# FINA 1082 Financial Management
# FINA 1098 Financial Management (Dual Award)

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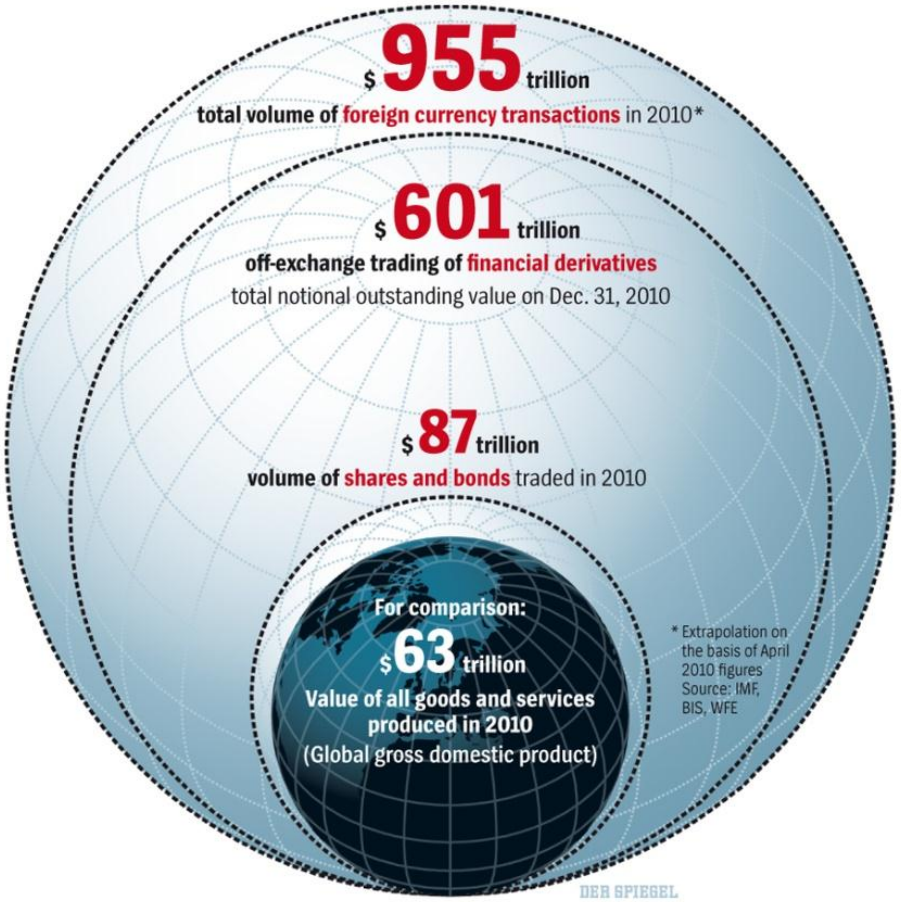
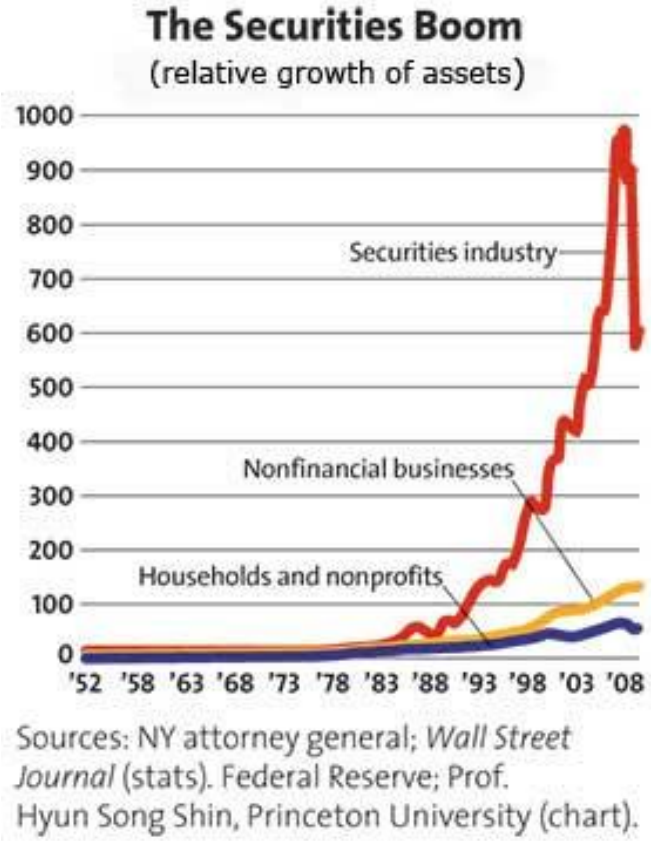
# Session 6
## Derivatives

May, 18, 2014

## *Derivatives*

*"financial weapons of mass destruction" due to their complex and obscure nature*
*Warren Buffet (2003)*



In a January 2009 interview with NBC's Tom Brokaw, Warren Buffett criticized leveraging "to the sky," and creating "phony instruments [RMBSs, CDOs, et al.] that fool other people so you stick money in your pocket." He claimed over-the-counter derivatives are "financial weapons of mass destruction" and participants who account for them have "enormous incentives to cheat"

# What is a derivative?

- A derivative contract is an instrument whose value derives from that of an underlying product
  - The underlying product can be commodities, shares, market indices, interest rates, currencies, etc

- Forward and futures contracts are obligations to purchase or sell the underlying product at a pre-specified price at a pre-specified maturity (or expiration) date

- Option contracts are rights, but not obligations, to purchase or sell the underlying product at a pre-specified price at, or before, a pre-specified maturity (or expiration) date

# Overview of Derivatives Markets

• Since forward and futures contracts are obligations they protect the holder (or buyer) from losses but they also impede any gains from favorable movements in the price of the underlying product

• Since option contracts are rights they give the holder (or buyer) the opportunity to gain from favorable price movements while protecting the holder from unfavorable price movements in the underlying product

  • However, this upside potential comes at a price!

# Overview of Derivatives Markets

- Over-the-counter derivatives are traded privately between two parties with prices set by mutual negotiation

- Exchange traded derivatives are traded on a public exchange with prices set by a bidding process

- Derivatives markets dominated by the Chicago Mercantile Exchange (CME)
    - International Financial Futures Exchanges in London (LIFFE) and Tokyo (TIFFE) also important markets

# Forward and Futures Contracts

- A forward contract is an agreement to buy or sell the underlying asset at a specified price on a specified future date
  - Note that it costs nothing to buy or sell a forward contract and there is no premium paid by one party to another

- Long versus short positions
  - The party who agrees to buy the underlying asset on a certain specified future date for the specified price is long a forward contract or has bought the forward contract
  - The party who agrees to sell the underlying asset on a certain specified future date for the specified price is short a forward contract or has sold the forward contract

# Forward and Futures Contracts

- Spot price
  - The price at which the underlying asset can be bought and sold in the spot market
- Delivery price
  - The specified delivery price on the forward contract
- Forward price
  - The forward price and the delivery price are equal at the time the contract is entered into
  - With the passage of time, the forward price will change while the delivery price remains fixed

# Forward and Futures Contracts

- Maturity or delivery date
  - The specified date on which the contract is settled
  - The holder of the short position delivers the asset to the holder of the long position in return for the delivery price
  - Some contracts are settled in cash since it is either impossible or impractical to deliver the underlying asset

- Settlement
  - Physical delivery where the underlying security is exchanged for cash
  - Cash settlement where payment is made by the buyer to the seller of an amount equal to the forward price minus the market price at settlement multiplied by the number of units in the contract

# Forwards Versus Futures Contracts

- Futures are standardized forward contracts
  - Contract is for the exchange of the underlying commodity or security at a future date, at a prespecified price
  - Contract is standardized in terms of size, maturity, quotations, settlement, delivery, etc

- Major differences in forwards and futures contracts - see next slide
  - Daily marking-to-market in futures contracts implies that a futures contract can be viewed of as a series of one-day forward contracts
  - Note that the standardization of futures contracts is also a major weakness of these contracts

# Forwards Versus Futures Contracts

| *Feature* | *Forward Contract* | *Futures Contract* |
|---|---|---|
| 1. Type | Informal arrangements | Standardized by exchange |
| 2. Maturity | Any maturity (usually multiples of 30 days) | Few, prespecified maturity dates |
| 3. Contract size | Generally over $1,000,000 | Smaller and prespecified |
| 4. Security arrangements | Customers maintain minimum deposit with bank | Minimum margin deposits as a percent of contract's face value |
| 5. Cash flows | None until delivery | Daily settlement from margin account |
| 6. Final settlement | Majority settled by delivery | Delivery is rare - settlement through contract reversal |
| 7. Default risk | Higher than futures | Minimal (exchange guarantee) |
| 8. Commissions | Dealer's bid-ask spread | Floor traders, brokers pay and receive fees |
| 9. Regulation | Self-regulated | External regulation |

# Pricing of Forwards and Futures

- Forward and futures prices depend on the cost of carrying the underlying commodity to the delivery date
  - Storage costs
  - Insurance costs
  - Transportation costs
  - Financing costs

- The cost of carry model
  - $F_{0,t} = S_0 \times (1 + c)$
  - $F_{0,t}$ = Futures (or forward) price today for delivery at time t
  - $S_0$ = Spot price of underlying commodity today
  - c = Cost of carrying the underlying commodity to the settlement date as a fraction of the spot price

# Pricing of Forwards and Futures

- Cost of carry arbitrage exists when: $F_{0,t} > S_0 \times (1 + c)$
- Reverse cost of carry arbitrage exists when: $F_{0,t} < S_0 \times (1 + c)$
- Cost of carry arbitrage: $F_{0,t} > S_0 \times (1 + c)$
  - Borrow funds
  - Buy spot now
  - Sell forward (or futures) contract
- Reverse cost of carry arbitrage: $F_{0,t} < S_0 \times (1 + c)$
  - Sell short spot
  - Lend funds
  - Buy forward (or futures) contract

# Pricing of Forwards and Futures

Example:

Suppose the price of an ounce of gold is USD 800 and the futures price for settlement in one year's time is USD 890. Assume no other costs other than financing costs and a borrowing and lending rate of 10% p.a. What will traders do?

What will they do if the price of gold is USD 820? What will happen in equilibrium?

# Pricing of Forwards and Futures

Case 1:

Cost of carry arbitrage opportunity exists…

$F_{0,t} > S_0 \times (1 + c)$

$890 > 800 \times (1 + 0.10) = 880$

| | |
|---|---|
| *Time 0* | |
| Borrow $800 for 1 year | +800 |
| Buy an ounce of gold | -800 |
| Sell a futures contract | 0 |
| Net amount | 0 |
| *Time 1* | |
| Remove gold from storage | 0 |
| Deliver gold against futures contract | +890 |
| Repay loan with interest | -880 |
| Net profit | +10 |

# Pricing of Forwards and Futures

## Case 2:

Reverse cost of carry arbitrage opportunity exists…

$F_{0,t} < S_0 \times (1 + c)$

$890 < 820 \times (1 + 0.10) = 902$

| | |
|---|---|
| *Time 0* | |
| Sell short an ounce of gold | +820 |
| Lend $820 for 1 year | -820 |
| Buy a futures contract | 0 |
| Net amount | 0 |
| *Time 1* | |
| Collect proceeds from the loan | +902 |
| Accept delivery on futures contract | -890 |
| Use gold to cover short sale | 0 |
| Net profit | +12 |

# Introduction to Options Contracts

- Examine what options are and how they are traded
- Analyze the payoffs associated with purchasing a call option
- Analyze the payoffs associated with selling a call option
- Analyze the payoffs associated with purchasing a put option
- Analyze the payoffs associated with selling a put option

# Overview of Options Markets

- Option contracts are instruments that give the holder of the contract the right, but not the obligation, to buy or sell the underlying instrument at a prespecified price
  - Equity option contracts usually represent 1000 shares of the underlying stock
  - The exercise (or strike) price is the prespecified price for which the underlying security may be purchased or sold by the option buyer/holder if the option is exercised

- Equity option holders do not enjoy the rights due stockholders
  - For example, voting rights, regular dividends, etc

- In an exchange market, option prices are set in a competitive auction market among various buyers and sellers

# Overview of Options Markets

- Over-the-counter instruments
  - Contracts are privately negotiated and tailored to meet customer needs
  - Transactions occur off-market or outside registered exchanges
  - Counterparty risk is a major consideration
  - Products typically traded through commercial banks, investment banks and brokers

- Exchange traded instruments
  - Contracts are standardized
  - Clearinghouse acts as a middleman between the buyer and seller
  - Counterparty risk or the risk of default is quite low
  - Products are liquid and can be easily traded

# Call and Put Options

- An option gives the holder the right to buy or sell the underlying security at, or before, a specified expiration date, at a pre-specified exercise (or strike) price
  - To the buyer/holder the contract is an option and not an obligation (unlike forwards and futures contracts)
  - A call option gives the right to purchase the underlying security
  - A put option gives the right to sell the underlying security

- To the option writer (or seller) the contract is an obligation
  - The writer of a call option has the obligation to sell the underlying security
  - The writer of a put option has the obligation to purchase the underlying security

# Call and Put Options

| Contract type | Buyer or Holder | Seller or Writer |
|---|---|---|
| Call option | *Right*, but no obligation, to *buy* the underlying security | *Obligation*, and not a right, to *sell* the underlying security if option exercised |
| Put option | *Right*, but no obligation, to *sell* underlying security | *Obligation*, and not a right, to *buy* the underlying security if option exercised |

Is a bought call option the same as, or similar to, a sold put option?
Is a bought put option the same as, or similar to, a sold call option?

# Call and Put Options

- American versus European options
  - An American option can be exercised at any time up to and including the expiration date
  - A European option can be exercised only at expiration

- American options are more common than European ones

- All else being the same, which option would you value more?

# Payoff and Profit on Call Options

- The payoff to a call option buyer is: $Max(S_T – X, 0)$
  - $S_T$ = Stock price at expiration
  - X = Exercise (or strike) price of the option

- The profit to a call option buyer is: $Max(S_T – X, 0) – C$
  - C = Call option price (or premium)

- $Max(S_T – X, 0)$ means…
  - If $S_T – X > 0$ then $Max(S_T – X, 0) = S_T – X$
  - If $S_T – X$ 0 then $Max(S_T – X, 0) = 0$
  - The payoff from an option cannot be negative!

Note that the payoff and profit to a call option seller (or writer) are the negatives of the above

# Payoff and Profit on Put Options

- The payoff to a put option buyer is: $\text{Max}(X - S_T, 0)$
  - $S_T$ = Stock price at expiration
  - X = Exercise (or strike) price of the option

- The profit to a put option buyer is: $\text{Max}(X - S_T, 0) - P$
  - P = Put option price (or premium)

- $\text{Max}(X - S_T, 0)$ means…
  - If $X - S_T > 0$ then $\text{Max}(X - S_T, 0) = X - S_T$
  - If $X - S_T$ 0 then $\text{Max}(X - S_T, 0) = 0$
  - The payoff from an option cannot be negative!

Note that the payoff and profit to a put option seller (or writer) are the negatives of the above

# Moneyness of Options

- At-the-money option: Current spot price, $S_t$ = Exercise price (X)

- In-the-money option: If profitable to exercise at the spot price
  - Call option: Current spot price, $S_t$ > Exercise price (X)
  - Put option: Current spot price, $S_t$ < Exercise price (X)

- Out-of-the-money option: If unprofitable to exercise at the spot price
  - Call option: Current spot price, $S_t$ < Exercise price (X)
  - Put option: Current spot price, $S_t$ > Exercise price (X)

- Breakeven prices are where the profit to the buyer is zero
  - Call option: Exercise price (X) + Option premium (or price, C)
  - Put option: Exercise price (X) – Option premium (or price, P)

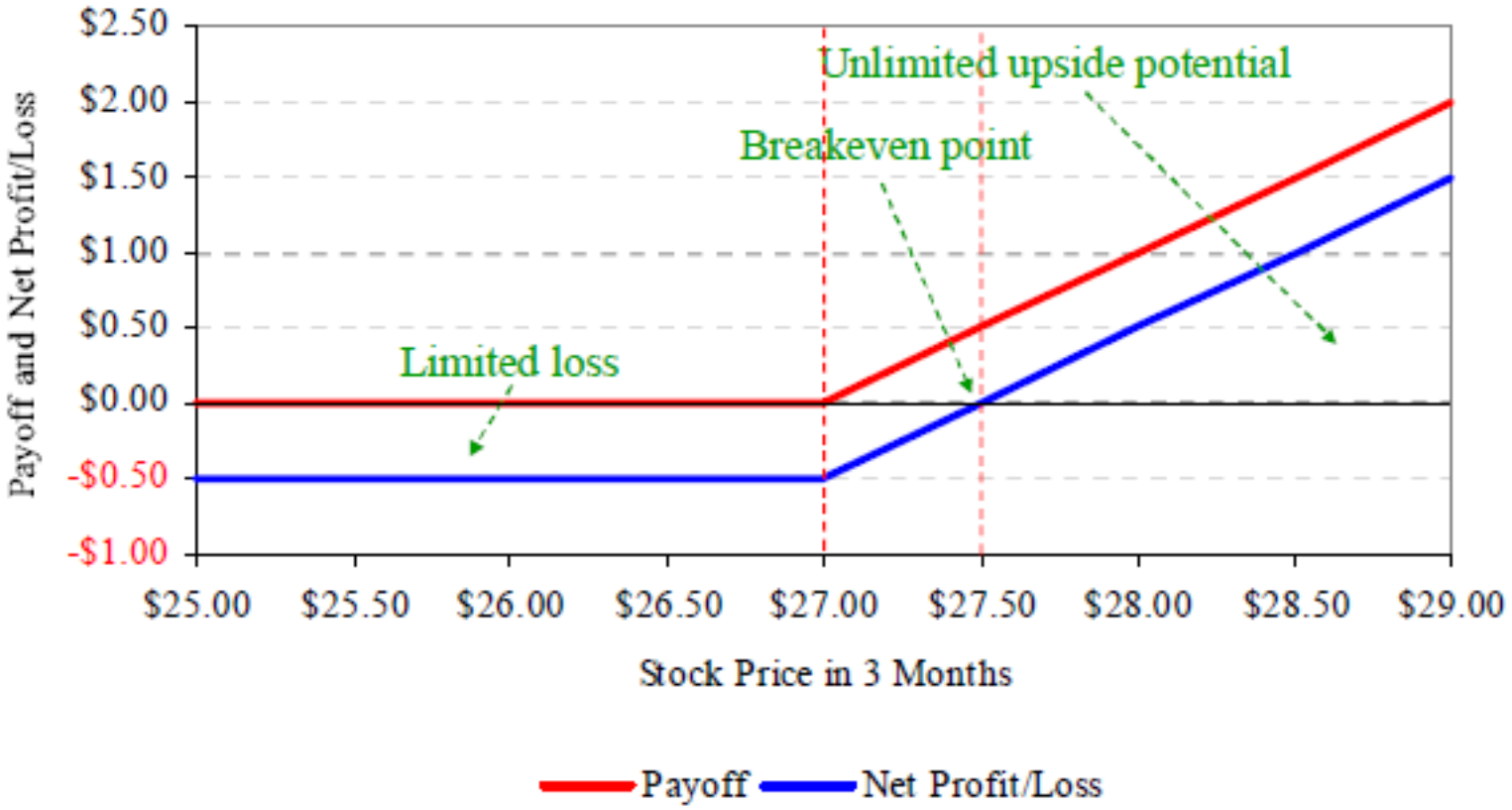
# Payoff and Profit on Long Call Options

Example: You purchase a call option on ANZ Bank shares expiring in three months' time at a premium of $0.50. The exercise price of the call is $27 per share. What is the payoff and profit to the buyer if the price of ANZ's shares in three months is $25, $26, $27, $28 and $29?

Payoff to call option buyer = $\text{Max}(S_T - X, 0)$
Profit to call option buyer = $\text{Max}(S_T - X, 0) - C$

| Spot Price in 3 Months | Payoff | Profit |
|---|---|---|
| $25 | $0.00 | -$0.50 |
| $26 | $0.00 | -$0.50 |
| $27 | $0.00 | -$0.50 |
| $28 | $1.00 | $0.50 |
| $29 | $2.00 | $1.50 |

# Payoff and Profit on Long Call Option




What are your expectations regarding the future price of ANZ shares?

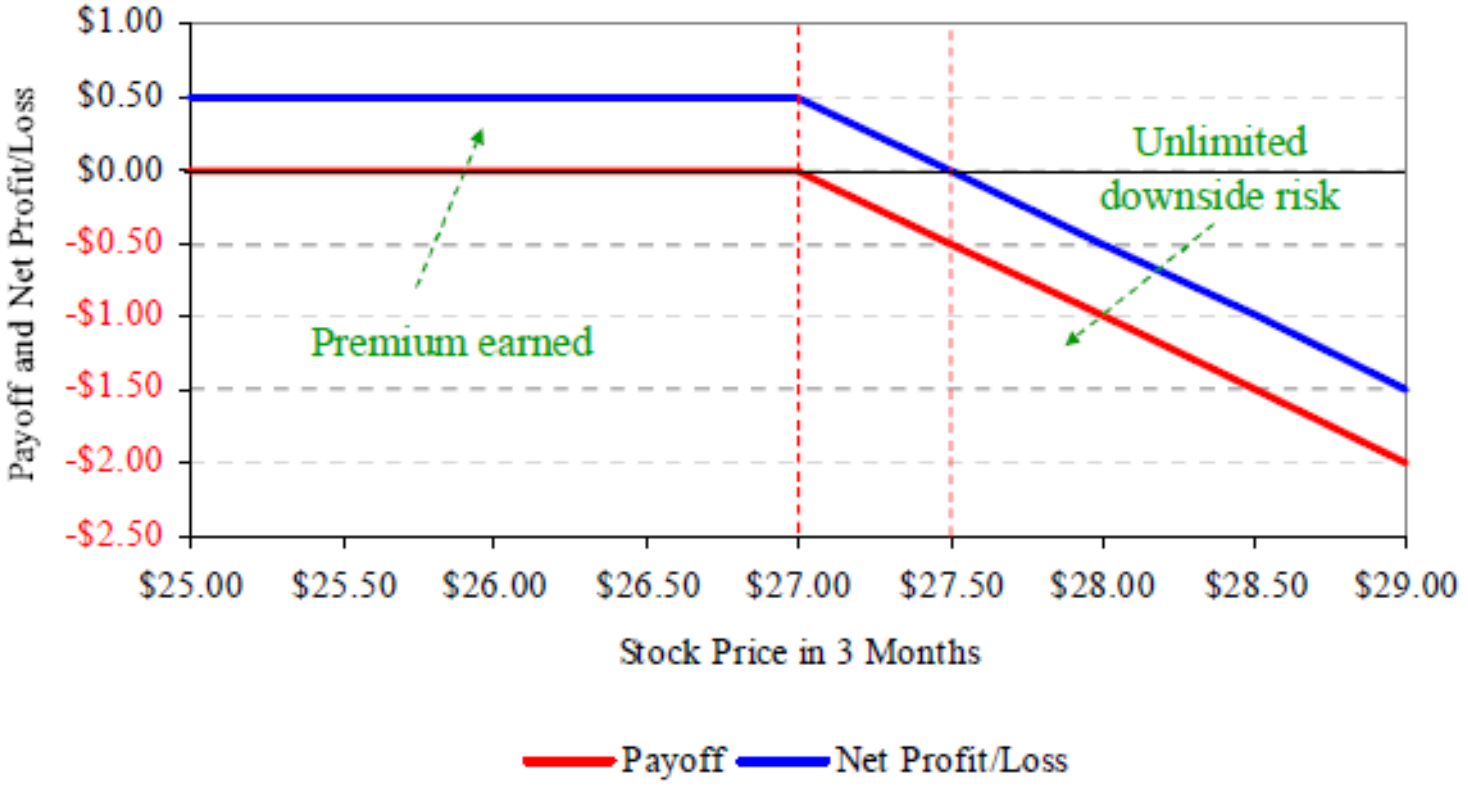
# Payoff and Profit on Short Call Option

Example (continued): If you are the seller of the call option in the previous example what would your payoff and profit be if the price of ANZ's shares in three months is \$25, \$26, \$27, \$28 and \$29?

Payoff to call option seller = $-\text{Max}(S_T - X, 0)$
Profit to call option seller = $C - \text{Max}(S_T - X, 0)$

| Spot Price in 3 Months | Payoff | Profit |
|---|---|---|
| \$25 | \$0.00 | \$0.50 |
| \$26 | \$0.00 | \$0.50 |
| \$27 | \$0.00 | \$0.50 |
| \$28 | -\$1.00 | -\$0.50 |
| \$29 | -\$2.00 | -\$1.50 |

# Payoff and Profit on Short Call Option




What are your expectations regarding the future price of ANZ shares?

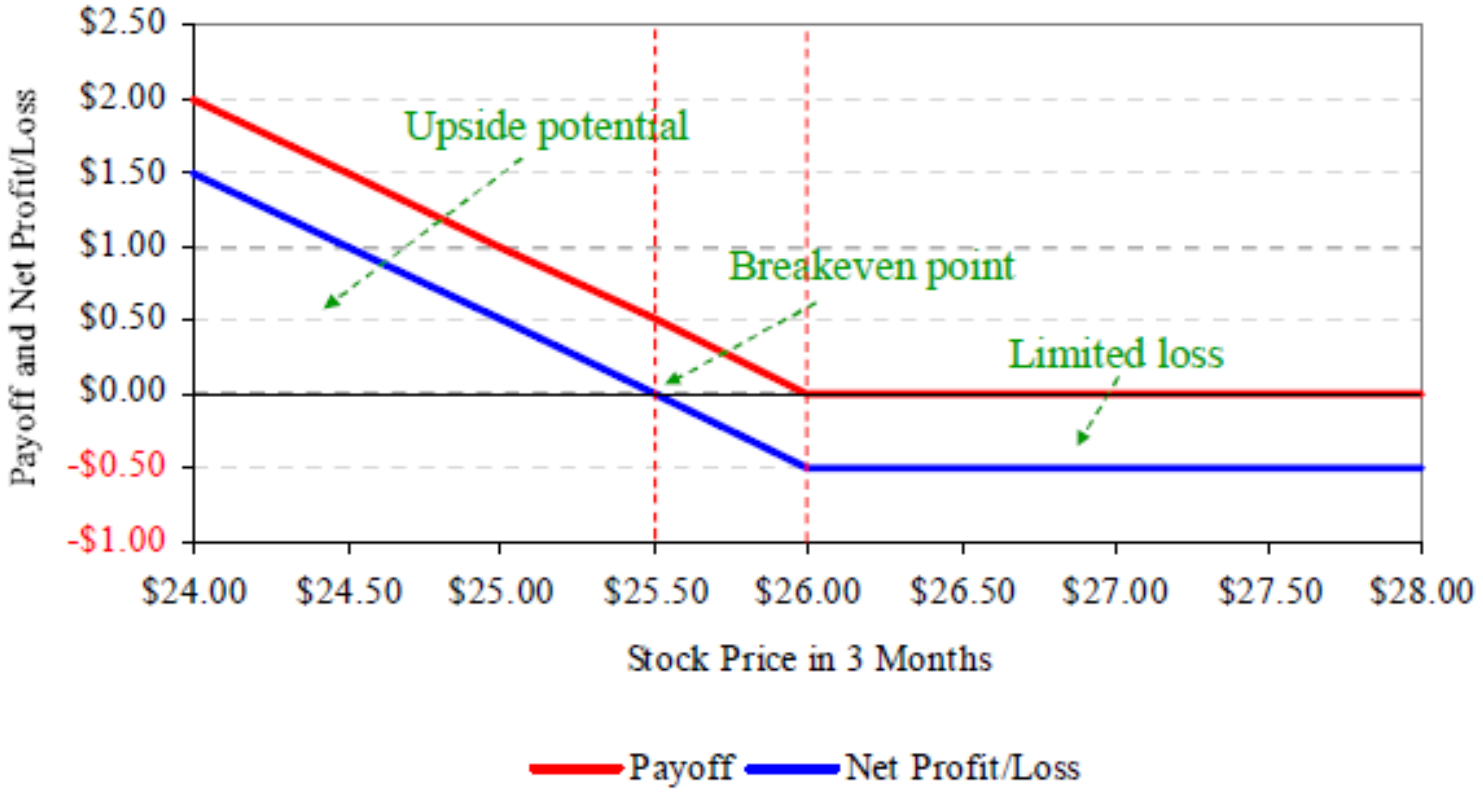
# Payoff and Profit on Long Put Option

Example: You purchase a put option on ANZ Bank shares expiring in three months' time at a premium of $0.50. The exercise price of the put is $26.00 per share. What's the payoff and profit to the buyer if the price of ANZ's shares in three months is $24, $25, $26, $27 and $28?

Payoff to put option buyer = $\text{Max}(X - S_T, 0)$
Profit to put option buyer = $\text{Max}(X - S_T, 0) - P$

| Spot Price in 3 Months | Payoff | Profit |
|---|---|---|
| $24 | $2.00 | $1.50 |
| $25 | $1.00 | $0.50 |
| $26 | $0.00 | -$0.50 |
| $27 | $0.00 | -$0.50 |
| $28 | $0.00 | -$0.50 |

# Payoff and Profit on Long Put Option




What are your expectations regarding the future price of ANZ shares?

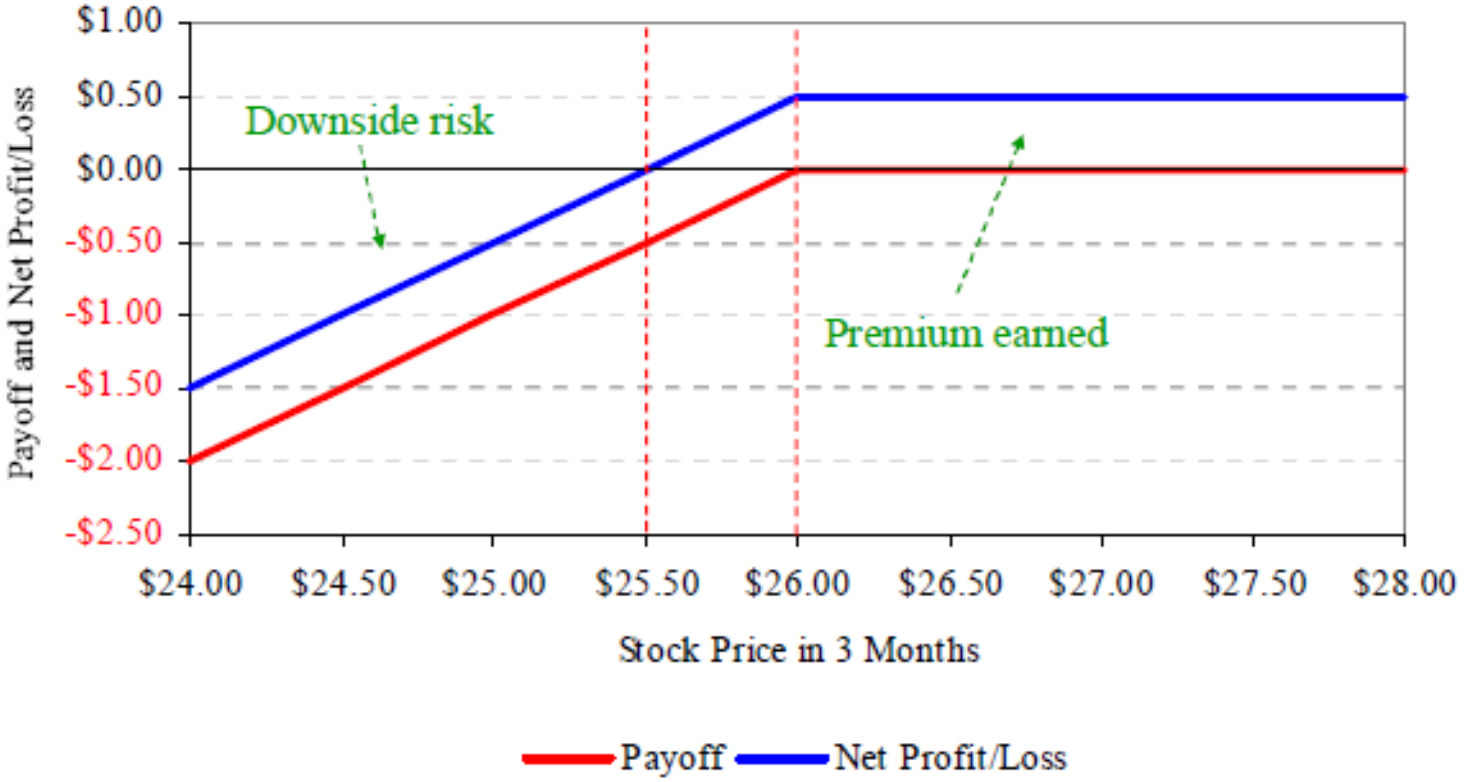
# Payoff and Profit on Short Put Option

Example (continued): If you are the seller of the put option in the previous example what would your payoff and profit be if the price of ANZ's shares in three months is \$24, \$25, \$26, \$27 and \$28?

Payoff to put option seller = $-\text{Max}(X - S_T, 0)$
Profit to put option seller = $P - \text{Max}(X - S_T, 0)$

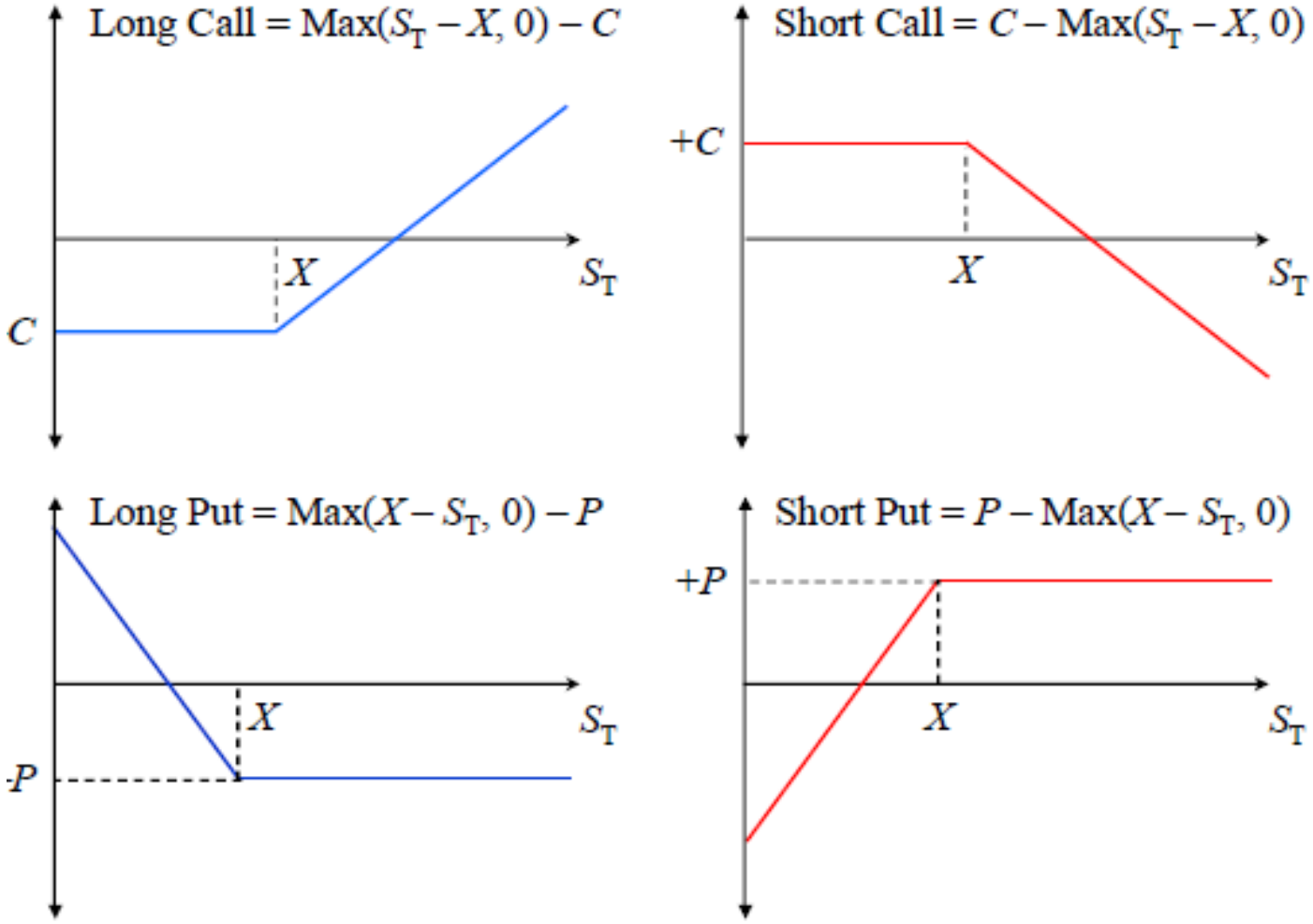
| Spot Price in 3 Months | Payoff | Profit |
|---|---|---|
| \$24 | -\$2.00 | -\$1.50 |
| \$25 | -\$1.00 | -\$0.50 |
| \$26 | \$0.00 | \$0.50 |
| \$27 | \$0.00 | \$0.50 |
| \$28 | \$0.00 | \$0.50 |

# Payoff and Profit on Short Put Option




What are your expectations regarding the future price of ANZ shares?

# Summary of Profits on Option Contracts



THE WALL STREET JOURNAL.

# LISTED OPTIONS QUOTATIONS

Tuesday, February 21, 2006

| OPTION/STRIKE | | EXP | -CALL- VOL | -CALL- LAST | -PUT- VOL | -PUT- LAST |
|---|---|---|---|---|---|---|
| Amazon | 35 | Jul | ... | ... | 1,758 | 1.75 |
| 38.29 | 37.50 | Mar | 1,015 | 1.85 | 2,083 | 0.70 |
| 38.29 | 37.50 | Apr | 231 | 2.50 | 902 | 1.25 |
| 38.29 | 40 | Mar | 1,072 | .50 | 1,155 | 2.10 |
| 38.29 | 40 | Apr | 1,219 | 1.15 | 969 | 2.55 |
| 38.29 | 42.50 | Mar | 2,708 | .10 | 144 | 4.10 |
| 38.29 | 45 | Mar | 2 | .05 | 27,662 | 6.50 |
| 38.29 | 45 | Jul | 112 | 1.25 | 1,762 | 7.20 |
| 38.29 | 50 | Apr | 12 | .05 | 6,002 | 11.60 |

- Last recorded price $38.29

- Options are traded on Amazon at exercised prices of $35 through $50 (strike prices)

- At any time both in-the-money and out-of-money options will
be listed (as in Amazon).

- Volume, number of contracts traded

- Closing price for the *call and put*

• The value of the *call is lower when the exercise price is higher,* for the same maturity.

  • Ex: The March maturity AMAZON call option with a strike price $37.5 sells for $1.85, $40/$0.50, $42.5/$0.10 and $45/$0.05

    • The right to buy a share at a give exercise price is not as valuable when the purchase price is higher

• Conversely, the value of a *put is higher when the exercise price* is higher, for the same maturity

  • Ex: The March maturity AMAZON put option with a strike price $37.5 sells for $0.70, $40/$2.10, $42.5/$4.10 and $45/$6.50

    • The right to sell a share at a give exercise price is more valuable when the purchase price is higher

# Factors in call option value (resume)

| Increase in factor | Effect on call value |
|---|---|
| ❑ Stock price | ❑ Increases |
| ❑ Exercise price | ❑ Decreases |
| ❑ Volatility of stock price | ❑ Increases |
| ❑ Time to expiration | ❑ Increases |
| ❑ Interest rate | ❑ Increases |
| ❑ Dividend Rate | ❑ Decrease |

# Key Concepts

- An option gives the holder the right to buy or sell the underlying security at, or before, a specified expiration date, at a pre-specified exercise (or strike) price

- A call option gives the right to purchase the underlying security

- A put option gives the right to sell the underlying security

- To the option writer (or seller) the contract is an obligation

- American options can be exercised at any time up to and including the expiration date while European option can be exercised only at expiration

- In the money options are profitable to exercise now while at or out of the money options are not profitable to exercise now

http://www.surveymonkey.com/s/MSWLY7H

# The Put-Call Parity

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

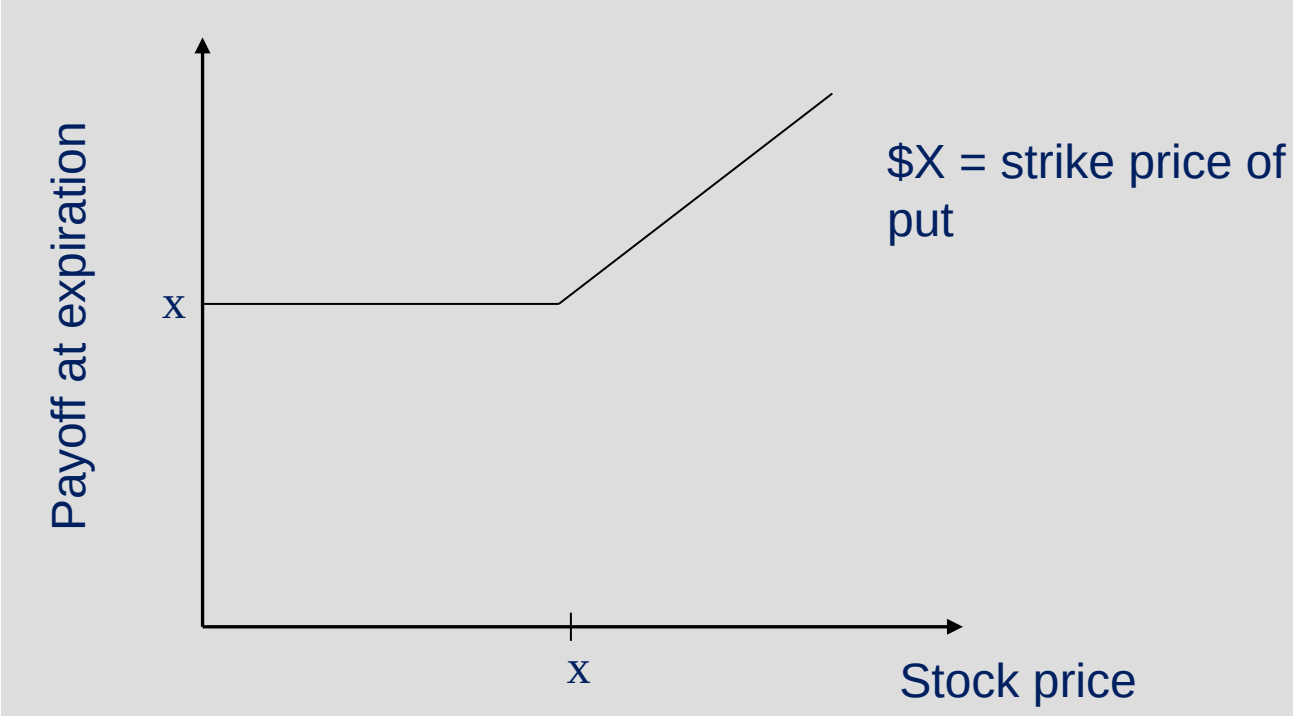
- Put and call have same exercise price and expiration date;
- Underlying Shares pays no dividends during life of options;
- Put and call are European options;
- Bond is risk-free, zero-coupon, price at maturity = strike (X),
- Bond matures when options expire.

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

http://www.surveymonkey.com/s/MSWLY7H

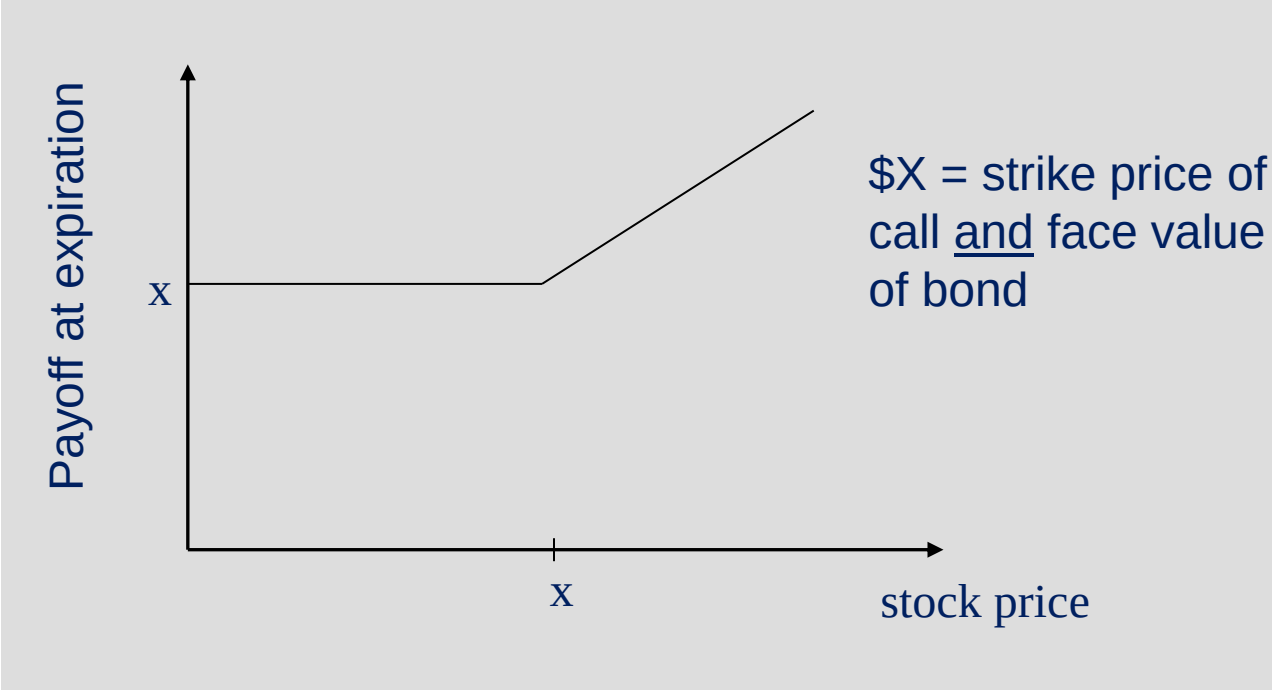
# Gross Payoff of Stock + Put




This position allows an investor to profit if stock price rises above $X.
If stock price falls below $X the portfolio provides protection in that the put option allows the investor to sell at a price no lower than $X.

http://www.surveymonkey.com/s/MSWLY7H

# Gross Payoff of Bond + Call




This payoff diagram and the one before are identical!

# Factors Affecting Option Prices (holding other factors equal)

| | |
|---|---|
| Price of underlying asset | Asset price and call price are positively related.<br>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.<br>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 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

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

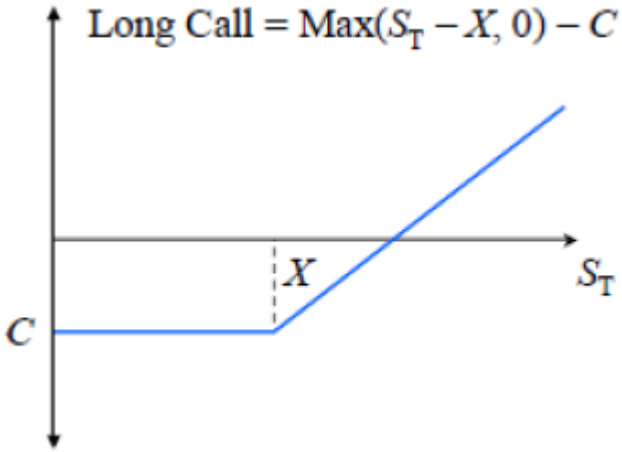
12 > 10

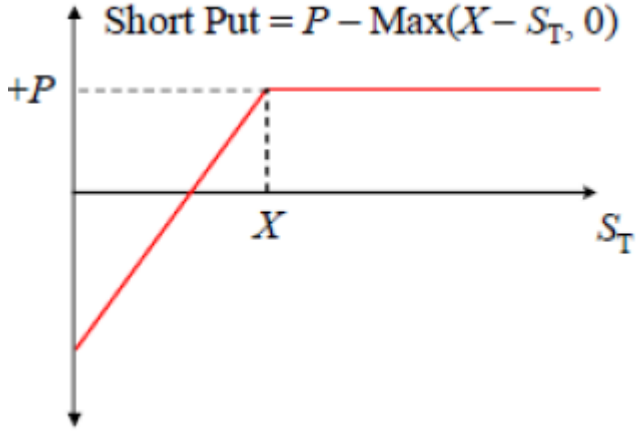
# Synthetic Positions

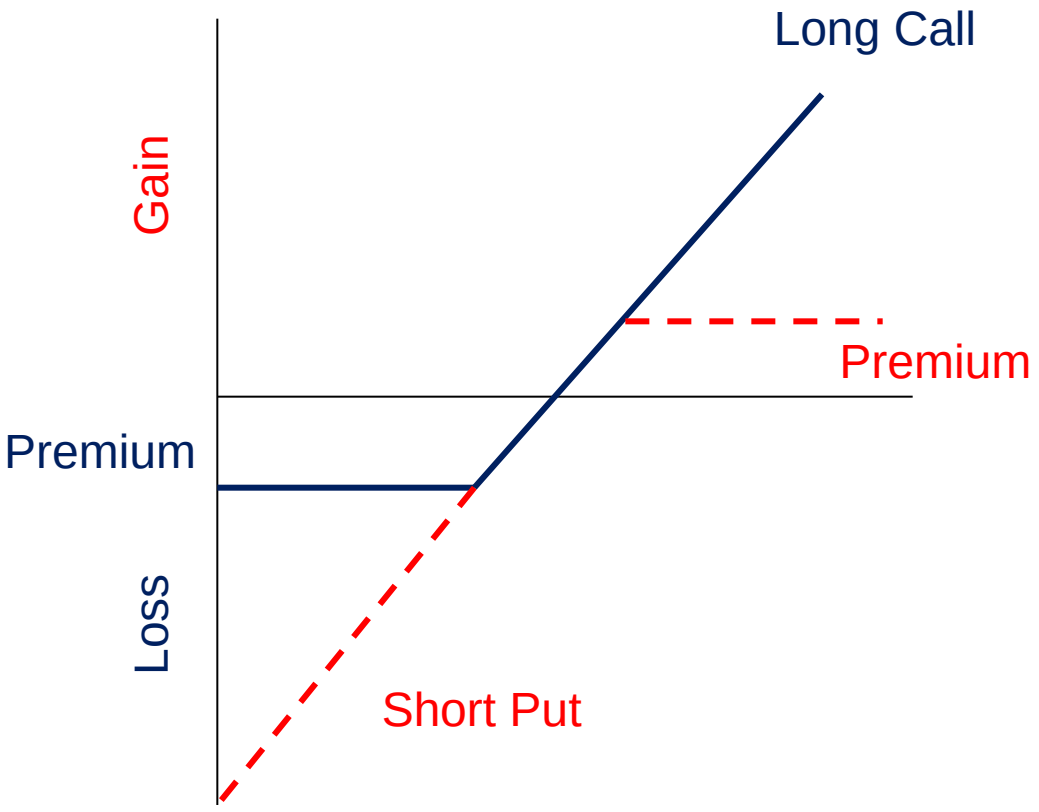
Way to create the payoff of a financial instrument using other financial instruments.

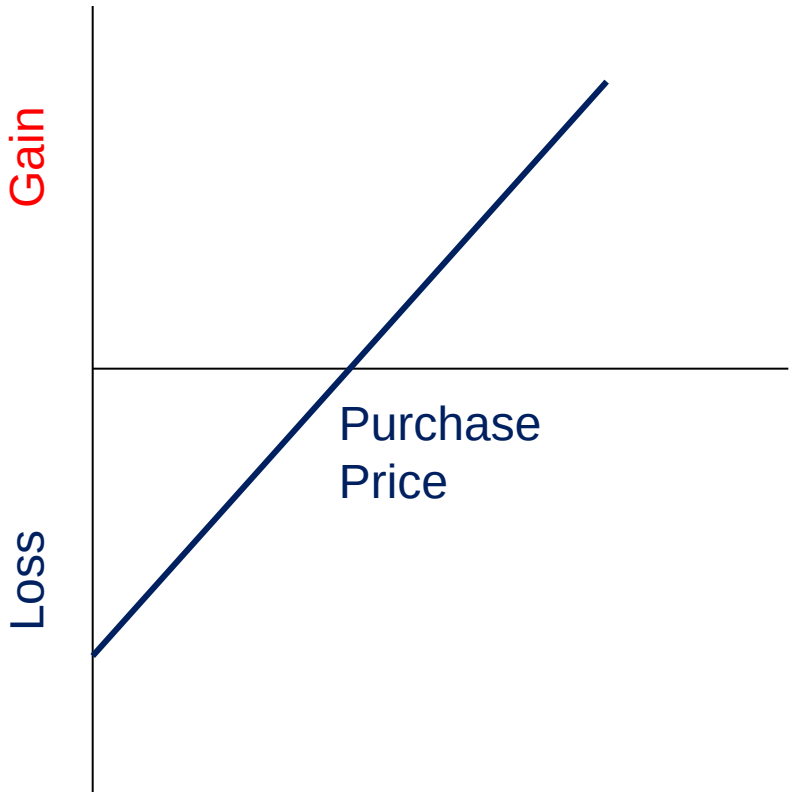
## The Synthetic Long Position

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

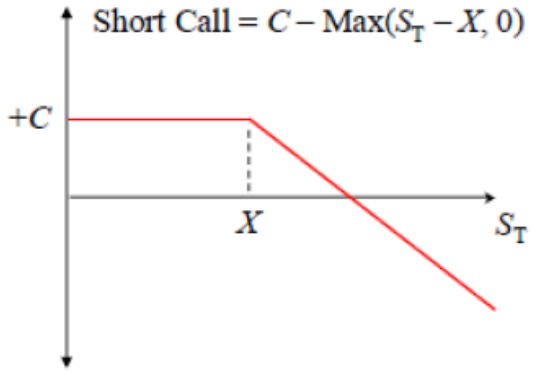
Selling (short) a call and simultaneously buying (long) a put with a similar exercise prices on the same underlying stock creates a Synthetic Short Position.

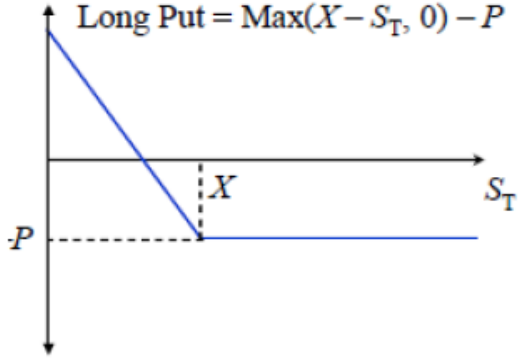
More desirable than a traditional short position for 3 reasons:

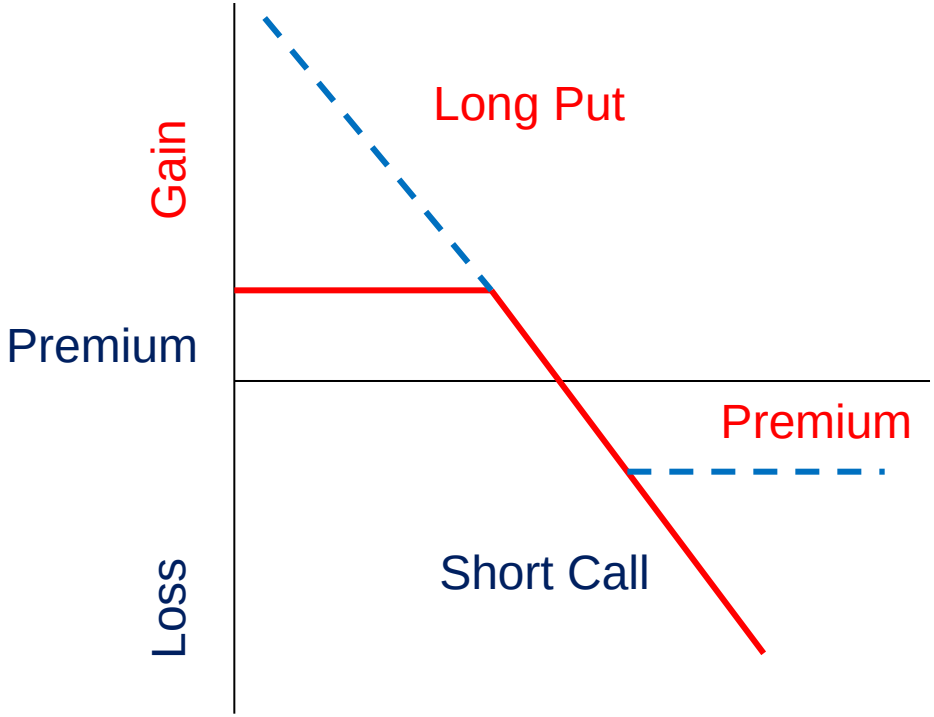
1) The option position is superior since the call premium is higher than the put premium.
2) Synthetic short position brings more leverage. Short sales require an initial margin and a synthetic shorter position involves a smaller investment.
3) Synthetic short seller does not have to pay dividends.

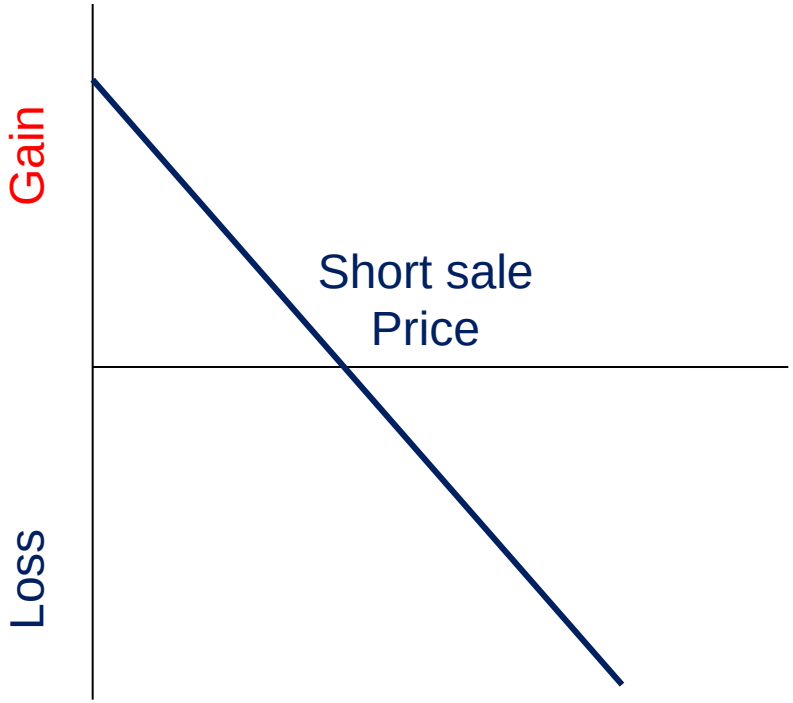
Disadvantages:

- 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:

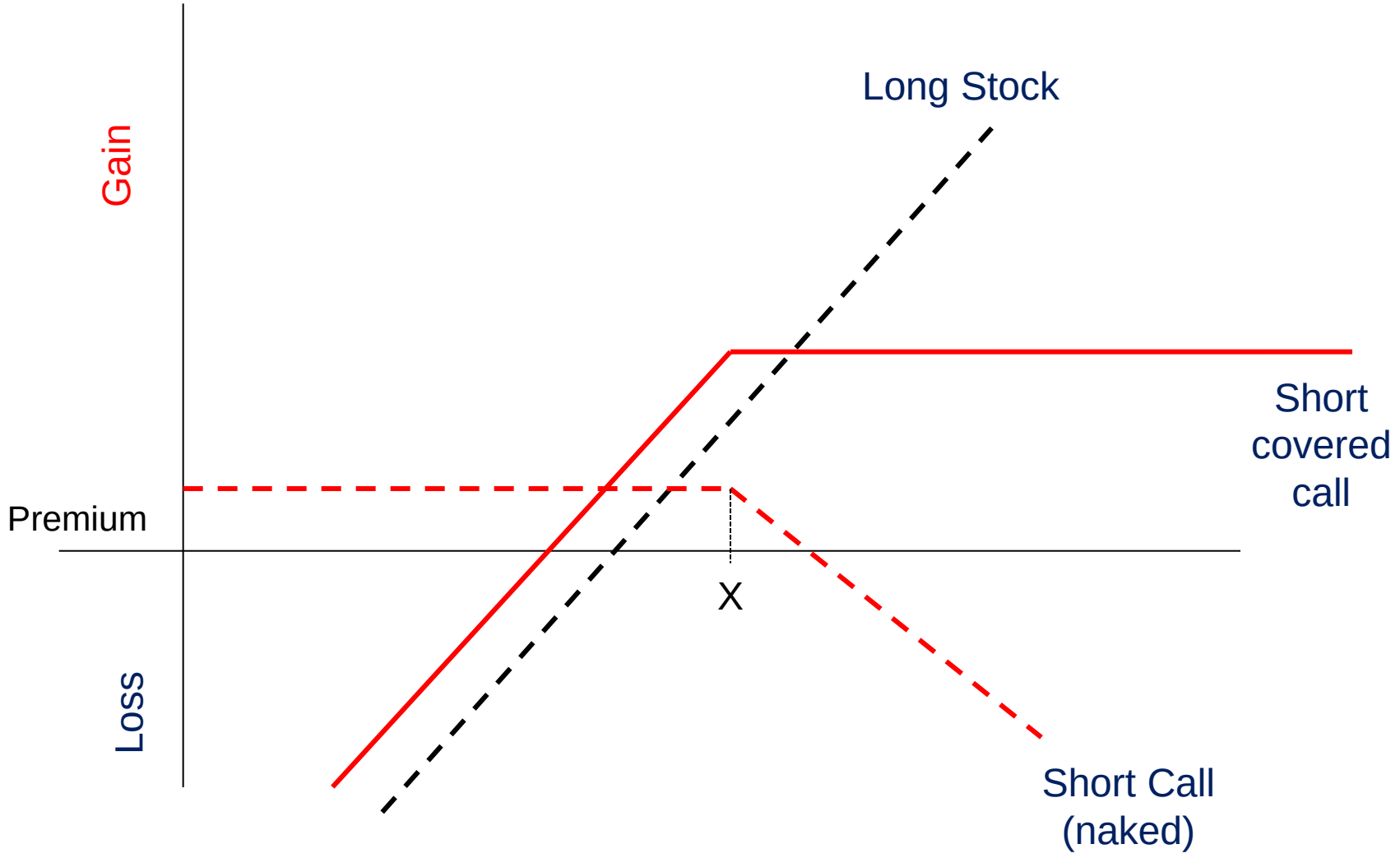
As value of stock falls, loss is partially offset by premium received on calls sold.

Essentially costless since hedge generates a cash inflow

Bad:

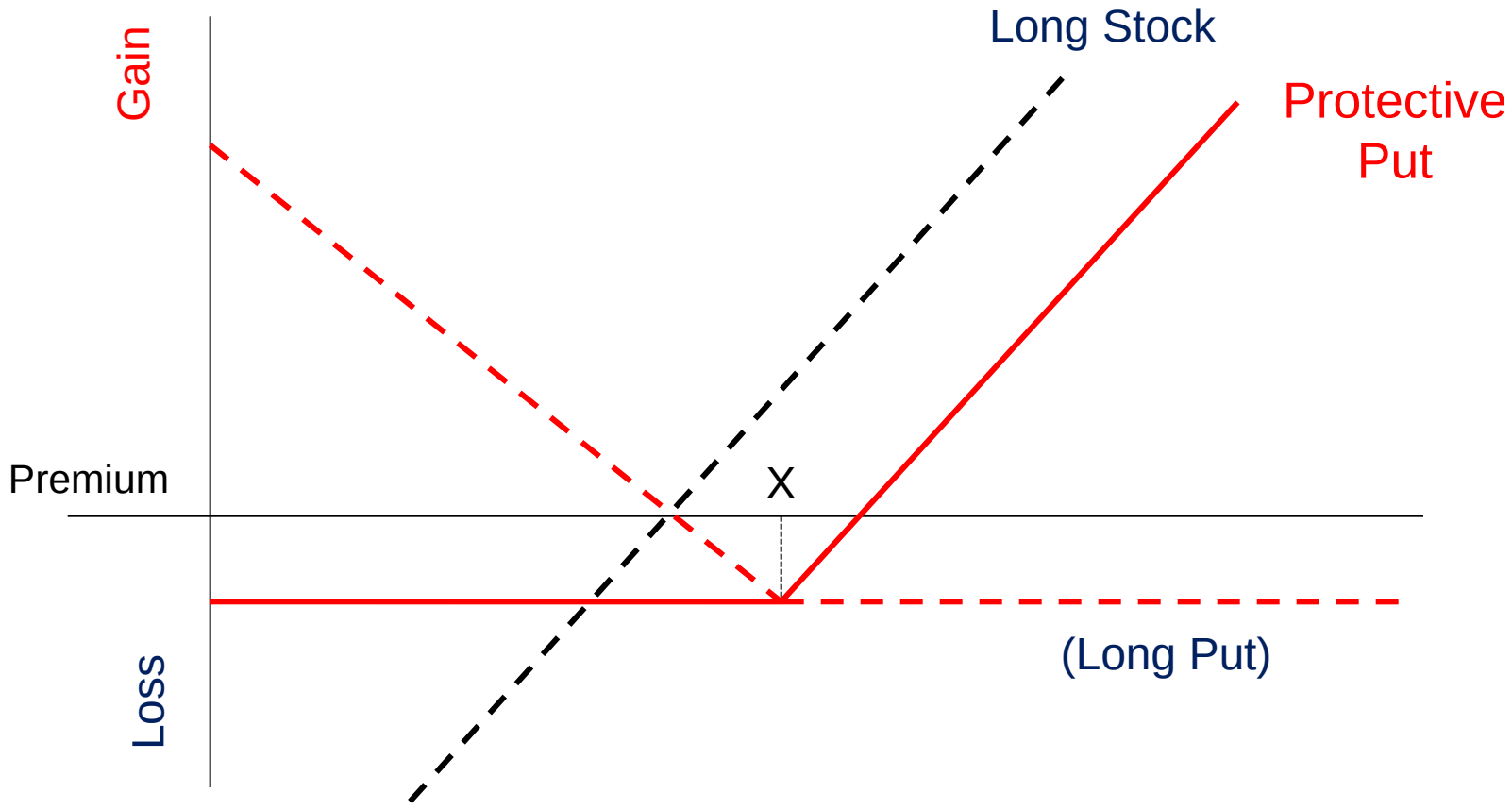
Maximum inflow from call = premium; Hedge is less effective for large drop in stock price

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

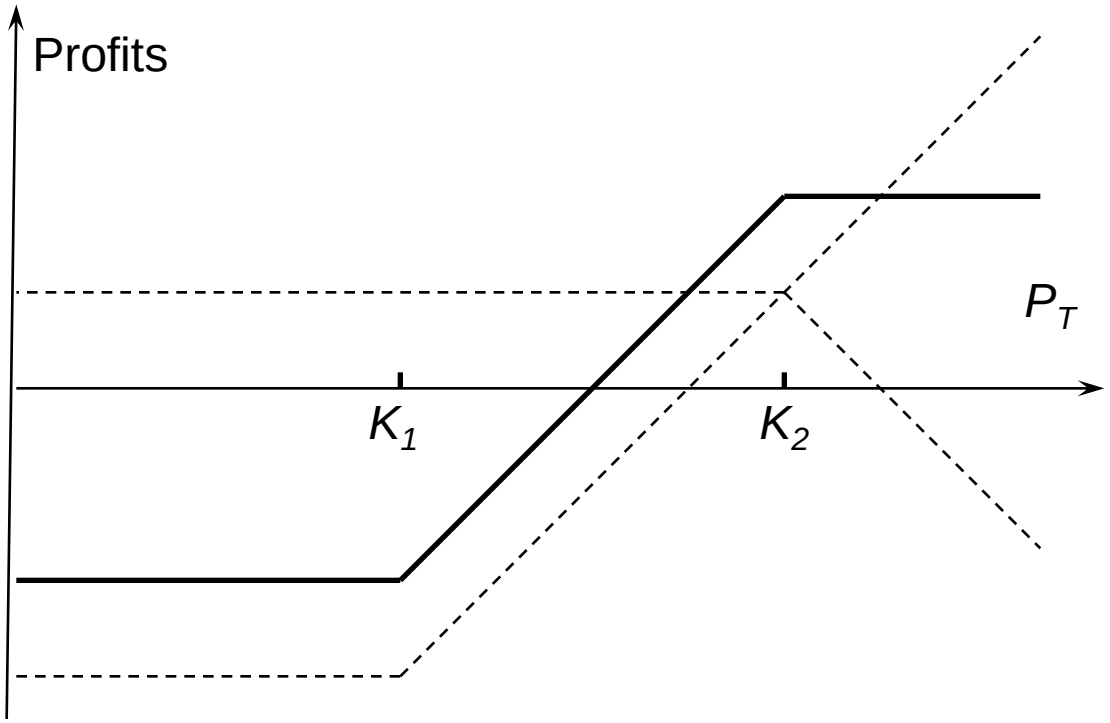
## long stock position combined with a long put position



# 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 |
|---|---|---|---|
| $S_T \geq K_2$ | $S_T - K_1$ | $K_2 - S_T$ | $K_2 - K_1$ |
| $K_1 < S_T < K_2$ | $S_T - K_1$ | 0 | $S_T - K_1$ |
| $S_T \leq K_1$ | 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.

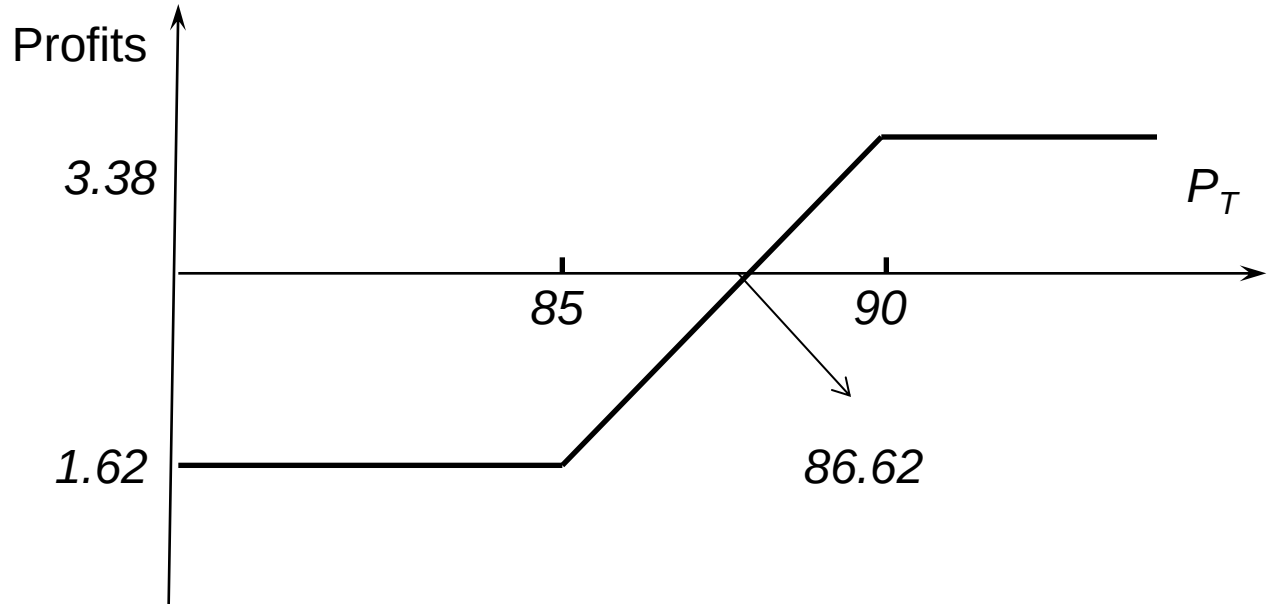
With all spreads the maximum gain and loss occur at the striking prices

It is not necessary to consider prices outside this range

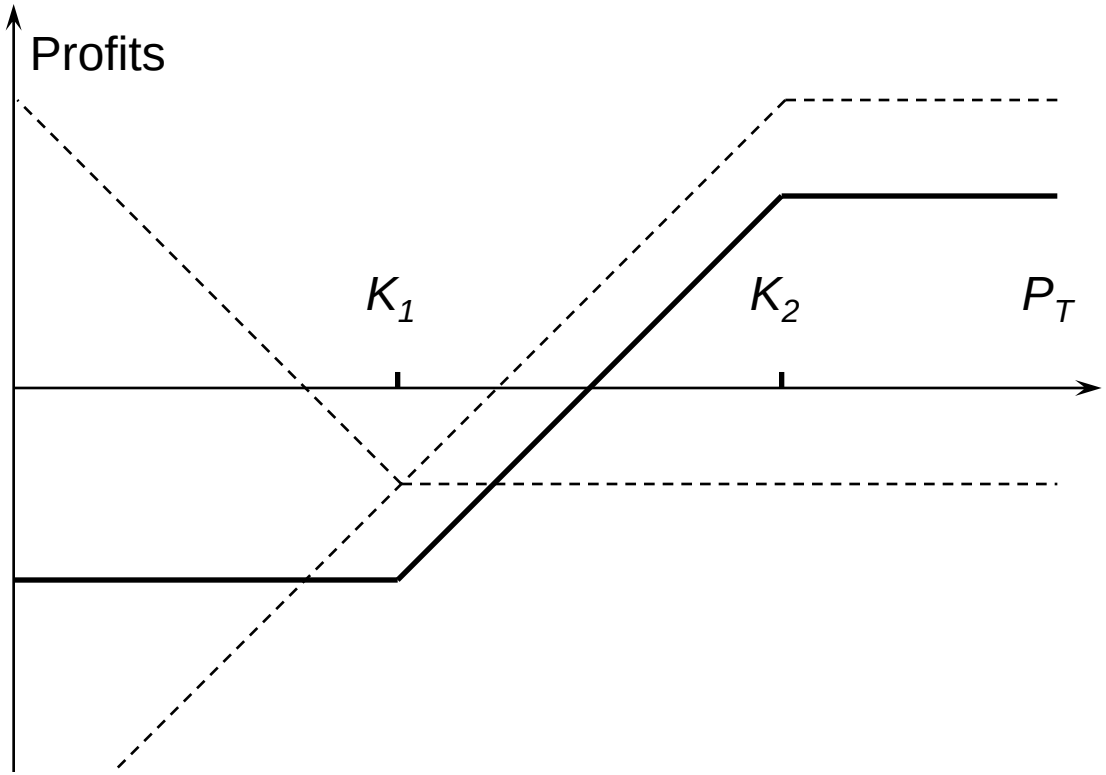
With an 85/90 spread, you only need to look at the stock prices from $85 to $90

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

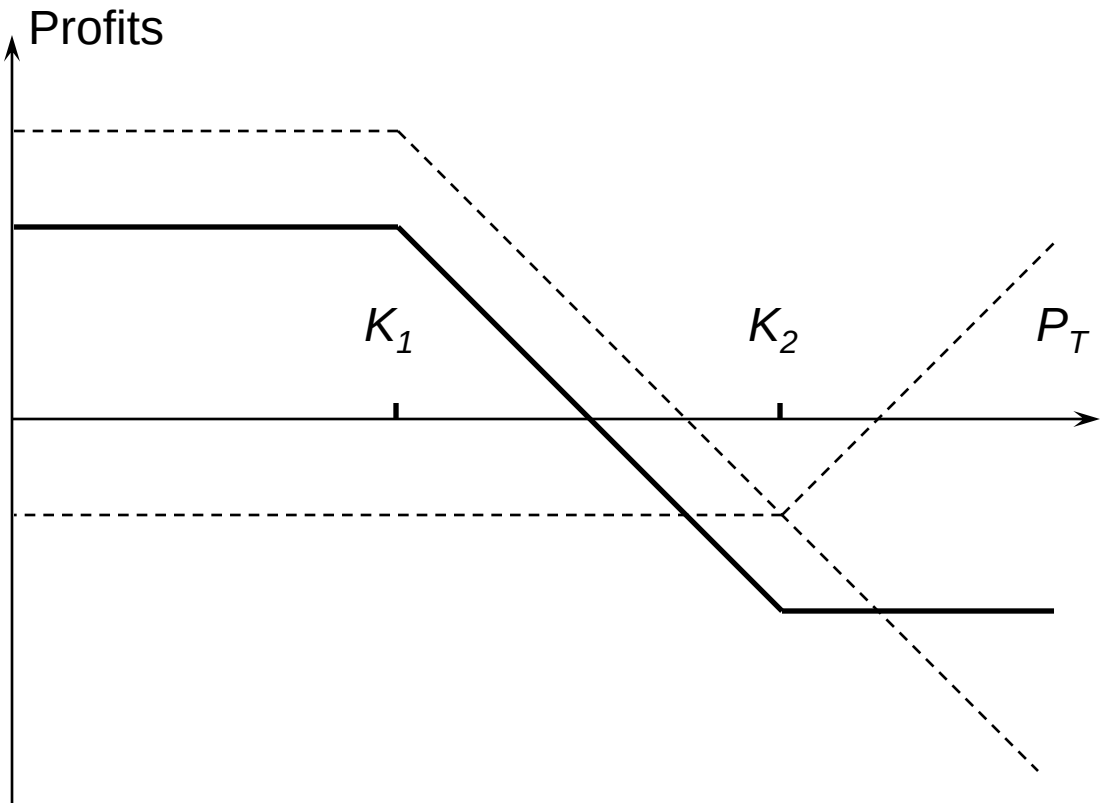
The maximum profit occurs with falling prices

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

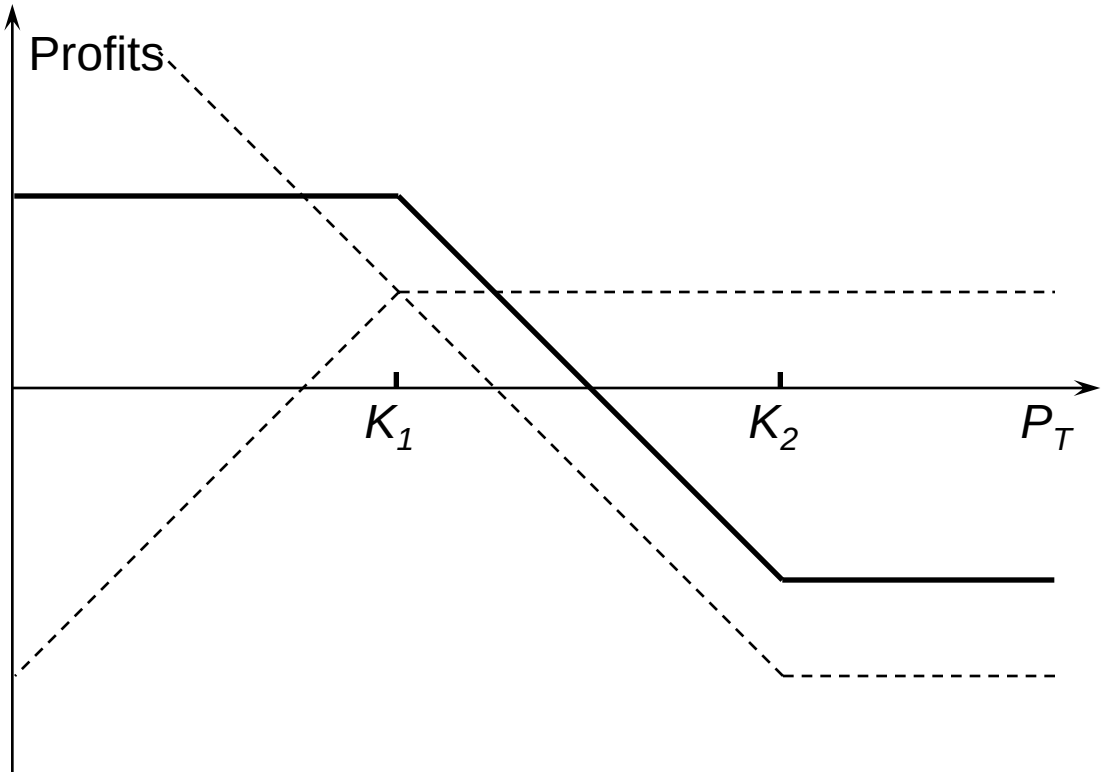
| Stock Price range | Payoff from long call option | Payoff from short call option | Total payoff |
|---|---|---|---|
| $ST \geq K2$ | $ST - K2$ | $K1 - ST$ | $-(K2 - K1)$ |
| $K1 < ST < K2$ | 0 | $K1 - ST$ | $-(ST - K1)$ |
| $ST \leq K1$ | 0 | 0 | 0 |

## 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

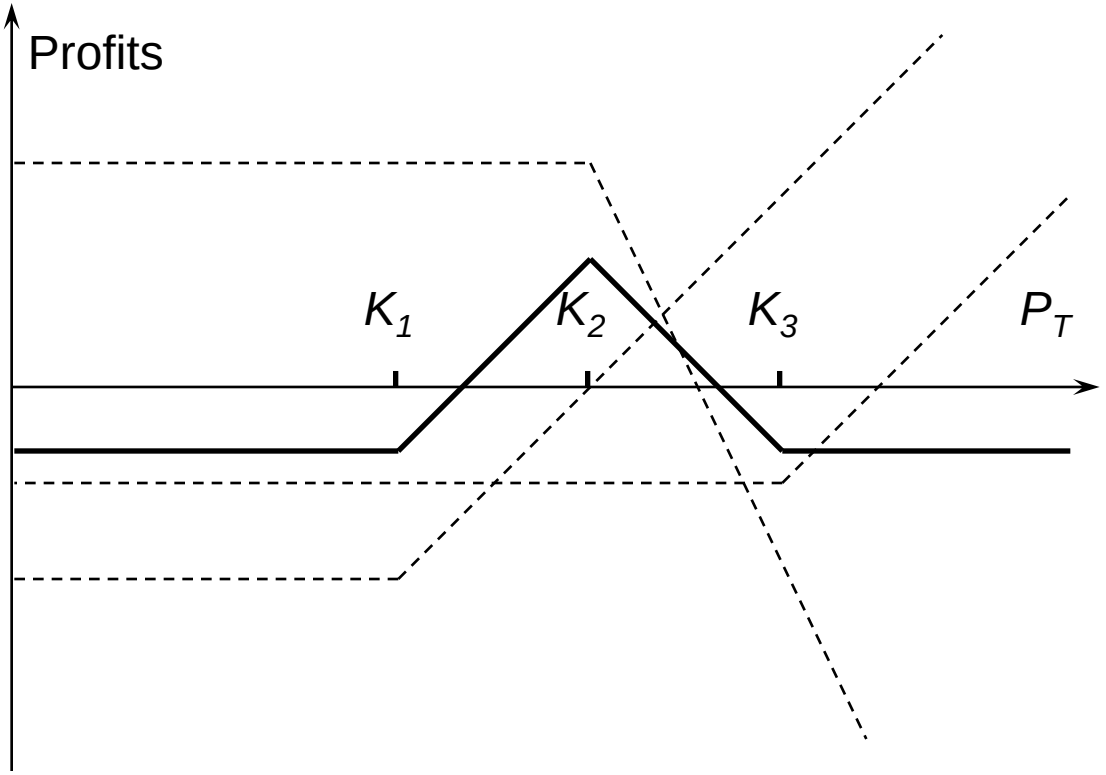
In a *bullspread,* the spreader will buy a call with a distant expiration and write a call that is near expiration

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