

An Introduction to Cattle Feeding Spreads

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INTRODUCTION

Through the use of various combinations of CME Group derivative products, market participants have the ability to simulate the financial aspects of several real world product transformations as they seek to hedge price risks or profit from pricing opportunities. This simulation of a real world product transformation or manufacturing process by entering into multiple futures positions is frequently called a “crush” trade.

The “crush” expression is taken from the soybean processing term for buying soybeans, crushing them and selling the resulting soymeal and soyoil. In the soybean crush, a raw material input (soybeans) is processed into output products (soybean meal and oil). A similar process exists in cattle feeding, though it differs in that multiple inputs are transformed into a single output. Specifically, feedlot operators buy feeder calves and feed to start the process then, after a period of time, sell finished cattle ready for slaughter. Thus, the cattle crush involves buying Feeder Cattle futures and Corn futures, and selling Live Cattle futures.

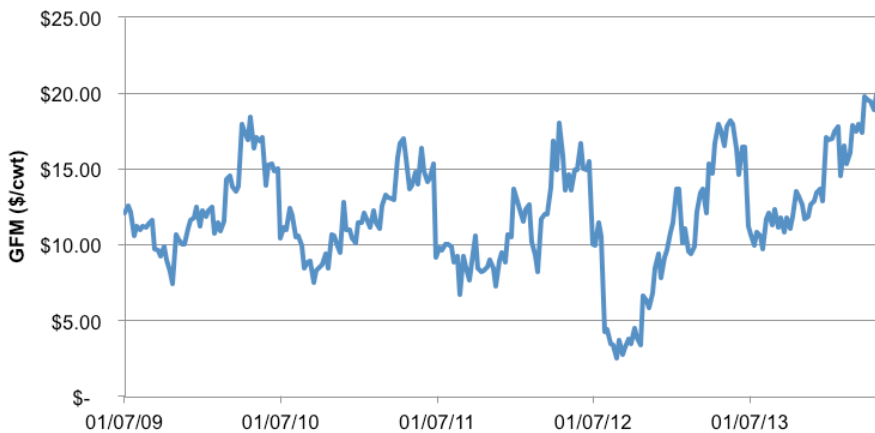
This article will discuss the concept and profitability of the beef cattle feeding process in the context of what is commonly known as the cattle feeding spread. The cattle feeding spread or “cattle crush” models the economics of the feedlot operation and provides a way to estimate profitability and manage margin risk. Additionally, the cattle crush offers profit opportunities for traders seeking returns from spread trades.

Cattle Production and the Gross Feeding Margin

A feedlot will typically purchase 650-850 pound calves and sufficient feed to grow the animals into 1200-1400 pound cattle. This process takes place over four to six months, depending on the weight at which calves are purchased, and each animal consumes between one and a half to two tons of feed. Using a combination of Feeder Cattle, Corn and Live Cattle futures contracts, a trader can put on positions that will simulate the feeding process in many respects. Although soybean meal is also used in cattle feed rations, it is only a very small part of the feeding ration so will not be included in this discussion. It should be understood that the time period for feeding and the rate of gain can vary due to factors such as market forces or weather conditions. Further, some expenses such as operating overhead, death losses, transportation, other ingredients added to the rations, medications and veterinarian bills are not addressed in the examples. The relationship of the local cash markets for cattle and feed to the futures markets (the basis) is also needed to calculate what the end result will be for a particular location.

The difference between the purchased inputs' value and the sold finished cattle value is known as the gross feeding margin (GFM). Figure 1 depicts the estimated GFM for cattle to be placed on feed in the month following the crush calculation for an Iowa-based feedlot since 2009. This GFM calculation uses the relevant futures contract prices plus the expected Iowa basis for each

Figure 1 - Expected Gross Feeding Margin (per hundred-weight of fed cattle) for Iowa Feedlots for Cattle Placed on Feed in the Following Month. Source: Iowa State University.



commodity to generate cash market prices. The GFM represents returns per hundred-weight of live cattle above the costs of feeder cattle and corn. As can be seen, there is a high degree of movement in the feeding margin which motivates feedlot operators to seek ways to hedge the financial aspects of their operations. The futures cattle crush trade can provide a vehicle for price risk management.

Constructing the Cattle Crush

A cattle crush trade that represents the cattle feeding process consists of a purchase of Feeder Cattle futures and Corn futures, combined with a sale of Live Cattle futures. Different numbers of each contract are necessary to balance the crush properly. Because a Feeder Cattle contract covers about 66 animals (50,000 pounds per contract divided by an average 750 pound feeder calf) and a Live Cattle contract only covers about 32 animals (40,000 pounds per contract divided by an average 1250 pound steer), the number of Live Cattle contracts sold must be double the number of Feeder Cattle contracts bought.

For example, if a cattle feeder plans to purchase 66 feeder animals, each weighing 750 pounds in the cash market, the price risk of this transaction can be managed by buying one Feeder Cattle futures contract. This will result in slight over-hedging as the total weight of the purchased animals is 49,500 pounds, less than the 50,000 pounds covered in one Feeder Cattle futures contract. Similarly, the price risk of the final sale of these 66 animals (assuming no death loss) as finished cattle can be managed by selling two Live Cattle futures contracts. Selling two Live Cattle futures contracts will slightly under-hedge this production scenario by two animals (two Live Cattle futures contracts covers 64 steers weighing 1,250 pound animals, less than the 66 steers hedged in the Feeder Cattle contract).

The final component to consider when constructing a cattle crush spread trade is the number of Corn futures contracts to trade. In general, six pounds of feed will produce one pound of weight gain in a feedlot steer¹ and most commercial feedlot rations consist of 60% to 85% corn. Continuing the example of placing 66 feeder

animals in a feedlot, if the total pen weight gain is 33,000 pounds (1,250 pound finished weight less 750 placement weight times 66 animals) it will take 198,000 pounds of feed (33,000 pounds of weight gain times the 6 pound feed-to-gain ratio) to achieve the total pen weight gain. If we assume a 75% corn ration for this example, then the cattle feeder will need 148,500 pounds of corn (2,651 bushels) to achieve this weight gain. The price risk of feeding this corn can be managed by buying one Corn futures contract of 5,000 bushels. However, for this production system, that will result in over-hedging the needed corn input by approximately 2,348 bushels (hedging 89% more corn than will be fed). Alternatively, the cattle feeder could hedge the corn price risk by buying three, 1,000 bushel Mini-sized Corn futures contracts which would over-hedge cash corn purchases by only 348 bushels.

The above example illustrates that, depending on the production parameters of a given cattle feeding operation, a 2-1-1 (Live Cattle-Feeder Cattle-Corn) cattle crush may over- and under-hedge each of the commodities. Commercial cattle feeders can compensate for this by using different hedge ratios which may more closely follow specific production parameters. For example, an 8-4-2 crush would hedge approximately 266 animals that are placed at 750 pounds, marketed at 1250 pounds, and fed a total of 10,678 bushels of corn. This ratio over-hedges cash feeder cattle by 0.3% and under-hedges cash fed cattle and corn by 3.8% and 6.4%, respectively. Similarly, a 10-5-3 crush would over-hedge 333 feeder cattle by 0.1%, under hedge fed cattle by 4% and over hedge corn by 12% (see Table 3 in the Appendix for details on these calculations). The exact number of contracts to trade in the crush will depend on the production system of an individual feedlot as well as the risk preferences of those managing the hedges.

While commercial hedgers should determine the number of contracts to trade based on feedlot characteristics, speculators trading the cattle crush may use different criteria. Knowing the relationship of quantities hedged using various spread combinations allows the speculator to assess risk sources and manage them accordingly. For example, a speculator entering a 2-1-1 cattle crush

1. This feed-to-gain conversion rate is highly variable across individual animals and is easily influenced by factors such as weather, stress, feed quality, and feed additives.

may realize this combination of futures contracts creates more risk from corn price movements than is likely to exist in feeding physical cattle. The speculator may be willing to accept this risk or may choose to mitigate it by increasing the number of Live Cattle or Feeder Cattle contracts in the crush. Increasing the number of cattle contracts to a 4-2-1 crush would spread the corn price risk across the equivalent of two, 65 head “pens” of cattle.

The proportion of feeder cattle, live cattle, and corn over- or under-hedged using a 4-2-1 crush would be the same as that of an 8-4-2 crush. The advantage of using a 4-2-1 crush, for the speculator, would be a reduction in risk and a possible reduction in performance bond requirements. Thus, with slight spread modifications like those shown above, speculators can trade the cattle crush in such a way that it fits their trading system and risk preferences.

Choosing Contract Months

While the number of contracts to be traded in the cattle crush is critical, equally important in the arrangement of the contract months to be traded. The Feeder Cattle contract that is purchased should be four to six months earlier than the Live Cattle contract that is sold; this represents the amount of time required to feed an animal to slaughter weight. When hedging or speculating the

cattle crush, the contract month for Corn typically falls between the Feeder Cattle and Live Cattle contract months. This is done to represent the average cost of corn for the duration of the feeding period.

When hedges or speculative position are set up this way, the Feeder Cattle contract will expire first. Since Feeder Cattle futures contracts are cash settled, there is no delivery for them. If the entire spread combination is offset by the time the chosen Feeder Cattle futures expire, delivery of Corn or Live Cattle futures will not be a concern. However, feedlot operators might keep the Corn and Live Cattle positions open to provide hedges against any ongoing feed purchases and the final sales of the finished cattle. Some possible Feeder Cattle/Corn/Live Cattle spread trade combinations are shown in Table 1.

To assess the value of the spread, traders total the values of the Corn and Feeder Cattle inputs and subtract that figure from the value of the Live Cattle. For example, with November feeders at \$160 per hundred pounds (cwt), one contract of 50,000 pounds is worth \$80,000. A single contract (5,000 bushels) of December Corn at \$4.20 per bushel is worth \$21,000. The total of these inputs is \$101,000. Two futures contracts of Live Cattle are 80,000 pounds and at a price for April of \$130 per hundred pounds (cwt) are worth \$104,000. At the values

Table 1 - Possible Contract Months for Cattle Crush Spread Trades

Feeder Cattle	Corn	Live Cattle		Feeder Cattle	Corn	Live Cattle
January	March	June		August	December	December
March	May	August		September	December	February
April	May	August		October	December	February
May	May	October		November	December	April

noted in the example, the cattle crush or GFM has a positive value of \$3,000 and can also be expressed as a positive value of \$3.75 per cwt of live cattle (\$3,000 divided by 800 cwt) or \$6 per cwt of feeder cattle (\$3,000 divided by 500 cwt).

As an example, assume that in July a feedlot operator plans for cattle to begin feeding in November. If the

prices noted previously are trading in July, the spread is profitable. To hedge the risk that the margin may turn unfavorable by November, a cattle crush trade is put on. In November, the operator will purchase feeder cattle in the cash market. As that process unfolds, the feeder side of the hedge will be offset and, as the corn component is purchased, so will the corn hedge. If by November feeder prices have risen, the operator will realize a gain in the

value of the long futures position. Similarly, if corn prices rise, a profit on the long futures position will result. The gains from the futures positions for the inputs will be used to offset the increased cost in the cash market. If the short position in Live Cattle futures is kept in place until April, it will protect the operator from any decline in prices for finished cattle.

The combined futures positions of Corn and Feeder Cattle with an opposite position in Live Cattle can receive a reduction in the level of performance bonds required compared to the levels required for the outright positions.

Forward and Reverse Cattle Crush Trades

Of course, speculators also can benefit from these cattle crush trades. Traders who want to use these spreads to feed cattle “on paper” can put on a forward crush. Other traders may prefer to use a contrarian strategy by using a reverse cattle crush when they believe price relationships differ from historical levels. These reverse spreads involve taking opposite futures positions to those that a livestock feeder would use. For example, a reverse crush trader may sell one Corn contract and one Feeder Contract each, coupled with buying two Live Cattle contracts.

Those who trade a forward cattle crush try to put on the trade for as much value as they can and attempt to buy it back for less. Using the example for November feeders noted above, the forward crush trader hopes that the crush value of \$3,000 will decrease so that the trade can be unwound at a profit. If Live Cattle futures prices decrease to \$125 per cwt with Feeder Cattle and Corn prices staying unchanged, the value of the two Live Cattle contracts will fall to \$100,000 while the value of the inputs stays at \$101,000. The new crush value is now -\$1,000 and the profit is \$4,000 (\$3,000 beginning value minus -\$1,000 ending value). Alternatively, the prices for Corn futures or Feeder Cattle futures could rise with Live Cattle prices unchanged and that would also decrease the

crush value. Reverse crush traders attempt the opposite and seek to buy the crush value at a low level and then sell it at a higher level.

The average crush value from 2009 until October 2013 was \$11.98/cwt. As seen in Figure 1, extreme high and low values of the crush often exist only for short periods of time. If a speculative trader sees what is believed to be an abnormally high value of the crush (say, \$25/cwt), he or she may believe the spread value will decrease in the near future. To profit from this by trading the cattle crush, the trader would enter a forward crush by selling two Live Cattle futures contracts and buying one Corn and one Feeder Cattle futures contract. In so doing, the trader is positioned to take advantage of falling live cattle prices relative to corn and feeder cattle prices. The trader could also benefit from rising live cattle prices, providing corn and feeder cattle increase more rapidly than live cattle prices do.

To illustrate this further, suppose it is January and live cattle prices are \$125/cwt, feeders are \$150/cwt, and corn is \$4.00/bushel. The value of a 2-1-1 cattle crush (two Live Cattle contracts, one Feeder Cattle contract, and one Corn contract) is \$2,500 (or \$3.13/cwt of live cattle) at these prices. If a trader believes this crush margin will rise (cattle feeding will become more profitable or live cattle prices will increase relative to feeders and corn), the trader would enter a reverse cattle crush and buy two Live Cattle contracts while simultaneously selling one Feeder Cattle and one Corn contract.

Now suppose by June, all prices have risen. Live cattle prices increased 5% to \$131.25/cwt, feeders rose 10% to \$165/cwt, and corn prices increased 3% to \$4.64/bushel. The value of the 2-1-1 spread is now -\$675 (-\$0.84/cwt of live cattle). If a trader in January had entered a forward crush (selling Live Cattle futures and buying Corn and Feeder Cattle), the trader would have

experienced a profit of \$3,175 (\$3.97/cwt of live cattle) upon exiting the trade in June. Conversely, a trader entering a reverse crush (buying Live Cattle and selling

Corn and Feeder Cattle) would have experienced a loss of -\$3,175 (-\$3.97/cwt of live cattle). This example is shown in Table 2.

Table 2 - Profitability of Forward and Reverse Crush Trades under Rising Prices Example

	LC	FC	C
January Prices*	\$ 125.00	\$ 150.00	\$ 4.50
Quantity	400 cwt	500 cwt	5,000 bushels
Value/contract	\$ 50,000.00	\$ 75,000.00	\$ 22,500.00
2-1-1 Spread Value	\$ 2,500.00		
Spread/cwt of LC	\$3.13		

June Prices*	\$ 131.25	\$ 165.00	\$ 4.64
Quantity	400 cwt	500 cwt	5,000 bushels
Value/contract	\$ 52,500.00	\$ 82,500.00	\$ 23,175.00
2-1-1 Spread Value	\$ (675.00)		
Spread/cwt of LC	\$ (0.84)		

Gain/Loss from Forward Crush (sell LC, buy FC and C)

	LC	FC	C
Gain/Crush "Leg"	\$ (5,000.00)	\$ 7,500.00	\$ 675.00
Total Spread	\$ 3,175.00		
Spread/cwt of LC	\$ 3.97		

Gain/Loss from Reverse Crush (buy LC, sell FC and C)

	LC	FC	C
Gain/Crush "Leg"	\$ 5,000.00	\$ (7,500.00)	\$ (675.00)
Total Spread	\$ (3,175.00)		
Spread/cwt LC	\$ (3.97)		

* Prices for Live Cattle and Feeder cattle are in \$/cwt. while Corn prices are in \$/bushel

Conclusion

The price interactions between commodities in the cattle crush offer opportunities to hedge price risks and profitably trade agricultural futures at reduced capital costs. There are many different ways to construct cattle crush trades (e.g. varying the ratio of contracts traded, contract months, etc.) and traders can structure them to

fit a particular trading system. The availability of all three contracts of the cattle crush (Live Cattle, Feeder Cattle and Corn futures) at CME Group enhance the efficiency and cost-effectiveness of executing the trade. For more information about the costs of trading or the design of trading strategies, contact your broker.

APPENDIX

Table 3 - Analysis of Different Hedge Ratio Construction

Futures Contact	LC	FC	C
Spread	2	1	1
Contract Size	40,000	50,000	5,000
Total Qty Hedged	80,000	50,000	5,000
	Marketed	Placed	Wt. Gain
# Animals	66	66	
Wt/Hd	1250	750	500
Total Lbs. of Cattle	82,500	49,500	33,000
Feed Conversion			6
Feed Input (lbs)			198,000
% Corn in Ration			75%
Corn Input (lbs)			148,500
Corn Input (Bu)			2,652
Contracts Needed for Hedge	LC	FC	C
# Contracts Needed	2.06	0.99	0.53
Over/Under Hedge (lbs and Bu)	(2,500)	500	2,348
Over/Under Hedge %	-3.0%	1.0%	88.6%

Futures Contact	LC	FC	C
Spread	8	4	2
Contract Size	40,000	50,000	5,000
Total Qty Hedged	320,000	200,000	10,000
	Marketed	Placed	Wt. Gain
# Animals	266	266	
Wt/Hd	1250	750	500
Total Lbs. of Cattle	332,500	199,500	133,000
Feed Conversion			6
Feed Input (lbs)			798,000
% Corn in Ration			75%
Corn Input (lbs)			598,500
Corn Input (Bu)			10,688
Contracts Needed for Hedge	LC	FC	C
# Contracts Needed	8.31	3.99	2.14
Over/Under Hedge (lbs and Bu)	(12,500)	500	(688)
Over/Under Hedge %	-3.8%	0.3%	-6.4%

APPENDIX

Table 3 continued - Analysis of Different Hedge Ratio Construction

Futures Contact	LC	FC	C
Spread	10	5	3
Contract Size	40,000	50,000	5,000
Total Qty Hedged	400,000	250,000	15,000
	Marketed	Placed	Wt. Gain
# Animals	333	333	
Wt/Hd	1250	750	500
Total Lbs. of Cattle	416,250	249,750	166,500
Feed Conversion			6
Feed Input (lbs)			999,000
% Corn in Ration			75%
Corn Input (lbs)			749,250
Corn Input (Bu)			13,379
Contracts Needed for Hedge	LC	FC	C
# Contracts Needed	10.41	5.00	2.68
Over/Under Hedge (lbs and Bu)	(16,250)	250	1,621
Over/Under Hedge %	-3.9%	0.1%	12.1%

Live Cattle and Feeder Cattle futures and options are listed with and subject to the rules and regulations of the CME.

Corn futures and options are listed with and subject to the rules and regulations of the CBOT.

Futures trading is not suitable for all investors, and involves the risk of loss. Futures are a leveraged investment, and because only a percentage of a contract's value is required to trade, it is possible to lose more than the amount of money deposited for a futures position. Therefore, traders should only use funds that they can afford to lose without affecting their lifestyles. And only a portion of those funds should be devoted to any one trade because they cannot expect to profit on every trade.

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