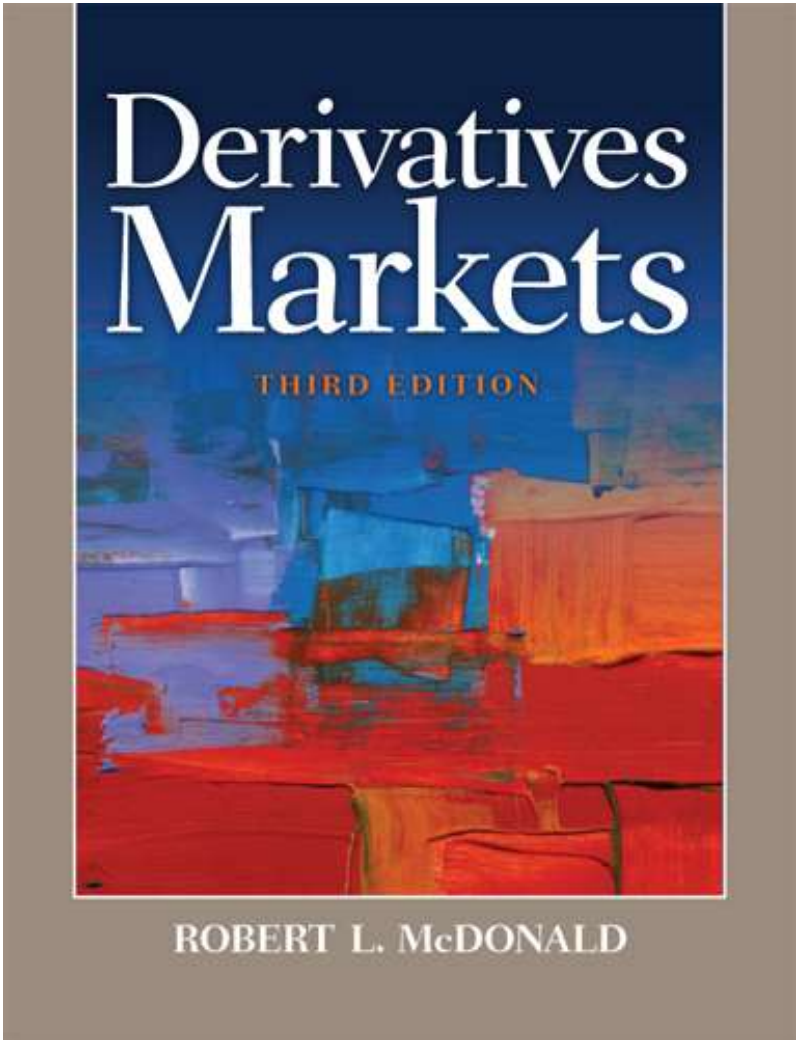


Chapter 3

Insurance, Collars, and Other Strategies

Points to note

1. Basic insurance strategies
   a. Floor, see P. 4 – 7.
   b. Cap, see P. 8 – 11.
   c. Covered call/put, see P. 12 – 17.
2. Synthetic forwards, see P. 18 – 19.
3. Put-call parity, see P. 20 – 22.
4. Spread (see P. 23 – 24)
   a. Bull spread, see P. 25 – 27.
   b. Bear spread, see P. 28.
   c. Box spread, see P. 28.
   d. Ratio spread, see P. 29.
   e. Collars, see P. 30 – 40.
5. Speculating on volatility (see P. 41)
   a. Straddles, see P. 42 – 44.
   b. Strangles, see P. 45 – 47.
   c. Butterfly spreads/asymmetric spreads, see P. 48 – 55.

put - call parity

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

1) K is a strike price of call and put

2) t : time to expiration

3) Both C and P are European.

Use of put - call parity

1) Synthetic security
   - Call
   - put
   - Bond
   - underlying

$$Call(K,t) = Put(K,t) + PV(F_{0,t} - K)$$
$$= Put(K,t) + S_0 - PV(K)$$

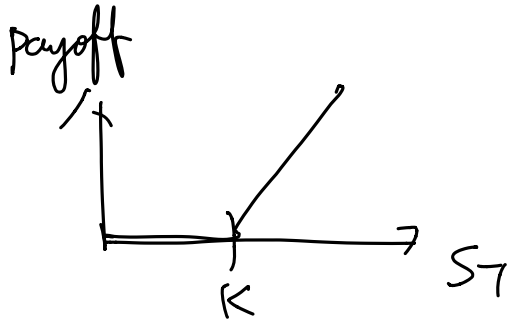
2) Arbitrage portfolio

if $Call(K,t) > Put(K,t) + S_0 - PV(K)$

Buy Low (Right) sell high (left)

Speculation

Speculate ↑ Call option



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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

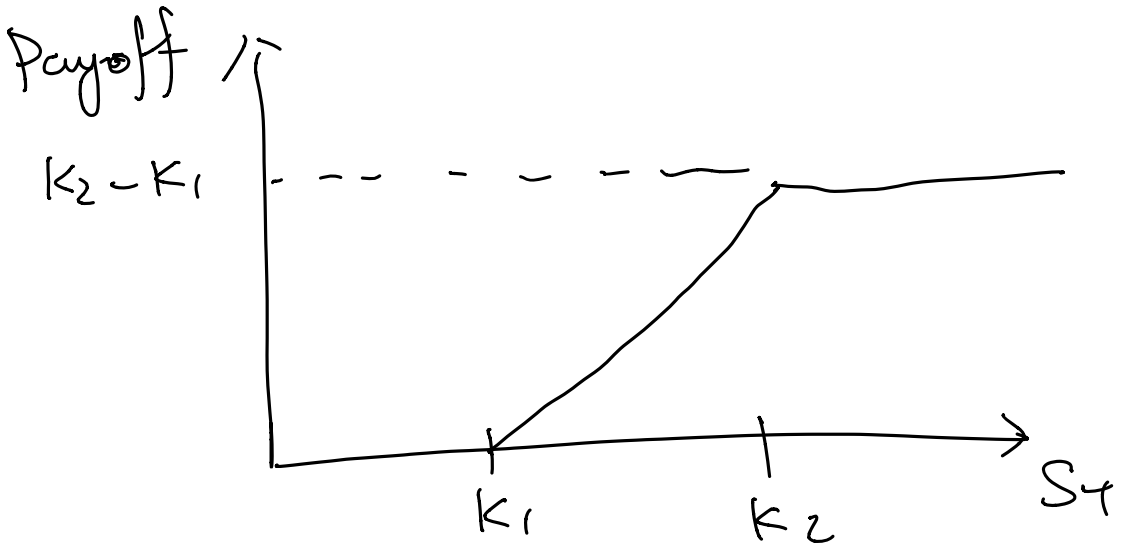
Buy 35-Strike Put (0.44) Sell 45-Strike put (5.08)

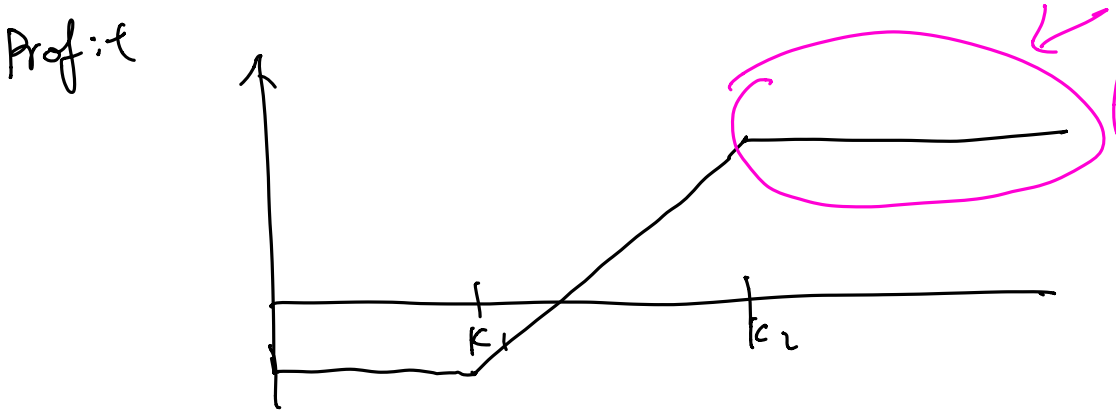
Spreads

- 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.

Bull Spread = Long a K_1-Strike Call + Short a K_2-Strike Call $(K_1 < K_2)$

Bull spread (payoff) ($K_1 < K_2$)





limited profit

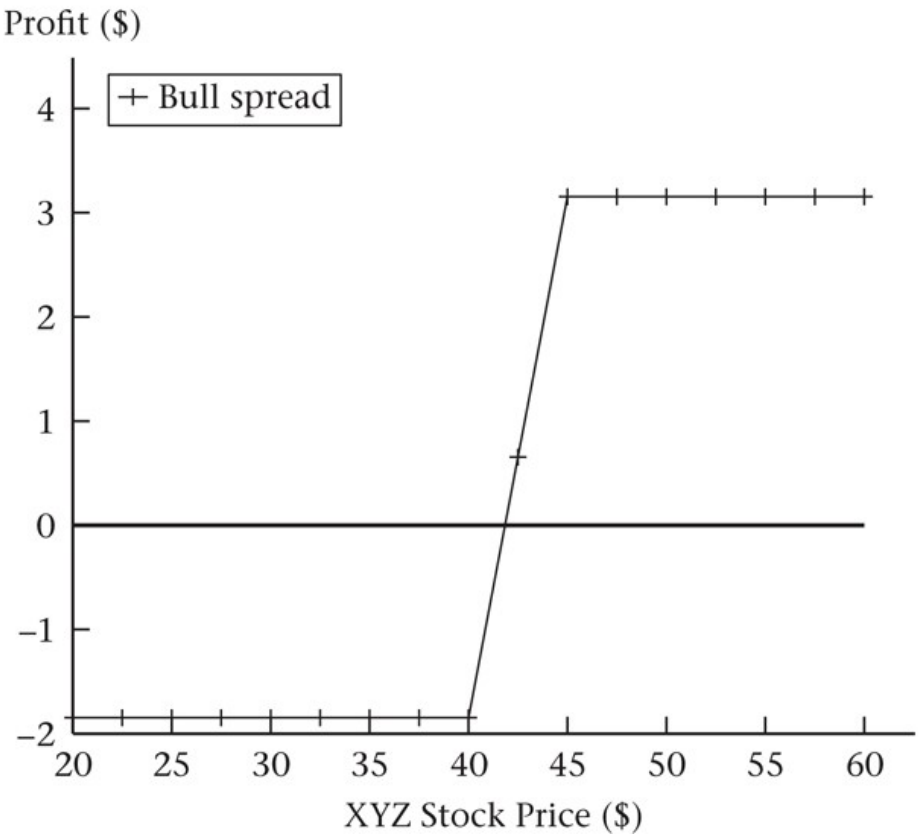
(vs unlimited profit in call option)

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)



Bull Put spread

Buy K_1- strike put + Short K_2 - strike put

$(K_1 < K_2)$ $\quad$ $Put(K_1, t) < Put(K_2, t)$

compare with Bull Call spread

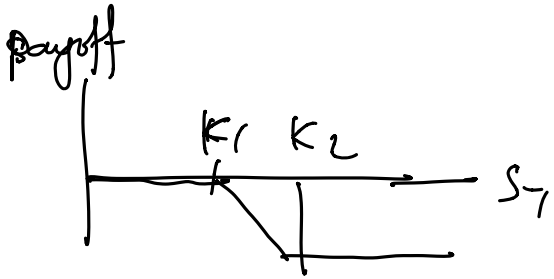
1) different payoff.

2) Identical profit.

3) Bull call spread : cost > 0

Bull put spread : cost < 0

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.

→ Long Bull Call Spread + Long Bear put Spread

Box spread

Long K_1 - synthetic forward + short K_2 - synthetic forward

$$\text{Call}(K_1,t) - \text{Put}(K_1,t) + -(\text{Call}(K_2,t) - \text{Put}(K_2,t))$$

$$= \underbrace{\text{Call}(K_1,t) - \text{Call}(K_2,t)}_{\text{Long Bull Call spread}} + \underbrace{[\text{Put}(K_2,t) - \text{Put}(K_1,t)]}_{\text{Long bear put spread}}$$

2 cases

1) $K_1 < K_2$

2) $K_1 > K_2$

Spreads (cont'd)

(Assignment)

- 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)

$(K_1 < K_2)$

Long Collar = Long K_1-Strike Put + Short K_2-Strike Call

- 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

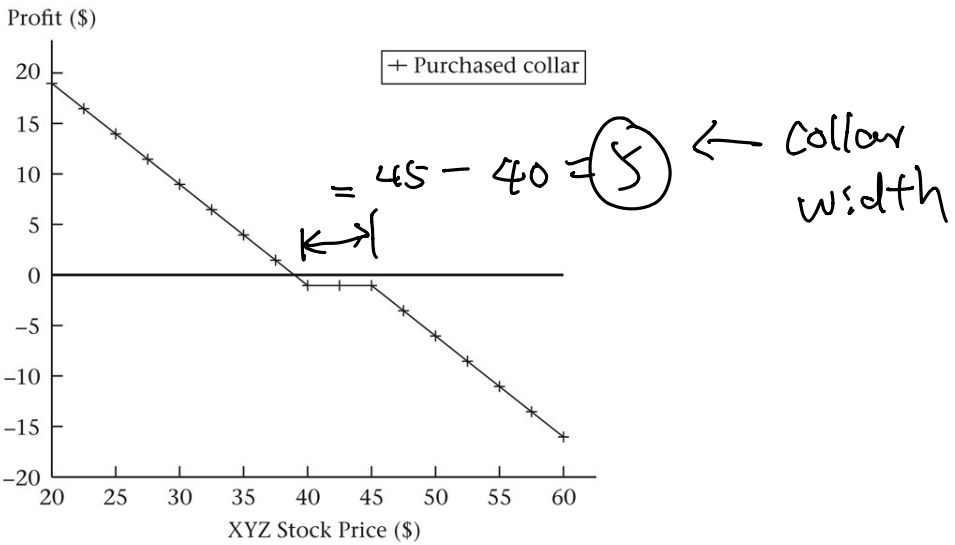
Suppose we sell a 45-strike call with a $0.97 premium and buy a 40-strike put with a $1.99 premium.

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

    Floor

    Collated stock 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.

Cost of Collated Stock < Cost of Floor

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.

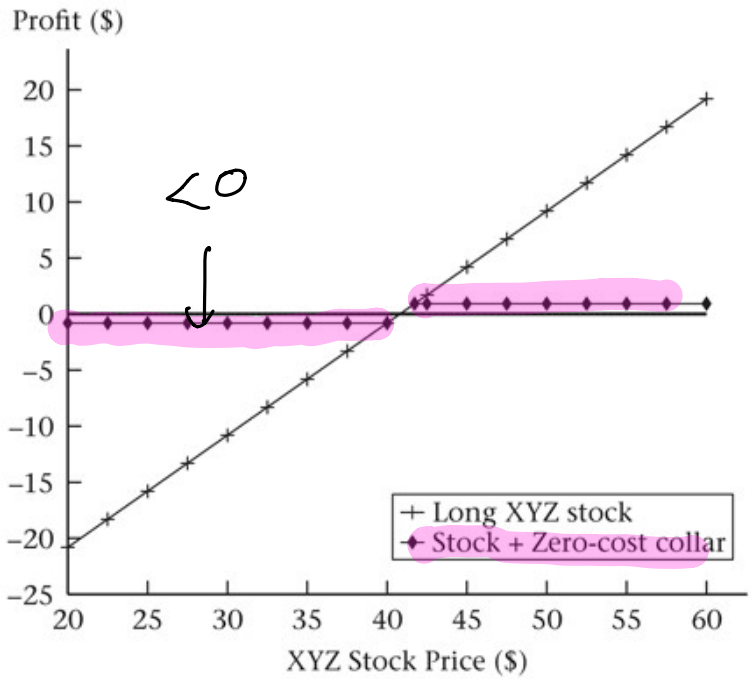
Long Collar = Long K_1 - Strike put
+ Short K_2 - Strike Call

Choose K_1, K_2 to make
Put (K_1, t) = Call (K_2, t) $\Rightarrow$ Cost of Collar $= 0$

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.



$K_1 = 40$

$K_2 = 41.72$

Zero-cost collar + stock

= Collated stock (cost of insurance = 0)

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: Zero cost 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 $t = 0$

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

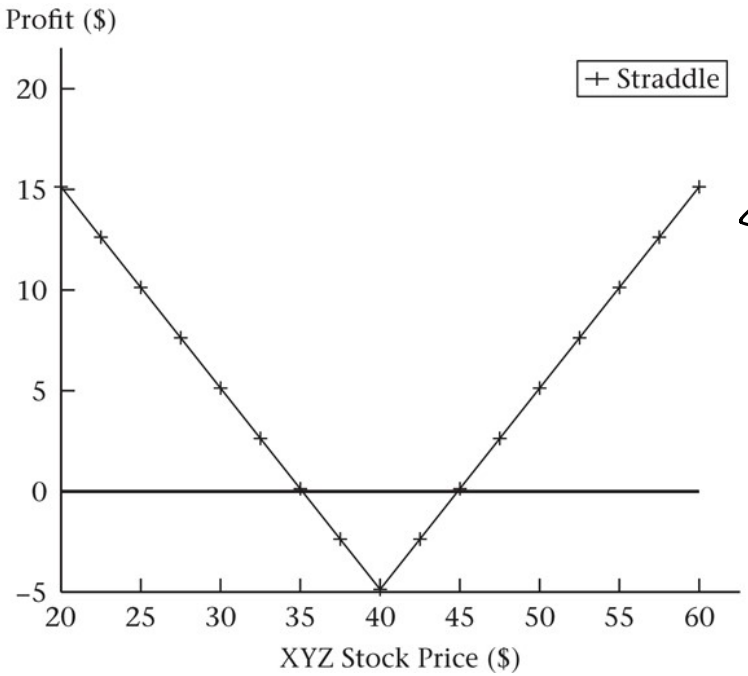
Speculating on Volatility

- 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)



← Long straddle

- 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

$K_1 < K_2$

Buy Call(K_2, t) + Buy Put(K_1, t)

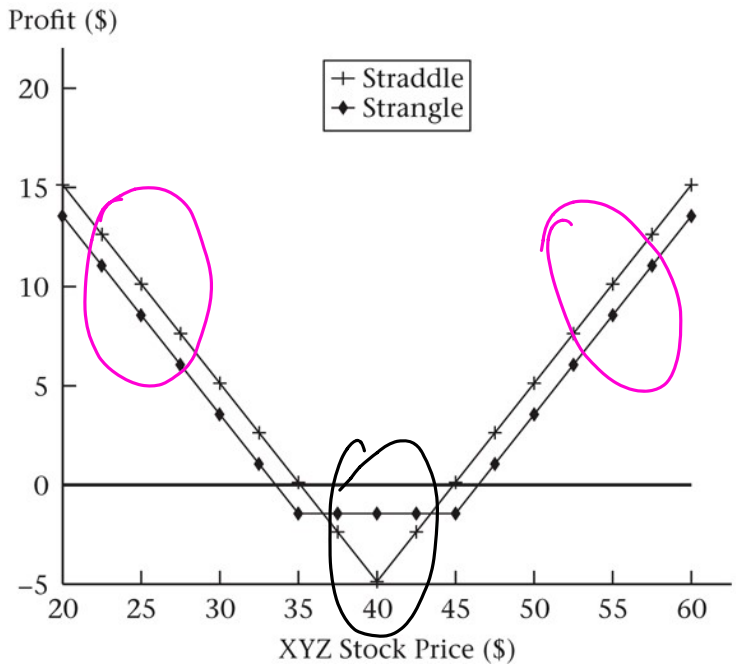
- Buying an out-of-the-money call and put with the same time to expiration.
- A strangle can be used to reduce the high premium cost, associated with a straddle.

Example (OTM) (OTM)

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

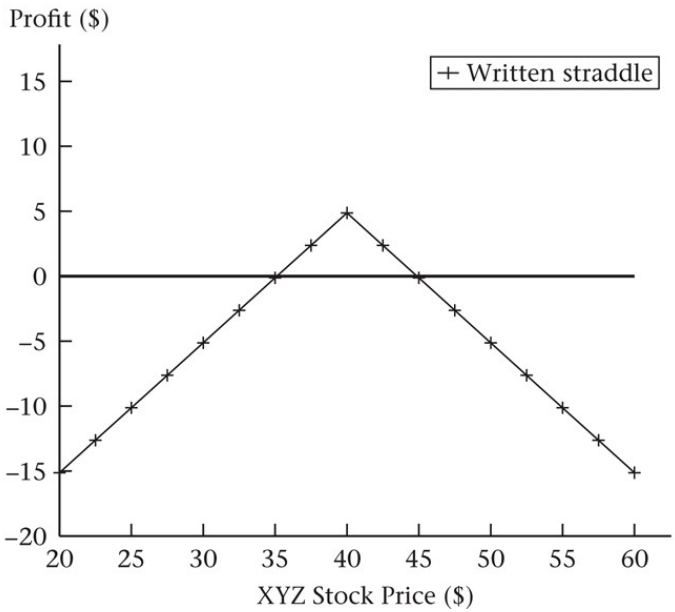
$S_0 = 40$

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.

$C - P = PV(F_{0,t} - K)$

$C - P = S_0 - PV(K) \Rightarrow C + PV(K) = P + S_0$

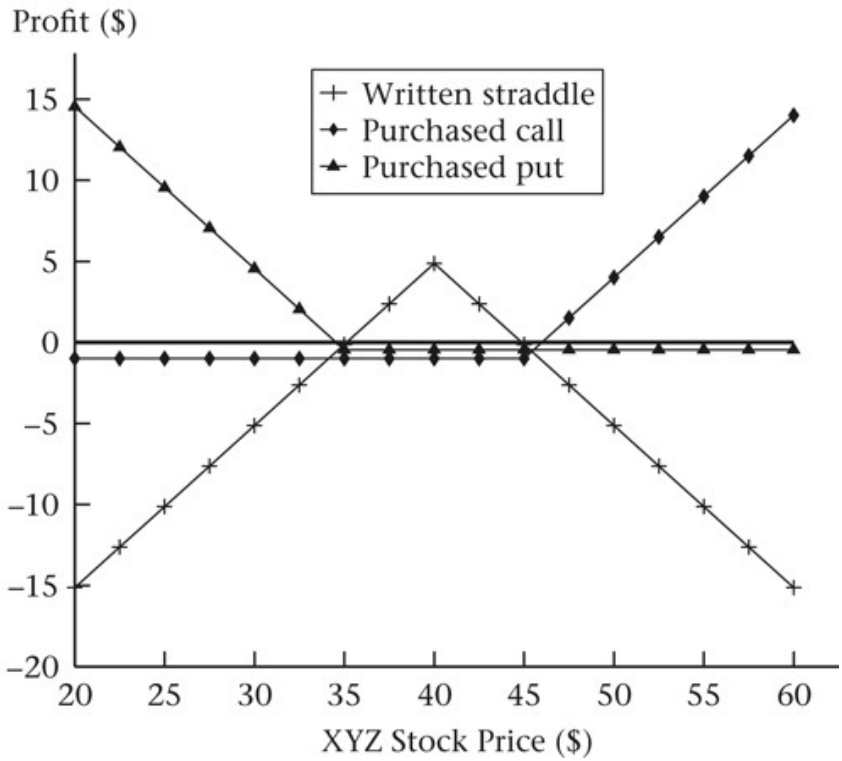
Example

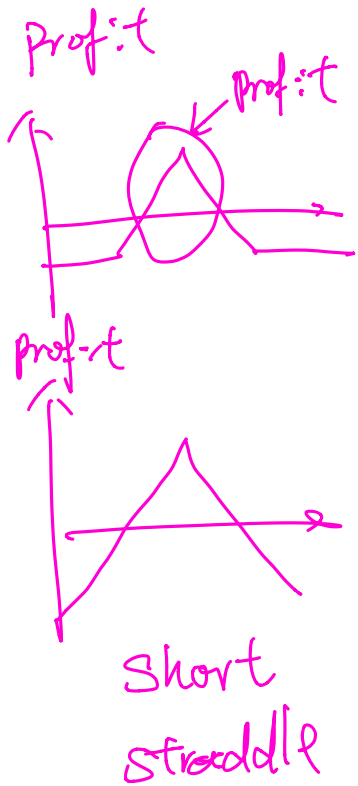
A straddle written at a strike price of \$40 + a 35-strike put + 45-strike call.

= write a straddle + Long 35-put + 45-call

= write a 40-call + write a 40-put + Long 35-put + 45-call

Butterfly Spreads (cont'd)

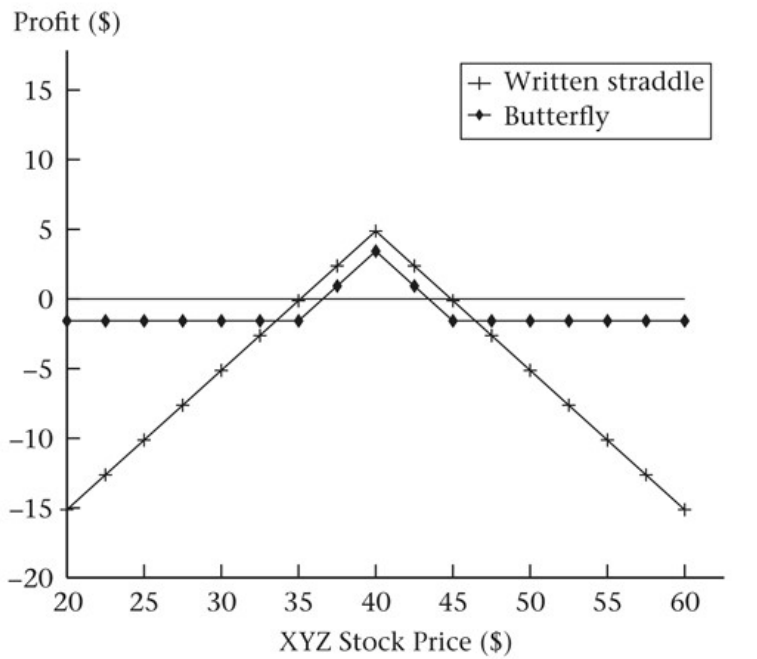




Butterfly Spreads (cont'd)

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.

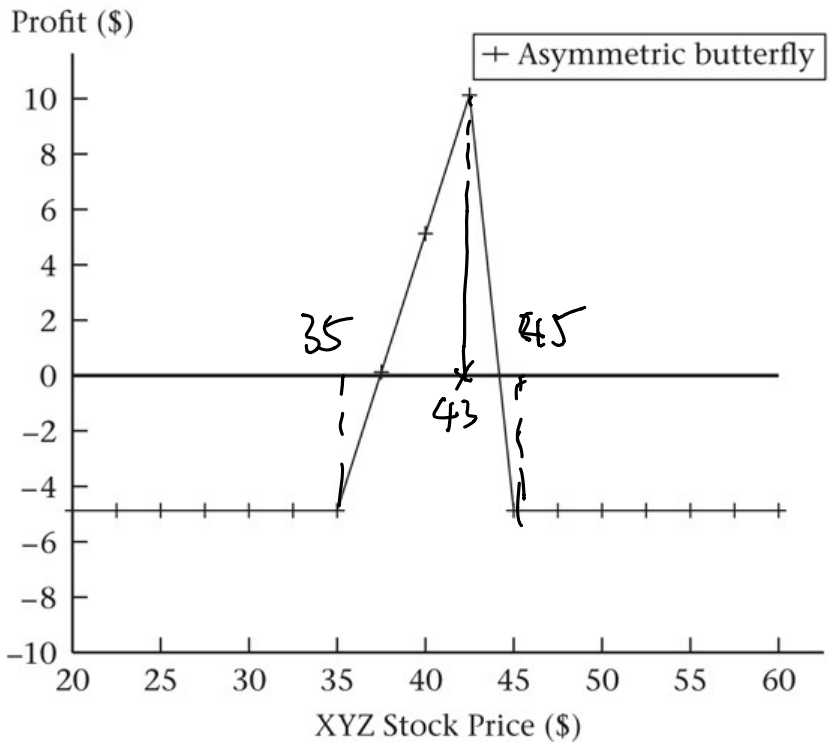
$$43 = a(35) + (1-a)45$$

$$\Rightarrow a = 0.2$$

$$43 = (0.2)(35) + (0.8)(45)$$

$$(10)(43) = (2)(35) + 8(45)$$

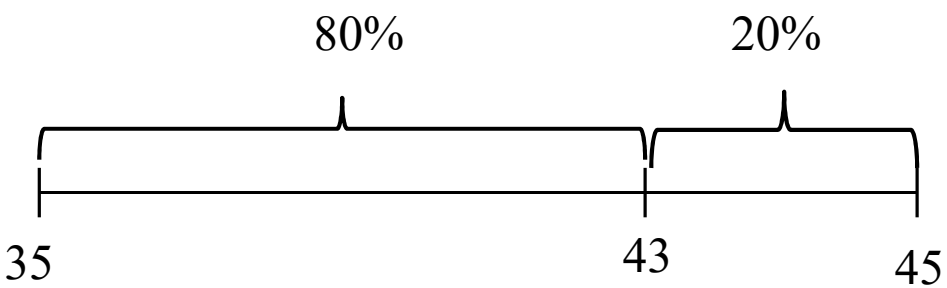
Asymmetric Butterfly Spreads (cont'd)



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.