

Options Markets: Introduction

Chapter 20

Option Contracts

- **call option** = contract that gives the holder the right to *purchase* an asset at a specified price, on or before a certain date
- **put option** = contract that gives the holder the right to *sell* an asset at a specified price, on or before a certain date
- key feature: the holder is *not* required to exercise the option, but can *choose* to do so or not → the holder has to pay for this right
- the holder has a *long* position in the option, the seller of the option has the *short* position

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Key Elements of Options

- **exercise (strike) price** = the price at which the asset is traded when the option is exercised
- **expiration date** = the last date the option can be exercised on
- **premium** = purchase price of option (paid when the option is purchased, regardless of whether the option is exercised or not)
- **writer** = person initially selling the option
- **American option** = the holder can exercise the option any time *on or before* the expiration date
- **European option** = the holder can exercise the option *only* on the expiration date

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“Moneyiness”

- **in the money** = the option is worth exercising
- **out the money** = the option is not worth exercising
- **at the money** = the holder is indifferent between exercising the option or not
- the moneyiness of an option is given by the relationship between the exercise price and the current price of the stock and the type of option
- moneyiness is not related to *positive* profits, but to whether the option is exercised or not

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Underlying Assets

- stock options are the common options
- *index options* = options based on the value of an index → the execution is done by cash settlement
- *futures options* = the holder has the right to buy or sell a specified futures contract, with the price of the futures as exercise price
- *foreign currency options* = the holder can buy or sell a certain sum of foreign currency for a certain sum of domestic currency
- *interest rate options* = options based on debt securities

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Call Options

■ Value at expiration (payoff)

- a call option will be executed only if the exercise price is lower than the ongoing price of the stock
- hence, the value of the option at expiration is

$$\text{Payoff to call holder} = \begin{cases} S_T - X, & \text{if } S_T > X \\ 0, & \text{if } S_T \leq X \end{cases}$$

where S_T is the "current price" of the stock, and X is the exercise price

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Call Options (cont.)

■ Moneyness

- a call option is
 - *in the money* – if the exercise price is below the current price
 - *out the money* – if the exercise price is above the current price
 - *at the money* – if the exercise price is equal to the current price

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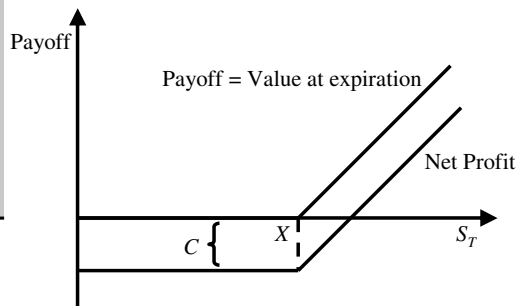
Call Options (cont.)

■ Profits

- for the holder of the call option, the net profit is
Profit = Value at expiration – Premium (C)
- notice that the holder might not get positive profit even if the option is exercised
- for the writer of the call option, the value at expiration and net profit are exactly the opposite those of the holder
Profit of writer = – Profit of holder
- writing a *naked call* (i.e., a call option without an offsetting position in the stock) exposes the investor to unlimited losses if stock price rises

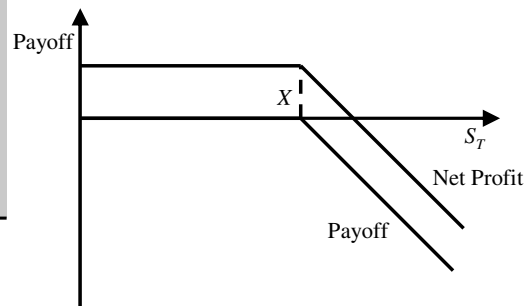
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Call Options – Holder



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Call Options – Writer



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Call Options – Example

- strike price: $X = \$100$
- premium: \$15

Value of stock (S_T)	Payoff	Profit for holder	Profit for writer
\$90	\$0	-\$15	\$15
\$100	\$0	-\$15	\$15
\$110	\$10	-\$5	\$5
\$120	\$20	\$5	-\$5

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Put Options

- Value at expiration (payoff)
 - a put option will be executed only if the exercise price is higher than the ongoing price of the stock
 - hence, the value of the option at expiration is

$$\text{Payoff to put holder} = \begin{cases} 0, & \text{if } S_T > X \\ X - S_T, & \text{if } S_T \leq X \end{cases}$$

where S_T is the "current price" of the stock, and X is the exercise price

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Put Options (cont.)

■ Moneyness

- a put option is
 - *in the money* – if the exercise price is above the current price
 - *out the money* – if the exercise price is below the current price
 - *at the money* – if the exercise price is equal to the current price

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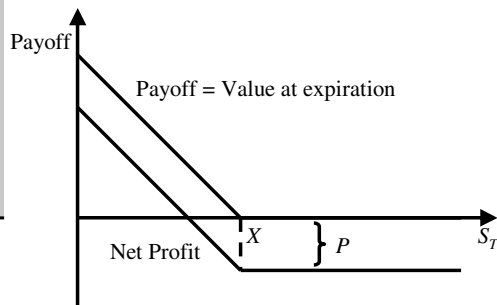
Put Options (cont.)

■ Profits

- for the holder of the put option, the net profit is
Profit = Value at expiration – Premium (P)
- for the writer of the put option, the value at expiration and net profit are exactly the opposite those of the holder
Profit of writer = – Profit of holder
- writing a *naked put* (i.e., a put option without an offsetting short position in the stock) exposes the investor to losses if the stock price falls

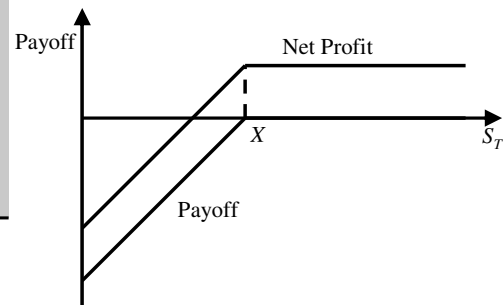
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Put Options – Holder



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Put Options – Writer



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Put Options – Example

- strike price: $X = \$100$
- premium: \$15

Value of stock (S_T)	Payoff	Profit for holder	Profit for writer
\$80	\$20	\$5	-\$5
\$90	\$10	-\$5	\$5
\$100	\$0	-\$15	\$15
\$110	\$0	-\$15	\$15

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Investments in Options

- purchasing call options or writing put options are *bullish* strategies (i.e., provide profits when stock prices increase)
- writing call options or purchasing put options are *bearish* strategies (i.e., provide profits when stock prices fall)
- as opposed to stock investments, investments in options provide better hedging opportunities
- also, remember that quotations and information about options are given *per share*, but an option contract is usually written for 100 shares

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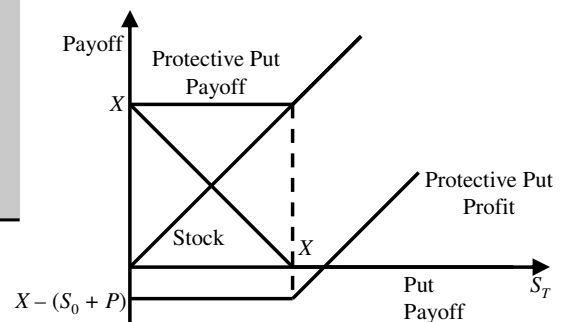
Option Strategies

- Protective Put
 - buy a stock and a put option on the stock at the same time
 - used to limit loss to a certain level (portfolio insurance) → used for *risk management*
 - value of protective put at expiration:

	$S_T \leq X$	$S_T > X$
Payoff of stock	S_T	S_T
Payoff of put	$X - S_T$	0
Total payoff	X	S_T

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Protective Put – Profit of Holder



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Option Strategies (cont.)

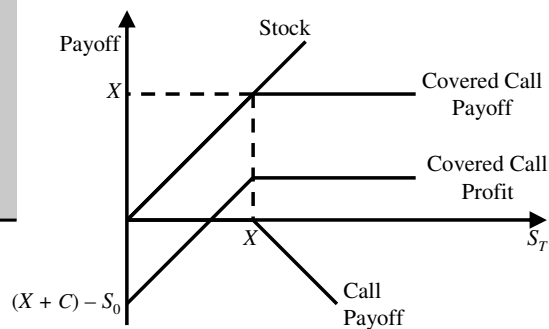
■ Covered Call

- buy a stock and sell a call option on the stock at the same time
- used for downside protection, at the expense of giving up gain potential
- value of protective put at expiration:

	$S_T \leq X$	$S_T > X$
Payoff of stock	S_T	S_T
Payoff of call	0	$-(S_T - X)$
Total payoff	S_T	X

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Covered Call – Profit of Holder



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Option Strategies (cont.)

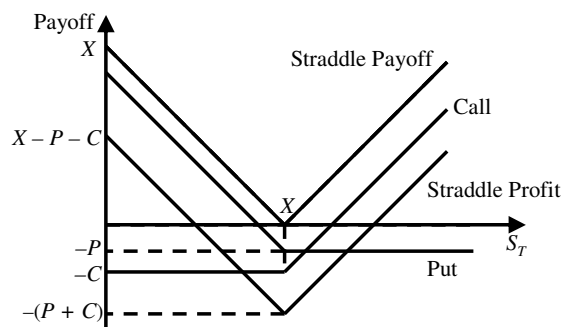
■ Straddle

- buy a call and a put option on the same stock, with same exercise price and same expiration date
- used if price is believed to change, but direction of change is unknown (bet on volatility)
- value of straddle at expiration:

	$S_T \leq X$	$S_T > X$
Payoff of call	0	$S_T - X$
Payoff of put	$-(S_T - X)$	0
Total payoff	$X - S_T$	$S_T - X$

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Straddle – Profit of Holder



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Option Strategies (cont.)

■ Spreads

- combinations of two or more call options (or put options) on the same stock, with different exercise prices or expiration dates
- *money spread* = difference between options is exercise price
- *time spread* = difference between options is expiration date

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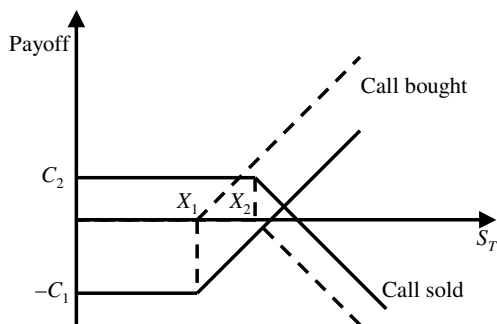
Example of Spread

- money spread: buy a call option with exercise price X_1 and sell a call option with exercise price $X_2 > X_1$
- bullish spread - payoff is either increased or unaffected by stock price increases
- value of spread at maturity:

	$S_T \leq X_1$	$X_1 < S_T \leq X_2$	$S_T > X_2$
Payoff of call 1	0	$S_T - X_1$	$S_T - X_1$
Payoff of call 2	0	0	$-(S_T - X_2)$
Total payoff	0	$S_T - X_1$	$X_2 - X_1$

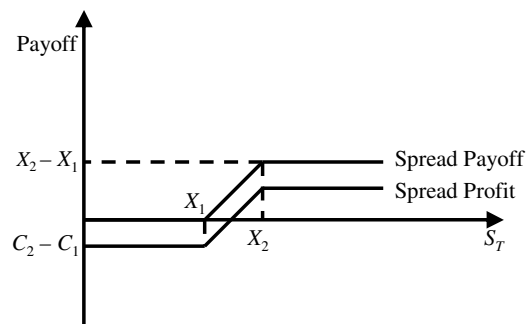
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Spread – Calls Profits and Payoffs



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Spread – Profit of Holder



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Option Strategies (cont.)

- Collar
 - options strategy that brackets the value of an existing portfolio between two bounds
 - used if a target wealth is set, and losses need to be limited
 - a lower bound can be placed by buying a put option → need to pay a premium → to recover the money paid for premium, write a call option (with higher exercise price)
 - the protection against downside risk is obtained by giving up the gain potential from price increases

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Example of Collar

- you already hold stock, so buy a put option on the same stock with exercise price X_1 and sell a call option with exercise price $X_2 > X_1$

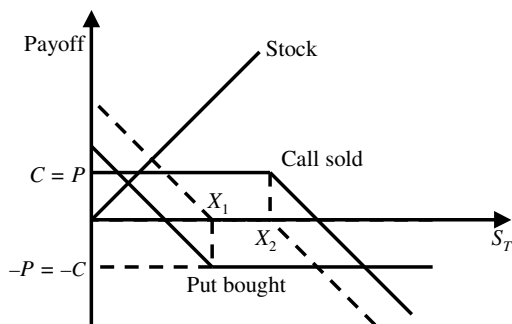
- value of collar at maturity:

	$S_T \leq X_1$	$X_1 < S_T \leq X_2$	$S_T > X_2$
Payoff of stock	S_T	S_T	S_T
Payoff of put	$X_1 - S_T$	0	0
Payoff of call	0	0	$-(S_T - X_2)$
<i>Total payoff</i>	X_1	S_T	X_2

- notice that the payoff and the profit of the holder are equal, since the premiums cancel out

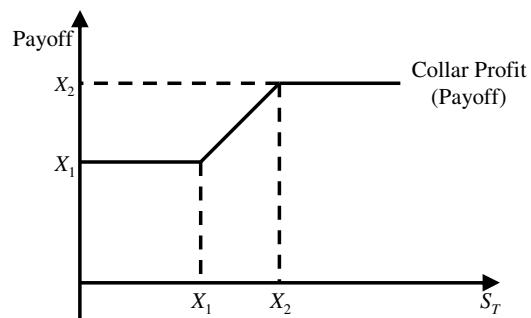
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Collar – Calls Profits and Payoffs



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Collar – Profit of Holder



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Put-Call Parity Relationship

- an alternative strategy that provides the same type of protection as a protective put is a call with same expiration date and strike price X and a riskless bond with face value equal to X
- value of investment at maturity:

	$S_T \leq X$	$S_T > X$
Payoff of call	0	$S_T - X$
Payoff of bond	X	X
<i>Total payoff</i>	X	S_T

- this is exactly the same payoff pattern as the protective put

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Put-Call Parity Relationship (cont.)

- arbitrage argument: if two investments always have the same value, they should have the same price
- the price of the protective put is the sum of put premium and stock price at time 0
- the price of the call + bond investment is the sum of the call premium and the present discounted value of the bond (i.e., of X)
- hence,

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

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Put-Call Parity Relationship (cont.)

- this relationship is called the *put-call parity theorem*
- notice that it applies only to European options, because they are exercised only at maturity
- it can be generalized to include dividends paid on the underlying stock:

$$P = C - S_0 + PV(X) + PV(Dividends)$$
- if it fails – arbitrage opportunity (create the other investment and profit from the price difference)

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Exotic Options

- *Asian options* = payoff depends on average price of underlying asset during some portion of the life of the option
- *barrier options* = payoff depends not only on price at expiration, but also on whether the price has crossed through some barrier
- *lookback options* = payoffs depend in part on the min or max price during the life of the option
- *currency-translated options* = asset or exercise prices denominated in foreign currency
- *binary options* = payoffs depends on whether the price satisfies a certain condition or not

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