorbing the fixed costs. As applied to storage, one might be willing to hedge at a loss if it were less than the fixed costs. This, however, would set a lower limit to the amount by which F_1 could fall below C_1^*. In all cases, however, F_1 would have to exceed C_1 (the actual cash price); if not, some variable storage costs as well as the cost of the commodity would not be covered.

Working's contention is that one would carry stocks (sometimes hedged) in amount equal to necessary working stocks.[20] That is, one would hold inventories considered essential to the smooth operation of the business. This, first of all, would suggest a business engaged in processing. If this were the case, hedging storage for future usage would result in the effective procurement cost to the processor exceeding the cash cost at that time by the difference between C_1^* and F_1 (Table 7).

As shown in the table, the procurement cost of the commodity, under either rising prices or falling prices, exceeded the cash price at T_2 by the initial difference between C_1^* (\$1.30) and F_1 (\$1.28). Under conditions of rising prices, a trader would have ultimately paid \$1.29 for the product (acquisition cost plus storage less profit on futures transaction) when he could have purchased it on the cash market for \$1.27 at T_2. Clearly, the use of a storage hedge (when F_1 is less than C_1^*) for stocks being held for a later processing would be rational only if one desired physical possession of

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[20] Ibid., pp. 21-2.

the product at the present and desired that his buying price reflect a cash price in the future. If both of these conditions were not met, one could be better off economically by either storing the cash product unhedged, by purchasing a futures contract, or by buying the cash product as needed.

Table 7.--A hypothetical example illustrating the effective procurement cost if a commodity is bought and stored hedged for later processing when F_1 is initially less than C_1^*

	Price trends			
	Period of rising cash prices		Period of falling cash prices	
	Cash market	Futures market	Cash market	Futures markets
T_1[a]	Buy at $1.25	Sell at $1.28	Buy at $1.25	Sell at $1.28
T_2	$1.27	Buy at $1.27	$1.22	Buy at $1.22
Gain in each market	N/A	$0.01	N/A	$0.06
Effective procurement price[b]	$1.25 + 0.05 - 0.01 = $1.29		$1.25 + 0.05 - 0.06 = $1.24	

[a]It is assumed that storage costs equal $0.05 so that C_1^* equals $1.30.

[b]This price is found by adding storage costs to and subtracting gains or losses on the futures transactions from the cost of acquiring the cash product.

Another possibility might be merchants who simply hold the product for later sale, without performing any processing. This, in essence, amounts to storage. If a merchant were desirous of maintaining a certain inventory for sale, he would be willing to conduct storage even if this would not appear profitable. Thus, one might be willing to hedge at a loss to avoid a possible greater loss. This could account for F_1 persisting below C_1^*, or even C_1, but only in the short run. It should be pointed out, however, that stocks could be made available for resale at a lower cost by purchasing a futures contract rather than through actual storage if assured storage losses from hedging were greater than fixed costs.

To recapitulate, the condition of F_1 greater than C_1^* indicates that the present price of the commodity is less than a possible value at a future date. The activities of traders to capitalize on this profitable differential would, in turn, eliminate it. On the other hand, F_1 less than C_1^* suggests that a product may be worth more at the present than at a later date. With the exception of those incurring fixed costs, the optimum action for traders in terms of immediate monetary gains would be to sell unhedged inventories and to terminate hedged storage. Strategies counter to those proposed in the preceding sentence, which would hinder the restoration of the expected basis, would be feasible only in the short-run. Thus, in the theoretical context, the equilibrium condition would be for F_1 to equal C_1^*.

In actuality, a range of values rather than a specific one for the basis might be more meaningful. The various types of arbitrage activities, transaction costs, and differing concepts of storage costs would account for this. Furthermore, arbitrage transactions might not be immediately undertaken if those in a position to do so would feel that an even more favorable basis might develop in the immediate future. Thus, at any time, there might be only a pursuit of an equilibrium, rather than an actual attainment.

With the basis at any given time expected to be equal to storage costs, the expected relationship between cash and futures prices over time would depend upon the change in storage costs. As the latter would be composed of some variable costs (e.g., the interest on capital required for ownership of the product, or the rental fees for storage space), storage costs from a point in time (T_1) to some predetermined fixed point in time (T_2) would be expected to decrease as T_1 approached T_2. Thus, one would expect the cash and futures prices to continually converge as the maturity date of the contract approaches.

The existence of any storage costs for holding a product would negate the hypothesis that, under ideal conditions, movements of the cash and futures would exactly parallel one another. This, in turn, would cast doubt as to the validity of the idea that the effectiveness of hedging, i.e., a perfect hedge, would depend upon gains in one market to be exactly offset by losses in the other.[21] If the assumption were that one hedges merely to offset gains against losses, then the above measure of effectiveness would be correct. A more realistic assumption would be that one hedges to be assured of a price or a profit margin; hedging would then be effective only if the expected price or profit margin were met or exceeded. The crux of the matter is that

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[21]See any of the following for a presentation of this idea:

Blau, "Some Aspects of the Theory of Futures Trading," pp. 7-8 and 14.

Robinson and Marousek, "Beef Cattle Futures Market," p. 3.

Charles H. Greene, Fred Olson, and Michael Turner, "Futures Trading in Beef Cattle," Western Livestock Round Up, December, 1964, p. 4.

Leland L. Johnson, "The Theory of Hedging and Speculation in Commodity Futures," The Review of Economic Studies, XXVII (June, 1960), p. 140.

The literature on hedging contains numerous examples of authors who have contended that the effectiveness of hedging is dependent upon how well the cash and futures prices parallel one another. Thus, in hypothetical examples of hedging, an equality of price movements is assumed to illustrate a perfect hedge. Although some authors have recognized that cash and futures price will converge, rather than parallel one another, the general viewpoint is that a deviation from an equality of price movements detracts from the effectiveness of hedging. For an exception to this idea, see Working, "Futures Trading and Hedging," pp. 320-1.

equal price movements (which would, in fact, contradict the existence of the expected convergence between cash and futures prices) would result in a final selling price equal to the initial cash price. If actual price movements are as expected, i.e., the futures price always equals the cash price plus storage costs, then the anticipated price or margin would be maintained. (Table 8)

Table 8.--A hypothetical comparison of the results of hedging between equal price movements and expected price convergence during a period of falling prices

	Equal movement of the futures and cash prices		Expected convergence of the futures and cash prices	
	Cash market	Futures market	Cash market	Futures market
T_0[a]	Buy at \$1.25	Sell at \$1.30	Buy at \$1.25	Sell at \$1.30
T_1[b]	Sell at \$1.22	Buy at \$1.27	Sell at \$1.22	Buy at \$1.25
Gain in each market	\$-0.03	\$0.03	\$-0.03	\$0.05
Accrued storage charges from T_0 to T_1	\$-0.02		\$-0.02	
Net gain	\$-0.02		\$0.00	

[a]At T_0, storage charges until T_2 (contract maturity) are assumed equal to \$0.05. Thus F_0 (\$1.30) equals C_0 (\$1.25 + 0.05 = \$1.30). This indicates that, if carried until maturity, the commodity could be delivered against the futures contract at a price equal to the cost of making the product available.

[b]At T_1, storage charges until T_2 are assumed to be \$0.03. The futures price at T_1 must then equal \$1.25 if F_1 is to equal $C_1{}^*$. Storage charges from T_0 to T_1 are assumed to be \$0.02.

In Table 8, a hypothetical comparison is made between two different situations of cash and futures price movements to determine a measure of a perfectly effective hedge. At T_0, it is indicated that F_0 (\$1.30) equals

C_0^* (\$1.25 + 0.05 = \$1.30), or that the future value of the commodity exactly equals the cost of making it available. If storage were carried only until T_1, than an assumed equality of price movements would have resulted in a net selling price (C_2 plus the gain on the futures contract) equal to the initial cash price (\$1.22 + 0.03 = \$1.25). This would not have covered storage costs. Clearly, these results would not have been effective from the viewpoint of the hedger. If, however, cash and futures price movements were such that F_1 were to equal C_1^* (which would be the expected relationship), then the hedged storage could be terminated with sales revenue (\$1.22 + 0.05 = \$1.27) exactly equal to all costs (acquisition price plus storage costs) of making the product available (\$1.25 + 0.02 = \$1.27). These results indicate that the expected price convergence would be perfectly effective in maintaining the result initially indicated.

Thus, the idea that the effectiveness of hedging is dependent upon an equality of price movements is both erroneous and misleading; its usage cannot be justified, even on the grounds of simplification for illustrative purposes. It would be more accurate to state that hedging would be perfectly effective if it maintained the same profit margin that could have been obtained by delivering against the contract.

The traditional concept of hedging has been primarily one of taking opposing positions in the cash and futures markets to avoid the risk of a price change during the time period involved. The previous analysis, however, has suggested that the futures market merely provides a vehicle for establishing a price at the beginning, rather than having to wait until the end of a time period. The provisions for offsetting previous futures transactions relieve one of the requirements to make or accept delivery on the contract. The net price paid or sold, when offsetting transactions are made, however, would be expected to be equal to the same price as if delivery were actually made or accepted.

Live steers

The expectation of a continuous coordination between cash and futures price movements over time for storable commodities is associated with a logical futures-cash relationship at any point in time. This relationship evolves from the ability to store the product; available gains from either storing or not storing are the primary force maintaining the relationship.

In order for concepts pertinent to storable commodities to pertain to live steers, the underlying premises must be similar. With the "storage" of live slaughter steers decidedly limited, a logical basis similar to that for storable commodities would not apply. Therefore, other procedures must be conceived if a consistent cash-futures price relationship is to be evolved.

Ehrich has hypothesized a relationship between feeder steer prices and futures prices based upon the costs of feeding.[22] His results evolved from an equilibrium equation for the cattle feeding industry which is given below.

(1) $C_2 W_s - P_f W_f - B(W_s - W_f) = 0$

where

C_2 = selling price of slaughter steers per hundredweight

P_f = price of feeder steers per hundredweight

W_s = hundredweight at which slaughter steers are sold

[22] R. L. Ehrich, "Cash-Futures Price Relationships for Live Beef Cattle," American Journal of Agricultural Economics, LI (February, 1969), pp. 26-40.

W_f = hundredweight at which feeder steers are purchased

B = total costs of feeding per hundredweight, including a normal profit.

That is, in equilibrium, total revenue ($C_2 W_s$) would equal all costs of production.

By addition and division, (1) can be rewritten as:

$$(2) \quad C_2 = \frac{P_f W_f + B(W_s - W_f)}{W_s}$$

In equilibrium, the cash selling price would equal all costs per hundredweight of finishing the animal, i.e., the breakeven price.

By subtracting P_f from both sides of the above equation (and simplifying) (2) can be changed into the following equality:

$$(3) \quad C_2 - P_f = (P_f - B)\left(\frac{W_f}{W_s} - 1\right)$$

This equation shows that the equilibrium difference between the cash selling price and feeder steer prices would be dependent upon feeding costs in relation to feeder steer prices.[23] A positive differential would be expected if feeding costs per hundredweight were greater than feeder steer prices, i.e., if B were greater than P_f.

By replacing C_2 with C_1 (the current cash price for steers), Ehrich used the equations to explain an observed relationship between slaughter steer and feeder steer prices.[24] That is, the current cash price would equal the breakeven price or the difference between slaughter steer and feeder

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[23]Ehrich (p. 31) derived the following equation in place of (3): $C_2 - P_f = (C_2 - B)\left(1 - \frac{W_s}{W_f}\right)$. This still shows that the price differential is dependent upon feeding costs; only in this equation, it is in relation to the cash selling price.

[24]Ibid., pp. 29-31.

steer prices at any one time would be a function of feeding costs. The explanation was based on the assumption that the current cash price (C_1) represented producers' expectations as to the cash price in the future.

By using similar reasoning, F_1, which would represent a forward selling price, was used to replace C_2. Equilibrium conditions would then call for F_1 to equal the breakeven price. For the concept to apply, however, a condition differing from that hypothesized must suggest transactions which would eliminate the discrepancy.

If F_1 were to exceed the breakeven price, an above normal profit would be indicated. Cattle feeders would react to this by selling futures and, possibly, intensifying competition for feeder cattle. This would act to restore prices to the hypothesized basis.

However, if F_1 were below the breakeven price, an adjustment might not be readily made. For those incurring no fixed costs of feeding[25], a more optimum action at this time would be to buy futures rather than feed cattle. This would help to restore the basis. For those incurring fixed costs, however, this might not be true. For in the short run, a producer would be better off by continuing his operation, as long as he could cover variable costs, rather than ceasing production. Thus, he might still purchase feeder steers and sell futures which would further aggravate the price relationship. More logically, a feeder might be perfectly willing to continue his operations without benefit of hedging. This would not aid in restoration of the basis.

Other arbitrage activities which were possible for storable commodities, e.g., terminating a hedged operation and arbitrage between futures contracts,

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[25]For example, one who buys cattle and places them in a custom operated feedlot.

would not apply. Thus, it would be possible to conclude that the futures price could remain below the breakeven price for an extended period of time with no movement towards equality. Data from the simulated feeding program indicated that 152 of the 247 lots had initial futures prices below the associated breakeven price (which furthermore did not include a normal profit).

Ehrich's hypothesis that, in equilibrium, the futures price will equal the breakeven price (or that the futures-feeder steer price relationship is determined by feeding costs) is based on the premise that selling revenue must equal all production costs. This concept, however, applies only in the long-run when firm adjustments are feasible. The application of long-run equilibrium conditions to futures contracts which are traded for only a short period (actively about 12 months) might be somewhat tenuous.

In any event, this mechanism does not give rise to an explanation of any relationship between F_1 and C_1. This would be necessary if one desired to hedge in a contract whose delivery date did not correspond to that of the termination of the feeding period.

As no hypothesis for a consistent explanation of a live cattle cash-futures price relationship is currently available, one might reason that as the two prices call for different delivery dates, prices will differ as present supply and demand conditions differ from some estimate of future conditions. The expected basis could then be expressed as follows:

$$E\ (F_1 - C_1) = ??$$ [26]

In other words, a theoretically determinable basis does not exist. With this in mind, one of three different price relationships could exist at any

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[26]In the future, this will be termed an indeterminate basis. Futrell and Skadberg, "The Futures Market in Live Beef Cattle," p. 6, reached a similar conclusion.

one time: $F_1 > C_1$, $F_1 = C_1$, and $F_1 < C_1$. None of these situations could be considered a disequilibrium as none of these would suggest transactions which would allow a trader certain gains, or even a base for calculating the probability of any gain.

The basis for live steers would not always be indeterminate for at a futures contract maturity (T_2) when both markets call for immediate delivery, arbitrage would be possible as time differences would no longer be involved. The expected basis becomes:

$$E\ (F_2 - C_2) = 0.$$

Any basis differing from the above equation would be a disequilibrium in that actions by informed traders would cause a restoration of the expected basis. If F_2 were greater than C_2 one could secure a gain by selling a futures contract and then buying the cash commodity to fulfill the contract. These actions would restore equality since buying is done in the lower priced market and the selling in the higher priced market. If the converse (F_2 less than C_2) were true, one would buy a futures contract, then accept delivery, and sell the product on the cash market. Again equality would tend to be restored.

On the actual market, it could not be expected that F_2 would always equal C_2. Some empirical data are available to indicate how well the theoretical has been realized. By using the cash and futures prices recorded for each simulated feeding operation, the average basis at the end of the feeding period was found to be \$-0.44, i.e., the futures prices averaged 44 cents lower than the cash prices on transactions closed out. As the operations were continuous on a weekly basis, not all futures prices for the end of the feeding period corresponded to a maturity date, e.g., if finished cattle were sold on August 23, 1969, an October, 1969 futures would have been used for hedging. Thus, on August 23, the basis used was composed of a current cash price and a futures price calling for delivery approximately two months later. By using only the recorded bases for dates approximating contract maturity date (and only one figure per futures contract), the average basis at T_2 was reduced to $-.22. The two averages do suggest a tendency towards price equality as the maturity date of the futures contract approaches.

With the conclusion that the cash-futures price relationship is indeterminate except at T_2, expected price movements between two points in time could not be evolved unless T_2 were one of the periods. Under these circumstances, there would be a net convergence between the two prices. Movements between any two points in time, in which the latter were not a delivery date, would be indeterminate. As a result, any generalizations as to relative price movements for live steers, particularily those arising from futures markets for storable commodities, could not be substantiated by theoretical considerations.

An observation of charted cash and futures prices indicates some tendency for both to move in the same direction.[27] However, an extended exception was noted from August, 1969 until December, 1969 when the futures market generally advanced while cash prices declined. The point is that there is no assurance that cash and futures prices in the future will move in the same direction as there is no reason to expect any particular cash-futures price relationship except at contract maturity.

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[27]A discussion of hedging in other than a futures contract with a maturity date corresponding to the end of the feeding period is given in Appendix 2. This is based on the premise that prices will bear some consistent relationship to one another. It is, however, speculation, in that there is no assurance that this will happen.

CHAPTER IV

HEDGING LIVE STEERS

Concepts

Previously it was indicated that a consideration of hedging as a means of offsetting gains or losses from cash price changes was a misleading concept. This would also apply to live steer futures. The general condition at T_1, that F_1 does not equal C_1 (F_1 equal to C_1 must be considered a special case), means that prices must converge to meet the expected equality of C_2 and F_2. This inequality of movement, in turn, results in price gains or losses in one market greater than the corresponding losses or gains in the other. Table 9 depicts this inequality of movement. Clearly the data indicate that hedging, in the expectation of offsetting cash price changes, would be ineffective as in only 30 of the 247 lots did price changes approach equality. Gains or losses of more than $1.00 occurred over one half of the time, i.e., for 138 lots.

Table 9.--Amount by which price movements in one market (cash or futures) exceeded those in the other for the 247 feeding periods

Amount of inequality of price movements	Number of lots
$0.00 - 0.25	30
0.26 - 0.50	32
0.51 - 1.00	47
1.01 - 1.50	45
1.51 - 2.00	37
More than 2.00	56
Total	247

If, however, hedging be considered as a technique for establishing a selling price in advance, these inequalities of price movements become meaningful. For they allow the hedged selling price[28] to equal the initial futures price. Hedging whenever F_1 is greater than C_1 results in a positive price gain although not necessarily a profit; i.e., one would be selling his output at T_2 for a price greater than that prevailing at T_1. (Table 10.)

Table 10.--A hypothetical example illustrating hedging results for live steers when F_1 is greater than C_1

	Period of rising prices		Period of falling prices	
	Cash market	Futures market	Cash market	Futures market
T_1	$25.00	sell at $26.00	$25.00	sell at $26.00
T_2	sell at $28.00	buy at $28.00	sell at $23.00	buy at $23.00
Price gain in each market	$ 3.00	$-2.00	$-2.00	$3.00
Hedged selling price	$28.00 - $2.00 = $26.00		$23.00 + $3.00 = $26.00	

Table 10 shows that, despite the inequalities of price changes, the hedged selling price ($26.00) would be expected to equal F_1 ($26.00) under either rising or falling price trends. Hedging would have been perfectly effective as it would have given the same results obtainable by delivering against the futures contract.

Hedging whenever F_1 is less than C_1 would again result in the expected hedged selling price equalling F_1. As this price would be lower than C_1, price losses would exceed gains.[29] This is depicted in Table 11.

[28]The hedged selling price is determined by adding the results of the futures transactions to the price at which the product is sold in the cash market. In the hedging sequences considered, this is the sum of $C_2 + (F_1 - F_2)$.

[29]A price loss or gain is to be interpreted as a comparison between the hedged selling price and C_1. It should not be construed as a profit or loss.

Table 11.--A hypothetical example illustrating hedging results for live steers when F_1 is less than C_1

	Period of rising prices		Period of falling prices	
	Cash market	Futures market	Cash market	Futures market
T_1	$25.00	sell at $24.00	$25.00	sell at $24.00
T_2	sell at $28.00	buy at $28.00	sell at $22.00	buy at $22.00
Price gain in each market	$ 3.00	$-4.00	$-3.00	$2.00
Hedged selling price	$28.00 - $4.00 = $24.00		$22.00 + $2.00 = $24.00	

Tables 10 and 11 illustrate a point which merits consideration when making a hedging decision. That is, hedging whenever F_1 is greater than C_1 will result in a higher selling price unless cash prices rise above F_1. Likewise hedging whenever F_1 is less than C_1 will have a detrimental effect on sales revenue unless cash prices fall below F_1. Thus one cannot generalize by stating that one should hedge in advance of a cash price decline; the magnitude of the change, as well as the direction, must be considered.

The futures-cash price criteria for hedging

It was then hypothesized that a selective hedge based on the futures-cash price relationship, i.e., hedging only if F_1 were greater than C_1, would be more effective than the other selling methods previously discussed in selecting the higher selling price. If so, this method would give the highest average profit per steer. The test of this hypothesis, termed the futures-cash method, is shown in Table 12, along with data from the other methods discussed in Chapter II.

Table 12.--Simulated data obtained on profits from the alternative selling methods, 247 lots

Selling method	Average profit per head	Variance of profits	Number of lots which returned negative profits
Routinely hedged	$-0.56	$184.33	138
Unhedged	7.29	555.73	89
Futures-breakeven method[a]	7.14	359.91	63
Futures-cash method[a]	9.63	434.21	66

[a]Lots were assumed to be produced unhedged if the criteria for hedging were not met.

The objective of the futures-cash method was to decide between hedging or not hedging, depending upon which would give the higher selling price. The existence of the highest average profit per head indicated that, over time, this method, i.e., the futures-cash method, was the most successful of the four listed. More specifically, this procedure resulted in the selection of the higher price 57 of the 86 times when F_1 was greater than C_1 (i.e., hedging was the more profitable alternative). When F_1 was less than C_1, not hedging gave the higher selling price 134 times out of 161.

In comparison to the breakeven method, the futures-cash method emphasized expected selling prices, while the former concentrated on production costs. If the current cash price and the breakeven price bore the same relationship to the futures price, i.e., both C_1 and the breakeven price were greater or lesser than F_1, then both methods would suggest the same action. For the futures-cash method to be more effective, it would have to have given the higher average profit when the two methods suggested a different hedging decision. That this was true is indicated in Table 13.

Table 13.--A comparison of average simulated profits for those lots for which the two selected methods suggested different hedging decisions

Price relationships	Number of lots of cattle	Average profit per steer	
		Futures-breakeven method	Futures-cash method
$C_1 > F_1 >$ Breakeven price[a]	30	\$ 8.42	\$28.00
Breakeven price $> F_1 > C_1$[b]	21	\$-4.27	\$-2.88

[a]Under this pricing relationship, the futures-breakeven method would suggest hedging while the futures-cash method would suggest the opposite.

[b]Under this pricing relationship, the futures-breakeven method would suggest not hedging; the futures-cash method, the opposite.

Table 13 illustrates that for 30 lots, the breakeven price was below F_1; however, C_1 was above F_1. Based on the futures-breakeven criteria, one would have hedged; however the use of the futures-cash method would have resulted in no hedging. The latter method, with an average profit per steer nearly \$20.00 higher than the other, was obviously the more effective in making the correct hedging decision. For the 21 lots for which the breakeven price was greater than F_1, while C_1 was less than F_1, the decision to hedge (which the futures-cash method suggested) resulted in a somewhat lower average loss per steer. Clearly, the futures-cash method was the more effective of the two in selecting the higher selling price over time.

Hedging and risk

A reason often advanced for hedging is that it provides one with the opportunity to reduce risks or to shift them to others.[30] A problem associated with risks, however, lies in the meaning as several interpretations are available.[31] For the purpose of this paper, a concept of risks is developed below.

The basic idea of a risk is considered to be the possibility of incurring a loss. If two or more alternative strategies exist, then the possibility of a relative loss arises, i.e., one method has a smaller profit or greater loss. Risk is thus expanded to include the possibility of relative as well as absolute losses.

If the decision to feed cattle has been made, the risk of an absolute loss has been incurred. With hedging possible, two different risks of relative losses come into being. They are (1) hedging which creates the risk that not hedging would entail greater profits or smaller losses and (2) not hedging which incurs the risk that losses could have been reduced or profits increased by hedging. Clearly both procedures could involve absolute losses or gains; however, one method would have a gain relative to the other.

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[30] Johnson, "The Theory of Hedging and Speculation in Commodity Futures," pp. 140-2.

Greene, et.al., "Futures Trading in Beef Cattle," p. 4.

Futrell and Skadberg, "The Futures Market in Live Beef Cattle," p. 1.

[31] Jerome L. Stein, "The Simultaneous Determination of Spot and Futures Prices," American Economic Review, LI (December, 1961), p. 1014. The author lists the following measures of risk: (1) the probability of loss, (2) the expected value of a loss, or (3) the failure to receive an expected return. The last measure is considered to be synonymous with the variance of the expected return.

The idea of risk reduction at the initiation of a feeding operation might be largely subjective, depending upon one's expectations and willingness to accept one risk in preference to another. The concept of risk developed above, however, provides a means to determine risk reduction among the various selling procedures on an ex post basis. For if one method minimized absolute losses while not minimizing relative gains, then it could be said to have reduced risks. Thus, one selling method (A) would have reduced risks relative to another (B) over time if (1) summed losses for (A) were equal to or smaller than losses for (B) while the sum of all profits for (A) were greater than profits for (B) or (2) (A) had smaller total losses with total profits equal to or greater than (B). Demonstrating the reduction of risks ex post from data in Table 14 will dispel some concepts pertaining to risk, while suggesting a means of evaluating risk ex ante.

Table 14.--Data on total profits and losses for the alternative selling procedures, 247 simulated feeding operations

	Financial outcome on the feeding operations			
	Routinely hedged	Never hedged	Futures-breakeven method	Futures-cash method
Variance	$ 184.07	$ 555.73	$ 351.91	$ 434.21
Total losses[a]	1,288.12	1,432.75	900.68	899.81
Total profits[a]	1,167.83	3,232.54	2,663.89	3,279.56
Net profits	- 120.29	1,799.79	1,763.21	2,379.75

[a]Profits and losses were computed by totaling the results of each lot fed, based on whether the result of the individual transaction were a profit or a loss.

From Table 14, it can be seen that the futures-cash method involved the least risk of all methods as dollar losses were lowest and dollar profits were highest. The futures-breakeven method involved less risk than the routine hedge, but in comparison with never hedging all that can be said is that for each dollar by which losses were reduced using the former, $1.07 in profits, from using the latter would have had to be given up. Whether risks were reduced would be a subjective decision. Likewise, comparing the routine hedge with never hedging would be subjective; however, for each dollar of losses avoided by routine hedging, $14.28 of profits available from the other method would have been foregone.

Variances were included in Table 14 to show that this statistic was essentially meaningless as a measure of risk. The method which offered the least risk had the second highest variance; routine hedging which had the lowest variance could have ranked no higher than third in risk reduction. Finally, never hedging, which had the highest variance, might be considered by some as the poorest risk reduction; others might have ranked it as high as second.

When considered on the basis of an individual lot, risks were reduced by the selection of the higher selling price. This would either minimize a loss or produce the maximum gain. When a span of time involving many transactions was considered, that procedure, which consistently selected between hedging and not hedging--the one which gave the higher price, involved the least risk. For a cattle feeder concerned with risk reduction, data as to which method has been most effective in selecting the higher selling price might be more meaningful than a comparison of variances.

Over the time period studied, the futures-cash method of selective hedging appeared the most promising of all selling methods considered in the selecting of the higher selling price. As the time period considered in this study was one of generally rising prices, one might suggest that results might be changed under differing conditions. This, however, might not be necessarily so. For the adequacy of the futures-cash method depends only upon how well the futures market estimates distant cash prices, not on price trends. A strong tendency was apparent for cash prices not to vary in any given direction as much as a futures price would have suggested. In fact, when considering price changes over a 17 week period, the futures price anticipated price trends with somewhat less than 50 per cent accuracy. That is, if F_1 were greater than C_1, then C_2 were greater than C_1 only about one half of the time, and vice versa.

If the price data utilized in the simulated feeding program would be considered as a sample indicative of the future, then the following 99 per cent confidence intervals can be computed. If F_1 were greater than C_1, then F_1 would be greater than C_2 from 53 per cent to 78 per cent of the time; hedging would be expected to be the more profitable alternative. If F_1 were less than C_1, then F_1 would be less than C_2 from 78 per cent to 92 per cent of the time; not hedging would be expected to give the higher selling price.

Price relationships at contract maturity

So far, major attention has been given to the initial futures-cash price relationships with the assumption of price equality at contract maturity. Previous data indicated that this is not always true; the existence of an inequality could mean that the hedged selling price would not equal F_1.

Table 15 shows the results of different producer actions to fulfill the futures contract requirements under alternative price relationships at T_2.

Table 15.--Results of alternative producer actions with respect to the futures contracts

Price relationships at T_2	Alternative producer actions	Effect of the action on the selling price in relation to F_1
$F_2 > C_2$	Deliver on the contract	No effect
	Purchase an offsetting futures contract	Hedged selling price is less than F_1 by an amount equal to $F_2 - C_2$
$F_2 = C_2$	Deliver on the contract	No effect
	Purchase an offsetting futures contract	No effect
$F_2 < C_2$	Deliver on the contract	No effect
	Purchase an offsetting futures contract	Hedged selling price exceeds F_1 by an amount equal to $C_2 - F_2$

Under conditions of price equality at T_2 or when actual delivery would be accomplished, the selling price would equal F_1. An inequality at T_2, however, would result in a hedged selling price differing from F_1 if an offsetting futures contract purchase were made. If the inequality were C_2 greater than F_2, the hedging sequence would be recommended as the hedged selling price would be greater than F_1, i.e., the price available by making actual delivery. In the situations where F_2 would be greater than C_2, a producer might consider delivery as the hedged selling price would be less than F_1.

CHAPTER V

THE SIMULTANEOUS USAGE OF THE FUTURES MARKET AND DIRECT CASH CONTRACTING

Contracting at a price known at T_1

Hedging differs from direct cash contracting in that the former has provisions relieving one from the need to actually deliver or accept delivery of the product.[32] As a result, it becomes possible, with certain modifications, to use both direct contracting and futures contracts simultaneously.

The idea for this arose from a consideration of those simulated feeding lots which had F_1 less than C_1. Using the futures-cash method of selective hedging, a feeder would wait until T_2 to establish a selling price, i.e., by selling his production at the price, C_2. In an effort to determine if another procedure could be utilized to reduce the uncertainty as to selling price without lowering net income, the idea of direct cash contracting was introduced. As a cash contract price was needed, C_1 was arbitrarily selected as the figure. Under conditions of F_1 less than C_1, contracting at C_1 would be expected to be more profitable than hedging.

If, however, one were to contract at C_1 and then reverse the hedging sequence, i.e., initially buy a futures contract, the resulting hedged selling price[33] would exceed C_2 by an amount equal to the difference between C_1 and F_1.

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[32] It is recognized that in direct cash contracting it may be possible for one to liquidate a contract without making delivery. This, however, is not customary.

[33] The hedged selling price is again defined as the cash selling price plus the results on the futures transactions. When direct cash contracting is used, the contract price becomes the cash selling price.

(Table 16) As selling at C_2 was usually more profitable than normal hedging when F_1 was less than C_1, then it would follow that, under the same circumstances, the use of a reversed hedging sequence would be more profitable than just contracting.

Table 16.--A hypothetical example illustrating a direct cash contract with the hedging sequence reversed, F_1 less than C_1

	Period of rising cash prices		Period of falling cash prices	
	Cash market	Futures market	Cash market	Futures market
T_1	sell contract at $25.00	buy at $24.00	sell contract at $25.00	buy at $24.00
T_2	$27.00	sell at $27.00	$22.00	sell at $22.00
Gain in each market	$-2.00	$ 3.00	$ 3.00	$-2.00
Hedged selling price	$25.00 + 3.00 = $28.00		$25.00 - 2.00 = $23.00	

Under either rising or falling price trends, the type of transaction illustrated in Table 16 caused the hedged selling price to exceed C_2 by $1.00, which was the initial difference between C_1 ($25.00) and F_1 ($24.00). In essence, this procedure allows one to establish a selling price at T_1, then converting the selling price to one which is not completely determined until T_2. The initial relationship of the contract price to F_1 determines whether the hedged selling price will be above or below C_2 as use of this technique when F_1 is greater than C_1 results in a hedged selling price lower than C_2. This method (contracting and reversing the hedging sequence) was tested using simulated data to determine the effect on profits. A comparison with several alternative selling methods is given in Table 17.

As hypothesized, this method gave the highest simulated average profit ($16.66). To measure its effect on risks, total profits and losses for selected selling methods are entered in Table 18. Criteria developed in Chapter IV are utilized to measure the results.

Table 17. Simulated data obtained on profits from alternative selling methods, 247 lots

Selling method	Average profit per head	Variance of profits	Number of lots which returned negative profits
Routinely hedged	$-0.56	$184.33	138
Unhedged	7.29	555.73	89
Futures-breakeven method	7.14	359.91	63
Futures-cash method	9.63	434.21	66
Routinely contracted[a]	3.60	138.68	83
Contract-hedge method[b]	8.40	116.27	50
Contract-reverse hedge method[c]	16.66	440.77	58

[a]This method consisted of selling every lot at the contract price of C_1.

[b]This method utilized a normal hedging sequence on those lots for which F_1 exceeded C_1; otherwise the lots were sold at a contract price of C_1.

[c]Hedging was utilized when F_1 exceeded C_1; otherwise direct contracting at C_1 and a reversed hedging sequence (as illustrated in Table 16) was employed.

Table 18.--Data on total profits and losses for selected selling procedures, 247 simulated feeding operations

	Futures-cash method	Routinely contracted	Contract-hedge method	Contract-reverse hedge method
Variances	$ 434.21	$ 138.68	$ 116.27	$ 440.77
Total losses	899.81	795.68	284.93	475.56
Total profits	3,279.56	1,685.24	2,358.94	4,590.42
Net profits	2,379.75	889.56	2,074.01	4,114.86

Using the simulated data in Table 18, one can conclude that the contract-reverse hedge method reduced risks relative to the futures-cash and the routinely contracted methods as losses were smaller and profits greater. In relation to the contract-hedge method, all that can be said is that, for every dollar of losses avoided by using this method, $11.71 in profits available from the contract-reverse hedge method would be lost. Likewise, the contract-hedge method reduced risks relative to the routinely contracted method. All other comparisons could be made only on a subjective basis. The inclusion of the variances again illustrates the ineffectiveness of this statistic as a measure of risk.

The introduction of contracting, however, must consider the other party, i.e., the processors. Their basic desire would be to purchase inputs (live steers) at the lowest possible price. For the time period studied, they could have accomplished this by utilizing a buying hedge [34] whenever F_1 was less than C_1 and by buying on the cash market at T_2 whenever F_1 was greater than C_1. Thus, in the absence of contracting, processor strategies were exactly the

[34] A buying hedge consists of a purchase of a futures contract at T_1. At T_2, either delivery would be accepted or an offsetting futures sold and the cash product purchased. The hedged buying price is expected to equal F_1.

converse of producers. This would also be true if contracting were introduced. Strategies can be summarized as follows:

1. Producer - A producer would not desire to contract at any value less than F_1 as he could sell his production at a price equal to F_1 by hedging. A contract and reverse hedge would cause a selling price lower than C_2; therefore it would always be less desirable than selling on the cash market at T_2.
2. Processor - A processor would be reluctant to contract at a value greater than F_1 as he could procure the product at a price equal to F_1 by entering a buying hedge. Contracting and reversing the buying hedge, i.e., initially sell futures, would result in a procurement cost greater than C_2; a more profitable alternative would be to buy on the cash market at C_2.

From a standpoint of pricing, a contract price of F_1 would be the only one which both parties could accept. Depending upon their price expectations, they would decide between (1) either accepting the contract price or hedging and (2) either accepting the contract price and reverse hedging or transacting on the cash market at T_2.

If the situation were such that a processor were concerned with objectives other than prices alone, e.g., an assured supply from a given area, he might be willing to contract at a price above F_1 to fulfill his desires. This situation would be most opportune for a producer as he could either just accept the contract price (which would be more profitable than hedging) or both accept the contract price and reverse hedge (which would be more profitable than selling on the cash market at T_2). The decision between the two strategies would depend upon one's expectation of distant price trends. A producer would not need to avoid direct contracting if he felt that the distant cash market would be more favorable; the reverse hedge would allow him to take advantage of cash price trends.

As an indication of how a feeder could utilize the futures market and direct contracting to his advantage, simulated data were used to measure the difference between a policy of always just accepting a contract price and a more selective usage of hedging and direct contracting. To be more specific, several different levels of contract prices were used. One method was to sell each of the 247 lots at the specified contract price. The selective method consisted of either hedging or just accepting the contract price (if the contract price were greater than F_1) when F_1 was greater than C_1. If F_1 were less than C_1, the lots were produced unhedged unless the contract price was greater than F_1. In this case, the contract price was accepted and a reverse hedge was employed. Table 19 shows that the selective use of the futures market and direct cash contracting was more profitable than a policy of always contracting.

Table 19.--Simulated data to compare a policy of always contracting with a selective use of the futures market and direct contracting

Contract price	Average profit per head	
	Policy of always contracting[a]	Selective use of the futures market and direct contracting[b]
$25.00	$-9.98	$11.27
26.00	0.21	14.98
27.00	10.44	22.48
28.00	20.81	31.11
29.00	31.33	40.45
30.00	41.77	50.36

[a]For each contract price, all 247 lots were assumed to be sold at this price.

[b]Lots were hedged if F_1 were greater than C_1 and the contract price were less than F_1; the contract price was accepted if it were greater than F_1. If F_1 were less than C_1, lots were produced unhedged unless the contract price were greater than F_1. Then the contract and reverse hedge was utilized.

<u>Contracting at a price unknown until T_2</u>

Another possibility for direct cash contracting is that a producer would agree to sell his production to a processor at some price greater than the prevailing distant price. In other words, the contract is made at T_1, but the contract price will be at some specified value above C_2. The actual price is thus unknown until T_2.

This contracting situation would again represent an opportune position for a cattle feeder. The acceptance of the contract would always be more profitable than selling on the cash market at T_2. If, however, a feeder felt that the distant cash market would be unfavorable, he could hedge and still accept the contract. The hedged selling price would exceed F_1 by the amount by which the contract price was to exceed C_2. This would always be more profitable than just hedging. (Table 20)

Table 20 illustrates that hedging when the contract price is to exceed C_2 by $1.00 results in a hedged selling price ($27.00) greater than F_1 ($26.00). Through the use of hedging, the $1.00 gain over C_2 was transformed into a comparable gain over F_1.

In essence, based on theoretical considerations, direct cash contracting always presents the more profitable alternative as long as the contract price is greater than F_1 or is to be greater than C_2. The selective use of futures contracts allows one to transform a gain over one price into a gain over the other. Thus, one could always accept either form of direct cash contracting, no matter one's price expectations. Finally, both forms would be equally profitable as long as the contract price were to exceed either F_1 or C_2 by the same amount.

In actuality, deviations from the theoretical would occur if F_2 were not equal to C_2. Losses would occur if one had to buy an offsetting contract when F_2 were greater than C_2 and sell one when F_2 were less than C_2. In the latter case one could accept delivery rather than offset the earlier purchase of a futures and then sell on the cash market. In the former, delivery would be precluded, but one could buy on the cash market to fulfill the futures contract requirements. Within certain limits, these strategies could reduce losses relative to those obtained from offsetting futures transactions.

Table 20.--A hypothetical example illustrating the use of hedging and contracting when the contract price is to exceed C_2 by \$1.00, F_1 greater than C_1

	Period of rising prices		Period of falling prices	
	Cash market	Futures market	Cash market	Futures market
T_1	\$25.00	sell at \$26.00	\$25.00	sell at \$26.00
T_2	sell at \$29.00 (\$28.00)[a]	buy at \$28.00	sell at \$23.00 (\$22.00)[a]	buy at \$22.00
Gain in each market	\$ 4.00	\$-2.00	\$-2.00	\$ 4.00
Hedged selling price	\$29.00 - \$2.00 = \$27.00		\$23.00 + \$4.00 = \$27.00	

[a]The actual cash selling price exceeds the cash price at T_2 by \$1.00 as this is the amount by which the contract price is to exceed C_2.

CHAPTER VI

SUMMARY

In the most elemental form, hedging is considered as a technique of taking opposing positions in the cash and futures markets. By so doing, it has been considered possible to offset losses from price changes in one market by an equal gain in the other market as it is generally assumed that the two prices will parallel one another. Hedging is considered by many a means to remove the effects of price changes while allowing one to earn a normal return on his operation.

A preliminary analysis of hedging (using live steer futures contracts) on cattle feeding profits indicated that one could not depend upon a policy of routinely hedging to guarantee a normal return. The data revealed, however, that hedging enhanced total profits almost exclusively when losses were sustained on the cattle feeding transactions; otherwise, hedging tended to reduce overall profits. This then suggested a selective policy which could effectively determine when hedging would be profitable.

The current literature has generally proposed hedging only when a futures contract could be sold for more than the breakeven price. The simulated data indicated that this method was at least partially effective in eliminating some of the losses from cattle feeding. This was done with no appreciable loss of income in comparison to a policy of never hedging.

The assumption basic to hedging has been that the futures and cash prices will parallel each other. The discussion of futures markets for storable commodities indicated a possible relationship between the cash and futures prices based on storage costs. Gains from either storing or terminating storage are the forces tending to cause a basis equal to storage costs.

Transactions which would act counter to this would be feasible only to minimize a possibly greater loss or for a convenience yield. The fact that one can most logically expect the futures price to exceed the cash price by storage costs means that the two prices must continually converge, rather than move parallel to one another. In turn, hedging can be effective only if prices converge so that the futures price at least covers the cash price plus storage costs. This led to the conclusion that hedging is a means of establishing a price, rather than a means of offsetting price changes.

Live steers are basically a non-storable commodity. Thus, concepts arising from futures markets for storable commodities do not apply to live steers if these ideas were based on the necessity of storage. Thus, a cash-futures price relationship similar to storable commodities is not applicable to live steers. Some other technique is needed to explain any relationship.

One hypothesis is that the futures price will bear a relationship to feeder steer prices as determined by the costs of feeding. The simulated data did not substantiate this idea as the basis was generally smaller than hypothesized. Further, arbitrage transactions to eliminate this situation do not appear as well defined as those for storable commodities.

No hypothesis exists, however, which advances any explanation as to a relationship between cash and futures prices for live slaughter steers. It was then suggested that cash and futures prices will differ as present supply and demand conditions differ from an estimate of those in the future. An expected relationship between the two prices would then exist only at contract maturity. Relative price movements would be indeterminate unless the futures maturity date were involved. In this case, a net convergence of prices would be expected.

Selective hedging based on the futures-cash relationship was then proposed. Hedging when F_1 was greater than C_1 generally gave a higher selling price than selling in the cash market at T_2. When F_1 was less than C_1, however, selling on the cash market was usually more profitable than hedging.

By defining risk as including relative as well as absolute losses, a concept of risk reduction was developed. This was based on the minimizing of absolute losses without minimizing relative gains. Under this criteria, the futures-cash method involved the least risk. Risk reduction was then found to be a function of consistently selecting the higher selling price rather than providing the lower income variance.

The last phase of the study was to develop the interactions between hedging and direct cash contracting. To simplify, a contract selling price was considered rational only if it were above F_1 or to be above C_2. A reverse hedging sequence would allow one to transfer a gain over F_1 into a comparable gain over C_2. If the contract price were to be at a premium to C_2, a normal hedging sequence would transfer this gain into one above F_1. It was concluded that one should always consider accepting a contract with the price above F_1 or C_2 as the judicious use of futures contracts would allow one to benefit from expected price trends.

APPENDIX I

THE SIMULATED FEEDING PROGRAM

The following specifications in regard to pricing and actual physical production were utilized.[1]

1) Weight of the purchased feeder steers--725 lbs.

2) Average daily gain--3 lbs. (see Appendix Table 1)

3) Length of feeding period--119 days (17 weeks).

4) Finished weight--1,084 lbs.

5) Final weight market shrinkage--3.1 per cent.

6) Selling weight of the finished steers--1,050 lbs.

7) Death loss--½ per cent.

8) Ration--(see Appendix Table 3).

9) The following price series were utilized to determine the appropriate costs or revenues:

   a) Feeder steer prices--average weekly Kansas City quotation for choice 550-750 lb. feeder steers.

   b) Finished steer prices--average weekly Kansas City quotation for choice 900-1,100 lb slaughter steers.

   c) Price series used for costing inputs:
   silage--constant at $8.00 per ton,
   grain sorghum--prices received by Kansas farmers,
   soybean meal--prices paid by Kansas farmers, and
   non-feed costs--index of prices paid by farmers (for) commodities and services, interest, taxes, and wage rates. All price series were taken from the U.S.D.A. publication, Agricultural Prices, and were interpolated to provide weekly data.

   d) Prices of futures contracts--figured as the weekly average of the daily closing prices based on quotations from the Chicago Mercantile Exchange. A discount of one dollar was used to compensate for locational differences between Kansas City and Chicago markets.

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[1]Data on the average daily gain, shrink, death loss, ration and silage price were suggested by Dr. Philip Farr, Department of Animal Science and Industries, Kansas State University.

Costs of feeding: First the nutrient requirements for the specified gain were determined for several different weight ranges (Appendix Table 1); then, based upon the composition of the various feeds, rations were balanced for each weight level (Appendix Tables 2 and 3). Weekly feed consumption was then multiplied by the appropriate prices to determine costs.

Non-feed costs were determined from an earlier published bulletin (Appendix Table 4). Adjustments were made to compensate for differing time on feed (between the original feeding operation and the simulated feeding program), and for inflationary trends since the date of the study. The latter was accomplished through the use of weekly price indices.

Death loss was assumed to be ½ per cent of all animals fed. To place this on a per steer figure, the acquisition cost of each steer was adjusted upward by ½ per cent. Production costs (feed and non-feed costs) per steer were then increased by ¼ per cent as it was assumed that deaths were so distributed that, on the average, one half of total production costs per steer that died would have been lost. The addition of the adjusted production costs and feeder steer costs gave the total costs. Profits from cattle feeding were computed by subtracting total costs from total revenue (selling weight multiplied by selling price).

The futures contract used for hedging purposes was the "near month" contract, i.e., that contract which had a maturity date following closest to the end of the feeding period. Contracts for the months of February, April, June, August, October, and December were used in the study. It was further assumed that each steer were "fully hedged" as the final sale of a 1,050 lb. steer was offset by the purchase of a futures contract equivalent to 1,050 lbs. of live steer. Profits on the futures transactions were found by subtracting the buying price (futures price at the end of the feeding period) from the

Appendix Table 1.--Feed requirements[a]

Weight (pounds)	Average daily gain	Daily feed (90% dry matter)	Digestible protein	Digestible energy
	(Pounds)	(Pounds)	(Pounds)	(Kilocalories)
700 - 800	3.1	21.0	1.6	30,102
800 - 900	3.2	23.0	1.8	33,805
900 - 1000	3.0	25.0	1.8	35,275
1000 - 1100	2.8	25.8	1.9	36,430
Overall average	3.0			

[a]Adapted from: National Academy of Sciences - National Research Council, "Nutrient Requirements of Beef Cattle," Publication 1137, (Washington, D.C.: National Academy of Sciences - National Research Council, 1963), p. 2. These requirements were adapted for those of finishing yearling cattle. The requirements were based on an average weight for the range. The average daily gains per weight range yielded an average daily gain of 3 pounds over the weight range of 725 to 1084 pounds.

Appendix Table 2.--Feed composition per pound of feed[a]

	Dry matter	Digestible protein	Digestible energy
	(Percent)	(Percent)	(Kilocalories)
Sorghum, milo, grain	89	8.6	1,420
Soybean, meal, solvent	89	43.1	1,560
Corn dent silage	29	1.5	401

[a]Reproduced from: National Academy of Sciences, National Research Council, "Nutrient Requirements of Beef Cattle," pp. 22-23.

Appendix Table 3.--Daily ration at various weight levels

Type of feed	Daily feed (lb.) As fed	90% dry	Digestible protein (pounds)	Digestible energy (kilocalories)
Ration for 725-800 lb. steer, 3.1 lb./day gain				
Requirements	--	21.0	1.6	30,102
Grain sorghum	18.5	18.5	1.59	26,270
Soybean meal	1.0	1.0	.43	1,560
Corn silage	6.2	2.0	.09	2,488
Totals	25.7	21.5	2.11	30,318
Ration for 801-900 lb. steer, 3.2 lb./day gain				
Requirements	--	23.0	1.8	33,805
Grain sorghum	21.0	21.0	1.81	29,820
Soybean meal	1.0	1.0	.43	1,560
Corn silage	6.2	2.0	.09	2,488
Totals	28.2	24.0	2.33	33,868
Ration for 901-1000 lb. steer, 3.0 lb./day gain				
Requirements	--	25.0	1.8	35,275
Grain sorghum	23.0	23.0	1.98	32,660
Soybean meal	1.0	1.0	.43	1,560
Corn silage	3.1	1.0	.05	1,244
Totals	27.1	25.0	2.46	35,464
Ration for 1001-1084 lb. steer, 2.8 lb./day gain				
Requirements	--	25.8	1.9	36,430
Grain sorghum	23.7	23.7	2.04	33,654
Soybean meal	1.0	1.0	.43	1,560
Corn silage	3.1	1.0	.05	1,244
Totals	27.8	25.7	2.52	36,458

Appendix Table 4.--Adjusted annual nonfeed costs for a 2,500 head commercial feedlot[a]

Fixed costs:		
Depreciation	$ 9,296	
Maintenance and repair	1,118	
Taxes	978	
Interest	3,662	
Insurance	827	
Management and office	7,674	
Total fixed costs	$23,555	
Variable costs:		
Veterinary	$ 2,551	
Insecticide	845	
Dues, fees and subscriptions	220	
Trucking (other than cattle)	4,206	
Equipment-maintenance & repair	3,619	
Electricity	2,002	
Fuel	3,532	
Taxes on cattle	7,438	
Interest on cattle	26,775	
Insurance on cattle	3,749	
Insurance on feedlot	326	
Hired labor	18,207	
Total variable costs	$73,470	
Buying, selling and trucking cattle costs:		
Buying cattle	$ 4,459	
Selling cattle	1,850	
Trucking cattle	34,023	
Total	$40,332	
Total all costs:	$137,357	
Cost per head		$17.97

[a]John H. McCoy and Calvin C. Hausman, "Economies of Scale in Commercial Cattle Feedlots of Kansas - An Analysis of Nonfeed Costs," Agricultural Experiment Station, Kansas State University, Technical Bulletin 151, April, 1967, pp. 45 and 47. Data were adjusted to allow for a slightly faster turnover rate than in the original study.

selling price (the initial futures price), then multiplying this difference by 10.5 (for cwts. transacted), and finally subtracting the hedging costs (see Appendix Table 5). The addition of futures profits to cattle profits gave the hedged profits.

In those circumstances where a contract and a reverse hedge were employed, cattle profits were found by subtracting total costs from a revenue figure determined by pricing the selling weight at the contract price. Buying and selling prices of the futures contracts were reversed from that depicted above; otherwise the determination of futures profits was the same.

Appendix Table 5.--Hedging costs

	Commission	Margin	Interest on margin (6%)	Total cost	Cost per head[a]
25,000 pound contract[b]	$25.00	$500.00	$ 9.78	$34.78	$1.46
40,000 pound contract	36.00	550.00	10.76	46.76	1.23

[a]Based on an average weight of 1,050 lbs. per steer.

[b]Prior to the August, 1969 contract, par futures contracts called for the delivery of 25,000 lbs. of liveweight steers, choice grade. Beginning with the August, 1969 contract, delivery requirements were for 40,000 lbs. of liveweight steers, choice grade.

APPENDIX II

HEDGING USING OTHER THAN A NEAR MONTH FUTURES

In the body of the text, all discussion about hedging centered on the near month futures, i.e., the futures contract whose maturity date followed the closest after the termination of the feeding operations. As contract maturity is the only time at which a determinate basis exists, hedging in other than the near month futures does not give determinate results.

An observation of charted cash and futures prices reveals that the futures prices for any one contract usually bore the same relationship to the cash prices throughout the span of time that it was traded. That is, if a futures price was initially above the cash price; subsequent futures prices tended to remain so until contract maturity. Occasionally, prices for a futures contract changed from a position above to a position below the cash price, and vice versa. This situation was more common as the maturity date of the contract approached.

If one proceeds on the assumption that cash and futures prices will bear some predictable relationship to one another, it becomes possible to specify a range of values that the hedged selling price could attain. Appendix Table 6 presents some hypothetical data on possible cash-future price relationships when F_1 is assumed greater than C_1.

If a near month futures were used, it could be expected that the hedged selling price would equal F_1. Under the assumption that the terminating transactions are made at other than a cash-future price equality, Appendix Table 6 shows how the hedged selling price differs from F_1 under alternative relative price movements. If the prices converge and then diverge, i.e., cross, then the hedged selling price (\$27.00) would exceed F_1 (\$26.00).

An equality of movements would result in a hedged selling price ($25.00) equal to C_1 while a divergence would cause the hedged selling price to fall below F_1. In essence, hedging under these circumstances is most favorable if prices converge or cross; the most unfavorable results occur if prices diverge. If the prices for the various futures contracts being traded are similar, then the near month futures contract would normally be the most desirable as its convergence is somewhat assured.

Appendix Table 6.--A hypothetical example illustrating possible results of hedging under various assumptions of cash-futures price trends, F_1 greater than C_1

	Cash market	Futures market		
		Futures and cash prices "cross"	Futures and cash prices move at equal rates	Futures and cash prices diverge
T_1	$25.00	sell at $26.00	sell at $26.00	sell at $26.00
End of feeding period	sell at $26.00	buy at $25.00	buy at $27.00	buy at $28.00
Gain in each market	$ 1.00	$1.00	$-1.00	$-2.00
Hedged selling price	N/A	$26.00 + $1.00 = $27.00	$26.00 - 1.00 = $25.00	$26.00 - 2.00 = $24.00

If the initial conditions are that F_1 is less than C_1, then the conclusions are different. Hypothetical data to illustrate this are given in Appendix Table 7.

Under conditions of equal price movements, the hedged selling price ($25.00) again equals C_1 ($25.00). However, if prices diverge, hedging is benefited as the hedged selling price ($27.00) exceeds F_1 ($24.00). The more the divergence, the more hedging is enhanced. On the other hand, if prices cross, then the hedged selling price ($23.00) falls below F_1. Thus when F_1 is below C_1, the further the two prices remain apart, the higher is the hedged selling price. If all futures contracts being traded when F_1 is less than C_1 have similar prices, hedging in other than the near month futures might be more profitable as a convergence might be avoided.

If one assumes that past relationships between the cash and futures prices indicate a tendency for relative price movements to be somewhat predictable, one might be willing to hedge in other than a near month futures. This might be particularily true if F_1 is below C_1 as a divergence is the most profitable possibility. Hedging on this basis, however, amounts to speculation as there is no assurance as to what relative price movements in the future will be.

Appendix Table 7.--A hypothetical example illustrating possible results of hedging under various assumptions of cash-futures price trends, F_1 less than C_1

		Futures market		
	Cash market	Futures and cash prices "cross"	Futures and cash prices move at equal rates	Futures and cash prices diverge
T_1	$25.00	sell at $24.00	sell at $24.00	sell at $24.00
End of feeding period	sell at $26.00	buy at $27.00	buy at $25.00	buy at $23.00
Gain in each market	$ 1.00	$-3.00	$-1.00	$1.00
Hedged selling price	N/A	$26.00 - 3.00 = $23.00	$26.00 - 1.00 = $25.00	$26.00 + 1.00 = $27.00

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THE USE OF LIVE STEER FUTURES CONTRACTS AND THEIR EFFECT ON CATTLE FEEDING PROFITS

by

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Hedging, as developed from futures markets for storable commodities, has been considered as a technique of taking opposing positions in the cash and futures markets. The expected result from doing this has been considered by many to be a removal of the effects of price changes on income. The initiation of futures trading in live steer contracts provided a means for hedging cattle feeding operations. Previous experience from other futures markets led some to the contention that hedging would act to eliminate the income problems arising from price changes.

A preliminary analysis of the effects of hedging on cattle feeding profits indicated that routinely hedging would not guarantee a normal return. The data revealed, however, that hedging generally enhanced total profits when losses were sustained on the cattle feeding transactions; otherwise it tended to reduce overall profits. This suggested the use of a selective policy which could determine when hedging would be profitable.

A selective system currently proposed has been to hedge only if a futures contract could be sold for more than the breakeven price. The test of this method indicated that it was at least partially effective in eliminating some of the losses from cattle feeding without an appreciable loss of income in comparison to a policy of never hedging.

The assumption basic to hedging has been that the futures and cash prices will parallel each other. For storable commodities, arbitrage transactions would appear to account for a relationship between the cash and futures prices based on storage costs. This type of relationship indicates, however, that the two prices must continually converge over time rather than parallel each other, as storage costs could be expected to decrease with a shortening in the storage period. In turn, hedging can be effective only if prices converge so that the futures price at least covers the cash price plus storage costs.

Live steers are basically a non-storable commodity so that a similar cash-futures price relationship would not apply. An alternate hypothesis suggested is that the futures price will bear a relationship to feeder steer prices as determined by the costs of feeding. The simulated data did not substantiate this idea as the basis was generally smaller than hypothesized. Further, arbitrage transactions to eliminate this situation do not appear as well defined as those for storable commodities.

It was then suggested that, for live steer futures, no specific cash-futures price relationship would exist except at contract maturity. As a result, relative price movements would be indeterminate unless the futures maturity date were involved. In this case, a net convergence of prices would be expected.

Selective hedging based on the futures-cash relationship was then proposed. Hedging when the futures price at the start of a feeding period (F_1) was greater than the cash price of slaughter steers at the same time (C_1) generally gave a higher selling price than selling in the cash market at the termination of the feeding period. When F_1 was less than C_1, however, selling on the cash market was usually more profitable than hedging.

By defining risk as including relative as well as absolute losses, a concept of risk reduction was developed. This was based on the minimizing of absolute losses without minimizing relative gains. Under this criteria, the futures-cash method involved the least risk. Risk reduction was then found to be a function of consistently selecting the higher selling price rather than providing the lower income variance.

The last phase of the study was to develop the interactions between hedging and direct cash contracting. To simplify, a contract selling price was considered rational only if it were above F_1 or to be above the cash price of slaughter steers at the end of the feeding period (C_2). A reverse hedging sequence would allow one to transfer an initial contract price gain over F_1 into a comparable gain over C_2. If the contract price were to be at a premium to C_2, a normal hedging sequence would transfer this gain into one above F_1. It was concluded that one could always consider accepting a contract with the price above F_1 or C_2 as the judicious use of futures contracts would allow one to benefit from expected price trends.