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FACT SHEET

Futures and Options: Graphically Speaking

Fact Sheet 718

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Futures and options contracts are valuable tools for farmers. Through their use, farmers can potentially increase the price received for their products while at the same time reducing price risk. In essence, futures and options contracts provide insurance against adverse price moves.

For example, a farmer who wants to set a price for corn production can sell a corn futures contract. If the price should fall between the time the contract is sold and the time the corn is sold locally, the farmer's insurance payment will come from profits in the futures market. These profits, when added to the lower cash value for the corn, help increase the net price. If instead prices increase, a farmer will encounter losses on the futures market. However, because the cash value is higher, the net result will be the same as if prices had stayed the same. That is, with a futures contract, a farmer is guaranteed (excluding basis risk) the same price regardless of whether prices rise or fall. (Refer to Fact Sheet 488, "Grain Marketing: The Futures Market," for more detailed information on futures contracts.)

Many farmers, however, prefer options contracts to futures contracts. (Refer to Fact Sheet 492, "Grain Marketing: Using Options.") Farmers who buy a put option have protection against falling prices, but limit the amount they can lose (i.e., the premium) in the futures market if prices increase. The net result of owning the put option is to set a price floor with the potential for higher prices if they should occur.

Other option strategies include using call options in combination with a forward contract, or utilizing a combination of put and call options simultaneously at different strike prices. There can be advantages to using these more sophisticated strategies, but there can also be hidden price risks that may not be well understood.

This fact sheet provides a guide to understanding how futures and options impact the final net price received by farmers. The net price—which is defined as the cash price plus the profit on a futures or options position—will depend on the futures price at the time the hedge

is lifted and the grain is sold in the local market. The easiest way to understand this relationship is to view it graphically. Therefore, this fact sheet utilizes a graphical framework for understanding futures and options contracts. Because futures and/or options are only one piece of a farmer's portfolio, it is important to visualize the full combination of both the cash value and the hedged (futures/options) value. Ultimately, it is the sum of these two components that farmers should be concerned about.

Cash, Futures, and Options

By taking a futures or options position, a farmer is building a financial portfolio composed of two distinct elements:

1) the cash grain that will be produced (or stored) for sale at a later date; and

2) the hedged position in a futures and/or options contract.

Profits or losses on the futures/options position get added to the value of the cash position when sold. Therefore, the portfolio price or net price can be thought of as the sum of the two. That is,

Net Price Received = Cash Price Received + Profit on Futures/Options Position.

For example, a $2 cash price, plus a 45-cent futures profit gives the same net price as a $3 cash price and a 55-cent loss on the futures contract. The net price can also be analyzed in terms of a number of factors: the basis when the cash grain is sold, the futures price when the futures or options contract is entered and, potentially, on the futures price when the cash grain is sold. If an options contract is used, the net price will also depend on the strike price of the option.

A strategy consists of a choice of futures or options positions to go along with a farmer's cash position. It is important to examine how given strategies will impact the net price. For example, the choice between using futures contracts or options contracts involves some built-in tradeoffs. The buyer of a put option is able to establish a minimum net price with the potential for a higher net price if the market moves higher. However, the minimum net price (or price floor) of an option strategy is always less than the net price from using a futures contract. This is because a futures contract, like a forward contract, guarantees a fixed price (excluding basis risk), whereas an option contract, as the name implies, gives the buyer the flexibility to take advantage of higher prices, if they should occur.

Therefore, the choice of a pricing strategy should be dictated by a number of factors, including

- willingness to accept price risk,
- cash flow to buy option premiums,
- cash flow to manage a margin account (in the case of futures contracts, or options contracts that are sold), and
- expectations about market prices in the future.

Marketing Strategies

Five different strategies utilizing futures or options contracts are demonstrated in this fact sheet. While not exhaustive of all the possibilities, these five strategies are the most widely used by farmers. The specific strategies considered are:

1) Sell a futures contract.
2) Buy a put option contract.
3) Forward contract and buy a call option.
4) Buy a put option and sell a call option.
5) Forward contract, buy a call option, and sell a call option.

To make the strategy examples definitive, assume that the decisionmaker is a corn farmer who, upon planting a crop in April, is trying to decide among the five different alternatives listed above. The farmer anticipates harvesting and selling the crop in November. Therefore, the December futures and options contracts are the relevant contracts for making forward-pricing decisions. The December futures price and the December option contract premiums the farmer observes in April are listed in Table 1.

In addition, the farmer anticipates the local basis to be 10 cents per bushel at harvest time. That is, the local cash price is expected to be 10 cents higher than the December futures price in November.

Lastly, it is assumed that once a futures or options position is initially entered (in April) it is not lifted or offset until harvest time (in November). For options, this implies that the option premium when it is sold will be worth its intrinsic value because the option expires on the third Friday of November.

As an aid for choosing between alternative strategies, a graphical visualization of price relationships can be useful. The following graphical presentations of some of the more common futures/options strategies are shown in a general setting, using notation for such things as the strike price, basis, and premium. They also include real price information from the corn market.

Sell a Futures Contract

With this strategy, the farmer sells the December futures contract at the price in April of 280 (F_0) and will buy back the contract at harvest to offset it. At the same time, in November the corn crop is sold in the cash market at the prevailing price. Between April and November, it is likely that market conditions have changed, causing the futures price to change from its April level. The left-hand graph in Figure 1 shows the profit on the futures position as a function of the futures price at harvest. Because the contract was sold at 280 (F_0), a futures price below this level at harvest will imply a profit on the futures position, whereas any price higher than 280 will produce a loss.

As for the net price (right-hand graph in Figure 1), using the futures contract guarantees the farmer a net price of F_0+b. That is, the net price is the futures price in April (F_0) plus the expected basis when the corn is sold in November (b). If the harvest time futures price is higher than F_0 at harvest, the farmer will suffer a loss on the futures position. However, the higher cash price will offset this

Table 1. December Corn Futures and Options Prices in April.

Item	Example Value (cents/bu)	Notation
December Futures Price	280	F_0
Expected Harvest Basis	10	b
280 Call Option Premium	19	S for Strike Price and π for premium
300 Call Option Premium	10	S for Strike Price and π for premium
280 Put Option Premium	19	S for Strike Price and π for premium

loss, yielding the same net price of F_0+b. If instead, the harvest time futures price is lower than F_0, the futures position will be profitable and will offset the lower cash price. Again, the net price will be F_0+b. This is very similar to a forward contract, which guarantees an exact price no matter whether prices fall or rise by harvest time.

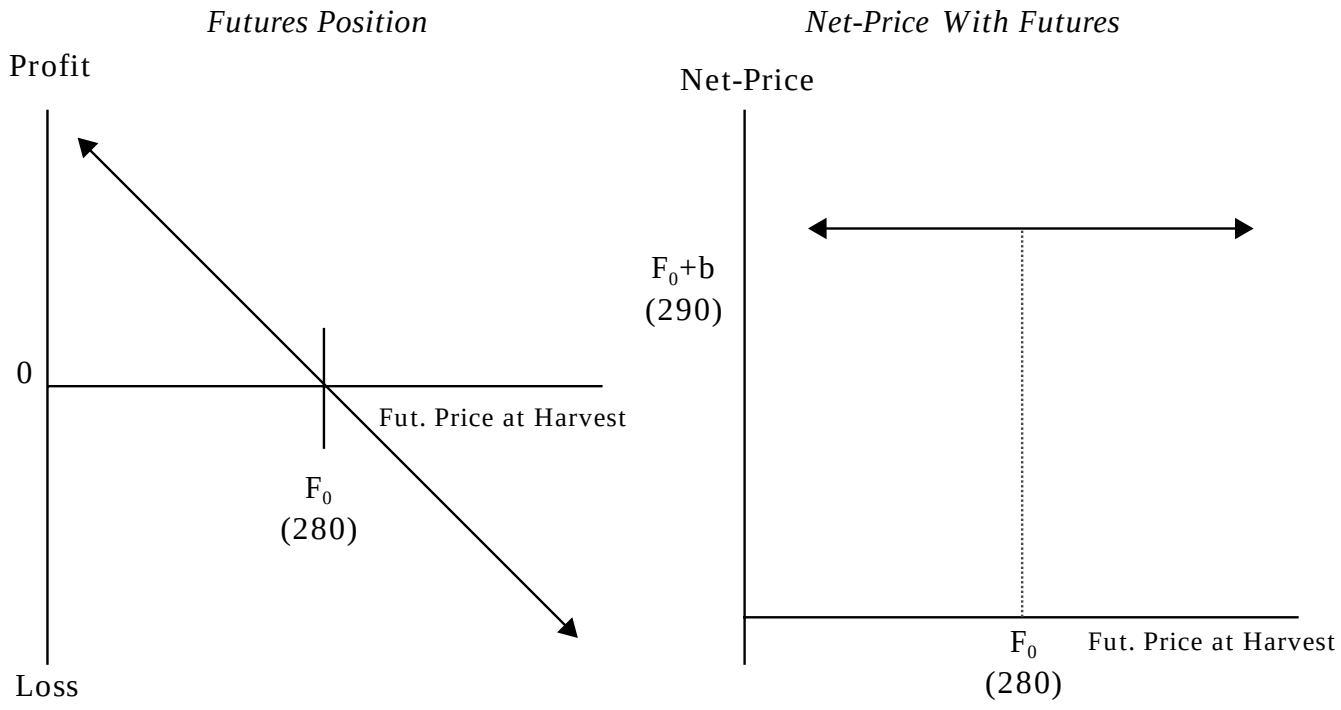
The disadvantage of using a futures contract is the farmer is liable for all losses on the futures position. In this case, if the futures price rises, the loss on the futures position must be supplemented with additional funds (that is, margin calls) to keep the position from being terminated. For this reason, many prefer to use a forward contract, which does not require funds and has the same forward-pricing ability.

Buy a Put Option

As a put option buyer, the farmer has the right to sell on the futures market anytime prior to expiration at the option strike price (indicated in the graph by S). For this right, the farmer must pay a premium (π). The profit from a put option (see left graph in Figure 2) as a function of the harvest time futures price, differs from the futures contract in several regards. First, the loss from a put option is at most the premium (π); for a futures price greater than the strike price (S), the put option will expire with no value and the buyer simply loses the premium. Second, lower futures prices increase the value of the put option, but they must fall enough to offset the premium paid by the buyer. Therefore, a put option will be profitable if the futures price is less than S-π (that is, 261).

As for the impact on the net price (see right graph in Figure 2), a put option guarantees a minimum net price (or price floor) equal to S+b-π. Notice that the price floor will be less than the net price from using a futures contract (271 vs. 290). Again, this is because the

Figure 1. Profit from Selling a Futures Contract and Net-Price.



option contract requires a premium for the opportunity to benefit from higher prices. If the harvest time futures price is higher than the option strike price, the net price is higher than the price floor and is equal to the futures price at harvest plus the basis less the premium. To be higher than what a futures contract would have guaranteed requires the futures price at harvest to be greater than the strike price plus the premium (that is, greater than 299).

Of course, by choosing a different strike price (and paying a different premium), the net price received will differ. For example, a high strike price put yields a higher price floor but, because the premium is higher, it will reduce the net price in situations when the futures price is high. Therefore, there is a trade-off between various option strike prices.

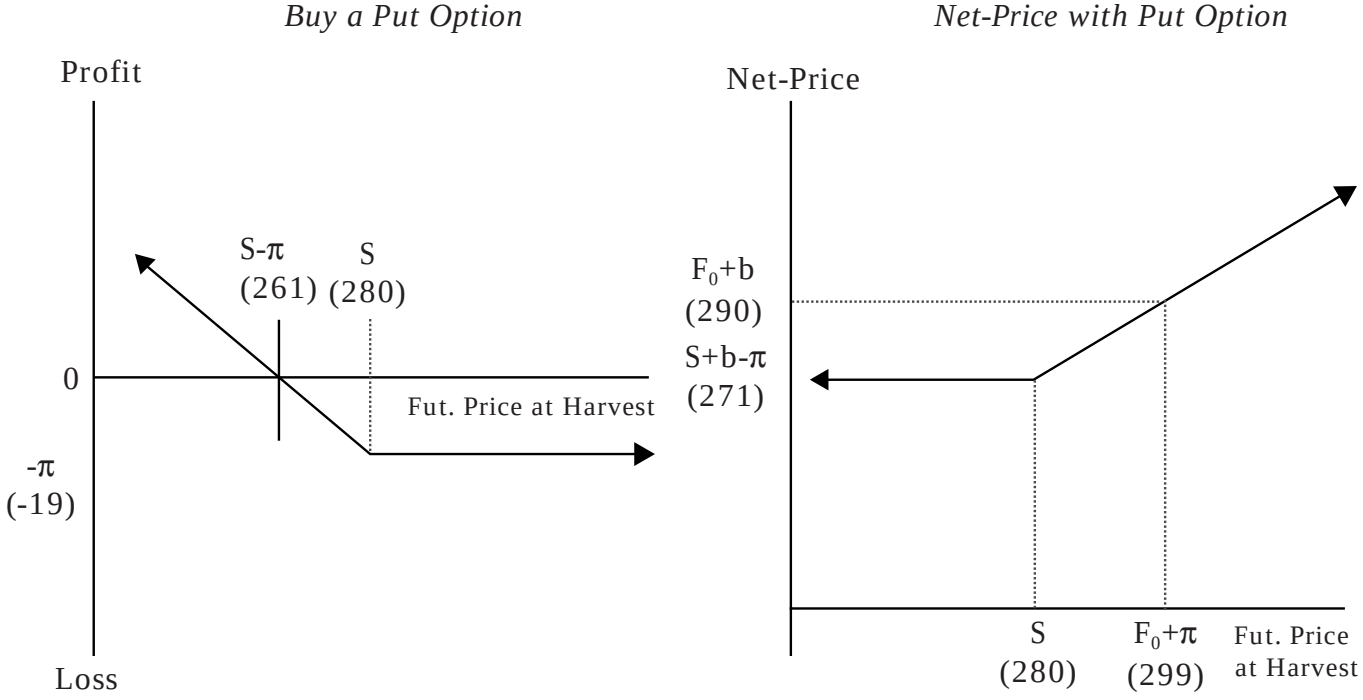
An advantage of buying a put option is that it will not require margined funds like a futures position. Upon execution, the option buyer must pay the premium and this amount is the most that can be lost.

Forward Contract and Buy a Call Option

In combination, a forward contract and call option has very similar features to buying a put option as described above. The forward contract sets an exact price for the cash market sale, so basis risk is eliminated. The call option, which gives the buyer the right to buy at the strike price, is profitable if prices rise. Therefore, the combination of the two yields a price floor with the potential for higher prices. The price floor is the forward contract price less the premium of the call option (see Figure 3).

It is assumed that the forward contract price is the current futures price plus expected basis (that is, $F_0+b=290$), which may or may not be the case. Usually, however, forward contracts for grain are

Figure 2. Profit from Buying a Put Option and Net-Price.



fairly close to this relationship, especially in Maryland.

Although this strategy eliminates basis risk because it is fixed in the forward contract, it adds an additional source of risk—production risk. Because the crop must be delivered to satisfy the forward contract, the risk exists that poor growing conditions may lead to less production than expected. With a put option, production risk is less important because no delivery is required for the option.

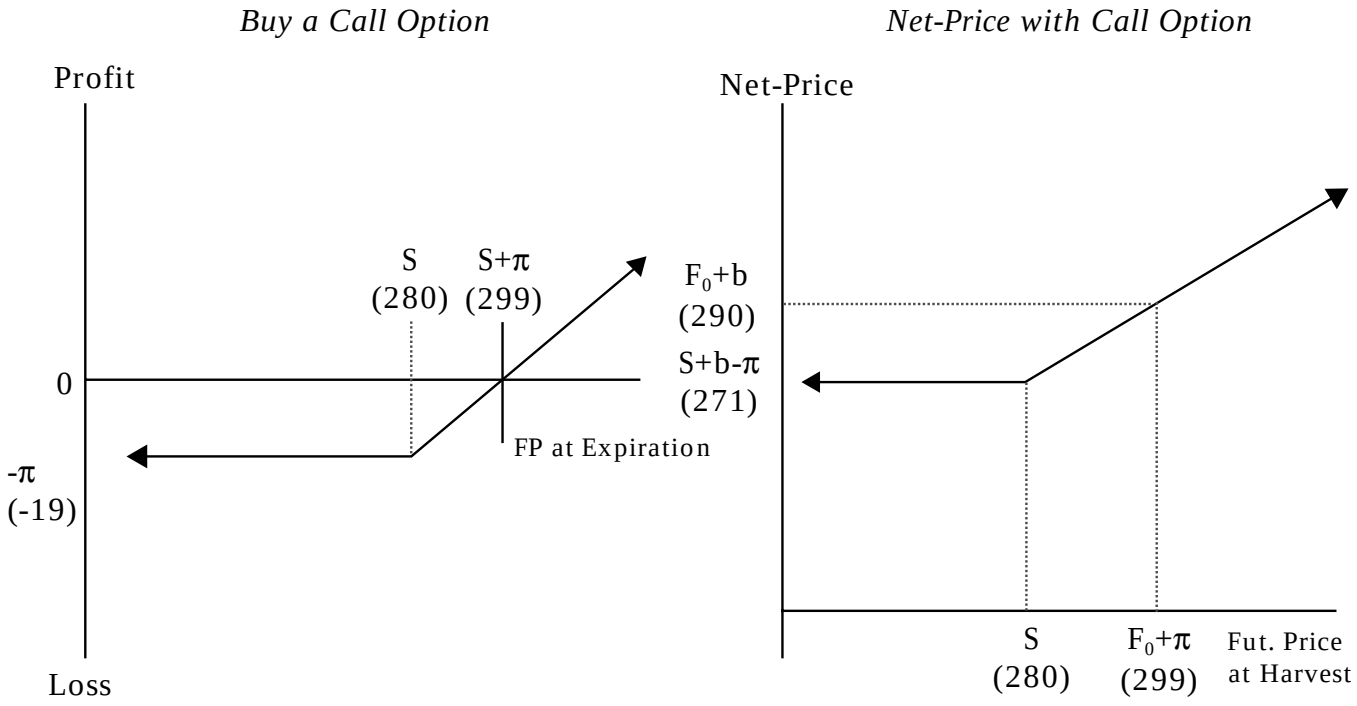
As with put options, the choice of strike price for a call option will lead to different net prices. A low strike price call option will give a higher price floor but lower upside price potential, because call options with lower strike prices have higher premiums.

Buya Put and Sell a Call

This strategy is sometimes referred to as a bear fence and involves buying a put option with an out-of-the-money strike price (that is, a strike price less than the current futures price) and selling an out-of-the-money call option (strike price higher than the futures price). Buying a put option requires paying the premium (π_p), while the sale of the call option allows the farmer to collect the premium (π_c). Because the put option strike price is less than the call option strike price, the net premium paid (π_p-π_c) will be positive.

While this analysis has demonstrated the profit from buying a call option, it has yet to consider selling a call option. The profit from selling a call option is simply the mirror image of the profit from buying a call option (Figure 3), because a gain for the call option buyer is a loss to the call option seller and vice versa. As an example, consider the 300 call option priced at 10 cents. The option seller would receive the 10-cent premium (margin funds would have to be posted on any option sale). If the futures price is less than 300 at harvest, then the call option premium would become zero and the seller would profit all of the 10 cents.

Figure 3. Forward Contract and Call Option.



If, however, the futures price exceeds the strike price, then the call option premium would not go to zero. As an example, if the futures price were 325, the option premium would be 25 cents. In this case, the seller would suffer a 15-cent loss.

Figure 4 demonstrates the simultaneous purchase of a 280 put option (at 19 cents) and sale of a 300 call option (at 10 cents). The net premium of this strategy is 9 cents and implies a price floor of 281. Selling the call option increases the price floor from simply buying the put (that is, a price floor of 271). However, the disadvantage of this strategy is that it sets a price ceiling or maximum net price from the sale of the call option. The price ceiling is the call strike price plus the basis minus the net premium. In this example, the price ceiling is 301.

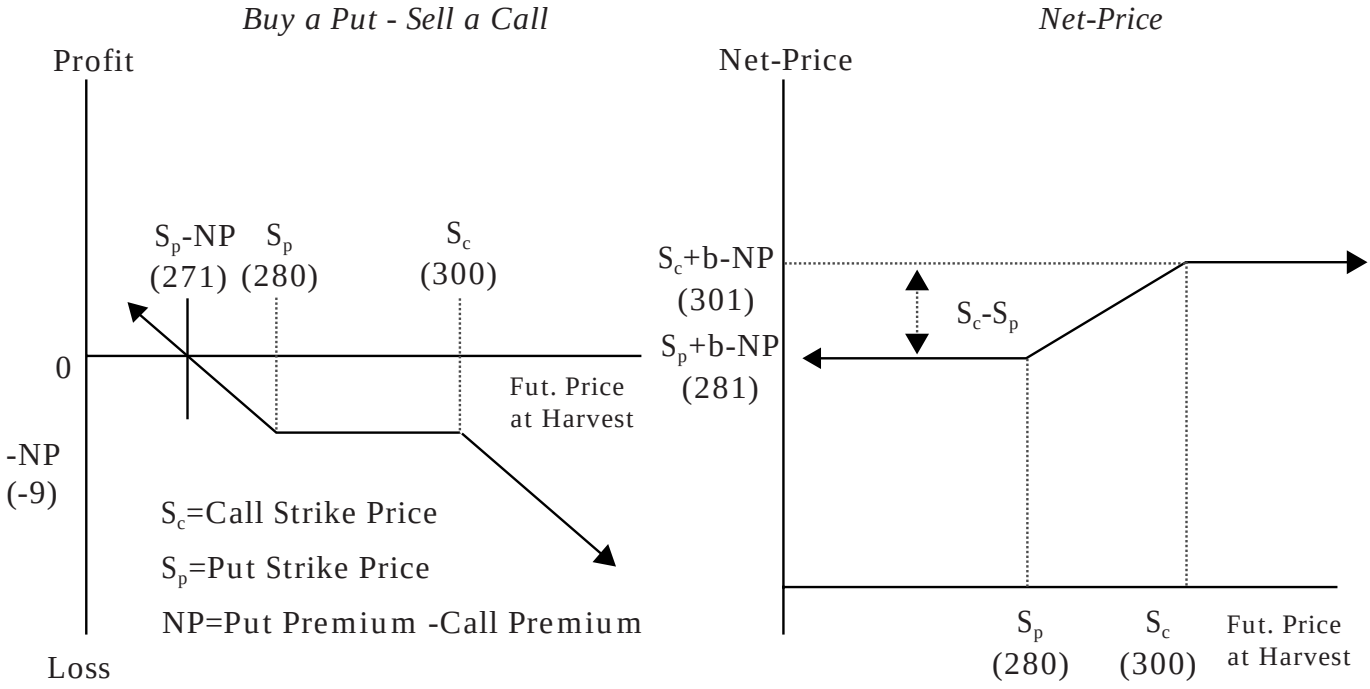
Of course, different put or call strike prices imply different price floors and ceilings. The difference between the price ceiling and the price floor is the difference between the call strike price and put strike price (that is, 301-281=300-280=20). Therefore, a lower put strike price and higher call strike price will increase the price ceiling and decrease the price floor.

This strategy, while riskier than buying a put, can be useful. For example, if you believe prices are more likely to go lower than higher but you still want some reward for higher prices, you may want to use this strategy. Also, if you are confident that prices won't rise above a certain level, then you can sell a call option at or above that price level to take advantage of this situation.

Forward Contract, Buya Call, and Sell a Call

A bull spread involves buying a low strike price call option and selling a high strike price call option. When combined with a forward contract, a bull spread is analogous to the bear fence considered above.

Figure 4. Profit and Net-Price from Buying a Put and Selling a Call.



The bull spread will yield a price floor, but also set a price ceiling. As with the bear fence, the bull spread has a net premium equal to the premium of the low strike price call minus the premium of the high strike price call. (The lower strike price is indicated in Figure 5 by S_L and the higher strike price by S_H.) The price floor is then equal to S_L+b-NP where NP is the net premium and the price ceiling is S_H+b-NP.

Suppose the 280 call option is purchased and the 300 call option is sold. Using the prices from Table 1, the price floor is 281 and the price ceiling is 301. Of course, just like the bear fence, a bull spread can have a lower floor and higher ceiling by widening the gap in strike prices between the call option sold and call option bought.

Figure 5. Net-Price and Profit on Bull Spread.