Hedging ahead

Continuing our series of tutorials on risk management tools, *Dan Rowe* looks at how physical positions can be hedged with exchange-traded futures and options contracts

Futures contracts plus physical commodity equals hedged position. Does it seem unusual that a derivatives instrument could be used to hedge a physical position? It should not sound all that bizarre by now, at least not if you have been following prior instalments of these tutorials (see *EPRM* March 2002, pages 65–67). This month we look at the proper way to hedge a physical position using exchange-traded futures and options contracts.

The idea is simple: use a financial tool to offset all or at least part of the price risk exposure on the physical commodity. Once we have identified the directional exposure on the physical commodity – that is, whether it is rising or falling prices that we fear – we can determine how the futures or options contract will be used.

If this concept is simple enough, the application should not be much more difficult – just more involved. To start with, we need to know what a futures contract will and will not do for us.

As a hedge tool, futures will only produce one end result – to fix, or lock-in, a price. As a result, futures contracts will not allow us to participate in any future price movement, whether favourable or not. In other words, when using futures contracts to hedge, we had better be comfortable with the price of the physical commodity at the time of the hedge, as this is the price we are now guaranteed. If a futures contracts is not suitable, there is an alternative – options – which we discuss later in this article.

So now that we are aware of what a futures contract can and cannot do for us as a hedge, let us look at how hedging takes place. In a very fundamental sense, hedging is all about opposite relationships. This is generally true for futures and options if we assume a positive correlation in price movement between the physical and the financial tool – that is, if they move a similar amount in the same direction. To take advantage of this relationship, all we need is a financial tool that will offset any losses on the physical commodity, should the value of the physical commodity move in a direction unfavourable to us.

If we are long natural gas at $2.40 per million British thermal units (mmBtu), we will go short futures contracts on natural gas for the coming month. The point is that if natural gas prices fall below $2.40/mmBtu, we will suffer financial loss by selling for less than our purchase price of $2.40. But, with a short futures contract in place, the declining value of our physical commodity will be offset by the rising value of our short futures contract. The end result is a fixed price of $2.40/mmBtu, regardless of the future price movement of my physical commodity. We can further expand on hedging with another example.

Practical example

As an end-user of natural gas, we are always short natural gas – we will forever be buying gas to operate our factory. As a result, we are worried about gas prices rising. The forward price for July is $3.00/mmBtu. On February 25, the New York Mercantile Exchange (Nymex) Henry Hub natural gas futures contract is trading at $2.20/mmBtu for July 2002. Suppose we want to lock-in a price for gas supplied in July. If we wanted to protect the $3.00/mmBtu forward price today, we would simply set up a hedge on February 25 as shown in table 1.

Once the hedge is established, we would continue to operate as usual – only this time, as we purchase the physical natural gas, we would liquidate the futures contract. Assume on the day of liquidation that physical gas prices have risen to $3.50/mmBtu and the Nymex Henry Hub futures contract to $2.70/mmBtu. The end result would appear as shown in table 2.

At the point we purchase the physical commodity, we would have to liquidate the futures contract to offset the movement in the physical commodity. In the case above, we have lost $0.50/mmBtu on the physical. The futures contract has, however, offset this higher physical price by an even $0.50/mmBtu. When all is netted out, we ended up buying our physical at the original price of $3.00/mmBtu ($3.50 purchase price minus $0.50 gain on futures = $3.00/mmBtu).

So, the good news is that the futures contract locked us into a price of $3.00/mmBtu when the market moved up to $3.50. The example in table 3 should help us figure out the bad news.

Notice how the physical market price had fallen to $2.75/mmBtu. Had we not hedged, we could have simply paid $2.75, for a $0.25 saving. But, unaware of the eventual outcome, we locked-in $3.00/mmBtu, for better or worse.

Basis risk

However, this example assumes the futures contract and our physical commodity move up and down in exact unison. The reality is that these two mechanisms will move independent of one another. It is neither safe nor correct to

Table 1: Simple hedge set-up

	February 25
Physical	Short July natural gas @ $3.00/mmBtu
Futures	Long July natural gas @ $2.20/mmBtu

Table 2: Hedge on day of liquidation

	February 25	June 26	Net profit/loss
Physical	Short July natural gas @ $3.00/mmBtu	Long natural gas @ $3.50/mmBtu	$0.50 loss on physical commodity
Futures	Long July natural gas @ $2.20/mmBtu	Sell July natural gas @ $2.70/mmBtu	$0.50 profit on financial contract
Net price paid after hedge = $3.00			

assume a perfect correlation between the price of our physical commodity and the futures contract we use to hedge it. As a result, in the process of eliminating price risk, we must contend with another type of risk – basis risk.

In our previous example, if the physical commodity is needed in New York and our futures contract is for delivery to Louisiana, then due to the location differential each commodity will move up and down independently of the other. Basis risk exists due to the inexact match of our physical commodity and financial tool. In short, basis risk exists due to time, location or grade differentials.

Hedging with options

Options are a slightly different breed of hedge tool. Where futures contracts lock us into a price, options allow us flexibility in not only determining what level of hedge protection we want, but also how much we will spend for that protection.

There are four basic options strategies: long call, long put, short call and short put (see *EPRM* December 2001, pages 32–34), which can be broken down into two categories (see table 4). These groups are based on our physical position.

A call gives the buyer of the option the right but not the obligation to buy a futures contract at a specified price within a specific period of time in exchange for a one-off premium. It obligates the seller to sell the underlying futures contract at the designated price, should the option be exercised at that price. A put does the opposite – that is, it gives the buyer the right to sell the said contract at a specified price, and obligates the seller to buy it.

Building on our example, how would the options affect our hedge? Once again, being short physical, we will hedge against rising prices with either a long call or a short put. Looking at the long call, we can easily see how we get the benefit of participating when the market falls but little or none of the unfavourable movement when the market rises.

For example, on February 25 we decide to hedge our July natural gas purchases. We want to retain the ability to participate if the market should fall, without having to pay more than $3.20/mmBtu. By buying a call – that is, taking a long call – with a strike price of $3.20/mmBtu, we now have the right to receive gas at $3.20/mmBtu for the month of July.

Should prices rise to $3.50/mmBtu, our call option will have increased by $0.30.

Table 3: Hedge liquidation with falling prices

	February 25	June 26	Net profit/loss
Physical	Short July natural gas @$3.00/mmBtu	Long natural gas @ $2.75/mmBtu	$0.25 profit on physical commodity
Futures	Long July natural gas @ $2.20/mmBtu	Sell July natural gas @ $1.95/mmBtu	$0.25 loss on financial contract

Net price paid after hedge = $2.75 purchase + $0.25 loss = $3.00/mmBtu

The increase in value of the call will offset the rising physical price we will have to pay. Since the call gives us the right not to pay more than the strike price of $3.20, we have set an absolute maximum on the price we will pay. When used as a hedge, a call will always be set at a price higher than the current market price.

Of course, this participation does not come free of charge. With options, you pay a premium for the freedom of participation. The premium can either be treated as a cost of the hedge and therefore not recoverable, or as a payment we seek to recover as part of the hedge. In either case, we would have to liquidate the option prior to expiration to receive the $0.30 profit noted above.

In the case of selling a put – that is, taking a short put – we would be receiving free, but limited protection. From the sale we would collect a premium that would then be used as an offset against higher market prices. Put options set floors and, therefore, will always be set at a price lower than the market price.

Assume we sell a put with a strike price of $2.60/mmBtu. From this sale we will collect a premium – of, let's say, $0.30. If the market should rise to $3.50, the buyer of the put will not exercise the option and we will keep the premium of $0.30. This $0.30 will be used to offset the higher price paid for the physical commodity. The net price paid for the physical natural gas would be $3.20 – that is, $3.50 minus $0.30.

If, on the other hand, prices fall, we open ourselves up to some risk. Should prices fall to $2.00/mmBtu, thanks to our obligation to buy at the strike price of $2.60/mmBtu, we will be paying $0.60 more for our natural gas than the rest of the market. Although we will use the premium to reduce our exposure down to $0.30, we will still pay $0.30 above the market price.

This was the risk we took when selling the option in the first place. In fact, in return for having collected the premium upfront, we gave up the opportunity to participate if the market fell below the $2.60 floor.

Table 4: Breakdown of options

Long physical	Short physical
Long put	Long call
Short call	Short put

A final consideration when using options is another risk on top of basis risk – delta risk. Option premiums do not increase or decrease dollar-for-dollar with movements in the underlying physical. As a result, one option may not be enough to cover profits or losses in the underlying market.

Delta is a measure of change – specifically, with options, it measures how much of a change in the underlying market will be reflected in our option premium. Delta is measured in percentage terms, from 0 to +1 (100%) for call options and 0 to –1 (100%) for put options. Given that our option is unlikely to have a delta of 1 – that is, dollar-for-dollar movement with the underlying – we will not have adequate coverage in our hedge. We will need to hedge not only basis risk but also delta risk in order to ensure a one-for-one profit or loss between the physical commodity and the option used to hedge.

Buyer beware

If we now consider ourselves hedge experts, we should bear in mind one word – basis. We should have a complete understanding of basis before entering into any hedge. And, in conjunction with basis, we should know the effects of delta on options. Ignoring the effects of these two instruments does not make them go away, but merely compounds the risk in our portfolio. EPRM

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