Derivatives

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Hedging with Derivatives

The Put-Call Parity Formula

Basic Option Strategies

- Synthetic Long Position
- Synthetic Short Position
- Covered Call
- Protective Put
- Options Spreads

Factors Affecting Option Prices (holding other factors equal)

Price of underlying asset	Asset price and call price are positively related. Asset price and put price are negatively related.
Time to expiration	More time usually makes options more valuable.
Strike price	Higher X means higher put price; lower X means higher call price.
Interest rate	Calls: higher rate means higher call value. Puts: higher rate reduces put value.

Factors Affecting Option Prices: Volatility

Suppose a Shares now worth €40 might increase or decrease in value by €10:

Call option with X = €40 will pay €10 or €0.

Now suppose a Shares worth €40 might increase or decrease in value by €20:

Call option with X = €40 will pay €20 or €0.

The 2nd call option is more valuable … upside is better, downside the same as the 1st option.

The Put-Call Parity

Future payoffs of “Shares+put” are identical to payoffs of “bond+call” provided:

- Put and call have same exercise price and expiration date;
- Underlying Shares pays no dividends during life of options;
- Put and call are European options;
- Bond is risk-free, zero-coupon, price at maturity = strike (X),
- Bond matures when options expire.

If two assets A and B, have same future payoffs with certainty, then they should sell for the same price now

Price of put + price of shares =
Price of call + price of bond $P + S = C + B$

The Put-Call Parity Formula

Arbitrage-free (partial equilibrium) relationship between the prices of a put and a call on the same underlying security, if the two options have identical exercise prices and identical times to maturity.

$$C - P = S_0 - \frac{X}{(1+r_F)^T}$$

Disequilibrium Example

Stock Price = 110
Call Price = 17
Put Price = 5
RF rate = 10.25%
Maturity = 0.5 yrs
Exercise Price =105

$$17 - 5 = 110 - \frac{105}{(1+0.1025)^{0.5}}$$

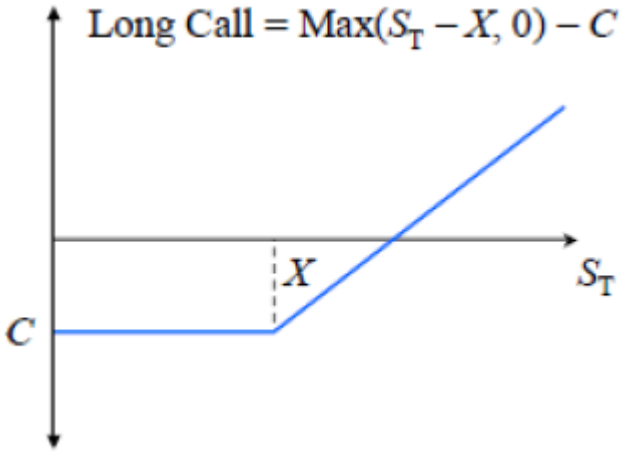
12 > 10

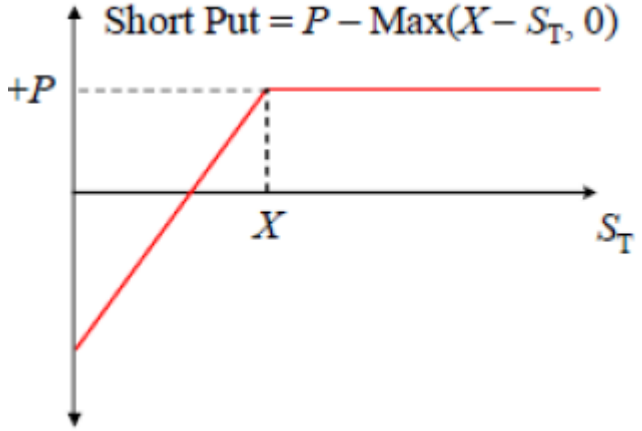
Synthetic Positions

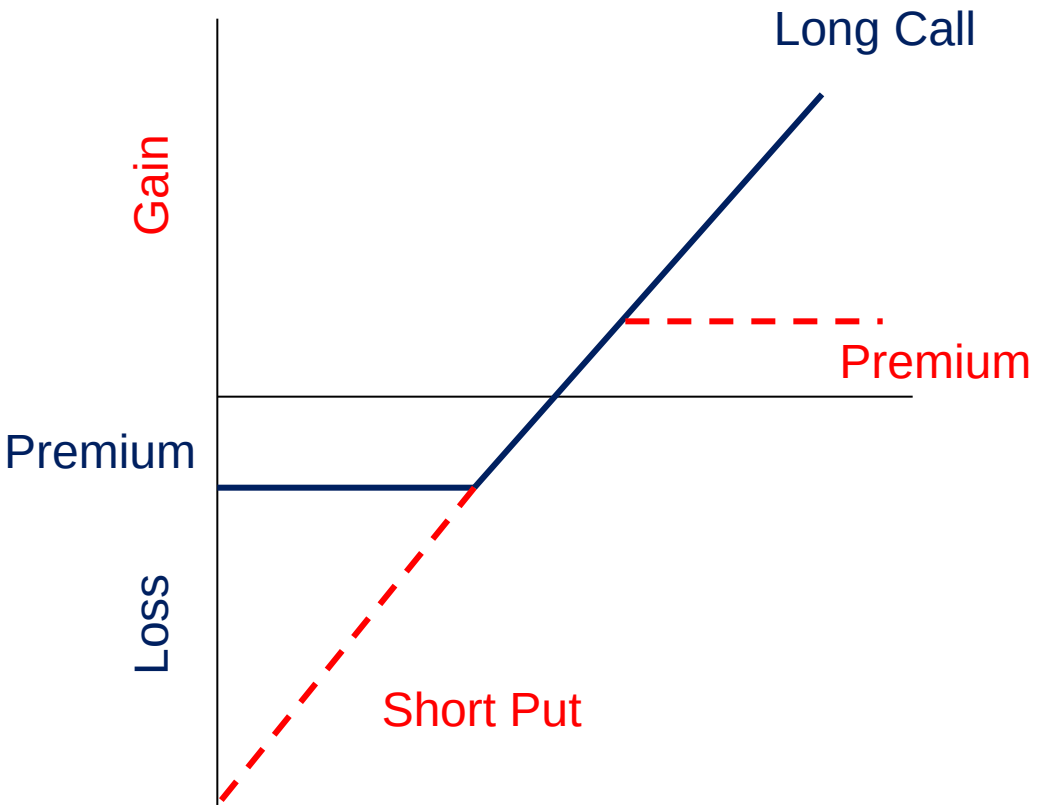
Way to create the payoff of a financial instrument using other financial instruments.

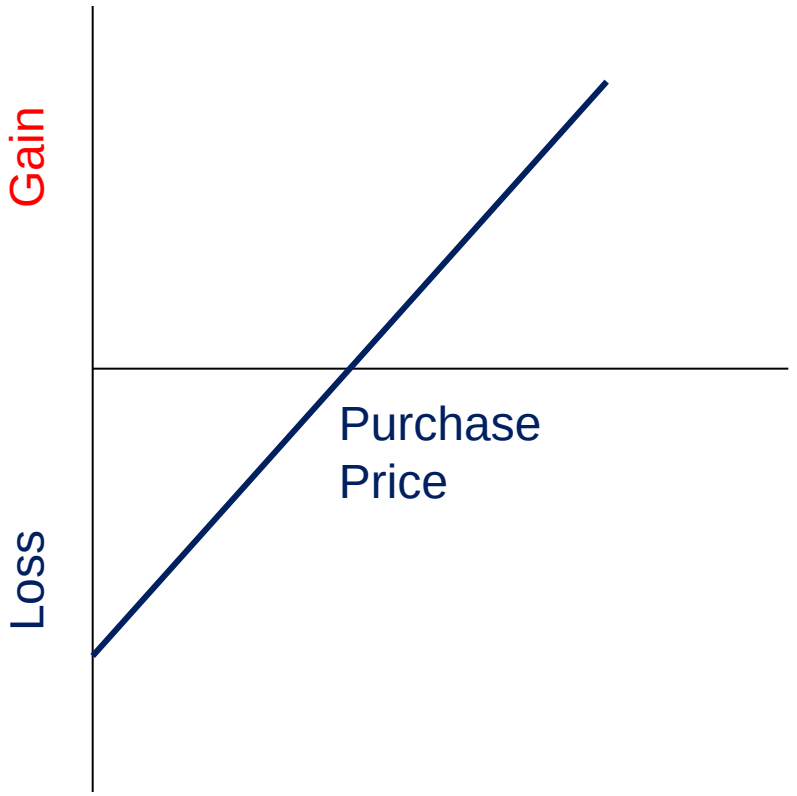
The Synthetic Long Position

Buying (long) a call and selling (short) a put on the same security creates a *synthetic long position* in the optioned security similar to a buy-and-hold position in the security.









A long position can be created via financial engineering. Purchasing a call and shorting a put with about the same exercise price on the same underlying stock creates a synthetic long position in that stock.

Notes:

If the prices of a put and a call stock are not equal, the synthetic long position would not be equivalent to the actual long position.

Put-call parity relationship shows that if the exercise prices and maturity dates are equal, a put is worth less than a call on the same stock.

To make the put and call prices equal it is necessary to assume different maturities for the call and put.

Some investors would find a synthetic long position more desirable than a long position in the stock because the synthetic position requires less initial cash investment, and investing less funds creates more financial leverage.

The Synthetic Short Position

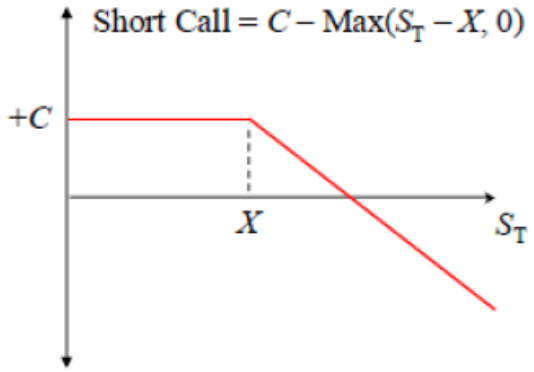
Selling (short) a call and simultaneously buying (long) a put with a similar exercise prices on the same underlying stock creates a Synthetic Short Position.

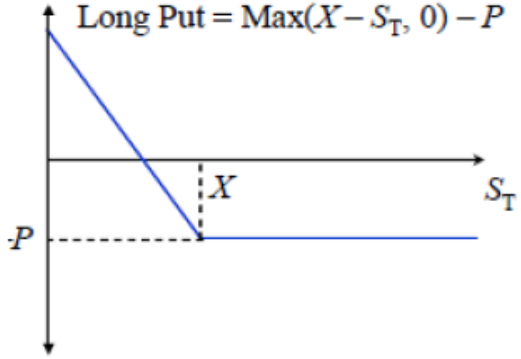
More desirable than a traditional short position for 3 reasons:

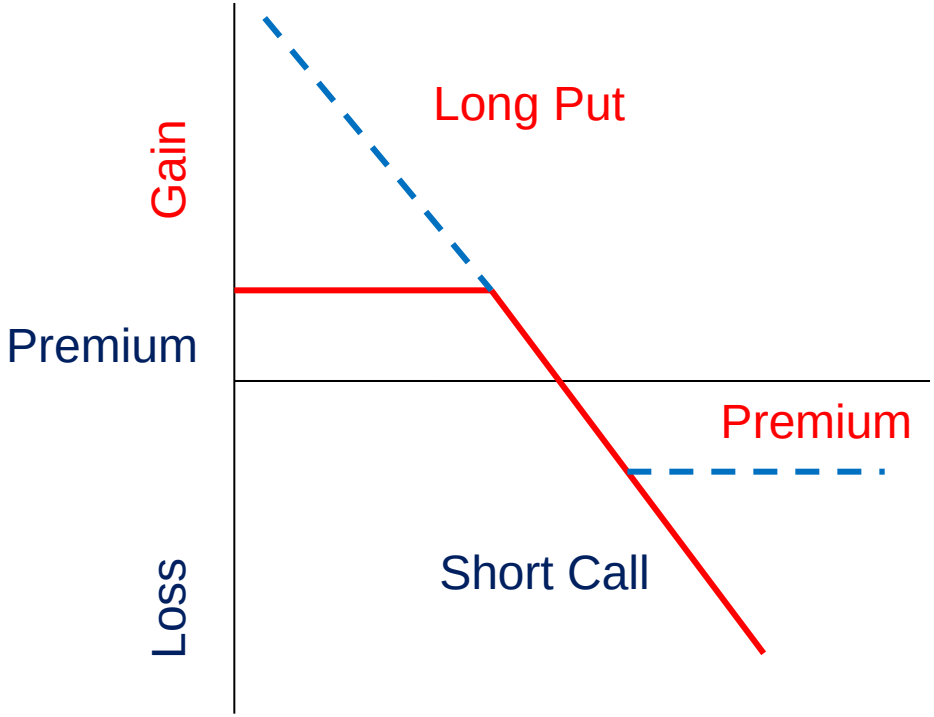
1) The option position is superior since the call premium is higher than the put premium.
2) Synthetic short position brings more leverage. Short sales require an initial margin and a synthetic shorter position involves a smaller investment.
3) Synthetic short seller does not have to pay dividends.

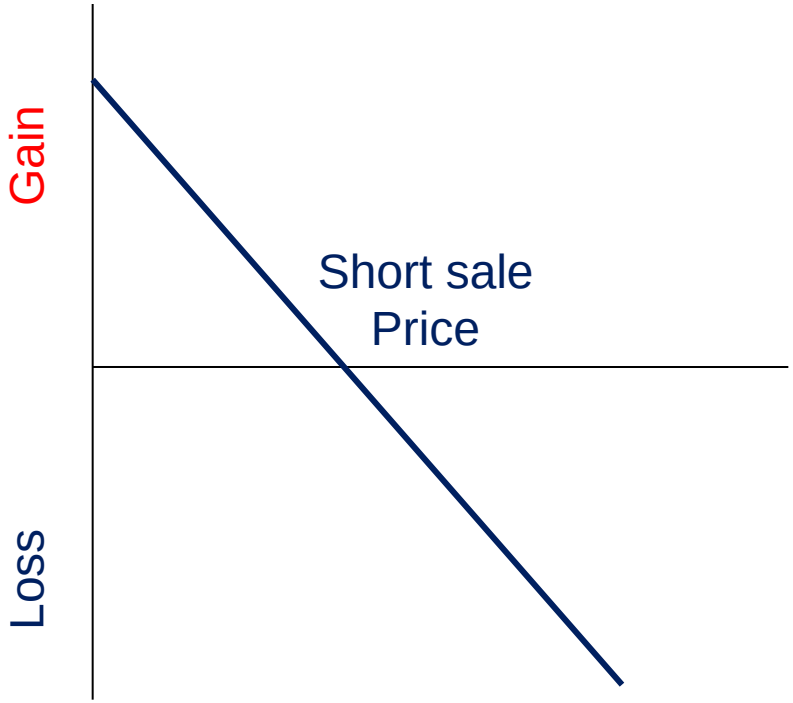
Disadvantages:

- Options expire and more money must be spent to purchase new options to reestablish the position.
- Investor has a short call position that could accumulate unlimited losses if the price of the underlying stock rose high enough.


Short Call = $C - \text{Max}(S_T - X, 0)$
+C
X
S_T


Long Put = $\text{Max}(X - S_T, 0) - P$
X
S_T
-P


Gain
Long Put
Premium
Premium
Loss
Short Call


Gain
Short sale
Price
Loss

Covered Call

Sell call on stock you own. (Long stock, short call)

Good:

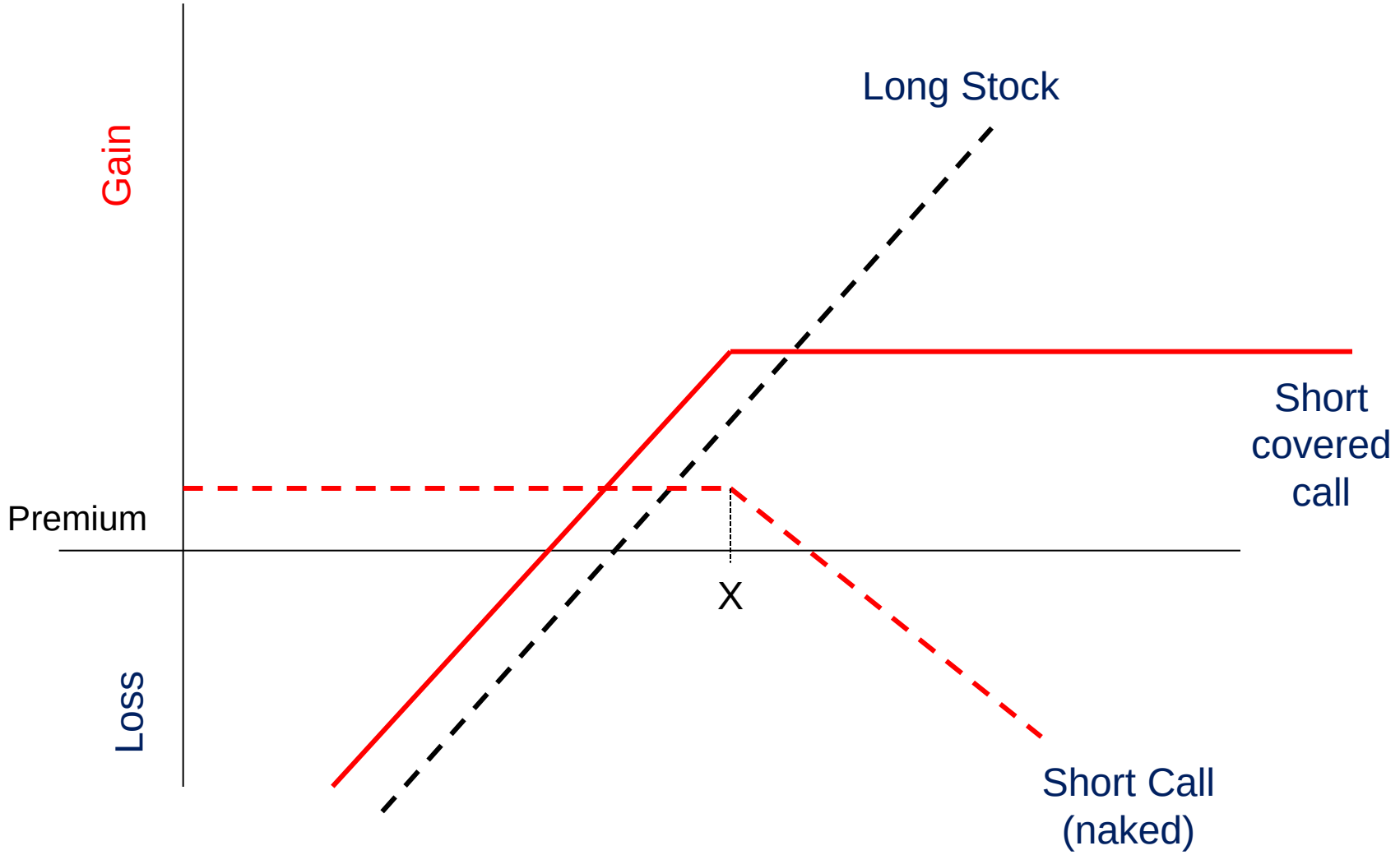
As value of stock falls, loss is partially offset by premium received on calls sold.

Essentially costless since hedge generates a cash inflow

Bad:

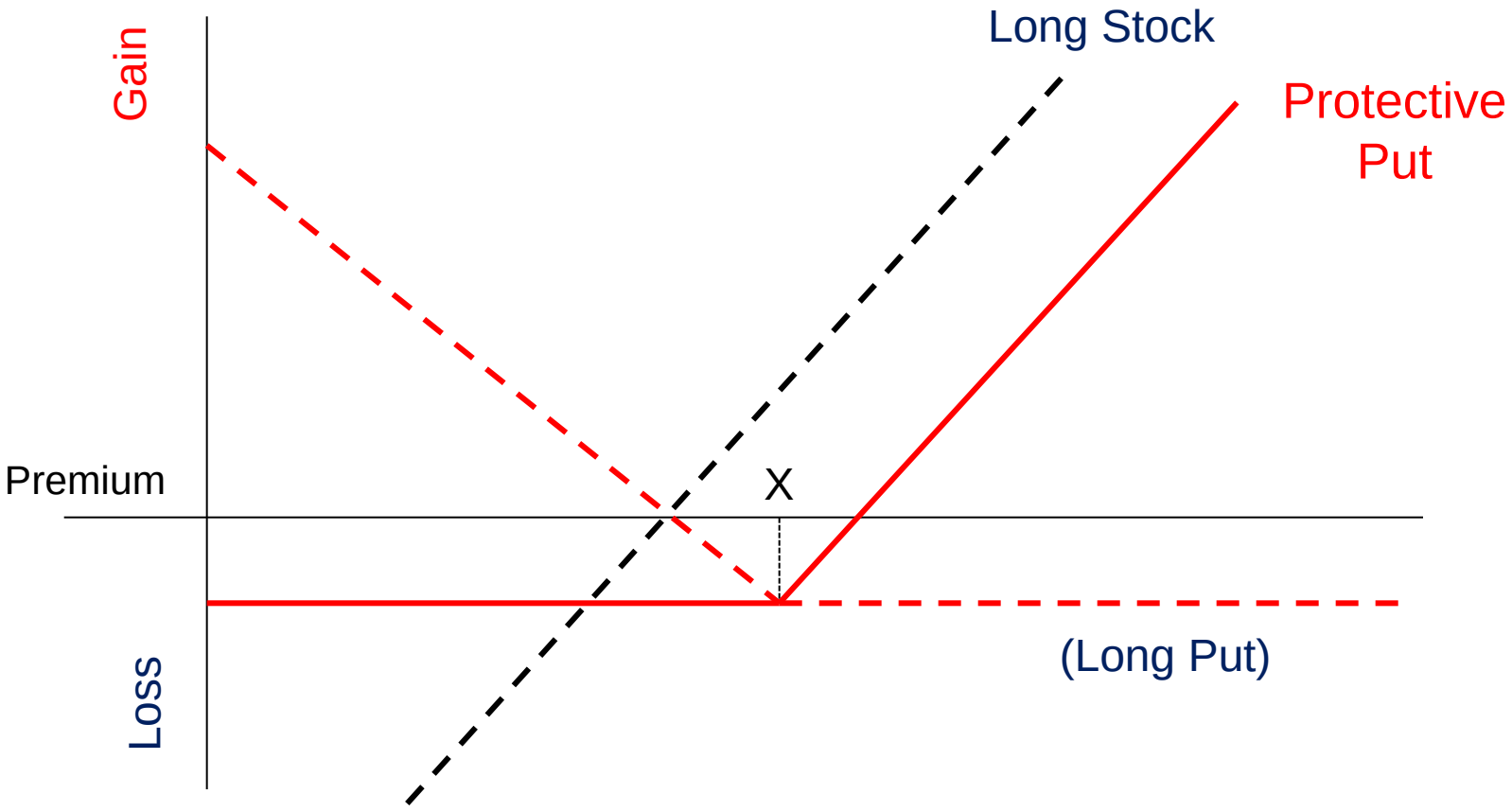
Maximum inflow from call = premium; Hedge is less effective for large drop in stock price

If stock price rises, call will be exercised; Investor transfers gains on stock to holder of call.


Gain
Long Stock
Short
covered
call
Premium
X
Loss
Short Call
(naked)

Protective Puts

long stock position combined with a long put position



Option Spreads

Price or Vertical spreads

Vertical spreads with calls

Vertical spreads with puts

Calendar spreads

Butterfly spreads

Straddles

Strangles

Price Spreads (also known as Vertical Spreads & Money Spreads)

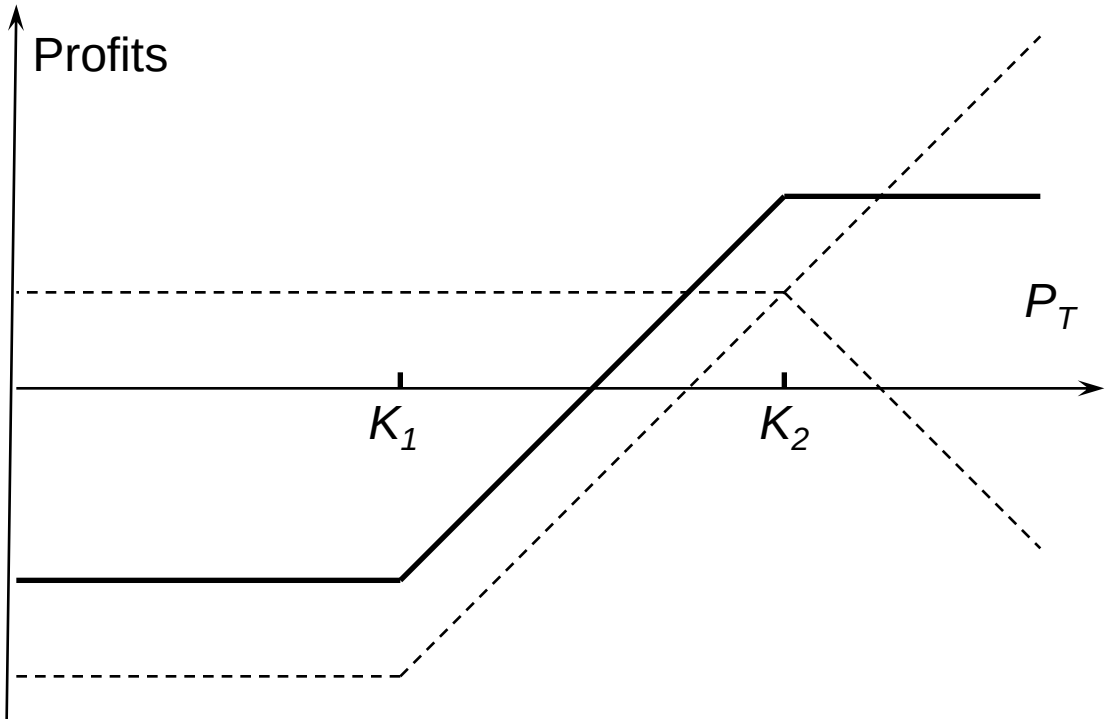
In a price/*vertical spread*, options are selected vertically from the financial pages i.e. Different strike prices. Buying and selling options on the same stock with the same expiration, but with different strike prices

The options have the same expiration date
The spreader will long one option and short the other
…..*risk reduction strategy relative to a pure call or put option*

Bull Spread

Buy a call and sell a call with a higher strike price (on the same stock) or buy a put with a low strike price and sell a put with a high strike price

Bull Spread with Calls



Dashed lines: Profits from the 2 positions taken separately

Solid line: Profit from the whole strategy

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 brought. A bull spread, when created from calls. therefore requires an initial investment.

Stock Price range	Payoff from long call option	Payoff from short call option	Total payoff
$ST \geq K2$	$ST - K1$	$K2 - ST$	$K2 - K1$
$K1 < ST < K2$	$ST - K1$	0	$ST - K1$
$ST \leq K1$	0	0	0

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

Example:

An investor buys a $3 a call with a strike price of $30 and sells for $1 a call with a strike price of $35.

Stock price range	Profit
$ST \leq 30$	-1
$30 < ST < 35$	$ST - 32$
$ST \geq 35$	3

Another example

Assume a person believes IBM stock will appreciate soon

A possible strategy is to construct a *vertical call bullspread* and:

- Buy an OCT 85 IBM call
- Write an OCT 90 IBM call

The spreader trades part of the profit potential for a reduced cost of the position.

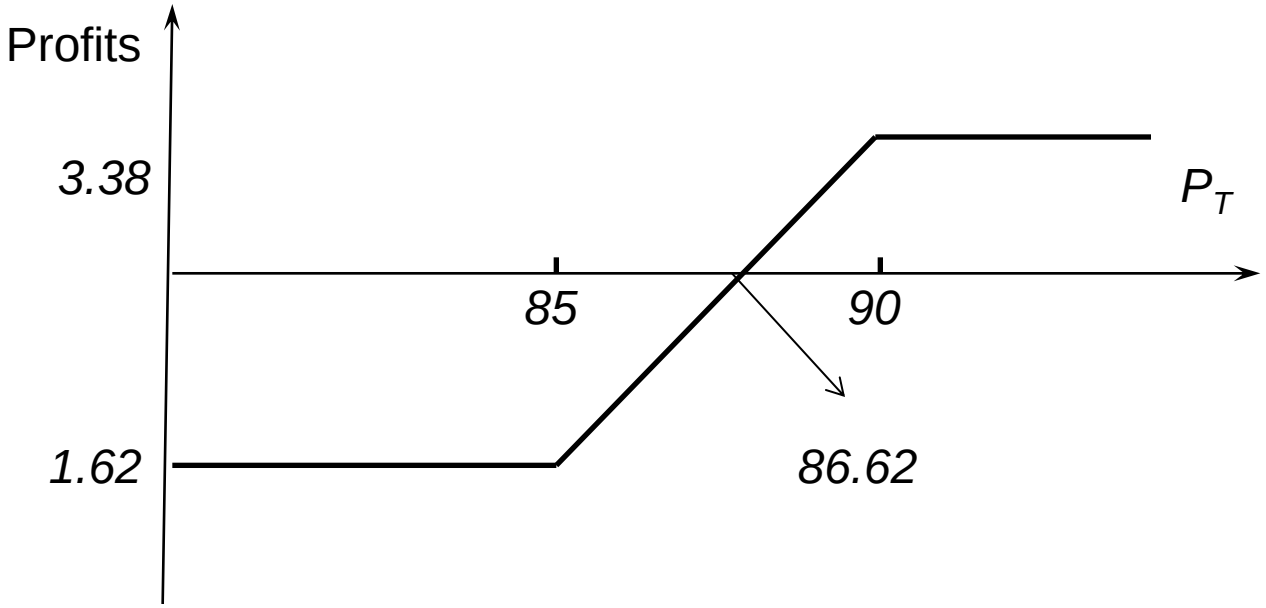
With all spreads the maximum gain and loss occur at the striking prices

It is not necessary to consider prices outside this range

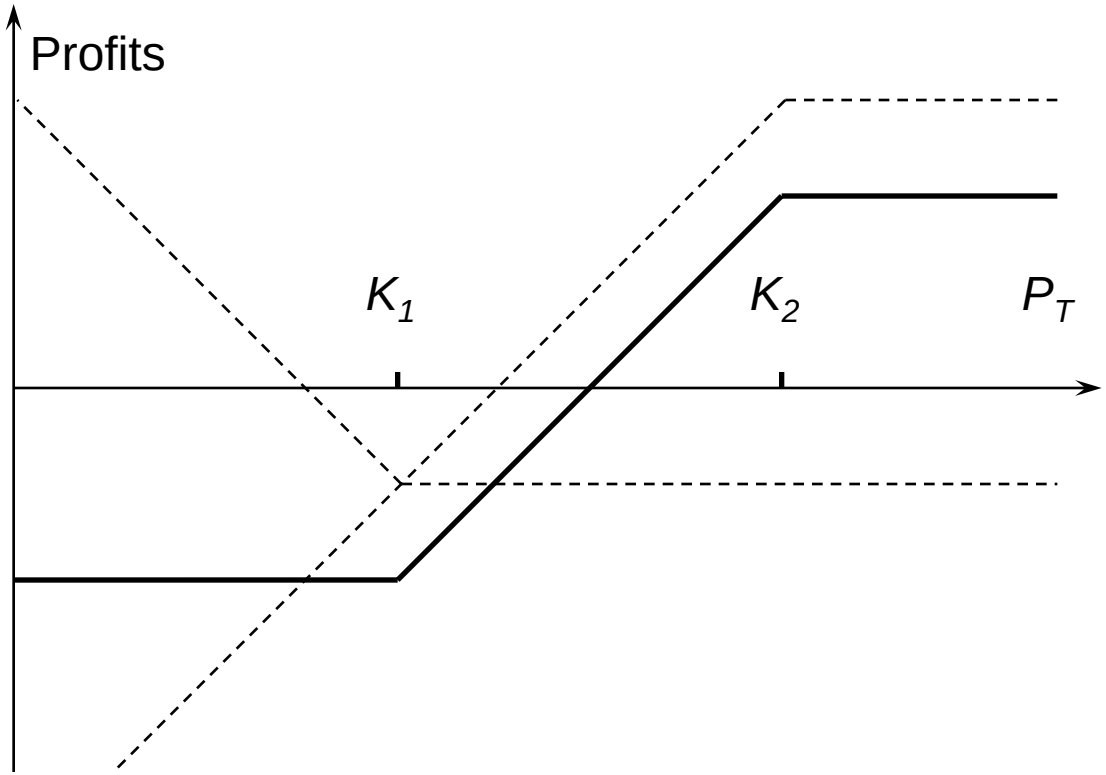
With an 85/90 spread, you only need to look at the stock prices from $85 to $90

Construct a profit and loss worksheet to form the *bullspread*:

	Stock Price at Option Expiration					
	0	85	86	88	90	100
Long $85 call @$5	-5	-5	-4	-2	0	10
Short $90 call @$3.38	3.38	3.38	3.38	3.38	3.38	-6.62
Net	-1.62	-1.62	-.62	1.38	3.38	3.38



Bull Spread with Puts



Bear Spread with Calls

A *bearspread* is the reverse of a bullspread

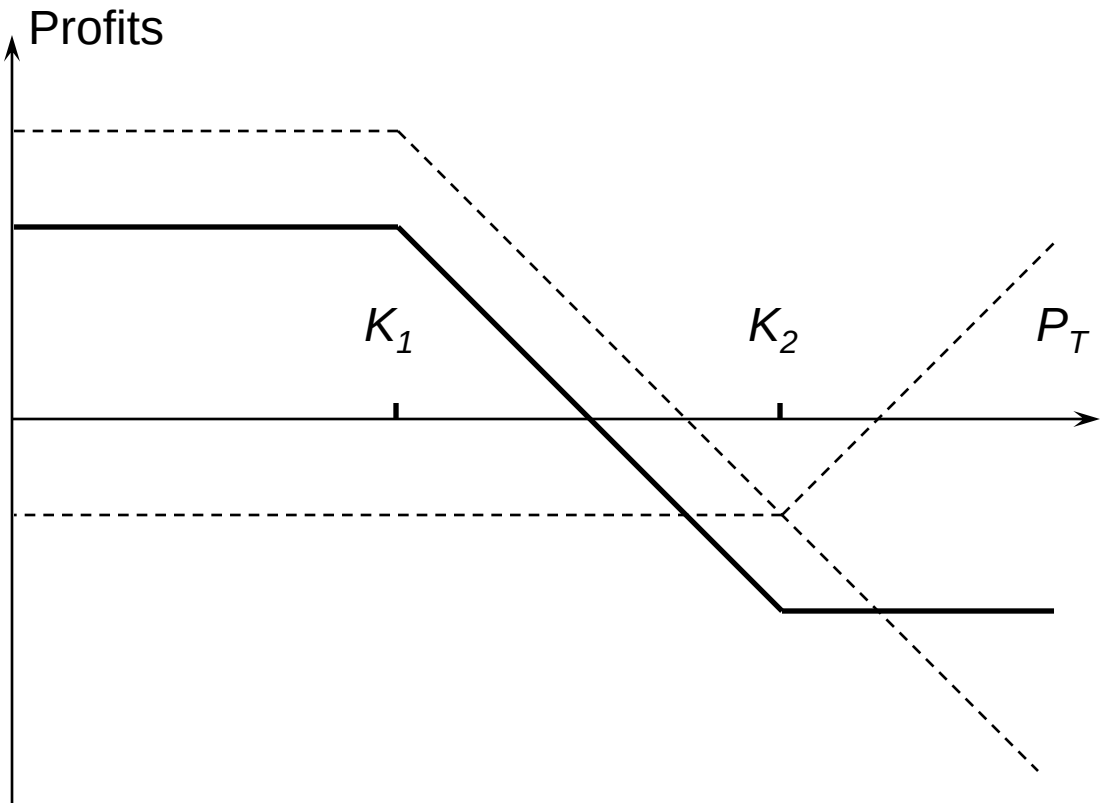
The maximum profit occurs with falling prices

The investor buys (long) the option with the higher striking price and writes (short) the option with the lower striking price

Profit from the sale of the call without risk of a sharp run up in the price of the stock

Bear Spread with Calls

Buy a call with a higher strike price and sell a call (on the same stock).
Hope that the stock price will decline.



A bear spread can be created by buying a call with one strike price and selling a call with another strike price. The strike price of the option purchased is greater than the strike price of the option sold

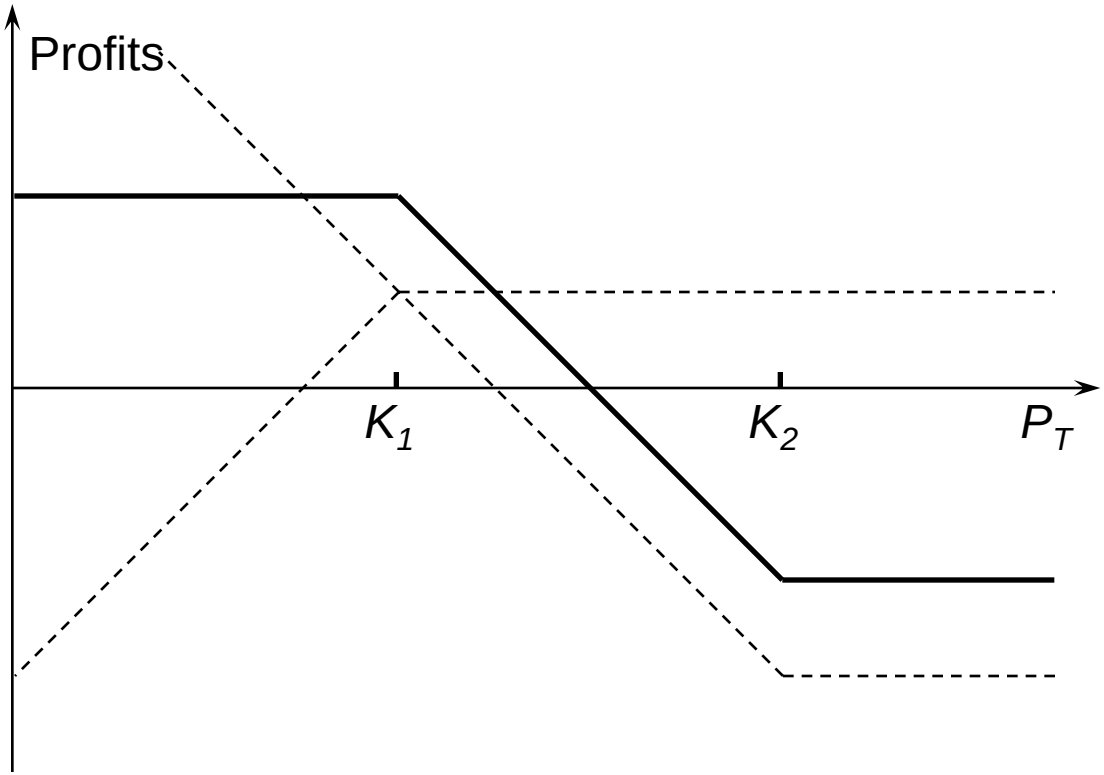
Stock Price range	Payoff from long call option	Payoff from short call option	Total payoff
$ST \geq K2$	$ST - K2$	$K1 - ST$	$-(K2 - K1)$
$K1 < ST < K2$	0	$K1 - ST$	$-(ST - K1)$
$ST \leq K1$	0	0	0

Example:

An investor buys a \$1 a call with a strike price of \$35 and sells for \$3 a call with a strike price of \$30.

Stock price range	Profit
$ST \leq 30$	+2
$30 < ST < 35$	$32 - ST$
$ST \geq 35$	-3

Bear Spread with Puts



Calendar (or Time) Spreads

In a *calendar spread*, options are chosen horizontally from a given row in the financial pages. Buying and selling options on the same stock with the same strike price, but with different expirations

They have the same striking price

The spreader will long one option and short the other

The trading objective is to take advantage of the 'time decay' factor.

Options are worth more the longer they have until expiration

Calendar spreads are either bullspreads or bearspreads

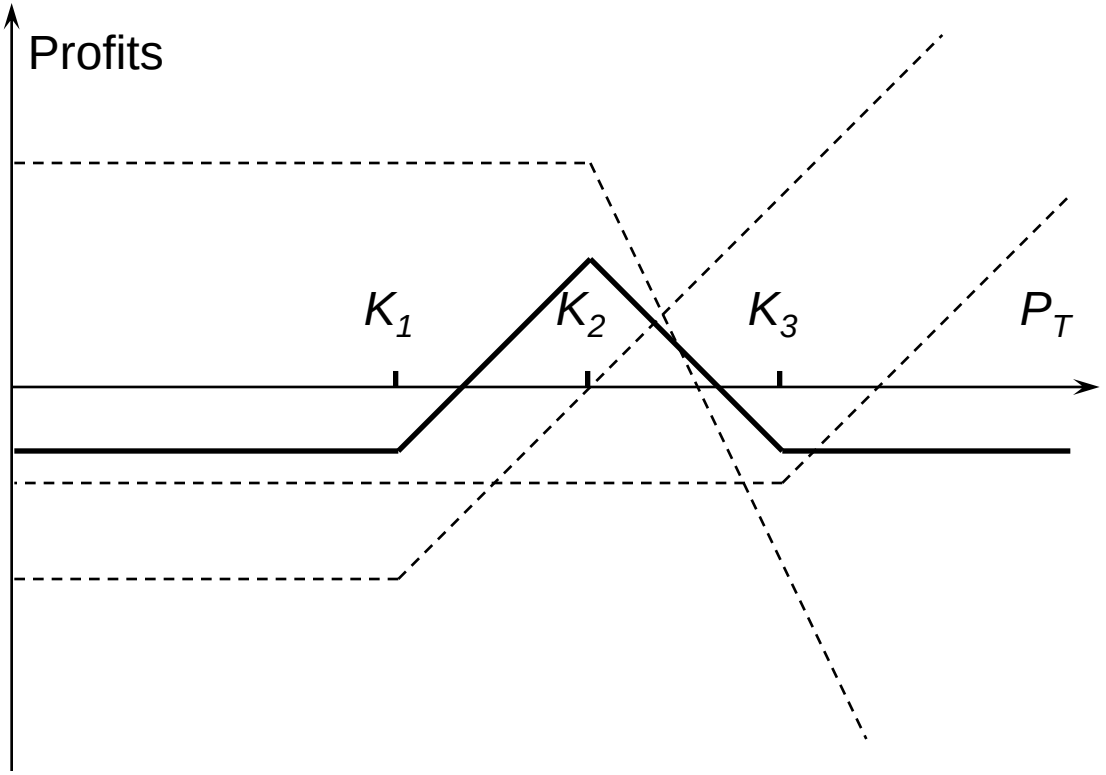
In a *bullspread,* the spreader will buy a call with a distant expiration and write a call that is near expiration

In a *bearspread,* the spreader will buy a call that is near expiration and write a call with a distant expiration

…..*taking advantage of the greater time value*

Butterfly Spread with Calls

Three different strike prices (on the same stock). Buy a call with a relatively low strike price x1, buy a call with a relatively high strike price x3 and sell two calls with a strike price half way x2 (can use put options too). Generally K2 is close to the current stock price



Butterfly spread leads to a profit if the stock price stays close to K_2 but gives rise to a small loss if there is a significant stock price move in either direction.

It is an appropriate strategy for an investor who feels that large stock price moves are unlikely

Example:
Stock currently worth \$61 Market prices of six-months calls are as follows:

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

Costs: $10 + $5 – (2 × $7) = $1

ST < $ 55 or ST > $65 (in 6 months)

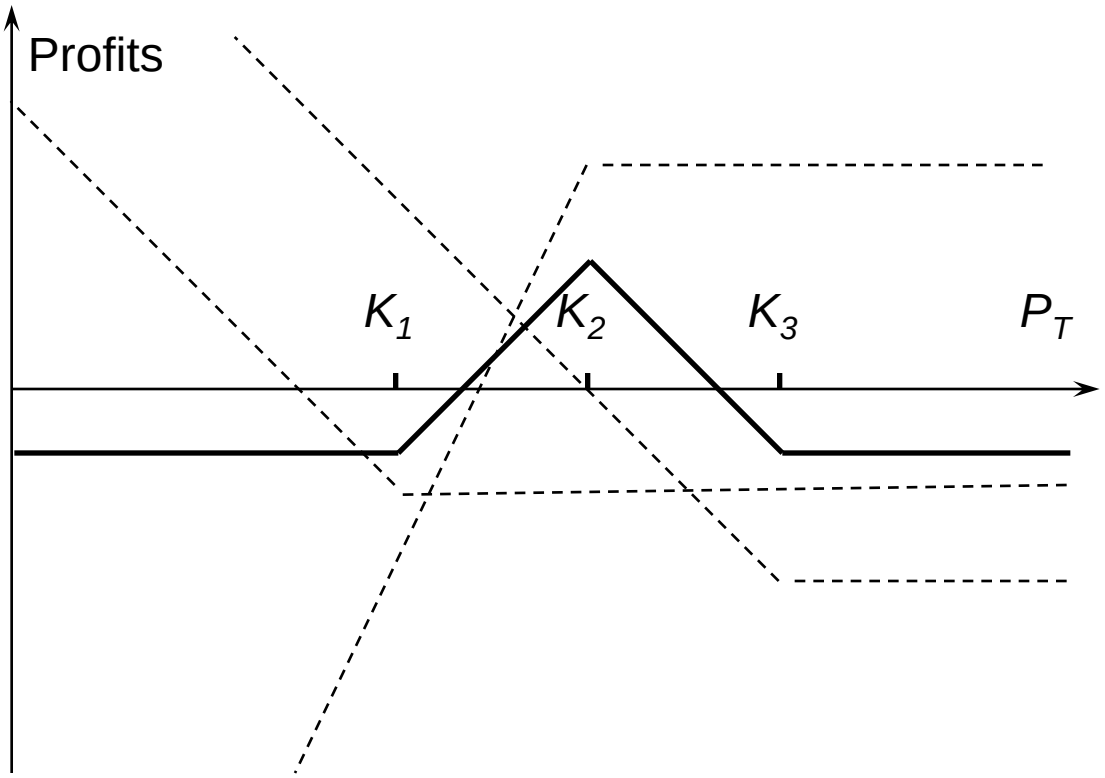
Total payoff is zero (net loss $1)

$56 < ST < $64 profit is made

Maximum profit ($4) when the stock price in six months is $60

Stock Price range	Payoff from first long call	Payoff from second long call	Payoff from short Calls	Total payoff
ST < K1	0	0	0	0
K1 < ST < K3	ST – K1	0	0	ST – K1
K2 < ST < K3	ST – K1	0	-2 (ST – K2)	K3 – ST
ST > K3	ST – K1	ST – K3	-2 (ST – K2)	0

Butterfly Spread with Puts



Straddle

Combination of a purchasing (long) or selling (short) a put and a call on the same expiration.

Betting on a large price movement (long straddle) or little price movement (short straddle)

The best-known option combination

You are long a straddle if you own both a put and a call with the same

- Striking price
- Expiration date
- Underlying security

You are short a straddle if you are short both a put and a call with the same

- Striking price
- Expiration date
- Underlying security

Buying a Straddle

A long call is bullish
A long put is bearish
Why buy a long straddle?

Whenever a situation exists when it is likely that a stock will move sharply one way or the other

Very Speculative - typically a situation where a company is involved in a lawsuit or takeover - unclear how the situation will be resolved.

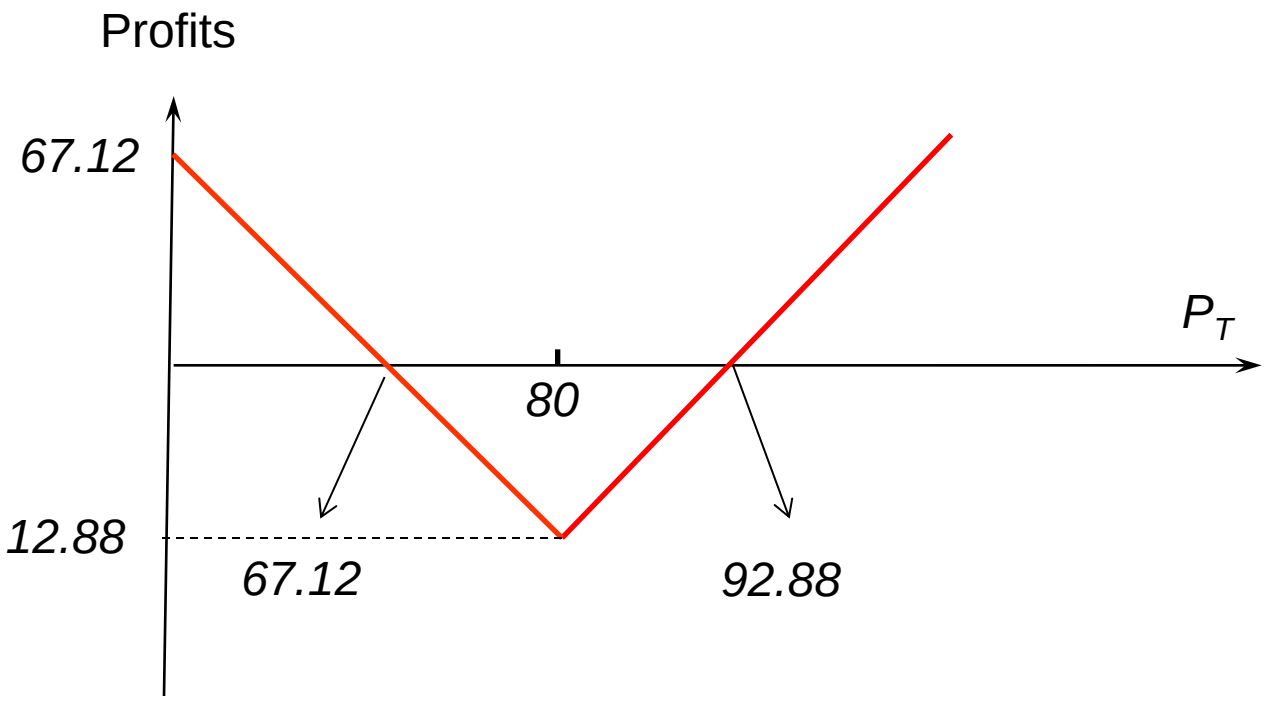
Example

Suppose a speculator

Buys an OCT 80 call on MSFT @ $7
Buys an OCT 80 put on MSFT @ $5.88

Construct a profit and loss worksheet to form the long straddle:

	Stock Price at Option Expiration					
	0	50	75	80	90	100
Long $80 call @$7	-7	-7	-7	-7	3	13
Long $80 put @$5.88	74.12	-.88	-5.31	-5.88	-5.88	-5.88
Net	67.12	-7.88	-12.31	-12.88	-2.88	7.12



The worst outcome for the straddle buyer is when both options expire worthless

Occurs when the stock price is at-the-money

The straddle buyer will lose money if MSFT closes near the striking price
The stock must rise or fall to recover the cost of the initial position

Writing a Straddle

Popular with speculators

The straddle writer wants little movement in the stock price

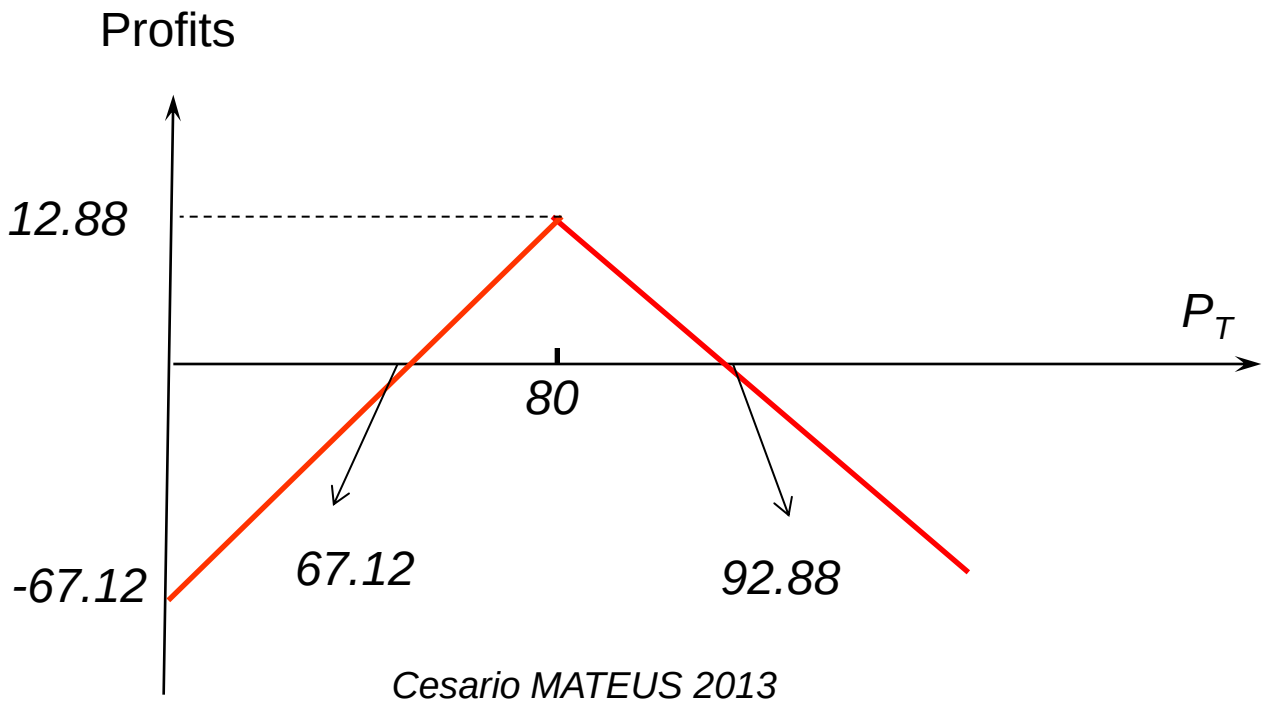
Losses are potentially unlimited on the upside because the short call is uncovered

Suppose a speculator

Buys an OCT 80 call on MSFT @ $7
Buys an OCT 80 put on MSFT @ $5.88

Construct a profit and loss worksheet to form the short straddle:

	Stock Price at Option Expiration					
	0	50	75	80	90	100
Short $80 call @$7	7	7	7	7	-3	-17
short $80 put @$5.88	-74.12	-24.12	.88	5.88	5.88	5.88
Net	-67.12	-17.12	6.12	12.88	2.88	-12.88



Strangle

A *strangle* is similar to a straddle, except the puts and calls have different striking prices

Strangles are more popular due to the smaller capital investment and the max. gain occurs over a wider trading range

Combination of a call and put with the same expiration but different exercise prices (long or short)

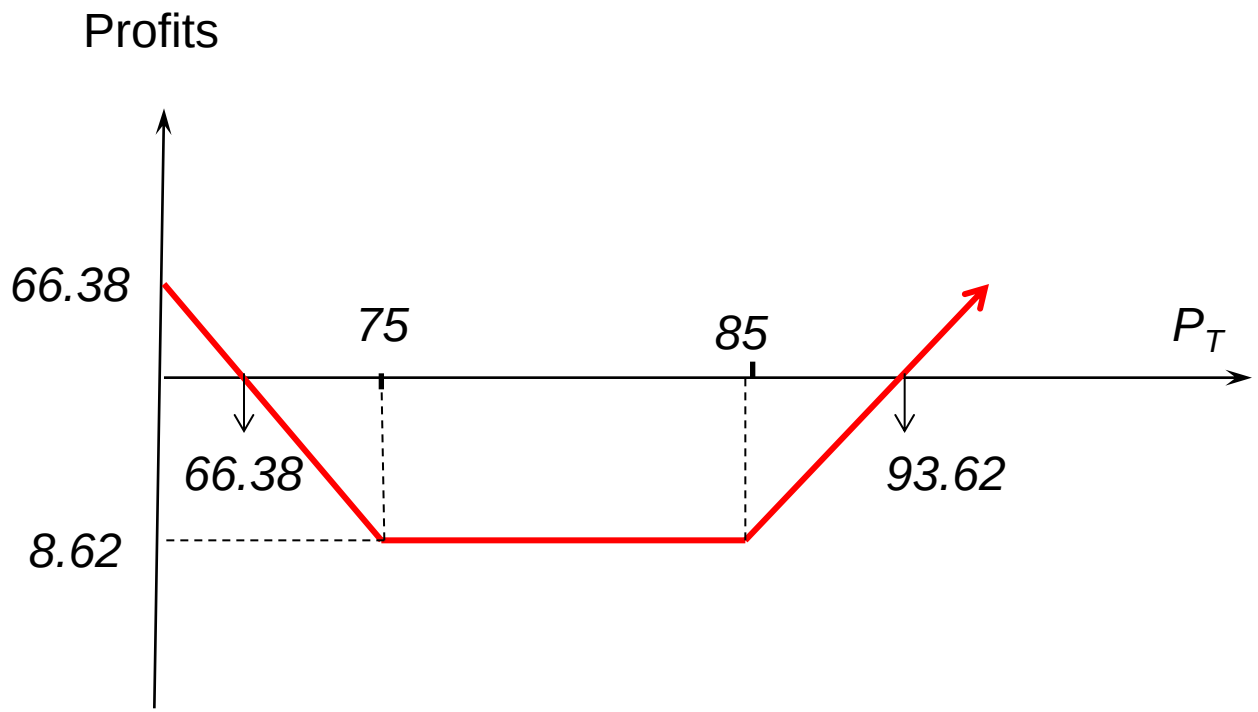
Buying a Strangle

The speculator long a strangle expects a sharp price movement either up or down in the underlying security

Suppose a speculator:

Buys a MSFT OCT 75 put @ $3.62
Buys a MSFT OCT 85 call @ $5

	Stock Price at Option Expiration					
	0	50	75	80	85	100
Long $75 put @$3.62	71.38	21.38	-3.62	-3.62	-3.62	-3.62
Long $85 call @$5	-5	-5	-5	-5	-5	10
Net	-66.38	16.38	-8.62	-8.62	-8.62	7.62


Profits
66.38
75
85
P_T
66.38
93.62
8.62

Writing a Strangle

The maximum gains for the strangle writer occurs if both option expire worthless

Occurs in the price range between the two exercise prices

- similar to writing a straddle
- some movement in the stock price results in the max. Profit
- maximum profit is somewhat reduced from the straddle