

# CHAPTER 17

## Options Markets: Introduction (44 slides)

# Options

- Derivatives are securities that get their value from the price of other securities.
- Derivatives are contingent claims because their payoffs depend on the value of other securities.
- Options are traded both on organized exchanges and OTC. Chinese currency option next page

# Chinese Currency options

Bank foreign exchange survey: Option trading blowout risk surge

Source: 21st Century Business Herald (Guangzhou)

<http://money.163.com/16/1019/05/C3NG68VD002580S6.html>

(Original title: RMB exchange rate fluctuations under the foreign exchange survey of options trading in the risk of blowout hedge surge)

On the contrary, he began to worry about whether the banks had enough capacity to hedge against the risk of a growing option position, after all, banks had never crossed such a large number of FX option positions.

As at 18:00 on October 18, the US dollar against the RMB exchange rate (CNY) hovered near 6.7363, intraday low of 6.7410 intraday record.

This also allows a state-owned bank foreign exchange business customer manager Zhao Cheng (a pseudonym) has become particularly busy.

However, with the rapid growth of foreign exchange options business, the risk of hedging positions in the bank's options are also increasing. This is an intangible test of bank foreign exchange risk management wisdom.

Forward and options trading shifts

"Many companies fear that the end of the yuan may fall below 6.9, want to exchange exchange rate as early as possible to reduce foreign exchange losses." Zhao told reporters. But the face of strong demand for foreign exchange business, he often can only say no to them.

The reason for this, in February this year, his bank has introduced a number of measures, including the amount of foreign exchange settlement deficit to be reduced month by month, the monthly settlement amount to be higher than the amount of foreign exchange sales, as far as possible to create foreign exchange earnings to curb capital outflows pressure.

# The Option Contract: Calls

- A call option gives its holder the right to buy an asset: example next page
  - At the exercise or strike price
  - On or before the expiration date
- Exercise the option to buy the underlying asset if market value  $>$  strike.

# Option quotation

## PRICES AT CLOSE DECEMBER 02, 2009

**I B M (IBM)**

**Underlying Stock Price: 127.21**

| Expiration | Strike | Call  |        |               | Put   |        |               |
|------------|--------|-------|--------|---------------|-------|--------|---------------|
|            |        | Last  | Volume | Open Interest | Last  | Volume | Open Interest |
| Dec 2009   | 120    | 7.75  | 197    | 2370          | 0.26  | 644    | 8806          |
| Jan 2010   | 120    | 8.63  | 130    | 21884         | 1.18  | 1267   | 8871          |
| Apr 2010   | 120    | 11.25 | 43     | 1705          | 4.20  | 33     | 1903          |
| Jul 2010   | 120    | 13.30 | 34     | 108           | 6.70  | 1      | 34            |
| Dec 2009   | 125    | 3.25  | 416    | 14419         | 1.02  | 1872   | 9203          |
| Jan 2010   | 125    | 4.75  | 278    | 14180         | 2.44  | 1060   | 9094          |
| Apr 2010   | 125    | 7.90  | 69     | 3652          | 6.05  | 82     | 1122          |
| Jul 2010   | 125    | 10.05 | 7      | 150           | 8.85  | 15     | 215           |
| Dec 2009   | 130    | 0.77  | 2108   | 11033         | 3.55  | 844    | 4233          |
| Jan 2010   | 130    | 2.18  | 3489   | 19278         | 4.79  | 198    | 3273          |
| Apr 2010   | 130    | 5.49  | 29     | 2773          | 8.50  | 66     | 1312          |
| Jul 2010   | 130    | 7.75  | 31     | 111           | 11.30 | 85     | 228           |
| Dec 2009   | 135    | 0.11  | 214    | 8955          | 7.65  | 86     | 631           |
| Jan 2010   | 135    | 0.84  | 176    | 24556         | 7.75  | 24     | 776           |
| Apr 2010   | 135    | 3.45  | 126    | 3798          | 11.50 | 45     | 433           |
| Jul 2010   | 135    | 5.67  | 6      | 140           | 13.80 | 1      | 113           |

# Warrants in Hong Kong

- Warrant Terms and Indicators
- Warrant Name South Africa A Goldman thirty-two
- Publisher Goldman Sachs
- Related assets South A50
- Warrant Price (HKD) 0.040
- Change (%) 8.11
- Warrant Type Ordinary Warrant
- Exercise price 10.80
- Underlying Price 9.49
- Turnover (\$) 600
- Call / Put Subscription
- ITM / OTM (%) 13.8% (OTM)
- Maturity (Year - Month - Day) 2013-12-30
- Last Trading Date (Year - Month - Day) 2013-12-19
- Maturity 67
- Conversion Ratio 1
- Lot Size 2,000
- Technical information
- Gearing (x) 237.25
- Premium% (break-even price) 14.23% (10.840)
- Effective Gearing (x) 22.87
- Implied Volatility 22.08
- Over the past 30 days Underlying Historical Volatility Not applicable
- Delta 9.64
- Outstanding Ratio% 30.40%
- Time loss value -4.02
- Technical information

## The Chinese Warrants Bubble, by Wei Xiong et al.

- In 2005-2008, over a dozen put warrants traded in China went so deep out of the money that they were almost certain to expire worthless. Nonetheless, each warrant was traded more than three times each day at substantially inflated prices. This bubble is unique in that the underlying stock prices make warrant fundamentals publicly observable and that warrants have predetermined finite maturities. This sample allows us to examine a set of bubble theories. In particular, our analysis highlights the joint effects of short-sales constraints and heterogeneous beliefs in driving bubbles and confirms several key findings of the experimental bubble literature. (JEL G12, G13, O16, P34)

# The Option Contract: Puts

- A put option gives its holder the right to sell an asset:
  - At the exercise or strike price
  - On or before the expiration date
- Exercise the option to sell the underlying asset if market value  $<$  strike.

# The Option Contract

- The purchase price of the option is called the premium.
- Sellers (writers) of options receive premium income.
- If holder exercises the option, the option writer must make (call) or take (put) delivery of the underlying asset.

## Example 17.1 Profit and Loss on a Call

- A January 2010 call on IBM with an exercise price of \$130 was selling on December 2, 2009, for \$2.18.
- The option expires on the third Friday of the month, or January 15, 2010.
- If IBM remains below \$130, the call will expire worthless.

## Example 17.1 Profit and Loss on a Call

- Suppose IBM sells for \$132 on the expiration date.
- Option value = stock price-exercise price  
 $\$132 - \$130 = \$2$
- Profit = Final value – Original investment  
 $\$2.00 - \$2.18 = -\$0.18$
- Option will be exercised to offset loss of premium.
- Call will not be strictly profitable unless IBM's price exceeds \$132.18 (strike + premium) by expiration.

## Example 17.2 Profit and Loss on a Put

- Consider a January 2010 put on IBM with an exercise price of \$130, selling on December 2, 2009, for \$4.79.
- Option holder can sell a share of IBM for \$130 at any time until January 15.
- If IBM goes above \$130, the put is worthless.

## Example 17.2 Profit and Loss on a Put

- Suppose IBM's price at expiration is \$123.
- Value at expiration = exercise price – stock price:  
$$\$130 - \$123 = \$7$$
- Investor's profit:  
$$\$7.00 - \$4.79 = \$2.21$$
- Holding period return = 46.1% over 44 days!

# Market and Exercise Price Relationships

In the Money - exercise of the option would be profitable

Call: exercise price  $<$  market price

Put: exercise price  $>$  market price

Out of the Money - exercise of the option would not be profitable

Call: market price  $<$  exercise price.

Put: market price  $>$  exercise price.

At the Money - exercise price and asset price are equal

# American vs. European Options

American - the option can be exercised at any time before expiration or maturity

European - the option can only be exercised on the expiration or maturity date

- In the U.S., most options are American style, except for currency and stock index options.

# Different Types of Options

- Stock Options
- Index Options
- Futures Options
- Foreign Currency Options (e.g. Chinese Currency options)
- Interest Rate Options

# Payoffs and Profits at Expiration - Calls

## Notation

Stock Price =  $S_T$     Exercise Price =  $X$

## Payoff to Call Holder

$(S_T - X)$  if  $S_T > X$

0 if  $S_T \leq X$

## Profit to Call Holder

Payoff - Purchase Price

# Payoffs and Profits at Expiration - Calls

## Payoff to Call Writer

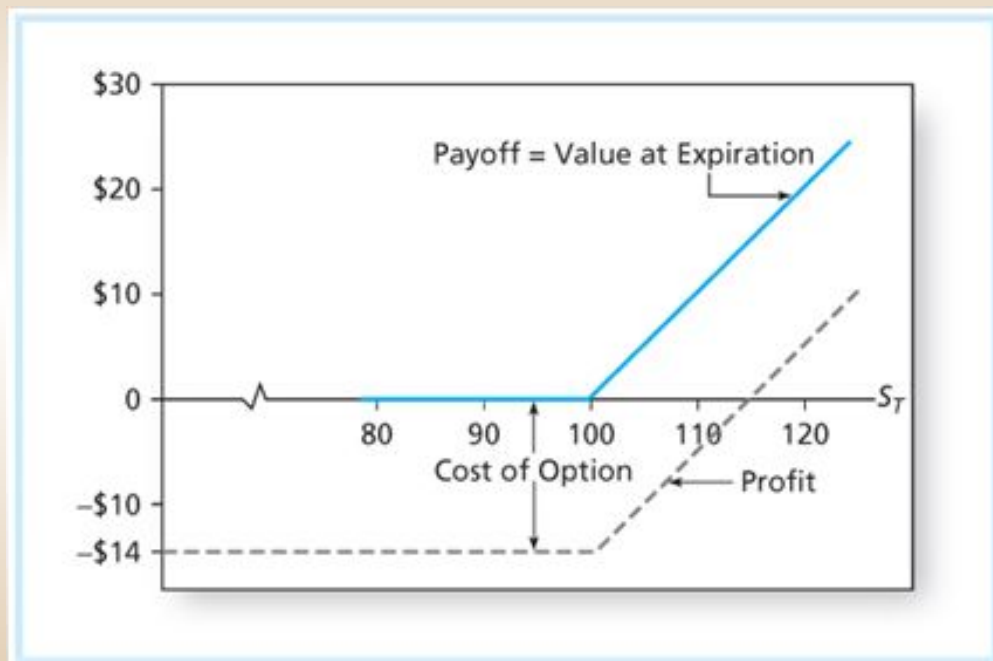
$$-(S_T - X) \quad \text{if } S_T > X$$

$$0 \quad \text{if } S_T \leq X$$

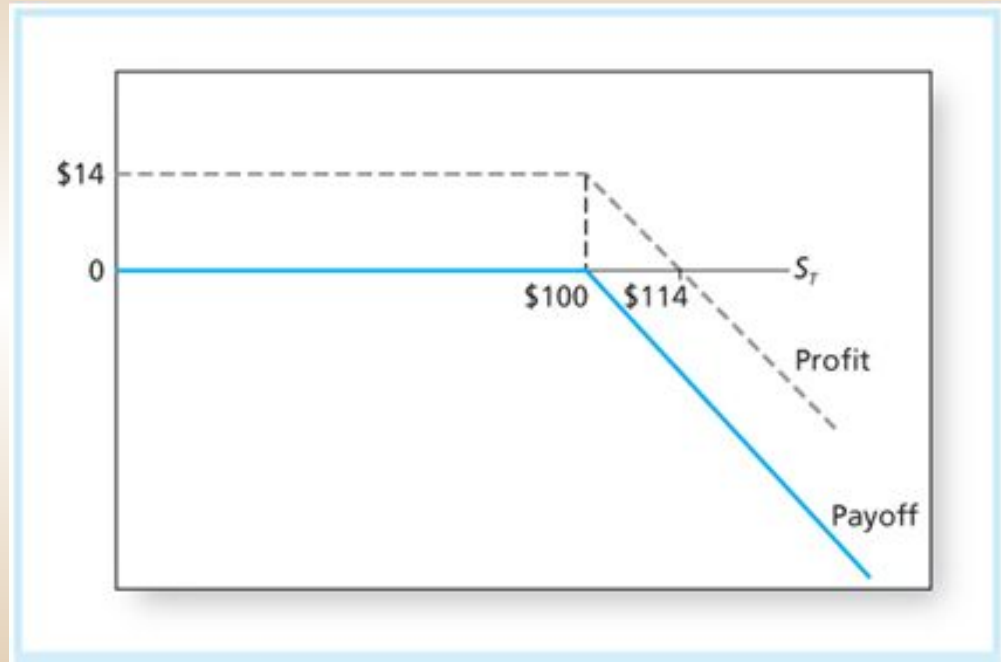
## Profit to Call Writer

Payoff + Premium

# Figure 17.2 Payoff and Profit to Call Option at Expiration



# Figure 17.3 Payoff and Profit to Call Writers at Expiration



# Payoffs and Profits at Expiration - Puts

## Payoffs to Put Holder

$$\begin{array}{ll} 0 & \text{if } S_T \geq X \\ (X - S_T) & \text{if } S_T < X \end{array}$$

## Profit to Put Holder

Payoff - Premium

# Payoffs and Profits at Expiration – Puts

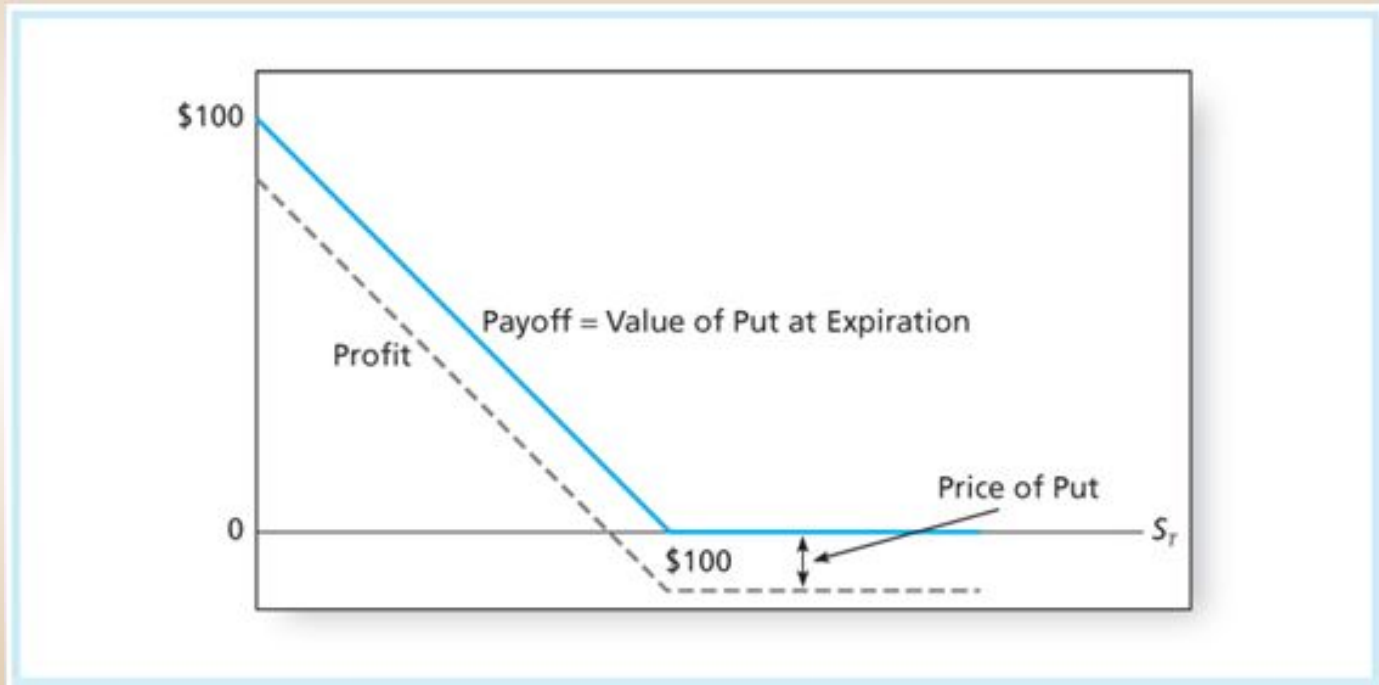
## Payoffs to Put Writer

$$\begin{array}{ll} 0 & \text{if } S_T \geq X \\ -(X - S_T) & \text{if } S_T < X \end{array}$$

## Profits to Put Writer

Payoff + Premium

# Figure 17.4 Payoff and Profit to Put Option at Expiration



# Option versus Stock Investments

- Could a call option strategy be preferable to a direct stock purchase?
- Suppose you think a stock, currently selling for \$100, will appreciate.
- A 6-month call costs \$10 (contract size is 100 shares).
- You have \$10,000 to invest.

# Option versus Stock Investments

- Strategy A: Invest entirely in stock. Buy 100 shares, each selling for \$100.
- Strategy B: Invest entirely in at-the-money call options. Buy 1,000 calls, each selling for \$10. (This would require 10 contracts, each for 100 shares.)
- Strategy C: Purchase 100 call options for \$1,000. Invest your remaining \$9,000 in 6-month T-bills, to earn 3% interest. The bills will be worth \$9,270 at expiration.

# Option versus Stock Investment

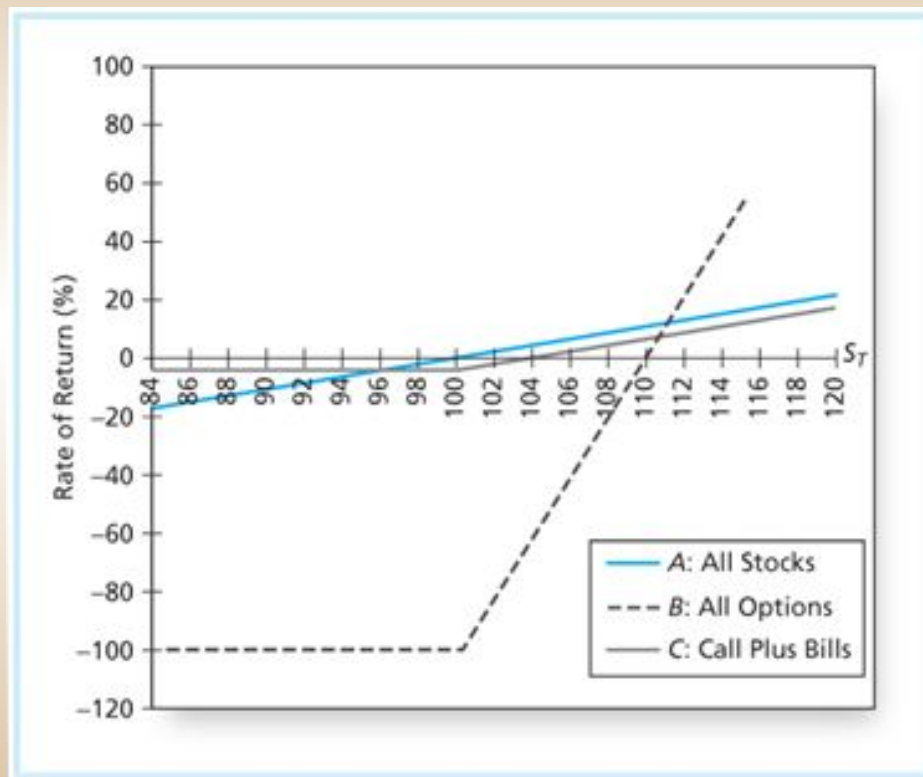
| Investment       | Strategy         | Investment            |
|------------------|------------------|-----------------------|
| Equity only      | Buy stock @ 100  | 100 shares \$10,000   |
| Options only     | Buy calls @ 10   | 1000 options \$10,000 |
| Leveraged equity | Buy calls @ 10   | 100 options \$1,000   |
|                  | Buy T-bills @ 3% | \$9,000               |
| Yield            |                  |                       |

# Strategy Payoffs

| Portfolio                    | Stock Price |          |          |          |          |          |
|------------------------------|-------------|----------|----------|----------|----------|----------|
|                              | \$95        | \$100    | \$105    | \$110    | \$115    | \$120    |
| Portfolio A: All stock       | \$9,500     | \$10,000 | \$10,500 | \$11,000 | \$11,500 | \$12,000 |
| Portfolio B: All options     | 0           | 0        | 5,000    | 10,000   | 15,000   | 20,000   |
| Portfolio C: Call plus bills | 9,270       | 9,270    | 9,770    | 10,270   | 10,770   | 11,270   |

| Portfolio                    | Stock Price |        |       |       |       |       |
|------------------------------|-------------|--------|-------|-------|-------|-------|
|                              | \$95        | \$100  | \$105 | \$110 | \$115 | \$120 |
| Portfolio A: All stock       | -5.0%       | 0.0%   | 5.0%  | 10.0% | 15.0% | 20.0% |
| Portfolio B: All options     | -100.0      | -100.0 | -50.0 | 0.0   | 50.0  | 100.0 |
| Portfolio C: Call plus bills | -7.3        | -7.3   | -2.3  | 2.7   | 7.7   | 12.7  |

# Figure 17.5 Rate of Return to Three Strategies



# Strategy Conclusions

- Figure 17.5 shows that the all-option portfolio, B, responds more than proportionately to changes in stock value; it is levered.
- Portfolio C, T-bills plus calls, shows the insurance value of options.
  - C 's T-bill position cannot be worth less than \$9270.
  - Some return potential is sacrificed to limit downside risk.

# Protective Put Conclusions

- Puts can be used as insurance against stock price declines.
- Protective puts lock in a minimum portfolio value.
- The cost of the insurance is the put premium.
- Options can be used for risk management, not just for speculation.

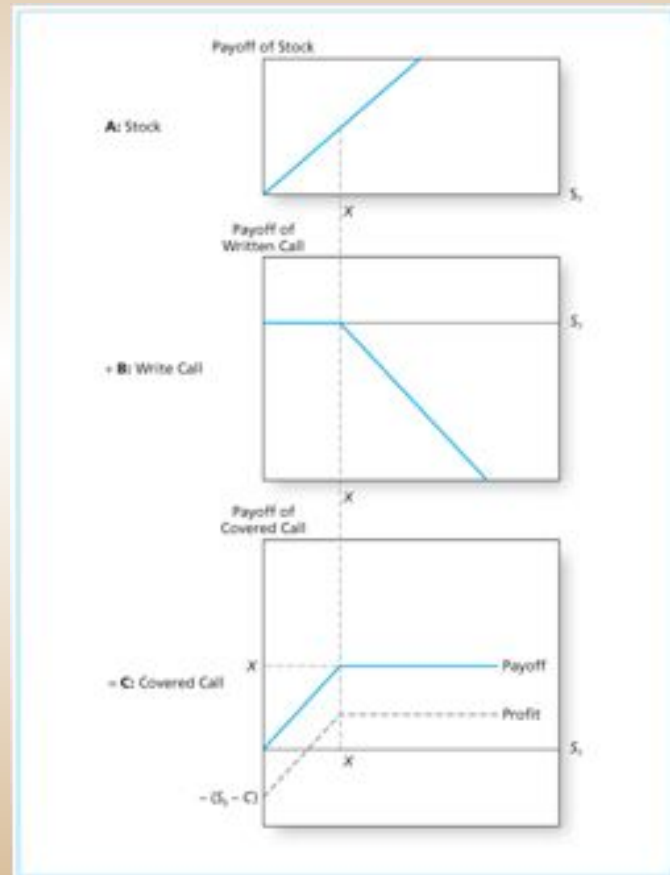
# Covered Calls

- Purchase stock and write calls against it.
- Call writer gives up any stock value above  $X$  in return for the initial premium.
- If you planned to sell the stock when the price rises above  $X$  anyway, the call imposes “sell discipline.”

# Table 17.2 Value of a Covered Call Position at Expiration

|                          | $S_T \leq X$ | $S_T > X$    |
|--------------------------|--------------|--------------|
| Payoff of stock          | $S_T$        | $S_T$        |
| + Payoff of written call | $-0$         | $-(S_T - X)$ |
| = <i>TOTAL</i>           | $S_T$        | $X$          |

# Figure 17.8 Value of a Covered Call Position at Expiration



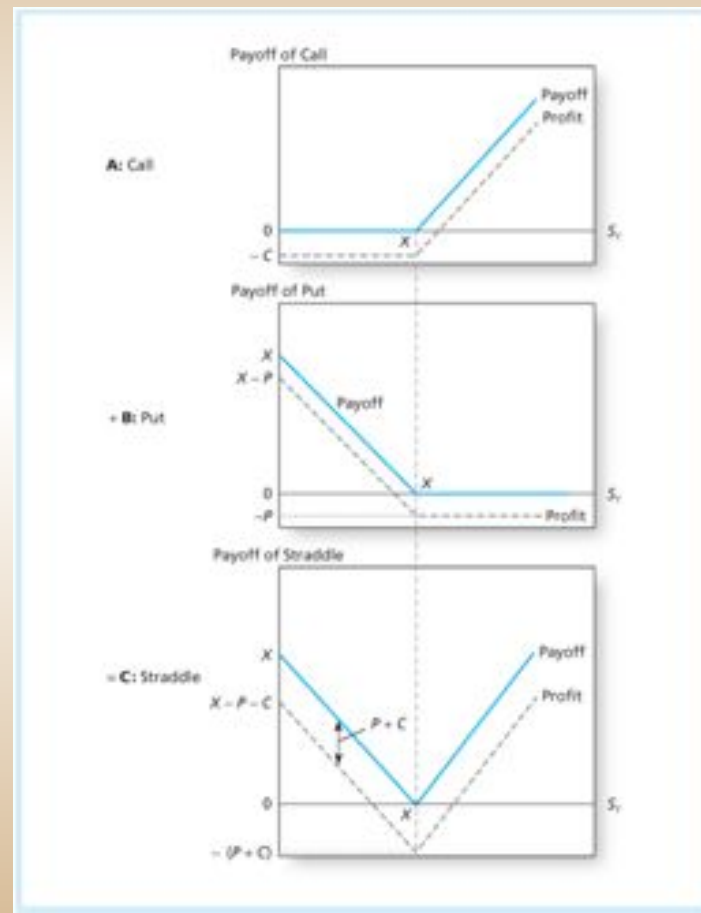
# Straddle

- Long straddle: Buy call and put with same exercise price and maturity.
- The straddle is a bet on volatility.
  - To make a profit, the change in stock price must exceed the cost of both options.
  - You need a strong change in stock price in either direction.
- The writer of a straddle is betting the stock price will not change much.

# Table 17.3 Value of a Straddle Position at Option Expiration

|                 | $S_T < X$ | $S_T \geq X$ |
|-----------------|-----------|--------------|
| Payoff of call  | 0         | $S_T - X$    |
| + Payoff of put | $X - S_T$ | 0            |
| = <i>TOTAL</i>  | $X - S_T$ | $S_T - X$    |

# Figure 17.9 Value of a Straddle at Expiration



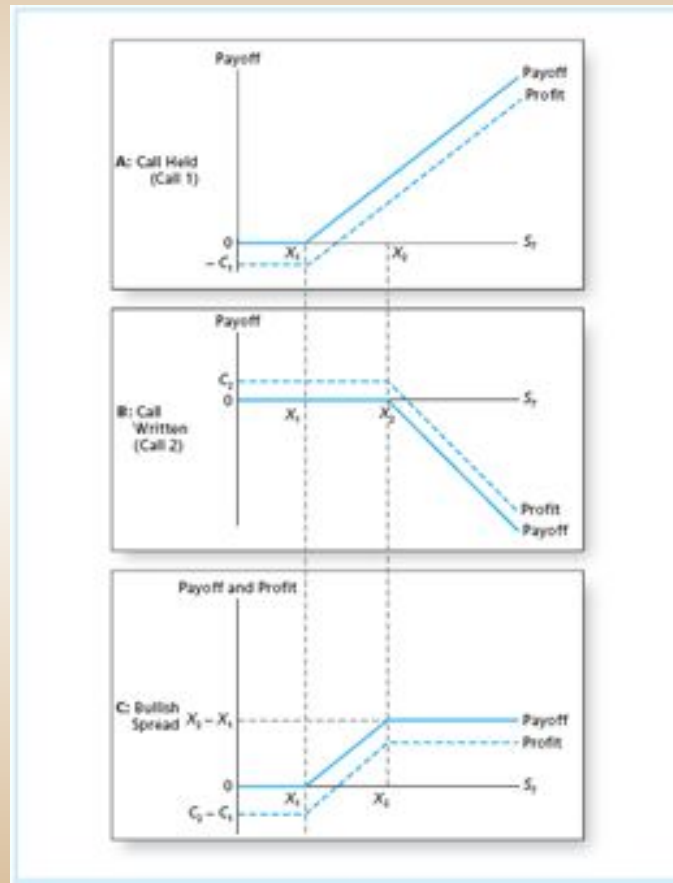
# Spreads

- A spread is a combination of two or more calls (or two or more puts) on the same stock with differing exercise prices or times to maturity.
- Some options are bought, whereas others are sold, or written.
- A bullish spread is a way to profit from stock price increases.

# Table 17.4 Value of a Bullish Spread Position at Expiration

|                                                  | $S_T \leq X_1$ | $X_1 < S_T \leq X_2$ | $S_T \geq X_2$ |
|--------------------------------------------------|----------------|----------------------|----------------|
| Payoff of purchased call, exercise price = $X_1$ | 0              | $S_T - X_1$          | $S_T - X_1$    |
| + Payoff of written call, exercise price = $X_2$ | -0             | -0                   | $-(S_T - X_2)$ |
| = TOTAL                                          | 0              | $S_T - X_1$          | $X_2 - X_1$    |

# Figure 17.10 Value of a Bullish Spread Position at Expiration



# Collars

- A collar is an options strategy that brackets the value of a portfolio between two bounds.
- Limit downside risk by selling upside potential.
- Buy a protective put to limit downside risk of a position.
- Fund put purchase by writing a covered call.
  - Net outlay for options is approximately zero.

# Put-Call Parity

- The call-plus-bond portfolio (on left) must cost the same as the stock-plus-put portfolio (on right):

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

# Put Call Parity - Disequilibrium Example

Stock Price = 110    Call Price = 17

Put Price = 5    Risk Free = 5%

Maturity = 1 yr    X = 105

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

$$117 > 115$$

Since the leveraged equity is less expensive,  
acquire the low cost alternative and sell the  
high cost alternative

# Table 17.5 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              |
| <b>TOTAL</b>                | <b>2</b>            | <b>0</b>            | <b>0</b>       |

# Option-like Securities

- Callable Bonds
- Convertible Securities
- Warrants
- Collateralized Loans