

# Option Markets:

## Introduction

# Option Terminology

- Buy - Long
- Sell – Short
- Call
  - Holder has the right to purchase an asset for a specified price
- Put
  - Holder has the right to purchase an asset for a specified price
- Key Elements
  - Exercise or Strike Price
    - Specified price set in option contract
  - Premium or Price
    - Price of option
  - Maturity or Expiration
    - When to exercise an option

# Market and Exercise Price Relationships

In the Money - exercise of the option would be profitable.

Call: market price > exercise price

Put: exercise price > market price

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

Call: market price < exercise price

Put: exercise price < market 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.

# Options Trading

- OTC markets
  - Terms tailor to the needs of traders
  - Costs higher
- Exchange
  - Standardized
    - 100 shares of stock
    - Limited and uniform set of securities
  - Two benefits
    - Ease of trading
    - Liquid secondary market

# Figure 20.1 Stock Options on IBM

<b>PRICES AT CLOSE MARCH 23, 2006</b>							
<b>IBM (IBM)</b>		<b>Underlying stock price: 83.20</b>					
<b>Expiration</b>	<b>Strike</b>	<b>Call</b>			<b>Put</b>		
		<b>Last</b>	<b>Volume</b>	<b>Open Interest</b>	<b>Last</b>	<b>Volume</b>	<b>Open Interest</b>
Apr	75.00	8.50	201	2568	0.10	27	19877
May	75.00	...	...	239	0.20	29	170
Jul	75.00	10.10	1	962	0.50	30	9616
Oct	75.00	11.10	1	378	1.10	56	541
Apr	80.00	4.10	1390	19671	0.55	3378	32086
May	80.00	4.40	174	215	0.75	1052	513
Jul	80.00	5.50	57	4357	1.44	234	10156
Oct	80.00	7.30	5	892	2.20	79	1114
Apr	85.00	0.95	2221	42456	2.45	1548	16330
May	85.00	1.35	331	1300	2.90	676	959
Jul	85.00	2.59	570	19451	3.50	103	7963
Oct	85.00	4.10	9	1073	...	...	804
Apr	90.00	0.15	989	21447	6.80	146	587
May	90.00	0.25	7	348	6.80	26	89
Jul	90.00	0.85	353	17257	7.00	670	792
Oct	90.00	2.15	2516	4587	7.40	25	194

# Different Types of Options

- Stock Options
- Index Options
  - Base on a stock market index
    - Broad base or industry specific indexes or commodity price indexes
    - In contrast to stock options, index options do not require that the writer actually “deliver the index” or “purchase the index”
      - Cash settlement procedure is used
- Futures Options
  - For a specific futures contract
- Foreign Currency Options
  - Quantity of foreign currency for a specified amount of domestic currency
  - Difference between currency option and currency futures option
- Interest Rate Options
  - On T-notes or T-bonds, LIBOR, EUROBOR, etc

# Payoffs and Profits at Expiration - Calls

Recall that a call option gives the right to purchase a security at exercise price

Exercise price \$100, now sellin \$110

## Notation

Stock Price =  $ST$    Exercise Price =  $X$

## Payoff to Call Holder

$(ST - X)$    if  $ST > X$

0   if  $ST \leq X$

## Profit to Call Holder

Payoff - Purchase Price



# Payoffs and Profits at Expiration - Calls

## Payoff to Call Writer

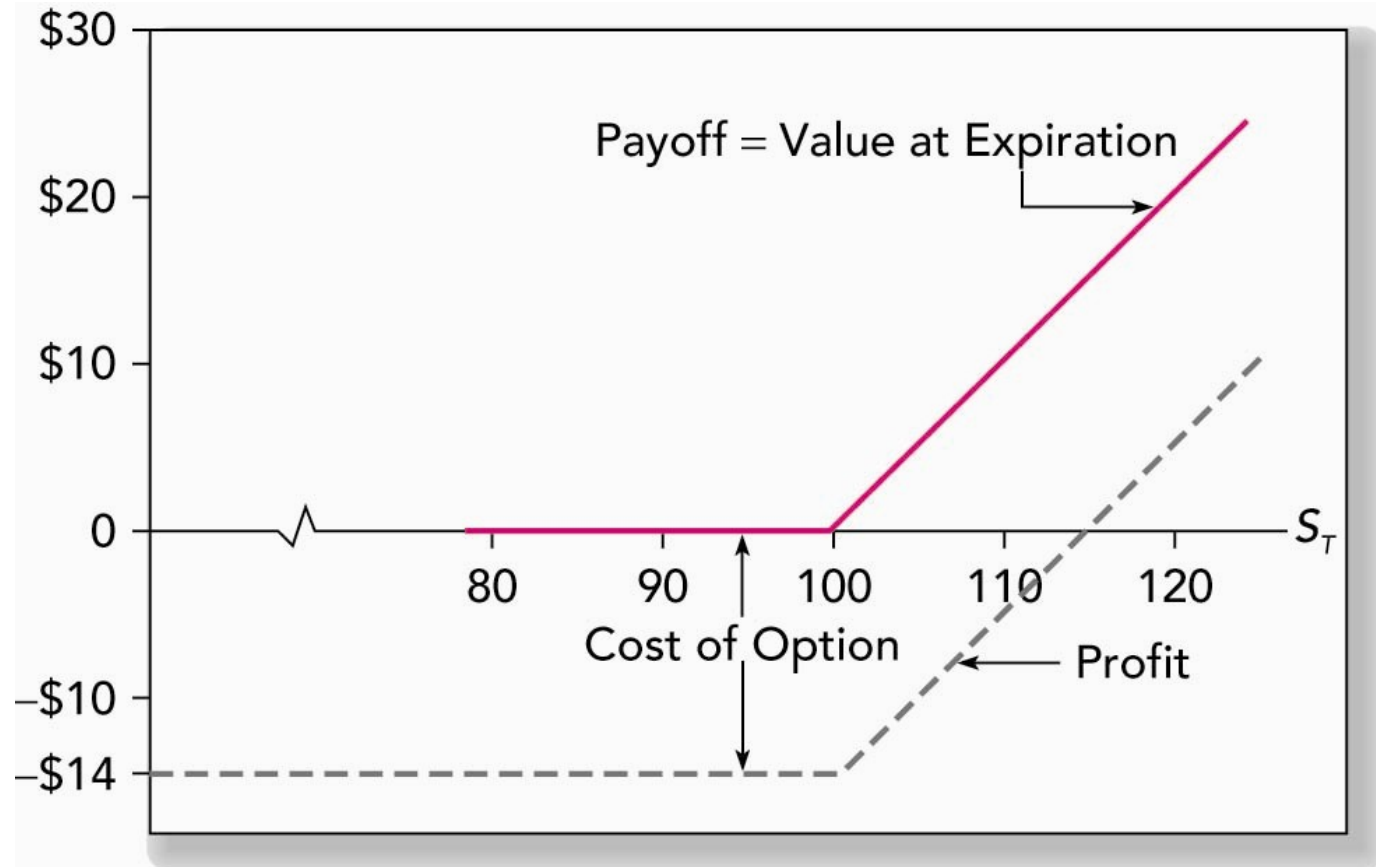
$$-(S_T - X) \quad \text{if } S_T > X$$

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

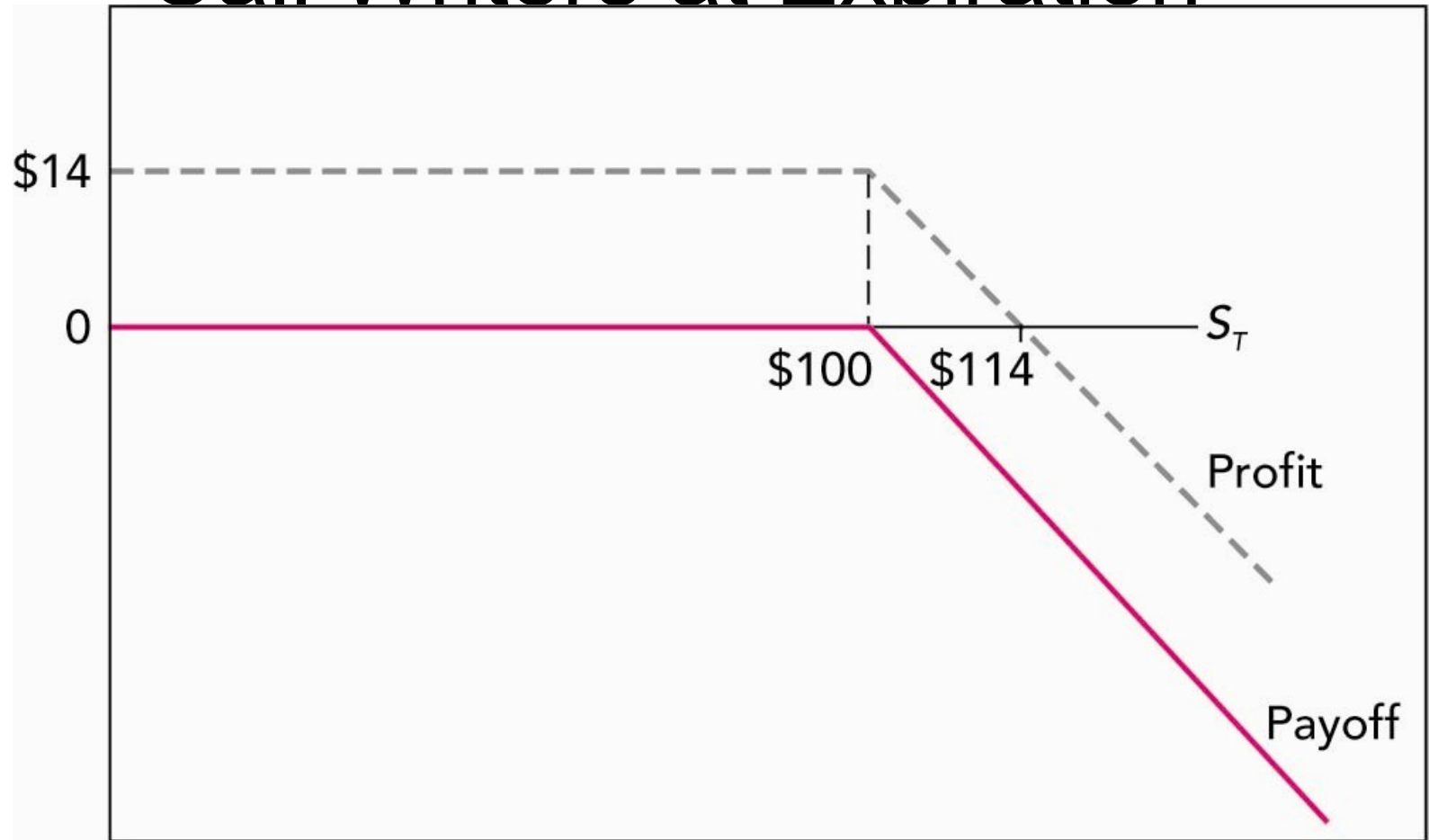
## Profit to Call Writer

$$\text{Payoff} + \text{Premium}$$

# Figure 20.3 Payoff and Profit to Call Option at Expiration



# Figure 20.4 Payoff and Profit to Call Writers at Expiration



# Payoffs and Profits at Expiration - Puts

A put options is the right to sell an asset at the exercise price

The holder will not exercise the option unless the asset is worth less than the exercise price

## 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

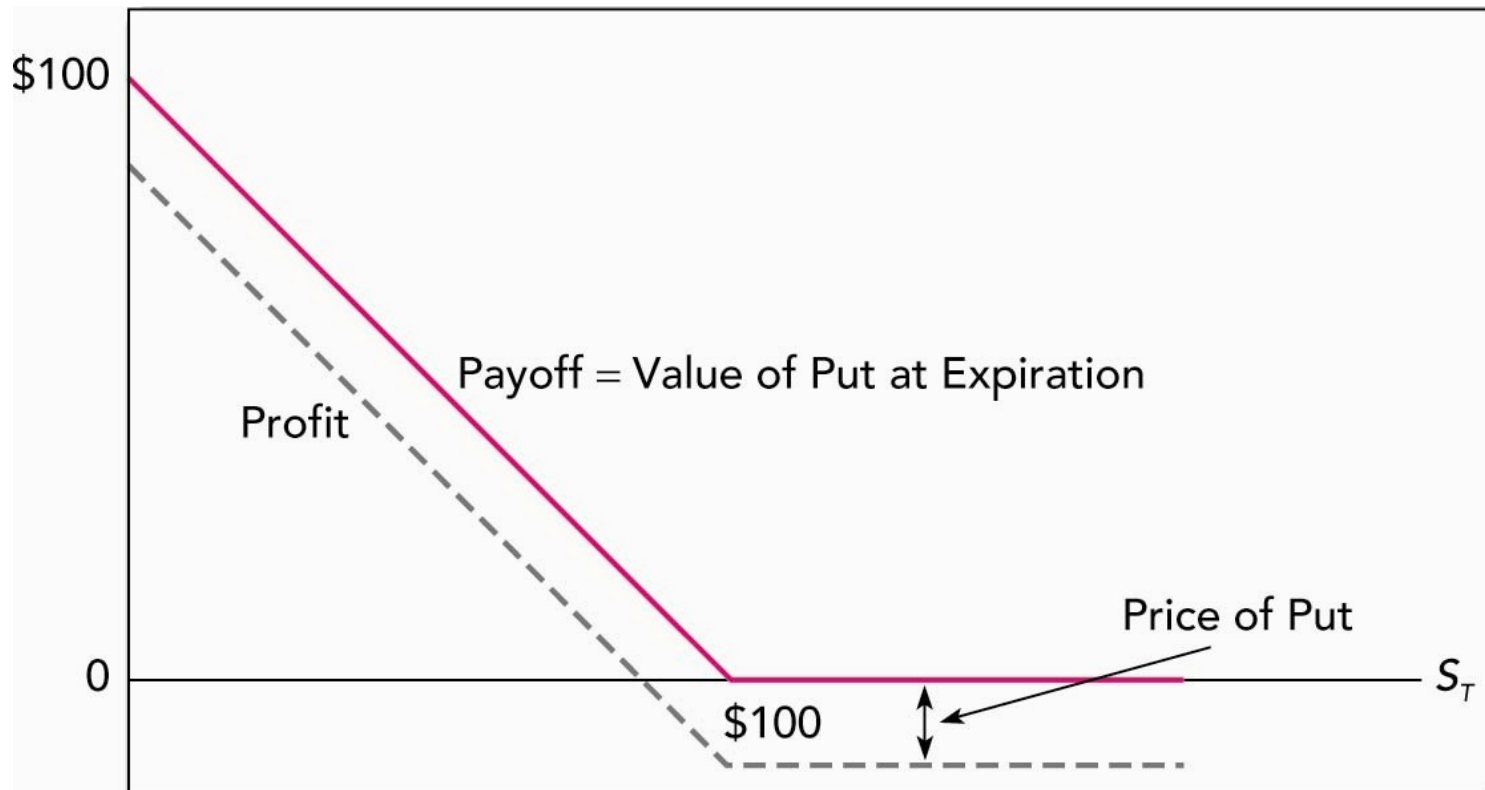
### Payoffs to Put Writer

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

### Profits to Put Writer

Payoff + Premium

# Figure 20.5 Payoff and Profit to Put Option at Expiration



# Equity, Options & Leveraged Equity

- Purchasing call option
  - Bullish strategy
  - Profit when stock prices are increase
- Writing call option
  - Bearish strategy
- Purchasing put option
  - Bearish strategy
- Writing put option
  - Bullish strategy
- Because option values depend on the price of the underlying stock, purchase of options may be viewed as a substitute to direct purchase or sale of a stock

# Equity, Options & Leveraged Equity

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



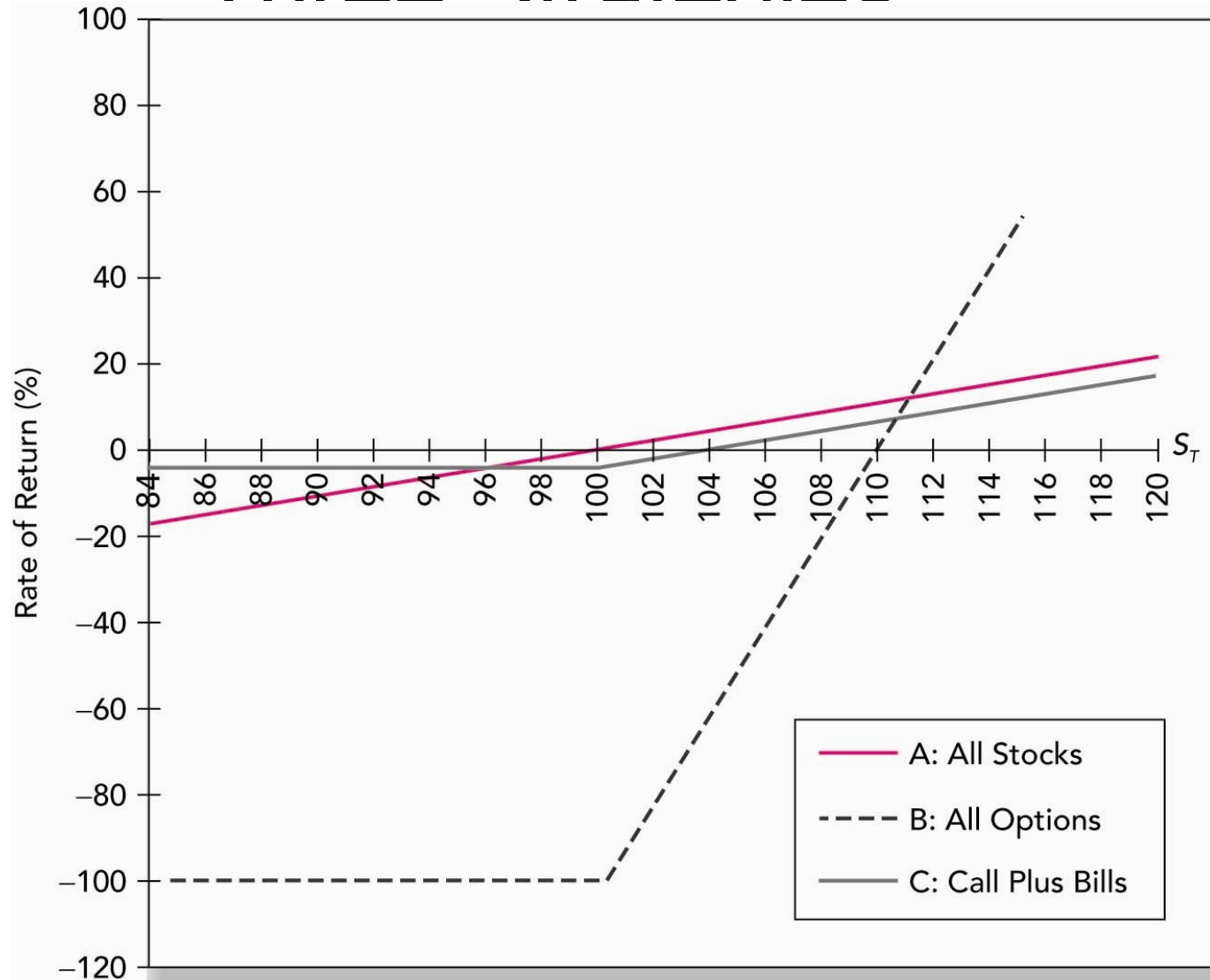
# Equity, Options Leveraged Equity - Payoffs

	IBM Stock Price		
	\$95	\$105	\$115
All Stock	\$9,500	\$10,500	\$11,500
All Options	\$0	\$5,000	\$15,000
Lev Equity	\$9,270	\$9,770	\$10,770

# Rates of Return

	IBM Stock Price		
	\$95	\$105	\$115
All Stock	-5.0%	5.0%	15%
All Options	-100%	-50%	50%
Lev Equity	-7.3%	-2.3%	7.7%

# Figure 20.6 Rate of Return to Three Strategies



# Protective Put

- Investing in a stock but with unwillingness to bear potential losses beyond some given level
  - Investing in stock with purchasing a put option on stock

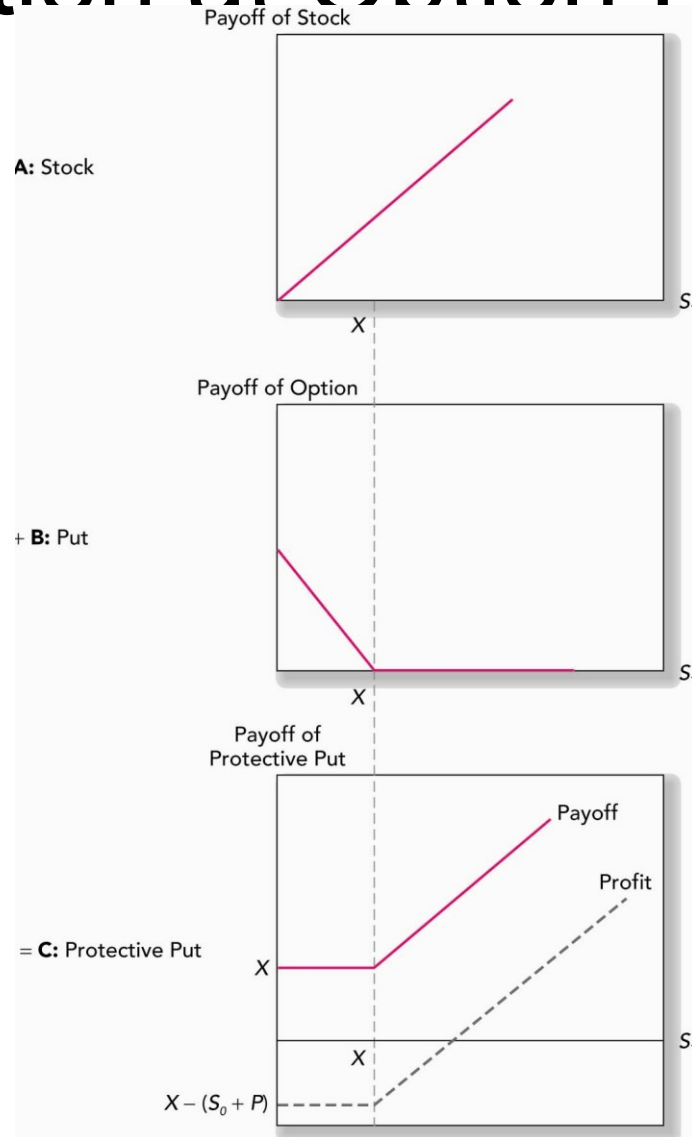
# Table 20.1 Value of a Protective Put Position at Option Expiration

**TABLE 20.1**

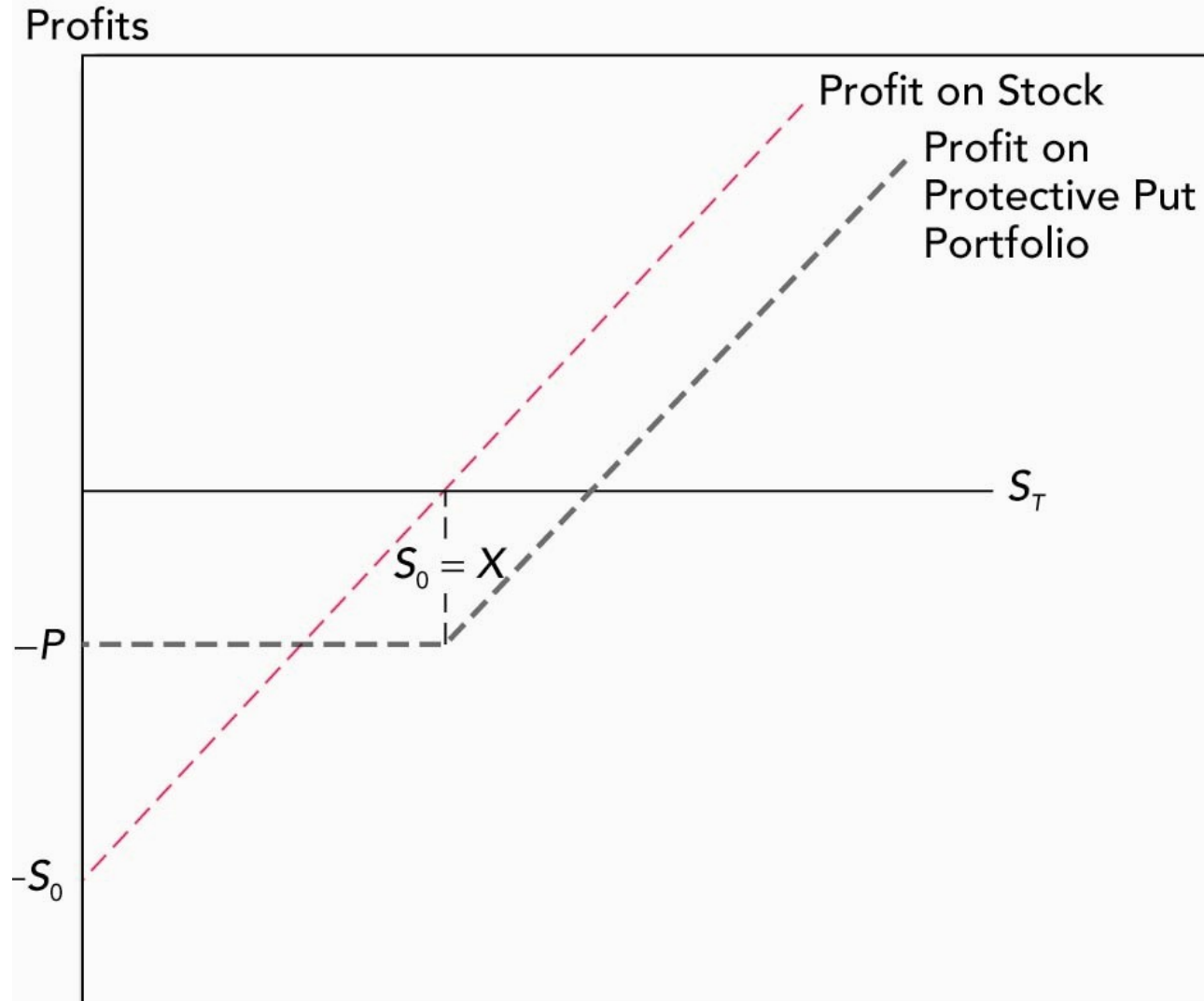
Value of protective  
put portfolio at  
option expiration

	$S_T \leq X$	$S_T > X$
Stock	$S_T$	$S_T$
+ Put	$X - S_T$	0
= TOTAL	$X$	$S_T$

# Figure 20.7 Value of a Protective Put Position at Option Expiration



# Figure 20.8 Protective Put versus Stock Investment (at-the-money option)



# Covered Calls

- The purchase of a share of stock with a simultaneous sale of a call on the stock
  - The call is covered because the potential obligation to deliver the stock is covered by the stock held in the portfolio
- Writing covered call options has been a popular investment strategy among institution investors
- The written call guarantees the sale will occur as planned



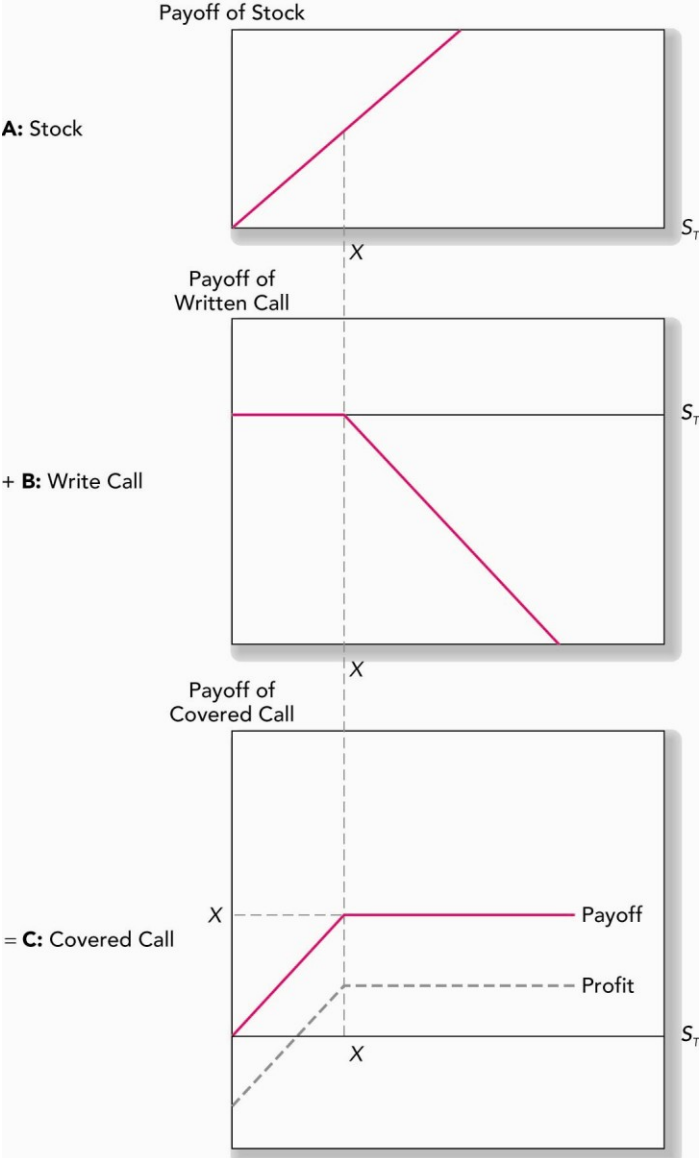
# Table 20.2 Value of a Covered Call Position at Expiration

**TABLE 20.2**

Value of covered call position at option 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 20.9 Value of a Covered Call Position at Expiration



# Option Strategies

- A long straddle buying both a call and a put on a stock with the same exercise price
- For investors who expect move a lot in price but are not certain about direction of the move
- The straddle position will do well regardless of the outcome because its value is higher when the stock price makes extreme upward or downward move from  $X$
- The worst scenario for straddle is no movement in the stock price
- Bets on volatility

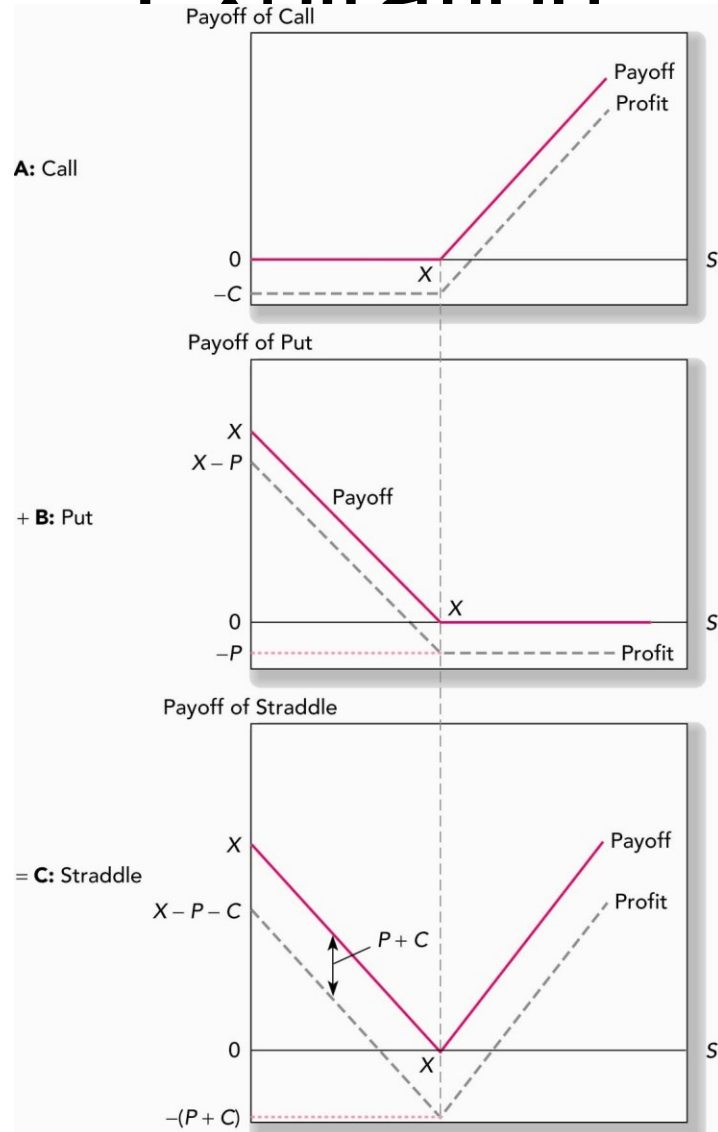
# Table 20.3 Value of a Straddle at Option Expiration

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

**TABLE 20.3**

Value of a straddle position at option expiration

# Figure 20.10 Value of a Straddle at Expiration



# Option Strategies

- Spread is a combination of two or more call options (or two or more puts) on the same stock with differencing exercise prices or times to maturity
- Some options are bought, sold or written
- A money spread
  - Purchase of one option and the simultaneous sale of another with different exercise price
- A time spread
  - The sale and purchase of options with differing expiration dates

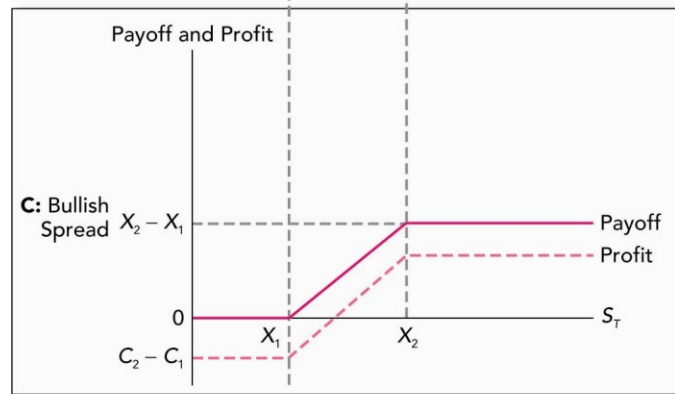
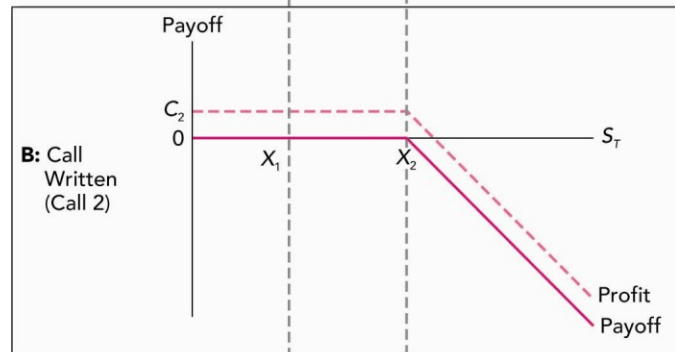
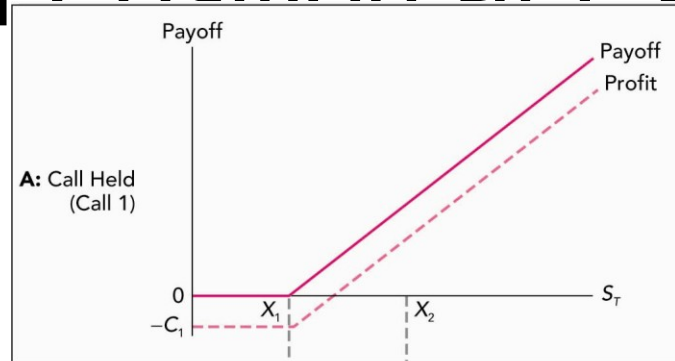
# Table 20.4 Value of a Bullish Spread Position at Expiration

**TABLE 20.4**

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	- ( $S_T - X_2$ )
= <i>TOTAL</i>	0	$S_T - X_1$	$X_2 - X_1$

# Figure 20.11 Value of a Bullish Spread Position at Expiration





# Option Strategies

- Collars
- Brackets value of portfolio between two bounds

# The Put-Call parity relationship

- Protective put portfolio provides a payoff with guarantees minimum value, but unlimited upside potential

# Put Call Parity

$$C + X / (1 + r_f)^T = S_0 + P$$

- Put-call parity theorem
  - Proper relation between put and call prices

If the prices are not equal arbitrage will be possible.

# Put Call Parity - Disequilibrium

## Example

Stock Price = 110    Call Price = 17

Put Price = 5        Risk Free = 5%

Maturity = 1 yr     X = 105

$$C + X / (1 + r_f)^T > S_0 + P$$

$$117 > 115$$

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

# Table 20.5 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>

**TABLE 20.5**

Arbitrage strategy

- More general formulation of put-call parity
- $P = C - S_0 + PV(X) + PV(\text{dividends})$

# Optionlike Securities

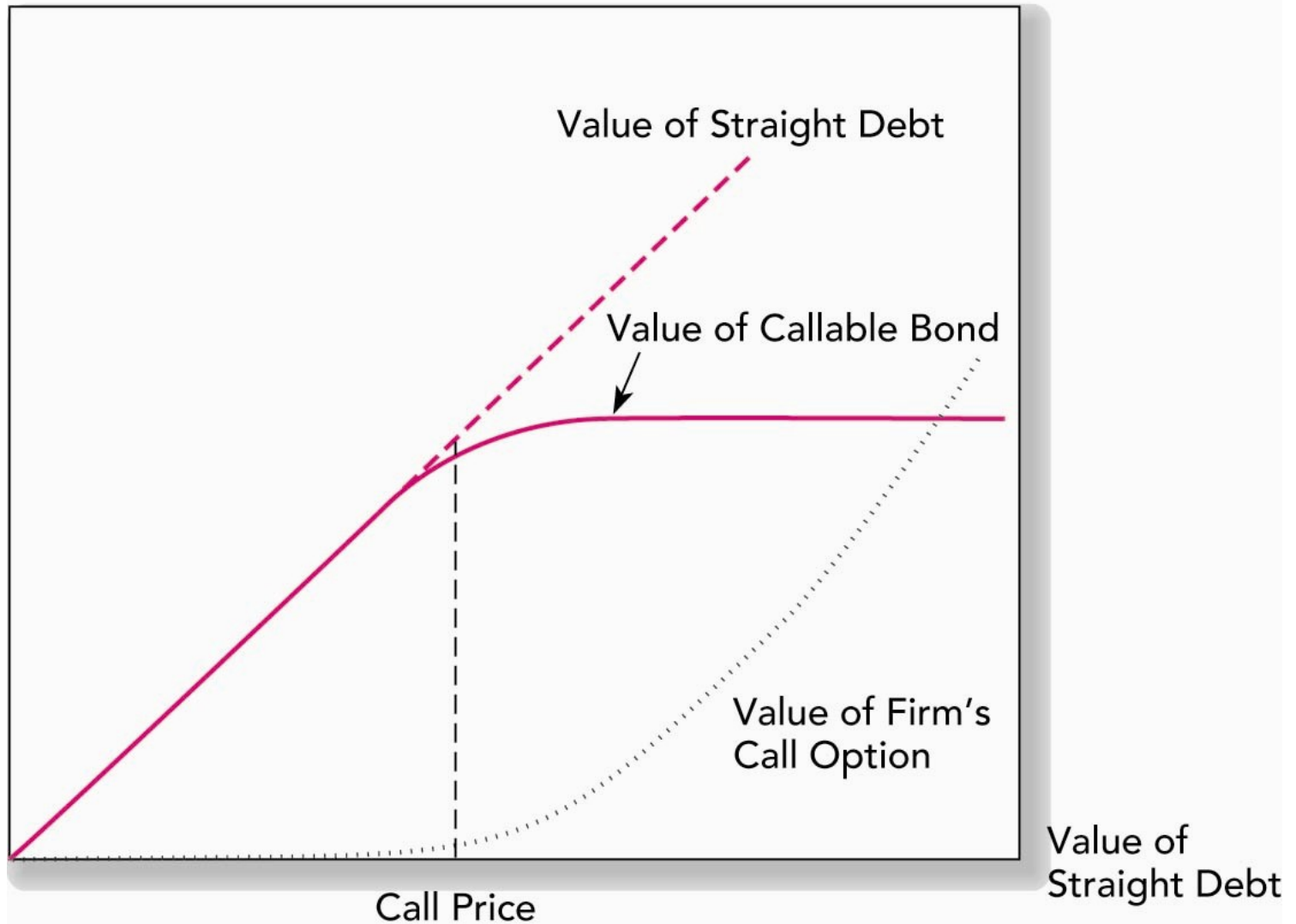
- Callable Bonds
- Convertible Securities
- Warrants
- Collateralized Loans

# Callable Bonds

- Corporate bonds are issued with call provisions
  - Issuer can buy bonds back from bondholders at some time in the future at a specified call price
- Callable bond
  - Straight bond and concurrent issuance of a call option
- Compensation for conveying this implicit call option to the firm
  - If callable bond is issued with coupon rate, it would sell at a lower price than the straight bonds
    - Difference would equal the value of the call
  - To sell callable bonds at par, firms must issue them with coupon rates higher than the coupon on straight debt



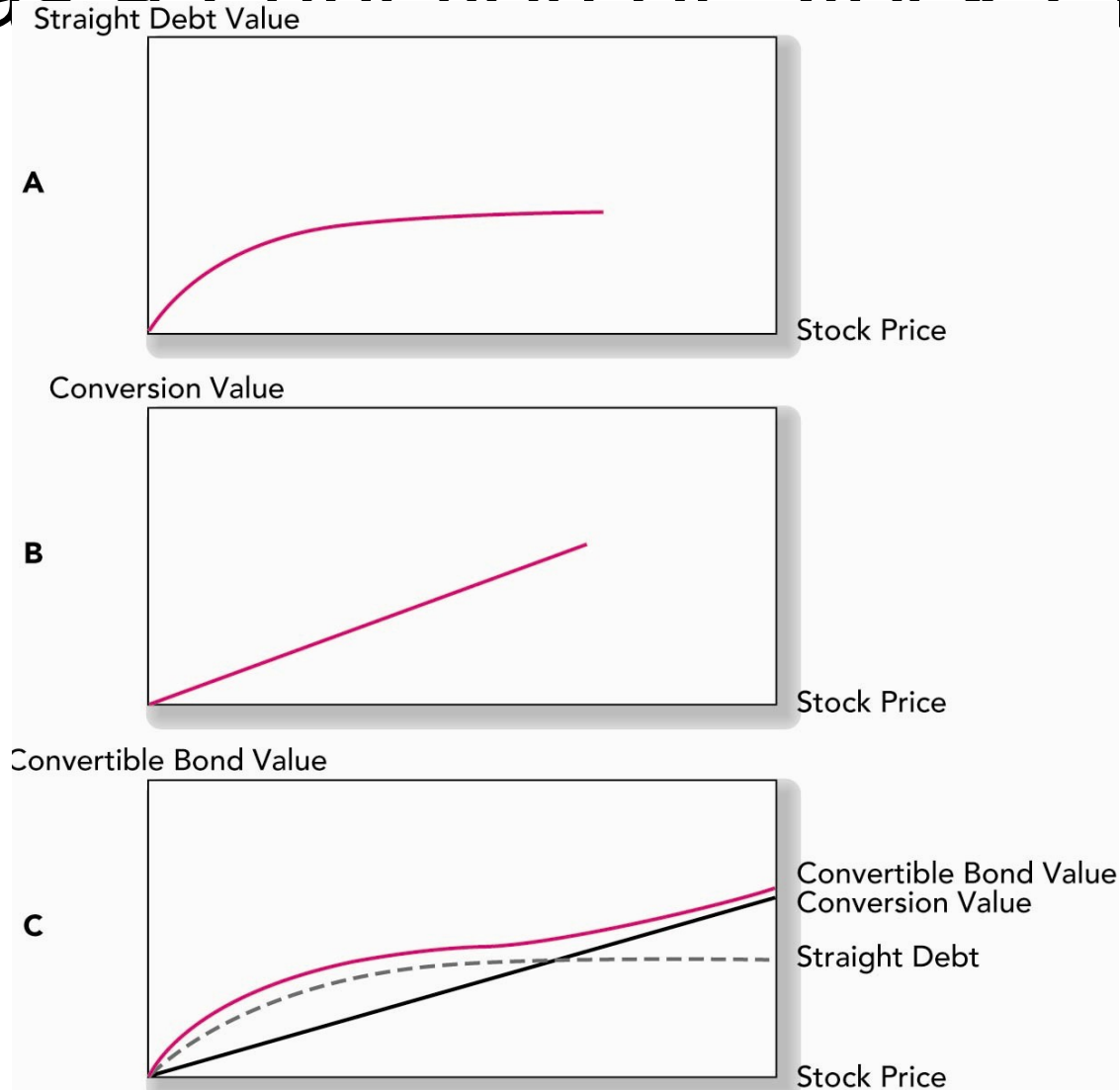
# Figure 20.12 Values of Callable Bonds Compared with Straight



# Convertibles Securities

- Convertible preferred stock convey options to the holder of the security rather than to the issuing firm
- Right to exchange each bond or share of preferred stock for a fixed number of shares of common stock, regardless of the market prices of the securities at the time
- Most convertible bonds are issued “deep out of money”
  - Issuer sets the conversion ration so that conversion will not be profitable unless there is a substantial increase in stock prices or decrease in bond prices from the time of issue

# Figure 20.13 Value of a Convertible Bond as a Function of Stock Price



# Warrants

- Call option issued by a firm
- Exercise of a warrant requires the firm to issue a new share of stock – total number of shares outstanding increases
- Warrants result in a cash flow to the firm when the warrant holder pays the exercise price
  - Warrants values will somewhat from the values of call options with identical terms
- Issued in conjunction with another security

# Collateralized Loans

- Many loan arrangements require that the borrower put up collateral to guarantee the loan will be paid back
  - This arrangements gives an implicit call option to the borrower

# Exotic Options

- Asian Options
- Barrier Options
- Lookback Options
- Currency Translated Options
- Digital Options

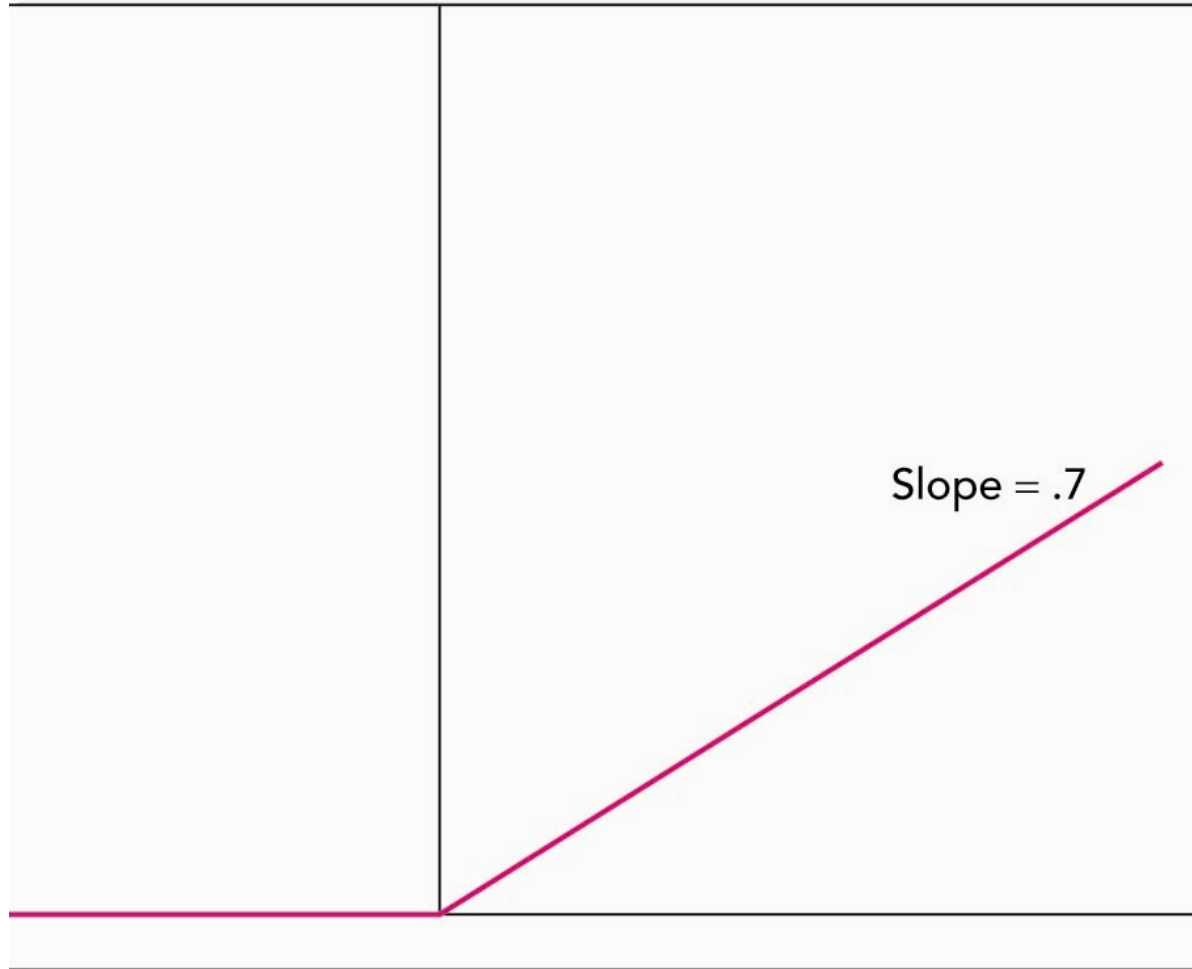
# Financial Engineering

- One of the attractions of options is the ability they provide to create investment positions with payoffs that depend in a variety of ways on the values of other securities.
- Index-linked certificate of deposit
  - Small position in index options
    - Guarantee a minimum rate of return the market fall

- The index-linked CD is clearly a type of call option
  - If market rises, the depositor profits according to the participation rate or multiplies
  - If the market falls, the investor is insured against loss
- Bank offering these CDs
  - Writing call options
  - Hedge its position by buying index call
- Multiplier



## Rate of Return on Index-Linked CD



$r_M$  = Market Rate  
of Return