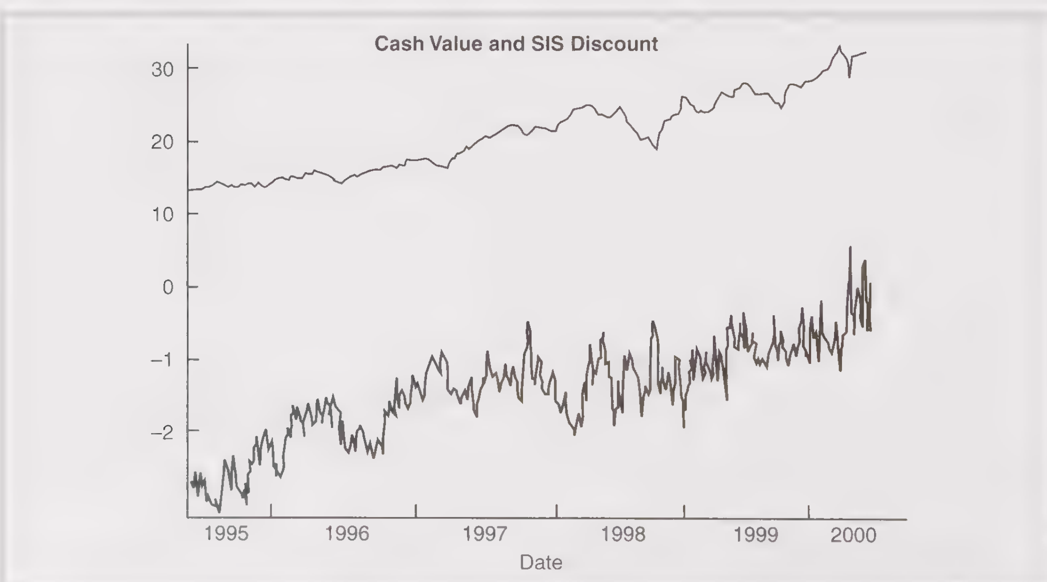
As it turned out, MID was strong during this seven-year period, and SIS wound up being worth just over $30 per share. So, in the end, the owner of SIS tripled his money in seven years and had no risk to begin with. Not a bad scenario.

SIS TRACK RECORD

What SIS also imparts to us, though, is a track record of how it traded during its life. Figure 32-1 shows the discount at which SIS traded during its lifetime. It is the lower line on the chart. The upper line is the corresponding cash value on the same dates. Note that the upper line has the exact same shape as the S&P Midcap 400 (MID) would, since it is merely MID multiplied by some arithmetic constant. The graph of the discount is rather "choppy" because it uses last sales of SIS to compute the discount. In reality, since SIS was a somewhat low-volume security, the last sale was not always representative of the closing bid–asked market in SIS. Nevertheless, the graph shows that the discount was greater than 2 points at the left side of the graph (1995) and gradually decreased until it reached zero near maturity (2000).

The graph in Figure 32-1 is useful because it encompasses cases where MID traded both above and below the striking price of 166.10. No matter whether SIS was in-the-money (MID above 166.1) or out-of-the-money, SIS traded at a discount. As mentioned previously, this is akin to a closed-end mutual fund trading at a discount to net asset value.

FIGURE 32-1.
SIS trading at a discount.



At a minimum, this discount allows the buyer of SIS to add an additional component of overall return to his investment. Also, in some cases—when MID was trading below the striking price—the buyer of SIS actually has a guaranteed return, as one might have with a bond paying interest or a stock paying a dividend. The examples in the next section examine those situations.

SIS TRADING AT A DISCOUNT TO CASH VALUE

When SIS is trading at a discount to cash value, the buyer of SIS actually has some downside protection.

Example: In late 1996, MID closed at 238.54 one day, and SIS closed at 13. The cash value of SIS for that price of MID is:

$$\text{Cash Value} = 10 + 10 \times 1.15 \times (238.54/166.10 - 1) = 15.02$$

Therefore, SIS is trading at almost exactly a 2-point discount to cash value. That is a fairly large discount of 15.4% (2/13 = .154).

One way to look at this would be to say that an investor is making an "extra" 15.4% on his investment. That is, if MID were at exactly the same price at expiration, the cash value would be the settlement price—15.02. In other words, the "stock market" as measured by MID was exactly unchanged. However, the investor would make a return of 15.4% because he bought SIS at a discount.

In fact, no matter where MID is at maturity, the investor feels the positive effect of having bought at a discount.

Thus, the discount can and should be perceived as adding to the overall return of owning the structured product. These discounts to net asset value are commonplace with structured products. However, there is another way to view it: as downside protection.

Example: Using the same prices, MID is at 238.54 and SIS is at 13—a 15.4% discount to the cash value of 15.02. Another way to view what this discount means is to view it as downside protection. In other words, MID could decline in price by maturity and this investor could still break even. The exact amount of the downside protection can be calculated. Essentially, one wants to know, at what price for MID would the cash value be 13?

Solving the following equation for MID would give the desired answer:

$$\begin{aligned}\text{Cash Value} = 13 &= 10 + 11.5 \times (\text{MID}/166.1 - 1)\\ 3 &= 11.5 \times \text{MID}/166.1 - 11.5\\ 14.5 \times 166.1/11.5 &= \text{MID}\\ 209.43 &= \text{MID}\end{aligned}$$

So, if MID were at 209.43, the cash value would be 13—the price the investory is currently paying for SIS. This is protection of 12.2% down from the current price of 238.54. That is, MID could decline 12.2% at maturity, from the current price of 238.54 to a price of 209.43, and the investor who bought SIS would break even because it would still have a cash value of 13.

Of course, this discount could have been computed using the SIS prices of 13 and 15.02 as well, but many investors prefer to view it in terms of the underlying index—especially if the underlying is a popular and often-cited index such as the S&P 500 or Dow-Jones Industrials.

From Figure 32-1, it is evident that the discount persisted throughout the entire life of the product, shrinking more or less linearly until expiration.

SIS TRADING AT A DISCOUNT TO THE GUARANTEE PRICE

In the previous example, the investor could have bought SIS at a discount to its cash value computation, but if the stock market had declined considerably, he would still have had exposure from his SIS purchase price of 13 down to the guarantee price of 10. The discount would have mitigated his percentage loss when compared to the MID index itself, but it would be a loss nevertheless.

However, there are sometimes occasions when the structured product is trading at a discount not only to cash value, but also to the guarantee price. This situation occurred frequently in the early trading life of SIS. From Figure 32-1, you can see that in 1995 the cash value was near 11, but SIS was trading at a discount of more than 2 points. In other words, SIS was trading below its guarantee price, while the cash value was actually *above* the guarantee price. It is a "double bonus" for an investor when such a situation occurs.

Example: In February 1995, the following prices existed:

MID:	177.59
SIS:	8.75

For a moment, set aside considerations of the cash value. If one were to buy SIS at 8.75 and hold it for the 5.5 years remaining until maturity, he would make 1.25 points on his 8.75 investment—a return of 14.3% for the 5.5-year holding period. As a compounded rate of interest, this is an annual compound return of 2.43%.

Now, a rate of return of 2.43% is rather paltry considering that the risk-free T-bill rate was more than twice that amount. However, in this case, you own a call option on the stock market and get to earn 2.43% per year while you own the call. In other words, *"they" are paying you to own a call option!* That's a situation that doesn't arise too often in the world of listed options.

If we introduce cash value into this computation, the discrepancy is even larger. Using the MID price of 177.59, the cash value can be computed as:

$$\text{Cash Value} = 10 + 11.5 \times (177.59/166.10 - 1) = 10.80$$

Thus, with SIS trading at 8.75 at that time, it was actually trading at a whopping 19% discount to its cash value of 10.80. Even if the stock market declined, the guarantee price of 10 was still there to provide a minimal return.

In actual practice, a structured product will not normally trade at a discount to its guarantee price while the cash value is *higher* than the guarantee price. There's only a narrow window in which that occurs.

There have been times when the stock market has declined rather substantially while these products existed. We can observe the discounts at which they then traded to see just how they might actually behave on the downside if the stock market declined after the initial offering date. Consider this rather typical example:

Example: In 1997, Merrill Lynch offered a structured product whose underlying index was Japan's Nikkei index. At the time, the Nikkei was trading at 20,351, so that was the striking price. The participation rate was 140% of the increase of the Nikkei above 20,351—a very favorable participation rate. This structured product, trading under the symbol JEM, was designed to mature in five years, on June 14, 2002.

As it turned out, that was about the peak of the Japanese market. By October of 1998, when markets worldwide were having difficulty dealing with the Russian debt crisis and the fallout from a major hedge fund in the U.S. going broke, the Nikkei had plummeted to 13,300. Thus, the Nikkei would have had to increase in price by just over 50% merely to get back to the striking price. Hence, it would not appear that JEM was ever going to be worth much more than its guarantee price of 10.

Since we have actual price histories of JEM, we can review how the marketplace viewed the situation. In October 1998, JEM was actually trading at 8.75—only 1.25 points below its guarantee price. That discount equates to an annual compounded rate of 3.64%. In other words, if one were to buy JEM at 8.75 and it matured at 10 about 40 months later, his return would have been 3.64% compounded annually. That by itself is a rather paltry rate of return, but one must keep in mind that he also would own a call option on the Nikkei index, and that option has a 140% participation rate on the upside.

COMPUTING THE VALUE OF THE IMBEDDED CALL WHEN THE UNDERLYING IS TRADING AT A DISCOUNT

Can we compute the value of the imbedded call when the structured product itself is trading at a discount to its guarantee price? Yes, the formulae presented earlier can always be used to compute the value of the imbedded call.

Example: Again using the example of JEM, the structured product on the Nikkei index, recall that it was trading at 8.75 with a guaranteed price of 10, with maturity 40 months hence. Assume that the risk-free interest rate at the time was 5.5%. Assuming continuous compounding, \$8.75 invested today would be worth \$10.51 in 40 months.

$$\text{Money in the bank} = 8.75 \times e^{rt}$$

$$\text{where } r = 0.05 \text{ and } t = 3.33 \text{ years (40 months)}$$

$$\text{Money in the bank} = 8.75 \times e^{0.055 \times 3.333} = 10.51$$

Since the structured product will be worth 10 at maturity, the value of the call is 0.51.

There is another, nearly equivalent way to determine the value of the call. It involves determining where the structured product would be trading if it were completely a zero-coupon debt of the underwriting brokerage. The difference between that value and the actual trading price of the structured product is the value of the imbedded call.

The credit rating of the underwriter of the structured product is an important factor in how large a discount occurs. Recall that the guarantee price is only as good as the creditworthiness of the underwriter. The underwriter is the one who will pay the cash settlement value at maturity—not the exchange where the product is listed nor any sort of clearinghouse or corporation.

THE ADJUSTMENT FACTOR

In recent years, some of the structured products have been issued with an *adjustment factor.* The adjustment factor is generally a negative thing for investors, although the underwriters try to couch it in language that makes it difficult to discern what is going on. Simply put, the adjustment factor is a multiplier (less than 100%) applied to the underlying index value *before* calculating the Final Cash Value. Adjustment factors seemed to come into being at about the time that index option implied volatility began to trade at much higher levels than it ever had (1997 onward).

Example: A structured product is issued at an initial price of \$10. It ostensibly allows one to participate in the appreciation of the S&P 500 index over a price of 1,100.00. However, upon closer inspection, what the product really offers is the opportunity for one to participate in the appreciation of the S&P 500 index (SPX) *over an adjusted value*, which is a percentage of the SPX price—not the actual price itself. The cash value settlement formula is stated as:

$$\text{Cash settlement value} = 10 + 10 \times (\text{Adjusted SPX} - 1{,}100.00) \ / \ 1{,}100.00$$

The formula looks similar to the "normal" cash settlement value formulae shown earlier in the chapter, but the term "adjusted SPX" has yet to be defined. In fact, it is defined as *a percentage of the final SPX Price*—91.25% in this case. In reality, the prospectus says something to the effect that the final price of SPX will be adjusted downward by an annual adjustment factor of 1.25%. Thus, at the end of the seven-year maturity period, the total adjustment factor would be seven times 1.25%, or 8.75%. The adjusted value is then equal to 100%—8.75%, or 91.25%.

The adjustment factor is an onerous burden for the investor. It means that the final value of SPX will be reduced by the adjustment factor *before* it is determined how far, or if at all, SPX is above the striking price of 1,100.00.

Example: Suppose that SPX exactly doubles in price during the life of the example structured product. That is, it finishes at 2,200.00—exactly twice the amount of the striking price. Before the cash settlement value can be determined, SPX must be adjusted:

$$\text{SPX adjusted value} = 0.9125 \times 2{,}200.00 = 2{,}007.50$$

So the final cash settlement value is based on the adjusted value of SPX:

$$\text{Cash settlement value} = 10 + 10 \times (2{,}007.50 - 1{,}100.00)/1{,}100.00 = 18.25$$

Hence, instead of doubling your money, as you might expect to do since the SPX Index doubled in price, you "only" make 82.5%.

Another way to view it: If the index doubles, then the structured product "should" be worth double the initial price, or 20. But instead, it's worth 91.25% of 20, or 18.25.

Carrying the example a little further, suppose that SPX had *tripled* in price by the maturity date, and was thus at 3,300. In this case, the cash settlement value would be:

$$\text{SPX adjusted value} = 0.9125 \times 3{,}300.00 = 3{,}011.25$$
$$\text{Cash settlement value} = 10 + 10 \times (3{,}011.25 - 1{,}100.00)/1{,}100.00 = 27.375$$

Or, thinking in the alternative, if the index triples, then the structured product (before adjustment factor) would be triple its initial price, or 30. Then $30 \times 91.25\% = 27.375$.

This example begins to demonstrate just how onerous the adjustment factor is. Notice that if the underlying doubles, you don't make "double" less 8.75% (the adjustment factor). No, you make "double" *times* the adjustment factor—17.5%—less than double. In the case of tripling, you make $3 \times 8.75\%$, or 26.25%, less than triple (i.e., the structured product is worth 27.375, not 30, so the percentage increase was 173.75%, not 200%—a difference of 26.25%, stated in terms of the initial investment). How can that be? It is a result of the adjustment factor being applied to the SPX price *before* your profit (cash settlement value) is computed.

THE BREAK-EVEN FINAL INDEX VALUE

Before discussing the adjustment factor in more detail, one more point should be made: The owner of the structured product doesn't get back anything more than the base value unless the underlying has increased by at least a fixed amount at maturity. In others words, the underlying must appreciate to a price large enough that the final price times the adjustment factor is greater than the striking price of the structured product. We'll call this price the *break-even final index value*.

An example will demonstrate this concept.

Example: As in the preceding example, suppose that the striking price of the structured product is 1,100 and the adjustment factor is 8.75%. At what price would the final cash settlement value be something *greater* than the base value of 10? That price can be solved for with the following simple equation:

$$\begin{aligned}\text{Break–even final index value} &= \text{Striking price}/(1 - \text{Adjustment factor})\\ &= 1,100/(0.9125) = 1,205.48.\end{aligned}$$

Generally speaking, the underlying index must increase in value by a specific amount just to break even. In this case that amount is:

$$1/(1 - \text{Adjustment factor}) = 1/0.9175 = 1.0959$$

In other words, the underlying index must increase in value by more than 9.5% by maturity just to overcome the weight of the adjustment factor. If the index increases by a lesser amount, then the structured product holder will merely receive back his base value (10) at maturity.

The previous examples all show that the adjustment factor is not a trivial thing. At first glance, one might not realize just how burdensome it is. After all, one might ask himself, what does 1.25% per year really matter? However, you can see that it *does* matter. In fact, our above examples did not even factor in the other cost that any investor has when his money is at risk—the cost of carry, or what he could have made had he just put the money in the bank.

MEASURING THE COST OF THE ADJUSTMENT FACTOR

The magnitude of the adjustment increases as the price of the underlying increases. It is an unusual concept. We know that the structured product initially had an imbedded call option. Earlier in this chapter, we endeavored to price that option. However, with the introduction of the concept of an adjustment factor, it turns out that the call option's cost is not a fixed amount. It varies, depending on the *final value* of the underlying index. In fact, the cost of the option is a percentage of the final value of the index. Thus, we can't really price it at the beginning, because we don't know what the final value of the index will be, In fact, we have to cease thinking of this option's cost as a fixed number. Rather, it is a geometric cost, if you will, for it increases as the underlying does.

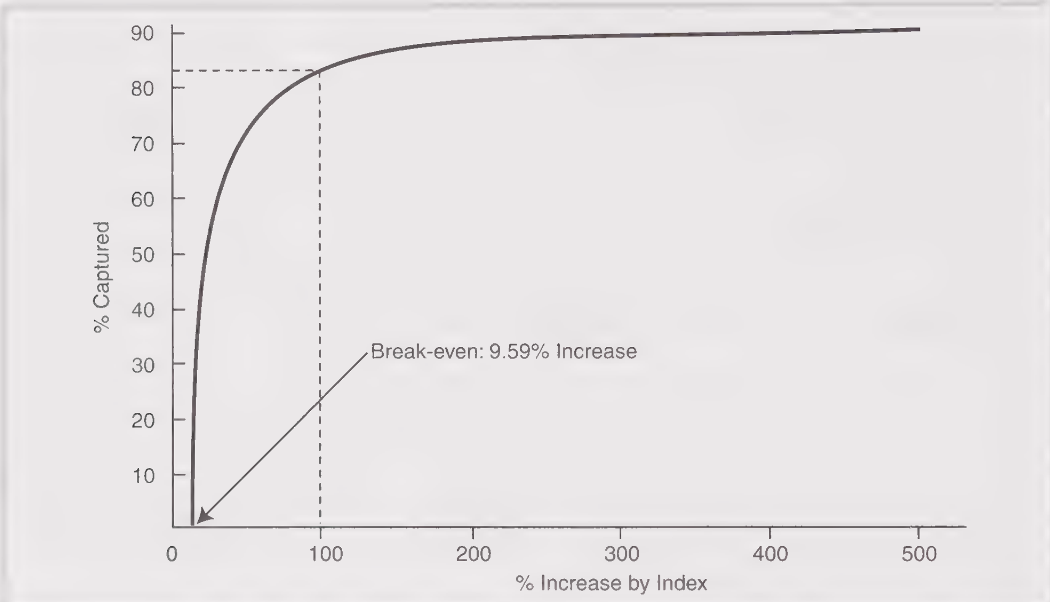
Perhaps another way to think of this is to visualize what the cost will be in percentage terms. Figure 32-2 compares how much of the percent increase in the index is captured by the structured product in the preceding example. The x-axis on the graph is the percent increase by the index. The y-axis is the percent realized by the structured product. The terms are the same as used in the previous examples: The strike price is 1,100, the total adjustment factor is 8.75%, and the guarantee price of the structured product is 10.

The dashed line illustrates the first example that was shown, when a doubling of the index value (an increase of 100%) to 2,200 resulted in a gain of 83.5% in the price of the structured. Thus, the point (100%, 83.5%) is on the line on the chart where the dashed lines meet.

Figure 32-2 points out just how little of the percent increase one captures if the underlying index increases only modestly during the life of the structured product. We already know that the index has to increase by 9.59% just to get to the break-even final price. That point is where the curved line meets the x-axis in Figure 32-2.

The curved line in Figure 32-2 increases rapidly above the break-even price, and then begins to flatten out as the index appreciation reaches 100% or so. This depicts the

FIGURE 32-2.
Percent of increase captured by structured product.

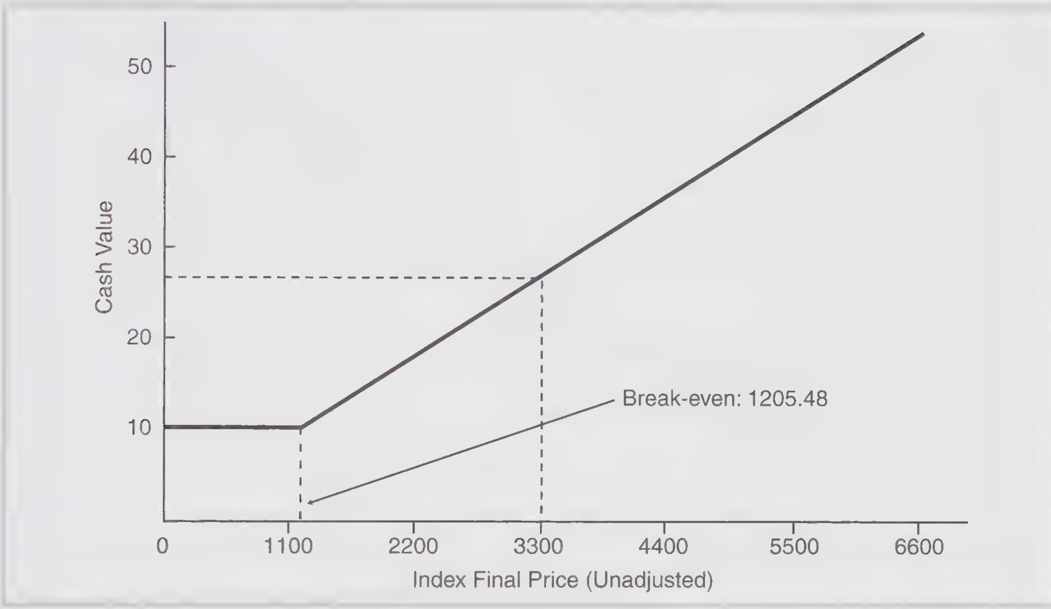


fact that, for small percentage increases in the index, the 8.75% adjustment factor—which is a flat-out downward adjustment in the index price—robs one of most of the percentage gain. It is only when the index has doubled in price or so that the curve stops rising so quickly. In other words, the index has increased enough in value that the structured product, while not capturing *all* of the percentage gain by any means, is now capturing a great deal of it.

After that, the curve in Figure 32-2 flattens dramatically. It eventually flattens out completely at 91.25%. That is, if the index increases enough in value (about 3,000% or more!), then the structured product final cash value will reflect the full 91.25% percent of appreciation of the index itself. That kind of increase in seven years is virtually unattainable. In reality, the index—if it increases at all—will probably be more in line with the values shown on the x-axis in Figure 32-2. In those cases, especially for increases of 100% or less, the oppressive weight of the adjustment factor significantly harms the return from the structured product.

One could visualize the graph in Figure 32-2 another way, if it would help. Replace the values on the x-axis with the actual index values: 2,200, 3,300, 4,400, 5,500, and 6,600 would replace the figures shown as 100, 200, 300, 400, and 500. Thus, the x-axis could then represent the final value of the index (before adjustment). That might help to

FIGURE 32-3.
Cash value of structured product at maturity.

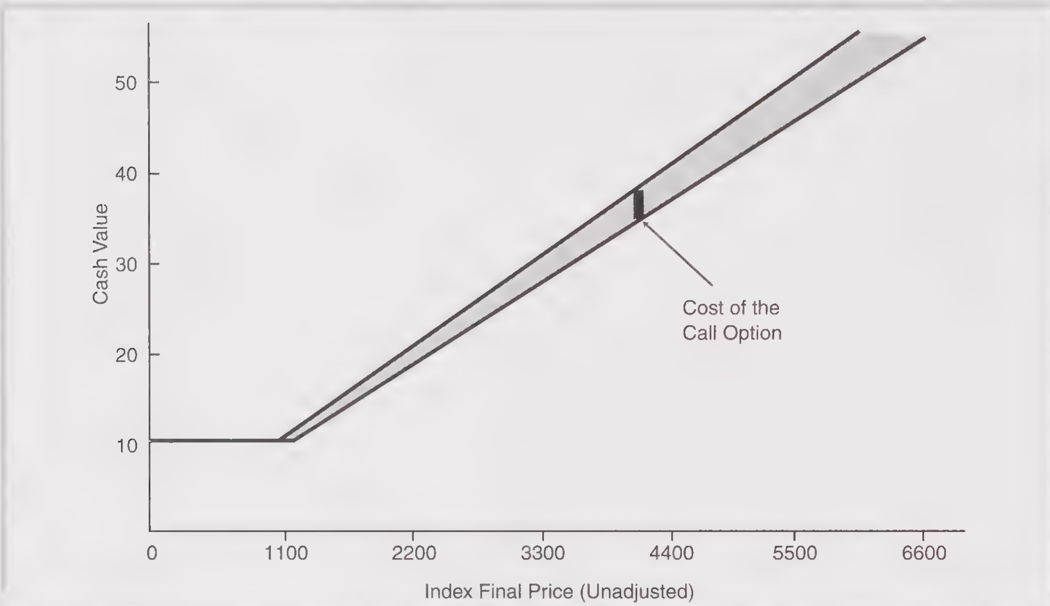


relate just how far the index would have to rise in order to overcome the downward adjustment.

Figure 32-3 shows a more conventional look at the comparison between the index value at maturity and the cash value of the structured product. For example, the dashed line shows that, with the final value (unadjusted) of the index at 3,300, the structured product's final cash value would be 27.375, as shown in a prior example. The line on Figure 32-3 looks like that of owning a call—limited risk, with large upside profit potential. It is much more difficult to tell that the adjustment factor is weighing down the value of the structured product so dramatically from this chart. Both Figures 32-2 and 32-3 are mathematically correct. However, only Figure 32-2 depicts the real cost of owning a structured product with an adjustment factor.

The final graph on this topic, Figure 32-4, shows the cash value of the adjusted structured product (the same line as was shown in Figure 32-3), compared with an unadjusted line. For example, the unadjusted line shows a true doubling of the price of the structured product if the underlying index has doubled. The difference between the two lines (the shaded area) can be thought of as the cost of the imbedded call—or at least as the cost of the adjustment factor. You can see from Figure 32-4 how the call's "cost" increases as the value of the underlying index increases.

FIGURE 32-4.
Comparison of adjusted and unadjusted cash values at maturity.



OTHER CONSTRUCTS

The financial engineers who create structured products have come up with a number of different constructs over time. Some resemble spreads, and some have two or three different products bundled into one. In fact, just about anything is possible. All that is required is that the underwriter thinks there is enough interest somewhere for him to be able to create the product, mark it up, and sell it to whomever has interest. In this section, a couple of different constructs, ones that have been brought to the public marketplace in the past, are discussed.

THE BULL SPREAD

Several structured products have represented a bull spread, in effect. In some cases, the structured product terms are stated just like those of a call spread in that the final cash value is defined with both a minimum and a maximum value. For example, it might be described something like this:

"The final cash value of the (structured) product is equal to a minimum of a base price of 10, plus any appreciation of the underlying index above the striking price, subject to a maximum price of 20" (where the striking price is stated elsewhere).

* * *

It's fairly simple to see how this resembles a bull spread: The worst you can do is to get back your $10, which is presumably the initial offering price, just as in any of the structured products described previously in this chapter. Then, above that, you'd get some appreciation of the index price above the stated striking price—again like the products discussed earlier. However, in this case, there is a maximum that the cash value can be worth: 20. In other words, there is a *ceiling* on the value of this structured product at maturity. It is exactly like a bull spread with two striking prices, one at 10 and one at 20. In reality, this structured product would have to be evaluated using *both* striking prices. We'll get to that in a minute.

There is another way that the underwriter sometimes states the terms of the structured product, but it is also a bull spread in effect. The prospectus might say something to the effect that the structured product is defined pretty much in the standard way, but that it is *callable* at a certain (higher) price on a certain date. In other words, someone else can call your structured product away on that date. In effect, you have *sold* a call with a higher striking price against your structured product. Thus, you own an imbedded call via the usual purchase of the structured product and you have written a call with a higher strike. That, again, is the definition of a bull spread.

When analyzing a product such as this, one must be mindful that there are *two* calls to price, not only in determining the final value, but more importantly in determining where you might expect the structured product to trade *during* its life, prior to maturity. An option strategist knows that a bull spread doesn't widen out to its maximum profit potential when there is still a lot of time remaining before expiration, unless the underlying rises by a substantial amount in excess of the higher striking price of the spread. Thus, one would expect this type of structured product to behave in a similar manner.

The example that will be used in the rest of this section is based on actual "bull spread" structured products of this type that trade in the open marketplace.

Example: Suppose that a structured product is linked to the Internet index. The strike price, based on index values, is 150. If the Internet index is below 150 at maturity, seven years hence, then the structured product will be worth a base value of 10. There is no adjustment factor, nor is there a participation rate factor. So far, this is just the same sort of definition that we've seen in the simpler examples presented previously. The final cash value formula would be simply stated as:

$$\text{Final cash value} = 10 \times (\text{Final Internet index value}/150)$$

However, the prospectus also states that this structured product is *callable* at a price of 25 during the last month of its life.

This call feature means that there is, in effect, a cap on the price of the underlying. In actual practice, the call feature may be for a longer or shorter period of time, and may be callable well in advance of maturity. Those factors merely determine the expiration date of the imbedded call that has been "written."

The first thing one should do is to convert the striking price into an equivalent price for the underlying index, so that he can see where the higher striking price is in relation to the index price. In this example, the higher striking price when stated in terms of the structured product is 2.5 times the base price. So the higher striking price, in *index* terms, would be 2.5 times the striking price, or 375:

$$\begin{aligned}\text{Index call price} &= (\text{Call price}/\text{Base price}) \times \text{Striking price}\\ &= (25/10) \times 150\\ &= 375\end{aligned}$$

Hence, if the Internet index rose above 375, the call feature would be "in effect" (i.e., the written call would be in-the-money). The value at which we can expect the structured product to trade, at maturity, would be equal to the base price plus the value of the bull spread with strikes of 10 and 25.

Valuing the Bull Spread. Just as the single-strike structured products have an imbedded call option in them, whose cost can be inferred, so do double-strike structured products. The same line of analysis leads to the following:

$$\text{“Theoretical” cash value} = 10 + \text{Value of bull spread} - \text{Cost of carry}$$

Cost of carry refers to the cost of carry of the base price (10 in this example).

By using an option model and employing knowledge of bull spreads, one can calculate a theoretical value for the structured product at any time during its life. Moreover, one can decide whether it is cheap or expensive—factors that would lead to a decision as to whether or not to buy.

Example: Suppose that the Internet index is trading at a price of 210. What price can we expect the structured product to be trading at? The answer depends on how much time has passed. Let's assume that two years have passed since the inception of the structured product (so there are still five years of life remaining in the option).

With the Internet index at 210, it is 40% above the structured product's lower striking price of 150. Thus, the equivalent price for the structured product would be 14. Another way to compute this would be to use the cash value formula:

$$\text{Cash value} = 10 \times (210 / 150) = 14$$

Now, we could use the Black–Scholes (or some other) model to evaluate the two calls—one with a striking price of 10 and the other with a striking price of 25. Using a volatility estimate of 50%, and assuming the underlying is at 14, the two calls are roughly valued as follows:

Underlying price: 14

Option	Theoretical Price
5-year call, strike = 10	7.30
5-year call, strike = 25	3.70

Thus, the value of the bull spread would be approximately 3.60 (7.30 minus 3.70). The structured product would then be worth 13.60—the base price of 10, plus the value of the spread:

$$\text{“Theoretical” cash value} = 10 + 3.60 - \text{Cost of carry} = 13.60 - \text{Cost of carry}$$

It may seem strange to say that the value of the structured product is actually less than the cash value, but that is what the call feature does: It reduces the worth of the structured product to values *below* what the cash value formula would indicate.

Given this information, we can predict where the structured product would trade at any price or at any time prior to maturity. Let's look at a more extreme example, then, one in which the Internet index has a tremendously big run to the upside.

Example: Suppose that the Internet index has risen to 525 with four years of life remaining until maturity of the structured product. This is well above the index-equivalent call price of 375. Again, it is first necessary to translate the index price back to an equivalent price of the structured product, using either percentage gains or the cash value formula:

$$\text{Cash value} = 10 \times (525/150) = 35$$

Again, using the Black–Scholes model, we can determine the following theoretical values:

Underlying price: 35

Option	Theoretical Price
3-year call, strike = 10	25.50
3-year call, strike = 25	14.70

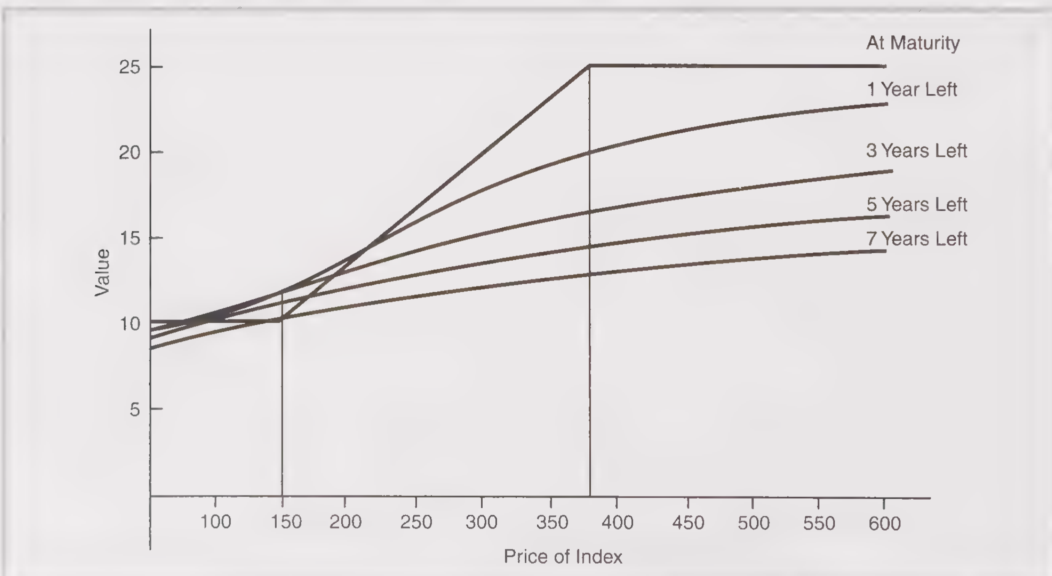
Now, the value of the bull spread is 10.80 (25.50 minus 14.70). The deepest in-the-money option is trading near parity, but the (written) option is only 10 points in-the-money and thus has quite a bit of time value premium remaining, since there are three years of life left:

$$\text{"Theoretical" cash value} = 10 + 10.80 = 20.80 - \text{Cost of carry}$$

Hence, even though the Internet index is at 525—far above the equivalent call price of 375—the structured product is expected to be trading at a price well below its maximum price of 25.

Figure 32-5 shows the values over a broad spectrum of prices and for various expiration dates. One can clearly see that the structured product will not trade near its

FIGURE 32-5.
Value of bull spread structured product.



maximum price of 25 until time shrinks to nearly the maturity date, or until the underlying index rises to very high prices. In particular, note where the theoretical values for the bull spread product lie when the index is at the higher striking price of 375 (there is a vertical line on the chart to aid in identifying those values). The structured product is not worth 20 in any of the cases, and for longer times to maturity, it isn't even worth 15. Thus, the call feature tends to dampen the upside profit potential of this product in a dramatic manner.

The curves in Figure 32-5 were drawn with the assumption that volatility is 50%. Should volatility change materially during the life of the structured product, then the values would change as well. A *lower* volatility would push the curves *up* toward the "at maturity" line, while an *increase* in volatility would push the curves down even further.

MULTIPLE EXPIRATION DATES

In some cases, more than one expiration date is involved when the structured product is issued. These products are very similar to the simple ones first discussed in this chapter. However, rather than maturing on a specific date, the final index value—which is used to determine the final cash value of the structured product—is the average of the underlying index price on two or three different dates.

For example, one such listed product was issued in 1996 and used the S&P 500 index (SPX) as the underlying index. The strike price was the price of SPX on the day of issuance, as usual. However, there were three maturity dates: one each in April 2001, August 2002, and December 2003. The final index value used to determine the cash settlement value was specified as the average of the SPX closings on the three maturity dates.

In effect, this structured product was really the sum of three separate structured products, each maturing on a different date. Hence, the values of the imbedded calls could each be calculated separately, using the methods presented earlier. Then those three values could be averaged to determine the overall value of the imbedded call in this structured product.

OPTION STRATEGIES INVOLVING STRUCTURED PRODUCTS

Since the structured products described previously are similar to well-known option strategies (long call, bull spread, etc.), it is possible to use listed options in conjunction with the structured products to produce other strategies. These strategies are actually quite simple and would follow the same lines as adjustment strategies discussed in the earlier chapters of this book.

Example: Assume that an investor purchased 15,000 shares of a structured product some time ago. It is essentially a call option on the S&P 500 index (SPX). The product was issued at a price of 10, and that is the guarantee price as well. The striking price is 700, which is where SPX was trading at the time. However, now SPX is trading at 1,200, well above the striking price. The cash value of the product is:

$$10 \times (1{,}200/700) = 17.4$$

Furthermore, assume that there are still two years remaining until maturity of the structured product, and the investor is getting a little nervous about the market. He is thinking of selling or hedging his holding in the structured product. However, the structured product itself is trading at 16.50, a discount of 64 cents from its theoretical cash value. He is not too eager to sell at such a discount, but he realizes that he has a lot of exposure between the current price and the guarantee price of 10.

He might consider writing a listed call against his position. That would convert it into the equivalent of a bull spread, since he already holds the equivalent of a long call via ownership of the structured product. Suppose that he quotes the SPX options that trade on the CBOE and finds the following prices for 6-month options, expiring in December:

SPX: 1,200

Option	Price
December 1,200 call	85
December 1,250 call	62
December 1,300 call	43

Suppose that he likes the sale of the December 1,250 call for 62 points. How many should he sell against his position in order to have a proper hedge?

First, one must compute a *multiplier* that indicates how many shares of the structured product are equivalent to one "share" of the SPX. That is done in the simple case by dividing the striking price by the guarantee price:

$$\begin{aligned}\text{Multiplier} &= \text{Striking price}/\text{Base price}\\ &= 700/10 = 70\end{aligned}$$

This means that buying 70 shares of the structured product is equivalent to being long one share of SPX. To verify this, suppose that one had bought 70 shares of the structured product initially at a price of 10, when SPX was at 700. Later, assume that SPX doubles to 1,400. With the simple structure of this product, which has a 100% participation rate and no adjustment factor, it should also double to 20. So 70 shares bought at 10 and sold at 20 would produce a profit of $700. As for SPX, one "share" bought at 700 and later sold at 1,400 would also yield a profit of $700. This verifies that the 70-to-1 ratio is the correct multiplier.

This multiplier can then be used to figure out the current equivalent structured product position in terms of SPX. Recall that the investor had bought 15,000 shares initially. Since the multiplier is 70-to-1, these 15,000 shares are equivalent to:

$$\begin{aligned}\text{SPX equivalent shares} &= \text{Shares of structured product held / Multiplier} \\ &= 15{,}000/70 = 214.29\end{aligned}$$

That is, owning this structured product is the equivalent of owning 214+ shares of SPX at current prices. Since an SPX call option is an option on 100 "shares" of SPX, one would write 2 calls (rounding off) against his structured profit position. Since the SPX December 1,250 calls are selling for 62, that would bring in $12,400 less commissions.

Note that the sale of these calls effectively puts a cap on the profit potential of the investor's overall position until the December expiration of the listed calls. If SPX were to rise substantially above 1,250, his profits would be "capped" because the two calls were sold. Thus, he has effectively taken his synthetic long call position and converted it into a bull spread (or a collared index fund, if you prefer that description).

In reality, *any* calls written against the structured product would have to be margined as naked calls. In a virtual sense, the 15,000 shares of the structured product "cover" the sale of 2 SPX calls, but margin rules don't allow for that distinction. In essence, the sale of two calls would create a bull spread. Alternatively, if one thinks of the structured product as a long index fully protected by a put (which is another way to consider it), then the sale of the SPX listed call produces a "collar."

Of course, one could write *more* than two SPX calls, if he had the required margin in his account. This would create the equivalent of a call ratio spread, and would have the properties of that strategy: greatest profit potential at the striking price of the written calls, limited downside profit potential, and theoretically unlimited upside risk if SPX should rise quickly and by a large amount.

In any of these option writing strategies, one might want to write out-of-the-money, short-term calls against his structured product periodically or continuously. Such a strategy would produce good results if the underlying index does not advance quickly while the written calls are in place. However, if the index should rise through the striking price of the written calls, such a strategy would detract from the overall return of the structured product.

Changing the Striking Price. Another strategy that the investor could use if he so desired is to establish a vertical call spread in order to effectively change the striking price of the (imbedded) call. For example, if the market had advanced by a great deal since the product was bought, the imbedded call would theoretically have a nice profit. If one could sell it and buy another, similar call at a higher strike, he would effectively be rolling his call up. This would raise the striking price and would reduce downside risk greatly (at the cost of slightly reducing upside profit potential).

Example: Using the same product as in the previous example, suppose that the investor who owns the structured product considers another alternative. In the previous example, he evaluated the possibility of selling a slightly out-of-the-money listed call to effectively produce a collared position, or a bull spread. The problem with that is that it limits upside profit potential. If the market were to continue to rise, he would only participate up to the higher strike (plus the premium received).

A better alternative might be to roll his imbedded call up, thereby taking some money out of the position but still retaining upside profit potential. Recall that the structured product had these terms:

Guarantee price: 10
Underlying index: S&P 500 index (SPX)
Striking price: 700

As in the earlier example, the investor owns 15,000 shares of the structured product. Furthermore, assume that there are about two years remaining until maturity of the structured product, and that the current prices are the same as in the previous example:

Current price of structured product: 16.50
Current price of SPX: 1,200

For purposes of simplicity, let's assume that there are listed two-year LEAPS options available for the S&P index, whose prices are:

S&P 2-year LEAPS, striking price 700:	550
S&P 2-year LEAPS, striking price 1,200:	210

In reality, S&P LEAPS options are normally reduced-value options, meaning that they are for one-tenth the value of the index and thus sell for one-tenth the price. However, for the purposes of this theoretical example, we will assume that the full-value LEAPS shown here exist.

It was shown in the previous example that the investor would trade *two* of these calls as an equivalent amount to the quantity of calls imbedded in his structured product. So, this investor could *buy* two of the 1,200 calls and *sell* two of the 700 calls and thereby roll his striking price up from 700 to 1,200. This roll would bring in 340 points, two times; or $68,000 less commissions.

Since the difference in the striking prices is 500 points, you can see that he is leaving something "on the table" by receiving only 340 points for the roll-up. This is common when rolling up: One loses the time value premium of the vertical spread. However, when viewed from the perspective of what has been accomplished, the investor might still find this roll worthwhile. He has now raised the striking price of his call to 1,200, based on the S&P index, and has taken in $68,000 in doing so. Since he owns 15,000 shares of the structured product, that means he has taken in 4.53 per share (68,000 / 15,000). Now, for example, if the S&P crashes during the next two years and plummets below 700 at the maturity date, he will receive $10 as the guarantee price plus the $4.53 he got from the roll—a total "guarantee" of $14.53. Thus, he has protected his downside.

Note that his downside risk is not completely eliminated, though. The current price of the structured product is 16.50 and the cash value at the current S&P price is 17.14 (see the previous example for this calculation), so he has risk from these levels down to a price of $14.53.

His upside is still unlimited, because he is not long two calls—the S&P 2-year LEAPS calls, struck at 1,200. The two LEAPS calls that he sold, struck at 700, effectively offsets the call imbedded in the structured product, which is also struck at 700.

This example showed how one could effectively roll the striking price of his structured product up to a higher price after the underlying had advanced. The individual investor would have to decide if the extra downside protection acquired is worth the profit potential sacrificed. That depends heavily, of course, on the prices of the listed S&P options, which in turn depend on things such as volatility and time remaining until expiration.

Of course, one other alternative exists for a holder of a structured product who has built up a good profit, as in the previous two examples: He could sell the product he owns and buy another one with a striking price closer to the current market value of the underlying index. This is not always possible, of course, but as long as these products continue to be brought to market every few months or so by the underwriters, there will be a wide variety of striking prices to choose from. A possible drawback to rolling to another structured product is that one might have to extend his holding's maturity date, but that is not necessarily a bad thing.

A different scenario exists when the underlying index *drops* after the structured product is bought. In that case, one would own a synthetic call option that might be quite far *out-of-the-money*. A listed call spread could be used to theoretically lower the call's striking price, so that upside movement might more readily produce profits. In such a case, one would sell a listed call option with a striking price equal to the striking price of the structured product and would buy a listed call option with a lower striking price—one more in line with current market values. In other words, he would buy a listed call bull spread to go along with his structured product. Whatever debit he pays for this call bull spread will increase his downside risk, of course. However, in return he gains the ability to make profits more quickly if the underlying index rises above the new, lower striking price.

Many other strategies involving listed options and the structured product could be constructed, of course. However, the ones presented here are the primary strategies that an investor should consider. All that is required to analyze any strategy is to remember that this type of structured product is merely a synthetic long call. Once that concept is in mind, then any ensuing strategies involving listed options can easily be analyzed. For example, the purchase of a listed put with a striking price essentially equal to that of the structured product would produce a position similar to a long straddle. The reader is left to interpret and analyze other such strategies on his own.

LISTS OF STRUCTURED PRODUCTS

The descriptions provided so far encompass the great majority of listed structured products. There are many similar ones involving individual stocks instead of indices (often called equity-linked notes). The concepts are the same; merely substitute a stock price for an index price in the previous discussions in this chapter.

Some large insurance companies offer similar products in the form of annuities. They behave in exactly the same way as the products described above, except that there is no continuous market for them. However, they still afford one the opportunity to own an index fund with no risk. Many of the insurance company products, in fact, pay interest to the annuity holder—something that most of the products listed on the stock exchanges do not.

Many of these structured products are introduced by brokerage firms and shown to their clients. Some are listed, although far fewer than there used to be. There are magazines and websites that specialize in listing the available products. Doing a web search for them is an easy way to obtain a potential list of current structured products.

OTHER STRUCTURED PRODUCTS

EXCHANGE-TRADED FUNDS

Other listed products exist that are simpler in nature than those already discussed, but that the exchanges sometimes refer to as structured products. They often take the form of unit trusts and mutual funds. The general term for these products is Exchange-Traded Funds (ETFs). In a unit trust, an underwriter (Merrill Lynch, for example) packages together 10 to 12 stocks that have similar characteristics; perhaps they are in the same industry group or sector. The underwriter forms a unit trust with these stocks. That is, the shares are held in trust and the resulting entity—the unit trust—can actually be traded as shares of its own. The units are listed on an exchange and trade just like stocks.

Example: One of the better-known and popular unit trusts is called the Standard & Poor's Depository Receipt (SPDR). It is a unit trust that exactly matches the S&P 500 index, divided by 10. The SPDR unit trust is affectionately called Spiders (or Spyders). It trades under the symbol SPY. If the S&P 500 index itself is at 1,400, for example, then SPY will be trading near 140. Unit trusts are very active, mostly because they allow any investor to buy an index fund, and to move in and out of it at will. The bid–asked spread differential is very tight, due to the liquidity of the product. When a customer trades the SPY, he pays a commission, just as he would with any listed stock.

Exchange-traded funds are attractive to all investors who like to trade or invest in index funds, preferring the diversity provided by an index (passive management of stocks) to an active role in managing individual stocks. Exchange-traded funds can be sold short as long as the shares can be borrowed. Some of them don't even require an uptick when executing the short sale.

Two other large and well-known unit trusts are similar to SPY. One is the NASDAQ-100 tracking stock, whose symbol is QQQ. QQQ is $\frac{1}{40}$th of the value of the NASDAQ-100 index (NDX), although it should be noted that NDX has split two-for-one in the past, as has QQQ, so the relationship could change by a factor of two. The other large, popular unit trust is linked to the Dow-Jones 30 Industrials; it is called Diamonds and trades under the symbol DIA. Since this concept has proved to be popular, *sector SPDRs* were created on a large number of S&P index sectors—technology, oil, semiconductors, etc. These have proven to be less popular. There are even ETFs that are equal to one-tenth of the OEX index, although they have not proven to be liquid.

ETFs are "created" by institutions in blocks of shares known as Creation Units. A creation requires a deposit with the trustee of a specified number of shares of a portfolio of stocks closely approximating the composition of a specific index, and cash equal to accumulated dividends in return for specific index shares. Similarly, block-sized units of ETFs can be redeemed in return for a portfolio of stocks approximating the index and a specified amount of cash. Very large blocks of shares—50,000 or more—are required to create SPY, QQQ, DIA, and so forth. Slightly smaller blocks of shares are required to create the sector funds.

A very large segment of ETFs, called iShares, was created by Barclays Global Investors to track all kinds of index funds. Many of these are not well known to the public, such as the Russell 2000 Value Fund and the Russell 2000 Growth Fund, but most of them are understandable upon inspection. There are iShares on funds that track foreign industries, plus a broad spectrum of funds that track small-cap stocks, value stocks, growth stocks, or individual sectors such as health care, the Internet, or real estate. The website www.ishares.com shows all of the currently available iShares. The iShares are all traded on major stock exchanges.

Another major segment of ETFs are called Holding Company Depository Receipts (HOLDERS). They were created by Merrill Lynch. A large number of ETFs in recent years have been added to simulate commodities. These include Crude Oil, Gold, Silver, Cotton, Natural Gas, Gasoline, and so forth. These will be discussed in more detail in Chapter 34s and 35.

Options on ETFs. Options are listed on many ETFs. QQQ options, for example, are listed on all of the option exchanges and are some of the most liquid contracts in existence. Things can always change, of course: Witness OEX, which at one time traded a million contracts a day and now barely trades one-thirtieth of that on most days.

The options on ETFs can be used as substitutes for many expensive indices. This brings index option trading more into the realm of reasonable cost for the small individual investor.

Example: The PHLX Semiconductor index (SOX) has been a popular index since its inception, especially during the time that tech stocks were roaring. The index, whose options are expensive because of its high statistical volatility, traded at prices between 500 and 1,300 for several years. During that time, both implied and historical volatility was near 70%. So, for example, if SOX were at 1,000 and one wanted to buy a three-month at-the-money call, it would cost approximately 135 points. That's $13,500 for *one* call option. For many investors, that's out of the realm of feasibility.

However, there are HOLDRS known as Semiconductor HOLDRS (symbol: SMH). The Semiconductor HOLDERS are composed of 20 stocks (in differing quantities, since it is a capitalization-weighted unit trust) that behave in aggregate in much the same manner as the Semiconductor index (SOX) does. However, SMH has traded at prices between 40 and 100 over the same period of time that SOX was trading between 500 and 1,300.

The implied volatility of SMH options is 70%—just like SOX options—because the same stocks are involved in both indices. However, a three-month at-the-money call on the $100 SMH, say, would cost only 13.50 points ($1,350)—a much more feasible option cost for most investors and traders.

Thus, a strategy that most option traders should keep in mind is one in which ETFs are substituted when one has a trading signal or opinion on a high-priced index. Similarities exist among many of them. For example, the Morgan Stanley High-Tech index (MSH) is well known for the reliability of its put–call ratio sentiment signals. However, the index is high-priced and volatile, much like SOX. Upon examination, though, one can discover that QQQ trades almost exactly like MSH. So QQQ options and "stock" can be used as a substitute when one wants to trade MSH.

STRUCTURED PRODUCT SUMMARY

Structured products can and should be utilized by investors looking for unique ways to protect long-term holdings in indices or individual stocks.

The number of these products is constantly evolving and changing. Analytical tools are available on the web as well. For example, the site www.derivativesmodels.com has over 40 different models especially designed for evaluating options and structured products. They range from the simple Black–Scholes model to models that are designed to evaluate extremely complicated exotic options.

All of these products have a place, but the most conservative seem to be the structured products that provide upside market potential while limiting downside risk—the products discussed at the beginning of the chapter. As long as the creditworthiness of the underwriter is not suspect, such products can be useful longer-term investments for nearly everyone who bothers to learn about and understand them.

CHAPTER 33

Mathematical Considerations for Index Products

In this chapter, we look at some riskless arbitrage techniques as they apply to index options. Then a summary of mathematical techniques, especially modeling, is presented.

ARBITRAGE

Most of the normal arbitrage strategies have been described previously. We will review them here, concentrating on specific techniques not described in previous chapters on hedging (market baskets) and index spreading.

DISCOUNTING

Discounting is only applicable to index options that are American-style—that can be exercised on any trading day. Most index options are European-style, meaning they can only be exercised at the end of their life.

We saw that discounting in cash-based index options is done with in-the-money options as it is with stock options. However, since the discounter cannot exactly hedge the cash-based index options, he will normally do his discounting near the close of the day so that there is as little time as possible between the time the option is bought and the close of the market. This reduces the risk that the underlying index can move too far before the close of trading.

Example: OEX is trading at 673.53 and an arbitrageur can buy the June 690 puts for 16. That is a discount of 0.47 since parity is 16.47. Is this enough of a discount? That is, can the discounter buy this put, hold it unhedged until the close of trading, and exercise it; or is there too great a chance that OEX will rally and wipe out his discount?

If he buys this put when there is very little time left in the trading day, it *might* be enough of a discount. Recall that a one-point move in OEX is roughly equivalent to 15 points on the Dow (while a one-point move in SPX is about 7.5 Dow points). Thus, this OEX discount of 0.47 is about equal to 7 Dow points. Obviously, this is not a lot of cushion, because the Dow can easily move that far in a short period of time, so it would be sufficient only if there are just a few minutes of trading left and there were not previous indications of large orders to buy "market on close."

However, if this situation were presented to the discounter at an earlier time in the trading day, he might defer because he would have to hedge his position and that might not be worth the trouble. If there were several hours left in the trading day, even a discount of a full point would not be enough to allow him to remain unhedged (one full OEX point is about 30 Dow points). Rather, he would, for example, buy futures, buy OEX calls, or sell puts on another index. At the end of the day, he could exercise the puts he bought at a discount and reverse the hedge in the open market.

CONVERSIONS AND REVERSALS

Conversions and reversals in cash-based options are really the market basket hedges (index arbitrage) described in Chapter 30. That is, the underlying security is actually all the stocks in the index. However, the more standard conversions and reversals can be executed with futures and futures options.

Since there is no credit to one's account for selling a future and no debit for buying one, most futures conversions and reversals trade very nearly at a net price equal to the strike. That is, the value of the out-of-the-money futures option is equal to the time premium of the in-the-money option that is its counterpart in the conversion or reversal.

Example: An index future is trading at 179.00. If the December 180 call is trading for 5.00, then the December 180 put should be priced near 6.00. The time value premium of the in-the-money put is 5.00 (6.00 + 179.00 – 180.00), which is equal to the price of the out-of-the-money call at the same strike.

If one were to attempt to do a conversion or reversal with these options, he would have a position with no risk of loss but no possibility of gain: A reversal would be established, for example, at a "net price" of 180. Sell the future at 179, add the premium of the put, 6.00, and subtract the cost of the call, 5.00: 179 + 6.00 – 5.00 = 180.00. As we know from Chapter 27 on arbitrage, one unwinds a conversion or reversal for a "net price" equal to the strike. Hence, there would be no gain or loss from this futures reversal.

For index futures options, there is no risk when the underlying closes near the strike, since they settle for cash. One is not forced to make a choice as to whether to exercise his calls. (See Chapter 27 on arbitrage for a description of risks at expiration when trading reversals or conversions.)

In actual practice, floor traders may attempt to establish conversions in futures options for small increments—perhaps 5 or 10 cents in S&P futures, for example. The arbitrageur should note that futures options do actually create a credit or debit in the account. That is, they are like stock options in that respect, even though the underlying instrument is not. This means that if one is using a deep in-the-money option in the conversion, there will actually be some carrying cost involved.

Example: An index future is trading at 179.00 and one is going to price the December 190 conversion, assuming that December expiration is 50 days away. Assume that the current carrying cost of money is 10% annually. Finally, assume that the December 190 call is selling for 1.00, and the December 190 put is selling for 11.85. Note that the put has a time value premium of only 85 cents, less than the premium of the call. The reason for this is that one would have to pay a carrying cost to do the December 190 conversion.

If one established the 190 conversion, he would buy the futures (no credit or debit to the account), buy the put (a debit of 11.85), and sell the call (a credit of 1.00). Thus, the account actually incurs a debit of 10.85 from the options. The carrying cost for 10.85 at 10% for 50 days is $10.85 \times 10\% \times 50/365 = 0.15$. This indicates that the converter is willing to pay 15 cents less time premium for the put (or conversely that the reversal trader is willing to sell the put for 15 cents less time premium). Instead of the put trading with a time value premium equal to the call price, the put will trade with a premium of 15 cents less. Thus, the time premium of the put is 85 cents, rather than being equal to the price of the call, 1.00.

BOX SPREADS

Recall that a "box" consists of a bullish vertical spread involving two striking prices, and a bearish vertical spread using the same two strikes. One spread is constructed with puts and the other with calls. The profitability of the box is the same regardless of the price of the underlying security at expiration.

Box arbitrage with equity options involves trying to buy the box for less than the difference in the striking prices, for example, trying to buy a box in which the strikes are 5 points apart for 4.75. Selling the box for more than 5 points would represent arbitrage as well. In fact, even selling the box at exactly 5 points would produce a profit for the arbitrageur, since he earns interest on the credit from the sale.

These same strategies apply to options on futures. However, boxes on cash-based options involve another consideration. It is often the case with cash-based options that the box sells for more than the difference in the strikes. For example, a box in which the strikes are 10 points apart might sell for 10.50, a substantial premium over the striking price differential. The reason that this happens is because of the possibility of early assignment. The seller of the box assumes that risk and, as a result, demands a higher price for the box.

If he sells the box for half a point more than the striking price differential, then he has a built-in cushion of .50 of index movement if he were to be assigned early. In general, box strategies are not particularly attractive. However, if the premium being paid for the box is excessively high, then one should consider selling the box. Since there are four commissions involved, this is not normally a retail strategy.

MATHEMATICAL APPLICATIONS

The following material is intended to be a companion to Chapter 28 on mathematical applications. Index options have a few unique properties that must be taken into account when trying to predict their value via a model.

The Black–Scholes model is still the model of choice for options, even for index options. Other models have been designed, but the Black–Scholes model seems to give accurate results without the extreme complications of most of the other models.

FUTURES

Modeling the fair value of most futures contracts is a difficult task. The Black–Scholes model is not usable for that task. Recall that we saw earlier that the fair value of a future contract on an index could be calculated by computing the present value of the dividend and also knowing the savings in carrying cost of the futures contract versus buying the actual stocks in the index.

CASH-BASED INDEX OPTIONS

The futures fair value model for a capitalization-weighted index requires knowing the exact dividend, dividend payment date, and capitalization of each stock in the index (for price-weighted indices, the capitalization is unnecessary). This is the only way of getting the accurate dividend for use in the model. The same dividend calculation must be done for any other index before the Black–Scholes formula can be applied.

In the actual model, the dividend for cash-based index options is used in much the same way that dividends are used for stock options: The present value of the dividend is subtracted from the index price and the model is evaluated using that adjusted stock price. With stock options, there was a second alternative—shortening the time to expiration to be equal to the ex-date—but that is not viable with index options since there are numerous ex-dates.

Let's look at an example using the same fictional dividend information and index that were used in Chapter 30 on stock index hedging strategies.

Example: Assume that we have a capitalization-weighted index composed of three stocks: AAA, BBB, and CCC. The following table gives the pertinent information regarding the dividends and floats of these three stocks:

Stock	Dividend Amount	Days until Dividend	Float
AAA	1.00	35	50,000,000
BBB	0.25	60	35,000,000
CCC	0.60	8	120,000,000
Divisor: 150,000,000			

One first computes the present worth of each stock's dividend, multiplies that amount by the float, and then divides by the index divisor. The sum of these computations for each stock gives the total dividend for the index. The present worth of the dividend for this index is $0.8667.

Assume that the index is currently trading at 175.63 and that we want to evaluate the theoretical value of the July 175 call. Then, using the Black–Scholes model, we would perform the following calculations:

1. Subtract the present worth of the dividend, 0.8667, from the current index price of 175.63, giving an adjusted index price of 174.7633.
2. Evaluate the call's fair value using 174.7633 as the stock price. All other variables are as they are for stocks, including the risk-free interest rate at its actual value (10%, for example).

The theoretical value for puts is computed in the same way as for equity options, by using the arbitrage model. This is sufficient for cash-based index options because it is possible—albeit difficult—to hedge these options by buying or selling the entire index. Thus, the options should reflect the potential for such arbitrage. The put value should, of course, reflect the potential for dividend arbitrage with the index. The arbitrage valuation model presented in Chapter 28 on modeling called for the dividend to be used. For these index puts, one would use the present worth of the dividend on the index—the same one that was used for the call valuation, as in the last example.

THE IMPLIED DIVIDEND

If one does not have access to all of the dividend information necessary to make the "present worth of the dividends" calculation (i.e., if he is a private individual or public customer who does not subscribe to a computer-based dividend "service"), there is still a way to estimate the present worth of the dividend. All one need do is make the assumption that the market-makers know what the present worth of the dividend is, and are thus pricing the options accordingly. The individual public customer can use this information to deduce what the dividend is.

Example: SPX is trading at 1400, the June options have 30 days of life remaining, the short-term interest rate is 10%, and the following prices exist:

June 1400 call: 38.00
June 1400 put: 30.00

One can use iterations of the Black–Scholes model to determine what the SPX "dividend" is. In this case, it turns out to be something on the order of $2.50

Briefly, these are the steps that one would need to follow in order to determine this dividend:

1. Assume the dividend is $0.00.
2. Using the assumed dividend, use the Black–Scholes model to determine the implied volatility of the call option, whose price is known (38.00 in the above example).
3. Using the implied volatility determined from step 2 and the assumed dividend, is the arbitrage put value as derived from the Black–Scholes calculations at the end of step 2 roughly equal to the market value of the put (30.00 in the above example)? If yes, you are done. If not, increase the assumed dividend by some nominal amount, say $0.10, and return to step 2.

Thus, without having access to complete dividend information, one can use the information provided to him by the marketplace in order to *imply* the dividend of an index option. The only assumption one makes is that the market-makers know what the dividend is (they most assuredly do). Note that the implied volatility of the options is determined concurrently with the implied dividend (step 2 above). A very useful tool, this simple "implied dividend calculator" can be added to any software that employs the Black–Scholes model.

EUROPEAN EXERCISE

To account for European exercise, one basically ignores the fact that an in-the-money put option's minimum value is its intrinsic value. European exercise puts can trade at a discount to intrinsic value. Consider the situation from the viewpoint of a conversion arbitrage. If one buys stock, buys puts, and sells calls, he has a conversion arbitrage. In the case of a European exercise option, he is forced to carry the position to expiration in order to remove it: He cannot exercise early, nor can he be called early. Therefore, his carrying costs will always be the maximum value to expiration. These carrying costs are the amount of the discount of the put value.

For a deeply in-the-money put, the discount will be equal to the carrying charges required to carry the striking price to expiration:

$$\text{Carry} = s\left[1 - \frac{1}{(1+r)^t}\right]$$

Less deeply in-the-money puts, that is, those with deltas less than –1.00, would not require the full discounting factor. Rather, one could multiply the discounting factor by the absolute value of the put's delta to arrive at the appropriate discounting factor.

FUTURES OPTIONS

A modified Black–Scholes model, called the Black Model, can be used to evaluate futures options. See Chapter 29 on futures for a futures discussion. Essentially, the adjustment is as follows: Use 0% as the risk-free rate in the Black–Scholes model and obtain a theoretical call value; then discount that result.

Black model:

$$\text{Call value} = e^{-rt} \times \text{Black–Scholes call value } [\text{using } r = 0\%]$$

where

r is the risk-free interest rate

and t is the time to expiration in years.

The relationship between a futures call theoretical value and that of a put can also be discussed from the model:

$$\text{Call} = \text{Put} + e^{-rt}(f - s)$$

where
f is the futures price
and s is the striking price.

Example: The following prices exist:

ZYX Cash Index: 174.49
ZYX December future: 177.00

There are 80 days remaining until expiration, the volatility of ZYX is 15%, and the risk-free interest rate is 6%.

In order to evaluate the theoretical value of a ZYX December 185 call, the following steps would be taken:

1. Evaluate the regular Black–Scholes model using 185 as the strike, 177.00 as the stock price, 15% as the volatility, 0.22 as the time remaining (80/365), *and 0% as the interest rate.* Note that the *futures price*, not the index price, is input to the model as stock price.

   Suppose that this yields a result of 2.05.
2. Discount the result from step 1:

$$\begin{aligned}\text{Black Model call value} &= e^{-(.06\times 0.22)} \times 2.05\\ &= 2.02\end{aligned}$$

In this case, the difference between the Black model and the Black–Scholes model is small (3 cents). However, the discounting factor can be large for longer-term or deeply in-the-money options.

The other items of a mathematical nature that were discussed in Chapter 28 on mathematical applications are applicable, without change, to index options. Expected return and implied volatility have the same meaning. Implied volatility can be calculated by using the Black–Scholes formulas as specified above.

Neutral positioning retains its meaning as well. Recall that any of the above theoretical value computations gives the delta of the option as a by-product. These deltas can be used for cash-based and futures options just as they are used for stock options to maintain a neutral position. This is done, of course, by calculating the equivalent stock position (or equivalent "index" or "futures" position, in these cases).

FOLLOW-UP ACTION

The various types of follow-up action that were applicable to stock options are available for index options as well. In fact, when one has spread options on the same underlying index, these actions are virtually the same. However, when one is doing inter-index spreads, there is another type of follow-up picture that is useful. The reason for this is that the spread will have different outcomes not only based on the price of one index, but also based on that index's relationship to the other index.

It is possible, for example, that a mildly bullish strategy implemented as an inter-index spread might actually lose money even if one index rose. This could happen if the other index performed in a manner that was not desirable. If one could have his computer "draw" a picture of several different outcomes, he would have a better idea of the profit potential of his strategy.

Example: Assume a put spread between the ZYX and the ABX indices was established. An ABX June 180 put was bought at 3.00 and a ZYX June 175 put was sold at 3.00, when the ZYX was at 175.00 and the ABX Index was at 178.00. This spread will obviously have different outcomes if the prices of the ZYX and the ABX move in dramatically different patterns.

On the surface, this would appear to be a bearish position—long a put at a higher strike and short a put at a lower strike. However, the position could make money even in a rising market if the indices move appropriately: If, at expiration, the ZYX and ABX are both at 179.00, for example, then the short option expires worthless and the long option is still worth 1.00. This would mean that a 1-point profit, or $500, was made in the spread ($1,500 profit on the short ZYX puts less a $1,000 loss on the one ABX put).

Conversely, a downward movement doesn't guarantee profits either. If the ZYX falls to 170.00 while the ABX declines to 175.00, then both puts would be worth 5 at expiration and there would be no gain or loss in the spread.

What the strategist needs in order to better understand his position is a "sliding scale" picture. That is, most follow-up pictures give the outcome (say, at expiration) of the position at various stock or index prices. That is still needed: One would want to see the outcome for ZYX prices of, say, 165 up to 185 in the example. However, in this spread something else is needed: The outcome should also take into account how the ZYX matches up with the ABX. Thus, one might need three (or more) tables of outcomes, each of which depicts the results as ZYX ranges from 165 up to 185 at expiration. One might first show how the results would look if ZYX were, say, 5 points below ABX; then another table would show ZYX and ABX unchanged from their original relationship (a 3-point differential); finally, another table would show the results if ZYX and ABX were equal at expiration.

If the relationship between the two indices were at 3 points at expiration, such a table might look like this:

	Price at Expiration				
ZYX	165	170	175	180	185
ABX	168	173	178	183	188
ZYX June 175P	10	5	0	0	0
ABX June 180P	12	7	2	0	0
Profit	+$1,000	+$1,000	+$1,000	0	0

This picture indicates that the position is neutral to bearish, since it makes money even if the indices are unchanged. However, contrast this with the situation in which the ZYX falls to a level 5 points below the ABX by expiration.

	Price at Expiration				
ZYX	165	170	175	180	185
ABX	170	175	180	185	190
ZYX June 175P	10	5	0	0	0
ABX June 180P	10	5	0	0	0
Profit	0	0	0	0	0

In this case, the spread has no potential for profit at all, even if the market collapses. Thus, even a bearish spread like this might not prove profitable if there is an adverse movement in the relationship of the indices.

Finally, observe what happens if the ZYX rallies so strongly that it catches up to the ABX.

	Price of Expiration				
ZYX	165	170	175	180	185
ABX	165	170	175	180	185
ZYX June 175P	10	5	0	0	0
ABX June 180P	15	10	5	0	0
Profit	+$2,500	+$2,500	+$2,500	+$2,500	+$2,500

These tables can be called "sliding scale" tables, because what one is actually doing is showing a different set of results by sliding the ABX scale over slightly each time while keeping the ZYX scale fixed. Note that in the above two tables, the ZYX results are unchanged, but the ABX has been slid over slightly to show a different result. Tables like this are necessary for the strategist who is doing spreads in options with different underlying indices or is trading inter-index spreads.

The astute reader will notice that the above example can be generalized by drawing a three-dimensional graph. The X axis would be the price of ZYX; the Y axis would be the dollars of profit in the spread; and instead of "sliding scales," the Z axis would be the price of ABX. There is software that can draw 3-dimensional profit graphs, although they are somewhat difficult to read. The previous tables would then be horizontal planes of the three-dimensional graph.

This concludes the chapter on riskless arbitrage and mathematical modeling. Recall that arbitrage in stock options can affect stock prices. The arbitrage techniques outlined here do not affect the indices themselves. That is done by the market basket hedges. It was also known that no new models are necessary for evaluation. For index options, one merely has to properly evaluate the dividend for usage in the standard Black–Scholes model. Future options can be evaluated by setting the risk-free interest rate to 0% in the Black–Scholes model and discounting the result, which is the Black model.

CHAPTER 34

Futures and Futures Options

In the previous chapters on index trading, a particular type of futures option—the index option—was described in some detail. In this chapter, some background information on futures themselves is spelled out, and then the broad category of futures options is investigated. In recent years, options have been listed on many types of futures as well as on some physical entities. These include options on things as diverse as gold futures and cattle futures, as well as options on currency and bond futures.

Much of the information in this chapter is concerned with describing the ways that futures options are similar to, or different from, ordinary equity and index options. There are certain strategies that can be developed specifically for futures options as well. However, it should be noted that once one understands an option strategy, it is generally applicable no matter what the underlying instrument is. That is, a bull spread in gold options entails the same general risks and rewards as does a bull spread in any stock's options—limited downside risk and limited upside profit potential. The gold bull spread would make its maximum profit if gold futures were above the higher strike of the spread at expiration, just as an equity option bull spread would do if the stock were above the higher strike at expiration. Consequently, it would be a waste of time and space to go over the same strategies again, substituting soybeans or orange juice futures, say, for XYZ stock in all the examples that have been given in the previous chapters of this book. Rather, the concentration will be on areas where there is truly a new or different strategy that futures options provide.

Before beginning, it should be pointed out that futures contracts and futures options have far less standardization than equity or index options do. Most futures trade in different units. Most options have different expiration months, expiration times, and striking price intervals. All the different contract specifications are not spelled out here. One should contact his broker or the exchange where the contracts are traded in order to receive complete details. However, whenever examples are used, full details of the contracts used in those examples are given.

FUTURES CONTRACTS

Before getting into options on futures, a few words about futures contracts themselves may prove beneficial. Recall that a futures contract is a standardized contract calling for the delivery of a specified quantity of a certain commodity at some future time. Future contracts are listed on a wide variety of commodities and financial instruments. In some cases, one must make or take delivery of a specific quantity of a physical commodity (50,000 bushels of soybeans, for example). These are known as futures on physicals. In others, the futures settle for cash as do the S&P 500 Index futures described in a previous chapter; there are other futures that have this same feature (Volatility Index [VIX] futures, for example). These types of futures are cash-based, or cash settlement, futures.

In terms of total numbers of contracts listed on the various exchanges, the more common type of futures contract is one with a physical commodity underlying it. These are sometimes broken down into subcategories, such as agricultural futures (those on soybeans, oats, coffee, or orange juice) and financial futures (those on U.S. Treasury bonds, bills, and notes).

Traders not familiar with futures sometimes get them confused with options. There really is very little resemblance between futures and options. *Think of futures as stock with an expiration date.*

That is, futures contracts can rise dramatically in price and can fall all the way to nearly zero (theoretically), just as the price of a stock can. Thus, there is great potential for risk. Conversely, with ownership of an option, risk is limited. The only real similarity between futures and options is that both have an expiration date. In reality, futures behave much like stock, and the novice should understand that concept before moving on.

HEDGING

The primary economic function of futures markets is hedging—taking a futures position to offset the risk of actually owning the physical commodity. The physical commodity or financial instrument is known as the "cash." For index futures, this hedging was designed to remove the risk from owning stocks (the "cash market" that underlines index futures). A portfolio manager who owned a large quantity of stocks could sell index futures against the stock to remove much of the price risk of that stock ownership. Moreover, he is able to establish that hedge at a much smaller commission cost and with much less work than would be required to sell thousands of shares of stock. Similar thinking applies to all the cash markets that underlie futures contracts. The ability to hedge is important for people who must deal in the "cash" market, because it gives them price protection as well as allowing them to be more efficient in their pricing and profitability. A general example may be useful to demonstrate the hedging concept.

Example: An international businessman based in the United States obtains a large contract to supply a Swiss manufacturer. The manufacturer wishes to pay in Swiss francs, but the payment is not due until the goods are delivered six months from now. The U.S. businessman is obviously delighted to have the contract, but perhaps is not so delighted to have the contract paid in francs six months from now. If the U.S. dollar becomes stronger relative to the Swiss franc, the U.S. businessman will be receiving Swiss francs which will be worth fewer dollars for his contract than he originally thought he would. In fact, if he is working on a narrow profit margin, he might even suffer a loss if the Swiss franc becomes too weak with respect to the dollar.

A futures contract on the Swiss franc may be appropriate for the U.S. businessman. He is "long" Swiss francs via his contract (that is, he will get francs in six months, so he is exposed to their fluctuations during that time). He might sell short a Swiss franc futures contract that expires in six months in order to lock in his current profit margin. Once he sells the future, he locks in a profit no matter what happens.

The future's profit and loss are measured in dollars since it trades on a U.S. exchange. If the Swiss franc becomes stronger over the six-month period, he will lose money on the futures sale, but will receive more dollars for the sale of his products. Conversely, if the franc becomes weak, he will receive fewer dollars from the Swiss businessman, but his futures contract sale will show a profit. In either case, the futures contract enables him to lock in a future price (hence the name "futures") that is profitable to him at today's level.

The reader should note that there are certain specific factors that the hedger must take into consideration. Recall that the hedger of stocks faces possible problems when he sells futures to hedge his stock portfolio. First, there is the problem of selling futures below their fair value; changes in interest rates or dividend payouts can affect the hedge as well. The U.S. businessman who is attempting to hedge his Swiss francs may face similar problems. Certain items such as short-term interest rates, which affect the cost of carry, and other factors may cause the Swiss franc futures to trade at a premium or discount to the cash price. That is, there is not necessarily a complete one-to-one relationship between the futures price and the cash price. However, the point is that the businessman is able to substantially reduce the currency risk, since in six months there could be a large change in the relationship between the U.S. dollar and the Swiss franc. While his hedge might not eliminate every bit of the risk, it will certainly get rid of a very large portion of it.

SPECULATING

While the hedgers provide the economic function of futures, speculators provide the liquidity. The attraction for speculators is leverage. One is able to trade futures with very little margin. Thus, large percentages of profits and losses are possible.

Example: A futures contract on cotton is for 50,000 pounds of cotton. Assume the March cotton future is trading at 60 (that is, 60 cents per pound). Thus, one is controlling $30,000 worth of cotton by owning this contract ($0.60 per pound × 50,000 pounds). However, assume the exchange minimum margin is $1,500. That is, one has to initially have only $1,500 to trade this contract. This means that one can trade cotton on 5% margin ($1,500/$30,000 = 5%).

What is the profit or risk potential here? A one-cent move in cotton, from 60 to 61, would generate a profit of $500. One can always determine what a one-cent move is worth as long as he knows the contract size. For cotton, the size is 50,000 pounds, so a one-cent move is 0.01 × 50,000 = $500.

Consequently, if cotton were to fall three cents, from 60 to 57, this speculator would lose 3 × $500, or $1,500—his entire initial investment. Alternatively, a 3-cent move to the upside would generate a profit of $1,500, a 100% profit.

This example clearly demonstrates the large risks and rewards facing a speculator in futures contracts. Certain brokerage firms may require the speculator to place more initial margin than the exchange minimum. Usually, the most active customers who have a sufficient net worth are allowed to trade at the exchange minimum margins; other customers may have to put up two or three times as much initial margin in order to trade. This still allows for a lot of leverage, but not as much as the speculator has who is trading with exchange minimum margins. Initial margin requirements can be in the form of cash or Treasury bills. Obviously, if one uses Treasury bills to satisfy his initial margin requirements, he can be earning interest on that money while it serves as collateral for his initial margin requirements. If he uses cash for the initial requirement, he will not earn interest. (Note: Some large customers do earn credit on the cash used for margin requirements in their futures accounts, but most customers do not.)

A speculator will also be required to keep his account current daily through the use of maintenance margin. His account is marked to market daily, so unrealized gains and losses are taken into account as well as are realized ones. If his account loses money, he must add cash into the account or sell out some of his Treasury bills in order to cover the loss, on a daily basis. However, if he makes money, that unrealized profit is available to be withdrawn or used for another investment.

Example: The cotton speculator from the previous example sees the price of the March cotton futures contract he owns fall from 60.00 to 59.20 on the first day he owns it. This means there is a $400 unrealized loss in his account, since his holding went down in price by 0.80 cents and a one-cent move is worth $500. He must add $400 to his account, or sell out $400 worth of T-bills.

The next day, rumors of a drought in the growing areas send cotton prices much higher. The March future closes at 60.90, up 1.70 from the previous day's close. That represents a gain of $850 on the day. The entire $850 could be withdrawn, or used as initial margin for another futures contract, or transferred to one's stock market account to be used to purchase another investment there.

Without speculators, a futures contract would not be successful, for the speculators provide liquidity. Volatility attracts speculators. If the contract is not trading and open interest is small, the contract may be delisted. The various futures exchanges can delist futures just as stocks can be delisted by the New York Stock Exchange. However, when stocks are delisted, they merely trade over-the-counter, since the corporation itself still exists. When futures are delisted, they disappear—there is no over-the-counter futures market. Futures exchanges are generally more aggressive in listing new products, and delisting them if necessary, than are stock exchanges.

TERMS

Futures contracts have certain standardized terms associated with them. However, trading in each separate commodity is like trading an entirely different product. The standardized terms for soybeans are completely different from those for cocoa, for example, as might well be expected. The size of the contract (50,000 pounds in the cotton example) is often based on the historical size of a commodity delivered to market; at other times it is merely a contrived number ($100,000 face amount of U.S. Treasury bonds, for example).

Also, futures contracts have expiration dates. For some commodities (for example, crude oil and its products, heating oil and unleaded gasoline), there is a futures contract for every month of the year. Other commodities may have expirations in only 5 or 6 calendar months of the year. These items are listed along with the quotes in a good financial newspaper, so they are not difficult to discover.

The number of expiration months listed at any one time varies from one market to another. Eurodollars, for example, have futures contracts with expiration dates that extend up to ten years in the future. T-bond and 10-year note contracts have expiration dates for only about the next year or so. Soybean futures, on the other hand, have expirations going out about two years, as do S&P futures.

The day of the expiration month on which trading ceases is different for each commodity as well. It is not standardized, as the third Friday is for stock and index options.

Trading hours are different, even for different commodities listed on the same futures exchange. For example, U.S. Treasury bond futures, which are listed on the Chicago Board of Trade, have very long trading hours (currently 8:20 a.m. to 3 p.m. and also 7 p.m. to 10:30 p.m. every day, Eastern time). But, on the same exchange, soybean futures trade a very short day (10:30 a.m. to 2:15 p.m., Eastern time). Some markets alter their trading hours occasionally, while others have been fixed for years. For example, as the foreign demand for U.S. Treasury bond futures increases, the trading hours might expand even further. However, the grain markets have been using these trading hours for decades, and there is little reason to expect them to change in the future.

Units of trading vary for different futures contracts as well. Grain futures trade in eighths of a point, 30-year bond futures trade in thirty-seconds of a point, while the S&P 500 futures trade in 10-cent increments (0.10). Again, it is the responsibility of the trader to familiarize himself with the units of trading in the futures market if he is going to be trading there.

Each futures contract has its own margin requirements as well. These conform to the type of margin that was described with respect to the cotton example above: An initial margin may be advanced in the form of collateral, and then daily mark-to-market price movements are paid for in cash or by selling some of the collateral. Recall that maintenance margin is the term for the daily mark to market.

Finally, futures are subject to position limits. This is to prevent any one entity from attempting to corner the market in a particular delivery month of a commodity. Different futures have different position limits. This is normally only of interest to hedgers or very large speculators. The exchange where the futures trade establishes the position limit.

TRADING LIMITS

Most futures contracts have some limit on their maximum daily price change. For index futures, it was shown that the limits are designed to act like circuit breakers to prevent the stock market from crashing. Trading limits exist in many futures contracts in order to help ensure that the market cannot be manipulated by someone forcing the price to move tremendously in one direction or the other. Another reason for having trading limits is ostensibly to allow only a fixed move, approximately equal to or slightly less than the amount covered by the initial margin requirement, so that maintenance margin can be collected if need be. However, limits have been applied to all futures, some of which don't really seem to warrant a limit—U.S. Treasury bonds, for example. The bond issue is too large to manipulate, and there is a liquid "cash" bond market to hedge with.

Regardless, limits are a fact of life in futures trading. Each individual commodity has its own limits, and those limits may change depending on how the exchange views the volatility of that commodity. For example, when gold was trading wildly at a price of more than $700 per ounce, gold futures had a larger daily trading limit than they do at more stable levels of $300 to $400 an ounce (the current limit is a $15 move per day). If a commodity reaches its limit repeatedly for two or three days in a row, the exchange will usually increase the limit to allow for more price movement. The Chicago Board of Trade automatically increases limits by 50% if a futures contract trades at the limit three days in a row.

Whenever limits exist there is always the possibility that they can totally destroy the liquidity of a market. The actual commodity underlying the futures contract is called the "spot" and trades at the "spot price." The spot trades without a limit, of course. Thus, it is possible that the spot commodity can increase in price tremendously while the futures contract can only advance the daily limit each day. This scenario means that the futures could trade "up or down the limit" for a number of days in a row. As a consequence, no one would want to sell the futures if they were trading up the limit, since the spot was much higher. In those cases there is no trading in the futures—they are merely quoted as bid up the limit and no trades take place. This is disastrous for short sellers. They may be wiped out without ever having the chance to close out their positions. This sometimes happens to orange juice futures when an unexpected severe freeze hits Florida. Options can help alleviate the illiquidity caused by limit moves. That topic is covered later in this chapter.

DELIVERY

Futures on physical commodities can be assigned, much like stock options can be assigned. When a futures contract is assigned, the buyer of the contract is called upon to receive the full contract. Delivery is at the seller's option, meaning that the owner of the contract is informed that he must take delivery. Thus, if a corn contract is assigned, one is forced to receive 5,000 bushels of corn. The old adage about this being dumped in your yard is untrue. One merely receives a warehouse receipt and is charged for storage. His broker makes the actual arrangements. Futures contracts cannot be assigned at any time during their life, as options can. Rather, there is a short period of time before they expire during which one can take delivery. This is generally a 4- to 6-week period and is called the "notice period"—the time during which one can be notified to accept delivery. The first day upon which the futures contract may be assigned is called the "first notice day," for logical reasons. Speculators close out their positions before the first notice day, leaving the rest of the trading up to the hedgers. Such considerations are not necessary for cash-based futures contracts (the index futures), since there is no physical commodity involved.

It is always possible to make a mistake, of course, and receive an assignment when you didn't intend to. Your broker will normally be able to reverse the trade for you, but it will cost you the warehouse fees and generally at least one commission.

The terms of the futures contract specify exactly what quantity of the commodity must be delivered, and also specify what form it must be in. Normally this is straightforward, as is the case with gold futures: That contract calls for delivery of 100 troy ounces of gold that is at least 0.995 fine, cast either in one bar or in three one-kilogram bars.

However, in some cases, the commodity necessary for delivery is more complicated, as is the case with Treasury bond futures. The futures contract is stated in terms of a nominal 8% interest rate. However, at any time, it is likely that the prevailing interest rate for long-term Treasury bonds will not be 8%. Therefore, the delivery terms of the futures contract allow for delivery of bonds with other interest rates.

Notice that the delivery is at the seller's option. Thus, if one is short the futures and doesn't realize that first notice day has passed, he has no problem, for delivery is under his control. It is only those traders holding long futures who may receive a surprise delivery notice.

One must be familiar with the specific terms of the contract and its methods of delivery if he expects to deal in the physical commodity. Such details on each futures contract are readily available from both the exchange and one's broker. However, most futures traders never receive or deliver the physical commodity; they close out their futures contracts before the time at which they can be called upon to make delivery.

PRICING OF FUTURES

It is beyond the scope of this book to describe futures arbitrage versus the cash commodity. Suffice it to say that this arbitrage is done, more in some markets (U.S. Treasury bonds, for example) than others (soybeans). Therefore, futures can be overpriced or underpriced as well. The arbitrage possibilities would be calculated in a manner similar to that described for index futures, the futures premium versus cash being the determining factor.

OPTIONS ON FUTURES

The reader is somewhat familiar with options on futures, having seen many examples of index futures options. The commercial use of the option is to lock in a worst-case price as opposed to a future price. The U.S. businessman from the earlier example sold Swiss franc futures to lock in a future price. However, he might decide instead to buy Swiss franc futures put options to hedge his downside risk, but still leave room for upside profits if the currency markets move in his favor.

DESCRIPTION

A futures option is an option on the futures contract, not on the cash commodity. Thus, if one exercises or assigns a futures option, he buys or sells the futures contract. The options are always for one contract of the underlying commodity. Splits and adjustments do not apply in the futures markets as they do for stock options. Futures options generally trade in the same denominations as the future itself (there are a few exceptions to this rule, such as the T-bond options, which trade in sixty-fourths while the futures trade in thirty-seconds).

Example: Soybean options will be used to illustrate the above features of futures options.

Suppose that March soybeans are selling at 575.

Soybean quotes are in cents. Thus, 575 is \$5.75—soybeans cost \$5.75 per bushel. A soybean contract is for 5,000 bushels of soybeans, so a one-cent move is worth \$50 ($5{,}000 \times .01$).

Suppose the following option prices exist. The dollar cost of the options is also shown (one cent is worth \$50).

Option	Price	Dollar Cost
March 525 put	5	\$ 250
March 550 call	35½	\$1,775
March 600 call	8¼	\$ 412.50

The actual dollar cost is not necessary for the option strategist to determine the profitability of a certain strategy. For example, if one buys the March 600 call, he needs March soybean futures to be trading at 608.25 or higher at expiration in order to have a profit at that time. This is the normal way in which a call buyer views his break-even point at expiration: strike price plus cost of the call. It is not necessary to know that soybean options are worth $50 per point in order to know that 608.25 is the break-even price at expiration.

If the future is a cash settlement future (Eurodollar, S&P 500, and other indices), then the options and futures generally expire simultaneously at the end of trading on the last trading day. (Actually, the S&P's expire on the next morning's opening.) However, options on physical futures will expire before the first notice day of the actual futures contract, in order to give traders time to close out their positions before receiving a delivery notice. The fact that the option expires in advance of the expiration of the underlying future has a slightly odd effect: The option often expires in the month preceding the month used to describe it.

Example: Options on March soybean futures are referred to as "March options." They do not actually expire in March—however, the soybean *futures* do.

The rather arcane definition of the last trading day for soybean options is "the last Friday preceding the last business day of the month prior to the contract month by at least 5 business days"!

Thus, the March soybean options actually expire in February. Assume that the last Friday of February is the 23rd. If there is no holiday during the business week of February 19th to 23rd, then the soybean options will expire on Friday, February 16th, which is 5 business days before the last Friday of February.

However, if President's Day happened to fall on Monday, February 19th, then there would only be four business days during the week of the 19th to the 23rd, so the options would have to expire one Friday earlier, on February 9th.

Not too simple, right? The best thing to do is to have a futures and options expiration calendar that one can refer to. *Futures Magazine* publishes a yearly calendar in its December issue, annually, as well as monthly calendars which are published each month of the year. Alternatively, your broker should be able to provide you with the information. The website of the appropriate exchange where the futures trade has all the information regarding expiration dates for futures and options.

In any case, the March soybean futures options expire in February, well in advance of the first notice day for March soybeans, which is the last business day of the month preceding the expiration month (February 28th in this case). The futures option trader must be careful not to assume that there is a long time between option expiration and first notice day of the futures contract. In certain commodities, the futures first notice day is the day after the options expire (live cattle futures, for example).

Thus, *if one is long calls or short puts and, therefore, acquires a long futures contract via exercise or assignment, respectively, he should be aware of when the first notice* *day of the futures is; he could receive a delivery notice on his long futures position unexpectedly if he is not paying attention.*

OTHER TERMS

Striking Price Intervals. Just as futures on differing physical commodities have differing terms, so do options on those futures. Striking price intervals are a prime example. Some options have striking prices 5 points apart, while others have strikes only 1 point apart, reflecting the volatility of the futures contract. Specifically, S&P 500 options have striking prices 5 points apart, while soybean options striking prices are 25 points (25 cents) apart, and gold options are 10 points ($10) apart. Moreover, as is often the case with stocks, the striking price differential for a particular commodity may change if the price of the commodity itself is vastly different.

Example: Gold is quoted in dollars per ounce. Depending on the price of the futures contract, the striking price interval may be changed. The current rules are:

Striking Price Interval	Price of Futures
$10	below $500/oz.
$20	between $500 and $1,000/oz.
$50	above $1,000/oz.

Thus, when gold futures are more expensive, the striking prices are further apart. Note that gold has never traded above $1,000/oz., but the option exchanges are all set if it does.

This variability in the striking prices is common for many commodities. In fact, some commodities alter the striking price interval depending on how much time is remaining until expiration, possibly in addition to the actual prices of the futures themselves.

Realizing that the striking price intervals may change—that is, that new strikes will be added when the contract nears maturity—may help to plan some strategies, as it will give more choices to the strategist as to which options he can use to hedge or adjust his position.

Automatic Exercise. All futures options are subject to automatic exercise as are stock options. In general, a futures option will be exercised automatically, even if it is one tick in the money. You can give instructions to *not* have a futures option automatically exercised if you wish.

SERIAL OPTIONS

Serial options are futures options whose expiration month is not the same as the expiration month of their corresponding underlying futures.

Example: Gold futures expire in February, April, June, August, October, and December. There are options that expire in those months as well. Notice that these expirations are spaced two months apart. Thus, when one gold contract expires, there are two months remaining until the next one expires.

Most option traders recognize that the heaviest activity in an option series is in the nearest-term option. If the nearest-term option has two months remaining until expiration, it will not draw the trading interest that a shorter-term option would.

Recognizing this fact, the exchange has decided that *in addition to the regular expiration, there will be an option contract that expires in the nearest non-cycle month*, that is, in the nearest month that does not have an actual gold future expiring. So, if it were currently January 1, there might be gold options expiring in February, March, April, etc.

Thus, the March option would be a *serial option*. There is no actual March gold future. Rather, the March options would be exercisable into April futures.

Serial options are exercisable into the nearest actual futures contract that exists after the options' expiration date. The number of serial option expirations depends on the underlying commodity. For example, gold will always have at least one serial option trading, per the definition highlighted in the example above. Certain futures whose expirations are three months apart (S&P 500 and all currency options) have serial options for the nearest two months that are not represented by an actual futures contract. Sugar, on the other hand, has only one serial option expiration per year—in December—to span the gap that exists between the normal October and March sugar futures expirations.

Strategists trading in options that may have serial expirations should be careful in how they evaluate their strategies. For example, June S&P 500 futures options strategies can be planned with respect to where the underlying S&P 500 Index of stocks will be at expiration, for the June options are exercisable into the June futures, which settle at the same price as the Index itself on the last day of trading. However, if one is trading April S&P 500 options, he must plan his strategy on where the June futures contract is going to be trading at April expiration. The April options are exercisable into the June futures at April expiration. Since the June futures contract will still have some time premium in it in April, the strategist cannot plan his strategy with respect to where the actual S&P 500 Index will be in April.

Example: The S&P 500 Stock Index (symbol SPX) is trading at 1410.50. The following prices exist:

	Options
Cash (SPX): 1410.50	April 1415 call: 5.00
June futures: 1415.00	June 1415 call: 10.00

If one buys the June 1415 call for 10.00, he knows that the SPX Index will have to rise to 1425.00 in order for his call purchase to break even at June expiration. Since the SPX is currently at 1410.50, a rise of 14.50 by the cash index itself will be necessary for break-even at June expiration.

However, a similar analysis will not work for calculating the break-even price for the April 1415 call at April expiration. Since 5.00 points are being paid for the 1415 call, the break-even at April expiration is 1420. But exactly what needs to be at 1420? The June future, since that is what the April calls are exercisable into.

Currently, the June futures are trading at a premium of 4.50 to the cash index (1415.00 – 1410.50). However, by April expiration, the fair value of that premium will have shrunk. Suppose that fair value is projected to be 3.50 premium at April expiration. Then the SPX would have to be at 1416.50 in order for the June futures to be fairly valued at 1420.00 (1416.50 + 3.50 = 1420.00).

Consequently, the SPX cash index would have to rise 6 points, from 1410.50 to 1416.50, in order for the June futures to trade at 1420 at April expiration. If this happened, the April 1415 call purchase would break even at expiration.

Quote symbols for futures options have improved greatly over the years. Most vendors use the convenient method of stating the striking price as a numeric number. The only "code" that is required is that of the expiration month. The codes for futures and futures options expiration months are shown in Table 34-1. Thus, a March (2002) soybean 600 call would use a symbol that is something like SH2C600, where S is the symbol for soybeans, H is the symbol for March, 2 means 2002, C stands for call option, and 600 is the striking price. This is a lot simpler and more flexible than stock options. There is no need for assigning striking prices to letters of the alphabet, as stocks do, to everyone's great consternation and confusion.

Bid-Offer Spread. The actual markets—bids and offers—for most futures options are not generally available from quote vendors (options traded on the Chicago Merc are usually a pleasant exception). The same is true for futures contracts themselves. One can

TABLE 34-1.
Month symbols for futures or futures options.

Futures or Futures Options Expiration Month	Month Symbol
January	F
February	G
March	H
April	J
May	K
June	M
July	N
August	Q
September	U
October	V
November	X
December	Z

always request a market from the trading floor, but that is a time-consuming process and is impractical if one is attempting to analyze a large number of options. Strategists who are used to dealing in stock or index options will find this to be a major inconvenience. The situation has persisted for years and shows no sign of improving.

Commissions. Futures traders generally pay a commission only on the closing side of a trade. If a speculator first buys gold futures, he pays no commission at that time. Later, when he sells what he is long—closes his position—he is charged a commission. This is referred to as a "round-turn" commission, for obvious reasons. Many futures brokerage firms treat future options the same way—with a round-turn commission. Stock option traders are used to paying a commission on every buy and sell, and there are still a few futures option brokers who treat futures options that way, too. This is an important difference. Consider the following example.

Example: A futures option trader has been paying a commission of $15 per side—that is, he pays a commission of $15 per contract each time he buys and sells. His broker informs him one day that they are going to charge him $30 per *round turn*, payable up front, rather than $15 per side. That is the way most futures option brokerage firms charge their commissions these days. Is this the same thing, $15 per side or $30 round turn, paid up front? *No, it is not!* What happens if you buy an option and it expires worthless? You have already paid the commission for a trade that, in effect, never took place. Nevertheless, there is little you can do about it, for it has become the industry standard to charge round-turn commission on futures options.

In either case, commissions are negotiated to a flat rate by many traders. Discount futures commission merchants (i.e., brokerage houses) often attract business this way. In general, this method of paying commissions is to the customer's benefit. However, it does have a hidden effect that the option trader should pay attention to. This effect makes it potentially more profitable to trade options on some futures than on others.

Example: A customer who buys corn futures pays \$30 per round turn in option commissions. Since corn options are worth \$50 per one point (one cent), he is paying 0.60 of a point every time he trades a corn option (30/50 = 0.60).

Now, consider the same customer trading options on the S&P 500 futures. The S&P 500 futures and options are worth \$250 per point. So, he is paying only 0.12 of a point to trade S&P 500 options (30/250 = .12).

He clearly stands a much better chance of making money in an S&P 500 option than he does in a corn option. He could buy an S&P option at 5.00 and sell it at 5.20 and make .08 points profit. However, with corn options, if he buys an option at 5, he needs to sell it at $5\frac{5}{8}$ to make money—a substantial difference between the two contracts. In fact, if he is participating in spread strategies and trading many options, the differential is even more important.

Position limits exist for futures options. While the limits for financial futures are generally large, other futures—especially agricultural ones—may have small limits. A large speculator who is doing spreads might inadvertently exceed a smaller limit. Therefore, one should check with his broker for exact limits in the various futures options before acquiring a large position.

OPTION MARGINS

Futures option margin requirements are generally more logical than equity or index option requirements. For example, if one has a conversion or reversal arbitrage in place, his requirement would be nearly zero for futures options, while it could be quite large for equity options. Moreover, futures exchanges have introduced a better way of margining futures and futures option portfolios.

SPAN Margin. The SPAN margin system (Standard Portfolio ANalysis of Risk) is used by nearly all of the exchanges. SPAN is designed to determine the entire risk of a portfolio, including all futures and options. It is a unique system in that it bases the option requirements on projected movements in the futures contracts as well as on potential changes in implied volatility of the options in one's portfolio. This creates a more realistic measure of the risk than the somewhat arbitrary requirements that were previously used (called the "customer margin" system) or than those used for stock and index options.

Not all futures clearing firms automatically put their customers on SPAN margin. Some use the older customer margin system for most of their option accounts. As a strategist, it would be beneficial to be under SPAN margin. Thus, one should deal with a broker who will grant SPAN margin.

The main advantages of SPAN margin to the strategist are twofold. First, naked option margin requirements are generally less; second, certain long option requirements are reduced as well. This second point may seem somewhat unusual—margin on long options? SPAN calculates the amount of a long option's value that is at risk for the current day. Obviously, if there is time remaining until expiration, a call option will still have some value even if the underlying futures trade down the limit. SPAN attempts to calculate this remaining value. If that value is less than the market price of the option, the excess can be applied toward any other requirement in the portfolio! Obviously, in-the-money options would have a greater excess value under this system.

How SPAN Works. Certain basic requirements are determined by the futures exchange, such as the amount of movement by the futures contract that must be margined (maintenance margin). Once that is known, the exchange's computers generate an array of potential gains and losses for the next day's trading, based on futures movement within a range of prices and based on volatility changes. These results are stored in a "risk array." There is a different risk array generated for each futures contract and each option contract. The clearing member (your broker) or you do not have to do any calculations other than to see how the quantities of futures and options in your portfolio are affected under the gains or losses in the SPAN risk array. The exchange does all the mathematical calculations needed to project the potential gains or losses. The results of those calculations are presented in the risk array.

There are 16 items in the risk array: For seven different futures prices, SPAN projects a gain or loss for both increased and decreased volatility; that makes 14 items. SPAN also projects a profit or loss for an "extreme" upward move and an "extreme" downward move. The futures exchange determines the exact definition of "extreme," and defines "increased" or "decreased" volatility.

SPAN "margin" applies to futures contracts as well, although volatility considerations don't mean anything in terms of evaluating the actual futures risk. As a first example, consider how SPAN would evaluate the risk of a futures contract.

Example: The S&P 500 futures will be used for this example. Suppose that the Chicago Mercantile Exchange determines that the required maintenance margin for the futures is $10,000, which represents a 40-point move by the futures (recall that S&P futures are worth $250 per point). Moreover, the exchange determines that an "extreme" move is 28 points, or $7,000 of risk.

Scenario	Long 1 Future Potential Pft/Loss
Futures unchanged; volatility up	0
Futures unchanged; volatility down	0
Futures up one-third of range; volatility up	+ 3,330
Futures up one-third of range; volatility down	+ 3,330
Futures down one-third of range; volatility up	– 3,330
Futures down one-third of range; volatility down	– 3,330
Futures up two-thirds of range; volatility up	+ 6,670
Futures up two-thirds of range; volatility down	+ 6,670
Futures down two-thirds of range; volatility up	– 6,670
Futures down two-thirds of range; volatility down	– 6,670
Futures up three-thirds of range; volatility up	+ 10,000
Futures up three-thirds of range; volatility down	+ 10,000
Futures down three-thirds of range; volatility up	**–10,000**
Futures down three-thirds of range; volatility down	– 10,000
Futures up "extreme" move	+ 7,000
Futures down "extreme" move	– 7,000

The 16 array items are always displayed in this order. Note that since this array is for a futures contract, the "volatility up" and "volatility down" scenarios are always the same, since the volatility that is referred to is the one that is used as the input to an option pricing model.

Notice that the actual price of the futures contract is not needed in order to generate the risk array. *The SPAN requirement is always the largest potential loss from the array.* Thus, if one were long one S&P 500 futures contract, his SPAN margin requirement would be $10,000, which occurs under the "futures down three-thirds" scenarios. This will always be the maintenance margin for a futures contract.

Now let us consider an option example. In this type of calculation, the exchange uses the same moves by the underlying futures contract and calculates the option theoretical values as they would exist on the next trading day. One calculation is performed for volatility increasing and one for volatility decreasing.

Example: Using the same S&P 500 futures contract, the following array might depict the risk array for a long December 1400 call. One does not need to know the option or futures price in order to use the array; the exchange incorporates that information into the model used to generate the potential gains and losses.

Scenario	Long 1 Dec 1400 call Potential Pft/Loss
Futures unchanged; volatility up	+ 460
Futures unchanged; volatility down	– 610
Futures up one-third of range; volatility up	+ 2,640
Futures up one-third of range; volatility down	+ 1,730
Futures down one-third of range; volatility up	– 1,270
Futures down one-third of range; volatility down	– 2,340
Futures up two-thirds of range; volatility up	+ 5,210
Futures up two-thirds of range; volatility down	+ 4,540
Futures down two-thirds of range; volatility up	– 2,540
Futures down two-thirds of range; volatility down	– 3,430
Futures up three-thirds of range; volatility up	+ 8,060
Futures up three-thirds of range; volatility down	+ 7,640
Futures down three-thirds of range; volatility up	– 3,380
Futures down three-thirds of range; volatility down	**–3,990**
Futures up "extreme" move	+ 3,130
Futures down "extreme" move	– 1,500

The items in the risk array are all quite logical: Upward futures movements produce profits and downward futures movements produce losses in the long call position. Moreover, worse results are always obtained by using the lower volatility as opposed to the higher one. In this particular example, the SPAN requirement would be $3,990 ("futures down three-thirds; volatility down"). That is, the SPAN system predicts that you could lose $3,990 of your call value if futures fell by their entire range and volatility decreased—a worst-case scenario. Therefore, that is the amount of margin one is required to keep for this long option position.

While the exchange does not tell us how much of an increase or decrease it uses in terms of volatility, one can get something of a feel for the magnitude by looking at the first two lines of the table. The exchange is saying that if the futures are unchanged tomorrow, but volatility "increases," then the call will increase in value by $460 (1.84 points at $250/point), if it "decreases," however, the call will lose $610 (2.44 points) of value. These are large price changes, so one can assume that the volatility assumptions are significant.

The real ease of use of the SPAN risk array is when it comes to evaluating the risk of a more complicated position, or even a portfolio of options. All one needs to do is to combine the risk array factors for each option or future in the position in order to arrive at the total requirement.

Example: Using the above two examples, one can see what the SPAN requirements would be for a covered write: long the S&P future and short the Dec 1400 call.

Scenario	Long 1 S&P Future	Short 1 Dec 1400 call Potential Pft/Loss	Covered Write
Futures unchanged; vol. up	0	– 460	– 460
Futures unchanged; vol. down	0	+ 610	+ 610
Futures up 1/3 of range; vol. up	+ 3,330	– 2,640	+ 690
Futures up 1/3 of range; vol. down	+ 3,330	– 1,730	+ 1,600
Futures down 1/3 of range; vol. up	– 3,330	+ 1,270	– 2,060
Futures down 1/3 of range; vol. down	– 3,330	+ 2,340	– 990
Futures up 2/3 of range; vol. up	+ 6,670	– 5,210	+ 1,460
Futures up 2/3 of range; vol. down	+ 6,670	– 4,540	+ 2,130
Futures down 2/3 of range; vol. up	– 6,670	+ 2,540	– 4,130
Futures down 2/3 of range; vol. down	– 6,670	+ 3,430	– 3,240
Futures up 3/3 of range; vol. up	+ 10,000	– 8,060	+ 1,940
Futures up 3/3 of range; vol. down	+ 10,000	– 7,640	+ 2,360
Futures down 3/3 of range; vol. up	**–10,000**	**+3,380**	**–6,620**
Futures down 3/3 of range; vol. down	– 10,000	+ 3,990	– 6,010
Futures up "extreme" move	+ 7,000	– 3,130	+ 3,870
Futures down "extreme" move	– 7,000	+ 1,500	– 5,500

As might be expected, the worst-case projection for a covered write is for the stock to drop, but for the implied volatility to increase. The SPAN system projects that this covered writer would lose $6,620 if that happened. Thus, "futures down 3/3 of range; volatility up" is the SPAN requirement, $6,620.

As a means of comparison, under the older "customer margin" option requirements, the requirement for a covered write was the futures margin, plus the option premium, less one-half the out-of-the-money amount. In the above example, assume the futures were at 408 and the call was trading at 8. The customer covered write margin would then be more than twice the SPAN requirement:

Futures margin	$10,000
Option premium	+ 4,000
½ out-of-money amount	– 1,000
	$13,000

Obviously, one can alter the quantities in the use of the risk array quite easily. For example, if he had a ratio write of long 3 futures and short 5 December 1400 calls, he could easily calculate the SPAN requirement by multiplying the projected futures gains and losses by 3, multiplying the projected option gains and losses by 5, and adding the two together to obtain the total requirement. Once he had completed this calculation, his SPAN requirement would be the worst expected loss as projected by SPAN for the next trading day.

In actual practice, the SPAN calculations are even more sophisticated: They take into account a certain minimum option margin (for deeply out-of-the-money options); they account for spreads between futures contracts on the same commodity (different expiration months); they add a delivery month charge (if you are holding a position past the first notice day); and they even allow for slightly reduced requirements for related, but different, futures spreads (T-bills versus T-bonds, for example).

If you are interested in calculating SPAN margin yourself, your broker may be able to provide you with the software to do so. More likely, though, he will provide the service of calculating the SPAN margin on a position prior to your establishing it. The details for obtaining the SPAN margin requirements should thus be requested from your broker.

PHYSICAL CURRENCY OPTIONS

From time to time, foreign currency options have had listed options. Occasionally these have required physical delivery. There is a large over-the-counter market in foreign currency options. Since the physical commodity underlying the option is currency, in some sense of the word, these are cash-based options as well. However, the cash that the options are based in is not dollars, but rather may be European Euros, Swiss francs, British pounds, Canadian dollars, or Japanese yen. Futures trade in these same currencies on the Chicago Mercantile Exchange. Hence, many traders of the physical options use the Chicago-based futures as a hedge for their positions.

Unlike stock options, currency options do not have standardized terms—the amount of currency underlying the option contract is not the same in each of the cases. The striking price intervals and units of trading are not the same either. However, since there are only the six different contracts and since their terms correspond to the details of the futures contracts, these options have had much success. The foreign currency markets are some of the largest in the world, and that size is reflected in the liquidity of the futures on these currencies.

The Japanese yen contract will be used to illustrate the workings of the foreign currency options. The other types of foreign currency options work in a similar manner, although they are for differing amounts of foreign currency. The amount of foreign currency controlled by the foreign currency contract is the unit of trading, just as 100 shares of stock is the unit of trading for stock options. The unit of trading for the Japanese yen option is 62,500 Japanese yen. Normally, the currency itself is quoted in terms of U.S. dollars. For example, a Japanese yen quote of 0.50 would mean that one Japanese yen is worth 50 cents in U.S. currency.

Note that when one takes a position in foreign currency options (or futures), he is simultaneously taking an opposite position in U.S. dollars. That is, if one owns a Japanese yen call, he is long the yen (at least delta long) and is by implication therefore short U.S. dollars.

Striking prices in yen options are assigned in one-cent increments and are stated in cents, not dollars. That is, if the Japanese yen is trading at 50 cents, then there might be striking prices of 48, 49, 50, 51, and 52. Given the unit of trading and the striking price in U.S. dollars, one can compute the total dollars involved in a foreign currency exercise or assignment.

Example: Suppose the Japanese yen is trading at 0.50 and there are striking prices of 48, 50, and 52, representing U.S. cents per Japanese yen. If one were to exercise a call with a strike of 48, then the dollars involved in the exercise would be 125,000 (the unit of trading) times 0.48 (the strike in U.S. dollars), or $60,000.

Option premiums are stated in U.S. cents. That is, if a Japanese yen option is quoted at 0.75, its cost is $.0075 times the unit of trading, 125,000, for a total of $937.50. Premiums are quoted in hundredths of a point. That is, the next "tick" from 0.75 would be 0.76. Thus, for the Japanese yen options, each tick or hundredth of a point is equal to $12.50 (.0001 × 125,000).

Actual delivery of the security to satisfy an assignment notice must occur within the country of origin. That is, the seller of the currency must make arrangements to deliver the currency in its country of origin. On exercise or assignment, sellers of currency would be put holders who exercise or call writers who are assigned. Thus, if one were short Japanese yen calls and he were assigned, he would have to deliver Japanese yen into a bank in Japan. This essentially means that there have to be agreements between your firm or your broker and foreign banks if you expect to exercise or be assigned. The actual payment for the exercise or assignment takes place between the broker and the Options Clearing Corporation (OCC) in U.S. dollars. The OCC then can receive or deliver the currency in its country of origin, since OCC has arrangements with banks in each country.

ETF-BASED FUTURES

Exchange-traded funds (ETFs) were described in Chapter 32. A number of ETFs are directly related to futures. This allows investors who can't or don't have futures accounts to participate in the movement of certain commodity futures.

There are two ways that these futures-related ETFs are constructed. In the first way, the ETF actually owns the physical commodity. That is the way the Gold ETF (GLD) works, for example. As a result, this type of ETF exactly adheres to the cash price of gold.

The second way that commodity ETFs are constructed is that they buy the underlying futures rather than the physical commodity. There are a number of them that are constructed this way. Some examples are the Crude Oil ETF (USO), the Natural Gas ETF (UNG), and the Volatility ETF (VXX). These ETFs might not match the performance of the underlying cash market, for they might have to pay a time value to continue to hold and roll the futures contracts.

The problem arises from the fact that—when the longer-term contracts are more expensive than the near-term contracts—the ETF pays the differential.

Example: The front-month Crude Oil futures are expiring, and thus are near the spot/cash price at expiration. Let's assume that price is 75. The USO ETF sells out their position in the front month futures, and buys the next month out—at a price of 76.50, say.

A month later, assume that the cash market is still unchanged at 75. The now-expiring futures that cost 76.50 are now trading at 75. So the ETF has a loss of 1.50 on these contracts, even though the spot/cash market is unchanged. Moreover, it must now buy the *next* month, presumably at a price near 76.50.

Over time, the cumulative effect of all these rolls forward into futures trading at higher prices puts a "drag" on the performance of the fund, with respect to the cash market. Furthermore, the ETF has only a limited amount of assets, and eventually these losses could actually cause the ETF to theoretically run out of cash.

FUTURES OPTION TRADING STRATEGIES

The strategies described here are those that are unique to futures option trading. Although there may be some general relationships to stock and index option strategies, for the most part these strategies apply only to futures options. It will also be shown—in the backspread and ratio spread examples—that one can compute the profitability of an option spread in the same manner, no matter what the underlying instrument is (stocks, futures, etc.) by breaking everything down into "points" and not "dollars."

Before getting into specific strategies, it might prove useful to observe some relationships about futures options and their price relationships to each other and to the futures contract itself. Carrying cost and dividends are built into the price of stock and index options, because the underlying instrument pays dividends and one has to pay cash to buy or sell the stock. Such is not the case with futures. The "investment" required to buy a futures contract is not initially a cash outlay. Note that the cost of carry associated with futures generally refers to the carrying cost of owning the cash commodity itself. That carrying cost has no bearing on the price of a futures option other than to determine the futures price itself. Moreover, the future has no dividends or similar payout. This is even true for something like U.S. Treasury bond options, because the interest rate payout of the cash bond is built into the futures price; thus, the option, which is based on the futures price and not directly on the cash price, does not have to allow for carry, since the future itself has no initial carrying costs associated with it.

Simplistically, it can be stated that:

$$\text{Futures Call} = \text{Futures Put} + \text{Futures Price} - \text{Strike Price}$$

Example: April crude oil futures closed at 18.74 ($18.74 per barrel). The following prices exist:

Strike Price	April Call Price	April Put Price	Put + Futures – Strike
17	1.80	0.06	1.80
18	0.96	0.22	0.96
19	0.35	0.61	0.35
20	0.10	1.36	0.10

Note that, at every strike, the above formula is true (Call = Put + Futures – Strike). These are not theoretical prices; they were taken from actual settlement prices on a particular trading day.

In reality, where deeply in-the-money or longer-term options are involved, this simple formula is not correct. However, for most options on a particular nearby futures contract, it will suffice quite well. Examine the current quotes to verify that this is a true statement.

A subcase of this observation is that *when the futures contract is exactly at the striking price, the call and put with that strike will both trade at the same price.* Note that in the above formula, if one sets the futures price equal to the striking price, the last two terms cancel out and one is left with: Call price = Put price.

One final observation before getting into strategies: For a put and a call with the same strike

$$\text{Net change call} - \text{Net change put} = \text{Net change futures}$$

This is a true statement for stock and index options as well, and is a useful rule to remember. If the last sales don't conform to the rule above, then at least one of the last sales is probably not representative of the true market in the options.

DELTA

While we are on the subject of pricing, a word about delta may be in order as well. The delta of a futures option has the same meaning as the delta of a stock option: It is the amount by which the option is expected to increase in price for a one-point move in the underlying futures contract. As we also know, it is an instantaneous measurement that is obtained by taking the first derivative of the option pricing model.

In any case, the delta of an at-the-money stock or index option is greater than 0.50; the more time remaining to expiration, the higher the delta is. In a simplified sense, this has to do with the cost of carrying the value of the striking price until the option expires. But part of it is also due to the distribution of stock price movements—there is an upward bias, and with a long time remaining until expiration, that bias makes call movements more pronounced than put movements.

Options on futures do not have the carrying cost feature to deal with, but they do have the positive bias in their price distribution. A futures contract, just like a stock, can increase by more than 100%, but cannot fall more than 100%. Consequently, deltas of at-the-money futures calls will be slightly larger than 0.50. The more time remaining until expiration of the futures option, the higher the at-the-money call delta will be.

Many traders erroneously believe that the delta of an at-the-money futures option is 0.50, since there is no carrying cost involved in the futures conversion or reversal arbitrage. That is not a true statement, since the distribution of futures prices affects the delta as well.

As always, for futures options as well as for stock and index options, *the delta of a put is related to the delta of a call with the same striking price and expiration date:*

$$\text{Delta of put} = 1 - \text{Delta of call}$$

Finally, the concept of equivalent stock position applies to futures option strategies, except, of course, it is called the *equivalent futures position* (EFP). The EFP is calculated by the simple formula:

$$\text{EFP} = \text{Delta of option} \times \text{Option quantity}$$

Thus, if one is long 8 calls with a delta of 0.75, then that position has an EFP of 6 (8×0.75). This means that being long those 8 calls is the same as being long 6 futures contracts.

Note that in the case of stocks, the equivalent stock position formula has another factor—shares per option. That concept does not apply to futures options, since they are always options on one futures contract.

MATHEMATICAL CONSIDERATIONS

This brief section discusses modeling considerations for futures options and options on physicals.

Futures Options. The Black model (see Chapter 33 on mathematical considerations for index options) is used to price futures options. Recall that futures don't pay dividends, so there is no dividend adjustment necessary for the model. In addition, there is no carrying cost involved with futures, so the only adjustment that one needs to make is to use 0% as the interest rate input to the Black–Scholes model. This is an oversimplification, especially for deeply in-the-money options. One is tying up some money in order to buy an option. Hence, the Black model will discount the price from the Black–Scholes model price. Therefore, the actual pricing model to be used for theoretical evaluation of futures options is the Black model, which is merely the Black–Scholes model, using 0% as the interest rate, and then discounted:

$$\text{Call Theoretical Price} = e^{-rt} \times \text{Black–Scholes formula } [r = 0]$$

Recall that it was stated above that:

$$\text{Futures call} = \text{Futures put} + \text{Future price} - \text{Strike price}$$

The actual relationship is:

$$\text{Futures call} = \text{Futures put} + e^{-rt}\ (\text{Futures price} - \text{Strike price})$$

where

r = the short-term interest rate,
t = the time to expiration in years, and
e^{-rt} = the discounting factor.

The short-term interest rate has to be used here because when one pays a debit for an option, he is theoretically losing the interest that he could earn if he had that money in the bank instead, earning money at the short-term interest rate.

The difference between these two formulae is so small for nearby options that are not deeply in-the-money that it is normally less than the bid–asked spread in the options, and the first equation can be used.

Example: The table below compares the theoretical values computed with the two formulae, where $r = 6\%$ and $t = 0.25$ (1/4 of a year). Furthermore, assume the futures price is 100. The strike price is given in the first column, and the put price is given in the second column. The predicted call prices according to each formula are then shown in the next two columns.

Strike	Put Price	Formula 1 (Simple)	Formula 2 (Using e^{-rt})
70	0.25	30.25	29.80
80	1.00	21.00	20.70
90	3.25	13.25	13.10
95	5.35	10.35	10.28
100	7.50	7.50	7.50
105	10.70	5.70	5.77
110	13.90	3.90	4.05
120	21.80	1.80	2.10

For options that are 20 or 30 points in- or out-of-the-money, there is a noticeable differential in these three-month options. However, for options closer to the strike, the differential is small.

If the time remaining to expiration is shorter than that used in the example above, the differences are smaller; if the time is longer, the differences are magnified.

Options on Physicals. Determining the fair value of options on physicals such as currencies is more complicated. The proper way to calculate the fair value of an option on a physical is quite similar to that used for stock options. Recall that in the case of stock options, one first subtracts the present worth of the dividend from the current stock price before calculating the option value. A similar process is used for determining the fair value of currency or any other options on physicals. In any of these cases, the underlying security bears interest continuously, instead of quarterly as stocks do. Therefore, all one needs to do is to subtract from the underlying price the amount of interest to be paid until option expiration and then add the amount of accrued interest to be paid. All other inputs into the Black–Scholes model would remain the same, including the risk-free interest rate being equal to the 90-day T-bill rate.

Again, the practical option strategist has a shortcut available to him. If one assumes that the various factors necessary to price currencies have been assimilated into the futures markets in Chicago, then one can merely use the futures price as the price of the underlying for evaluating the physical delivery options in Philadelphia. This will not work well near expiration, since the future expires one week prior to the PHLX option. In addition, it ignores the early exercise value of the PHLX options. However, except for these small differentials, the shortcut will give theoretical values that can be used in strategy-making decisions.

Example: It is sometime in April and one desires to calculate the theoretical values of the June Euro physical delivery options in Philadelphia. Assume that one knows four of the basic items necessary for input to the Black–Scholes formula: 60 days to expiration, strike price of 68, interest rate of 10%, and volatility of 18%. But what should be used as the price of the underlying Euro? Merely use the price of the June Euro futures contract in Chicago.

STRATEGIES REGARDING TRADING LIMITS

The fact that trading limits exist in most futures contracts could be detrimental to both option buyers and option writers. At other times, however, the trading limit may present a unique opportunity. The following section focuses on who might benefit from trading limits in futures and who would not.

Recall that a trading limit in a futures contract limits the absolute number of points that the contract can trade up or down from the previous close. Thus, if the trading limit in T-bonds is 3 points and they closed last night at 74 21/32, then the highest they can trade on the next day is $77^{21}/_{32}$, regardless of what might be happening in the cash bond market. Trading limits exist in many futures contracts in order to help ensure that the market cannot be manipulated by someone forcing the price to move tremendously in one direction or the other. Another reason for having trading limits is ostensibly to allow only a fixed move, approximately equal to the amount covered by the initial margin, so that maintenance margin can be collected if need be. However, limits have been applied in cases in which they are unnecessary. For example, in T-bonds, there is too much liquidity for anyone to be able to manipulate the market. Moreover, it is relatively easy to arbitrage the T-bond futures contract against cash bonds. This also increases liquidity and would keep the future from trading at a price substantially different from its theoretical value.

Sometimes the markets actually *need* to move far quickly and cannot because of the trading limit. Perhaps cash bonds have rallied 4 points, when the limit is 3 points. This makes no difference—when a futures contract has risen as high as it can go for the day, it is bid there (a situation called "limit bid") and usually doesn't trade again as long as the underlying commodity moves higher. It is, of course, possible for a future to be limit bid, only to find that later in the day, the underlying commodity becomes weaker, and traders begin to sell the future, driving it down off the limit. Similar situations can also occur on the downside, where, if the future has traded as low as it can go, it is said to be "limit offered."

As was pointed out earlier, futures *options* sometimes have trading limits imposed on them as well. This limit is of the same magnitude as the futures limit. In other markets, options are free to trade, even though futures have effectively halted because they are up or down the limit. However, even in the situations in which futures options themselves have a trading limit, there may be out-of-the-money options available for trading that have not reached their trading limit.

When options are still trading, one can use them to imply the price at which the futures would be trading, were they not at their trading limit.

Example: August soybeans have been inflated in price due to drought fears, having closed on Friday at 650 ($6.50 per bushel). However, over the weekend it rains heavily in the Midwest, and it appears that the drought fears were overblown. Soybeans open down 30 cents, to 620, down the allowable 30-cent limit. Furthermore, there are no buyers at that level and the August bean contract is locked limit down. No further trading ensues.

One may be able to use the August soybean options as a price discovery mechanism to see where August soybeans would be trading if they were open.

Suppose that the following prices exist, even though August soybeans are not trading because they are locked limit down:

Option	Last Sale Price	Net Change for the Day
August 625 call	19	–21
August 625 put	31	+16

An option strategist knows that synthetic long futures can be created by buying a call and selling a put, or vice versa for short futures. Knowing this, one can tell what price futures are projected to be trading at:

$$\text{Implied Futures Price} = \text{Strike Price} + \text{Call Price} - \text{Put Price}$$
$$= 625 + 19 - 31 = 613$$

With these options at the prices shown, one can create a synthetic futures position at a price of 613. Therefore, the implied price for August soybean futures in this example is 613.

Note that this formula is merely another version of the one previously presented in this chapter.

In the example above, neither of the options in question had moved the 30-point limit, which applies to soybean options as well as to soybean futures. If they had, they would not be useable in the formula for implying the price of the future. *Only options that are freely trading—not limit up or down—can be used in the above formula.*

A more complete look at soybean futures options on the day they opened and stayed down the limit would reveal that some of them are not tradeable either:

Example: Continuing the above example, August soybeans are locked limit down 30 cents on the day. The following list shows a wider array of option prices. Any option that is either up or down 30 cents on the day has also reached its trading limit, and therefore could not be used in the process necessary to discover the implied price of the August futures contract.

Option	Last Sale Price	Net Change for the Day
August 550 call	71	–30
August 575 call	48	–30
August 600 call	31	–26
August 625 call	19	–21
August 650 call	11	–15
August 675 call	6	–10

August 550 put	4	+3
August 575 put	9	+6
August 600 put	18	+11
August 625 put	31	+16
August 650 put	48	+22
August 675 put	67	+30

The deeply in-the-money calls, August 550's and August 575's, and the deeply in-the-money August 675 puts are all at the trading limit. All other options are freely trading and could be used for the above computation of the August future's implied price.

One may ask how the market-makers are able to create markets for the options when the future is not freely trading. They are pricing the options off cash quotes. Knowing the cash quote, they can imply the price of the future (613 in this case), and they can then make option markets as well.

The real value in being able to use the options when a future is locked limit up or limit down, of course, is to be able to hedge one's position. Simplistically, if a trader came in long the August soybean futures and they were locked limit down as in the example above, he could use the puts and calls to effectively close out his position.

Example: As before, August soybeans are at 620, locked down the limit of 30 cents. A trader has come into this trading day long the futures and he is very worried. He cannot liquidate his long position, and if soybeans should open down the limit again tomorrow, his account will be wiped out. He can use the August options to close out his position.

Recall that it has been shown that the following is true:

Long put + Short call is equivalent to short stock.

It is also equivalent to short futures, of course. So if this trader were to buy a put and short a call at the same strike, then he would have the equivalent of a short futures position to offset his long futures position.

Using the following prices, which are the same as before, one can see how his risk is limited to the effective futures price of 613. That is, buying the put and selling the call is the same as selling his futures out at 613, down 37 cents on the trading day.

Current prices:

Option	Last Sale Price	Net Change for the Day
August 625 call	19	–21
August 625 put	31	+16

Position:

Buy August 625 put for 19
Sell August 625 call for 31

August Futures at Option Expiration	Put Price	Put P/L	Call Price	Call P/L	Net Profit or Loss on Position
575	50	+$1,900	0	+$1,900	+$3,800
600	25	– 600	0	+ 1,900	+ 1,300
613	12	– 1,900	0	+ 1,900	0
625	0	– 3,100	0	+ 1,900	– 1,200
650	0	– 3,100	25	– 600	– 3,700

This profit table shows that selling the August 625 call at 19 and buying the August 625 put at 31 is equivalent to—that is, it has the same profit potential as—selling the August future at 613. So, if one buys the put and sells the call, he will effectively have sold his future at 613 and taken his loss.

His resultant position after buying the put and selling the call would be a conversion (long futures, long put, and short call). The margin required for a conversion or reversal is zero in the futures market. The margin rules recognize the riskless nature of such a strategy. Thus, any excess money that he has after paying for the unrealized loss in the futures will be freed up for new trades.

The futures trader does not have to completely hedge off his position if he does not want to. He might decide to just buy a put to limit the downside risk. Unfortunately, to do so after the futures are already locked limit down may be too little, too late. There are many kinds of partial hedges that he could establish—buy some puts, sell some calls, utilize different strikes, etc.

The same or similar strategies could be used by a naked option seller who cannot hedge his position because it is up the limit. He could also utilize options that are still in free trading to create a synthetic futures position.

Futures options generally have enough out-of-the-money striking prices listed that some of them will still be free trading, even if the futures are up or down the limit. This fact is a boon to anyone who has a losing position that has moved the daily trading limit. Knowing how to use just this one option trading strategy should be a worthwhile benefit to many futures traders.

COMMONPLACE MISPRICING STRATEGIES

Futures options are sometimes prone to severe mispricing. Of course, any product's options may be subject to mispricing from time to time. However, it seems to appear in futures options more often than it does in stock options. The following discussion of strategies concentrates on a specific pattern of futures options mispricing that occurs with relative frequency. It generally manifests itself in that out-of-the-money puts are too cheap, and out-of-the-money calls are too expensive. The proper term for this phenomenon is "volatility skewing" and it is discussed further in Chapter 36 on advanced concepts. In this chapter, we concentrate on how to spot it and how to attempt to profit from it.

Occasionally, stock options exhibit this trait to a certain extent. Generally, it occurs in stocks when speculators have it in their minds that a stock is going to experience a sudden, substantial rise in price. They then bid up the out-of-the-money calls, particularly the near-term ones, as they attempt to capitalize on their bullish expectations. When takeover rumors abound, stock options display this mispricing pattern. Mispricing is, of course, a statistically related term; it does not infer anything about the possible validity of takeover rumors.

A significant amount of discussion is going to be spent on this topic, because *the futures option trader will have ample opportunities to see and capitalize on this mispricing pattern;* it is not something that just comes along rarely. He should therefore be prepared to make it work to his advantage.

Example: January soybeans are trading at 583 ($5.83 per bushel). The following prices exist:
January beans: 583

Strike	Call Price	Put Price
525		½
550		3¼
575	19½	12
600	11	28
625	5¼	
650	3½	
675	2¼	

Suppose one knows that, according to historic patterns, the "fair values" of these options are the prices listed in the following table.

Strike	Call Price	Call Theo. Value	Put Price	Put Theo. Value
525			½	1.6
550			3¼	5.4
575	19½	21.5	12	13.7
600	11	10.4	28	27.6
625	5¾	4.3		
650	3½	1.5		
675	2¼	0.7		

Notice that the out-of-the-money puts are priced well below their theoretical value, while the out-of-the-money calls are priced above. The options at the 575 and 600 strikes are much closer in price to their theoretical values than are the out-of-the-money options.

There is another way to look at this data, and that is to view the options' implied volatility. Implied volatility was discussed in Chapter 28 on mathematical applications. It is basically the volatility that one would have to plug into his option pricing model in order for the model's theoretical price to agree with the actual market price. Alternatively, it is the volatility that is being implied by the actual marketplace. The options in this example each have different implied volatilities, since their mispricing is so distorted. Table 34-2

TABLE 34-2.
Volatility skewing of soybean options.

Strike	Call Price	Put Price	Implied Volatility	Delta Call/Put
525		½	12%	/–0.02
550		3¼	13%	/–0.16
575	19½	12	15%	0.59/–0.41
600	11	28	17%	0.37/–0.63
625	5¾		19%	0.21
650	3½		21%	0.13
675	2¼		23%	0.09

gives those implied volatilities. The deltas of the options involved are shown as well, for they will be used in later examples.

These implied volatilities tell the same story: The out-of-the-money puts have the lowest implied volatilities, and therefore are the cheapest options; the out-of-the-money calls have the highest implied volatilities, and are therefore the most expensive options.

So, no matter which way one prefers to look at it—through comparison of the option price to theoretical price or by comparing implied volatilities—it is obvious that these soybean options are out of line with one another.

This sort of pricing distortion is prevalent in many commodity options. Soybeans, sugar, coffee, gold, and silver are all subject to this distortion from time to time. The distortion is endemic to some—soybeans, for example—or may be present only when the speculators turn extremely bullish.

This precise mispricing pattern is so prevalent in futures options that strategists should constantly be looking for it. There are two major ways to attempt to profit from this pattern. Both are attractive strategies, since one is buying options that are relatively less expensive than the options that are being sold. Such strategies, if implemented when the options are mispriced, tilt the odds in the strategist's favor, creating a positive expected return for the position.

The two theoretically attractive strategies are:

1. Buy out-of-the-money puts and sell at-the-money puts; or
2. Buy at-the-money calls and sell out-of-the-money calls.

One might just buy one cheap and sell one expensive option—a bear spread with the puts, or a bull spread with the calls. However, it is better to implement these spreads with a ratio between the number of options bought and the number sold. That is, the first strategy involving puts would be a backspread, while the second strategy involving calls would be a ratio spread. By doing the ratio, each strategy is a more neutral one. Each strategy is examined separately.

BACKSPREADING THE PUTS

The backspread strategy works best when one expects a large degree of volatility. Implementing the strategy with puts means that a large drop in price by the underlying futures would be most profitable, although a limited profit could be made if futures rose. Note that a moderate drop in price by expiration would be the worst result for this spread.

Example: Using prices from the above example, suppose that one decides to establish a backspread in the puts. Assume that a neutral ratio is obtained in the following spread:

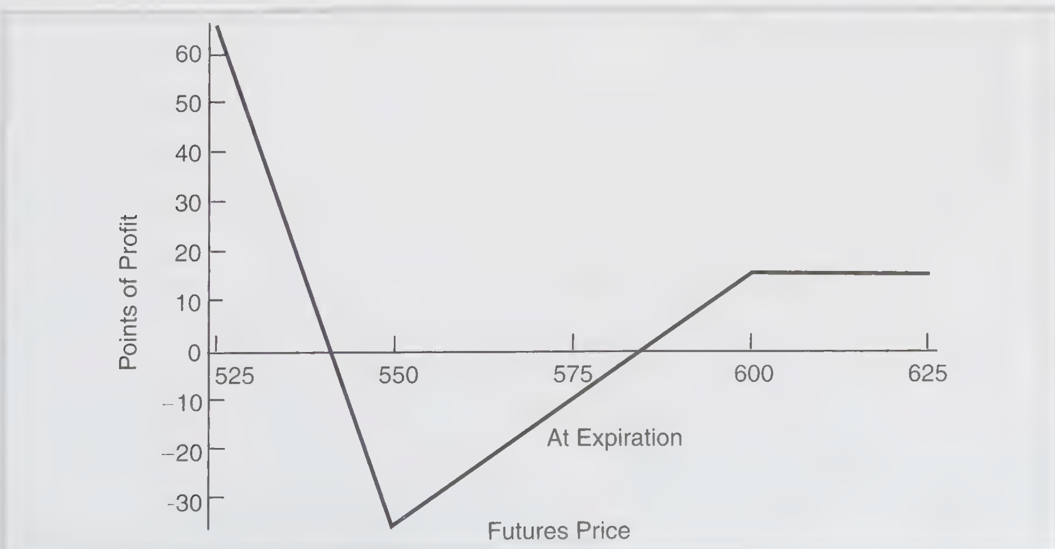
Buy 4 January bean 550 puts 3¼	13 DB
Sell 1 January bean 600 put at 28	28 CR
Net position:	15 Credit

The deltas (see Table 34-2) of the options are used to compute this neutral ratio.

Figure 34-1 shows the profit potential of this spread. It is the typical picture for a put backspread—limited upside potential with a great deal of profit potential for large downward moves. Note that the spread is initially established for a credit of 15 cents. If January soybeans have volatile movements in either direction, the position should profit. Obviously, the profit potential is larger to the downside, where there are extra long puts. However, if beans should rally instead, the spreader could still make up to 15 cents ($750), the initial credit of the position.

Note that one can treat the prices of soybean options in the same manner as he would treat the prices of stock options in order to determine such things as break-even points and maximum profit potential. The fact that soybean options are worth $50 per point (which is *cents* when referring to soybeans) and stock options are worth $100 per point do not alter these calculations for a put backspread.

FIGURE 34-1.
January soybean, backspread.



$$\text{Maximum upside profit potential} = \text{Initial debit or credit of position} = 15 \text{ points}$$

$$\begin{aligned}\text{Maximum risk} &= \text{Maximum upside} - \text{Distance between strikes} \\ &\quad \times \text{Number of puts sold short} \\ &= 15 - 50 \times 1 \\ &= -35 \text{ points}\end{aligned}$$

$$\begin{aligned}\text{Downside break-even point} &= \text{Lower strike} \\ &\quad - \text{Points of risk/Number of excess puts} \\ &= 550 - 35/3 \\ &= 538.3\end{aligned}$$

Thus, one is able to analyze a futures option position or a stock option position in the same manner—by reducing everything to be in terms of points, not dollars. Obviously, one will eventually have to convert to dollars in order to calculate his profits or losses. However, note that referring to everything in "points" works very well. Later, one can use the dollars per point to obtain actual dollar cost. Dollars per point would be \$50 for soybeans options, \$100 for stock or index options, \$400 for live cattle options, \$375 for coffee options, \$1,120 for sugar options, etc. In this way, one does not have to get hung up in the nomenclature of the futures contract; he can approach everything in the same fashion for purposes of analyzing the position. He will, of course, have to use proper nomenclature to enter the order, but that comes after the analysis is done.

RATIO SPREADING THE CALLS

Returning to the subject at hand—spreads that capture this particular mispricing phenomenon of futures options—recall that the other strategy that is attractive in such situations is the ratio call spread. It is established with the maximum profit potential being somewhat above the current futures price, since the calls that are being sold are out-of-the-money.

Example: Again using the January soybean options of the previous few examples, suppose that one establishes the following ratio call spread. Using the calls' deltas (see Table 34-2), the following ratio is approximately neutral to begin with:

Buy 2 January bean 600 calls at 11	22 DB
Sell 5 January bean 650 calls at 3½	17½ CR
Net position:	4½ Debit

FIGURE 34-2.
January soybean, ratio spread.

Figure 34-2 shows the profit potential of the ratio call spread. It looks fairly typical for a ratio spread: limited downside exposure, maximum profit potential at the strike of the written calls, and unlimited upside exposure.

Since this spread is established with both options out-of-the-money, one needs some upward movement by January soybean futures in order to be profitable. However, too much movement would not be welcomed (although follow-up strategies could be used to deal with that). Consequently, this is a moderately bullish strategy; one should feel that the underlying futures have a chance to move somewhat higher before expiration.

Again, the analyst should treat this position in terms of points, not dollars or cents of soybean movement, in order to calculate the significant profit and loss points. Refer to Chapter 11 on ratio call spreads for the original explanation of these formulae for ratio call spreads:

$$\begin{aligned}\text{Maximum downside loss} &= \text{Initial debit or credit}\\ &= -4\tfrac{1}{2} \text{ (it is a debit)}\end{aligned}$$

$$\begin{aligned}\text{Points of maximum profit} &= \text{Maximum downside loss}\\ &\quad + \text{Difference in strikes}\\ &\quad \times \text{Number of calls owned}\\ &= -4\tfrac{1}{2} + 50 \times 2\\ &= 95\tfrac{1}{2}\end{aligned}$$

$$\begin{aligned}\text{Upside break-even price} &= \text{Higher striking price} \\ &\quad + \text{Maximum profit/Net number of naked calls} \\ &= 650 + 95\tfrac{1}{2}/3 \\ &= 681.8\end{aligned}$$

These are the significant points of profitability at expiration. One does not care what the unit of trading is (for example, cents for soybeans) or how many dollars are involved in one unit of trading ($50 for soybeans and soybean options). He can conduct his analysis strictly in terms of points, and he *should* do so.

Before proceeding into the comparisons between the backspread and the ratio spread as they apply to mispriced futures options, it should be pointed out that the serious strategist should analyze how his position will perform over the short term as well as at expiration. These analyses are presented in Chapter 36 on advanced concepts.

WHICH STRATEGY TO USE

The profit potential of the put backspread is obviously far different from that of the call ratio spread. They are similar in that they both offer the strategist the opportunity to benefit from spreading mispriced options. Choosing which one to implement (assuming liquidity in both the puts and calls) may be helped by examining the technical picture (chart) of the futures contract. Recall that futures traders are often more technically oriented than stock traders, so it pays to be aware of basic chart patterns, because others are watching them as well. If enough people see the same thing and act on it, the chart pattern will be correct, if only from a "self-fulfilling prophecy" viewpoint if nothing else.

Consequently, if the futures are locked in a (smooth) downtrend, the put strategy is the strategy of choice because it offers the best downside profit. Conversely, if the futures are in a smooth uptrend, the call strategy is best.

The worst result will be achieved if the strategist has established the call ratio spread, and the futures have an explosive rally. In certain cases, very bullish rumors—weather predictions such as drought or El Niño, foreign labor unrest in the fields or mines, Russian buying of grain—will produce this mispricing phenomenon. The strategist should be leery of using the call ratio spread strategy in such situations, even though the out-of-the-money calls look and are ridiculously expensive. If the rumors prove true, or if there are too many shorts being squeezed, the futures can move too far, too fast and seriously hurt the spreader who has the ratio call spread in place. His margin requirements will escalate quickly as the futures price moves higher. The option premiums will remain high or possibly even expand if the futures rally quickly, thereby overriding the potential benefit of time decay. Moreover, if the fundamentals change immediately—it rains; the strike is settled; no grain credits are offered to the Russians—or rumors prove false, the futures can come crashing back down in a hurry.

Consequently, *if rumors of fundamentals have introduced volatility in the futures market, implement the strategy with the put backspread.* The put backspread is geared to taking advantage of volatility, and this fundamental situation as described is certainly volatile. It may seem that because the market is exploding to the upside, it is a waste of time to establish the put spread. Still, it is the wisest choice in a volatile market, and there is always the chance that an explosive advance can turn into a quick decline, especially when the advance is based on rumors or fundamentals that could change overnight.

There are a few "don'ts" associated with the ratio call spread. Do not be tempted to use the ratio spread strategy in volatile situations such as those just described; it works best in a slowly rising market. Also, do not implement the ratio spread with ridiculously far out-of-the-money options, as one is wasting his theoretical advantage if the futures do not have a realistic chance to climb to the striking price of the written options. Finally, *do not attempt to use overly large ratios in order to gain the most theoretical advantage.* This is an important concept, and the next example illustrates it well.

Example: Assume the same pricing pattern for January soybean options that has been the basis for this discussion. January beans are trading at 583. The (novice) strategist sees that the slightly in-the-money January 575 call is the cheapest and the deeply out-of-the-money January 675 call is the most expensive. This can be verified from either of two previous tables: the one showing the actual price as compared to the "theoretical" price, or Table 34-2 showing the implied volatilities.

Again, one would use the deltas (see Table 34-2) to create a neutral spread. A neutral ratio of these two would involve selling approximately six calls for each one purchased.

Buy 1 January bean 575 call at 19½	19½ DB
Sell 6 January bean 675 calls at 2¼	13½ CR
Net position:	6 Debit

Figure 34-3 shows the possible detrimental effects of using this large ratio. While one could make 94 points of profit if beans were at 675 at January expiration, he could lose that profit quickly if beans shot on through the upside break-even point, which is only 693.8. The previous formulae can be used to verify these maximum profit and upside break-even point calculations. The upside break-even point is too close to the striking price to allow

FIGURE 34-3.
January soybean, heavily ratioed spread.

for reasonable follow-up action. Therefore, this would not be an attractive position from a practical viewpoint, even though at first glance it looks attractive theoretically.

It would seem that neutral spreading could get one into trouble if it "recommends" positions like the 6-to-1 ratio spread. In reality, it is the strategist who is getting into trouble if he doesn't look at the whole picture. The statistics are just an aid—a tool. The strategist must use the tools to his advantage. It should be pointed out as well that there is a tool missing from the toolkit at this point. There are statistics that will clearly show the risk of this type of high-ratio spread. In this case, that tool is the gamma of the option. Chapter 40 covers the use of gamma and other more advanced statistical tools. This same example is expanded in that chapter to include the gamma concept.

FOLLOW-UP ACTION

The same follow-up strategies apply to these futures options as did for stock options. They will not be rehashed in detail here; refer to earlier chapters for broader explanations. This is a summary of the normal follow-up strategies:

Ratio call spread:

Follow-up action in strategies with naked options, such as this, generally involves taking or limiting losses. A rising market will produce a negative EFP.

Neutralize a negative EFP by:

Buying futures

Buying some calls

Limit upside losses by placing buy stop orders for futures at or near the upside break-even point.

Put backspread:

Follow-up action in strategies with an excess of long options generally involves taking or protecting profits. A falling market will produce a negative EFP.

Neutralize a negative EFP by:

Buying futures

Selling some puts

The reader has seen these follow-up strategies earlier in the book. However, there is one new concept that is important: *The mispricing continues to propagate itself no matter what the price of the underlying futures contract.* The at-the-money options will always be about fairly priced; they will have the average implied volatility.

Example: In the previous examples, January soybeans were trading at 583 and the implied volatility of the options with striking price 575 was 15%, while those with a 600 strike were 17%. One could, therefore, conclude that the at-the-money January soybean options would exhibit an implied volatility of about 16%.

This would still be true if beans were at 525 or 675. The mispricing of the other options would extend out from what is now the at-the-money strike. Table 34-3 shows what one might expect to see if January soybeans rose 75 cents in price, from 583 to 658.

Note that the same mispricing properties exist in both the old and new situations: The puts that are 58 points out-of-the-money have an implied volatility of only 12%, while the calls that are 92 points out-of-the-money have an implied volatility of 23%:

TABLE 34-3.
Propagation of volatility skewing.

Original Situation		New Situation
January beans: 583		January beans: 658
Strike	Implied Volatility	Strike
525	12%	600
550	13%	625
575	15%	650

600	17%	675
625	19%	700
650	21%	725
675	23%	750

This example is not meant to infer that the volatility of an at-the-money soybean futures option will always be 16%. It could be anything, depending on the historical and implied volatility of the futures contract itself. However, the volatility skewing will still persist even if the futures rally or decline.

This fact will affect how these strategies behave as the underlying futures contract moves. It is a benefit to both strategies. First, look at the put backspread when the stock falls to the striking price of the purchased puts.

Example: The put backspread was established under the following conditions:

Strike	Put Price	Theoretical Put Price	Implied Volatility
550	3¼	5.4	13%
600	28	27.6	17%

If January soybean futures should fall to 550, one would expect the implied volatility of the January 550 puts that are owned to be about 16% or 17%, since they would be at-the-money at that time. This makes the assumption that the at-the-money puts will have about a 17% implied volatility, which is what they had when the position was established.

Since the strategy involves being long a large quantity of January 550 puts, this increase in implied volatility as the futures drop in price will be of benefit to the spread.

Note that the implied volatility of the January 600 puts would increase as well, which would be a small negative aspect for the spread. However, since there is only one put short and it is quite deeply in-the-money with the futures at 550, this negative cannot outweigh the positive effect of the expansion of volatility on the long January 550 puts.

In a similar manner, the call spread would benefit. The implied volatility of the written options would actually drop as the futures rallied, since they would be *less* far out-of-the-money than they originally were when the spread was established. While the same can be said of the long options in the spread, the fact that there are extra, naked, options means the spread will benefit overall.

In short, the futures option strategist should be alert to mispricing situations like those described above. They occur frequently in a few commodities and occasionally in others. The put backspread strategy has limited risk and might therefore be attractive to more individuals; it is best used in downtrending and/or volatile markets. However, if the futures are in a smooth uptrend, not a volatile one, a ratio call spread would be better. In either case, the strategist has established a spread that is statistically attractive because he has sold options that are expensive in relation to the ones that he has bought.

SUMMARY

This chapter presented the basics of futures and futures options trading. The basic differences between futures options and stock or index options were laid out. In a certain sense, a futures option is easier to utilize than is a stock option because the effects of dividends, interest rates, stock splits, and so forth do not apply to futures options. However, the fact that each underlying physical commodity is completely different from most other ones means that the strategist is forced to familiarize himself with a vast array of details involving striking prices, trading units, expiration dates, first notice days, etc.

More details mean there could be more opportunities for mistakes, most of which can be avoided by visualizing and analyzing all positions in terms of points and not in dollars.

Futures options do not create new option strategies. However, they may afford one the opportunity to trade when the futures are locked limit up. Moreover, the volatility skewing that is present in futures options will offer opportunities for put backspreads and call ratio spreads that are not normally present in stock options.

Chapter 35 discusses futures spreads and how one can use futures options with those spreads. Calendar spreads are discussed as well. Calendar spreads with futures options are different from calendar spreads using stock or index options. These are important concepts in the futures markets—distinctly different from an option spread—and are therefore significant for the futures option trader.

CHAPTER 35

Futures Option Strategies for Futures Spreads

A spread with futures is not the same as a spread with options, except that one item is bought while another is simultaneously sold. In this manner, one side of the spread hedges the risk of the other. This chapter describes futures spreading and offers ways to use options as an adjunct to those spreads.

The concept of calendar spreading with futures options is covered in this chapter as well. This is the one strategy that is very different when using futures options, as opposed to using stock or index options.

FUTURES SPREADS

Before getting into option strategies, it is necessary to define futures spreads and to examine some common futures spreading strategies.

FUTURES PRICING DIFFERENTIALS

It has already been shown that, for any particular physical commodity, there are, at any one time, several futures that expire in different months. Oil futures have monthly expirations; sugar futures expire in only five months of any one calendar year. The frequency of expiration months depends on which futures contract one is discussing.

Futures on the same underlying commodity will trade at different prices. The differential is due to several factors, not just time, as is the case with stock options. A major factor is carrying costs—how much one would spend to buy and hold the physical commodity until futures expiration. However, other factors may enter in as well, including supply and demand considerations. In a normal carrying cost market, futures that expire later in time are more expensive than those that are nearer-term.

Example: Gold is a commodity whose futures exhibit forward or normal carry. Suppose it is March 1st and spot gold is trading at 1351. Then, the futures contracts on gold and their respective prices might be as follows:

Expiration Month	Price
April	1352.50
June	1354.70
August	1356.90
December	1361.00
June of following year	1366.90

Notice that each successive contract is more expensive than the previous one. There is a 2.20 differential between each of the first three expirations, equal to 1.10 per month of additional expiration time. However, the differential is not quite that great for the December, which expires in 9 months, or for the June contract, which expires in 15 months. The reason for this might be that longer-term interest rates are slightly lower than the short-term rates, and so the cost of carry is slightly less.

However, prices in all futures don't line up this nicely. In some cases, different months may actually represent different products, even though both are on the same underlying physical commodity. For example, wheat is not always wheat. There is a summer crop and a winter crop. While the two may be related in general, there could be a substantial difference between the July wheat futures contract and the December contract, for example, that has very little to do with what interest rates are.

Sometimes short-term demand can dominate the interest rate effect, and a series of futures contracts can be aligned such that the short-term futures are more expensive. This is known as a reverse carrying charge market, or contango.

INTRAMARKET FUTURES SPREADS

Some futures traders attempt to predict the relationships between various expiration months on the same underlying physical commodity. That is, one might buy July soybean futures and sell September soybean futures. *When one both buys and sells differing* *futures contracts, he has a spread. When both contracts are on the same underlying physical commodity, he has an intramarket spread.*

The spreader is not attempting to predict the overall direction of prices. Rather, he is trying to predict the *differential* in prices between the July and September contracts. He doesn't care if beans go up or down, as long as the spread between July and September goes his way.

Example: A spread trader notices that historic price charts show that if September soybeans get too expensive with respect to July soybeans, the differential usually disappears in a month or two. The opportunity for establishing this trade usually occurs early in the year—February or March.

Assume it is February 1st, and the following prices exist:

July soybean futures: 600 ($6.00/bushel)
September soybean futures: 606

The price differential is 6 cents. It rarely gets worse than 12 cents, and often reverses to the point that July futures are more expensive than the September futures—some years as much as 100 cents more expensive.

If one were to trade this spread from a historical perspective, he would thus be risking approximately 6 cents, with possibilities of making over 100 cents. That is certainly a good risk/reward ratio, if historic price patterns hold up in the current environment.

Suppose that one establishes the spread:

Buy one July future @ 600
Sell one September future @ 606

At some later date, the following prices and, hence, profits and losses, exist.

Futures Price	Profit/Loss
July: 650	+50 cents
September: 630	–24 cents
Total Profit:	26 cents ($1,300)

The spread has inverted, going from an initial state in which September was 6 cents more expensive than July, to a situation in which July is 20 cents more expensive. The spreader would thus make 26 cents, or $1,300, since 1 cent in beans is worth $50.

Notice that the same profit would have been made at any of the following pairs of prices, because the price differential between July and September is 20 cents in all cases (with July being the more expensive of the two).

July Futures	September Futures	July Profit	September Profit
420	400	–180	+206
470	450	–130	+156
550	530	–50	+76
600	580	0	+26
650	630	+50	–24
700	680	+100	–74
800	780	+200	–174

Therefore, the same 26-cent profit can be made whether soybeans are in a severe bear market, in a rousing bull market, or even somewhat unchanged. The spreader is only concerned with whether the spread widens from a 6-cent differential or not.

Charts, some going back years, are kept of the various relationships between one expiration month and another. Spread traders often use these historical charts to determine when to enter and exit intramarket spreads. These charts display the seasonal tendencies that make the relationships between various contracts widen or shrink. Analysis of the fundamentals that cause the seasonal tendencies could also be motivation for establishing intramarket spreads.

The margin required for intramarket spread trading (and some other types of futures spreads) is smaller than that required for speculative trading in the futures themselves. The reason for this is that spreads are considered less risky than outright positions in the futures. However, one can still make or lose a good deal of money in a spread—percentage-wise as well as in dollars—so it cannot be considered conservative; it's just less risky than outright futures speculation.

Example: Using the soybean spread from the example above, assume the speculative initial margin requirement is \$1,700. Then, the spread margin requirement might be \$500. That is considerably less than one would have to put up as initial margin if each side of the spread had to be margined separately, a situation that would require \$3,400.

In the previous example, it was shown that the soybean spread had the potential to widen as much as 100 points (\$1.00), a move that would be worth \$5,000 if it occurred. While it is unlikely that the spread would actually widen to historic highs, it is certainly possible that it could widen 25 or 30 cents, a profit of \$1,250 to \$1,500.

That is certainly high leverage on a $500 investment over a short time period, so one must classify spreading as a risk strategy.

INTERMARKET FUTURES SPREADS

Another type of futures spread is one in which one buys futures contracts in one market and sells futures contracts in another, probably related, market. *When the futures spread is transacted in two different markets, it is known as an intermarket spread.* Intermarket spreads are just as popular as intramarket spreads.

One type of intermarket spread involves directly related markets. Examples include spreads between currency futures on two different international currencies; between financial futures on two different bond, note, or bill contracts; or between a commodity and its products—oil, unleaded gasoline, and heating oil, for example.

Example: Interest rates have been low in both the United States and Japan. As a result, both currencies are depressed with respect to the European currencies, where interest rates remain high. A trader believes that interest rates will become more uniform worldwide, causing the Japanese yen to appreciate with respect to the Euro foreign currency.

However, since he is not sure whether Japanese rates will move up or Euro rates will move down, he is reluctant to take an outright position in either currency. Rather, he decides to utilize an intermarket spread to implement his trading idea.

Assume he establishes the spread at the following prices:

Buy 1 June yen future: 147.00
Sell 1 June Euro future: 130.00

This is an initial differential of 17.00 between the two currency futures. He is hoping for the differential to get larger. The dollar trading terms are the same for both futures: One point of movement (from 130.00 to 131.00, for example) is worth $1,250. His profit and loss potential would therefore be:

Spread Differential at a Later Date	Profit/Loss
14.00	–$3,750
16.00	–$1,250
18.00	+1,250
20.00	+3,750

In some cases, the exchanges recognize frequently traded intermarket spreads as being eligible for reduced margin requirements. That is, the exchange recognizes that the two futures are hedges against one another if one is sold and the other is bought.

These spreads between currencies, called cross-currency spreads, are so heavily traded that there are other specific vehicles—both futures and warrants—that allow the speculator to trade them as a single entity. Regardless, they serve as a prime example of an intermarket spread when the two futures are used.

In the example above, assume the outright speculative margin for a position in either currency future is $1,700 per contract. Then, the margin for this spread would probably be nearly $1,700 as well, equal to the speculative margin for one side of the spread. This position is thus recognized as a spread position for margin purposes. The margin treatment isn't as favorable as for the intramarket spread (see the earlier soybean example), but the spread margin is still only one-half of what one would have to advance as initial margin if both sides of the spread had to be margined separately.

Other intermarket spreads are also eligible for reduced margin requirements, although at first glance they might not seem to be as direct a hedge as the two currencies above were.

Example: A common intermarket spread is the TED spread, which consists of Treasury bill futures on one side and Eurodollar futures on the other. Treasury bills represent the safest investment there is; they are guaranteed. Eurodollars, however, are not insured, and therefore represent a less safe investment. Consequently, Eurodollars yield more than Treasury bills. How much more is the key, because as the yield differential expands or shrinks, the spread between the prices of T-bill futures and Eurodollar futures expands or shrinks as well. In essence, the yield differential is small when there is stability and confidence in the financial markets, because uninsured deposits and insured deposits are not that much different in times of financial certainty. However, in times of financial uncertainty and instability, the spread widens because the uninsured depositors require a comparatively higher yield for the higher risk they are taking.

Assume the outright initial margin for either the T-bill future or the Eurodollar future is $800 per contract. The margin for the TED spread, however, is only $400. Thus, one is able to trade this spread for only one-fourth of the amount of margin that would be required to margin both sides separately.

The reason that the margin is more favorable is that there is not a lot of volatility in this spread. Historically, it has ranged between about 0.30 and 1.70. In both futures contracts, one cent (0.01) of movement is worth $25. Thus, the entire 140-cent historic range of the spread only represents $3,500 ($140 \times \$25$).

More will be said later about the TED spread when the application of futures options to intermarket spreads is discussed. Since there is a liquid option market on both futures, it is sometimes more logical to establish the spread using options instead of futures.

One other comment should be made regarding the TED spread: It has carrying cost. That is, if one buys the spread and holds it, the spread will shrink as time passes, causing a small loss to the holder. When interest rates are low, the carrying cost is small (about 0.05 for 3 months). It would be larger if short-term rates rose. The prices in Table 35-1 show that the spread is more costly for longer-term contracts.

TABLE 35-1.
Carrying costs of the TED spread.

Month	T-Bill Future	Eurodollar Future	TED Spread
March	96.27	95.86	0.41
June	96.15	95.69	0.46
September	95.90	95.39	0.51

Many intermarket spreads have some sort of carrying cost built into them; the spreader should be aware of that fact, for it may figure into his profitability.

One final, and more complex, example of an intermarket spread is the crack spread. There are two major areas in which a basic commodity is traded, as well as two of its products: crude oil, unleaded gasoline, and heating oil; or soybeans, soybean oil, and soybean meal. A crack spread involves trading all three—the base commodity and both by-products.

Example: The crack spread in oil consists of buying two futures contracts for crude oil and selling one contract each for heating oil and unleaded gasoline.

The units of trading are not the same for all three. The crude oil future is a contract for 1,000 barrels of oil; it is traded in units of dollars per barrel, so a $1 increase in oil prices—from $18.00 to $19.00, say—is worth $1,000 to the futures contract. Heating oil and unleaded gasoline futures contracts have similar terms, but they are different from crude oil. Each of these futures is for 42,000 gallons of the product, and they are traded in cents. So, a one-cent move—gasoline going from 60 cents a gallon to 61 cents a gallon—is worth $420. This information is summarized in Table 35-2 by showing how much a unit change in price is worth.

TABLE 35-2.
Terms of oil production contract.

Contract	Initial Price	Subsequent Price	Gain in Dollars
Crude Oil	18.00	19.00	$1,000
Unleaded Gasoline	.6000	.6100	$ 420
Heating Oil	.5500	.5600	$ 420

The following formula is generally used for the oil crack spread:

$$\begin{aligned}\text{Crack} &= \frac{(\text{Unleaded gasoline} + \text{Heating oil}) \times 42 - 2 \times \text{Crude}}{2} \\ &= \frac{(.6000 + .5500) \times 42 - 2 \times 18.00}{2} \\ &= (48.3 - 36)/2 \\ &= 6.15\end{aligned}$$

Some traders don't use the divisor of 2 and, therefore, would arrive at a value of 12.30 with the above data.

In either case, the spreader can track the history of this spread and will attempt to buy oil and sell the other two, or vice versa, in order to attempt to make an overall profit as the three products move. Suppose a spreader felt that the products were too expensive with respect to crude oil prices. He would then implement the spread in the following manner:

Buy 2 March crude oil futures @ 18.00
Sell 1 March heating oil future @ 0.5500
Sell 1 March unleaded gasoline future @ 0.6000

Thus, the crack spread was at 6.15 when he entered the position. Suppose that he was right, and the futures prices subsequently changed to the following:

March crude oil futures:	18.50
March unleaded gas futures:	.6075
March heating oil futures:	.5575

The profit is shown in Table 35-3.

TABLE 35-3.
Profit and loss of crack spread.

Contract	Initial Price	Subsequent Price	Gain in Dollars
2 March Crude	18.00	18.50	+$1,000
1 March Unleaded	.6000	.6075	–$315
1 March Heating Oil	.5500	.5575	–$315
Net Profit (before commissions)			+$370

One can calculate that the crack spread at the new prices has shrunk to 5.965. Thus, the spreader was correct in predicting that the spread would narrow, and he profited.

Margin requirements are also favorable for this type of spread, generally being slightly less than the speculative requirement for two contracts of crude oil.

The above examples demonstrate some of the various intermarket spreads that are heavily watched and traded by futures spreaders. They often provide some of the most reliable profit situations without requiring one to predict the actual direction of the market itself. Only the differential of the spread is important.

One should not assume that all intermarket spreads receive favorable margin treatment. Only those that have traditional relationships do.

USING FUTURES OPTIONS IN FUTURES SPREADS

After viewing the above examples, one can see that futures spreads are not the same as what we typically know as option spreads. However, option contracts may be useful in futures spreading strategies. They can often provide an additional measure of profit potential for very little additional risk. This is true for both intramarket and intermarket spreads.

The futures option calendar spread is discussed first. The calendar spread with futures options is not the same as the calendar spread with stock or index options. In fact, it may best be viewed as an alternative to the intramarket futures spread rather than as an option spread strategy.

CALENDAR SPREADS

A calendar spread with futures options would still be constructed in the familiar manner—buy the May call, sell the March call with the same striking price. However, there is a major difference between the futures option calendar spread and the stock option calendar spread. That difference is that *a calendar spread using futures options involves two separate underlying instruments, while a calendar spread using stock options does not.* When one buys the May soybean 600 call and sells the March soybean 600 call, he is buying a call on the May soybean futures contract and selling a call on the March soybean futures contract. Thus, the futures option calendar spread involves two separate, but related, underlying futures contracts. However, if one buys the IBN May 100 call and sells the IBN March 100 call, both calls are on the same underlying instrument, IBN. This is a major difference between the two strategies, although both are called "calendar spreads."

To the stock option trader who is used to visualizing calendar spreads, the futures option variety may confound him at first. For example, a stock option trader may conclude that if he can buy a four-month call for 5 points and sell a two-month call for 2 points, he has a good calendar spread possibility. Such an analysis is meaningless with futures options. If one can buy the May soybean 600 call for 5 and sell the March soybean 600 call for 3, is that a good spread or not? It's impossible to tell, unless you know the relationship between May and March soybean futures contracts. Thus, in order to analyze the futures option calendar spread, one must not only analyze the options' relationship, but the two futures contracts' relationship as well. Simply stated, when one establishes a futures option calendar spread, he is not only spreading time, as he does with stock options, he is also spreading the relationship between the underlying futures.

Example: A trader notices that near-term options in soybeans are relatively more expensive than longer-term options. He thinks a calendar spread might make sense, as he can sell the overpriced near-term calls and buy the relatively cheaper longer-term calls. This is a good situation, considering the theoretical value of the options involved. He establishes the spread at the following prices:

Soybean Contract	Initial Price	Trading Position
March 600 call	14	Sell 1
May 600 call	21	Buy 1
March future	594	none
May future	598	none

The May/March 600 call calendar spread is established for 7 points debit. March expiration is two months away. At the current time, the May futures are trading at a 4-point premium to March futures. The spreader figures that if March futures are approximately unchanged at expiration of the March options, he should profit handsomely, because the March calls are slightly overpriced at the current time, plus they will decay at a faster rate than the May calls over the next two months.

Suppose that he is correct and March futures are unchanged at expiration of the March options. This is still no guarantee of profit, because one must also determine where May futures are trading. If the spread between May and March futures behaves poorly (May declines with respect to March), then he might still lose money. Look at the following table to see how the futures spread between March and May futures affects the profitability of the calendar spread. The calendar spread cost 7 debit when the futures spread was +4 initially.

Futures Prices March/May	Futures Spread Price	May 600 Call Price	Calendar Spread Profit/Loss
594/570	–24	4	–3 cents
594/580	–14	6½	–½
594/590	–4	10	+3
594/600	+6	14½	+7½

Thus, the calendar spread could lose money even with March futures unchanged, as in the top two lines of the table. It also could do better than expected if the futures spread widens, as in the bottom line of the table.

The profitability of the calendar spread is heavily linked to the futures spread price. In the above example, it was possible to lose money even though the March futures contract was unchanged in price from the time the calendar spread was initially established. This would never happen with stock options. If one placed a calendar spread on IBN and the stock were unchanged at the expiration of the near-term option, the spread would make money virtually all of the time (unless implied volatility had shrunk dramatically).

The futures option calendar spreader is therefore trading two spreads at once. The first one has to do with the relative pricing differentials (implied volatilities, for example) of the two options in question, as well as the passage of time. The second one is the relationship between the two underlying futures contracts. As a result, it is difficult to draw the ordinary profit picture. Rather, one must approach the problem in this manner:

1. Use the horizontal axis to represent the futures spread price at the expiration of the near-term option.
2. Draw several profit curves, one for each price of the near-term future at near-term expiration.

Example: Expanding on the above example, this method is demonstrated here.

Figure 35-1 shows how to approach the problem. The horizontal axis depicts the spread between March and May soybean futures at the expiration of the March futures options. The vertical axis represents the profit and loss to be expected from the calendar spread, as it always does.

The major difference between this profit graph and standard ones is that there are now several sets of profit curves. A separate one is drawn for each price of the *March futures* that one wants to consider in his analysis. The previous example showed the profitability for only one price of the March futures—unchanged at 594. However, one cannot

FIGURE 35-1.
Soybean futures calendar spreads, at March expiration.

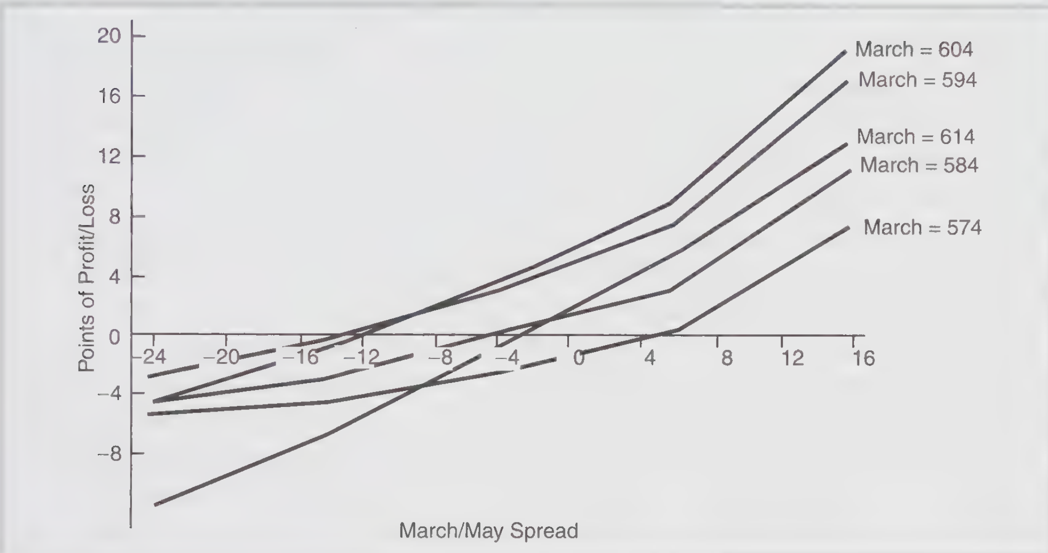


TABLE 35-4.
Profit and loss from soybean call calendar.

All Prices at March Option Expiration							
Futures Spread (May-March)	March Future Price:	Calendar Spread Profit 574	584	594	604	614	Future Spread Profit
−24		−5.5	−4.5	−3	−4.5	−11.5	−28
−14		−4.5	−3	−0.5	−1	−7	−18
−4		−2.5	0	+3	+3.5	−1	− 8
6		0	+ 3	+7.5	+9	+5.5	+ 2
16		+7	+11	+17	+19	+13	+12

rely on the March futures to remain unchanged, so he must view the profitability of the calendar spread at various March futures prices.

The data that is plotted in the figure is summarized in Table 35-4. Several things are readily apparent. First, if the futures spread improves in price, the calendar spread will generally make money. These are the points on the far right of the figure and on the bottom line of Table 35-4. Second, if the futures spread behaves miserably, the calendar spread will almost certainly lose money (points on the left-hand side of the figure, or top line of the table).

Third, if March futures rise in price too far, the calendar spread could do poorly. In fact, if March futures rally *and* the futures spread worsens, *one could lose more than his initial debit* (bottom left-hand point on figure). This is partly due to the fact that one is buying the March options back at a loss if March futures rally, and may also be forced to sell his May options out at a loss if May futures have fallen at the same time.

Fourth, as might be expected, the best results are obtained if March futures rally slightly or remain unchanged and the futures spread also remains relatively unchanged (points in the upper right-hand quadrant of the figure).

In Table 35-4, the far right-hand column shows how a futures spreader would have fared if he had bought May and sold March at 4 points May over March, not using any options at all.

This example demonstrates just how powerful the influence of the *futures* spread is. The calendar spread profit is predominantly a function of the futures spread price. Thus, even though the calendar spread was attractive from the theoretical viewpoint of the option's prices, its result does not seem to reflect that theoretical advantage, due to the influence of the futures spread. Another important point for the calendar spreader used to dealing with stock options to remember is that *one can lose more than his initial debit in a futures calendar spread* if the spread between the underlying futures inverts.

There is another way to view a calendar spread in futures options, however, and that is as a substitute or alternative to an intramarket spread in the futures contracts themselves. Look at Table 35-4 again and notice the far right-hand column. This is the profit or loss that would be made by an intramarket soybean spreader who bought May and sold March at the initial prices of 598 and 594, respectively. The calendar spread generally outperforms the intramarket spread for the prices shown in this example. This is where the true theoretical advantage of the calendar spread comes in. So, *if one is thinking of establishing an intramarket spread, he should check out the calendar spread in the futures options first.* If the options have a theoretical pricing advantage, the calendar spread may clearly outperform the standard intramarket spread.

Study Table 35-4 for a moment. Note that the intramarket spread is only better when prices drop but the spread widens (lower left corner of table). In all other cases, the calendar spread strategy is better. One could not always expect this to be true, of course; the results in the example are partly due to the fact that the March options that were sold were relatively expensive when compared with the May options that were bought.

In summary, the futures option calendar spread is more complicated when compared to the simpler stock or index option calendar spread. As a result, calendar spreading with futures options is a less popular strategy than its stock option counterpart. However, this does not mean that the strategist should overlook this strategy. As the strategist knows, he can often find the best opportunities in seemingly complex situations, because there may be pricing inefficiencies present. This strategy's main application may be for the intramarket spreader who also understands the usage of options.

LONG COMBINATIONS

Another attractive use of options is as a substitute for two instruments that are being traded one against the other. Since intermarket and intramarket futures spreads involve two instruments being traded against each other, futures options may be able to work well in these types of spreads. You may recall that a similar idea was presented with respect to pairs trading, as well as certain risk arbitrage strategies and index futures spreading.

In any type of futures spread, one might be able to substitute options for the actual futures. He might buy calls for the long side of the spread instead of actually buying futures. Likewise, he could sell calls or buy puts instead of selling futures for the other side of the spread. In using options, however, he wants to avoid two problems. First, he does not want to increase his risk. Second, he does not want to pay a lot of time value premium that could waste away, costing him the profits from his spread.

Let's spend a short time discussing these two points. First, he does not want to increase his risk. In general, selling options instead of utilizing futures increases one's risk. If he sells calls instead of selling futures, and sells puts instead of buying futures, he could be increasing his risk tremendously if the futures prices moved a lot. If the futures rose tremendously, the short calls would lose money, but the short puts would cease to make money once the futures rose through the striking price of the puts. *Therefore, it is* not *a recommended strategy to sell options in place of the futures in an intramarket or intermarket spread.* The next example will show why not.

Example: A spreader wants to trade an intramarket spread in live cattle. The contract is for 40,000 pounds, so a one-cent move is worth \$400. He is going to sell April and buy June futures, hoping for the spread to narrow between the two contracts.

The following prices exist for live cattle futures and options:

April future: 78.00
June future: 74.00
April 78 call: 1.25
June 74 put: 2.00

He decides to use the options instead of futures to implement this spread. He sells the April 78 call as an alternative to selling the April future; he also sells the June 74 put as an alternative to buying the June future.

Sometime later, the following prices exist:

April future: 68.00
June future: 66.00
April 78 call: 0.00
June 74 put: 8.05

The futures spread has indeed narrowed as expected—from 4.00 points to 2.00. However, this spreader has no profit to show for it; in fact he has a loss. The call that he sold is now virtually worthless and has therefore earned a profit of 1.25 points; however, the put that was sold for 2.00 is now worth 8.05—a loss of 6.05 points. Overall, the spreader has a net loss of 4.80 points since he used short options, instead of the 2.00-point gain he could have had if he had used futures instead.

The second thing that the futures spreader wants to ensure is that he does not pay for a lot of time value premium that is wasted, costing him his potential profits. If he buys at- or out-of-the-money calls instead of buying futures, and if he buys at- or out-of-the-money puts instead of selling futures, he could be exposing his spread profits to the ravages of time decay. *Do not substitute at- or out-of-the-money options for the futures in intramarket or intermarket spreads.* The next example will show why not.

Example: A futures spreader notices that a favorable situation exists in wheat. He wants to buy July and sell May. The following prices exist for the futures and options:

May futures: 410
July futures: 390
May 410 put: 20
July 390 call: 25

This trader decides to buy the May 410 put instead of selling May futures; he also buys the July 390 call instead of buying July futures.

Later, the following prices exist:

May futures: 400
July futures: 400
May 410 put: 25
July 390 call: 30

The futures spread would have made 20 points, since they are now the same price. At least this time, he has made money in the option spread. He has made 5 points on each option for a total of 10 points overall—only half the money that could have been made with the futures themselves. Note that these sample option prices still show a good deal of time value premium remaining. If more time had passed and these options were trading closer to parity, the result of the option spread would be worse.

It might be pointed out that the option strategy in the above example would work better if futures prices were volatile and rallied or declined substantially. This is true to a certain extent. If the market had moved a lot, one option would be very deeply in-the-money and the other deeply out-of-the-money. Neither one would have much time value premium, and the trader would therefore have wasted all the money spent for the initial time premium. So, unless the futures moved so far as to outdistance that loss of time value premium, the futures moved so far as to outdistance that loss of time value premium, the futures strategy would still outrank the option strategy.

However, this last point of volatile futures movement helping an option position is a valid one. It leads to the reason for the only favorable option strategy that is a substitute for futures spreads—that is, using in-the-money options. *If one buys in-the-money calls instead of buying futures, and buys in-the-money puts instead of selling futures, he can often create a position that has an advantage over the intramarket or intermarket futures spread.* In-the-money options avoid most of the problems described in the two previous examples. There is no increase of risk, since the options are being bought, not sold. In addition, the amount of money spent on time value premium is small, since both options are in-the-money. In fact, one could buy them so far in the money as to virtually eliminate any expense for time value premium. However, that is not recommended, for it would negate the possible advantage of using moderately in-the-money options: *If the underlying futures behave in a volatile manner, it might be possible for the option spread to make money, even if the futures spread does not behave as expected.*

In order to illustrate these points, the TED spread, an intermarket spread, will be used. Recall that in order to buy the TED spread, one would buy T-bill futures and sell an equal quantity of Eurodollar futures.

Options exist on both T-bill futures and Eurodollar futures. If T-bill calls were bought instead of T-bill futures, and if Eurodollar puts were bought instead of selling Eurodollar futures, a similar position could be created that might have some advantages over buying the TED spread using futures. The advantage is that if T-bills and/or Eurodollars change in price by a large enough amount, the option strategist can make money, even if the TED spread itself does not cooperate.

One might not think that short-term rates could be volatile enough to make this a worthwhile strategy. However, they can move substantially in a short period of time, especially if the Federal Reserve is active in lowering or raising rates. For example, suppose the Fed continues to lower rates and both T-bills and Eurodollars substantially rise in price. Eventually, the puts that were purchased on the Eurodollars will become worthless, but the T-bill calls that are owned will continue to grow in value. Thus, one could make money, even if the TED spread was unchanged or shrunk, as long as short-term rates dropped far enough.

Similarly, if rates were to rise instead, the option spread could make money as the puts gained in value (rising rates mean T-bills and Eurodollars will fall in price) and the calls eventually became worthless.

Example: The following prices for June T-bill and Eurodollar futures and options exist in January. All of these products trade in units of 0.01, which is worth $25. So a whole point is worth $2,500.

June T-bill futures: 94.75
June Euro$ futures: 94.15
June T-bill 9450 calls: 0.32
June Euro$ 9450 puts: 0.40

The TED spread, basis June, is currently at 0.60 (the difference in price of the two futures). Both futures have in-the-money options with only a small amount of time value premium in them.

The June T-bill calls with a striking price of 94.50 are 0.25 in the money and are selling for 0.32. Their time value premium is only 0.07 points. Similarly, the June Eurodollar puts with a striking price of 94.50 are 0.35 in the money and are selling for 0.40. Hence, their time value premium is 0.05.

Since the total time value premium—0.12 ($300)—is small, the strategist decides that the option spread may have an advantage over the futures intermarket spread, so he establishes the following position:

	Cost
Buy one June T-bill call @ 0.40	$1,000
Buy one June Euro$ put @ 0.32	$ 800
Total cost:	$1,800

Later, financial conditions in the world are very stable and the TED spread begins to shrink. However, at the same time, rates are being lowered in the United States, and T-bill and Eurodollar prices begin to rally substantially. In May, when the June T-bill options expire, the following prices exist:

June T-bill futures: 95.50
June Euro$ futures: 95.10
June T-bill 9450 calls: 1.00
June Euro$ 9450 puts: 0.01

The TED spread has shrunk from 0.60 to only 0.40. Thus, any trader attempting to buy the TED spread using only futures would have lost $500 as the spread moved against him by 0.20.

However, look at the option position. The options are now worth a combined value of 1.01 points ($2,525), and they were bought for 0.72 points ($1,800). Thus, the option strategy has turned a profit of $725, while the futures strategy would have lost money.

Any traders who used this option strategy instead of using futures would have enjoyed profits, because as the Federal Reserve lowered rates time after time, the prices of both T-bills and Eurodollars rose far enough to make the option strategist's calls more profitable than the loss in his puts. This is the advantage of using in-the-money options instead of futures in futures spreading strategies.

In fairness, it should be pointed out that if the futures prices had remained relatively unchanged, the 0.12 points of time value premium ($300) could have been lost, while the futures spread may have been relatively unchanged. However, this does not alter the reasoning behind wanting to use this option strategy.

Another consideration that might come into play is the margin required. Recall that the initial margin for implementing the TED spread was $400. However, if one uses the option strategy, he must pay for the options in full—$1,800 in the above example. This could conceivably be a deterrent to using the option strategy. Of course, if by investing $1,800, one can make money instead of losing money with the smaller investment, then the initial margin requirement is irrelevant. Therefore, the profit potential must be considered the more important factor.

FOLLOW-UP CONSIDERATIONS

When one uses long option combinations to implement a futures spread strategy, he may find that his position changes from a spread to more of an outright position. This would occur if the markets were volatile and one option became deeply in-the-money, while the other one was nearly worthless. The TED spread example above showed how this could occur as the call wound up being worth 1.00, while the put was virtually worthless.

As one side of the option spread goes out-of-the-money, the spread nature begins to disappear and a more outright position takes its place. One can use the deltas of the options in order to calculate just how much exposure he has at any one time. The following examples go through a series of analyses and trades that a strategist might have to face. The first example concerns establishing an intermarket spread in oil products.

Example: In late summer, a spreader decides to implement an intermarket spread. He projects that the coming winter may be severely cold; furthermore, he believes that gasoline prices are too high, being artificially buoyed by the summer tourist season, and the high prices are being carried into the future months by inefficient market pricing.

Therefore, he wants to buy heating oil futures or options and sell RBOB gasoline futures or options (at the current time, this is the main gasoline futures contract, having replaced unleaded gasoline futures in that role in 2006). He plans to be out of the trade, if possible, by early December, when the market should have discounted the facts about the winter. Therefore, he decides to look at January futures and options. The following prices exist:

Future or Option	Price	Time Value Premium
January heating oil futures:	.6550	
January RBOB gasoline futures:	.5850	
January heating oil 60 call:	6.40	0.90
January RBOB gas 62 put:	4.25	0.75

The differential in futures prices is .07, or 7 cents per gallon. He thinks it could grow to 12 cents or so by early winter. However, he also thinks that oil and oil products have the potential to be very volatile, so he considers using the options. One cent is worth $420 for each of these items.

The time value premium of the options is 1.65 for the put and call combined. If he pays this amount ($693) per combination, he can still make money if the futures widen by 5.00 points, as he expects. Moreover, the option spread gives him the potential for profits if oil products are volatile, even if he is wrong about the futures relationship.

Therefore, he decides to buy five combinations:

Position	Cost
Buy 5 January heating oil 60 calls @ 6.40	$13,440
Buy 5 January RBOB 62 puts @ 4.25	8,925
Total cost:	$22,365

This initial cost is substantially larger than the initial margin requirement for five futures spreads, which would be about $7,000. Moreover, the option cost must be paid for in cash, while the futures requirement could be taken care of with Treasury bills, which continue to earn money for the spreader. Still, the strategist believes that the option position has more potential, so he establishes it.

Notice that in this analysis, *the strategist compared his time value premium cost to the profit potential he expected from the futures spread itself.* This is often a good way to evaluate whether or not to use options or futures. In this example, he thought that, even if futures prices remained relatively unchanged, thereby wasting away his time premium, he could still make money—as long as he was correct about heating oil outperforming RBOB gasoline.

Some follow-up actions will now be examined. If the futures rally, the position becomes long. Some profit might have accrued, but the whole position is subject to losses if the futures fall in price. The strategist can calculate the extent to which his position has become long by using the delta of the options in the strategy. He can then use futures or other options in order to make the position more neutral, if he wants to.

Example: Suppose that both RBOB gasoline and heating oil have rallied some and that the futures spread has widened slightly. The following information is known:

Future or Option	Price	Net Change	Profit/Loss
January heating oil futures:	.7100	+.055	
January RBOB gasoline futures:	.6300	+.045	
January heating oil 60 call:	11.05	+4.65	+$9,765
January RBOB gas 62 put:	1.50	–2.75	–5,775
Total profit:			+$3,990

The futures spread has widened to 8 cents. If the strategist had established the spread with futures, he would now have a one-cent ($420) profit on five contracts, or a $2,100 profit. The profit is larger in the option strategy.

The futures have rallied as well. Heating oil is up 5½ cents from its initial price, while RBOB is up 4½ cents. This rally has been large enough to drive the puts out-of-the-money. When one has established the intermarket spread with options, and the futures rally this much, the profit is usually greater from the option spread. Such is the case in this example, as the option spread is ahead by almost $4,000.

This example shows the most desirable situation for the strategist who has implemented the option spread. The futures rally enough to force the puts out-of-the-money, or alternatively fall far enough to force the calls to be out-of-the-money. If this happens in advance of option expiration, one option will generally have almost all of its time value premium disappear (the calls in the above example). The other option, however, will still have some time value (the puts in the example).

This represents an attractive situation. However, there is a potential negative, and that is that the position is too long now. It is not really a spread anymore. If futures should drop in price, the calls will lose value quickly. The puts will not gain much, though, because they are out-of-the-money and will not adequately protect the calls. At this juncture, the strategist has the choice of taking his profit—closing the position—or making an adjustment to make the spread more neutral once again. He could also do nothing, of course, but a strategist would normally want to protect a profit to some extent.

Example: The strategist decides that, since his goal was for the futures spread to widen to 12 cents, he will not remove the position when the spread is only 8 cents, as it is now. However, he wants to take some action to protect his current profit, while still retaining the possibility to have the profit expand.

As a first step, the equivalent futures position (EFP) is calculated. The pertinent data is shown in Table 35-5.

TABLE 35-5.
EFP of long combination.

Future or Option	Price	Delta	EFP
January heating oil futures:	.7100		
January RBOB gasoline futures:	.6300		
January heating oil 60 call: Long 5	11.05	0.99	+4.95
January RBOB gas 62 put: Long 5	1.50	–0.40	–2.00
		Total EFP:	+2.95

Overall, the position is long the equivalent of about three futures contracts. The position's profitability is mostly related to whether the futures rise or fall in price, not to how the spread between heating oil futures and RBOB gas futures behaves.

The strategist could easily neutralize the long delta by selling three contracts. This would leave room for more profits if prices continue to rise (there are still two extra long calls). It would also provide downside protection if prices suddenly drop, since the 5 long puts plus the 3 short futures would offset any loss in the 5 in-the-money calls.

Which futures should the strategist short? That depends on how confident he is in his original analysis of the intermarket spread widening. If he still thinks it will widen further, then he should sell RBOB gasoline futures against the deeply in-the-money heating oil calls. This would give him an additional profit or loss opportunity based on the relationship of the two oil products. However, if he decides that the intermarket spread should have widened more than this by now, perhaps he will just sell 3 heating oil futures as a direct hedge against the heating oil calls.

Once one finds himself in a profitable situation, as in the above example, *the most conservative course is to hedge the in-the-money option with its own underlying future.* This action lessens the further dependency of the profits on the intermarket spread. There is still profit potential remaining from futures price action. Furthermore, if the futures should fall so far that both options return to in-the-money status, then the intermarket spread comes back into play. Thus, in the above example, the conservative action would be to sell three heating oil futures against the heating oil calls.

The more aggressive course is to hedge the in-the-money option with the future underlying the other side of the intermarket spread. In the above example, that would entail selling the RBOB gasoline futures against the heating oil calls.

Suppose that the strategist in the previous example decides to take the conservative action, and he therefore shorts three heating oil futures at .7100, the current price. This action preserves large profit potential in either direction. It is better than selling out-of-the-money options against his current position.

He would consider removing the hedge if futures prices dropped, perhaps when the puts returned to an in-the-money status with a put delta of at least -0.75 or so. At that point, the position would be at its original status, more or less, except for the fact that he would have taken a nice profit in the three futures that were sold and covered.

Epilogue. The above examples are taken from actual price movements. In reality, the futures fell back, not only to their original price, but far below it. The fundamental reason for this reversal was that the weather was warm, hurting demand for heating oil, and gasoline supplies were low. By the option expiration in December, the following prices existed:

January heating oil futures: .5200
January RBOB gas futures: .5200

Not only had the futures prices virtually crashed, but the intermarket spread had been decimated as well. The spread had fallen to zero! It had never reached anything near the 12-cent potential that was envisioned. Any spreader who had established this spread with futures would almost certainly have lost money; he probably would not have held it until it reached this lowly level, but there was never much opportunity to get out at a profit.

The strategist who established the spread with options, however, most certainly would have made money. One could safely assume that he covered the three futures sold in the previous example at a nice profit, possibly 7 points or so. One could also assume that as the puts became in-the-money options, he established a similar hedge and bought three RBOB gasoline futures when the EFP reached –3.00. This probably occurred with RBOB gasoline futures around .5700–5 cents in the money.

Assuming that these were the trades, the following table shows the profits and losses.

Position	Initial Price	Final Price	Net Profit/ Loss
Bought 5 calls	6.40	0	–$13,440
Bought 5 puts	4.25	10.00	+12,075
Sold 3 heating oil futures	.7100	.6400	+8,820
Bought 3 RBOB gas futures	.5700	.5200	–6,300
Total profit:			+$1,155

In the final analysis, the fact that the intermarket spread collapsed to zero actually aided the option strategy, since the puts were the in-the-money option at expiration. This was not planned, of course, but by being long the options, the strategist was able to make money when volatility appeared.

INTRAMARKET SPREAD STRATEGY

It should be obvious that the same strategy could be applied to an intramarket spread as well. If one is thinking of spreading two different soybean futures, for example, he could substitute in-the-money options for futures in the position. He would have the same attributes as shown for the intermarket spread: large potential profits if volatility occurs. Of course, he could still make money if the intramarket spread widens, but he would lose the time value premium paid for the options.

SPREADING FUTURES AGAINST STOCK SECTOR INDICES

This concept can be carried one step further. Many futures contracts are related to stocks—usually to a sector of stocks dealing in a particular commodity. For example, there are crude oil futures or the crude oil ETF (USO) and there is an Oil & Gas Sector Index (XOI). There are gold futures or the gold ETF (GLD) and there is a Gold & Silver Index (XAU). If one charts the history of the commodity versus the price of the stock sector, he can often find tradeable patterns in terms of the relationship between the two. That relationship can be traded via an intermarket spread using options.

For example, if one thought crude oil was cheap with respect to the price of oil stocks in general, he could buy calls on crude oil futures or USO and buy puts on the Oil & Gas (XOI) Index. One would have to be certain to determine the number of options to trade on each side of the spread, by using the ratio that was presented in Chapter 31 on inter-index spreading. (In fact, this formula should be used for futures intermarket spreading if the two underlying futures don't have the same terms.) Only now, there is an extra component to add if options are used—the delta of the options:

$$\text{Ratio} = \frac{v_1}{v_2} \times \frac{p_1}{p_2} \times \frac{u_1}{u_2} \times \frac{\Delta_1}{\Delta_2}$$

where v_i = volatility
p_i = price of the underlying
u_i = unit of trading of the option
Δ_i = delta of the option

Example: Suppose that one indeed wants to buy crude oil calls and also buy puts on the XOI Index because he thinks that crude oil is cheap with respect to oil stocks. The following prices exist:

July crude futures: 16.35	XOI: 256.50
Crude July 1550 call: 1.10	June 265 put: 14½
Volatility: 25%	Volatility: 17%
Call delta: 0.74	Put delta: 0.73

The unit of trading for XOI options is $100 per point, as it is with nearly all stock and index options. The unit of trading for crude oil futures and options is $1,000 per point. With all of this information, the ratio can be computed:

$\text{Crude} = 1{,}000 \times 0.25 \times 16.35 \times 0.74$
$\text{XOI} = 100 \times 0.17 \times 256.50 \times 0.73$
$\text{Ratio} = \text{Crude/XOI} = 0.91$

Therefore, one would buy 0.91 XOI put for every 1 crude oil call that he bought. For small accounts, this is essentially a 1-to-1 ratio, but for large accounts, the exact ratio could be used (for example, buy 91 XOI puts and 100 crude oil calls). The resultant quantities encompass the various differences in these two markets—mainly the price and volatility of the underlyings, plus the large differential in their units of trading (100 vs. 1,000).

SUMMARY

Futures spreading is a very important and potentially profitable endeavor. Utilizing options in these spreads can often improve profitability to the point that an originally mistaken assumption can be overcome by volatility of price movement.

Futures spreads fall into two categories—intermarket and intramarket. They are important strategies because many futures exhibit historic and/or seasonal tendencies that can be traded without regard to the overall movement of futures prices.

Options can be used to enhance these futures spreading strategies. The futures calendar spread is closely related to the intramarket spread. It is distinctly different from the stock or index option calendar spread.

Using in-the-money long option combinations in lieu of futures can be a very attractive strategy for either intermarket or intramarket spreads. The option strategy gives the spreader two ways to make money: (1) from the movement of the underlying futures in the spread; or (2) if the futures prices experience a big move, from the fact that one option can continually increase in value while the other can drop only to zero. The option strategy also affords the strategist the opportunity for follow-up action based on the equivalent futures position that accumulates as prices rise or fall.

The concepts introduced in this chapter apply not only to futures spreads, but to intermarket spreads between any two entities. An example was given of an intermarket spread between futures and a stock sector index, but the concept can be generalized to apply to any two related markets of any sort.

Traders who utilize futures spreads as part of their trading strategy should give serious consideration to substituting options when applicable. Such an alternative strategy will often improve the chances for profit.

PART VI

Measuring and Trading Volatility

Even though a myriad of strategies and concepts have been presented so far, a common thread among them is lacking. The one thing that ties all option strategies together and allows one to make comparative decisions is *volatility*. In fact, volatility is the most important concept in option trading. Oh, sure, if you're a great picker of stocks, then you *might* be able to get by without considering volatility. Even then, though, you'd be operating without full consideration of the main factor influencing option prices and strategy. For the rest of us, it is mandatory that we consider volatility carefully before deciding what strategy to use. In this section of the book, an extensive treatment of volatility and volatility trading is presented. The first part defines the terms and discusses some general concepts about how volatility can—and *should*—be used. Then, a number of the more popular strategies, described earlier in the book, are discussed from the vantage point of how they perform when implied volatilities change. After that, volatility trading strategies are discussed—and these are some of the most important concepts for option traders. A discussion is presented on how stock prices actually behave, as opposed to how investors *perceive* them to behave, and then specific criteria and methodology for both buying and selling volatility are introduced.

The information to be presented here is not overly theoretical. All of the concepts should be understandable by most option traders. Whether or not one chooses to actually "trade volatility," it is nevertheless important for an option trader to understand the concepts that underlie the basic principles of volatility trading.

WHY TRADE "THE MARKET"?

The "game" of stock market predicting holds appeal for many because one who can do it seems powerful and intelligent. Everyone has his favorite indicators, analysis techniques, or "black box" trading systems. But can the market really be predicted? And if it can't, what does that say about the time spent trying to predict it? The answers to these questions are not clear, and even if one were to prove that the market can't be predicted, most traders would refuse to believe it anyway. In fact, there may be more than one way to "predict" the market, so in a certain sense one has to qualify exactly what he is talking about before it can be determined if the market can be predicted or not.

The astute option trader knows that market prediction falls into two categories: (1) the prediction of the short-term movement of prices, and (2) the prediction of volatility of the underlying. These are not independent predictions. For example, anyone who is using a "target" is trying to predict *both*. That's pretty hard. Not only do you have to be right about the direction of prices, but you also have to be able to predict how volatile the underlying is going to be so that you can set a reasonable target. In certain cases, the first prediction can be made with some degree of accuracy, but the second one is extremely difficult.

Nearly every trader uses something to aid him in determining what to buy and when to buy it. Many of these techniques, especially if they are refined to a trading *system*, seem worthwhile. In that sense, it appears that the market *can* be predicted. However, this type of predicting usually involves a lot of work, including not only the initial selection of the position, but money management in determining position size, risk management in placing and watching (trailing) stops, and so on. Thus, it's not easy.

To make matters even worse, most mathematical studies have shown that the market can't really be predicted. They tend to imply that anyone who is outperforming an index fund is merely "hot"—has hit a stream of winners. Can this possibly be true? Consider this example. Have you ever gone to Las Vegas and had a winning day? How about a weekend? What about a week? You might be able to answer "yes" to all of those, even though you know for a certainty that the casino odds are mathematically stacked against you. What if the question were extended to your lifetime: Are you ahead of the casinos for your entire life? *This* answer is most certainly "no" if you have played for any reasonably long period of time.

Mathematicians have tended to believe that outperforming the broad stock market is just about the same as beating the casinos in Las Vegas—possible in the short term, but virtually impossible in the long term. Thus, when mathematicians say that the stock market can't be predicted, they are talking about consistently beating the "index"—say, the S&P 500—over a long period of time.

Those with an opposing viewpoint, however, say that the market *can* be beat. They say the "game" is more like poker—where a good player can be a consistent winner through money management techniques—than like casino gambling, where the odds are fixed. It would be impossible to get everyone to agree for sure on who is right. There's some credibility in both viewpoints, but just as it's very hard to be a good poker player, so it is difficult to beat the market consistently with directional strategies. Moreover, even the best directional traders know that there are large swings or draw downs in one's net worth during the year. Thus, the *consistency* of returns is generally erratic for the directional trader.

This inconsistency of returns, the amount of work required, and the necessity to have sufficient capital and to manage it well are all factors that can lead to the demise of a directional trader. As such, short-term directional trading probably is not really a "comfortable" trading strategy for most traders—and if one is trading a strategy that he is not comfortable with, he is eventually going to lose money doing it.

So, is there a better alternative? Or should one just pack it in, buy some index funds, and forget it? As an option strategist, one should most certainly believe that there's something better than buying the index fund. The alternative of volatility trading offers significant advantages in terms of the factors that make directional trading difficult.

If one finds that he *is* able to handle the rigors of directional trading, then stick with that approach. You might want to add some volatility trading to your arsenal, though, just to be safe. However, if one finds that directional trading is just too time-consuming, or you have trouble utilizing stops properly, or are constantly getting whipsawed, then it's time to concentrate more heavily on volatility trading, preferably in the form of straddle buying.

CHAPTER 36

The Basics of Volatility Trading

Volatility trading first attracted mathematically oriented traders who noticed that the market's prediction of forthcoming volatility—for example, implied volatility—was substantially out of line with what one might reasonably expect should happen. Moreover, many of these traders (market-makers, arbitrageurs, and others) had found great difficulties with keeping a "delta neutral" position neutral. Seeking a better way to trade without having a market opinion on the underlying security, they turned to volatility trading. This is not to suggest that volatility trading eliminates all market risk, turning it all into volatility risk, for example. But it does suggest that a certain segment of the option trading population can handle the risk of volatility with more deference and aplomb than they can handle price risk.

Simply stated, it seems like a much easier task to predict volatility than to predict prices. That is said notwithstanding the great bull market of the 1990s, in which every investor who strongly participated certainly feels that *he* understands how to predict prices. Remember not to confuse brains with a bull market. Consider the chart in Figure 36-1. This seems as if it might be a good stock to trade: Buy it near the lows and sell it near the highs, perhaps even selling it short near the highs and covering when it later declines. It appears to have been in a trading range for a long time, so that after each purchase or sale, it returns at least to the midpoint of its trading range and sometimes even continues on to the other side of the range. There is no scale on the chart, but that doesn't change the fact that it appears to be a tradeable entity. In fact, this is a chart of *implied volatility* of the options on a major U.S. corporation. It really doesn't matter which one (it's IBM), because the implied volatility chart of nearly every stock, index, or futures contract has a similar pattern—a trading range. The only time that implied volatility will totally break out of its

FIGURE 36-1.
A sample chart.

"normal" range is if something material happens to change the fundamentals of the way the stock moves—a takeover bid, for example, or perhaps a major acquisition or other dilution of the stock.

So, many traders observed this pattern and have become adherents of trying to predict volatility. Notice that if one is able to isolate volatility, he doesn't care where the stock price goes—he is just concerned with buying volatility near the bottom of the range and selling it when it gets back to the middle or high end of the range, or vice versa. In real life, it is nearly impossible for a public customer to be able to isolate volatility so specifically. He will have to pay some attention to the stock price, but he still is able to establish positions in which the direction of the stock price is irrelevant to the outcome of the position. This quality is appealing to many investors, who have repeatedly found it difficult to predict stock prices. Moreover, an approach such as this should work in both bull and bear markets. Thus, volatility trading appeals to a great number of individuals. Just remember that, for you *personally* to operate a strategy properly, you must find that it appeals to your own philosophy of trading. Trying to use a strategy that you find uncomfortable will only lead to losses and frustration. So, if this somewhat neutral approach to option trading sounds interesting to you, then read on.

DEFINITIONS OF VOLATILITY

Volatility is merely the term that is used to describe how fast a stock, future, or index changes in price. When one speaks of volatility in connection with options, there are two types of volatility that are important. The first is *historical volatility*, which is a measure of how fast the underlying instrument *has been* changing in price. The other is *implied volatility*, which is the option market's *prediction* of the volatility of the underlying over the life of the option. The computation and comparison of these two measures can aid immensely in predicting the forthcoming volatility of the underlying instrument—a crucial matter in determining today's option prices.

Historical volatility can be measured with a specific formula, as shown in the chapter on mathematical applications. It is merely the formula for standard deviation as contained in most elementary books on statistics. The important point to understand is that it is an exact calculation, and there is little debate over how to compute historical volatility. It is not important to know what the actual measurement means. That is, if one says that a certain stock has a historical volatility of 20%, that by itself is a relatively meaningless number to anyone but an ardent statistician. However, it *can* be used for comparative purposes.

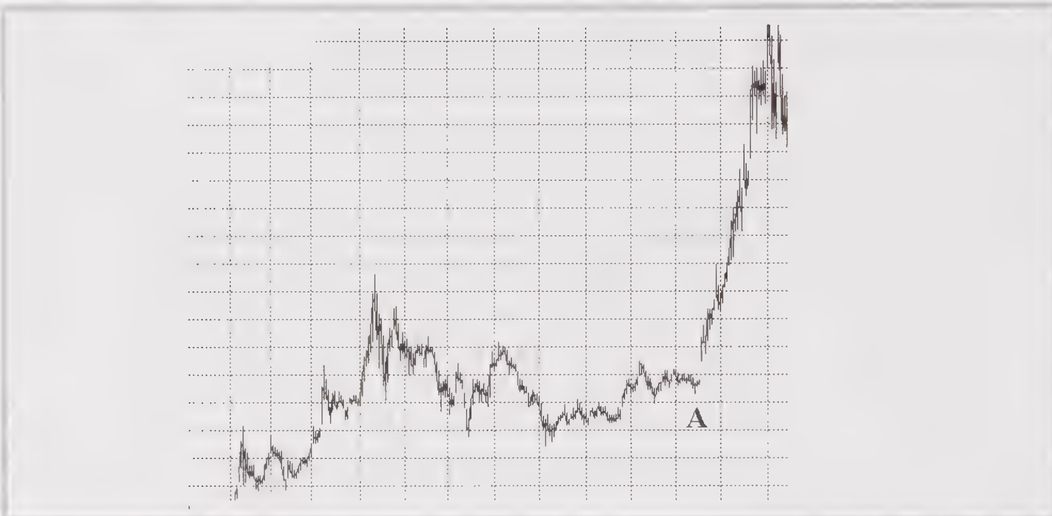
The standard deviation is expressed as a percent. One can determine that the historical volatility of the broad stock market has usually been in the range of 15% to 20%. A very volatile stock might have an historical volatility in excess of 100%. These numbers can be compared to each other, so that one might say that a stock with the latter historical volatility is five times more volatile that the "stock market." So, the historical volatility of one instrument can be compared with that of another instrument in order to determine which one is more volatile. That in itself is a useful function of historical volatility, but its uses go much further than that.

Historical volatility can be measured over different time periods to give one a sense of how volatile the underlying has been over varying lengths of time. For example, it is common to compute a 10-day historical volatility, as well as a 20-day, 50-day, and even 100-day. In each case, the results are annualized so that one can compare the figures directly.

Consider the chart in Figure 36-2. It shows a stock (although it could be a futures contract or index, too) that was meandering in a rather tight range for quite some time. At the point marked "A" on the chart, it was probably at its least volatile. At that time, the 10-day volatility might have been something quite low, say 20%. The price movements directly preceding point A had been very small. However, prior to that time the stock had been more volatile, so longer-term measures of the historical volatility would have shown higher numbers. The possible measures of historical volatility, then *at point A*, might have been something like:

10-day historical volatility: 20%
20-day historical volatility: 23%
50-day historical volatility: 35%
100-day historical volatility: 45%

FIGURE 36-2.
Sample stock chart.



A pattern of historical volatilities of this sort describes a stock that has been slowing down lately.

Its price movements have been less extreme in the near term.

Again referring to Figure 36-2, note that shortly after point A, the stock jumped much higher over a short period of time. Price action like this increases the implied volatility dramatically. And, at the far right edge of the chart, the stock had stopped rising but was swinging back and forth in far more rapid fashion than it had been at most other points on the chart. Violent action in a back-and-forth manner can often produce a higher historical volatility reading than a straight-line move can; it's just the way the numbers work out. So, by the far right edge of the chart, the 10-day historical volatility would have increased rather dramatically, while the longer-term measures wouldn't be so high because they would still contain the price action that occurred prior to point A.

At the far right edge of Figure 36-2, these figures might apply:

10-day historical volatility: 80%
20-day historical volatility: 75%
50-day historical volatility: 60%
100-day historical volatility: 55%

With this alignment of historical volatilities, one can see that the stock has been more volatile recently than in the more distant past. In Chapter 38 on the distribution of stock prices, we will discuss in some detail just which one, if any, of these historical volatilities one should use as "*the*" historical volatility input into option and probability models. We need to be able to make volatility estimates in order to determine whether or not a strategy might be successful, and to determine whether the current option price is a relatively cheap one or a relatively expensive one. For example, one can't just say, "I think XYZ is going to rise at least 18 points by February expiration." There needs to be some basis in fact for such a statement and, lacking inside information about what the company might announce between now and February, that basis should be statistics in the form of volatility projections.

Historical volatility is, of course, useful as an input to the (Black–Scholes) option model. In fact, the volatility input to any model is crucial because the volatility component is such a major factor in determining the price of an option. Furthermore, historical volatility is useful for more than just estimating option prices. It is necessary for making stock price projections and calculating distributions, too, as will be shown when those topics are discussed later. Any time one asks the question, "What is the probability of the stock moving from here to there, or of exceeding a particular target price?" the answer is heavily dependent on the volatility of the underlying stock (or index or futures).

It is obvious from the above example that historical volatility can change dramatically for any particular instrument. Even if one were to stick with just one measure of historical volatility (the 20-day historical is commonly the most popular measure), it changes with great frequency. Thus, one can never be certain that basing option price predictions or stock price distributions on the current historical volatility will yield the "correct" results. Statistical volatility may change as time goes forward, in which case your projections would be incorrect. Thus, it is important to make projections that are on the conservative side.

ANOTHER APPROACH: GARCH

GARCH stands for *Generalized Autoregressive Conditional Heteroskedasticity*, which is why it's shortened to GARCH. It is a technique for forecasting volatility that some analysts say produces better projections than using historical volatility alone or implied volatility alone. GARCH was created in the 1980s by specialists in the field of econometrics. It incorporates both historical and implied volatility, plus one can throw in a constant ("fudge factor"). In essence, though, the user of GARCH volatility models has to make some predictions or decisions about the weighting of the factors used for the estimate. By its very nature, then, it can be just as vague as the situations described in the previous section.

The model can "learn," though, if applied correctly. That is, if one makes a volatility prediction for today (using GARCH, let's say), but it turns out that the actual volatility was lower, then when you make the volatility prediction for tomorrow, you'll probably want to adjust it downward, using the experience of the real world, where you see volatility declining. This also incorporates the common-sense notion that volatility tends to remain the same; that is, tomorrow's volatility is likely to be much like today's. Of course, that's a little bit like saying tomorrow's weather is likely to be the same as today's (which it is, two-thirds of the time, according to statistics). It's just that when a tornado hits, you have to realize that your forecast could be wrong. The same thing applies to GARCH volatility projections. They can be wrong, too.

So, GARCH does not do a perfect job of estimating and forecasting volatility. In fact, it might not even be superior, from a strategist's viewpoint, to using the simple minimum/maximum techniques outlined in the previous section. It is really best geared to predicting short-term volatility and is favored most heavily by dealers in currency options who must adjust their markets constantly. For longer-term volatility projections, which is what a *position trader* of volatility is interested in, GARCH may not be all that useful. However, it is considered state-of-the-art as far as volatility predicting goes, so it has a following among theoretically oriented traders and analysts.

MOVING AVERAGES

Some traders try to use moving averages of daily composite implied volatility readings, or use a smoothing of recent past historical volatility readings to make volatility estimates. As mentioned in the chapter on mathematical applications, once the composite daily implied volatility has been computed, it was recommended that a smoothing effect be obtained by taking a moving average of the 20 or 30 days' implied volatilities. In fact, an *exponential* moving average was recommended, because it does not require one to keep accessing the last 20 or 30 days' worth of data in order to compute the moving average. Rather, the most recent exponential moving average is all that's needed in order to compute the next one.

IMPLIED VOLATILITY

Implied volatility has been mentioned many times already, but we want to expand on its concept before getting deeper into its measure and uses later in this section. Implied volatility pertains only to options, although one can aggregate the implied volatilities of the various options trading on a particular underlying instrument to produce a single number, which is often referred to as the composite implied volatility of the underlying.

At any one point in time, a trader knows for certain the following items that affect an option's price: stock price, strike price, time to expiration, interest rate, and dividends. The only remaining factor is volatility—in fact, *implied* volatility. It is the big "fudge factor" in option trading. If implied volatility is too high, options will be overpriced. That is, they will be relatively expensive. On the other hand, if implied volatility is too low, options will be cheap or underpriced. The terms "overpriced" and "underpriced" are not really used by theoretical option traders much anymore, because their usage implies that one knows what the option *should* be worth. In the modern vernacular, one would say that the options are trading with a "high implied volatility" or a "low implied volatility," meaning that one has some sense of where implied volatility has been in the past, and the current measure is thus high or low in comparison.

Essentially, implied volatility is the option market's guess at the forthcoming statistical volatility of the underlying over the life of the option in question. If traders believe that the underlying will be volatile over the life of the option, then they will bid up the option, making it more highly priced. Conversely, if traders envision a nonvolatile period for the stock, they will not pay up for the option, preferring to bid lower; hence the option will be relatively low-priced. The important thing to note is that traders normally do *not* know the future. They have no way of knowing, for sure, how volatile the underlying is going to be during the life of the option.

Having said that, it would be unrealistic to assume that inside information does not leak into the marketplace. That is, if certain people possess nonpublic knowledge about a company's earnings, new product announcement, takeover bid, and so on, they will aggressively buy or bid for the options and that will increase implied volatility. So, in certain cases, when one sees that implied volatility has shot up quickly, it is perhaps a signal that some traders do indeed know the future—at least with respect to a specific corporate announcement that is about to be made.

However, most of the time there is not anyone trading with inside information. Yet, every option trader—market-maker and public alike—is forced to make a "guess" about volatility when he buys or sells an option. That is true because the price he pays is heavily influenced by his volatility estimate (whether or not he realizes that he is, in fact, making such a volatility estimate). As you might imagine, most traders have no idea what volatility is going to be during the life of the option. They just pay prices that seem to make sense, perhaps based on historical volatility. Consequently, today's implied volatility may bear no resemblance to the actual statistical volatility that later unfolds during the life of the option.

For those who desire a more mathematical definition of implied volatility, consider this:

Opt price = f(Stock price, Strike price, Time, Risk-free rate, Volatility, Dividends)

Furthermore, suppose that one knows the following information:

XYZ price: 52
April 50 call price: 6
Time remaining to April expiration: 36 days
Dividends: $0.00
Risk-free interest rate: 5%

This information, which is available for every option at any time, simply from an option quote, gives us everything except the implied volatility. So what volatility would one have to plug in the Black–Scholes model (or whatever model one is using) to make the model give the answer 6 (the current price of the option)? That is, what volatility is necessary to solve the equation?

$$6 = f(52, 50, 36 \text{ days}, 5\%, \text{Volatility}, \$0.00)$$

Whatever volatility is necessary to make the model yield the current market price (6) as its value, is the implied volatility for the XYZ April 50 call. In this case, if you're interested, the implied volatility is 75.4%. The actual process of determining implied volatility is an iterative one. There is no formula, per se. Rather, one keeps trying various volatility estimates in the model until the answer is close enough to the market value.

THE VOLATILITY OF VOLATILITY

In order to discuss the implied volatility of a particular entity—stock, index, or futures contract—one generally refers to the implied volatility of individual options or perhaps the composite implied volatility of the entire option series. This is generally good enough for strategic comparisons. However, it turns out that there might be other ways to consider looking at implied volatility. In particular, one might want to consider how wide the *range* of implied volatility is—that is, how volatile the individual implied volatility numbers are.

It is often conventional to talk about the *percentile of implied volatility*. That is a way to rank the current implied volatility reading with past readings for the same underlying instrument.

However, a fairly important ingredient is missing when percentiles are involved. One can't really tell if "cheap" options are cheap as a practical matter. That's because one doesn't know how tightly packed together the past implied volatility readings are. For example, if one were to discover that the entire past range of implied volatility for XYZ stretched only from 39% to 45%, then a current reading of 40%, while low, might not seem all that attractive. That is, if the first percentile of XYZ options were at an implied volatility reading of 39% and the 100th percentile were at 45%, then a reading of 40% is really quite mundane. There just wouldn't be much room for implied volatility to increase on an absolute basis. Even if it rose to the 100th percentile, an individual XYZ option wouldn't gain much value, because its implied volatility would only be increasing from about 40% to 45%.

However, if the distribution of past implied volatility is *wide*, then one can truly say the options are cheap if they are currently in a low percentile. Suppose, rather than the tight range described above, that the range of past implied volatilities for XYZ instead stretched from 35% to 90%—that the first percentile for XYZ implied volatility was at 35% and the 100th percentile was at 90%. Now, if the current reading is 40%, there is a large range above the current reading into which the options could trade, thereby potentially increasing the value of the options if implied volatility moved up to the higher percentiles.

What this means, as a practical matter, is that one not only needs to know the current percentile of implied volatility, but he also needs to know the *range* of numbers over which that percentile was derived. If the range is wide, then an extreme percentile truly represents a cheap or expensive option. But if the range is tight, then one should probably not be overly concerned with the current percentile of implied volatility.

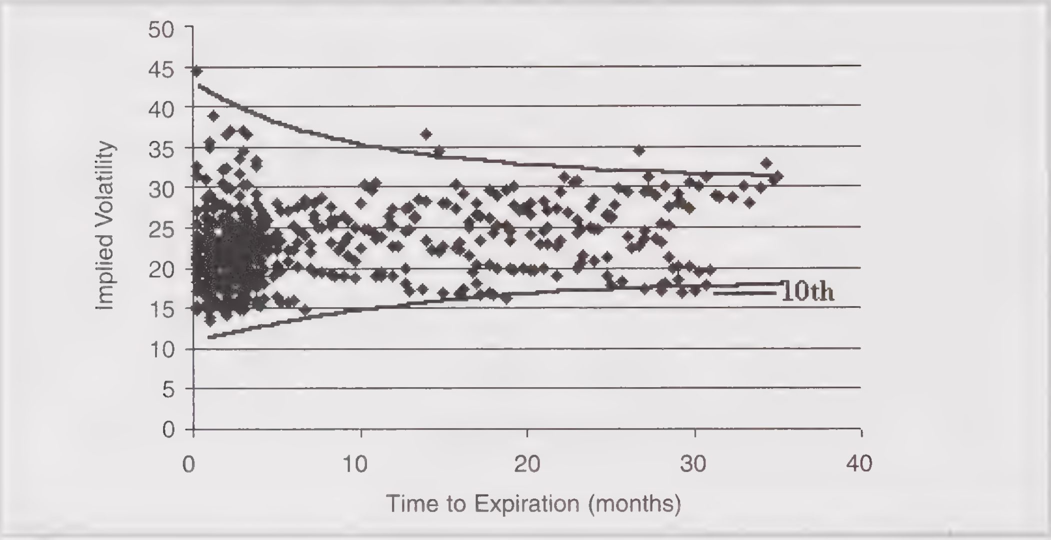
Another facet of implied volatility that is often overlooked is how it ranges with respect to the time left in the option. This is particularly important for traders of LEAPS (long-term) options, for the range of implied volatility of a LEAPS option will not be as great as that of a short-term option. In order to demonstrate this, the implied volatilities of OEX options, both regular and LEAPS, were charted over several years. The resulting scatter diagram is shown in Figure 36-3.

Two curved lines are drawn on Figure 36-3. They contain most of the data points. One can see from these lines that the range of implied volatility for near-term options is greater than it is for longer-term options. For example, the implied volatility readings on the far left of the scatter diagram range from about 14% to nearly 40% (ignore the one outlying point). However, for longer-term options of 24 months or more, the range is about 17% to 32%. While OEX options have their own idiosyncracies, this scatter diagram is fairly typical of what we would see for any stock or index option.

One conclusion that we can draw from this is that LEAPS option implied volatilities just don't change nearly as much as those of short-term options. That can be an important piece of information for a LEAPS option trader especially if he is comparing the LEAPS implied volatility with a *composite* implied volatility or with the *historical* volatility of the underlying.

Once again, consider Figure 36-3. While it is difficult to discern from the graph alone, the 10th percentile of OEX composite implied volatility, using all of the data points given, is 17%. The line that marks this level (the tenth percentile) is noted on the right

FIGURE 36-3.
Implied volatilities of OEX options over several years.



side of the scatter diagram. It is quite easy to see that the LEAPS options rarely trade at that low volatility level.

In Figure 36-3, the distance between the curved lines is much greater on the left side (i.e., for shorter-term options) than it is on the right side (for longer-term options). Thus, it's difficult for the longer-term options to register either an extremely high or extremely low implied volatility reading, when *all* of the options are considered. Consequently, LEAPS options will rarely appear "cheap" when one looks at their percentile of implied volatility, including all the short-term options, too.

One might say that, if he were going to buy long-term options, he should look only at the size of the volatility range on the right side of the scatter diagram. Then, he could make his decision about whether the options are cheap or not by only comparing the current reading to past readings of long-term options. This line of thinking, though, is somewhat fallacious reasoning, for a couple of reasons: First, if one holds the option for any long period of time, the volatility range will widen out and there is a chance that implied volatility could drop substantially. Second, the long-term volatility range might be so small that, even though the options are initially cheap, quick increase in implied volatility over several deciles might not translate into much of a gain in price in the short term.

It's important for anyone using implied volatility in his trading decisions to understand that the range of past implied volatilities is important, and to realize that the volatility range expands as time shrinks.

IS IMPLIED VOLATILITY A GOOD PREDICTOR OF ACTUAL VOLATILITY?

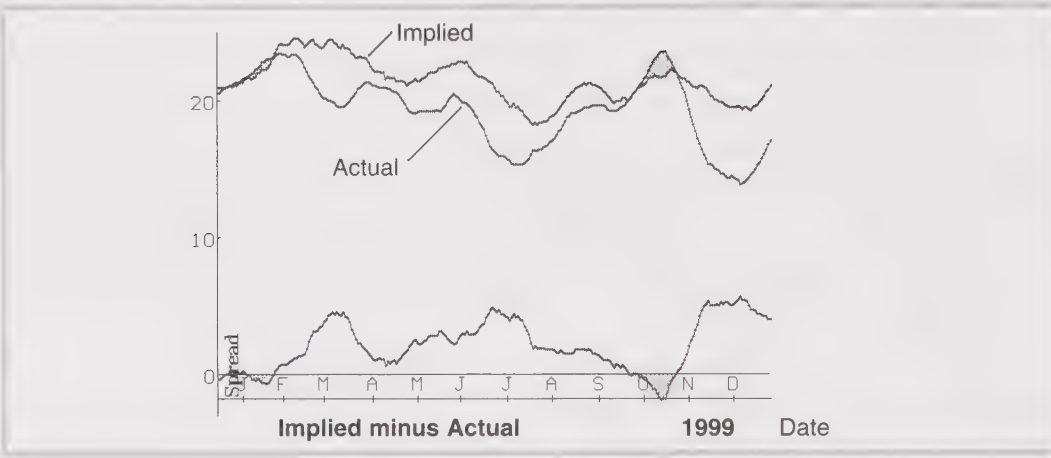
The fact that one can calculate implied volatility does not mean that the calculation is a good estimate of forthcoming volatility. As stated above, the marketplace does not really know how volatile an instrument is going to be, any more than it knows the forthcoming price of the stock. There are clues, of course, and some general ways of estimating forthcoming volatility, but the fact remains that sometimes options trade with an implied volatility that is quite a bit out of line with past levels. Therefore, implied volatility may be considered to be an inaccurate estimate of what is really going to happen to the stock during the life of the option. Just remember that implied volatility is a forward-looking estimate, and since it is based on traders' suppositions, it can be wrong—just as any estimate of future events can be in error.

The question posed above is one that should probably be asked more often than it is: "Is implied volatility a good predictor of actual volatility?" Somehow, it seems logical to assume that implied and historical (actual) volatility will converge. That's not really true, at least not in the short term. Moreover, even if they *do* converge, which one was right to begin with—implied or historical? That is, did implied volatility move to get more in line with actual movements of the underlying, or did the stock's movement speed up or slow down to get in line with implied volatility?

To illustrate this concept, a few charts will be used that show the comparison between implied and historical volatility. Figure 36-4 shows information for the OEX Index. In general, OEX options are overpriced. See the discussion in Chapter 29. That is, implied volatility of OEX options is almost always higher than what actual volatility turns out to be. Consider Figure 36-4. There are three lines in the figure: (a) implied volatility, (b) actual volatility, and (c) the difference between the two. There is an important distinction here, though, as to what comprises these curves:

(a) The implied volatility curve depicts the 20-day moving average of daily composite implied volatility readings for OEX. That is, each day one number is computed as a composite implied volatility for OEX for that day. These implied volatility figures are computed using the averaging formula shown in the chapter on mathematical applications, whereby each option's implied volatility is weighted by trading volume and by distance in- or out-of-the-money, to arrive at a single composite implied volatility reading for the trading day. To smooth out those daily readings, a 20-day simple moving average is used. This daily implied volatility of OEX options encompasses *all* the OEX options, so it is different from the Volatility Index (VIX), which uses only the options closest to the money. By using all of the options, a slightly different volatility figure is arrived at, as compared to VIX, but a chart of the two would show

FIGURE 36-4.
OEX implied versus historical volatility.



similar patterns. That is, peaks in implied volatility computed using all of the OEX options occur at the same points in time as peaks in VIX.

(b) The *actual* volatility on the graph is a little different from what one normally thinks of a historical volatility. It is the 20-day historical volatility, computed 20 days *later* than the date of the implied volatility calculation. Hence, points on the implied volatility curve are matched with a 20-day historical volatility calculation *that was made 20 days later.* Thus, the two curves more or less show the prediction of volatility and what actually happened over the 20-day period. These actual volatility readings are smoothed as well, with a 20-day moving average.

(c) The difference between the two is quite simple, and is shown as the bottom curve on the graph. A "zero" line is drawn through the difference.

When this "difference line" passes through the zero line, the projection of volatility and what actually occurred 20 days later were equal. If the difference line is above the zero line, then implied volatility was too high; the options were overpriced. Conversely, if the difference line is below the zero line, then actual volatility turned out to be greater than implied volatility had anticipated. The options were underpriced in that case. Those latter areas are shaded in Figure 36-4. Simplistically, you would want to own options during the shaded periods on the chart, and would want to be a seller of options during the non-shaded areas.

Note that Figure 36-4 indeed confirms the fact that OEX options are consistently overpriced. Very few charts are as one-dimensional as the OEX chart, where the options were so consistently overpriced. Most stocks find the difference line oscillating back and forth about the zero mark. Consider Figures 36-5 and 36-6. Figure 36-5 shows a chart similar to Figure 36-4, comparing actual and implied volatility, and their difference, for a particular stock. Figure 36-6 shows the price graph of that same stock, overlaid on implied volatility, during the period up to and including the heavy shading.

The volatility comparison chart (Figure 36-5) shows several shaded areas, during which the stock was more volatile than the options had predicted. Owners of options profited during these times, provided they had a more or less neutral outlook on the stock. Figure 36-6 shows the stock's performance up to and including the March–April 1999 period—the largest shaded area on the chart. Note that implied volatility was quite low before the stock made the strong move from 10 to 30 in little more than a month. These graphs are taken from actual data and demonstrate just how badly out of line implied volatility can be. In February and early March 1999, implied volatility was at or near the lowest levels on these charts. Yet, by the end of March, a major price explosion had begun in the stock, one that tripled its value in just over a month. Clearly, implied volatility was a poor predictor of forthcoming actual volatility in this case.

What about later in the year? In Figure 36-5, one can observe that implied and actual volatility oscillated back and forth quite a few times during the rest of 1999. It might appear that these oscillations are small and that implied volatility was actually

FIGURE 36-5.
Implied versus historical volatility of a stock.

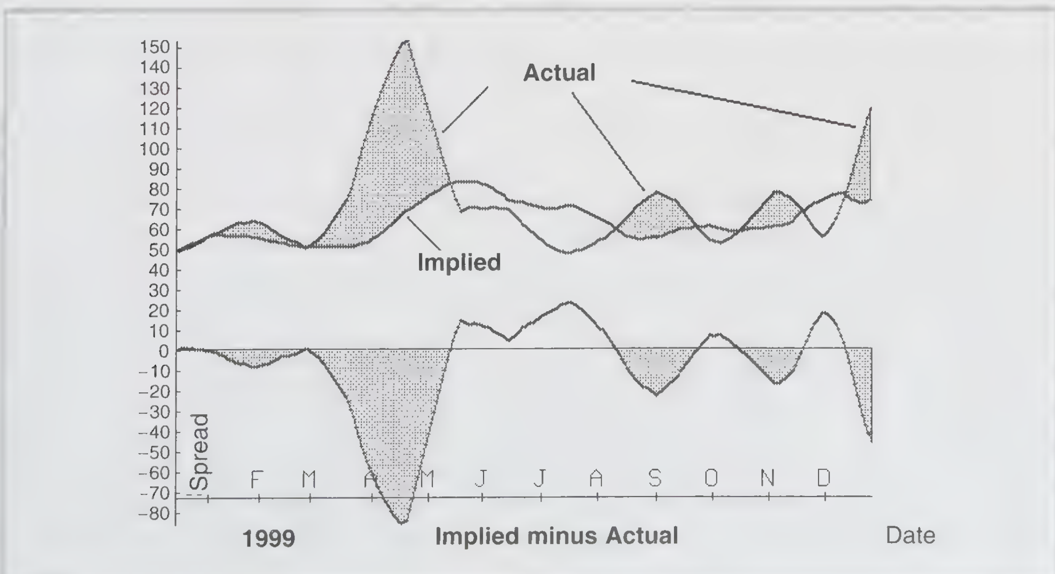
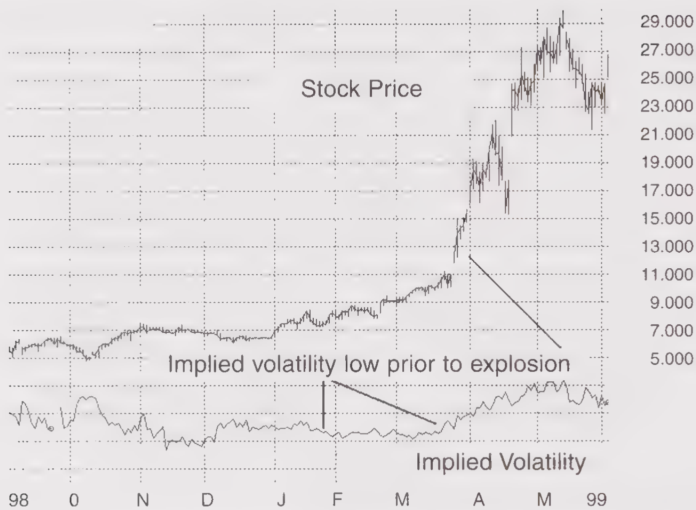


FIGURE 36-6.
The price graph of the stock.



doing a pretty good job of predicting actual volatility, at least until the final spike in December 1999. However, looking at the scale on the left-hand side of Figure 36-5, one can see that implied volatility was trying to remain in the 50% to 60% range, but actual volatility kept bolting higher rather frequently.

One more example will be presented. Figures 36-7 and 36-8 depict another stock and its volatilities. On the left half of each graph, implied volatility was quite high. It was higher than actual volatility turned out to be, so the difference line in Figure 36-7 remains above the zero line for several months. Then, for some reason, the option market decided to make an adjustment, and implied volatility began to drop. Its lowest daily point is marked with a circle in Figure 36-8, and the same point in time is marked with a similar circle in Figure 36-7. At that time, options traders were "saying" that they expected the stock to be very tame over the ensuing weeks. Instead, the stock made two quick moves, one from 15 down to 11, and then another back up to 17. That movement jerked actual volatility higher, but implied volatility remained rather low. After a period of trading between 13 and 15, during which time implied volatility remained low, the stock finally exploded to the upside, as evidenced by the spikes on the right-hand side of both Figures 36-7 and 36-8. Thus, implied volatility was a poor predictor of actual volatility for most of the time on these graphs. Moreover, implied volatility remained low at the right-hand side of the charts (January 2000) even though the stock doubled in the course of a month.

FIGURE 36-7.
Implied versus historical volatility of a stock.

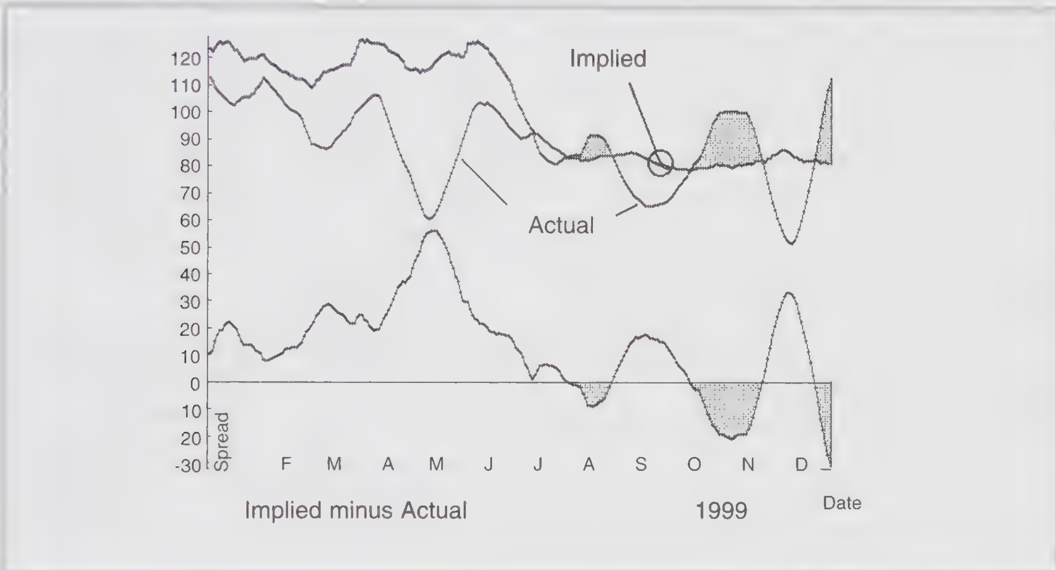
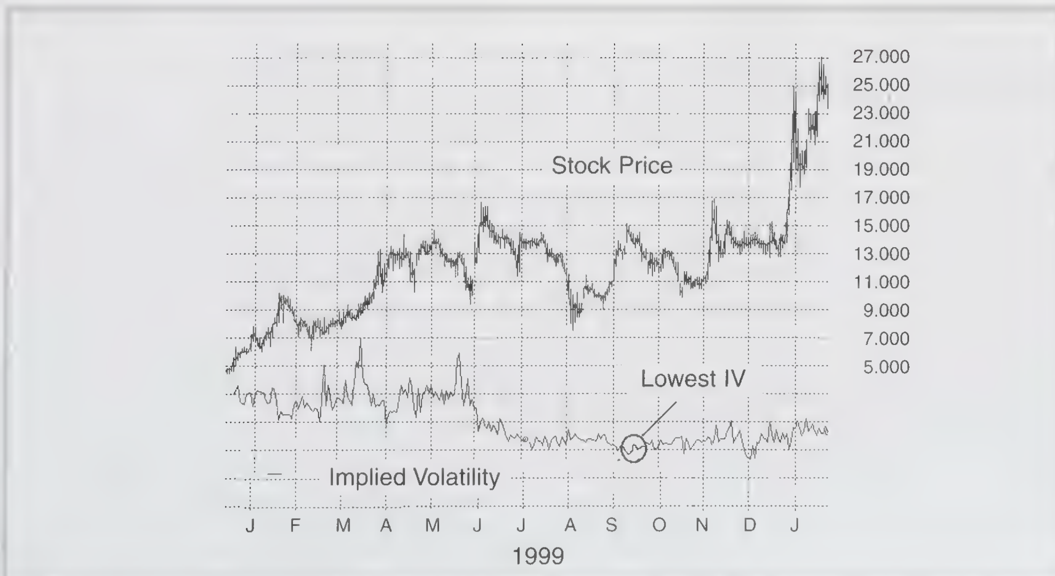


FIGURE 36-8.
The price graph of the stock.



The important thing to note from these figures is that they clearly show that implied volatility is really not a very good predictor of the actual volatility that is to follow. If it were, the difference line would hover near zero most of the time. Instead, it swings back and forth wildly, with implied volatility over- or underestimating actual volatility by quite wide levels. Thus, the current estimates of volatility by traders (i.e., implied volatility) can actually be quite wrong.

Conversely, one could also say that historical volatility is not a great predictor of volatility that is to follow, either, especially in the short term. No one really makes any claims that it is a good predictor, for historical volatility is merely a reflection of what has happened in the past. All we can say for sure is that implied and historical volatility tend to trade within a range.

One thing that does stand out on these charts is that implied volatility seems to fluctuate *less* than actual volatility. That seems to be a natural function of the volatility predictive process. For example, when the market collapses, implied volatilities of options rise only modestly. In other words, option traders and market-makers are predicting volatility when they price options, and one tends to make a prediction that is somewhat "middle of the road," since an extreme prediction is more likely to be wrong. Of course, it turns out to be wrong anyway, since actual volatility jumps around quite rapidly.

The few charts that have been presented here don't constitute a rigorous study upon which to draw the conclusion that implied volatility is a poor predictor of actual volatility, but it is this author's firm opinion that that statement is true. A graduate student looking for a master's thesis topic could take it from here.

VOLATILITY TRADING

As a result of the fact that implied volatility can sometimes be at irrational extremes, options may sometimes trade with implied volatilities that are significantly out of line with what one would normally expect. For example, suppose a stock is in a relatively nonvolatile period, like the price of the stock in Figure 36-2, just before point A on the graph. During that time, option sellers would probably become more aggressive while option buyers, who probably have been seeing their previous purchases decaying with time, become more timid. As a result, option prices drop. Alternatively stated, implied volatility drops. When implied volatilities are decreasing, option sellers are generally happy (and may often become more aggressive), while option buyers are losing money (and may often tend to become more timid). This is just a function of looking at the profit and loss statements in one's option account. But anyone who took a longer backward look at the volatility of the stock in Figure 36-2 would see that it had been much more volatile in the past. Consequently, he might decide that the implied volatility of the options had gotten too low and he would be a buyer of options.

It is the volatility trader's objective to spot situations when implied volatility is possibly or probably erroneous and to take a position that would profit when the error is brought to light. Thus, the volatility trader's main objective is spotting situations when implied volatility is overvalued or undervalued, irrespective of his outlook for the underlying stock itself. In some ways, this is not so different from the fundamental stock analyst who is attempting to spot overvalued or undervalued stocks, based on earnings and other fundamentals.

From another viewpoint, volatility trading is also a contrarian theory of investing. That is, when everyone else thinks the underlying is going to be nonvolatile, the volatility trader buys volatility. When everyone else is selling options and option buyers are hard to find, the volatility trader steps up to buy options. Of course, some rigorous analysis must be done before the volatility trader can establish new positions, but when those situations come to light, it is most likely that he is taking positions opposite to what "the masses" are doing. He will be buying volatility when the majority has been selling it (or at least, when the majority is refusing to buy it), and he will be selling volatility when everyone else is panicking to buy options, making them quite expensive.

WHY DOES VOLATILITY REACH EXTREMES?

One can't just buy every option that he considers to be cheap. There must be some consideration given to what the probabilities of stock movement are. Even more important, one can't just sell every option that he values as expensive. There may be valid reasons why options become expensive, not the least of which is that someone may have inside information about some forthcoming corporate news (a takeover or an earnings surprise, for example).

Since options offer a good deal of leverage, they are an attractive vehicle to anyone who wants to make a quick trade, especially if that person believes he knows something that the general public doesn't know. Thus, if there is a leak of a takeover rumor—whether it be from corporate officers, investment bankers, printers, or accountants—whoever possesses that information may quite likely buy options aggressively, or at least *bid* for them. Whenever demand for an option outstrips supply—in this case, the major supplier is probably the market-maker—the options quickly get more expensive. That is, implied volatility increases.

In fact, there are financial analysts and reporters who look for large increases in trading volume as a clue to which stocks might be ready to make a big move. Invariably, if the trading volume has increased and if implied volatility has increased as well, it is a good warning sign that someone with inside information is buying the options. In such a case, it might *not* be a good idea to sell volatility, even though the options are mathematically expensive.

Sometimes, even more minor news items are known in advance by a small segment of the investing community. If those items will be enough to move the stock even a couple of points, those who possess the information may try to buy options in advance of the news. Such minor news items might include the resignation or firing of a high-ranking corporate officer, or perhaps some strategic alliance with another company, or even a new product announcement.

The seller of volatility can watch for two things as warning signs that perhaps the options are "predicting" a corporate event (and hence should be avoided as a "volatility sale"). Those two things are a dramatic increase in option volume or a sudden jump in implied volatility of the options. One or both can be caused by traders with inside information trying to obtain a leveraged instrument in advance of the actual corporate news item being made public.

A SUDDEN INCREASE IN OPTION VOLUME OR IMPLIED VOLATILITY

The symptoms of insider trading, as evidenced by a large increase in option trading activity, can be recognized. Typically, the majority of the increased volume occurs in the near-term option series, particularly the at-the-money strike and perhaps the next strike out-of-the-money. The activity doesn't cease there, however. It propagates out to other option series as market-makers (who by the nature of their job function are *short* the near-term options that those with insider knowledge are buying) snap up everything on the books that they can find. In addition, the market-makers may try to entice others, perhaps institutions, to sell some expensive calls against a portion of their institutional stock holdings. Activity of this sort should be a warning sign to the volatility seller to stand aside in this situation.

Of course, on any given day there are many stocks whose options are extraordinarily active, but the increase in activity doesn't have anything to do with insider trading. This might include a large covered call write or maybe a large put purchase established by an institution as a hedge against an existing stock position, or a relatively large conversion or reversal arbitrage established by an arbitrageur, or even a large spread transaction initiated by a hedge fund. In any of these cases, option volume would jump dramatically, but it wouldn't mean that anyone had inside knowledge about a forthcoming corporate event. Rather, the increases in option trading volume as described in this paragraph are merely functions of the normal workings of the marketplace.

What distinguishes these arbitrage and hedging activities from the machinations of insider trading is: (1) There is little propagation of option volume into other series in the "benign" case, and (2) the stock price itself may languish. However, when true insider activity is present, the market-makers react to the aggressive nature of the call buying. These market-makers know they need to hedge themselves, because they do not want to be short naked call options in case a takeover bid or some other news spurs the stock dramatically higher. As mentioned earlier, they try to buy up any other options offered in "the book," but there may not be many of those. So, as a last result, the way they reduce their negative position delta is to *buy stock*. Thus, if the options are active and expensive, and if the stock is rising too, you probably have a reasonably good indication that "someone knows something." However, if the options are expensive but none of the other factors are present, especially if the stock is *declining* in price—then one might feel more comfortable with a strategy of selling volatility in this case.

However, there is a case in which options might be the object of pursuit by someone with insider knowledge, yet not be accompanied by heavy trading volume. This situation could occur with illiquid options. In this case, a floor broker holding the order of those with insider information might come into the pit to buy options, but the market-makers may not sell them many, preferring to raise their offering price rather than sell a large quantity. If this happens a few times in a row, the options will have gotten very expensive as the floor broker raises his bid price repeatedly, but only buys a few contracts each time. Meanwhile, the market-maker keeps raising his offering price.

Eventually, the floor broker concludes that the options are too expensive to bother with and walks away. Perhaps his client then buys stock. In any case, what has happened is that the options have gotten very expensive as the bids and offers were repeatedly raised, but not much option volume was actually traded because of the illiquidity of the contracts. Hence the normal warning light associated with a sudden increase in option volume would not be present. In this case, though, a volatility seller should still be careful, because he does not want to step in to sell calls right before some major corporate news item is released. The clue here is that implied volatility *exploded* in a short period of time (one day, or actually less time), and that alone should be enough warning to a volatility seller.

The point that should be taken here is that when options suddenly become very expensive, especially if accompanied by strong stock price movement and strong stock volume, there may very well be a good reason why that is happening. That reason will probably become public knowledge shortly in the form of a news event. In fact, a major market-maker once said he believed that *most* increases in implied volatility were eventually justified—that is, some corporate news item was released that made the stock jump. Hence, a volatility seller should avoid situations such as these. Any sudden increase in implied volatility should probably be viewed as a potential news story in the making. These situations are not what a neutral volatility seller wants to get into.

On the other hand, if options have become expensive *as a result of* corporate news, then the volatility seller can feel more comfortable making a trade. Perhaps the company has announced poor earnings and the stock has taken a beating while implied volatility rose. In this situation, one can assess the information and analyze it clearly; he is not dealing with some hidden facts known to only a few insider traders. With clear analysis, one might be able to develop a volatility selling strategy that is prudent and potentially profitable.

Another situation in which options become expensive in the wake of market action is during a bear market in the underlying. This can be true for indices, stocks, and futures contracts. The Crash of '87 is an extreme example, but implied volatility shot through the roof during the crash. Other similar sharp market collapses—such as October 1989, October 1997, and August–September 1998—caused implied volatility to jump dramatically. In these situations, the volatility seller knows why implied volatility is high. Given that fact, he can then construct positions around a neutral strategy or around his view of the future. The time when the volatility seller must be careful is when the options are expensive and no one seems to know why. That's when insider trading may be present, and that's when the volatility seller should defer from selling options.

CHEAP OPTIONS

When options are cheap, there are usually far less discernible reasons why they have become cheap. An obvious one may be that the corporate structure of the company has changed; perhaps it is being taken over, or perhaps the company has acquired another company nearly its size. In either case, it is possible that the combined entity's stock will be less volatile than the original company's stock was. As the takeover is in the process of being consummated, the implied volatility of the company's options will drop, giving the false impression that they are cheap.

In a similar vein, a company may mature, perhaps issuing more shares of stock, or perhaps building such a good earnings stream that the stock is considered less volatile than it formerly was. Some of the Internet companies will be classic cases: In the beginning they were high-flying stocks with plenty of price movement, so the options traded with a relatively high degree of implied volatility. However, as the company matures, it buys other Internet companies and then perhaps even merges with a large, established company (America Online and Time-Warner Communications, for example). In these cases, actual (statistical) volatility will diminish as the company matures, and implied volatility will do the same. On the surface, a buyer of volatility may see the reduced volatility as an attractive buying situation, but upon further inspection he may find that it is justified. If the decrease in implied volatility seems justified, a buyer of volatility should ignore it and look for other opportunities.

All volatility traders should be suspicious when volatility seems to be extreme—either too expensive or too cheap. The trader should investigate the possibilities as to *why* volatility is trading at such extreme levels. In some cases, the supply and demand of the public just pushes the options to extreme levels; there is nothing more involved than that. Those are the best volatility trading situations. However, if there is a hint that the volatility has gotten to an extreme reading because of some logical (but perhaps nonpublic) reason, then the volatility trader should be suspicious and should probably avoid the trade. Typically this happens with expensive options.

Buyers of volatility really have little to fear if they miscalculate and thus buy an option that appears inexpensive but turns out not to be, in reality. The volatility buyer might lose money if he does this, and overpaying for options constantly will lead to ruin, but an occasional mistake will probably not be fatal.

Sellers of volatility, however, have to be a lot more careful. One mistake could be the last one. Selling naked calls that seem terrifically expensive by historic standards could be ruinous if a takeover bid subsequently emerges at a large premium to the stock's current price. Even put sellers must be careful, although a lot of traders think that selling naked puts is safe because it's the same as buying stock. But who ever said buying stock wasn't risky? If the stock collapses—falling from 80, say, to 15 or 20, as Oxford Health did, or from 30 to 2 as Sunrise Technology did—then a put seller will be buried. Since the risk of loss from naked option selling is large, one could be wiped out by a huge gap opening. That's why it's imperative to study *why* the options are expensive before one sells them. If it's known, for example, that a small biotech company is awaiting FDA trial results in two weeks, and all the options suddenly become expensive, the volatility seller should *not* attempt to be a hero. It's obvious that at least some traders believe that there is a chance for the stock to gap in price dramatically. It would be better to find some other situation in which to sell options.

The seller of futures options or index options should be cautious too, although there can't be takeovers in those markets, nor can there be a huge earnings surprise or other corporate event that causes a big gap. The futures markets, though, do have things like crop reports and government economic data to deal with, and those can create volatile situations, too. The bottom line is that volatility selling—even *hedged* volatility selling—can be taxing and aggravating if one has sold volatility in front of what turns out to be a news item that justifies the expensive volatility.

SUMMARY

Volatility trading is a predictable way to approach the market, because volatility almost invariably trades in a range and therefore its value can be estimated with a great deal more precision than can the actual prices of the underlyings. Even so, one must be careful in his approach to volatility trading, because diligent research is needed to determine if, in fact, volatility is "cheap" or "expensive." As with any systematic approach to the market, if one is sloppy about his research, he cannot expect to achieve superior results. In the next few chapters, a good deal of time will be spent to give the reader a good understanding of how volatility affects positions and how it can be used to construct trades with positive expected rates of return.

CHAPTER 37

How Volatility Affects Popular Strategies

The previous chapter addressed the calculation or interpretation of implied volatility, and how to relate it to historical volatility. Another, related topic that is important is how implied volatility affects a specific option strategy. Simplistically, one might think that the effect of a change in implied volatility on an option position would be a simple matter to discern; but in reality, most traders don't have a complete grasp of the ways that volatility affects option positions. In some cases, especially option spreads or more complex positions, one may not have an intuitive "picture" of how his position is going to be affected by a change in implied volatility. In this chapter, we'll attempt a relatively thorough review of how implied volatility changes affect most of the popular option strategies.

There are ways to use computer analysis to "draw" a picture of this volatility effect, of course, and that will be discussed momentarily. But an option strategist should have some idea of the general changes that a position will undergo if implied volatility changes. Before getting into the individual strategies, it is important that one understands some of the basics of the effect of volatility on an option's price.

VEGA

Technically speaking, the term that one uses to quantify the impact of volatility changes on the price of an option is called the *vega* of the option. In this chapter, the references will be to vega, but the emphasis here is on practicality, so the descriptions of how volatility affects option positions will be in plain English as well as in the more mathematical realm of vega. Having said that, let's define vega so that it is understood for later use in the chapter.

Simply stated, vega is the amount by which an option's price changes when volatility changes by one percentage point.

Example: XYZ is selling at 50, and the July 50 call is trading at 7.25. Assume that there is no dividend, that short-term interest rates are 5%, and that July expiration is exactly three months away. With this information, one can determine that the implied volatility of the July 50 call is 70%. That's a fairly high number, so one can surmise that XYZ is a volatile stock. What would the option price be if implied volatility were to rise to 71%? Using a model, one can determine that the July 50 call would theoretically be worth 7.35 if that happened. Hence, the vega of this option is 0.10 (to two decimal places). That is, the option price increased by 10 cents, from 7.25 to 7.35, when volatility rose by one percentage point. (Note that "percentage point" here means a full point increase in volatility, from 70% to 71%.)

What if implied volatility had *decreased* instead? Once again, one can use the model to determine the change in the option price. In this case, using an implied volatility of 69% and keeping everything else the same, the option would then theoretically be worth 7.15—again, a 0.10 change in price (this time, a decrease in price).

This example points out an interesting and important aspect of how volatility affects a call option: *If implied volatility increases, the price of the option will increase, and if implied volatility decreases, the price of the option will decrease.* Thus, there is a *direct* relationship between an option's price and its implied volatility.

Mathematically speaking, vega is the partial derivative of the Black–Scholes model (or whatever model you're using to price options) with respect to volatility. In the above example, the vega of the July 50 call, with XYZ at 50, can be computed to be 0.098—very near the value of 0.10 that one arrived at by inspection.

Vega also has a direct relationship with the price of a put. That is, as implied volatility rises, the price of a put will rise as well.

Example: Using the same criteria as in the last example, suppose that XYZ is trading at 50, that July is three months away, that short-term interest rates are 5%, and that there is no dividend. In that case, the following theoretical put and call prices would apply at the stated implied volatilities:

Stock Price	July 50 call	July 50 put	Implied Volatility	Put's Vega
50	7.15	6.54	69%	0.10
	7.25	6.64	70%	0.10
	7.35	6.74	71%	0.10

Thus, the put's vega is 0.10, too—the same as the call's vega was.

In fact, it can be stated that a call and a put with the same terms have the same vega. To prove this, one need only refer to the arbitrage equation for a conversion. If the call increases in price and everything else remains equal—interest rates, stock price, and striking price—then the put price must increase by the same amount. A change in implied volatility will cause such a change in the call price, and a similar change in the put price. Hence, the vega of the put and the call must be the same.

It is also important to know how the vega changes as other factors change, particularly as the stock price changes, or as time changes. The following examples contain several tables that illustrate the behavior of vega in a typically fluctuating environment.

Example: In this case, let the stock price fluctuate while holding interest rate (5%), implied volatility (70%), time (3 months), dividends (0), and the strike price (50) constant. See Table 37-1.

In these cases, vega drops when the stock price does, too, but it remains fairly constant if the stock rises. It is interesting to note, though, that in the real world, when the underlying drops in price—especially if it does so quickly, in a panic mode—implied volatility can increase dramatically. Such an increase may be of great benefit to a call holder, serving to mitigate his losses, perhaps. This concept will be discussed further later in this chapter.

The above example assumed that the stock was making instantaneous changes in price. In reality, of course, time would be passing as well, and that affects the vega, too. Table 37-2 shows how the vega changes when time changes, all other factors being equal.

Example: In this example, the following items are held fixed: stock price (50), strike price (50), implied volatility (70%), risk-free interest rate (5%), and dividend (0). But now, *we let time fluctuate.*

Table 37-2 clearly shows that the passage of time results not only in a decreasing call

TABLE 37-1.

Stock Price	Implied Volatility July 50 Call Price	Theoretical Call Price	Vega
30	70%	0.47	0.028
40		2.62	0.073
50		7.25	0.098
60		14.07	0.092
70		22.35	0.091

TABLE 37-2.

Stock Price	Implied Volatility	Time Remaining	Theoretical Call Price	Vega
50	70%	One year	14.60	0.182
		Six months	10.32	0.135
		Three months	7.25	0.098
		Two months	5.87	0.080
		One month	4.16	0.058
		Two weeks	2.87	0.039
		One week	1.96	0.028
		One day	0.73	0.010

price, but in a decreasing vega as well. This makes sense, of course, since one cannot expect an increase in implied volatility to have much of an effect on a very short-term option—certainly not to the extent that it would affect a LEAPS option.

Some readers might be wondering how changes in implied volatility itself would affect the vega. This might be called the "vega of the vega," although I've never actually heard it referred to in that manner. The next table explores that concept.

Example: Again, some factors will be kept constant—the stock price (50), the time to July expiration (3 months), the risk-free interest rate (5%), and the dividend (0). Table 37-3 allows implied volatility to fluctuate and shows what the theoretical price of a July 50 call would be, as well as its vega, at those volatilities.

Thus, Table 37-3 shows that vega is surprisingly constant over a wide range of implied volatilities. That's the real reason why no one bothers with "vega of the vega." Vega begins to decline only if implied volatility gets exceedingly high, and implied volatilities of that magnitude are relatively rare.

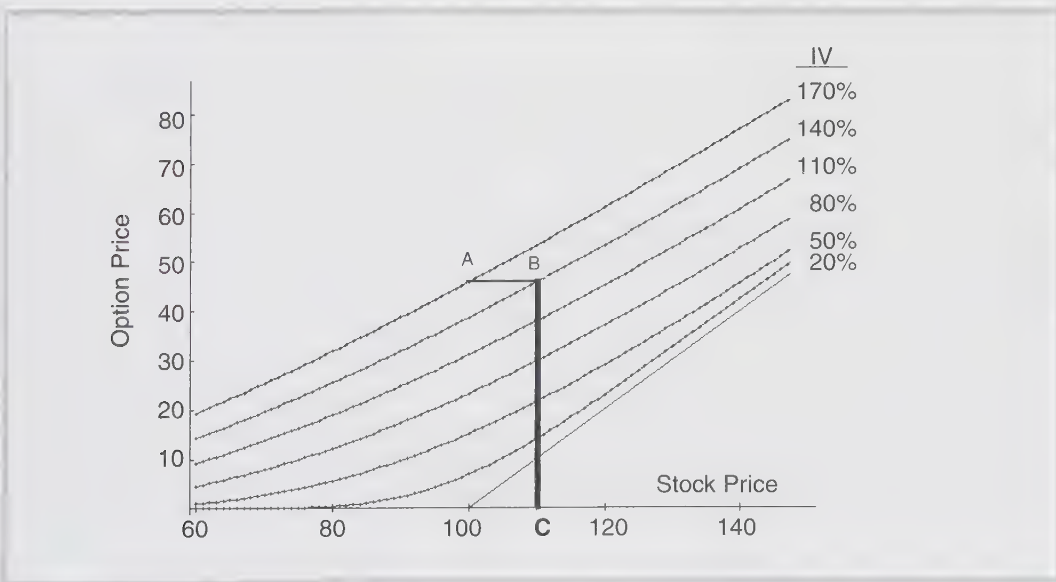
One can also compute the distance a stock would need to rise in order to overcome a decrease in volatility. Consider Figure 37-1, which shows the theoretical price of a 6-month call option with differing implied volatilities. Suppose one buys an option that currently has implied volatility of 170% (the top curve on the graph). Later, investor perceptions of volatility diminish, and the option is trading with an implied volatility of 140%. That means that the option is now "residing" on the *second* curve from the top of the list. Judging from the general distance between those two curves, the option has probably lost between 5 and 8 points of value due to the drop in implied volatility.

Here's another way to think about it. Again, suppose one buys an at-the-money option (stock price = 100) when its implied volatility is 170%. That option value is marked as point A on the graph in Figure 37-1. Later, the option's implied volatility drops to 140%.

TABLE 37-3.

Stock Price	Implied Volatility	Theoretical Call Price	Vega
50	10%	1.34	0.097
	30%	3.31	0.099
	50%	5.28	0.099
	70%	7.25	0.098
	100%	10.16	0.096
	150%	14.90	0.093
	200%	19.41	0.088

FIGURE 37-1.
Theoretical option prices at differing implied volatilities (6-month calls).



How much does the stock have to rise in order to overcome the loss of implied volatility? The horizontal line from point A to point B shows that the option value is the same on each line. Then, dropping a vertical line from B down to point C, we see that point C is at a stock price of about 109. Thus, the stock would have to rise 9 points just to keep the option value constant, *if implied volatility drops from 170% to 140%.*

IMPLIED VOLATILITY AND DELTA

Figure 37-1 shows another rather unusual effect: When implied volatility gets very high, the delta of the option doesn't change much. Simplistically, the delta of an option measures how much the option changes in price when the stock moves one point. Mathematically, the delta is the first partial derivative of the option model with respect to stock price. Geometrically, that means that *the delta of an option is the slope of a line drawn tangent to the curve in the preceding chart.*

The bottom line in Figure 37-1 (where implied volatility = 20%) has a distinct curvature to it when the stock price is between about 80 and 120. Thus the delta ranges from a fairly low number (when the stock is near 80) to a rather high number (when the stock is near 120). Now look at the top line on the chart, where implied volatility = 170%. It's almost a straight line from the lower left to the upper right! The slope of a straight line is constant. This tells us that the delta (which is the slope) *barely changes for such an expensive option—whether the stock is trading at 60 or it's trading at 150*! That fact alone is usually surprising to many.

In addition, the value of this delta can be measured: It's 0.70 or higher from a stock price of 80 all the way up to 150. Among other things, this means that an out-of-the-money option that has extremely high implied volatility has a fairly high delta—and can be expected to mirror stock price movements more closely than one might think, were he not privy to the delta.

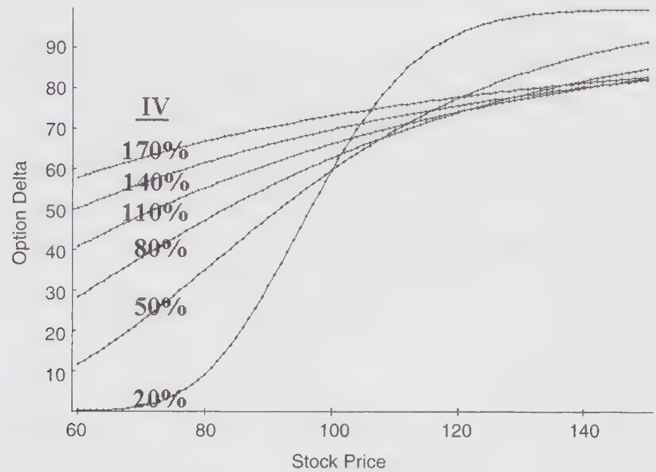
Figure 37-2 follows through on this concept, showing how the delta of an option varies with implied volatility. From this chart, it is clear how much the delta of an option varies when the implied volatility is 20%, as compared to how little it varies when implied volatility is extremely high.

That data is interesting enough by itself, but it becomes even more thought-provoking when one considers that a change in the implied volatility of his option (vega) also can mean a significant change in the delta of the option. In one sense, it explains why, in the first chart (Figure 37-1), the stock could rise 9 points and yet the option holder made nothing, because implied volatility declined from 170% to 140%.

EFFECTS ON NEUTRALITY

A popular concept that uses delta is the "delta-neutral" spread—a spread whose profitability is supposedly ambivalent to market movement, at least for short time frames and limited stock price changes. Anything that significantly affects the delta of an option can affect this neutrality, thus causing a delta-neutral position to become unbalanced (or,

FIGURE 37-2.
Value of delta of a 6-month option at differing implied volatilities.



more likely, causing one's intuition to be wrong regarding what constitutes a delta-neutral spread in the first place).

Let's use a familiar strategy, the straddle purchase, as an example. Simplistically, when one buys a straddle, he merely buys a put and a call with the same terms and doesn't get any fancier than that. However, it may be the case that, due to the deltas of the options involved, that approach is biased to the upside, and a neutral straddle position should be established instead.

Example: Suppose that XYZ is trading at 100, that the options have an implied volatility of 40%, and that one is considering buying a six-month straddle with a striking price of 100. The following data summarize the situation, including the option prices and the deltas:

XYZ Common: 100; Implied Volatility: 40%

Option	Price	Delta
XYZ October 100 call	12.00	0.60
XYZ October 100 put	10.00	–0.40

Notice that the stock price is *equal to* the strike price (100). However, the deltas are not at all equal. In fact, the delta of the call is 1.5 times that of the put (in absolute value). One must buy *three puts and two calls* in order to have a delta-neutral position.

Most experienced option traders know that the delta of an at-the-money calls is somewhat higher than that of an at-the-money put. Consequently, they often estimate, without checking, that buying three puts and two calls produces a delta-neutral "straddle buy." However, consider a similar situation, but with a much higher implied volatility—110%, say.

AAA Common: 100; Implied Volatility: 110%

Option	Price	Delta
AAA October 100 call	31.00	0.67
AAA October 100 put	28.00	–0.33

The delta-neutral ratio here is two-to-one (67 divided by 33), not three-to-two as in the earlier case—even though both stock prices are 100 and both sets of options have six months remaining. This is a big difference in the delta-neutral ratio, especially if one is trading a large quantity of options. This shows how different levels of implied volatility can alter one's perception of what is a neutral position. It also points out that one can't necessarily rely on his intuition; it is always best to check with a model.

Carrying this thought a step further, one must be mindful of a change in implied volatility if he wants to *keep* his position delta-neutral. If the implied volatility of AAA options should drop significantly, the 2-to-1 ratio will no longer be neutral, even if the stock is still trading at 100. Hence, a trader wishing to remain delta-neutral must monitor not only changes in stock price, but changes in implied volatility as well. For more complex strategies, one will also find the delta-neutral ratio changing due to a change in implied volatility.

The preceding examples summarize the major variables that might affect the vega and also show how vega affects things other than itself, such as delta and, therefore, delta neutrality. By the way, the vega of the underlying is zero; an increase in implied volatility does not affect the price of the underlying instrument at all, in theory. In reality, if options get very expensive (i.e., implied volatility spikes up), that usually brings traders into a stock and so the stock price will change. But that's not a mathematical relationship, just a market cause-and-effect relationship.

POSITION VEGA

As can be done with delta or with any other of the partial derivatives of the model, one can compute a *position vega*—the vega of an entire position. The position vega is determined by multiplying the individual option vegas by the quantity of options bought or sold. The "position vega" is merely the quantity of options held, times the vega, times the shares per options (which is normally 100).

Example: Using a simple call spread as an example, assume the following prices exist:

Security	Position	Vega	Position Vega
XYZ Stock	No position		
XYZ July 50 call	Long 3 calls	0.098	+0.294
XYZ July 70 call	Short 5 calls	0.076	−0.380
Net Position Vega:			**−0.086**

This concept is very important to a volatility trader, for it tells him if he has constructed a position that is going to behave in the manner he expects. For example, suppose that one identifies expensive options, and he figures that implied volatility will decrease, eventually becoming more in line with its historical norms. Then he would want to construct a position with a *negative position vega*. A negative position vega indicates that the position will profit if implied volatility *decreases*. Conversely, a buyer of volatility—one who identifies some underpriced situation—would want to construct a position with a *positive position vega*, for such a position will profit if implied volatility *rises*. In either case, other factors such as delta, time to expiration, and so forth will have an effect on the position's actual dollar profit, but the concept of position vega is still important to a volatility trader. It does no good to identify cheap options, for example, and then establish some strange spread with a negative position vega. Such a construct would be at odds with one's intended purpose—in this case, buying cheap options.

OUTRIGHT OPTION PURCHASES AND SALES

Let us now begin to investigate the affects of implied volatility on various strategies, beginning with the simplest strategy of all—the outright option purchase. It was already shown that implied volatility affects the price of an individual call or put in a *direct* manner. That is, an increase in implied volatility will cause the option price to rise, while a decrease in volatility will cause a decline in the option price. That piece of information is the most important one of all, for it imparts what an option trader needs to know: An explosion in implied volatility is a boon to an option owner, but can be a devastating detriment to an option seller, especially a naked option seller.

A couple of examples might demonstrate more clearly just how powerful the effect of implied volatility is, even when there isn't much time remaining in the life of an option. One should understand the notion that an increase in implied volatility can overcome days, even weeks, of time decay. This first example attempts to quantify that statement somewhat.

Example: Suppose that XYZ is trading at 100 and one is interested in analyzing a 3-month call with striking price of 100. Furthermore, suppose that implied volatility is currently at 20%. Given these assumptions, the Black–Scholes model tells us that the call would be trading at a price of 4.64.

Stock Price:	100
Strike Price:	100
Time Remaining:	3 months
Implied Volatility:	20%
Theoretical Call Value:	4.64

Now, suppose that a month passes. If implied volatility remained the same (20%), the call would lose nearly a point of value due to time decay. However, how much would implied volatility have had to increase to completely counteract the effect of that time decay? That is, after a month has passed, what implied volatility will yield a call price of 4.64? It turns out to be just under 26%.

Stock Price:	100
Strike Price:	100
Time Remaining:	2 months
Implied Volatility:	25.9%
Theoretical Call Value:	4.64

What would happen after *another* month passes? There is, of course, some implied volatility at which the call would still be worth 4.64, but is it so high as to be unreasonable? Actually, it turns out that if implied volatility increases to about 38%, the call will still be worth 4.64, even with only one month of life remaining:

Stock Price:	100
Strike Price:	100
Time Remaining:	1 month
Implied Volatility:	38.1%
Theoretical Call Value:	4.64

So, if implied volatility increases from 20% to 26% over the first month, then this call option would still be trading at the same price—4.64. That's not an unusual increase in implied volatility; increases of that magnitude, 20% to 26%, happen all the time. For it to then increase from 26% to 38% over the *next* month is probably less likely, but it is certainly not out of the question. There have been many times in the past when just such an increase has been possible—during any of the August, September, or October bear markets or mini-crashes, for example. Also, such an increase in implied volatility might occur if there were takeover rumors in this stock, or if the entire market became more volatile, as was the case in the latter half of the 1990s.

Perhaps this example was distorted by the fact that an implied volatility of 20% is a fairly low number to begin with. What would a similar example look like if one started out with a much higher implied volatility—say, 80%?

Example: Making the same assumptions as in the previous example, but now setting the implied volatility to a much higher level of 80%, the Black–Scholes model now says that the call would be worth a price of 16.45:

Stock Price:	100
Strike Price:	100
Time Remaining:	3 months
Implied Volatility:	80%
Theoretical Call Value:	16.45

Again, one must ask the question: "If a month passes, what implied volatility would be necessary for the Black–Scholes model to yield a price of 16.45?" In this case, it turns out to be an implied volatility of just over 99%.

Stock Price:	100
Strike Price:	100
Time Remaining:	2 months
Implied Volatility:	99.4%
Theoretical Call Value:	16.45

Finally, to be able to completely compare this example with the previous one, it is necessary to see what implied volatility would have to rise to in order to offset the effect of yet another month's time decay. It turns out to be over 140%:

Stock Price:	100
Strike Price:	100
Time Remaining:	1 month
Implied Volatility:	140.9%
Theoretical Call Value:	16.45

Table 37-4 summarizes the results of these examples, showing the levels to which implied volatility would have to rise to maintain the call's value as time passes.

Are the volatility increases in the latter example less likely to occur than the ones in the former example? Probably yes—certainly the last one, in which implied volatility would have to increase from 80% to nearly 141% in order to maintain the call's value. However, in another sense, it may seem more reasonable: Note that the increase in volatility from 20% to 26% is a 30% increase. That is, 20% times 1.30 equals 26%. That's what's required to maintain the call's value for the lower volatility over the first month—an increase in the magnitude of implied volatility of 30%. At the *higher* volatility, though, an increase in magnitude of only about 25% is required (from 80% to 99%). Thus, in *those* terms, the two appear on more equal footing.

What makes the top line of Table 37-4 *appear* more likely than the bottom line is merely the fact that an experienced option trader knows that many stocks have implied volatilities that can fluctuate in the 20% to 40% range quite easily. However, there are far fewer stocks that have implied volatilities in the higher range. In fact, until the Internet stocks got hot in the latter portion of the 1990s, the only ones with volatilities like those were very low-priced, extremely volatile stocks. Hence one's experience factor is lower with such high implied volatility stocks, but it doesn't mean that the volatility fluctuations appearing in Table 37-4 are impossible.

If the reader has access to a software program containing the Black–Scholes model, he can experiment with other situations to see how powerful the effect of implied volatility is. For example, without going into as much detail, if one takes the case of a 12-month option whose initial implied volatility is 20%, all it takes to maintain the call's value over

TABLE 37-4.

Initial Implied Volatility	Volatility Level Required to Maintain Call Value . . .	
	. . . After One Month	. . . After Two Months
20%	26%	38%
80%	99%	141%

a 6-month time period is an increase in implied volatility to 27%. Taken from the viewpoint of the option seller, this is perhaps most enlightening: If you sell a one-year (LEAPS) option and six months pass, during which time implied volatility increases from 20% to 27%—certainly quite possible—you will have made nothing! The call will still be selling for the same price, assuming the stock is still selling for the same price.

Finally, it was mentioned earlier that implied volatility often explodes during a market crash. In fact, one could determine just how much of an increase in implied volatility would be necessary in a market crash in order to maintain the call's value. This is similar to the first example in this section, but now the stock price will be allowed to decrease as well. Table 37-5, then, shows what implied volatility would be required to maintain the call's initial value (a price of 4.64), when the stock price falls. The other factors remain the same: time remaining (3 months), striking price (100), and interest rate (5%). Again, this table shows instantaneous price changes. In real life, a slightly higher implied volatility would be necessary, because each market crash could take a day or two.

Thus, from Table 37-5, one could say that even if the underlying stock dropped 20 points (which is 20% in this case) in one day, yet implied volatility exploded from 20% to 67% at the same time, the call's value would be unchanged! Could such an outrageous thing happen? It *has*: In the Crash of '87, the market plummeted 22% in one day, while the Volatility Index (VIX) theoretically rose from 36% to 150% in one day. In fact, call buyers of some OEX options actually broke even or made a little money due to the explosion in implied volatility, despite the fact that the worst market crash in history had occurred.

If nothing else, these examples should impart to the reader how important it is to be aware of implied volatility at the time an option position is established. If you are buying options, and you buy them when implied volatility is "low," you stand to benefit if implied volatility merely returns to "normal" levels while you hold the position. Of course, having the underlying increase in price is also important.

TABLE 37-5.

Stock Price	Implied Volatility Necessary for Call to Maintain Value
100	20% (the initial parameters)
95	33%
90	44%
85	55%
80	67%
75	78%
70	89%

Conversely, an option seller should be keenly aware of implied volatility when the option is initially sold—perhaps even more so than the buyer of an option. This pertains equally well to naked option writers and to covered option writers. If implied volatility is "too low" when the option writing position is established, then an increase (or worse, an explosion) in implied volatility will be very detrimental to the position, completely overcoming the effects of time decay. Hence, an option writer should not just sell options because he thinks he is collecting time decay each day that passes. That may be true, but an increase in implied volatility can completely dominate what little time decay might exist, especially for a longer-term option.

In a similar manner, a *decrease* in implied volatility can be just as important. Thus, if the call buyer purchases options that are "too costly," ones in which implied volatility is "too high," then he could lose money even if the underlying makes a modest move in his favor.

In the next chapters, the topic of just how an option buyer or seller should measure implied volatility to determine what is "too low" or "too high" will be discussed. For now, suffice it to grasp the general concept that a change in implied volatility can have substantial effects on an option's price—far greater effects than the passage of time can have.

In fact, all of this calls into question just exactly what *time value premium* is. That part of an option's value that is *not* intrinsic value is really affected much more by volatility than it is by time decay, yet it carries the term "time value premium."

TIME VALUE PREMIUM IS A MISNOMER

Many (perhaps novice) option traders seem to think of *time* as the main antagonist to an option buyer. However, when one really thinks about it, he should realize that the portion of an option that is *not* intrinsic value is really much more related to stock price movement and/or volatility than anything else, at least in the short term. For this reason, it might be beneficial to more closely analyze just what the "excess value" portion of an option represents and why a buyer should not primarily think of it as time value premium.

An option's price is composed of two parts: (1) intrinsic value, which is the "real" part of the option's value—the distance by which the option is in-the-money, and (2) "excess value"—often called time value premium. There are actually five factors that affect the "excess value" portion of an option. Eventually, time will dominate them all, but the longer the life of the option, the more the other factors influence the "excess value."

The five factors influencing excess value are:

1. stock price movements,
2. changes in implied volatility,
3. the passage of time,

4. changes in the dividend (if any exist), and
5. changes in interest rates.

Each is stated in terms of a movement or change; that is, these are not static things. In fact, to measure them one uses the "greeks": delta, vega, theta (there is no "greek" for dividend change), and rho. Typically, the effect of a change in dividend or a change in interest rate is small (although a large dividend change or an interest rate change on a very long-term option can produce visible changes in the prices of options).

If everything remains static, then time decay will eventually wipe out all of the excess value of an option. That's why it's called time value premium. But things don't ever remain static, and on a daily basis, time decay is small, so it is the remaining two factors that are most important.

Example: XYZ is trading at 82 in late November. The January 80 call is trading at 8. Thus, the intrinsic value is 2 (82 minus 80) and the excess value is 6 (8 minus 2). If the stock is still at 82 at January expiration, the option will of course only be worth 2, and one will say that the 6 points of excess value that was lost was due to time decay. But on that day in late November, the other factors are much more dominant.

On this particular day, the implied volatility of this option is just over 50%. One can determine that the call's greeks are:

Delta: 0.60
Vega: 0.13
Theta: –0.06

This means, for example, that time decay is only 6 cents per day. It would increase as time went by, but even with a day or so to go, theta would not increase above about 20 cents unless volatility increased or the stock moved closer to the strike price.

From the above figures, one can see—and this should be intuitively appealing—that the biggest factor influencing the price of the option is stock price movement (delta). It's a little unfair to say that, because it's conceivable (although unlikely) that volatility could jump by a large enough margin to become a greater factor than delta for one day's move in the option. Furthermore, since this option is composed mostly of excess value, these more dominant forces influence the excess value more than time decay does.

There is a direct relationship between vega and excess value. That is, if implied volatility increases, the excess value portion of the option will increase and, if implied volatility decreases, so will excess value.

The relationship between delta and excess value is not so straightforward. The farther the stock moves away from the strike, the more this will have the effect of shrinking the excess value. If the call is in-the-money (as in the above example), then an *increase* in stock price will result in a *decrease* of excess value. That is, a deeply in-the-money option is composed primarily of intrinsic value, while excess value is quite small. However, when the call is out-of-the-money, the effect is just the opposite: Then, an increase in call price will result in an increase in excess value, because the stock price increase is bringing the stock closer to the option's striking price.

For some readers, the following may help to conceptualize this concept. The part of the delta that addresses excess value is this:

Out-of-the-money call: 100% of the delta affects the excess value.

In-the-money call: "1.00 minus delta" affects the excess value. (So, if a call is very deeply in-the-money and has a delta of 0.95, then the delta only has 1.00—0.95, or 0.05, room to increase. Hence it has little effect on what small amount of excess value remains in this deeply in-the-money call.)

These relationships are not static, of course. Suppose, for example, that in the same situation of the stock trading at 82 and the January 80 call trading at 8, *there is only one week remaining until expiration*! Then the implied volatility would be 155% (high, but not unheard of in volatile times). The greeks would bear a significantly different relationship to each other in this case, though:

Delta: 0.59
Vega: 0.044
Theta: –0.51

This very short-term option has about the same delta as its counterpart in the previous example (the delta of an at-the-money option is generally slightly above 0.50). Meanwhile, vega has shrunk. The effect of a change in volatility on such a short-term option is actually about a third of what it was in the previous example. However, time decay in this example is huge, amounting to half a point per day in this option.

So now one has the idea of how the excess value is affected by the "big three" of stock price movement, change in implied volatility, and passage of time. How can one use this to his advantage? First of all, one can see that an option's excess value may be due much more to the potential volatility of the underlying stock, and therefore to the option's implied volatility, than to time.

As a result of the above information regarding excess value, one shouldn't think that he can easily go around selling what appear to be options with a lot of excess value and then expect time to bring in the profits for him. In fact, there may be a lot of volatility—both actual and implied—keeping that excess value nearly intact for a fairly long period of time. In fact, in the coming chapters on volatility estimation, it will be shown that option buyers have a much better chance of success than conventional wisdom has maintained.

VOLATILITY AND THE PUT OPTION

While it is obvious that an increase in implied volatility will increase the price of a put option, much as was shown for a call option in the preceding discussion, there are certain differences between a put and a call, so a little review of the put option itself may be useful. A put option tends to lose its premium fairly quickly as it becomes an in-the-money option. This is due to the realities of conversion arbitrage. In a conversion arbitrage, an arbitrageur or market-maker buys stock *and* buys the put, while selling the call. If he carries the position to expiration, he will have to pay carrying costs on the debit incurred to establish the position. Furthermore, he would earn any dividends that might be paid while he holds the position. This information was presented in a slightly different form in the chapter on arbitrage, but it is recounted here:

In a perfect world, all option prices would be so accurate that there would be no profit available from a conversion. That is, the following equation (1) would apply:

$$\text{(1) Call price} + \text{Strike price} - \text{Stock price} - \text{Put price} + \text{Dividend} - \text{Carrying cost} = 0$$

$$\text{where carrying cost} = \text{strike price}/(1+r)^t$$

$$t = \text{time to expiration}$$

$$r = \text{interest rate}$$

Now, it is also known that the time value premium of a put is the amount by which its value exceeds intrinsic value. The intrinsic value of an in-the-money put option is merely the difference between the strike price and the stock price. Hence, one can write the following equation (2) for the time value premium (TVP) of an in-the-money put option:

$$\text{(2) Put TVP} = \text{Put price} - \text{Strike price} + \text{Stock price}$$

The arbitrage equation, (1), can be rewritten as:

$$\text{(3) Put price} - \text{Strike price} + \text{Stock price} = \text{Call price} + \text{Dividends} - \text{Carrying cost}$$

and substituting equation (2) for the terms in equation (3), one arrives at:

$$\text{(4) Put TVP} = \text{Call price} + \text{Dividends} - \text{Carrying cost}$$

In other words, the time value premium of an in-the-money put is the same as the (out-of-the-money) call price, plus any dividends to be earned until expiration, less any carrying costs over that same time period.

Assuming that the dividend is small or zero (as it is for most stocks), one can see that an in-the-money put would lose its time value premium whenever carrying costs exceed the value of the out-of-the-money call. Since these carrying costs can be relatively large (the carrying cost is the interest being paid on the entire debit of the position—and that debit is approximately equal to the strike price), they can quickly dominate the price of an out-of-the-money call. Hence, the time value premium of an in-the-money put disappears rather quickly.

This is important information for put option buyers, because they must understand that a put won't appreciate in value as much as one might expect, even when the stock drops, since the put loses its time value premium quickly. It's even more important information for put *sellers*: A short put is at risk of assignment as soon as there is no time value premium left in the put. Thus, a put can be assigned well in advance of expiration—even a LEAPS put!

Now, returning to the main topic of how implied volatility affects a position, one can ask himself how an increase or decrease in implied volatility would affect equation (4) above. If implied volatility increases, the call price would increase, and if the increase were great enough, might impart some time value premium to the put. *Hence, an increase in implied volatility also may increase the price of a put, but if the put is too far in-the-money, a modest increase in implied volatility still won't budge the put.* That is, an increase in implied volatility would increase the value of the call, but until it increases enough to be greater than the carrying costs, an in-the-money put will remain at parity, and thus a short put would still remain at risk of assignment.

STRADDLE OR STRANGLE BUYING AND SELLING

Since owning a straddle involves owning both a put and a call with the same terms, it is fairly evident that an increase in implied volatility will be very beneficial for a straddle buyer. A sort of double benefit occurs if implied volatility rises, for it will positively affect both the put and the call in a long straddle. Thus, if a straddle buyer is careful to buy straddles in situations in which implied volatility is "low," he can make money in one of two ways. Either (1) the underlying price makes a move great enough in magnitude to exceed the initial cost of the straddle, or (2) implied volatility increases quickly enough to overcome the deleterious effects of time decay.

Conversely, a straddle seller risks just the opposite—potentially devastating losses if implied volatility should increase dramatically. However, the straddle seller can register gains faster than just the rate of time decay would indicate if implied volatility *decreases*. Thus, it is very important when selling options—and this applies to covered options as well as to naked ones—to sell only when implied volatility is "high."

A strangle is the same as a straddle, except that the call and put have different striking prices. Typically, the call strike price is higher than the put strike price. Naked option sellers often prefer selling strangles in which the options are well out-of-the-money, so that there is less chance of them having any intrinsic value when they expire. Strangles behave much like straddles do with respect to changes in implied volatility.

The concepts of straddle ownership will be discussed in much more detail in the following chapters. Moreover, the general concept of option buying versus option selling will receive a great deal of attention.

CALL BULL SPREADS

In this section, the bull spread strategy will be examined to see how it is affected by changes in implied volatility. Let's look at a call bull spread and see how implied volatility changes might affect the price of the spread if all else remains equal. Make the following assumptions:

Assumption Set 1:
Stock Price: 100
Time to Expiration: 4 months
Position: Long Call Struck at 90
Short Call Struck at 110

Ask yourself this simple question: If the stock remains unchanged at 100, and implied volatility increases dramatically, will the price of the 90–110 call bull spread grow or shrink? Answer before reading on.

The truth is that, if implied volatility *increases*, the price of the spread will *shrink*. I would suspect that this comes as something of a surprise to a good number of readers. Table 37-6 contains some examples, generated from a Black–Scholes model, using the assumptions stated above, the most important of which is that the stock is at 100 in all cases in this table.

One should be aware that it would probably be difficult to actually trade the spread at the theoretical value, due to the bid-asked spread in the options. Nevertheless, the impact of implied volatility is clear.

One can quantify the amount by which an option position will change for each per-

TABLE 37-6.

Stock Price = 100

Implied Volatility	90–110 Call Bull Spread (Theoretical Value)
20%	10.54
30%	9.97
40%	9.54
50%	9.18
60%	8.87
70%	8.58
80%	8.30

centage point of increase in implied volatility. Recall that this measure is called the vega of the option or option position. In a call bull spread, one would subtract the vega of the call that is sold from that of the call that is bought in order to arrive at the position vega of the call bull spread. Table 37-7 is a reprint of Table 37-6, but now including the vega.

Since these vegas are all negative, they indicate that the spread will shrink in value if implied volatility rises and that the spread will expand in value if implied volatility decreases. Again, these statements may seem contrary to what one would expect from a bullish call position.

Of course, it's highly unlikely that implied volatility would change much in the course of just one day while the stock price remained unchanged. So, to get a better handle on what to expect, one really needs to look at what might happen at some future

TABLE 37-7.

Implied Volatility	90–110 Call Bull Spread (Theoretical Value)	Position Vega
20%	10.54	–0.67
30%	9.97	–0.48
40%	9.54	–0.38
50%	9.18	–0.33
60%	8.87	–0.30
70%	8.58	–0.28
80%	8.30	–0.26

time (say a couple of weeks hence) at various stock prices. The graph in Figure 37-3 begins the investigation of these more complex scenarios.

The profit curve shown in Figure 37-3 makes certain assumptions: (1) The bull spread assumes the details in Assumption Set 1, above; (2) the spread was bought with an implied volatility of 20% and remained at that level when the profit picture above was drawn; and (3) 30 days have passed since the spread was bought. Under these assumptions, the profit graph shows that the bull spread conforms quite well to what one would expect; that is, the shape of this curve is pretty much like that of a bull spread at expiration, although if you look closely you'll see that it doesn't widen out to nearly its maximum gain or loss potential until the stock is well above 110 or below 90—the strike prices used in the spread.

Now observe what happens if one keeps all the other assumptions the same, except one. In this case, assume implied volatility was 80% at purchase and remains at 80% one month later. The comparison is shown in Figure 37-4. The 80% curve is overlaid on top of the 20% curve shown earlier. The contrast is quite startling. Instead of looking like a bull spread, the profit curve that uses 80% implied volatility is a rather flat thing, sloping only slightly upward—and exhibiting far less risk and reward potential than its lower implied volatility counterpart. This points out another important fact: *For volatile stocks, one cannot expect a 4-month bull spread to expand* or *contract much during the first month of life, even if the stock makes a substantial move.* Longer-term spreads have even less movement.

FIGURE 37-3.
Bull spread profit picture in 30 days, at 20% IV.