# Lecture 14: Options

ECON435: Financial Markets and the Macroeconomy

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## Derivative Securities

Derivative Securities (or "derivatives"):

- price depends on (derives from) another security, e.g. stocks
  → "contingent" securities
- useful for both hedging and speculation

Main Categories:

- Options
- Futures
- Swaps



## Definition of Options

**Call** Option = right to **buy** an *underlying security*

- at a specified price: *exercise* or *strike price*
- on or before the *maturity date* or *expiration date*

Premium or purchase price = compensation to the seller for "writing" (= selling) the option



## Definition of Options

**Put** Option = right to **sell** an *underlying security*

- at a specified price: *exercise* (or *strike price*)
- on or before the *maturity date* (or *expiration date*)

**Note:**

- holder will exercise the option to buy the security only if market price > strike price
  → make profit
- no obligation for holder to exercise
  → can let the option expire: value is zero



## Option Terminology

- "In the money"
  - option can be exercised profitably
- "At the money"
  - market price = exercise price
  - → investor indifferent
- "Out of the money"
  - exercising the option would not be profitable



## Options Trading

- OTC → offers more flexibility
- On exchanges, e.g.
  - Chicago Board Options Exchange (CBOE)
  - International Securities Exchange (ISE)
  - → more liquid, cheaper

Clearinghouse: Options Clearing Corporation

- becomes counterparty to each buyer/writer
- guarantees contract performance
- imposes margin requirement on writer

## American vs. European Options

European option: can only be exercised at the maturity date

American option: can be exercised at any time before maturity

BUT: typically this is not done
→ the holder would lose the *time value* of the option (i.e. the chance to profit from future price increases)



## Examples of Option Contracts

- Stock options
- Index options
- Futures options
- Foreign currency options
- Interest rate options
- Commodity price options
- …



## Notation of Option Contract

$S_T$ = Stock Price
X = Exercise Price

Payoff to holder of call option:
$S_T - X$ if $S_T > X$
0 if $S_T \leq X$

Cost to writer of call option:
$-(S_T - X)$ if $S_T > X$
0 if $S_T \leq X$



## Option Premium

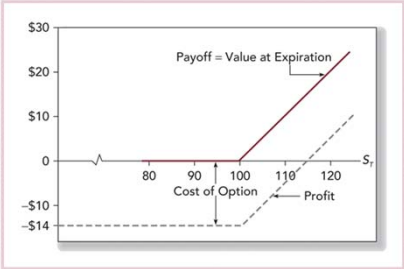
Buyer needs to compensate writer of option by paying a premium (purchase price)

→ Total profit for holder: payoff – premium
→ Total profit for writer: premium – payoff

Example: Call option on Apple shares
- Strike price: $100
- Premium: $14

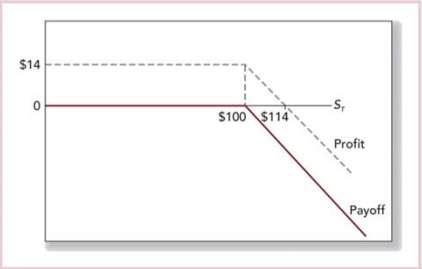


## Payoff to the Option Holder

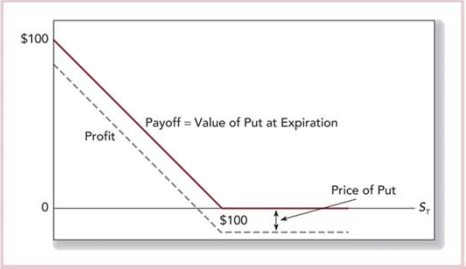





## Payoff to the Option Writer



## Payoff of a Put Option






## Risks of Option Investing

**Buying an option leads to:**

- large gains if shares move in the right direction
- a total loss if shares move in the wrong direction

**Writing an option leads to:**

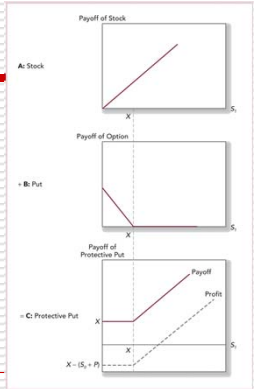
- immediate income from the premium received
- no losses if shares move in the right direction
- unlimited losses if shares move in the wrong direction



## Protective Put

Protective Put Strategy:

- owning a stock
- buying a put to hedge against price declines
- → potential losses are limited
- → gains are reduced by premium
- → "portfolio insurance"

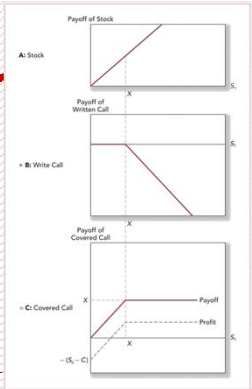



## Covered Call

Covered Call Strategy:

- owning a stock
- writing a call option
- → obtain premium income
- → potential gains are limited by call option

**Note:** the call option is "covered" by the shares owned, as opposed to "naked" option writing



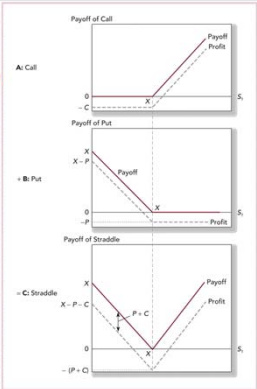

## Straddle

Straddle = buying

- a call option and
- a put option

on the same stock with identical strike price

- → gain if stock moves sharply up or down
- → loss of premium if stock doesn't move much




## Put-Call Parity

Two strategies with identical payoffs:

- holding a call option with strike price X and T-bills that pay out X
- a stock and a put option on it with strike price X (protective put portfolio)
- → need to trade at identical price

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

## Put-Call Parity: Example

Stock Price = 110 Call Price = 17
Put Price = 5 Risk Free = 5%
Maturity = 1 yr Strike = 105

117 > 115

→ sell call and buy put to make a risk-less arbitrage profit of $2



## Payoffs of Arbitrage Strategy

| Position | Immediate Cash Flow | Cash Flow in 1 year | |
|---|---|---|---|
| | | $S_T < 105$ | $S_T \geq 105$ |
| Buy stock | −110 | $S_T$ | $S_T$ |
| Borrow $105/1.05 = $100 | +100 | −105 | −105 |
| Sell call | +17 | 0 | $-(S_T - 105)$ |
| Buy put | −5 | $105 - S_T$ | 0 |
| *TOTAL* | 2 | 0 | 0 |