Section III
Advanced Pricing Tools

Chapter 16: Buying put options to establish a minimum price

Learning objectives

- Hedging with options
- Buying put options to establish a minimum price
- Delta and the hedge ratio

Key terms

Delta: A measure of how much an option price changes in relation to a change in the futures price, typically expressed as a percentage.

Hedge ratio: The reciprocal of the delta (1/delta).

There is a difference between hedging price risks with options instead of futures. Using futures, a hedger can fix a specific price, but they give up the opportunity to benefit from a favorable price move. By purchasing options, hedgers can fix a minimum (floor) or maximum (ceiling) price and retain the opportunity to profit from a favorable price move.

For grain sellers (e.g. farmers or producers), options based strategies that can serve as alternatives to a basic short hedge include:

1. Buying put options to establish a minimum price on grain to be produced, or on grain held in storage, i.e. put options as price insurance.
2. Selling a crop in the cash market and buying call options to establish a minimum price (aka paper farming) on grain to be produced, or on grain held in storage.

In this segment, we will explore the purchase of put options to establish a minimum price. This strategy can be used before harvest to protect the value of grain growing in the field. It can also be used after harvest, to protect the value of grain held in storage.

Buying put options establishes a minimum price, sometimes called a floor price. Here's a simple equation to calculate a minimum price established by buying put options…

put strike price + expected basis – premium – fees = expected minimum price

Again, this is an expected price, based on the expected basis. The actual basis will probably be a little different from expectations. It is also important to remember that basis is often a negative number.

Let's consider an example of buying put options to establish a minimum price on corn held in storage. A farmer in north central Iowa has harvested a large corn crop. Cash prices are good (over $5/bu.) but the farmer believes prices will go even higher. Buying put options allows the farmer to manage downside risk and while maintaining the opportunity for higher prices next spring. With July corn futures at $5.60/bu., the farmer places an order with his broker to buy "at-the-money" 560 July puts (the strike price is the same as the futures price, $5.60/bu. in this example). The premium is 48 cents and the basis is estimated to be 20 cents under July futures by late spring.

Buy Put Options to Establish a Minimum Price

Date	Cash	Options	Basis/Min. Price
October	Put corn crop into storage, current local price is $5.00/bu.	With July futures trading at $5.60, buy July 560 puts for 48 cents per bushel.	Expected basis next spring is -$0.20, or 20 cents under the July contract. Minimum expected price next spring: $5.60 strike + (-$0.20) basis - .48 premium = $4.92

In this example, brokerage fees of about 1 cent per bushel are ignored. This example also ignores storage costs - the cost of holding grain from harvest until next spring. This strategy could also be used to establish a minimum price before harvest.

Put options increase in value as prices go lower, and they lose value as prices go higher. Here's a question to ponder: Once you buy puts in this strategy, do you want prices to go higher or lower?

Even though puts increase in value as prices go lower, you want higher prices. Do you want to maximize the value of your puts, or the value of your grain held in storage? Maximizing the value of your puts simply means you are headed towards the minimum price. Clearly your best result comes from much higher prices and maximizing the value of the grain held in storage. The put options simply serve as price insurance and, like auto insurance, a driver is better off without accidents and payouts.

Here is how the purchased option strategy performs at various futures price outcomes. If the futures price trend lower, the value of the 560 July put increases, and this increase in value is what allows you to maintain a minimum price. If the futures price trend higher, the value of the 560 July put decreases, but the value of your grain held in storage increases.

Futures Market	+ $5.60 put value	- option premium paid	= net futures	+ basis estimate	= cash estimate
$7.20	0.00	0.48	$6.72	-0.20	$6.52
$6.80	0.00	0.48	$6.32	-0.20	$6.12
$6.40	0.00	0.48	$5.92	-0.20	$5.72
$6.00	0.00	0.48	$5.52	-0.20	$5.32
$5.60	0.00	0.48	$5.12	-0.20	$4.92
$5.20	0.40	0.48	$5.12	-0.20	$4.92
$4.80	0.80	0.48	$5.12	-0.20	$4.92
$4.40	1.20	0.48	$5.12	-0.20	$4.92
$4.00	1.60	0.48	$5.12	-0.20	$4.92

Delta and the hedge ratio

Delta is one of a handful of "Greeks" examined by options traders. Delta is how much an option price changes in relation to a one point move in the futures, typically expressed as a percentage. Knowing delta offers some interesting insights into option values.

delta = change in option premium/change in futures price

In general, at-the-money options have a delta close to 0.5, or 50%. Deep in-the-money options have a delta approaching 1, or 100%. Far out-of-the-money options have a delta approaching 0.

For example, if an option has a delta of 0.5, or 50%, this means that the option premium will move about ½ (50%) of the underlying futures price move (e.g., a 10 cent change in the futures prices will be met with about a 5 cents change in the option premium).

Delta is useful in two different ways. First, delta provides a simple interpretation of the probability of an option expiring in-the-money. For example, a deep in-the-money option with a delta of .80, may be said to have an 80% chance of expiring in-the-money. An out-of-the-money option with a delta of .15 could be said to have a 15% chance of expiring in-the-money.

The second use of delta is in calculating a hedge ratio. The hedge ratio is the reciprocal of the delta, and is critical to estimating the number of option contracts needed to reach a fully hedged position.

hedge ratio = 1/Delta

For example, if the delta of an at-the-money option is .5, then the hedge ratio is 2 (because 1/.5 = 2). In this case, two contracts of options are needed to hedge the full value of 5,000 bushels.

One common pitfall in the use of options for hedging is a poor understanding of the relationship between futures prices and option premiums, as expressed by delta and the hedge ratio. This pitfall is illustrated by the paper farmer – a grain producer who sells grain and "re-owns" it with the purchase of call options on a one-to-one basis (e.g., sell 25,000 bushels of wheat and buy 5 call option contracts). What if a producer buys call options that are far out-of-the-money (i.e., $12 wheat calls when the futures market is trading at $10 per bushel)? Out-of-the-money call options are much less expensive than options that are at or in-the-money. But if market prices rise by $1, low delta means that the value of the options will increase less than $1/bu.

Further reading

Self-Study Guide to Hedging with Grain and Oilseed Futures and Options (handbook), CME Group, April 2012 http://www.cmegroup.com/trading/agricultural/self-study-guide-to-hedging-with-grain-and-oilseed-futures-and-options.html

Grain and Oilseed Futures and Options (brochure), CME Group, February 2012 http://www.cmegroup.com/trading/agricultural/grain-and-oilseed-futures-and-options-fact-card.html

Exercise #16

At harvest, you decide to buy 10 put option contracts on July corn to lock in a minimum price on 50,000 bushels of corn, while retaining the possibility of a higher price, should prices trend higher in the months ahead. You are expecting to make final delivery of the corn next spring, when the corn basis reaches 15 cents under the July contract.

I want you to complete the transaction next spring, under three different scenarios. Fill in the blanks in the T-diagram, showing the price you received in $/bushel or in gross sales revenues (price * quantity). Ignore ownership (storage) costs.

Scenario #1: Futures prices change little from harvest to spring

Date	Cash	Options	Basis
October	Harvest 50,000 bushels of corn. Local elevator is bidding $5.15/ bu. The producer decides to hold grain in storage and buy put options on July futures.	With July futures trading at $5.80/bu., the producer buys 10 contracts of 580 July put options, at a premium of 47 cents/bu.	Minimum price established* (aka worst case scenario) is $5.80 + (-$.15) - $.47 - $.01 = $5.17/bu. * Assumes the basis reaches 15 cents under the July contract
mid-June	Sell 50,000 bushels of corn to the local elevator for $5.77/bu.	With July corn futures at $6.00/bu., the 580 puts are worth less than 1 cent/bu. Let them expire.	What is the basis in June? _____
Results	What did you receive in the cash market? $/bu. _____ $total _____	What was your gain or loss on the put options? $/bu. _____ $total _____	What final price did you receive for your corn? $/bu. _____ $total _____

Scenario #2: Futures prices rise $1/bu. from harvest to spring

Date	Cash	Futures	Basis
October	Harvest 50,000 bushels of corn. Store grain buy put options on July futures.	July futures at $5.80/bu., buy 10 contracts of 580 July put options, at a premium of $.47/bu.	Minimum price established* (aka worst case scenario) is $5.80 + (-$.15) - $.47 - $.01 = $5.17/bu.
mid-June	Sell 50,000 bushels of corn to the local elevator for $6.57/bu.	July corn futures at $6.80/bu., the 580 puts are worthless - let them expire.	What is the basis in June? _____
Results	What did you receive in the cash market? $/bu. _____ $total _____	What was your gain or loss on the put options? $/bu. _____ $total _____	What final price did you receive for your corn? $/bu. _____ $total _____

Scenario #3: Futures prices fall $1/bu. from harvest to spring

Date	Cash	Futures	Basis
October	Harvest 50,000 bushels of corn. Store grain buy put options on July futures.	July futures at $5.80/bu., buy 10 contracts of 580 July put options, at a premium of $.47/bu.	Minimum price established* (aka worst case scenario) is $5.80 + (-$.15) - $.47 - $.01 = $5.17/bu.
June	Sell 50,000 bushels of corn to the local elevator for $4.57/bu.	July corn futures at $4.80/bu., the 580 puts are worth $1.00/bu. Sell them for a $1/bu. gain.	What is the basis in June? _____
Results	What did you receive in the cash market? $/bu. _____ $total _____	What was your gain or loss on the put options? $/bu. _____ $total _____	What final price did you receive for your corn? $/bu. _____ $total _____