Ch 12 Trading Strategies Involving Options

Principal-Protected Notes

Options are often used to create *principal-protected notes*.

- appeal to conservative investors
- return depends on performance of underlying
- initial principal amount invested is not at risk

Examples of principal-protected notes:

- a zero-coupon bond and a call option (profit if underlying increases in value)
- a zero-coupon bond and a put option (profit if underlying decreases in value)

Banks can profit more easily when interest rates are high and volatility is low.
When interest rates are low and volatility is high, banks can profit by increasing the life of the option.

The dividend yield is also critical for the bank.

- higher dividend yield is more profitable for the bank
- zero dividend yield cannot be profitable for the bank

Trading an Option and the Underlying Asset

writing a covered call - long position in a stock plus short position in a European call option

- long stock position “covers” (protects) the investor from the payoff on the short call in the event of a sharp rise in the stock price

reverse of writing a covered call - short position in a stock plus long position in a call option

protective put - long position in a stock plus long position in a European put option

reverse of a protective put - short position in a stock plus short position in a put option

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Recall the put-call parity relationship

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

This shows a long position in a put option combined with a long position in the stock is equivalent to a long call option position plus a certain amount of cash ($Ke^{-rT} + D$).

Rearrange the relationship

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

This shows that a long position in a stock combined with a short position in a call option is equivalent to a short put position plus a certain amount of cash ($Ke^{-rT} + D$).

Spreads

A spread trading strategy involves taking a position in two or more options of the same type.

Bull Spreads

An investor entering into a bull spread is hoping the stock price will increase.

A bull spread using call options:

1. Buy European call option with a low strike price
2. Sell European call option with a high strike price

Both options are on the same underlying and have the same expiration date.

Call price always decreases as strike price increases, so value of option sold is less than value of option bought. Thus a bull spread requires an initial investment.

Let K_1 be strike price of call option bought, K_2 be strike price of call option sold, and S_T be the stock price on the expiration date of the options.

Payoff from a bull spread created using calls

Stock price range	*Payoff from long call*	*Payoff from short call*	*Total payoff*
$S_T \leq K_1$	0	0	0
$K_1 < S_T < K_2$	$S_T - K_1$	0	$S_T - K_1$
$S_T \geq K_2$	$S_T - K_1$	$-(S_T - K_2)$	$K_2 - K_1$

A bull spread strategy limits investor's upside as well as downside risk.

Three types of bull spreads:

1. Both calls are initially out of the money. (Most aggressive)
2. One call is initially in the money, the other is initially out of the money.
3. Both calls are initially in the money. (Most conservative)

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Example: Bull Spread

Consider an investor who
- buys for $3 a European call with strike price $30
- sells for $1 a European call with strike price $35

Note the cost of the strategy is $3 - $1 = $2

If final stock price (S) is above $35
- payoff from long call is S - 30
- payoff from short call is 35 - S
- total payoff of bull spread is 5
- profit is $5 - $2 = $3

If final stock price (S) is below $30
- payoff from long call is 0
- payoff from short call is 0
- total payoff of bull spread is 0
- profit is $0 - $2 = -$2

If final stock price (S) is $30 < S < $35
- payoff from long call is S - 30
- payoff from short call is 0
- total payoff of bull spread is S - 30
- profit is S - $30 - $2 = S - $32
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Bull spreads can also be created with put options:

1. Buy European put option with a low strike price
2. Sell European put option with a high strike price

Bull spreads created from calls require up-front cash payment by investor.
The payoff to the investor is either positive or zero (ignoring cost of strategy).

Bull spreads created from puts involve a positive up-front cash flow to the investor.
The payoff to the investor is either negative or zero (ignoring cost of strategy).

Bear Spreads

An investor entering into a bear spread is hoping the stock price will decrease.

Bear spread with put options:

1. Buy European put option with a high strike price
2. Sell European put option with a low strike price

A bear spread created from put options involves an initial cash outflow.

- price of put sold is less than price of put purchased

Let strike prices by K_1 and K_2 where $K_1 < K_2$.

Payoff from a bear spread created using puts

Stock price range	*Payoff from long put*	*Payoff from short put*	*Total payoff*
$S_T \leq K_1$	$K_2 - S_T$	$-(K_1 - S_T)$	$K_2 - K_1$
$K_1 < S_T < K_2$	$K_2 - S_T$	0	$K_2 - S_T$
$S_T \geq K_2$	0	0	0

Bear spreads (like bull spreads) limit both the upside profit potential and the downside risk.

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Example: Bear Spread

Consider an investor who
- buys for $3 a European put with strike price $35
- sells for $1 a European put with strike price $30

Note the cost of the strategy is $3 - $1 = $2

If final stock price (S) is above $35
- payoff from long put is 0
- payoff from short put is 0
- total payoff of bear spread is 0
- profit is 0 - $2 = -$2

If final stock price (S) is below $30
- payoff from long put is 35 - S
- payoff from short put is -(30 - S)
- total payoff of bear spread is 5
- profit is $5 - $2 = $3

If final stock price (S) is $30 < S < $35
- payoff from long put is 35 - S
- payoff from short put is 0
- total payoff of bear spread is 35 - S
- profit is $35 - S - $2 = $33 - S
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Bear spreads can also be created using calls

1. Buy European call with high strike price
2. Sell European call with low strike price

Bear spreads created with call options involve an initial cash inflow.

Box Spreads

Combination of

- bull call spread with strike prices K_1 and K_2
- bear put spread with strike prices K_1 and K_2

Payoff from a box spread

Stock price range	*Payoff from bull call spread*	*Payoff from bear put spread*	*Total payoff*
$S_T \leq K_1$	0	$K_2 - S_T$	$K_2 - S_T$
$K_1 < S_T < K_2$	$S_T - K_1$	$K_2 - S_T$	$K_2 - K_1$
$S_T \geq K_2$	$K_2 - K_1$	0	$K_2 - K_1$

The payoff from a box spread is always $K_2 - K_1$.
The value of a box spread is the present value of this payoff $(K_2 - K_1)e^{-rT}$.

How to buy a box spread

1. Buy a call with strike price K_1 and sell a call with strike price K_2 (bull call spread)
2. Buy a put with strike price K_2 and sell a put with strike price K_1 (bear put spread)

How to sell a box spread

1. Buy a call with strike price K_2 and sell a call with strike price K_1 (bear call spread)
2. Buy a put with strike price K_1 and sell a put with strike price K_2 (bull put spread)

Note that box-spread arbitrage only works with European options.
Most options trading on exchanges are American options.

Butterfly Spreads

Involves positions in options with three different strike prices.

Butterfly spread can be created using four call options

1. Buy European call option with low strike price K_1
2. Buy European call option with high strike price K_3
3. Sell two European call options with strike price K_2, where $K_1 < K_2 < K_3$

Generally, K_2 is close to the current stock price and halfway between K_1 and K_3.
Butterfly spread leads to a profit if the stock prices stays close to K_2.
Butterfly spread results in a small loss if there is a significant price move in either direction.

Butterfly spreads requires a small investment initially.

Payoff from a butterfly spread

Stock price range	*Payoff long call (1)*	*Payoff long call (2)*	*Payoff short calls*	*Total payoff*
$S_T \leq K_1$	0	0	0	0
$K_1 < S_T \leq K_2$	$S_T - K_1$	0	0	$S_T - K_1$
$K_2 < S_T < K_3$	$S_T - K_1$	0	$-2(S_T - K_2)$	$K_3 - S_T$
$S_T \geq K_3$	$S_T - K_1$	$S_T - K_3$	$-2(S_T - K_2)$	0

Note that the total payoffs are calculated using the relationship $K_2 = \frac{1}{2}(K_1 + K_3)$.

Butterfly spreads can also be created using four put options

1. Buy European put option with low strike price K_1
2. Buy European put option with high strike price K_3
3. Sell two European put options with intermediate strike price K_2

Put-call parity shows the initial investment is the same whether using calls or puts.

Butterfly spreads can be sold (shorted) by following the reverse strategy

- options are sold with strike prices K_1 and K_3
- the two options with intermediate strike price K_2 are purchased
- produces a profit if there is a significant movement in the stock prices

Calendar Spreads

The options have the same strike price but have different expiration dates.

Via call options

1. Sell European call with a certain strike price
2. Buy European call with same strike price but longer maturity

Options with longer maturity are usually more expensive, so a calendar spread usually requires initial investment.

Profit is based on the assumption the long-maturity option is closed out at expiration of the short-maturity option.

- investor profits if stock price at expiration of short-maturity option is close to the strike price of the short-maturity option
- investor incurs a loss if stock price is significantly above or below this strike price

Strike price close to current stock price: *neutral calendar spread*
Strike price higher than current stock price: *bullish calendar spread*
Strike price lower than current stock price: *bearish calendar spread*

Via put options

1. Sell European put with a short maturity
2. Buy European call with a long maturity

A *reverse calendar spread* is the reverse strategy

1. Buy a short-maturity option
2. Sell a long-maturity option

For a reverse calendar spread, profit if stock price at expiration of the short-maturity option is well above or well below the strike price of the short-maturity option. Loss if it is close to the strike price.

Diagonal Spreads

Both the expiration date and the strike price of the options are different.
This increases the range of profit patterns that are possible.

Combinations

combination - option trading strategy that involves both calls and puts on the same stock

Straddle

A *bottom straddle* or *straddle purchase*:

1. Buy European call with some strike price and expiration date
2. Buy European put with same strike price and expiration date

Let the strike price be K.

- profit if large stock price move in either direction
- loss if stock price at expiration is close to K

Payoff from a straddle

Stock price range	*Payoff from call*	*Payoff from put*	*Total payoff*
$S_T \leq K$	0	$K - S_T$	$K - S_T$
$S_T > K$	$S_T - K$	0	$S_T - K$

A *top straddle* or *straddle write* is the reverse:

1. Sell European call
2. Sell European put

This is highly risky.

- profit if stock price at expiration is close to the strike price
- the loss arising from a large move is unlimited

Note that investors must determine whether anticipated stock price movements are not already incorporated in option prices before using a straddle strategy.

Strips and Straps

Strip:

1. Long position in a European call with some strike price and expiration date
2. Long position in two European puts with same strike price and expiration date

- investor is betting there will be a big stock price move
- considers a decrease to be more likely than an increase

Strap:

1. Long position in two European calls with some strike price and expiration date
2. Long position in a European put with same strike price and expiration date

- investor is betting there will be a big stock price move (same as strip)
- considers an increase to be more likely than a decrease

Strangles

1. Buy European put with some expiration date and strike price K_1
2. Buy European call with same expiration date and strike price K_2, where $K_2 > K_1$

- investor is betting there will be a big stock price move
- investor is uncertain whether price will increase or decrease

A strangle is similar to a straddle. However, the price movement has to be even larger in a strangle than in a straddle for investor to profit. But, the downside risk is less with a strangle.

Payoff from a strangle

Stock price range	*Payoff from call*	*Payoff from put*	*Total payoff*
$S_T \leq K_1$	0	$K_1 S_T$	$K_1 S_T$
$K_1 < S_T < K_2$	0	0	0
$S_T \geq K_2$	$S_T K_2$	0	$S_T K_2$

Selling a straddle is appropriate when an investor feels that large stock price move is unlikely.
As with selling a strangle, it is risky because there is unlimited potential loss to the investor.

Other Payoffs

If European options expiring at time T were available with every single possible strike price, then any payoff function at time T can theoretically be obtained.