

# Trading Strategies Involving Options

BUSS386. Futures and Options

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# Lecture Outline

- Protected Principal Notes
- Options + Underlying Assets
- Spreads: Bull, Bear, Butterfly, Calendar
- Straddle and Strangle
- Reading: Chp. 12

# Trading Strategies Involving Options

- We can combine an option with bond, underlying assets, or other options and create many different payoff patterns.
- Thus, a portfolio can be constructed to meet investors' demand based on their preference or perspectives on the market.
  - e.g. An investor expects a big swing in Russian ruble after the presidential election in the US. How to make profits in such a case?
- Examples of strategies involving options
  - Protected principal note
  - Covered call
  - Spreads
  - Straddle/Strangle
  - ...

# Protected Principal Note

- This is an investment strategy where investors do not lose any of principal (initial investment) and sometimes earn additional profits.
- The portfolio consists of a bond and an option (either call or put).

e.g. A bank offers \$1,000 investment opportunity. If an investor invests \$1,000, the bank guarantees to pay back \$1,000 three years from now and additional profits in some cases. The risk-free interest rate is 6%. Also available is a 3-year call option on a stock index with the strike price of 1,500. The option price is \$160.

# Protected Principal Note

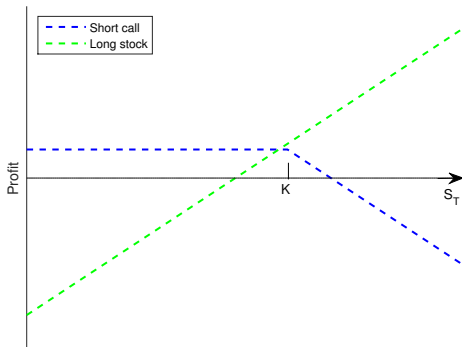
- To construct the strategy, the bank buys ...
  - ① 3-year zero coupon bond with the face value of 1,000.
    - In the bond purchase, the bank pays  $1,000e^{-0.06 \times 3} = 835.3$ , so  $(1,000 - 835.3) = 164.7$  remains.
  - ② Call option on a stock index
    - Use the remaining proceeds to buy the call.
- In year 3, the portfolio value is

$$1000 + \max(S_T - 1500, 0).$$

# Trading Option and Underlying Asset

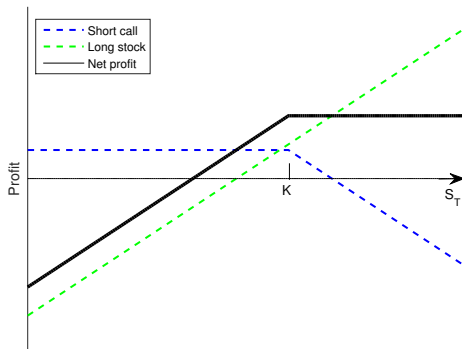
## ① Writing a covered call

- Suppose that we just shorted a European call option.
- To protect from negative payoffs on short call, we buy a stock.
- This combination of long stock and short call is “writing a covered call”.



# Trading Option and Underlying Asset

## ① Writing a covered call



- The profit pattern looks similar to short position in a put option. This makes sense, because

$$S_0 - c_0 = Ke^{-rT} - p_0$$

from the put-call parity.

# Trading Option and Underlying Asset - Example

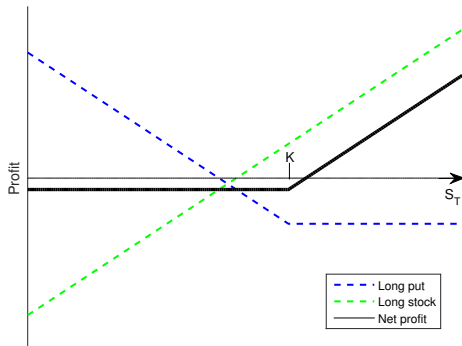
- This practice of writing a covered call is considered one of the contributors to the recent price surge of US tech stocks.
- A WSJ article
  - Small investors bought call options with roughly \$500 billion of notional value in August ... five times the previous monthly high ...
  - Option buying is important partly because it forces Wall Street banks, which sell options to investors, to hedge their positions, potentially accelerating trends in either direction.
  - When brokers sell call option to investors, they will buy shares and derivatives to protect themselves if the market soars. That act itself can drive up shares.



# Trading Option and Underlying Asset

## ② Protective put

- This consists of a long position in a stock and a long position in a European put.
- This protects an investor from big drops in the stock price.

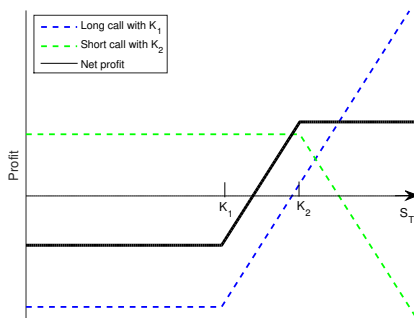


# Trading Option and Underlying Asset - Example

- A fund manager is long a stock with price  $S$  and it is worried about  $S$  declining. Consider 2 strategies:
  - It can hedge the risk by shorting a forward or futures contract on  $S$  with delivery price  $K$ .
  - It can insure against the risk by buying a put option.
- In this case, the option is really an insurance contract
- As with any insurance contract, it costs money upfront to purchase options (the option premium)
- By contrast, it costs nothing to enter the forward contract

# Spreads - Bull Spreads

- Spreads involve two or more options of the same type (call or put).
- Bull spreads
  - This consists of buying a European call option with the strike price ITM  $K_1$  and selling a European call option with the strike price OTM  $K_2(> K_1)$ . The two options have the same expiration dates.



# Spreads - Bull Spreads

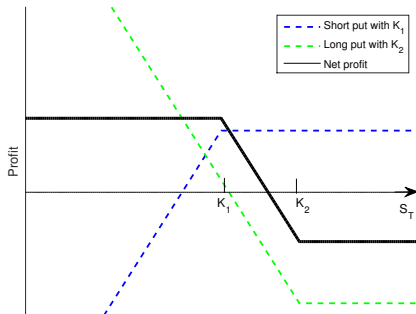
- Bull spreads
  - Payoff at expiration

Action	Payoff at time $T$		
	$S_T \geq K_2$	$K_2 > S_T \geq K_1$	$K_1 > S_T$
long call with $K_1$	$S_T - K_1$	$S_T - K_1$	0
short call with $K_2$	$-(S_T - K_2)$	0	0
Net	$K_2 - K_1$	$S_T - K_1$	0

- Note that the price of option with  $K_1$  is higher than the price of option with  $K_2$ . Thus, this strategy requires an initial investment.
- Using this strategy, the investor gives up some upside potential of long call with  $K_1$ . In return, the investor gets the price of the option with  $K_2$ .

# Spreads - Bear Spreads

- Bear spreads
  - This consists of selling a European put option with the strike price OTM  $K_1$  and buying a European put option with the strike price ITM  $K_2 (> K_1)$ . The two options have the same expiration dates.



# Spreads - Bear Spreads

- Bear spreads
  - Payoff at expiration

Action	Payoff at time $T$		
	$S_T \geq K_2$	$K_2 > S_T \geq K_1$	$K_1 > S_T$
short put with $K_1$	0	0	$-(K_1 - S_T)$
long put with $K_2$	0	$K_2 - S_T$	$K_2 - S_T$
Net	0	$K_2 - S_T$	$K_2 - K_1$

- Note that the price of option with  $K_2$  is higher than the price of option with  $K_1$ . Thus, this strategy requires initial investment.
- Using this strategy, the investor gives up some potential profit of long put with  $K_2$ . In return, the investor gets the price of the option with  $K_1$ .

## Spreads - Example

- Q. An investor expects the S&P500 to decrease in the future, so she wants to create a bear spread. She sees two 1-year European call options on the index; one with  $K = 1,900$  is priced at \$130 and the other with  $K = 2,000$  is priced at \$50. What should be her trading strategy? Find the profit at the option expiration.

# Spreads - Example

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**Answer:** To create a bear spread with call options, the investor should buy one with a higher strike price and sell the other. Then the initial cash flow from option transaction is  $130 - 50 = \$80$ .

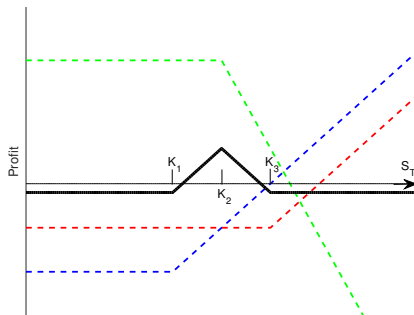
Profit at maturity is

Action	Payoff at time $T$		
	$S_T \geq 2,000$	$2,000 > S_T \geq 1,900$	$1,900 > S_T$
long call with $K = 2,000$	$S_T - 2000$	0	0
short call with $K = 1,900$	$-(S_T - 1900)$	$-(S_T - 1900)$	0
Net Payoff	-100	$-S_T + 1900$	0
Profit	-20	$-S_T + 1980$	80



# Spreads - Butterfly Spreads

- Butterfly spread is a strategy where profit is maximized at a certain stock price. This is appropriate for investors who believe that large stock price moves are unlikely.
- To create, we buy a European call with strike price of  $K_1$ , buy a European call with  $K_3$ , and sell two European calls with  $K_2$ , where  $K_1 < K_2 < K_3$ . All options have the same expiration dates.



# Spreads - Butterfly Spreads

- Payoff at expiration (assuming that  $K_2 = 0.5(K_1 + K_3)$ )

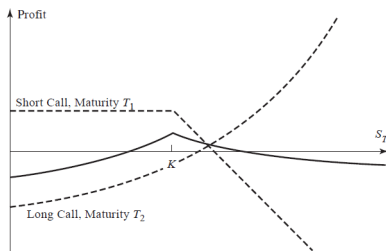
Action	Payoff at time $T$			
	$S_T \geq K_3$	$K_3 > S_T \geq K_2$	$K_2 > S_T \geq K_1$	$K_1 > S_T$
long call with $K_1$	$S_T - K_1$	$S_T - K_1$	$S_T - K_1$	0
long call with $K_3$	$S_T - K_3$	0	0	0
short 2 calls with $K_2$	$-2(S_T - K_2)$	$-2(S_T - K_2)$	0	0
net payoff	$\underbrace{2K_2 - K_1 - K_3}_{=0}$	$\underbrace{-S_T + 2K_2 - K_1}_{=-S_T + K_3}$	$S_T - K_1$	0

- The butterfly spreads can also be created using puts (buying a put with  $K_1$ , buying a put with  $K_3$  and selling two puts with  $K_2$ .)

# Spreads - Calendar Spreads

- Calendar spreads consist of European options with the same strike price  $K$  and different expiration dates.
- To create, we sell a European call with maturity  $T_1$  and buy a European call with maturity  $T_2(> T_1)$ .

**Figure 11.8** Profit from calendar spread created using two call options, calculated at the time when the short-maturity call option expires.



# Spreads - Calendar Spreads

- We start off with  $c_0(T_1) - c_0(T_2)$  at  $t=0$ .
- At  $T_1$ ,  $T_1$ -call is expired. The resulting payoff at  $T_1$  is

$$- \max(S_{T_1} - K, 0) + c_{T_1}(T_2)$$

where  $c_{T_1}(T_2)$  is the price of  $T_2$ -call at  $T_1$ .

- Usually, a longer-maturity call option has a higher price, so this strategy requires an initial investment.
- The investor makes profit when stock price is close to  $K$ . This pattern is similar to the butterfly spreads.

## Spreads - Calendar Spreads - Example

- An investor started a calendar spread in October 2019 with a short position in 1-year European call and a long position in 2-year European call. Both calls are on the same non-dividend-paying stock and have the strike price of \$120. At that time, the price of 1-year call was \$5 and the price of 2-year call was \$8. One year has passed, and the investor is now about to close all of the positions. The current stock price is \$150 and the risk-free interest rate is 3% per annum. What is smallest and largest possible profit from this calendar spread?

## Spreads - Calendar Spreads - Example

- The cash flow in October 2020 is

$$- \max(150 - 120, 0) + c_t(\text{Oct 2021})$$

where the first is payoff for the short position in the 2020-call and  $c_t(\text{Oct 2021})$  is the price of the 2021-call in October 2020. As the 2021-call will expire one year later, its price should be

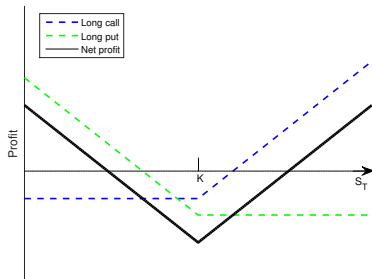
$$\underbrace{\max(150 - 120e^{-0.03 \times 1}, 0)}_{=33.547} \leq c_t(\text{Oct 2021}) \leq 150$$

using the lower/upper bound for the call price. Including initial cash flows, the profit is  $-30 + c_t(\text{Oct 2021}) + 5 - 8$ . Thus, the profit should be

$$0.547 \leq \underbrace{-30 + c_t(\text{Oct 2021}) + 5 - 8}_{=\text{profit}} \leq 117.$$

# Combinations - Straddle

- A combination is a trading strategy that involves taking a position in both calls and puts.
- Straddle
  - This consists of buying a European call and a European put with the same strike price and expiration date.



- This is appropriate for an investor who expects a large move in stock price but is uncertain about a direction.

## Combinations - Straddle

- Payoff at maturity

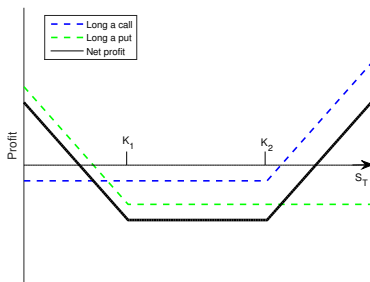
Action	Payoff at time $T$	
	$S_T \geq K$	$K > S_T$
long call	$S_T - K$	0
long put	0	$K - S_T$
Net	$S_T - K$	$K - S_T$

- Initially, an investor needs to pay option prices for both call and put.



# Combinations - Strangle

- A disadvantage of straddle is that it requires a large initial investment to buy both call and put.
- Strangle is similar to straddle, but we buy cheaper call and put.
- In particular, we buy a European put with  $K_1$  and a European call with  $K_2(> K_1)$ .



## Combinations - Strangle

- Payoff at maturity

Action	Payoff at time $T$		
	$S_T \geq K_2$	$K_2 > S_T \geq K_1$	$K_1 > S_T$
long call with $K_2$	$S_T - K_2$	0	0
long put with $K_1$	0	0	$K_1 - S_T$
Net	$S_T - K_2$	0	$K_1 - S_T$

- The profit structure is similar to straddle. However, the downside risk when the stock price does not move much is less than straddle.

## Combinations - Strangle - Example

- An investor considers making a strangle using a European call and a European put. The call has the strike price of \$80 and currently sells for \$6. The put has the strike price of \$50 and currently sells for \$5. Both options have the expiration date  $T$ . Find the range of future stock price  $S_T$  where the profit is positive.

## Combinations - Strangle - Example

- The profit of the strangle is as follows:

Action	Payoff at T		
	$S_T \geq 80$	$80 > S_T \geq 50$	$50 > S_T$
long 80-call	$S_T - 80$	0	0
long 50-put	0	0	$50 - S_T$
net payoff	$S_T - 80$	0	$50 - S_T$
initial cash flow	-11	-11	-11
net profit	$S_T - 91$	-11	$39 - S_T$

Thus, the profit is positive when  $S_T > 91$  or  $S_T < 39$ .

# Summary

- Principle-protected note: a zero-coupon bond and a European call option; for risk-averse investors
- A single option + underlying stock
  - Writing a covered call involves buying the stock and selling a call option on the stock
  - Protective put involves buying a put option and buying the stock
- Spreads
  - 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 put (call) with a high strike price and selling a put (call) with a low strike price.

# Summary

- 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.
- 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 strangle consists of a long position in a call and a put with different strike prices and the same expiration date.