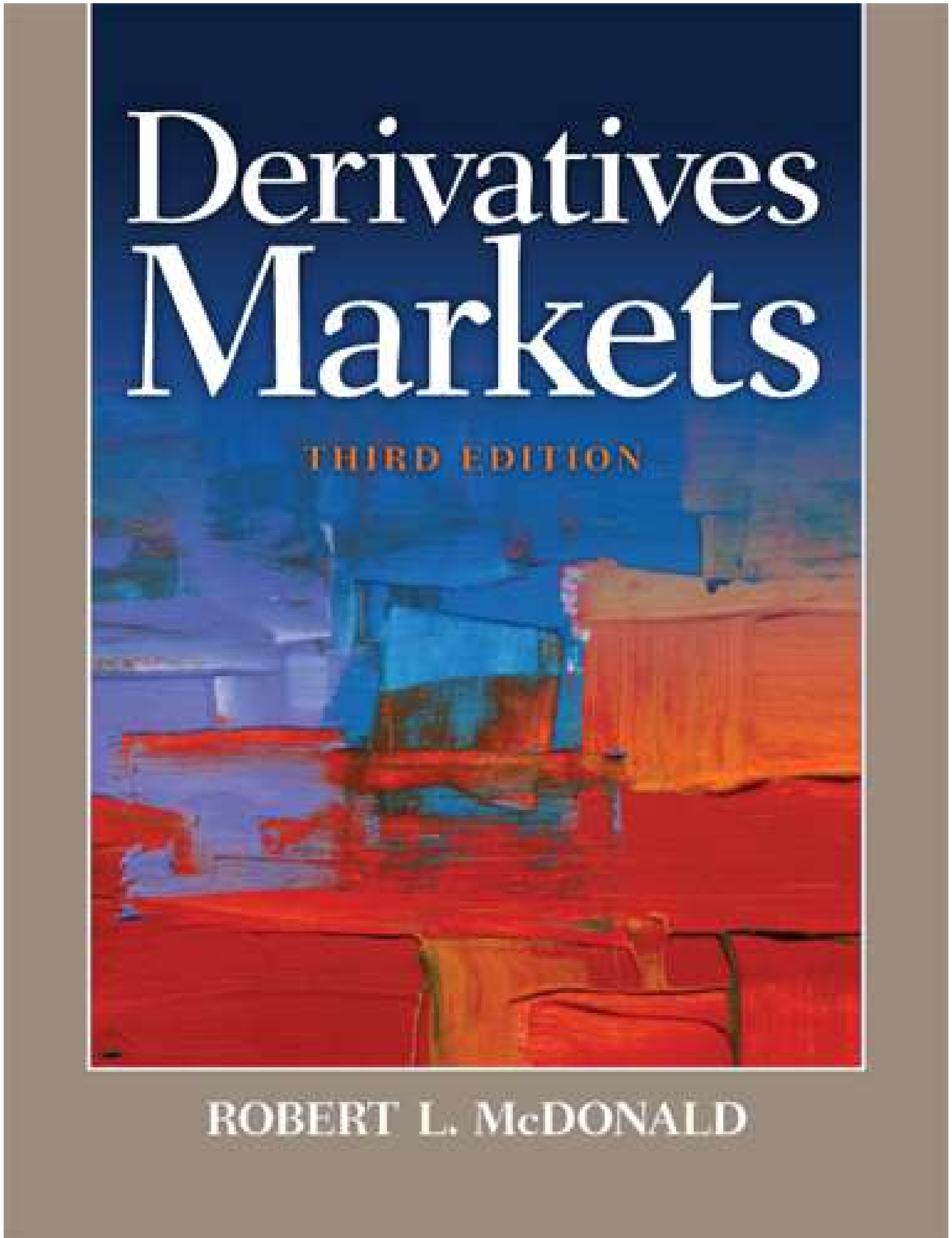
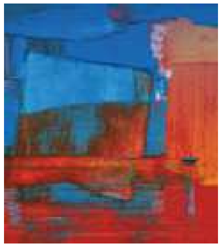


Chapter 3

Insurance, Collars, and Other Strategies

Points to note



Basic Insurance Strategies

- Options can be
  - Used to insure long asset positions (floors).
  - Used to insure short asset positions (caps).
  - Written against asset positions (selling insurance).
- Use the following information in this section:
  - a S&R index price of $1,000
  - a 2% effective 6-month interest rate
  - premiums of $93.809 for the 1,000-strike 6-month call
  - premiums of $74.201 for the 1,000-strike 6-month put

Insuring a Long Position: Floors

- A put option is combined with a long position in the underlying asset.
- Goal: to insure against a fall in the price of the underlying asset.

Insuring a Long Position: Floors (cont'd)

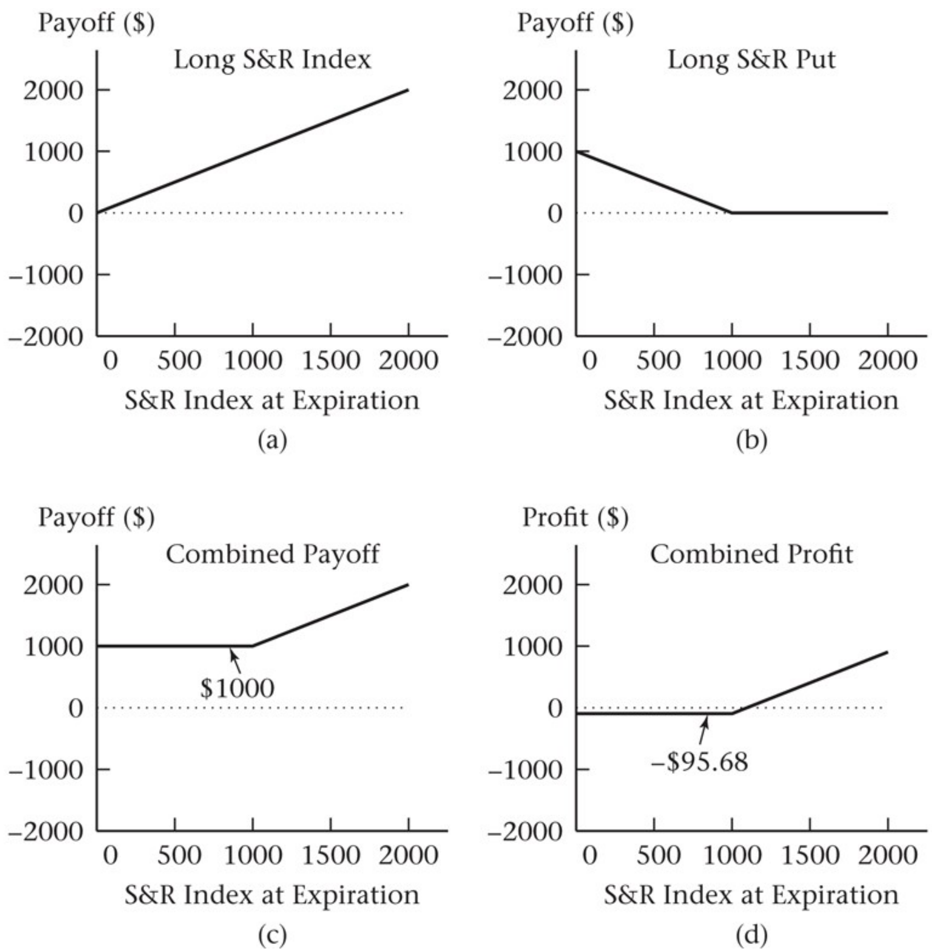
- Example: S&R index and an S&R put option with a strike price of $1,000 together.

Insuring a Long Position: Floors (cont'd)

TABLE 3.1 Payoff and profit at expiration from purchasing the S&R index and a 1000-strike put option. Payoff is the sum of the first two columns. Cost plus interest for the position is ($1000 + $74.201) × 1.02 = $1095.68. Profit is payoff less $1095.68.

Payoff at Expiration				
S&R Index	**S&R Put**	**Payoff**	**−(Cost + Interest)**	**Profit**
$900	$100	$1000	−$1095.68	−$95.68
950	50	1000	−1095.68	−95.68
1000	0	1000	−1095.68	−95.68
1050	0	1050	−1095.68	−45.68
1100	0	1100	−1095.68	4.32
1150	0	1150	−1095.68	54.32
1200	0	1200	−1095.68	104.32

Insuring a Long Position: Floors (cont'd)



Buying an asset and a put generates a position that looks like a call!

Insuring a Short Position: Caps

- A call option is combined with a short position in the underlying asset.
- Goal: to insure against an increase in the price of the underlying asset.

Insuring a Short Position: Caps (cont'd)

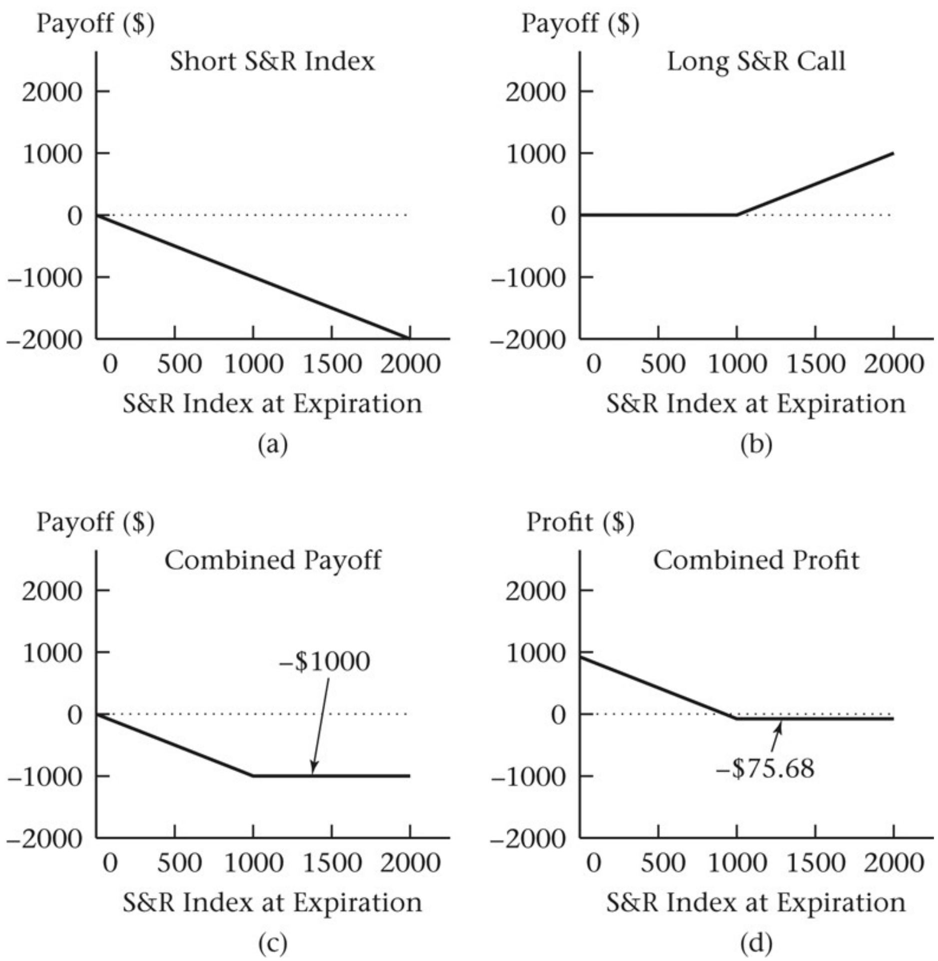
- Example: short-selling the S&R index and holding a S&R call option with a strike price of $1,000.

Insuring a Short Position: Caps (cont'd)

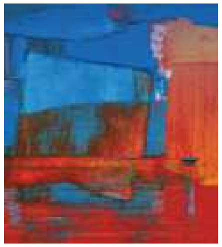
TABLE 3.2 Payoff and profit at expiration from short-selling the S&R index and buying a 1000-strike call option at a premium of \$93.809. The payoff is the sum of the first two columns. Cost plus interest for the position is $(-\$1000 + \$93.809) \times 1.02 = -\$924.32$. Profit is payoff plus \$924.32.

Payoff at Expiration				
Short S&R Index	S&R Call	Payoff	−(Cost + Interest)	Profit
−\$900	\$0	−\$900	\$924.32	\$24.32
−950	0	−950	924.32	−25.68
−1000	0	−1000	924.32	−75.68
−1050	50	−1000	924.32	−75.68
−1100	100	−1000	924.32	−75.68
−1150	150	−1000	924.32	−75.68
−1200	200	−1000	924.32	−75.68

Insuring a Short Position: Caps (cont'd)



An insured short position looks like a put!

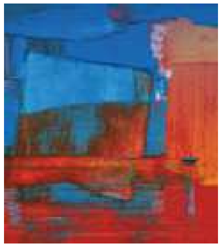


Selling Insurance

- For every insurance buyer there must be an insurance seller.
- Strategies used to sell insurance
  - **Covered writing** (or option overwriting or selling a covered call) is writing an option when there is a corresponding long position in the underlying asset is called covered writing.
  - **Naked writing** is writing an option when the writer does not have a position in the asset.

Covered Writing: Covered Calls

- Example: holding the S&R index and writing a S&R call option with a strike price of $1,000.

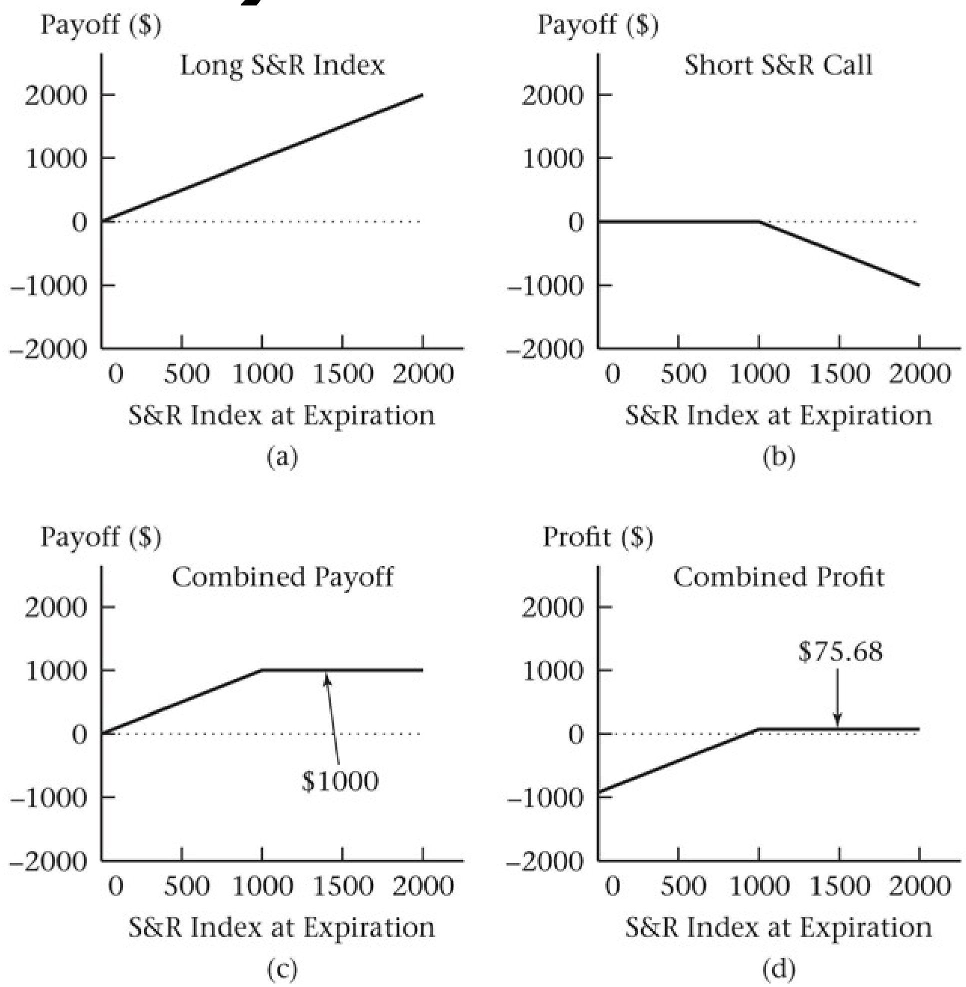


Covered Writing: Covered Calls (cont'd)

TABLE 3.3 Payoff and profit at expiration from purchasing the S&R index and selling a 1000-strike call option. The payoff column is the sum of the first two columns. Cost plus interest for the position is ($1000 − $93.809) × 1.02 = $924.32. Profit is payoff less $924.32.

Payoff at Expiration				
S&R Index	Short S&R Call	Payoff	−(Cost + Interest)	Profit
$900	$0	$900	−$924.32	−$24.32
950	0	950	−924.32	25.68
1000	0	1000	−924.32	75.68
1050	−50	1000	−924.32	75.68
1100	−100	1000	−924.32	75.68
1150	−150	1000	−924.32	75.68
1200	−200	1000	−924.32	75.68

Covered Writing: Covered Calls (cont'd)

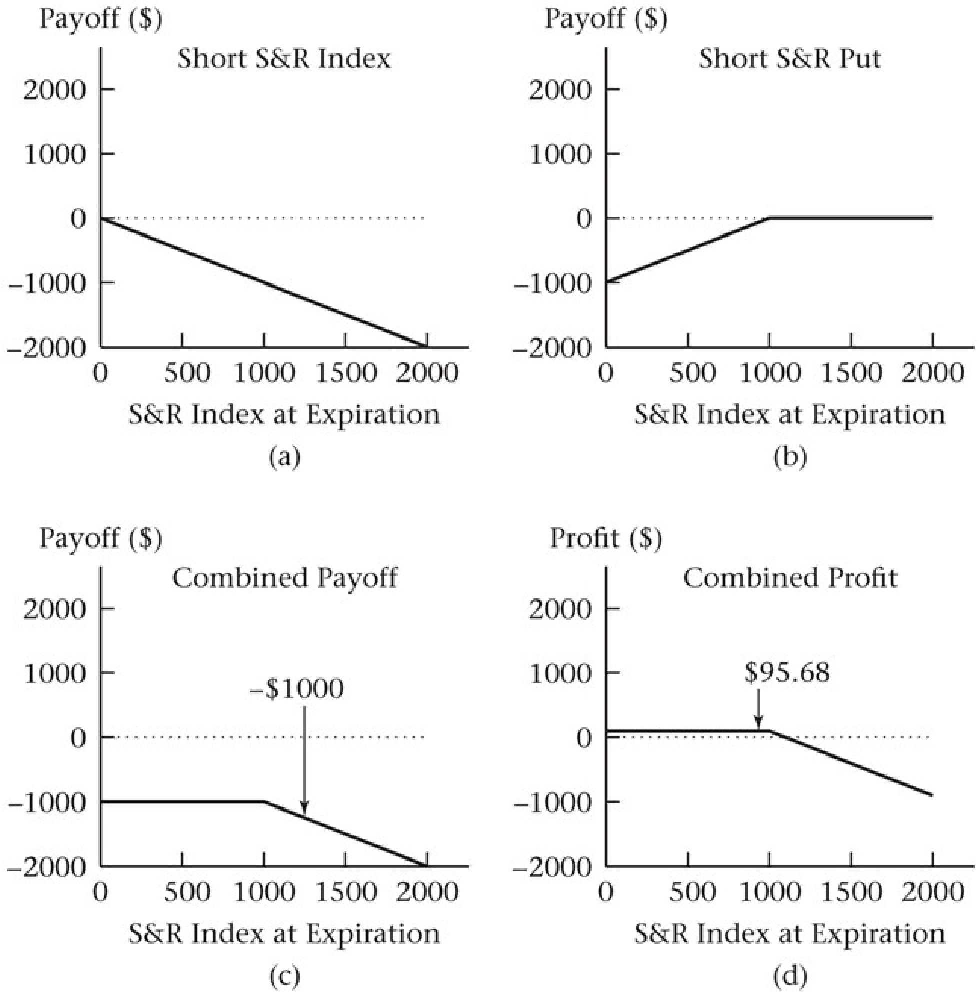


Writing a covered call generates the same profit as selling a put!

Covered Writing: Covered Puts

- Example: shorting the S&R index and writing a S&R put option with a strike price of $1,000.

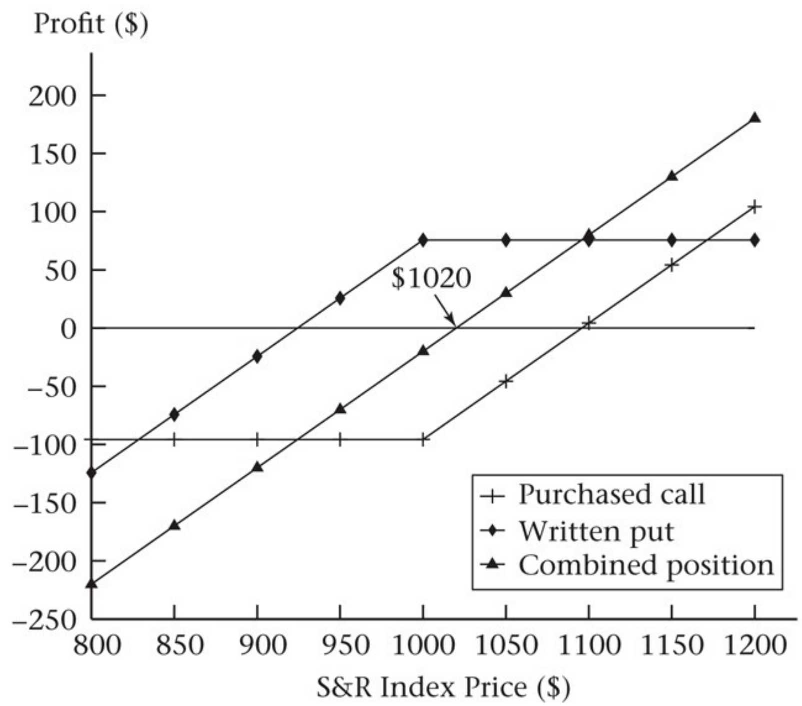
Covered Writing: Covered Puts (cont'd)



Writing a covered put generates the same profit as writing a call!

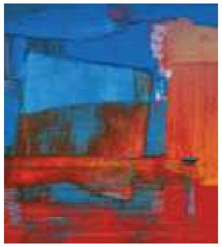
Synthetic Forwards

- A synthetic long forward contract
  - Buying a call and selling a put on the same underlying asset, with each option having the same strike price and time to expiration.
  - Example: buy the $1,000-strike S&R call and sell the $1,000-strike S&R put, each with 6 months to expiration.



Synthetic Forwards (cont'd)

- Differences between a synthetic long forward contract and the actual forward
  - The forward contract has a zero premium, while the synthetic forward requires that we pay the net option premium (net cost = \$93.81 – \$74.20 = \$19.61).
  - With the forward contract, we pay the forward price, while with the synthetic forward we pay the strike price.



Put-Call Parity

- The net cost of buying the index using options must equal the net cost of buying the index using a forward contract.
- Let Call (K, t) and Put (K, t) denote the premiums of options with strike price K and time t until expiration, and $F_{0,t}$ be the forward price.

Put-Call Parity (cont'd)

- PV of the net cost via options

  $$\text{Call}(K, t) - \text{Put}(K, t) + PV(K) \qquad (1)$$

- PV of the net cost via forward

  $$PV(F_{0,t}) \qquad (2)$$

- $(1) = (2) \Rightarrow$

  $$\text{Call}(K, t) - \text{Put}(K, t) = PV(F_{0,t} - K)$$

This is one of the most important relationships in derivatives!

Put-Call Parity (cont'd)

No arbitrage

The transaction has no risk of loss and generates a positive cash flow. Taking advantage of such an opportunity is called *arbitrage*, and the idea that prices should not permit arbitrage is called *no-arbitrage pricing*.

The put-call parity is derived from the no-arbitrage.

Spreads and Collars

- An option **spread** is a position consisting of only calls or only puts, in which some options are purchased and some written.
  – Examples: bull spread, bear spread, box spread.

Spreads and Collars (cont'd)

TABLE 3.4 Black-Scholes option prices assuming stock price = \$40, volatility = 30%, effective annual risk-free rate = 8.33% (8%, continuously compounded), dividend yield = \$0, and 91 days to expiration.

Strike	Call	Put
35	6.13	0.44
40	2.78	1.99
45	0.97	5.08

Spreads

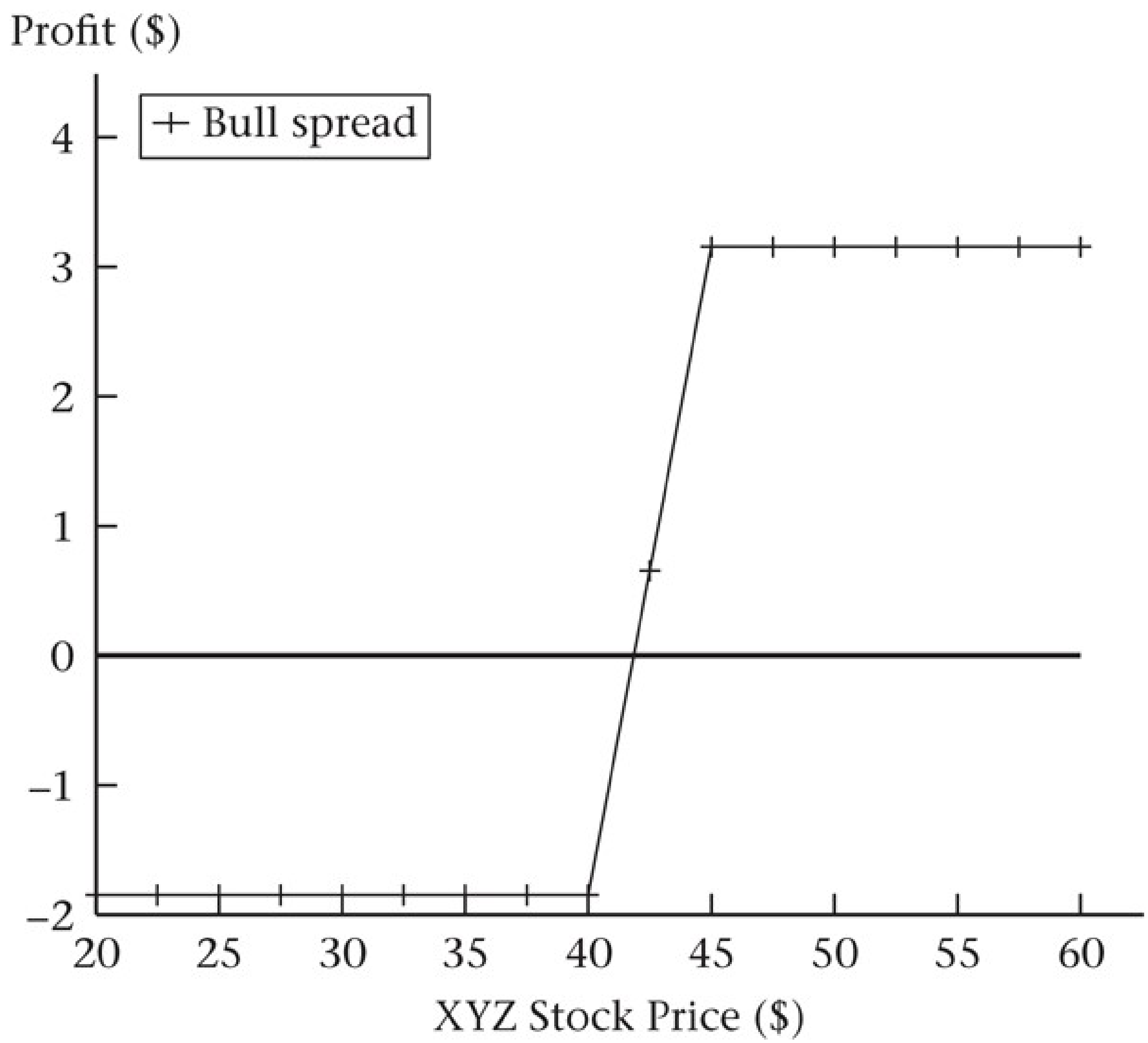
- A **bull spread** is a position, in which you buy a call and sell an otherwise identical call with a higher strike price.
  - It is a bet that the price of the underlying asset will increase.
  - Bull spreads can also be constructed using puts.

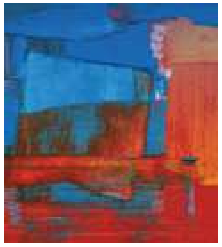
Spreads (cont'd)

TABLE 3.5 Profit at expiration from purchase of 40-strike call and sale of 45-strike call.

Stock Price at Expiration	Purchased 40-Call	Written 45-Call	Premium Plus Interest	Total
$35.0	$0.0	$0.0	−$1.85	−$1.85
37.5	0.0	0.0	−1.85	−1.85
40.0	0.0	0.0	−1.85	−1.85
42.5	2.5	0.0	−1.85	0.65
45.0	5.0	0.0	−1.85	3.15
47.5	7.5	−2.5	−1.85	3.15
50.0	10.0	−5.0	−1.85	3.15

Spreads (cont'd)





Spreads (cont’d)

- A **bear spread** is a position in which one sells a call and buys an otherwise identical call with a higher strike price (opposite of a bull spread).
- A **box spread** is accomplished by using options to create a synthetic long forward at one price and a synthetic short forward at a different price.
  - This strategy guarantees a cash flow in the future. Hence, it is an option spread that is purely a means of borrowing or lending money: It is costly but has no stock price risk.

Spreads (cont'd)

- A **ratio spread** is constructed by buying *m* options at one strike and selling *n* options at a different strike, with all options having the same type (call or put), same time to maturity, and same underlying asset.
  - Ratio spreads can also be constructed using puts.

Collars (cont'd)

- A collar is the purchase of a put and the sale of a call with a higher strike price, with both options having the same underlying asset and the same expiration date.
- If the position is reversed (sale of a put and purchase of a call), the collar is written.
- The collar width is the difference between the call and put strikes.

Collars (cont'd)

Example

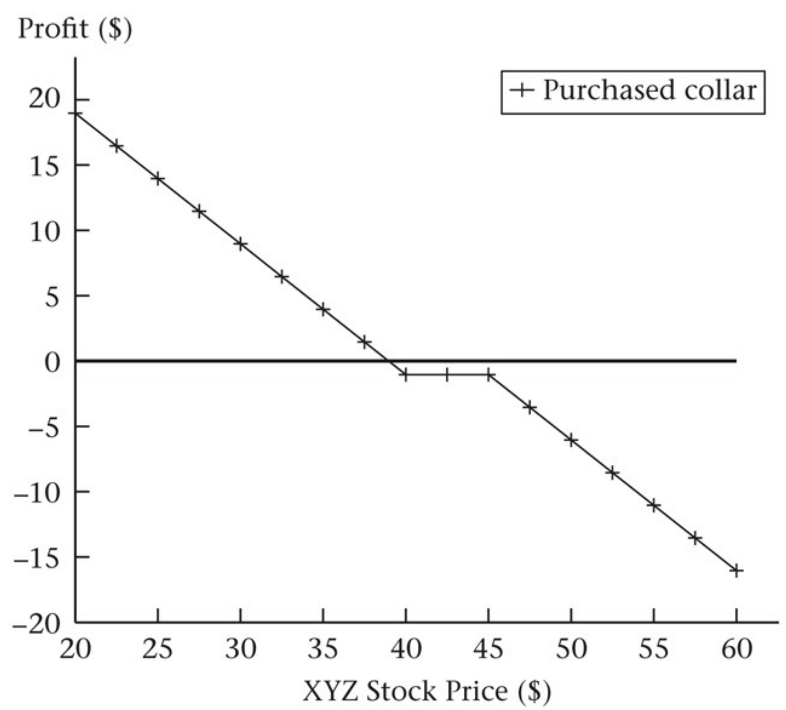
Suppose we sell a 45-strike call with a $0.97 premium and buy a 40-strike put with a $1.99 premium.

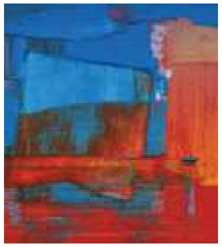
Initial investment = Put price – call price

= 1.99 – 0.97 = $1.02

Collars (cont’d)

- A collar represents a bet that the price of the underlying asset will decrease and resembles a short forward.





Collars (cont'd)

- Collars can be used to implement insurance strategies.
  - Collated Stock

    Buying a collar when we own the stock =

    buying a put + selling a call + buying the stock

    <u>Collated stock</u> is an insured position because we own the assets and buy a put. The sale of a call helps to pay the purchase of the put.

Collars (cont'd)

Example

Suppose you own shares of XYZ for which the current price of $40, and you wish to buy insurance.

You do this by purchasing a put option. A way to reduce the cost of the insurance is to sell an out-of-money call.

The profit calculations for this set of transactions-buy the stock, buy a 40-strike put, sell a 45-strike call-are shown in Table 3.6.

Collars (cont'd)

TABLE 3.6 Profit at expiration from purchase of 40-strike put and sale of 45-strike call.

Stock Price at Expiration	Purchased 40-Put	Written 45-Call	Premium Plus Interest	Profit on Stock	Total
$35.00	$5.00	$0.00	−$1.04	−$5.81	−$1.85
37.50	2.50	0.00	−1.04	−3.31	−1.85
40.00	0.00	0.00	−1.04	−0.81	−1.85
42.50	0.00	0.00	−1.04	1.69	0.65
45.00	0.00	0.00	−1.04	4.19	3.15
47.50	0.00	−2.50	−1.04	6.69	3.15
50.00	0.00	−5.00	−1.04	9.19	3.15

Collars (cont'd)

Comparing Table 3.6 to Table 3.5 demonstrates that profit on the collated stock position is identical to profit on the bull spread.

Note that it is essential to account for interest as a cost of holding the stock.

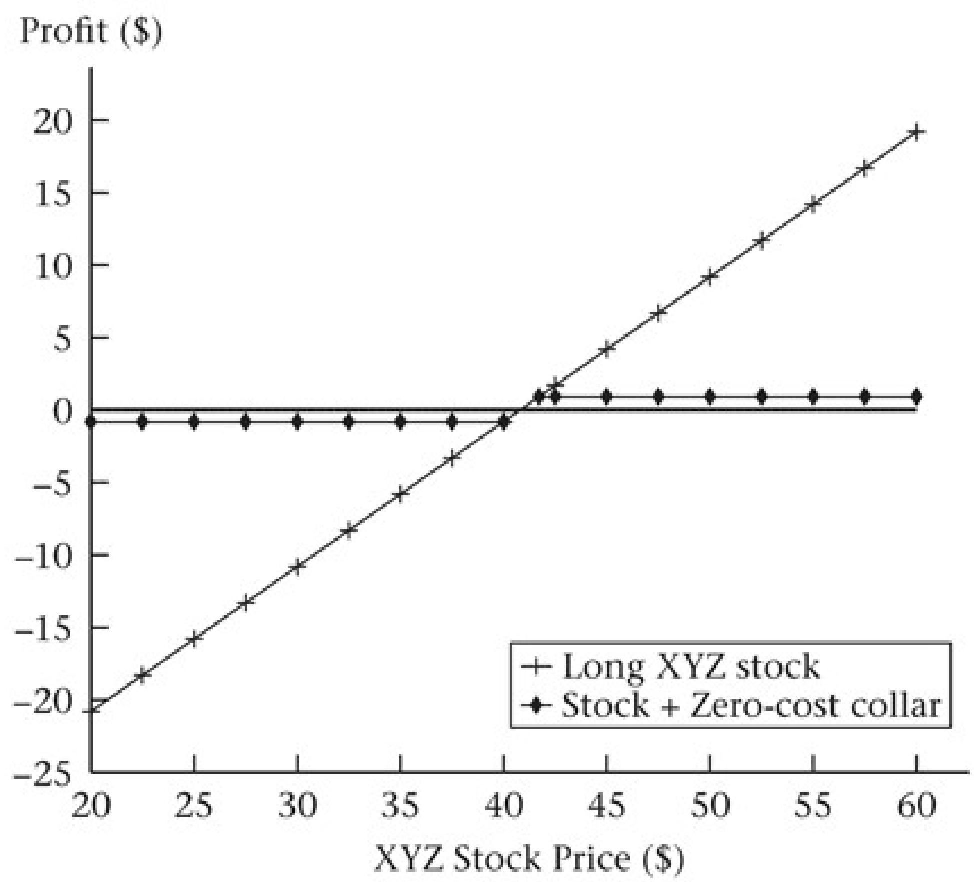
Collars (cont'd)

- A **zero-cost collar** can be created when the premiums of the call and put exactly offset one another.

Collars (cont'd)

FIGURE 3.9

Zero-cost collar on XYZ, created by buying XYZ at \$40, buying a 40-strike put with a premium of \$1.99, and selling a 41.72-strike call with a premium of \$1.99.



Collars (cont'd)

- From Fig. 3.9, at expiration, the collar exposes you to stock price movements between $40 and $41.72, coupled with downside protection below $40. You pay for this protection by giving up gains should the stock move above $41.72.
- Puzzle: <u>Zero cost</u> for the protection with some possibility of gain.

Collars (cont'd)

- Resolve the puzzle: taking into account financing cost for buying the stock.

  In the example, the amount of interest for the money to buy the stock at $t = 0$

  $= 40 \times (1.0833^{0.25} - 1) = \$0.808$

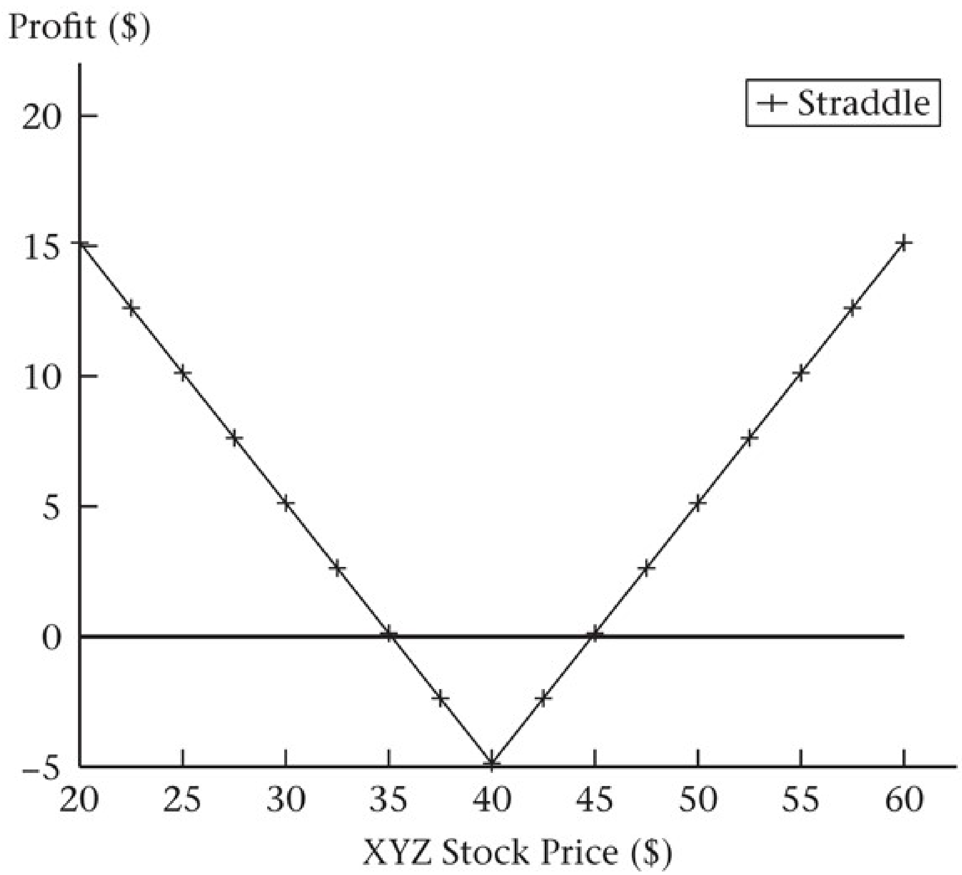
Speculating on Volatility

- Options can be used to create positions that are nondirectional with respect to the underlying asset.
- Examples:
  - Straddles
  - Strangles
  - Butterfly spreads
- Who would use nondirectional positions?
  - Investors who do not care whether the stock goes up or down, but only how much it moves, i.e., who speculate on volatility.

Straddles

- Buying a call and a put with the same strike price and time to expiration.
- *Advantage*: A straddle can profit from stock price moves in both directions.
- *Disadvantage*: A straddle has a high premium because it requires purchasing two options.

Straddles (cont'd)



- A straddle is a bet that volatility will be high relative to the market's assessment.

Straddles (cont'd)

- Because option prices reflect the market's estimate of volatility, the cost of a straddle will be greater when the market's perception is that volatility is greater.

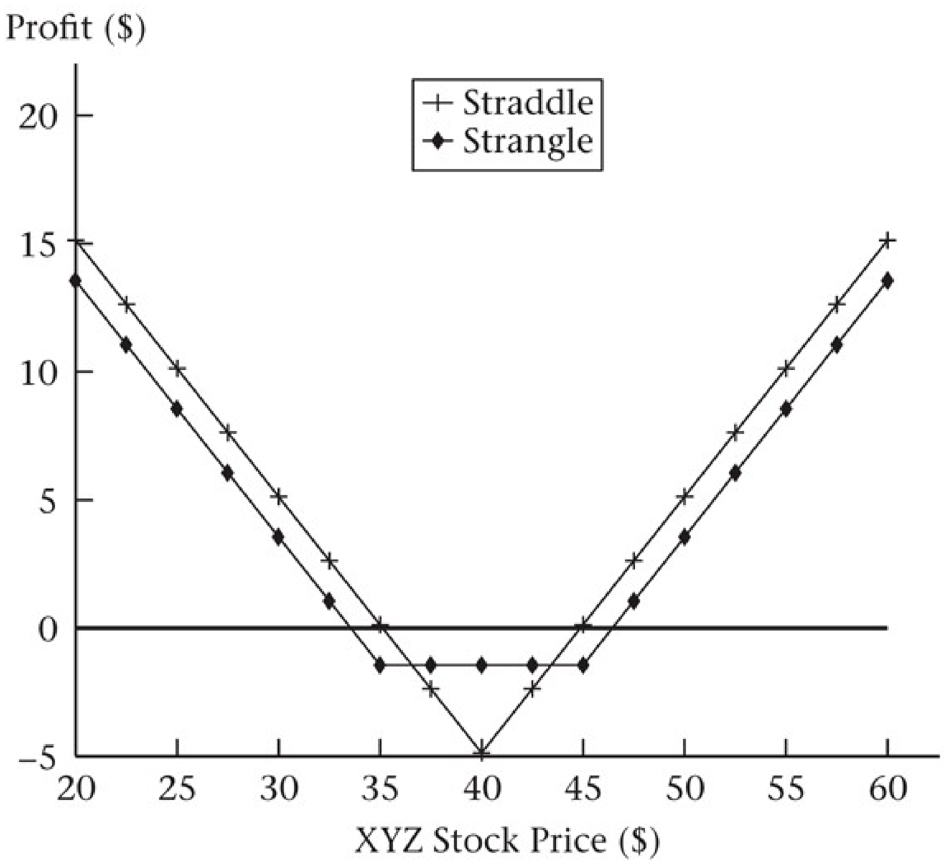
Strangles

- Buying an out-of-the-money call and put with the same time to expiration.
- A strangle can be used to reduce the high premium cost, associated with a straddle.

Example

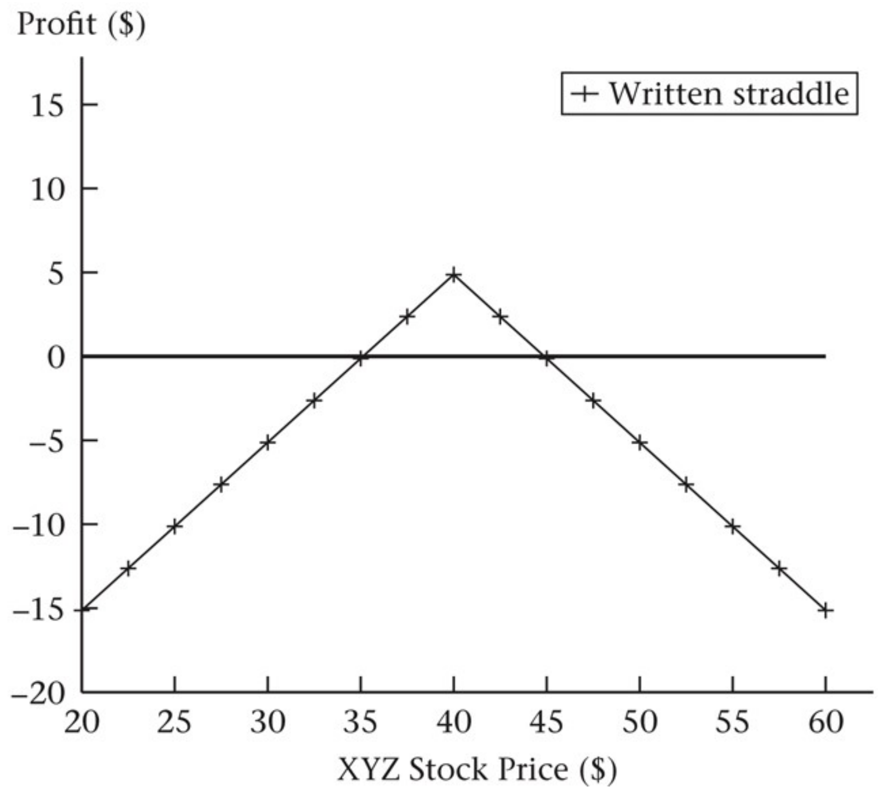
Buying a 35-strike put and a 45-strike call.

Strangles (cont'd)

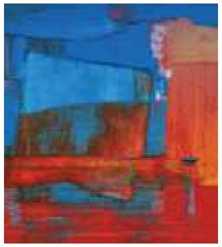


Written Straddles

- Selling a call and put with the same strike price and time to maturity.



- Unlike a purchased straddle, a written straddle is a bet that volatility will be low relative to the market's assessment.



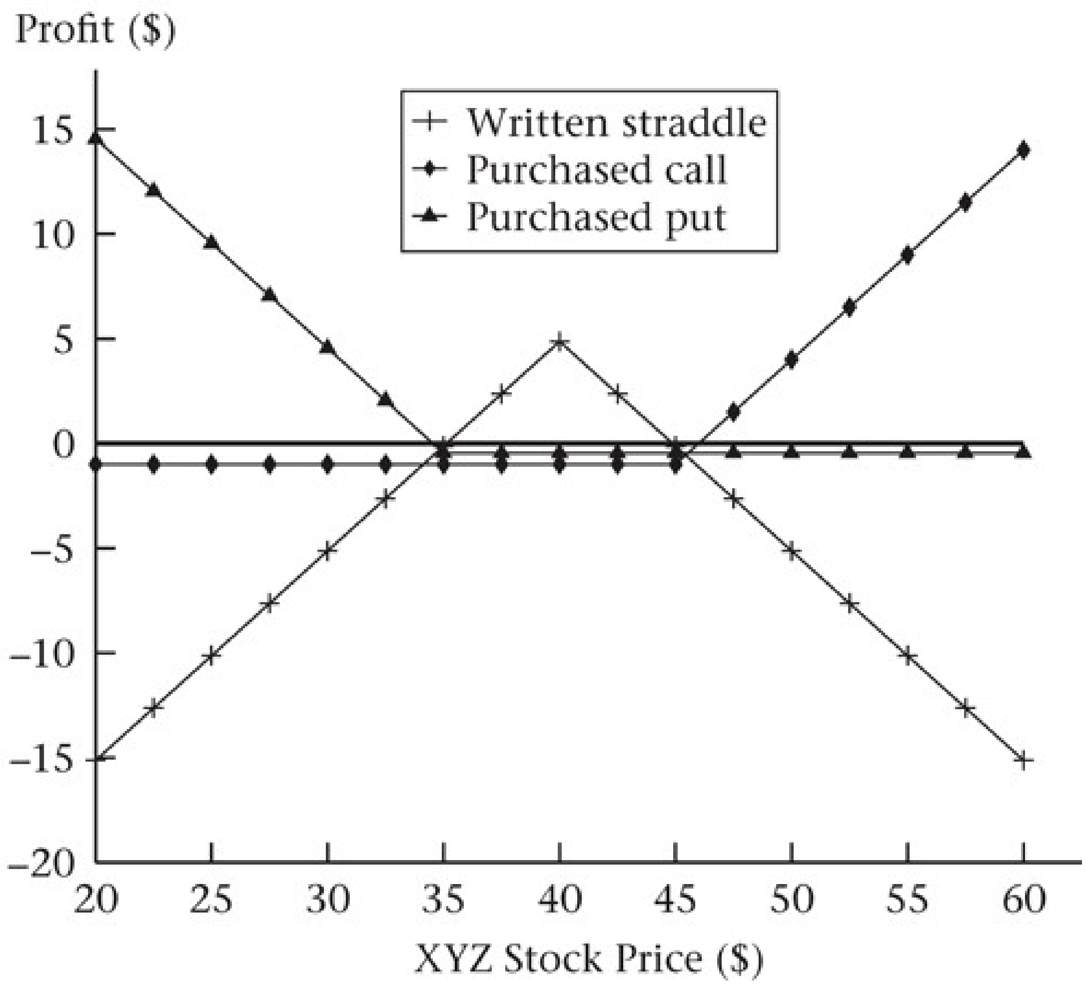
Butterfly Spreads

- Write a straddle + add a strangle = insured written straddle.
- A butterfly spread insures against large losses on a straddle.

Example

A straddle written at a strike price of $40 + a 35-strike put + 45-strike call.

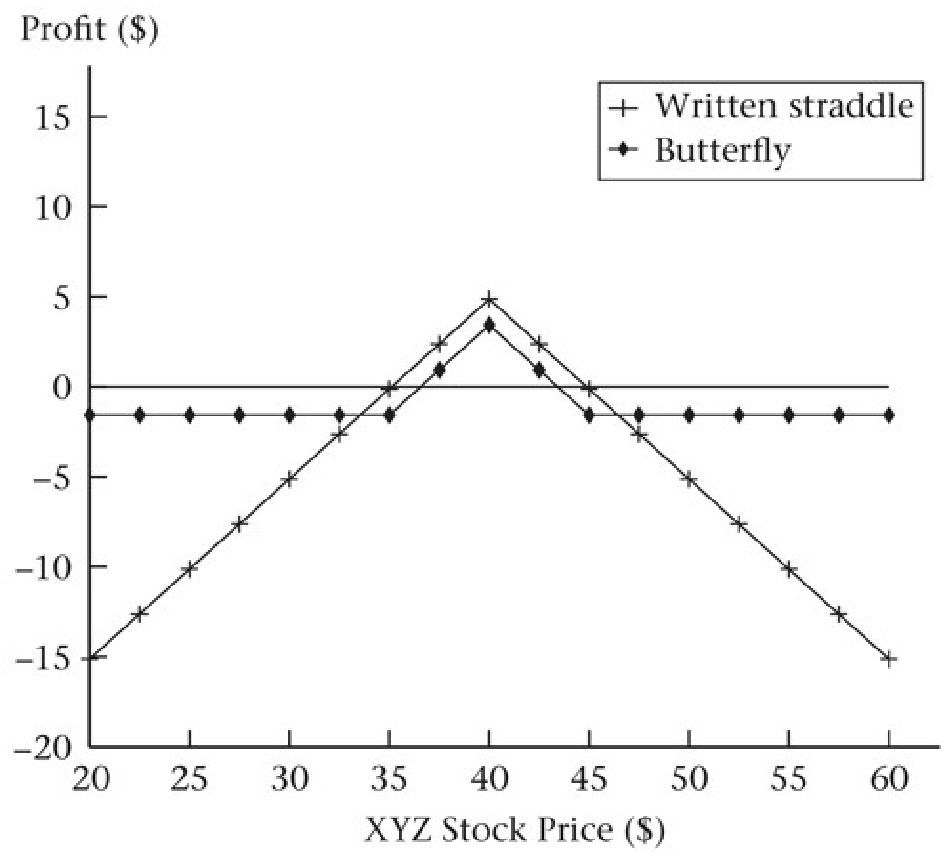
Butterfly Spreads (cont'd)



Butterfly Spreads (cont'd)

FIGURE 3.14

Comparison of the 35–40–45 butterfly spread, obtained by adding the profit diagrams in Figure 3.13, with the written 40-strike straddle.



Asymmetric Butterfly Spreads

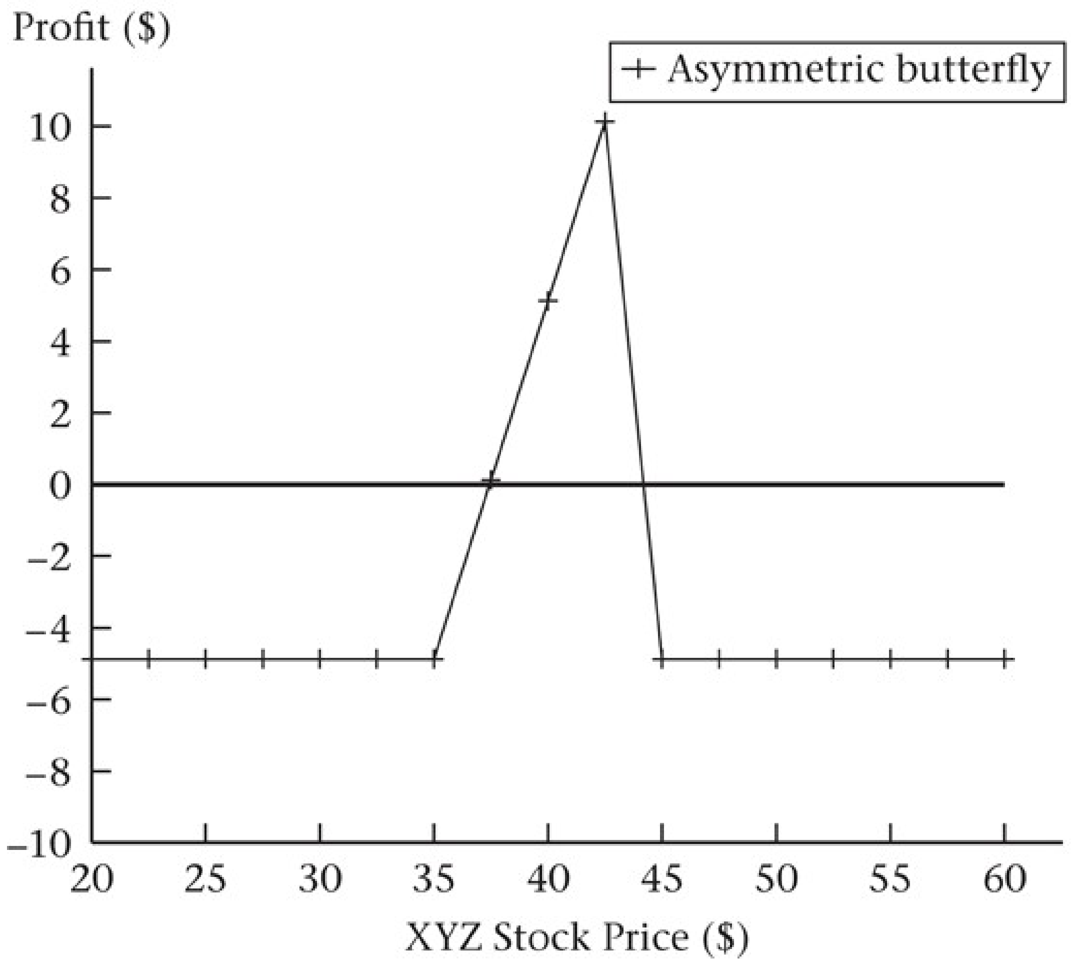
Example

An asymmetric butterfly spread can be created by

- buying two 35-strike calls and
- selling ten 43-strike calls and
- buying eight 45-strike calls

The position is like a butterfly in that it earns a profit if the stock stays within a small range, and the loss is the same for high and low stock prices.

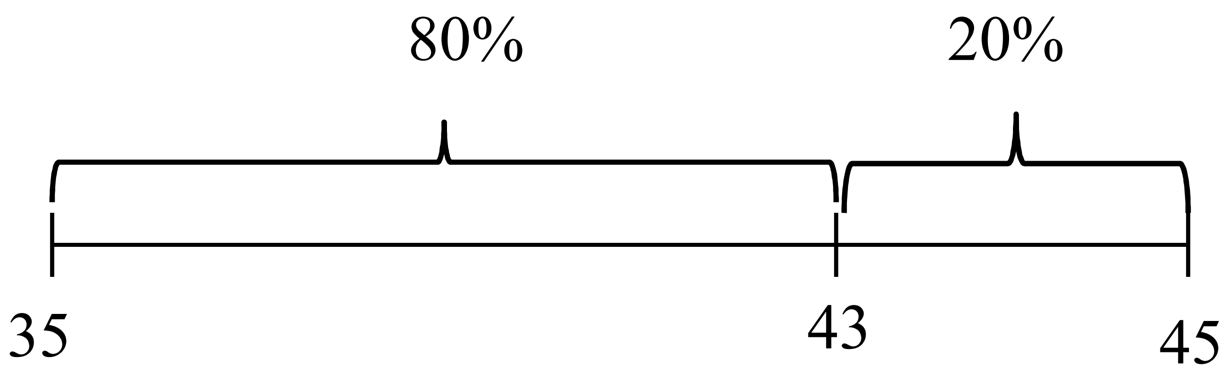
Asymmetric Butterfly Spreads (cont'd)



Asymmetric Butterfly Spreads (cont'd)

How to determine how many options to buy and sell to construct the position in the above example?

1. Distance between 35 and 45 = 10
2. 43 (peak value) is 80% of the way from 35 to 45



Asymmetric Butterfly Spreads (cont'd)

3. For every written 43-strike call, we need to buy 0.2 35-strike calls and 0.8 45-strike calls.
4. Thus if we sell 10 43-strike calls, we buy 2 35 calls and 8 45-strike calls.

Asymmetric Butterfly Spreads (cont'd)

In general, consider the strike prices K_1, K_2 and K_3, where $K_1 < K_2 < K_3$. Define

$$\lambda = \frac{K_3 - K_2}{K_3 - K_1} \quad \text{or} \quad K_2 = \lambda K_1 + (1 - \lambda) K_3$$

In order to construct an asymmetric butterfly, for every K_2 call we write, we buy λ K_1 calls and $(1 - \lambda)$ K_3 calls.