CHAPTER 9 Trading Strategies Involving Options

The profit pattern from an investment in a single stock option is discussed in Chapter 7. In this chapter we cover more fully the range of profit patterns obtainable using options. We will assume that the underlying asset is a stock. Similar results can be obtained for other underlying assets, such as foreign currencies, stock indices, and futures contracts. We will also assume that the options used in the strategies we discuss are European. American options may lead to slightly different outcomes because of the possibility of early exercise.

In the first section we consider what happens when a position in a stock option is combined with a position in the stock itself. We then move on to examine the profit patterns obtained when an investment is made in two or more different options on the same stock. One of the attractions of options is that they can be used to create a wide range of different payoff functions. If European options were available with every single possible strike price, any payoff function could in theory be created.

For ease of exposition we ignore the time value of money when calculating the profit from a trading strategy in this chapter. The profit is calculated as the final payoff minus the initial cost, not as the present value of the final payoff minus the initial cost.

9.1 STRATEGIES INVOLVING A SINGLE OPTION AND A STOCK

There are a number of different trading strategies involving a single option on a stock and the stock itself. The profits from these are illustrated in Figure 9.1. In this figure and in other figures throughout this chapter, the dashed line shows the relationship between profit and the stock price for the individual securities constituting the portfolio, whereas the solid line shows the relationship between profit and the stock price for the whole portfolio.

In Figure 9.1a the portfolio consists of a long position in a stock plus a short position in a call option. This is known as *writing a covered call.* The long stock position "covers" or protects the investor from the payoff on the short call that becomes necessary if there is a sharp rise in the stock price. In Figure 9.1b a short position in

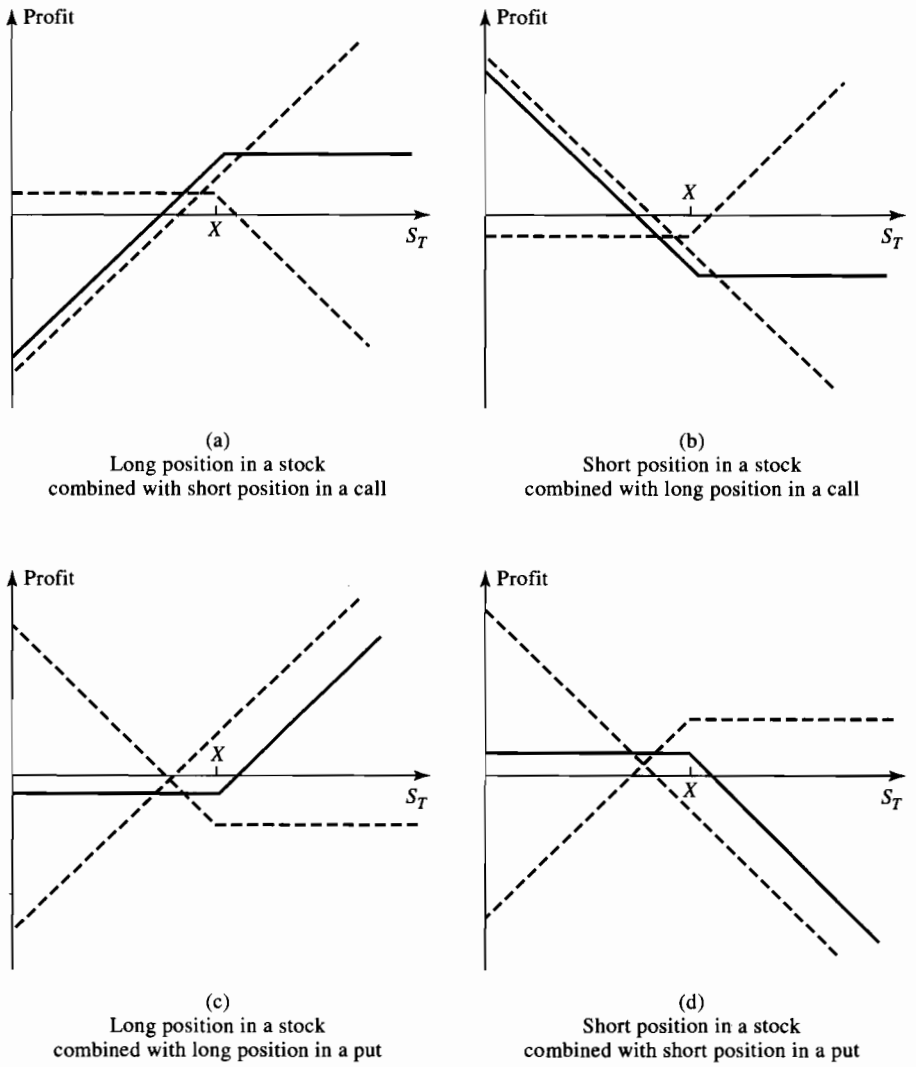

Figure 9.1 Profit patterns: (a) long position in a stock combined with short position in a call; (b) short position in a stock combined with long position in a call; (c) long position in a put combined with long position in a stock; (d) short position in a put combined with short position in a stock

a stock is combined with a long position in a call option. This is the reverse of writing a covered call. In Figure 9.1c the investment strategy involves buying a put option on a stock and the stock itself. The approach is sometimes referred to as a *protective put* strategy. In Figure 9.1d a short position in a put option is combined with a short position in the stock. This is the reverse of a protective put.

The profit patterns in Figures 9.1a, b, c, and d have the same general shape as the profit patterns discussed in Chapter 7 for short put, long put, long call, and short call, respectively. Put–call parity provides a way of understanding why this is so. It will be recalled from Chapter 8 that the put–call parity relationship is

$$p + S_0 = c + Xe^{-rT} + D \tag{9.1}$$

where p is the price of a European put, S_0 is the stock price, c is the price of a European call, X is the strike price of both call and put, r is the risk-free interest rate, T is the time to maturity of both call and put, and D is the present value of the dividends anticipated during the life of the option.

Equation (9.1) shows that a long position in a put combined with a long position in the stock is equivalent to a long call position plus a certain amount ($= Xe^{-rT} + D$) of cash. This explains why the profit pattern in Figure 9.1c is similar to the profit pattern from a long call position. The position in Figure 9.1d is the reverse of that in Figure 9.1c and therefore leads to a profit pattern similar to that from a short call position.

Equation (9.1) can be rearranged to become

$$S_0 - c = Xe^{-rT} + D - p$$

In other words, a long position in a stock combined with a short position in a call is equivalent to a short put position plus a certain amount ($= Xe^{-rT} + D$) of cash. This equality explains why the profit pattern in Figure 9.1a is similar to the profit pattern from a short put position. The position in Figure 9.1b is the reverse of that in Figure 9.1a and therefore leads to a profit pattern similar to that from a long put position.

9.2 SPREADS

A spread trading strategy involves taking a position in two or more options of the same type (i.e., two or more calls or two or more puts).

Bull Spreads

One of the most popular types of spreads is a *bull spread*. It can be created by buying a call option on a stock with a certain strike price and selling a call option on the same stock with a higher strike price. Both options have the same expiration date. The strategy is illustrated in Figure 9.2. The profits from the two option positions taken separately are shown by the dashed lines. The profit from the whole strategy is the sum of the profits given by the dashed lines and is indicated by the solid line. Because a call price always decreases as the strike price increases, the value of the option sold is always less than the value of the option bought. A bull spread, when created from calls, therefore requires an initial investment.

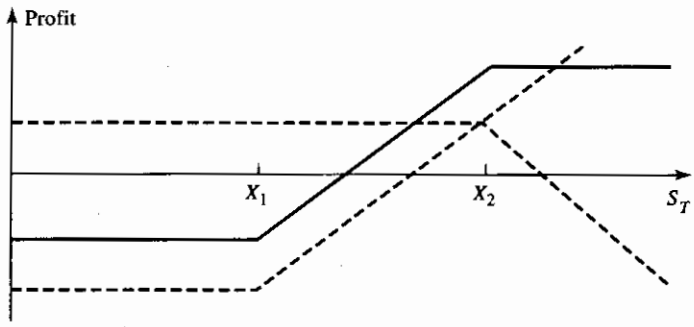

Figure 9.2 Bull spread created using call options

Table 9.1 Payoff from a bull spread

Stock price range	Payoff from long call option	Payoff from short call option	Total payoff
$S_T \geqslant X_2$	$S_T - X_1$	$X_2 - S_T$	$X_2 - X_1$
$X_1 < S_T < X_2$	$S_T - X_1$	0	$S_T - X_1$
$S_T \leqslant X_1$	0	0	0

Suppose that X_1 is the strike price of the call option bought, X_2 is the strike price of the call option sold, and S_T is the stock price on the expiration date of the options. Table 9.1 shows the total payoff that will be realized from a bull spread in different circumstances. If the stock price does well and is greater than the higher strike price, the payoff is the difference between the two strike prices, or $X_2 - X_1$. If the stock price on the expiration date lies between the two strike prices, the payoff is $S_T - X_1$. If the stock price on the expiration date is below the lower strike price, the payoff is zero. The profit in Figure 9.2 is calculated by subtracting the initial investment from the payoff.

A bull spread strategy limits the investor's upside as well as downside risk. The strategy can be described by saying that the investor has a call option with a strike price equal to X_1 and has chosen to give up some upside potential by selling a call option with strike price X_2 ($X_2 > X_1$). In return for giving up the upside potential, the investor gets the price of the option with strike price X_2. Three types of bull spreads can be distinguished:

1. Both calls are initially out of the money.
2. One call is initially in the money; the other call is initially out of the money.
3. Both calls are initially in the money.

The most aggressive bull spreads are those of type 1. They cost very little to set up and have a small probability of giving a relatively high payoff ($= X_2 - X_1$). As we move from type 1 to type 2 and from type 2 to type 3, the spreads become more conservative.

Example

An investor buys for \$3 a call with a strike price of \$30 and sells for \$1 a call with a strike price of \$35. The payoff from this bull spread strategy is \$5 if the stock price is above \$35 and zero if it is below \$30. If the stock price is between \$30 and \$35, the payoff is the amount by which the stock price exceeds \$30. The cost of the strategy is \$3 − \$1 = \$2. The profit is therefore as follows:

Stock price range	Profit
$S_T \leqslant 30$	−2
$30 < S_T < 35$	$S_T - 32$
$S_T \geqslant 35$	3

Bull spreads can also be created by buying a put with a low strike price and selling a put with a high strike price, as illustrated in Figure 9.3. Unlike the bull spread created from calls, bull spreads created from puts involve a positive cash flow to the investor up front (ignoring margin requirements) and a payoff that is either negative or zero.

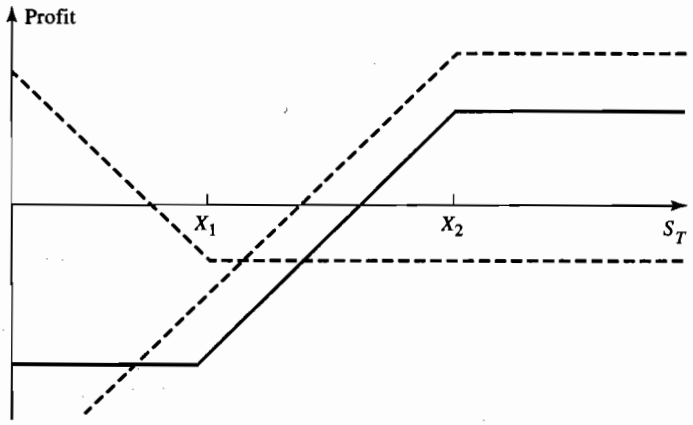

Figure 9.3 Bull spread created using put options

Bear Spreads

An investor who enters into a bull spread is hoping that the stock price will increase. By contrast, an investor who enters into a *bear spread* is hoping that the stock price will decline. As with a bull spread, a bear spread can be created by buying a call with one strike price and selling a call with another strike price. However, in the case of a bear spread, the strike price of the option purchased is greater than the strike price of the option sold. In Figure 9.4 the profit from the spread is shown by the solid line. A bear spread created from calls involves an initial cash inflow (when margin requirements are ignored), because the price of the call sold is greater than the price of the call purchased.

Assume that the strike prices are X_1 and X_2, with $X_1 < X_2$. Table 9.2 shows the payoff that will be realized from a bear spread in different circumstances. If the stock price is greater than X_2, the payoff is negative at $-(X_2 - X_1)$. If the stock price is less than X_1, the payoff is zero. If the stock price is between X_1 and X_2, the payoff is $-(S_T - X_1)$. The profit is calculated by adding the initial cash inflow to the payoff.

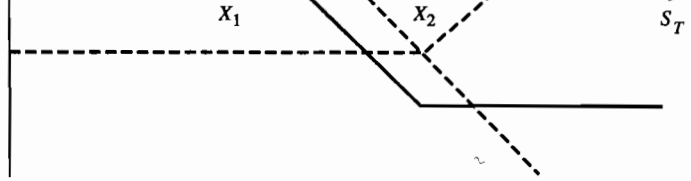

Figure 9.4 Bear spread created using call options

Example

An investor buys for \$1 a call with a strike price of \$35 and sells for \$3 a call with a strike price of \$30. The payoff from this bear spread strategy is \$5 if the stock

price is above \$35 and zero if it is below \$30. If the stock price is between \$30 and \$35, the payoff is $-(S_T - 30)$. The investment generates \$3 − \$1 = \$2 up front. The profit is therefore as follows:

Stock price range	Profit
$S_T \leqslant 30$	+2
$30 < S_T < 35$	$32 - S_T$
$S_T \geqslant 35$	−3

Like bull spreads, bear spreads limit both the upside profit potential and the downside risk. Bear spreads can be created using puts instead of calls. The investor buys a put with a high strike price and sells a put with a low strike price, as illustrated in Figure 9.5. Bear spreads created with puts require an initial investment. In essence, the investor has bought a put with a certain strike price and chosen to give up some of the profit potential by selling a put with a lower strike price. In return for the profit given up, the investor gets the price of the option sold.

Table 9.2 Payoff from a bear spread

Stock price range	Payoff from long call option	Payoff from short call option	Total payoff
$S_T \geqslant X_2$	$S_T - X_2$	$X_1 - S_T$	$-(X_2 - X_1)$
$X_1 < S_T < X_2$	0	$X_1 - S_T$	$-(S_T - X_1)$
$S_T \leqslant X_1$	0	0	0

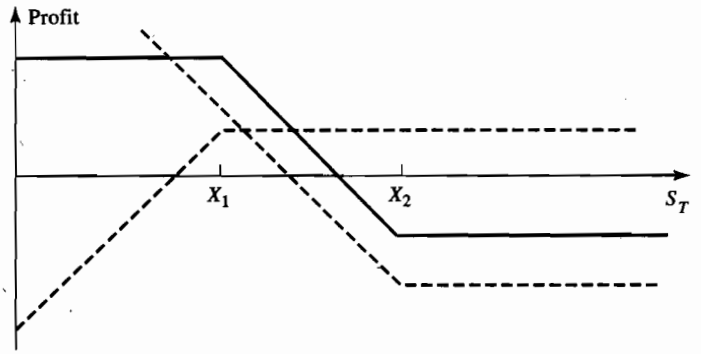

Figure 9.5 Bear spread created using put options

Butterfly Spreads

A *butterfly spread* involves positions in options with three different strike prices. It can be created by buying a call option with a relatively low strike price, X_1; buying a call option with a relatively high strike price, X_3; and selling two call options with a strike price, X_2, halfway between X_1 and X_3. Generally X_2 is close to the current stock price. The pattern of profits from the strategy is shown in Figure 9.6. A butterfly spread leads to a profit if the stock price stays close to X_2, but gives rise to a small loss if there is a significant stock price move in either direction. It is therefore an appropriate strategy

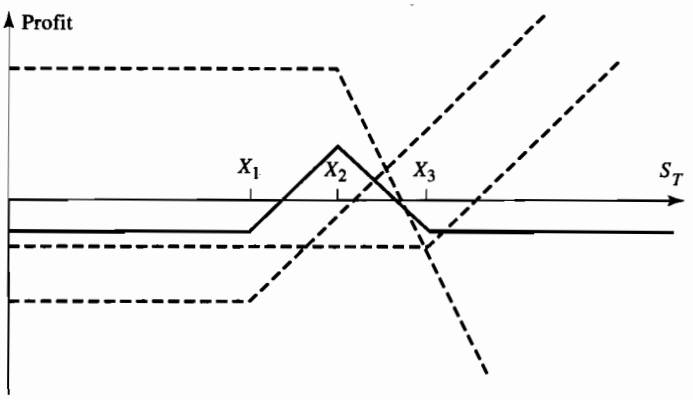

Figure 9.6 Butterfly spread using call options

for an investor who feels that large stock price moves are unlikely. The strategy requires a small investment initially. The payoff from a butterfly spread is shown in Table 9.3.

Suppose that a certain stock is currently worth \$61. Consider an investor who feels that a significant price move in the next six months is unlikely. Suppose that the market prices of six-month calls are as follows:

Strike price (\$)	Call price (\$)
55	10
60	7
65	5

The investor could create a butterfly spread by buying one call with a \$55 strike price, buying one call with a \$65 strike price, and selling two calls with a \$60 strike price. It costs $\$10 + \$5 - (2 \times \$7) = \$1$ to create the spread. If the stock price in six months is greater than \$65 or less than \$55, the total payoff is zero, and the investor incurs a net loss of \$1. If the stock price is between \$56 and \$64, a profit is made. The maximum profit, \$4, occurs when the stock price in six months is \$60. The example is summarized in Table 9.4.

Butterfly spreads can be created using put options. The investor buys a put with a low strike price, buys a put with a high strike price, and sells two puts with an intermediate strike price, as illustrated in Figure 9.7. The butterfly spread in the example just considered would be created by buying a put with a strike price of \$55, buying a put

Table 9.3 Payoff from a butterfly spread

Stock price range	Payoff from first long call	Payoff from second long call	Payoff from short calls	Total payoff*
$S_T < X_1$	0	0	0	0
$X_1 < S_T < X_2$	$S_T - X_1$	0	0	$S_T - X_1$
$X_2 < S_T < X_3$	$S_T - X_1$	0	$-2(S_T - X_2)$	$X_3 - S_T$
$S_T > X_3$	$S_T - X_1$	$S_T - X_3$	$-2(S_T - X_2)$	0

* These payoffs are calculated using the relationship $X_2 = 0.5(X_1 + X_3)$.

Table 9.4 Use of a butterfly spread

From the Trader's Desk

A stock is currently selling for \$61. The prices of call options expiring in six months are quoted as follows:

Strike price = \$55, call price = \$10
Strike price = \$60, call price = \$7
Strike price = \$65, call price = \$5

An investor feels it is unlikely that the stock price will move significantly in the next six months.

The Strategy

The investor sets up a butterfly spread:

1. Buy one call with a \$55 strike.
2. Buy one call with a \$65 strike.
3. Sell two calls with a \$60 strike.

The cost is \$10 + \$5 − (2 × \$7) = \$1. The strategy leads to a net loss (maximum \$1) if the stock price moves outside the \$56-to-\$64 range but leads to a profit if it stays within this range. The maximum profit of \$4 is realized if the stock price is \$60 on the expiration date.

with a strike price of \$65, and selling two puts with a strike price of \$60. If all options are European, the use of put options results in exactly the same spread as the use of call options. Put–call parity can be used to show that the initial investment is the same in both cases.

A butterfly spread can be sold or shorted by following the reverse strategy. Options are sold with strike prices of X_1 and X_3, and two options with the middle strike price X_2 are purchased. This strategy produces a modest profit if there is a significant movement in the stock price.

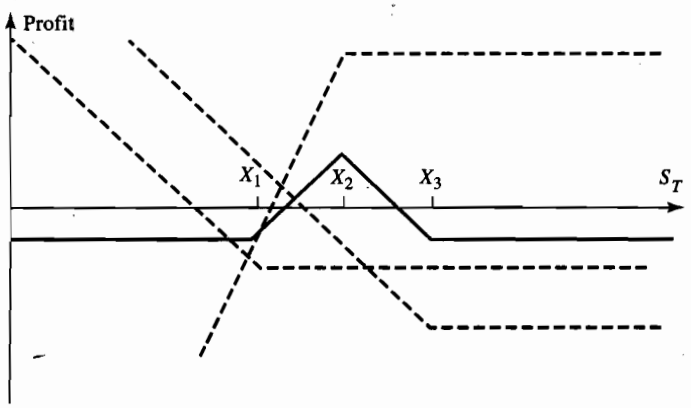

Figure 9.7 Butterfly spread using put options

Calendar Spreads

Up to now we have assumed that the options used to create a spread all expire at the same time. We now move on to *calendar spreads* in which the options have the same strike price and different expiration dates.

A calendar spread can be created by selling a call option with a certain strike price and buying a longer-maturity call option with the same strike price. The longer the maturity of an option, the more expensive it usually is. A calendar spread therefore usually requires an initial investment. Profit diagrams for calendar spreads are usually produced so that they show the profit when the short-maturity option expires on the assumption that the long-maturity option is sold at that time. The profit pattern for a calendar spread produced from call options is shown in Figure 9.8. The pattern is similar to the profit from the butterfly spread in Figure 9.6. The investor makes a profit if the stock price at the expiration of the short-maturity option is close to the strike price of the short-maturity option. However, a loss is incurred when the stock price is significantly above or significantly below this strike price.

To understand the profit pattern from a calendar spread, first consider what happens if the stock price is very low when the short-maturity option expires. The short-maturity option is worthless and the value of the long-maturity option is close to zero. The investor therefore incurs a loss that is close to the cost of setting up the spread initially. Consider next what happens if the stock price, S_T, is very high when the short-maturity option expires. The short-maturity option costs the investor $S_T - X$, and the long-maturity option (assuming early exercise is not optimal) is worth a little more than $S_T - X$, where X is the strike price of the options. Again, the investor makes a net loss that is close to the cost of setting up the spread initially. If S_T is close to X, the short-maturity option costs the investor either a small amount or nothing at all. However, the long-maturity option is still quite valuable. In this case a significant net profit is made.

In a *neutral calendar spread*, a strike price close to the current stock price is chosen. A *bullish calendar spread* involves a higher strike price, whereas a *bearish calendar spread* involves a lower strike price.

Calendar spreads can be created with put options as well as call options. The investor buys a long-maturity put option and sells a short-maturity put option. As shown in Figure 9.9, the profit pattern is similar to that obtained from using calls.

A *reverse calendar spread* is the opposite to that in Figures 9.8 and 9.9. The investor buys a short-maturity option and sells a long-maturity option. A small profit arises if

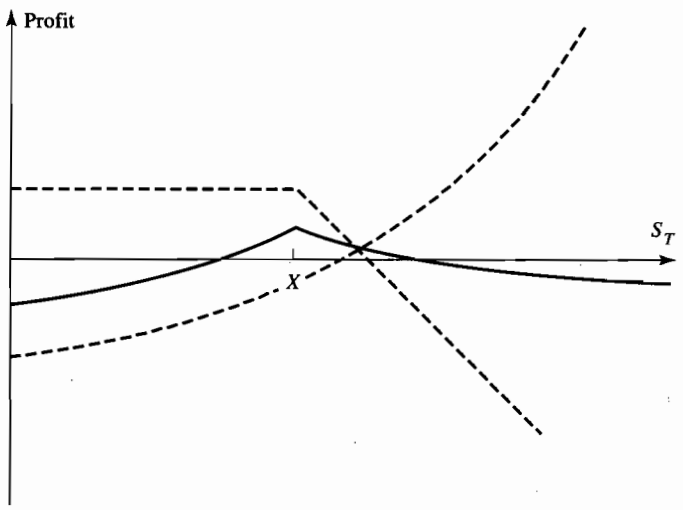

Figure 9.8 Calendar spread created using two calls

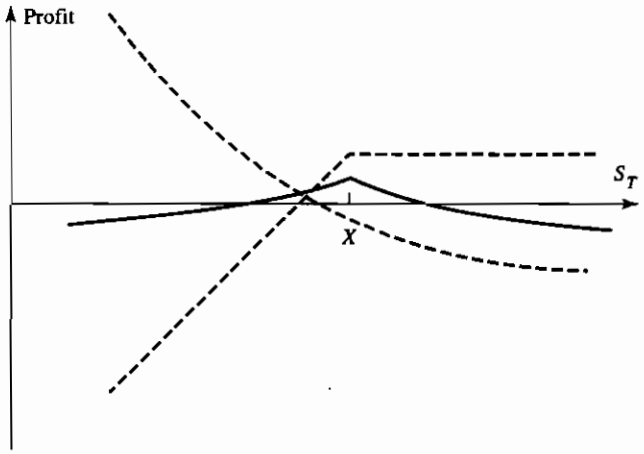

Figure 9.9 Calendar spread created using two puts

the stock price at the expiration of the short-maturity option is well above or well below the strike price of the short-maturity option. However, a significant loss results if it is close to the strike price.

Diagonal Spreads

Bull, bear, and calendar spreads can all be created from a long position in one call and a short position in another call. In the case of bull and bear spreads, the calls have different strike prices and the same expiration date. In the case of calendar spreads, the calls have the same strike price and different expiration dates. In a *diagonal spread* both the expiration date and the strike price of the calls are different. This increases the range of profit patterns that are possible.

9.3 COMBINATIONS

A *combination* is an option trading strategy that involves taking a position in both calls and puts on the same stock. We will consider straddles, strips, straps, and strangles.

Straddle

One popular combination is a *straddle*, which involves buying a call and put with the same strike price and expiration date. The profit pattern is shown in Figure 9.10. The strike price is denoted by X. If the stock price is close to this strike price at expiration of the options, the straddle leads to a loss. However, if there is a sufficiently large move in either direction, a significant profit will result. The payoff from a straddle is calculated in Table 9.5.

A straddle is appropriate when an investor is expecting a large move in a stock price but does not know in which direction the move will be. Consider an investor who feels that the price of a certain stock, currently valued at \$69 by the market, will move significantly in the next three months. The investor could create a straddle by buying both a put and a call with a strike price of \$70 and an expiration date in three months. Suppose that the call costs \$4 and the put costs \$3. If the stock price stays at \$69, it is

Table 9.5 Payoff from a straddle

Range of stock price	Payoff from call	Payoff from put	Total payoff
$S_T \leq X$	0	$X - S_T$	$X - S_T$
$S_T > X$	$S_T - X$	0	$S_T - X$

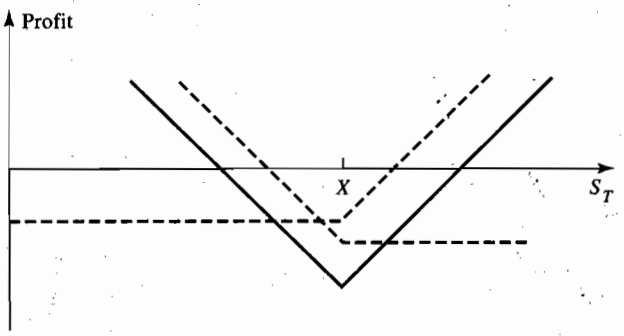

Figure 9.10 A straddle

easy to see that the strategy costs the investor \$6. (An up-front investment of \$7 is required, the call expires worthless, and the put expires worth \$1.) If the stock price moves to \$70, a loss of \$7 is experienced. (This is the worst that can happen.) However, if the stock price jumps up to \$90, a profit of \$13 is made; if the stock moves down to \$55, a profit of \$8 is made; and so on. The example is summarized in Table 9.6.

A straddle seems to be a natural trading strategy to use when a big jump in the price of a company's stock is expected, for example, when there is a takeover bid for the company or when the outcome of a major lawsuit is expected to be announced soon. However, this is not necessarily the case. If the general view of the market is that there will be a big jump in the stock price soon, that view will be reflected in the prices of options. An investor will find options on the stock to be significantly more expensive than options on a similar stock for which no jump is expected. For a straddle to be an effective strategy, the investor must believe that there are likely to be big movements in the stock price and these beliefs must be different from those of most other market participants.

The straddle in Figure 9.10 is sometimes referred to as a *bottom straddle* or *straddle purchase*. A *top straddle* or *straddle write* is the reverse position. It is created by selling a call and a put with the same exercise price and expiration date. It is a highly risky strategy. If the stock price on the expiration date is close to the strike price, a significant profit results. However, the loss arising from a large move in either direction is unlimited.

Strips and Straps

A *strip* consists of a long position in one call and two puts with the same strike price and expiration date. A *strap* consists of a long position in two calls and one put with the same strike price and expiration date. The profit patterns from strips and straps are shown in Figure 9.11. In a strip the investor is betting that there will be a big stock price move and considers a decrease in the stock price to be more likely than an increase. In a

Table 9.6 Use of a straddle

From the Trader's Desk

A stock is currently trading at \$69. A three-month call with a strike price of \$70 costs \$4, whereas a three-month put with the same strike price costs \$3. An investor feels that the stock price is likely to experience a significant jump (either up or down) in the next three months.

The Strategy

The trader buys both the put and the call. The worst that can happen is that the stock price is \$70 in three months. In this case the strategy costs \$7. The farther away from \$70 the stock price is, the more profitable the strategy becomes. For example, if the stock price is \$90, the strategy leads to a profit of \$13. If the stock price is \$55, the strategy leads to a profit of \$8.

strap the investor is also betting that there will be a big stock price move. However, in this case, an increase in the stock price is considered to be more likely than a decrease.

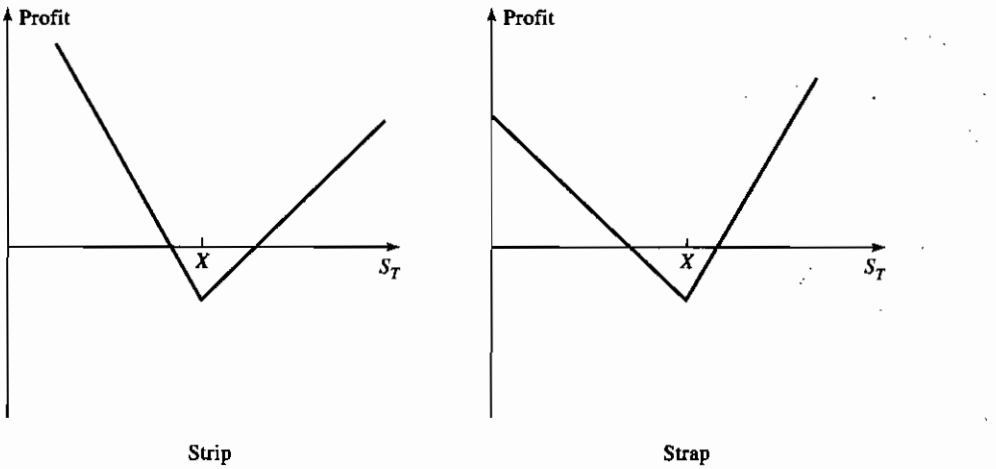

Figure 9.11 Profit patterns from a strip and a strap

Strangles

In a *strangle*, sometimes called a *bottom vertical combination*, an investor buys a put and a call with the same expiration date and different strike prices. The profit pattern that is obtained is shown in Figure 9.12. The call strike price, X_2, is higher than the put strike price, X_1. The payoff function for a strangle is calculated in Table 9.7.

A strangle is a similar strategy to a straddle. The investor is betting that there will be a large price move, but is uncertain whether it will be an increase or a decrease. Comparing Figures 9.12 and 9.10, we see that the stock price has to move farther in a strangle than in a straddle for the investor to make a profit. However, the downside risk if the stock price ends up at a central value is less with a strangle.

The profit pattern obtained with a strangle depends on how close together the strike prices are. The farther they are apart, the less the downside risk and the farther the stock price has to move for a profit to be realized.

Table 9.7 Payoff from a strangle

Range of stock price	Payoff from call	Payoff from put	Total payoff
$S_T \leqslant X_1$	0	$X_1 - S_T$	$X_1 - S_T$
$X_1 < S_T < X_2$	0	0	0
$S_T \geqslant X_2$	$S_T - X_2$	0	$S_T - X_2$

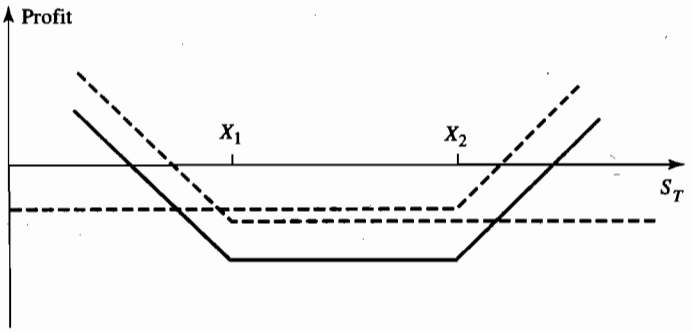

Figure 9.12 A strangle

The sale of a strangle is sometimes referred to as a *top vertical combination.* It can be appropriate for an investor who feels that large stock price moves are unlikely. However, as with sale of a straddle, it is a risky strategy involving unlimited potential loss to the investor.

9.4 OTHER PAYOFFS

This chapter has demonstrated just a few of the ways in which options can be used to produce an interesting relationship between profit and stock price. If European options expiring at time T were available with every single possible strike price, any payoff function at time T could in theory be obtained. The easiest illustration of this involves a series of butterfly spreads. Recall that a butterfly spread is created by buying options with strike prices X_1 and X_3 and selling two options with strike price X_2 where $X_1 < X_2 < X_3$ and $X_3 - X_2 = X_2 - X_1$. Figure 9.13 shows the payoff from a butterfly spread. The pattern could be described as a spike. As X_1 and X_3 move closer together, the spike becomes smaller. Through the judicious combination of a large number of very small spikes, any payoff function can be approximated.

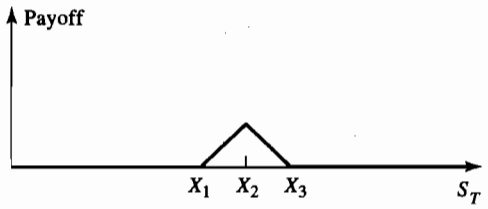

Figure 9.13 Payoff from a butterfly spread

9.5 SUMMARY

A number of common trading strategies involve a single option and the underlying stock. For example, writing a covered call involves buying the stock and selling a call option on the stock; a protective put involves buying a put option and buying the stock. The former is similar to selling a put option; the latter is similar to buying a call option.

Spreads involve either taking a position in two or more calls or taking a position in two or more puts. A bull spread can be created by buying a call (put) with a low strike price and selling a call (put) with a high strike price. A bear spread can be created by buying a call (put) with a high strike price and selling a call (put) with a low strike price. A butterfly spread involves buying calls (puts) with a low and high strike price and selling two calls (puts) with some intermediate strike price. A calendar spread involves selling a call (put) with a short time to expiration and buying a call (put) with a longer time to expiration. A diagonal spread involves a long position in one option and a short position in another option such that both the strike price and the expiration date are different.

Combinations involve taking a position in both calls and puts on the same stock. A straddle combination involves taking a long position in a call and a long position in a put with the same strike price and expiration date. A strip consists of a long position in one call and two puts with the same strike price and expiration date. A strap consists of a long position in two calls and one put with the same strike price and expiration date. A strangle consists of a long position in a call and a put with different strike prices and the same expiration date. There are many other ways in which options can be used to produce interesting payoffs. It is not surprising that option trading has steadily increased in popularity and continues to fascinate investors.

Suggestions for Further Reading

Bookstaber, R. M. *Option Pricing and Strategies in Investing*. Reading, MA: Addison-Wesley, 1981.

Degler, W. H., and H. P. Becker. "19 Option Strategies and When to Use Them." *Futures* (June 1984).

McMillan, L. G. *Options as a Strategic Investment*. New York: New York Institute of Finance, 1992.

Slivka, R. "Call Option Sprcading." *Journal of Portfolio Management* 7 (spring 1981): 71–76.

Welch, W. W. *Strategies for Put and Call Option Trading*. Cambridge, MA: Winthrop, 1982.

Yates, J. W., and R. W. Kopprasch. "Writing Covered Call Options: Profits and Risks." *Journal of Portfolio Management* 6 (fall 1980): 74–80.

Quiz (Answers at End of Book)

9.1. What is meant by a protective put? What position in call options is equivalent to a protective put?

9.2. Explain two ways in which a bear spread can be created.

9.3. When is it appropriate for an investor to purchase a butterfly spread?

9.4. Call options on a stock are available with strike prices of \$15, \$17$\frac{1}{2}$, and \$20, and expiration dates in three months. Their prices are \$4, \$2, and \$$\frac{1}{2}$, respectively. Explain how the options can be used to create a butterfly spread. Construct a table showing how profit varies with stock price for the butterfly spread.

9.5. What trading strategy creates a reverse calendar spread?

9.6. What is the difference between a strangle and a straddle?

9.7. A call option with a strike price of \$50 costs \$2. A put option with a strike price of \$45 costs \$3. Explain how a strangle can be created from these two options. What is the pattern of profits from the strangle?

Questions and Problems (Answers in Solutions Manual)

9.8. Use put–call parity to relate the initial investment for a bull spread created using calls to the initial investment for a bull spread created using puts.

9.9. Explain how an aggressive bear spread can be created using put options.

9.10. Suppose that put options on a stock with strike prices \$30 and \$35 cost \$4 and \$7, respectively. How can the options be used to create (a) a bull spread and (b) a bear spread? Construct a table that shows the profit and payoff for both spreads.

9.11. Use put–call parity to show that the cost of a butterfly spread created from European puts is identical to the cost of a butterfly spread created from European calls.

9.12. A call with a strike price of \$60 costs \$6. A put with the same strike price and expiration date costs \$4. Construct a table that shows the profit from a straddle. For what range of stock prices would the straddle lead to a loss?

9.13. Construct a table showing the payoff from a bull spread when puts with strike prices X_1 and X_2 are used ($X_2 > X_1$).

9.14. An investor believes that there will be a big jump in a stock price, but is uncertain as to the direction. Identify six different strategies the investor can follow and explain the differences among them.

9.15. How can a forward contract on a stock with a particular delivery price and delivery date be created from options?

9.16. A box spread is a combination of a bull call spread with strike prices X_1 and X_2 and a bear put spread with the same strike prices. The expiration dates of all options are the same. What are the characteristics of a box spread?

9.17. What is the result if the strike price of the put is higher than the strike price of the call in a strangle?

9.18. One Australian dollar is currently worth \$0.64. A one-year butterfly spread is set up using European call options with strike prices of \$0.60, \$0.65, and \$0.70. The risk-free interest rates in the United States and Australia are 5% and 4%, respectively, and the volatility of the exchange rate is 15%. Use the DerivaGem software to calculate the cost of setting up the butterfly spread position. Show that the cost is the same if European put options are used instead of European call options.

Assignment Questions

9.19. Three put options on a stock have the same expiration date and strike prices of \$55, \$60, and \$65. The market prices are \$3, \$5, and \$8, respectively. Explain how a butterfly spread can be created. Construct a table showing the profit from the strategy. For what range of stock prices would the butterfly spread lead to a loss?

9.20. A diagonal spread is created by buying a call with strike price X_2 and exercise date T_2 and selling a call with strike price X_1 and exercise date T_1 ($T_2 > T_1$). Draw a diagram showing the profit when (a) $X_2 > X_1$ and (b) $X_2 < X_1$.

9.21. Draw a diagram showing the variation of an investor's profit and loss with the terminal stock price for a portfolio consisting of
   a. One share and a short position in one call option
   b. Two shares and a short position in one call option
   c. One share and a short position in two call options
   d. One share and a short position in four call options

   In each case, assume that the call option has an exercise price equal to the current stock price.