DELTA NEUTRAL TRADING IN AGRICULTURAL OPTIONS

This article is a part of a series published by R.J. O'Brien & Associates Inc. on risk management topics for commercial grain and oilseed traders.

This article explores the concept of delta neutral trading in agricultural options. While delta neutral trading is basically a speculative strategy, an understanding of this type of trading approach provides valuable insight into the dynamics of option pricing. In this article we explain the concept of delta neutral trading and walk through two detailed examples of the rebalancing process. We also provide a current example of how a trader might analyze the merits of a delta neutral strategy. Finally, we provide some thoughts on how to place orders most effectively when trading options - delta neutral or otherwise.

Note: For a more basic introduction to volatility see our recent article entitled *Volatility Trading in Agricultural Options*.

I. DELTA NEUTRAL TRADING - BASIC CONCEPTS

When we buy or sell an option outright, we are taking a position with respect to both flat price and volatility. If we sell a call option, we are both short volatility (i.e., we benefit if implied volatility drops) and short flat price (i.e., we benefit if the underlying futures price drops). In a delta neutral position we are attempting to neutralize the flat price characteristics of the position and isolate a long or short volatility position. As we will see later on, we can never completely eliminate the flat price characteristics of an option position, but we can get close enough that we can effectively trade volatility, either from the long or short side.

Recall that delta is the change in the option premium given a change in the price of the underlying futures contract. If a December corn call has a delta of 0.5, then a 4 cent per bushel rally in December corn futures will result in an increase in the call premium of roughly 2 cents per bushel (holding all other factors constant). A position that is long 500 corn calls with a delta of 0.5 has a notional position of 2,500,000 bushels (500 contracts * 5,000 bushels) and a delta-equivalent position of 1,250,000 bushels (500 contracts * 5,000 bushels * 0.5 delta). So in flat price terms, we can say that being long 500 December corn calls with a 0.5 delta is equivalent to being long 250 December corn futures.

Now, if we want to be delta neutral, we simply figure out the delta-equivalent of the options and take the *opposite* position in the underlying futures contract. For example, if we are short 100 November soybean calls with a delta of 0.72, on a delta-equivalent basis, this position is short 360,000 bushels of November soybeans (100 contracts * 5,000 bushels * 0.72). To get delta neutral, we have to buy 72 November soybean futures (360,000 bushels). By doing so, we have negated the flat price component of the November calls, but we are still short these calls and hence still short volatility.

You will recall, however, that an option's delta changes as the underlying futures price moves. Thus, as the delta changes, the flat price (or delta) equivalent of our option position is either getting longer or shorter. To stay delta neutral, we have to adjust our offsetting futures position correspondingly. This process of *rebalancing* the position is discussed in the next section.

Speculators trade delta neutral because they may have a strong view on volatility but less conviction on flat price direction. Traders that can anticipate a calm or volatile market can reap significant rewards through this type of trading strategy. Hedgers, while taking into account the volatility aspects of their option position, are generally seeking flat price exposure as well, and thus delta neutral trading is not a suitable strategy.

Reference is sometimes made to the fact that volatility typically increases when prices are high or rallying, and vice versa. Thus, a corn consumer could take some disaster insurance by going long volatility, on the theory that if a drought hits the corn belt, both volatility and flat price will increase. However, an analysis of the data suggests that while there is some positive correlation between implied volatility and futures prices in the grains and oilseeds, the correlation is relatively weak. Table 1 shows the correlation between implied volatility and the underlying nearby futures for CBOT wheat, soybeans and corn for the period January 1/92 to June 15/99. Over this period, the correlation was 21.04% for wheat, 37.38% for soybeans and 37.96% for corn.

Table 1.
Relationship Between Implied Volatility and Underlying Futures [1/]

	Wheat	Soybeans	Corn
Correlation Between Implied Volatility & Futures	21.04%	37.38%	37.96%
Average Implied Volatility When Futures Are Below the Mean	21.65%	18.07%	20.22%
Average Implied Volatility When Futures Are Above the Mean	23.26%	21.27%	22.68%

1/ Based on daily data for the period January 1/92 to June 15/99

Table 1 also shows the average implied volatility when the underlying futures were above and below their mean for the period January 1/92 to June 15/99. In other words, we are testing to see if implied volatility tends to be higher when the underlying futures price is above average and vice versa. Based on the results shown in Table 1, while average implied volatility is indeed higher when the underlying futures price is above average, the difference is small. Thus, attempting to cover a flat price risk using a delta neutral strategy is unlikely to yield the desired results.

II. REBALANCING A DELTA NEUTRAL POSITION

Putting on a delta neutral position is straightforward. You simply have to know the current delta of the option and then place the order to ensure you are buying or selling volatility at the desired level. The main "trading" aspect of a delta neutral position is in the rebalancing. It is also important to understand that gains and losses from delta neutral positions come from *both* changes in implied volatility in the option, as well as gains and losses incurred through the rebalancing process. In this section we walk through the rebalancing process for two delta neutral positions - one that is long volatility and one that is short volatility. We have simulated the behavior of the options using a standard option pricing model in these examples.

Example 1: Long Volatility - CBOT Wheat

Let's assume we bought 500 December 260 wheat puts (WZ260P) at a premium of 9 cents per bushel. Assuming WZ9 is 284.5 cents per bushel, these puts are out-of-the-money and have a delta of say 0.27. On a flat price basis, this is equivalent to being short 675,000 bushels of WZ9. To get delta neutral, we buy 135 WZ9 futures (675,000/5,000) at 284.5 cents per bushel. Let's also assume that we bought our puts at an implied volatility of 26.7%, so we're long volatility at this level.

The next day, WZ9 rallies 10 cents per bushel to 294.5. Assuming implied volatility stays constant, the value of our puts drops to 6.75 cents and delta drops to 0.21. So, on a mark-to-market basis, we are now out 2.25 cents in our puts, but have a gain of 10 cents in our futures. The open equity in our position (ignoring transaction costs) is now:

WZ260P (Options)	Loss of 2.25 cents * 2,500,000 bushels =	($56,250)
WZ9 (Futures)	Gain of 10 cents * 675,000 bushels =	$67,500
Net Open Equity		$11,250

On a delta basis, our puts now represent a net short of only 525,000 bushels (500 contracts * 5,000 bushels * 0.21), but we are still long 675,000 bushels of WZ9. So as the price increases, our short delta position associated with the puts is getting smaller but the delta-equivalent of our offsetting long futures position remains the same, with the result being we are getting net long. This is in fact why our position is showing a gain of $11,250 (getting long in a rising market is a good thing).

Now to stay delta neutral, we must sell 150,000 bushels of WZ9 in order to once again match the delta equivalent of our puts. So we sell 150,000 bushels (30 contracts) at 294.5, realizing a gain of $15,000 (294.5 - 284.5 * 150,000 / 100). This is what we mean by rebalancing the position. (Note that we are assuming a rather dramatic price move here just to make a point.)

Now let's assume the following day the market gave back its entire rally and WZ9 settled back at 284.5. Assuming implied volatility remained unchanged, the value of the puts increased back to 9 cents and the delta returned to 0.27. In order to get back to delta neutral, we need to once again buy 150,000 bushels of WZ9, since the delta of our puts has returned to its original net short of 675,000 bushels. Our realized and unrealized equity (ignoring transaction costs) is now:

Realized Gain on WZ9	Gain of 10 cents * 150,000 bushels =	$ 15,000
Open Equity: WZ260P		0
WZ9		0
Net		$ 15,000

Consider the result if the above scenario had unfolded but you decided not to rebalance the position on day two. Rather than having captured a $15,000 gain, your net position would still be breaking even. On the other hand, if the market had continued to rally on day three, you would clearly have been better off if you hadn't rebalanced the position, since you were net long at the end of day two. Thus, the importance of the rebalancing process should be evident.

We also need to understand that whether we are long puts or calls (with the offsetting futures), the rebalancing process yields net gains to the position holder. In the above example, the more often the market rallies and then reverses itself the better, since we are always selling futures as the market rallies and then buying them back at a lower price.

It works the same way on the downside. Using the same example, if on the second day WZ9 dropped 10 cents per bushel, our option delta would increase (since it is moving closer to the money) to say 0.34. Thus our options would move to a delta-equivalent of short 850,000 bushels, however, our futures position would remain constant at long 675,000 bushels. Thus, we are now getting net short in a down market. Assuming we rebalanced the position on day two by buying 175,000 bushels (35 contracts) of WZ9 we would be quite happy if the market subsequently rebounded to 284.5 (since we would have bought 170,000 bushels at 274.5 which we can now sell back at 284.5 for a tidy profit).

The dynamics of the position are similar if we are long calls/short futures instead of being long puts/long futures on delta neutral basis. As the futures price increases, the delta equivalent of our calls increases and we start getting net long. As the futures price drops, the delta equivalent of our calls decreases and we become net short (since our short futures position stays the same). Put-call parity ensures that the implied volatility for a given strike price must be similar for the calls and puts. Thus, for an at-the-money delta neutral position, the trader is usually indifferent between using calls or puts.

So far we're having a lot of fun, since we make money regardless of whether the price goes up or down. The bad news is that if the futures stay relatively flat, we don't have any rebalancing opportunities and meanwhile the value of our options is slowly decaying away. So besides getting you long volatility, the above delta neutral positions are also a bet that the gains made in rebalancing the position will be sufficient to offset the time decay in the options.

Example 2: Short Volatility - Soybeans

Going short volatility using a delta neutral strategy is just the reverse of Example 1. We can either sell calls and buy futures or sell puts and sell futures (both on a delta-equivalent basis). In this case, we are earning time decay on the options (since we are short) but we are exposed to potential losses in the rebalancing process. If we can predict a calm market, not only can we benefit from a drop in implied volatility, but we can also earn some time decay on the short options.

Let's take a simple example where we have sold 200 September 500 soybean calls (SU500C) at 10.25 cents with a delta of 0.3. This is the delta equivalent of being short 300,000 bushels of SU9 futures. To get delta neutral, we buy 60 contracts of SU9 futures at the current price of 464.75. Now let's assume that on day two, SU9 rallies sharply to 480.00, causing our delta to increase to 0.40. Let's assume that given this sharp price move, implied volatility also increases from 29.5% to 31.0%. As a result, the price of our calls increases from 10.25 to 16.50 cents. Our mark-to-market position at the end of day two is:

SU 500C (Options)	Loss of 6.25 cents * 1,000,000 bushels =	($62,500)
SU9 (Futures)	Gain of 15.25 cents * 300,000 bushels =	$45,750
Net Open Equity		($16,750)

At the end of day two, we are now net short 100,000 bushels, since the delta-equivalent of our short calls has increased to 400,000 bushels (short), while we are still long only 300,000 bushels of SU9. Since we are net short in an up-market, our position incurs a loss. In this example, we have lost ground due to both the rebalancing loss and to the unfavorable move in implied volatility. When we are short volatility in this fashion, we will incur losses in the rebalancing process since we are always buying futures when the market rallies and selling them back if and when the market retraces. In the above example, if we bought an additional 100,000 bushels on day two to rebalance and then the market reversed itself back to 464.75, we would have realized a loss on the 100,000 bushels, with no corresponding gain in the short calls.

The big risk in trading volatility from the short side with a delta neutral position is when the market gaps higher or lower and/or you get caught in a limit move. Assume we had sold puts and sold futures against it on a delta equivalent basis and then the market traded limit up for 2 or 3 days. The long delta in our puts would be falling rapidly, but we would be unable to reduce our short futures position. As a result, we would be caught short and could incur substantial losses prior to being able to rebalance the position. Thus, while implied volatility often looks overvalued during the growing season, traders may still be reluctant to sell volatility aggressively [1]. Once again, when we short volatility in a delta neutral fashion, we are not only taking a position with respect to implied volatility, but we also taking on this rebalancing risk and in return earn the time decay on the options. The dynamics of the various delta neutral combinations are summarized in Table 2.

Table 2.
Delta Neutral Positions

Delta Neutral Position	Long/Short Volatility	Time Decay	Rebalancing Actions	
			Futures Up	Futures Down
Long Calls, Short Futures	Long	Paying	Sell Futures	Buy Futures
Long Puts, Long Futures	Long	Paying	Sell Futures	Buy Futures
Short Calls, Long Futures	Short	Earning	Buy Futures	Sell Futures
Short Puts, Short Futures	Short	Earning	Buy Futures	Sell Futures

There is no set "rule" for knowing when to rebalance a delta neutral position. The most common rule used to rebalance a delta neutral position is once a day based on the opening price. It is also possible to calculate the approximate size of move required to trigger a rebalancing gain or loss equivalent to the daily time decay in the option. The position is then rebalanced each time this size of move occurs in the underlying futures. Note again, that when the market gaps higher or lower, or is locked the limit, it can be impossible execute these rebalancing rules, which is a significant risk to traders that are short volatility on a delta neutral basis.

[1] Another way to get short volatility in this situation is by calendar spreading. For example, you could buy SQ475 calls and sell SX 475 calls with the idea that by the time the August calls expire we will know if there are any serious problems with the U.S. soybean crop. If there are no problems with the crop, the odds are good that your short November calls will expire worthless and implied volatility will drop.

III. ANALYZING THE MERITS OF A DELTA-NEUTRAL POSITION

Please note that this article was written in mid June of 1999. Now that we have mastered the basic concept and mechanics of delta neutral positions, let's analyze the merits of a specific delta neutral trade. September corn options have recently been trading at very high volatility levels, with the out-of-the-money calls trading in excess of 40% implied volatility. This is normal for this time of year, as the U.S. corn crop is now in its key production phase and heavily dependent on weather conditions. However, given the very large corn stocks in the U.S., and expectations for another large corn crop, it could be argued that the market has built an excessive volatility premium into these options. In other words, given the large carry-in stocks and the good condition of the crop to date, it could be argued that volatility is overpriced relative to the potential risk of any major disruption in the corn supply/demand balance.

Figure 1.
U.S. Ending Corn Stocks 91/92 to 99/00

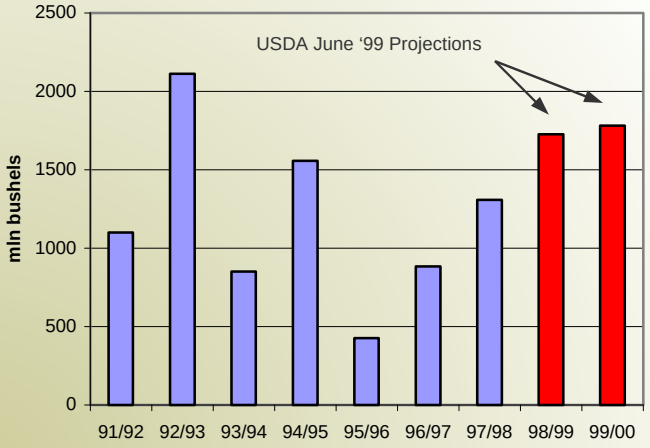
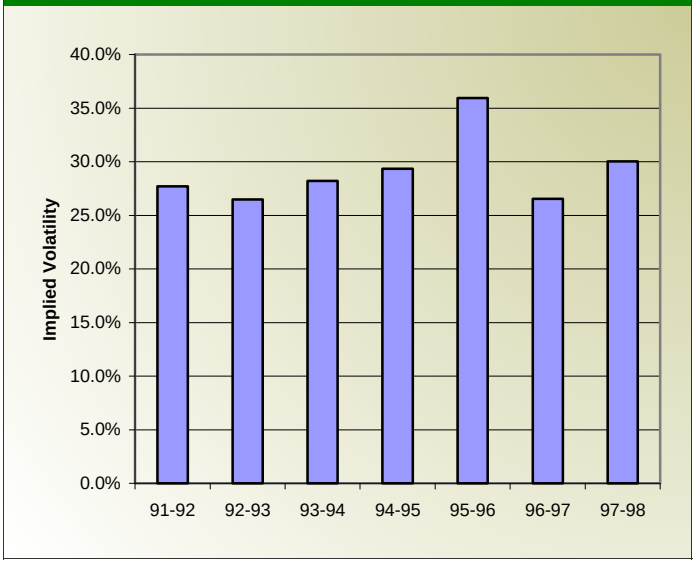


Figure 1 shows U.S. corn ending stocks going back to the 91/92 crop year, including USDA's June/99 projections for the 98/99 and 99/00 crop years. As shown in Figure 1, based on current projections there are ample stocks (both beginning and ending) projected for the 99/00 crop year. By way of comparison, Figure 2 shows the *average* implied volatility for September at-the-money corn options from June 1 to August 1 for the 91/92 to 97/98 crop years.

Figure 2.
Average September Corn Option Implied Volatility from June 1 to August 1 (At-the-Money)



As of this writing (June 21, 1999), implied volatility in at-the-money September corn options is trading around 33-34%. In the summer of 1996, when corn stocks were drawn down to a record low of 426 million bushels, implied volatility in September at-the-money corn options averaged 35.94% and peaked at 40.17% on July 1, 1996. At present, we have a vastly different stock situation, with USDA projecting corn carryout for 98/99 at 1,727 million bushels or *more than four times the 95/96 level*.

It should also be noted that the implied volatility in September corn options currently has a rather sharp positive skew, which means the further you move away from the at-the-money options, the higher the implied volatility. For example, with CU9 futures at 222 cents per bushel, the closing implied volatility levels for the September corn calls on June 21, 1999 were as follows:

CU220C (at-the-money)	33.39%
CU230C (1st out-of-the-money)	35.71%
CU240C (2nd out-of-the-money)	38.24%
CU250C (3rd out-of-the-money)	40.38%

Thus, by selling out-of-the-money calls, a trader has the opportunity to sell a higher implied volatility level. However, it should be recognized that the absolute volatility levels and the skew are largely independent of each other, and there is no guarantee that a general drop in implied volatility levels would be accompanied by a reduction in the skew.

We can also look at recent historical volatility in September corn futures and compare it to current implied volatility levels. Based on the 20-day average historical volatility measure, the *actual* volatility in CU9 has ranged between 15 and 21% over the past 20 trading sessions (May 25th to June 21st), well below recent implied volatility levels. Thus, up to this point, implied volatility has been overpriced relatively to the actual volatility in the underlying futures. However, keep in mind that implied volatility represents the market's view of *future* volatility and we may yet see volatility in September corn futures sufficient to warrant current implied volatility levels.

Finally, we can examine the merits of this trade (short volatility) from a seasonal standpoint. Figure 3 shows the average implied volatility for corn over the period January 1992 to May 1999. As shown in Figure 3, implied volatility in corn tends to peak in the last week of June, and then declines steadily into the harvest period. While the U.S. corn crop goes through the majority of its silking in the month of July, by the end of June the market is able to start building in a higher degree of confidence regarding the outcome of the crop.

Figure 3.
Corn Seasonal Implied Volatility—Jan/92 to May/99

Currently (as of the June 21/99 USDA Crop Progress Report), the U.S. corn crop is rated 75% good to excellent, with only 4% and 1% rating poor and very poor, respectively. Thus, based on current conditions and projected stock levels, it would appear that implied volatility is somewhat overpriced. Based on past years, this is also an optimal time to begin selling corn volatility based on its strong seasonal tendencies. However, we stress that this example is for illustrative purposes only. Shorting volatility at this point in the crop year is a risky proposition and this type of trade should be contemplated only by experienced traders. There is still ample time for the U.S. corn crop to run into problems that could cause implied volatility to rise sharply from current levels.

SUMMARY

This article has provided a detailed explanation of delta neutral trading. As noted, a trader using a delta neutral strategy to go long or short volatility must be cognizant of the risks and opportunities associated with *both* changes in implied volatility and the rebalancing of the position. However, while we have stressed the rebalancing process in this article, delta neutral trading is primarily a volatility play. In our experience, the majority of the gains and losses incurred in delta neutral trading are due to changes in implied volatility. We recommend that traders walk through a number of examples of delta neutral positions before commencing trading.

We have also provided a current example to illustrate the process a trader might go through to assess the merits of a delta neutral trade. This example is purely illustrative and is not meant to be an exhaustive treatment of the issue.

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Placing Option Volatility Orders

1. Be aware of the implied volatility level you are buying or selling. While your screen may provide "current" implied volatility levels for each strike and option month, these quotes are often stale since they are based on the last trade. You are better off entering the current bid/offer for the option and underlying futures for the option you are buying or selling to calculate your own implied volatility.

2. Generally speaking you should avoid leaving limit price orders in the pit. The reason is that the market makers in the pit will simply wait until the futures price moves in their favor to fill your order. Thus, while you thought would were buying puts at 20% implied volatility, you may end up getting filled at say 21%. You can limit the scope for this either by placing an explicit volatility order (see point 3) or by placing a fill or kill order, rather than leaving a resting order with the pit. Some traders also place contingent orders, where they specify the option price and where the futures must be before the order can be filled. For example, you might place an order to "buy 75 March 350 corn calls at 7 cents per bushel or better, contingent upon March corn futures trading at 352 or higher".

3. Rather than placing a price order you can also place orders in volatility terms. For example, rather than placing an order to "buy 75 March 350 corn calls at 7 cents per bushel", you could place the order to "buy 75 March 350 corn calls at 23% volatility or better". These orders are typically taken on a not-held basis, for a couple of reasons. First, often the underlying futures are fluctuating enough that it is difficult for the broker to guarantee an exact implied volatility level. Second, there are numerous pricing models in use that provide slightly different results with respect to implied volatility. We recommend that you compare your implied volatility levels to your broker well in advance of placing volatility orders.

4. When trading delta neutral positions it is also possible to place orders on a volatility *and* delta neutral basis. For example, you could place an order to "buy 75 March 350 corn calls at 23% implied volatility - delta neutral". To fill this order the broker will attempt to buy the 75 calls and sell the appropriate amount of futures to provide you with a delta neutral position at 23% implied volatility or better. These orders are also taken on a not held basis for a number of reasons. First, as with a straight volatility order, the underlying futures are often fluctuating as the order is being filled, thus the broker may not be willing to execute one leg of the position until he is sure he can get the other leg off successfully. Second, various option pricing models often differ in terms of their implied volatility and delta calculations. Finally, it is usually impossible to get a perfectly balanced position given the fixed size of each futures contract. For example, the delta equivalent of the option might be 253,478 bushels long, whereas you can only sell either 255,000 or 250,000 bushels of the underlying futures. It is strongly recommended that you discuss this type of order well in advance with your broker to ensure that both sides fully understand the objectives and parameters of the order. Rather than buying or selling the offsetting futures, some traders will use deep in-the-money options instead when establishing a delta neutral position. Deep in-the-money options have little or no time value and can be exercised to give the trader the desired futures position. An option pit broker may find it easier to execute a delta neutral position in this fashion since they can execute both sides of the position in the same pit.