Hedging with options

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Lecture notes for Econ 235

Notes

Definitions

- Remember that hedging is the action of taking an opposite position to counterbalance prices changes in one position.
  - For example, if long in the cash market, then take a short position in the futures market.
  - In the opposite case, if short in the cash market, then take a long position in the futures market.
- We have already covered hedging with futures.
- We will look at hedging with options in this section.

Notes

Suggested reading

- Self-Study Guide to Hedging with Grain and Oilseed Futures and Options.
- Self-Study Guide to Hedging with Livestock Futures and Options.
- Grain Price Hedging Basics from ISU extension.

Notes

Hedging with options

- Hedging with options on futures has a significant advantage.
  - Whether an option has value depends on the strike price and the price of the underlying futures contract;
  - Thus, it is possible to hedge with options to reduce negative price risk without a penalty for positive price risk.
- Hedging with options uses the fact that options have zero values for a range of futures prices.
- Other advantages of hedging with options are:
  - There is no need for a margin account (buyer of option).
  - Hedging with options also allows you to decide the price floor or ceiling depending on the strike price of the options that you purchase.

Put option payoff line

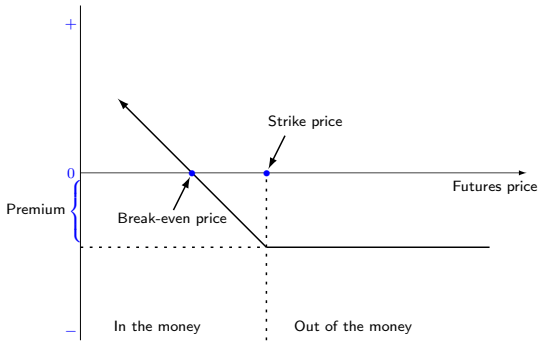

Figure : Put option payoff line

Notes

Call option payoff line

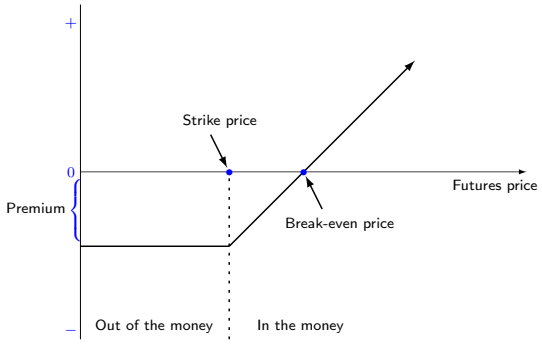

Figure : Call option payoff line

Notes

Hedging with options: short hedge with options

- Suppose that you are a farmer and that you wish to hedge your crop until harvest using options.
- The basic idea behind hedging with options is the same as hedging with futures:
  - That is, you want to create a position that is opposite to the one you have in the cash market.
  - Options give you the capacity to create that position.
- Thus, if you are **long** in the cash market, the hedging strategy with options is to buy a **put** option that will give you the right to acquire a short futures position at a specified strike price.

Notes

Example: short hedge with options

- Suppose that you decide to hedge in May against price risk at the moment you plan on delivering corn in November.
- In May, the price of the December corn futures contract is \$6.00 per bushel.
- The basis is currently -\$0.25 per bushel. You expect the basis to be -\$0.15 per bushel at the end of your hedge.
- Suppose that you buy a put option with a strike price of \$5.50 per bushel.
- The premium for that option is \$0.05 per bushel.

Notes

Example: short hedge with options

- This strategy effectively creates a price floor for your selling price.
- Using the put option, the lowest price you can sell your corn on the futures is \$5.50/bu.
- If the -\$0.15/bu basis at the end of your hedge holds true, then the lowest price you can sell your corn on the cash market is \$5.35/bu = \$5.50/bu - \$0.15/bu.
- Note that for a futures price of corn of \$5.50 per bushel that the option has no intrinsic value.
- Let us assume that at the end of the hedge that the option has zero time value as it nears its expiration.
- We can calculate the price floor as the strike price (\$5.50/bu), plus the basis at the end of the hedge (-\$0.15/bu) minus the premium of the option at purchase (\$0.05/bu):

$$\$5.30/bu = \$5.50/bu - \$0.15/bu - \$0.05/bu.$$

Notes

Example: short hedge with options

- We can find the price floor by supposing a futures price in November that is below or equal to the strike price.
- Suppose here that the price in November is equal to the strike price at \$5.50/bu.

Table : Price floor (strike price = \$5.50/bu)

	Futures	Option (put)	Cash	Basis
May price	\$6.00/bu	\$0.05/bu	\$5.75/bu	-\$0.25/bu
November price	\$5.50/bu	\$0.00/bu	\$5.35/bu	-\$0.15/bu
Gain/loss	\$0.50/bu	-\$0.05/bu	-\$0.40/bu	\$0.10/bu
	Price of cash corn at beginning of hedge			**\$5.75/bu**
	Gain/loss from cash position			**-\$0.40/bu**
	Gain/loss from option			**-\$0.05/bu**
	Net selling price			**\$5.30/bu**

Notes

Example: short hedge with options

- What happens if the price of corn is higher than the strike price?
- Suppose that at the end of your hedge that the price of corn is \$6.10 per bushel.
- Because the futures price is higher than the option strike price, then you do not exercise your option.
- As the option is near its expiration date and that the price of corn is above the strike price, the option premium should be very small (i.e. no intrinsic value and almost no time value). Suppose that it equals zero.
- Thus, the net price in this case equals the futures price (\$6.10/bu), plus the basis at the end of the hedge (-\$0.15/bu), minus the option premium at purchase (\$0.05/bu):

$$\$5.90/bu = \$6.10/bu - \$0.15/bu - \$0.05/bu.$$

Notes

Example: short hedge with options

Table : Futures price of corn higher than strike price (strike price = \$5.50/bu)

	Futures	Option (put)	Cash	Basis
May price	\$6.00/bu	\$0.05/bu	\$5.75/bu	-\$0.25/bu
November price	\$6.10/bu	\$0.00/bu	\$5.95/bu	-\$0.15/bu
Gain/loss	-\$0.10/bu	-\$0.05/bu	\$0.20/bu	\$0.10/bu
	Price of cash corn at beginning of hedge			**\$5.75/bu**
	Gain/loss from cash position			**\$0.20/bu**
	Gain/loss from option			**-\$0.05/bu**
	Net selling price			**\$5.90/bu**

Notes

Example: short hedge with options

- Now suppose that the futures price is below the strike price of the option.
- Let the price of corn on the futures market be \$5.25 per bushel.
- At that price you may either exercise your option with a strike price of \$5.50 per bushel or sell the option.
- The option has intrinsic value because it gives you the right to sell corn at a higher price. Let the time value equal zero because the option is near its expiration.
- The intrinsic value of the option is $\$0.25/bu = \$5.50/bu - \$5.25/bu$
- The net price is the futures price (\$5.25/bu), plus the basis at the end of the hedge (-\$0.15/bu), plus the current premium for the option (\$0.25/bu), minus the premium of the option at purchase (\$0.05/bu) :

$$\$5.30/bu = \$5.25/bu - \$0.15/bu + \$0.25/bu - \$0.05/bu.$$

Notes

Example: short hedge with options

Table : Futures price of corn lower than strike price (strike price = \$5.50/bu)

	Futures	Option (put)	Cash	Basis
May price	\$6.00/bu	\$0.05/bu	\$5.75/bu	-\$0.25/bu
November price	\$5.25/bu	\$0.25/bu	\$5.10/bu	-\$0.15/bu
Gain/loss	\$0.75/bu	\$0.20/bu	-\$0.65/bu	\$0.10/bu
	Price of cash corn at beginning of hedge			**\$5.75/bu**
	Gain/loss from cash position			**-\$0.65/bu**
	Gain/loss from option			**\$0.20/bu**
	Net selling price			**\$5.30/bu**

Notes

Payoffs line for a seller's hedge with a put option

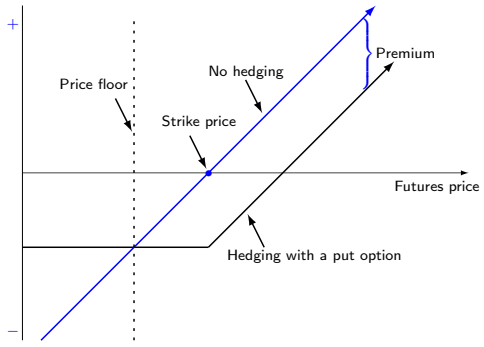

Figure : Seller's hedge with a put option

Notes

Example: short hedge with options

- As you can see in the previous figure, hedging with options comes at a cost when the price of futures increases.
- However, if the futures price falls, the hedging position provides a gain (i.e. it removes a loss).
- In the graph in the previous slide, identify the region where hedging results in a gain and where it results in a loss compared to not-hedging with option.

Notes

Example: short hedge with options

- What happens if you chose a put option with a higher or a lower strike price.
- Let's consider the same example as before but with a higher strike price of \$5.75 per bushel.
- The premium for the option is \$0.10 per bushel.
- The price floor with that option is:

$$\$5.50/bu = \$5.75/bu - \$0.15/bu - \$0.10/bu.$$

- Thus, a higher strike price means a higher price floor.
- But, as the next figure shows, it means a lower gain if the futures price increases.

Notes

Example: short hedge with options

- Remember that we can find the price floor by supposing a futures price in November below or equal to the strike price.
- Suppose here that the price in November is \$5.25/bu.

Table : Price floor with higher strike price (strike price = \$5.75/bu)

	Futures	Option (put)	Cash	Basis
May price	\$6.00/bu	\$0.10/bu	\$5.75/bu	-\$0.25/bu
November price	\$5.25/bu	\$0.50/bu	\$5.10/bu	-\$0.15/bu
Gain/loss	\$0.75/bu	\$0.40/bu	-\$0.65/bu	\$0.10/bu
		Price of cash corn at beginning of hedge		**\$5.75/bu**
		Gain/loss from cash position		**-\$0.65/bu**
		Gain/loss from option		**\$0.40/bu**
		Net selling price		**\$5.50/bu**

Notes

Payoffs line for a seller's hedge with a put option

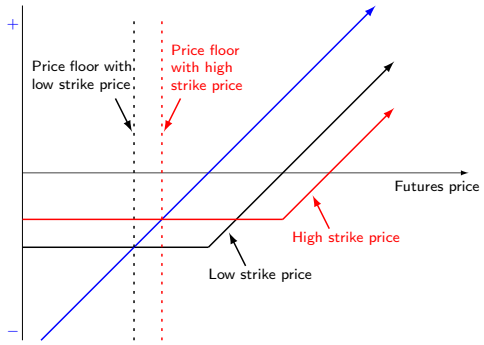

Figure : Seller's hedge with a put option

Notes

Hedging with options: long hedge with options

- Suppose that you manage price risk for corn procurement by an ethanol plant.
- The current price for the December futures contract is \$5.00 per bushel.
- The basis is currently -\$0.45 per bushel. You expect the basis to be -\$0.10 per bushel at the end of your hedge.
- You want to protect the ethanol plant from an increase in the price of corn.
- Again, the basic idea behind hedging with options is the same as hedging with futures.
- As you are **short** in the cash market, your strategy is therefore to buy a **call** option that will give you the option of gaining a long position in the futures market.

Notes

Hedging with options: long hedge with options

- In this case, hedging with options creates a price ceiling.
- Suppose that you purchase a call option with a strike price of \$5.50 per bushel.
- Suppose that the call option sells for \$0.10 per bushel.
- To calculate the ceiling price suppose that the futures price at the end of your hedge equals the strike price such that the premium for the call option equals zero. Assume no time value as the option nears its expiration.
- The price ceiling equals the futures price (\$5.50/bu), plus the basis at the end of the hedge (-\$0.10/bu), plus the premium of the option at purchase (\$0.10/bu):

$$\$5.50/bu = \$5.50/bu - \$0.10/bu + \$0.10/bu.$$

Notes

Example: long hedge with options

- We can find the price ceiling by supposing a futures price in November is above or equal to the strike price.
- Suppose here that the price in November is \$5.50/bu.

Table : Price ceiling (strike price = \$5.50/bu)

	Futures	Option (call)	Cash	Basis
May price	\$5.00/bu	\$0.10/bu	\$4.55/bu	-\$0.45/bu
November price	\$5.50/bu	\$0.00/bu	\$5.40/bu	-\$0.10/bu
Gain/loss	\$0.50/bu	-\$0.10/bu	-\$0.85/bu	\$0.35/bu
			Price of cash corn at beginning of hedge	**\$4.55/bu**
			Gain/loss from cash position	**-\$0.85/bu**
			Gain/loss from option	**-\$0.10/bu**
			Net buying price	**\$5.50/bu**

Notes

Hedging with options: long hedge with options

- Suppose now that the futures price at the end of the hedge is \$6.00 per bushel.
- At that price, the intrinsic value of the call option is $\$0.50/bu = \$6.00/bu - \$5.50/bu$. Assume no time value.
- The net buying price is the futures price (\$6.00/bu), plus the basis at the end of the hedge (-\$0.10/bu), minus the value of the option at the end of the hedge (\$0.50/bu), plus the premium you paid for the call option (\$0.10/bu):

$$\$5.50/bu = \$6.00/bu - \$0.10/bu - \$0.50/bu + \$0.10/bu.$$

Notes

Example: long hedge with options

Table : Futures price of corn is higher than the strike price (strike price = \$5.50/bu)

	Futures	Option (call)	Cash	Basis
May price	\$5.00/bu	\$0.10/bu	\$4.55/bu	-\$0.45/bu
November price	\$6.00/bu	\$0.50/bu	\$5.90/bu	-\$0.10/bu
Gain/loss	\$1.00/bu	\$0.40/bu	-\$1.35/bu	\$0.35/bu
			Price of cash corn at beginning of hedge	**\$4.55/bu**
			Gain/loss from cash position	**-\$1.35/bu**
			Gain/loss from option	**\$0.40/bu**
			Net buying price	**\$5.50/bu**

Notes

Hedging with options: long hedge with options

- The last case to consider is when the futures price is below the strike price.
- Suppose that the futures price is \$5.00 per bushel at the end of the hedge.
- At that price, you are not willing to exercise your option, which is worth nothing.
- Your net buying price is the futures price (\$5.00/bu), plus the basis at the end of the hedge (-\$0.10/bu), plus the premium you paid for the call option (\$0.10/bu):

$$\$5.00/bu = \$5.00/bu - \$0.10/bu + \$0.10/bu.$$

Notes

Example: long hedge with options

Table : Futures price of corn is below the strike price (strike price = \$5.50/bu)

	Futures	Option (call)	Cash	Basis
May price	\$5.00/bu	\$0.10/bu	\$4.55/bu	-\$0.45/bu
November price	\$5.00/bu	\$0.00/bu	\$4.90/bu	-\$0.10/bu
Gain/loss	\$0.00/bu	-\$0.10/bu	-\$0.35/bu	\$0.35/bu
		Price of cash corn at beginning of hedge		**\$4.55/bu**
		Gain/loss from cash position		**-\$0.35/bu**
		Gain/loss from option		**-\$0.10/bu**
		Net buying price		**\$5.00/bu**

Notes

Payoffs line for a buyer's hedge with a call option

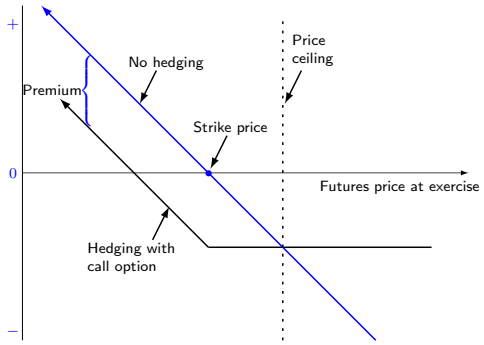

Figure : Buyer's hedge with a call option

Notes

Hedging with options: long hedge with options

- Suppose that you choose a lower strike price.
- It will of course set a lower price ceiling but the premium of that option will be larger.
- Recall that you take your hedge when the futures price is \$5.00 per bushel.
- Suppose that you buy a call option with a strike price of \$5.00 per bushel.
- The option sells at \$0.20 per bushel.
- The price ceiling is when the futures price equals the strike price of \$5.00 per bushel at the end of your hedge.
- The price ceiling for the your hedging strategy is the futures price (\$5.00/bu), plus the basis at the end of the hedge (-\$0.10/bu) and plus the premium of the option at purchase (\$0.20/bu):

$$\$5.10/bu = \$5.00/bu - \$0.10/bu + \$0.20/bu.$$

Notes

Example: long hedge with options

Table : Price ceiling with lower strike price (strike price = $5.00/bu)

	Futures	Option (call)	Cash	Basis
May price	$5.00/bu	$0.20/bu	$4.55/bu	-$0.45/bu
November price	$5.00/bu	$0.00/bu	$4.90/bu	-$0.10/bu
Gain/loss	$0.00/bu	-$0.20/bu	-$0.35/bu	$0.35/bu
		Price of cash corn at beginning of hedge		**$4.55/bu**
		Gain/loss from cash position		**-$0.35/bu**
		Gain/loss from option		**-$0.20/bu**
		Net buying price		**$5.10/bu**

Notes

Payoffs line for a buyer's hedge with a call option

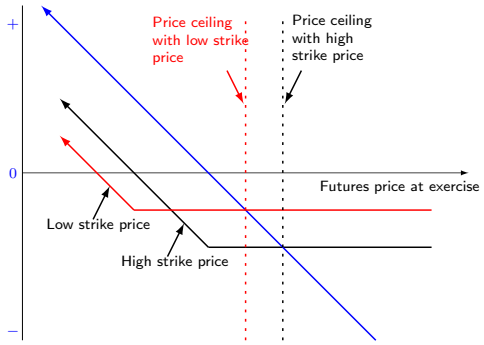

Figure : Buyer's hedge with a call option

Notes

Change in basis and hedging with options

- To see what is the effect of the basis on a hedging position, let's use the **short** hedge example with options that starts on slide 8.
- Recall that the example assumes that you expect the basis to be -$0.15 per bushel at the end of your hedge, that you buy a put option with a strike price of $5.50 per bushel and that the premium for the option is $0.05 per bushel.
- Under those conditions, your hedge yields a minimum price of

$$\$5.30/bu = \$5.50/bu - \$0.15/bu - \$0.05/bu.$$

Notes

Change in basis and hedging with options

- Suppose that you were wrong in predicting the basis and that instead the basis at the end of your hedge is -$0.25 per bushel.
- In such case, the price floor is

$$\$5.20/bu = \$5.50/bu - \$0.25/bu - \$0.05/bu.$$

- Thus, for a short hedge, as the basis widens, the price floor declines.
- Hedging with options does not remove basis risk.

Notes

Change in basis and hedging with options

Table : Price floor with lower basis (strike price = \$5.50/bu)

	Futures	Option (put)	Cash	Basis
May price	\$6.00/bu	\$0.05/bu	\$5.75/bu	-\$0.25/bu
November price	\$5.50/bu	\$0.00/bu	\$5.25/bu	-\$0.25/bu
Gain/loss	-\$0.50/bu	-\$0.05/bu	-\$0.50/bu	\$0.00/bu
	Price of cash corn at beginning of hedge			**\$5.75/bu**
	Gain/loss from cash position			**-\$0.50/bu**
	Gain/loss from option			**-\$0.05/bu**
	Net selling price			**\$5.20/bu**

Notes

Change in basis and hedging with options

- For a long hedge, as the basis widens, the price ceiling declines as well (you should verify this with a simple example).
- This shows that hedging does not remove local market conditions.
- That is, in a hedge with an option, the purchase or sale price still depends on local market conditions.

Notes

Summary: the basis and hedging with options

Table : Impact of change in basis on hedger's revenue

	Change in the basis over hedge period	
Type of hedge	Stronger basis	Weaker basis
Short hedge	Favorable	Unfavorable
Long hedge	Unfavorable	Favorable

Notes

What else?

- Other types of hedge: e.g. long in cash and hedge with a call option, short in cash and hedge with a put option.
- Production risk.
- Hedging with financial instruments.
- Optimal hedging ratio.
- ...

Notes