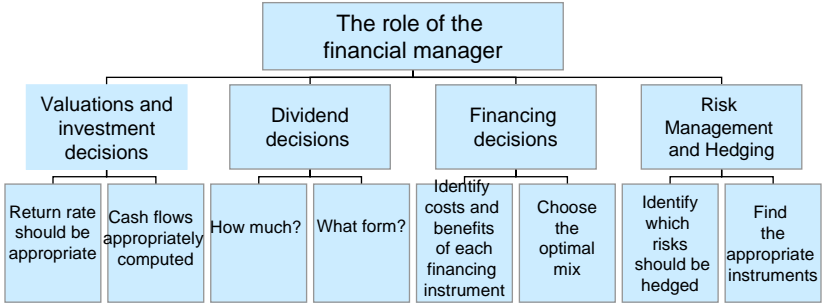


Lecture 4: Financial options

Corporate finance



Motivations

- Options theory provides the basic for improved NPV theory (real options)
- Options are imbedded in many corporate securities

3

Outline

- Basic instruments and terminology
- Definition of options (call and put)
- Portfolios of options
- Why buy and sell options?
- Application to corporate securities.

4

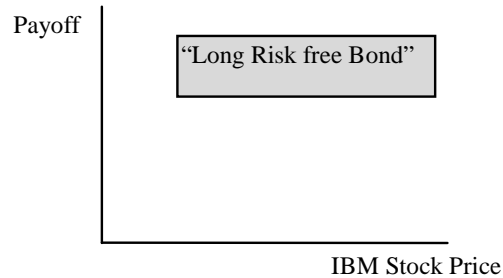
Basic Instruments

A. Bonds:

1. Long a risk free bond. What does it mean?

Draw the payoff diagram at expiration of a risk-free zero coupon bond long position with a face value of 100.

5



“Long Bond” Payoff=



Terminology and notation.

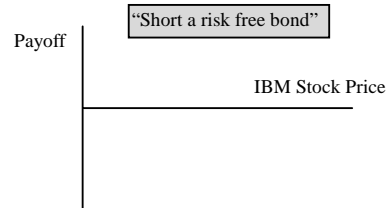
Payoff diagram= gross payoff from an investment as a function of stock price. [it is used to describe the payoffs from any security and, especially, options]. A payoff diagram does not include the purchase price. If you subtract the purchase price of a security from the gross payoff you get the net payoff or profit of an investment.

6

A. Bonds:

2. Short a risk free bond. What does it mean?

Draw the payoff diagram at expiration of a risk-free zero coupon bond short position with a face value of 100.



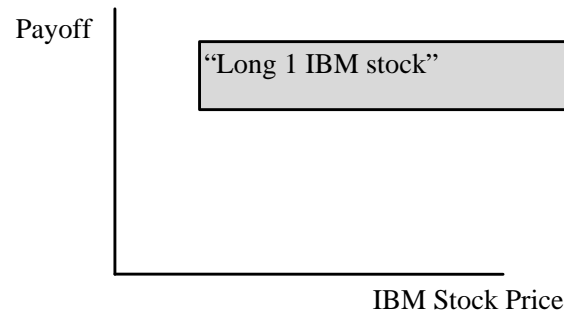
"Short Bond" Payoff=

7

B. Stocks

1. "Long a Stock." What does it mean?

Draw the payoff diagram of long position on 1 IBM stock

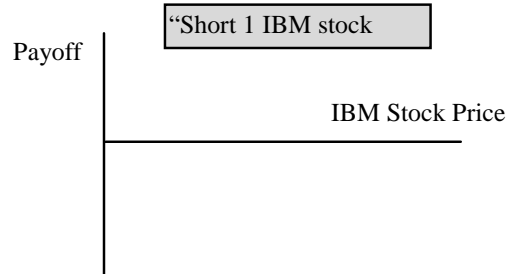


"Long Stock" Payoff=

8

2. "Short a Stock." What does it mean?

Draw the payoff diagram at expiration of a short position on IBM stock



"Short stock" Payoff=

9

C. Forward/Future Contracts

Forward contracts are agreements between a buyer and a seller calling for delivery of a specified amount of a specified asset at a specified, future date. The pre-specified price is called strike.



Terminology and notation.

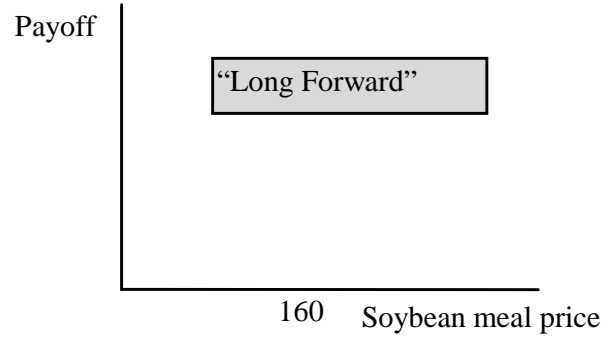
Strike price= or exercise price; price at which the commodity underlying a forward contract is purchased, I will denote this with X

T= expiration date of the forward contract

10

1. “Long a Forward”. What does it mean?

Draw the payoff diagram at expiration of long forward position on Soybean Meal (100 ton) with a strike price of 160

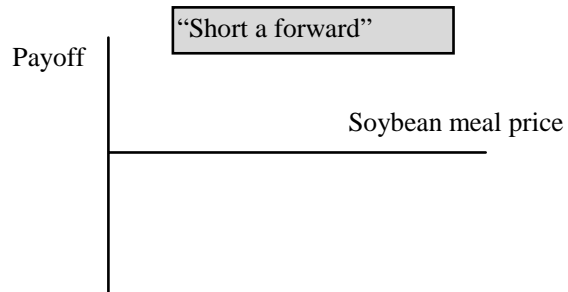


“Long Forward” Payoff=

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2. “Short a Forward”. What does it mean?

Draw the payoff diagram at expiration of a short forward position on Soybean Meal (100 ton) with a strike price of 160




“Short Forward” Payoff=

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I. Definitions of options.

A. Timeline

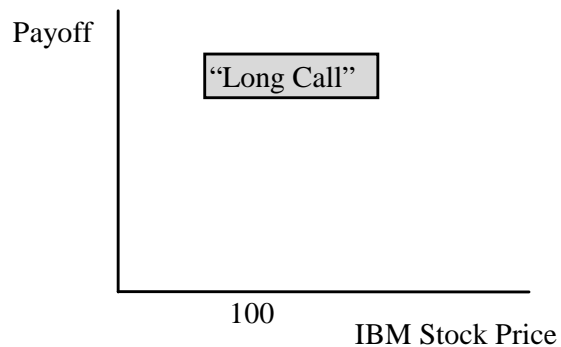
- 
- Today (time = t)
 - Option price, C, paid.
 - Expiration (time = T)
 - Exercise price paid and payoff received.

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B. Call option. The right but not the obligation to buy the underlying asset at a specified exercise or strike price on (European) or before (American) a specified expiration date.

1. “Long Call.”

Draw the payoff diagram at expiration of a long position on 1 European call on 1 IBM stock with $X=100$

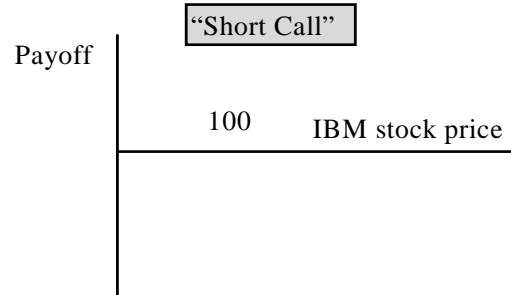


•“Long Call” Payoff=

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2. **“Short Call.”**

Draw the payoff diagram at expiration of a short position on 1 European call on 1 IBM stock with $X=100$

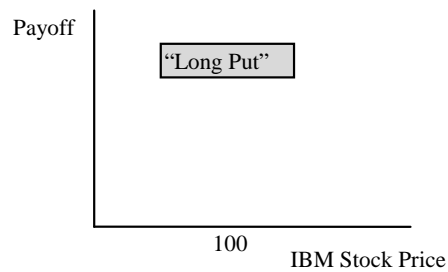


“Short Call” Payoff=

15

C. Put option. The right but not the obligation to sell the underlying asset at a specified exercise or strike price on (European) or before (American) a specified expiration date.

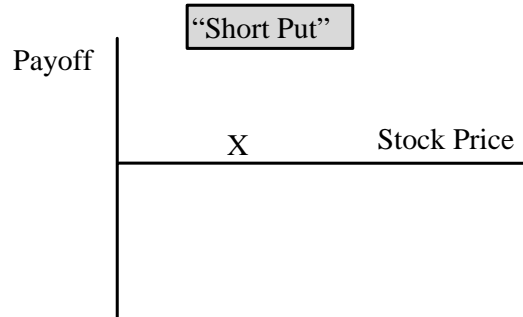
1. **“Long Put.”**



“Long Put” Payoff=

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2. "Short Put."



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Terminology and notation.

- In the money
- Out of the money



III. Portfolios of Options (Just like using portfolios of zero coupon bonds to value riskless payoffs. Those were payoffs over time, now over states.)

Using three basic building blocks, you can build a portfolio to replicate virtually any payoff that is derived from an underlying asset (e.g. a stock).

If you know how to value the building blocks individually, then by adding up their individual values, you can value the entire portfolio.

Same payoff \implies Same price. Why?

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B. Examples

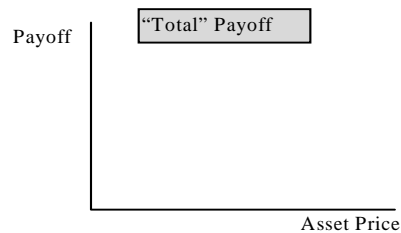
- Example 1.** Suppose that you are long a risk-free zero-coupon bond with a face value of \$100 and a call option on CISCO stock with a strike price of \$125. Graph the payoff from this portfolio as a function of CISCO's stock price.

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- Step #1: Generate a payoff table

	Stock Price	
Security	$0 \leq S_T \leq 125$	$125 \leq S_T \leq \infty$
Bond		
Call Option		
Total		

- Step #2: Graphs the payoff.



- Question: Would you have to pay or be paid to hold this portfolio? Why?

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Example 2. Suppose that you are long a risk-free bond with a face value of \$50, short a call option on CISCO stock with a strike price of \$50, and long a call option on CISCO stock with a strike price of \$150. Graph the payoff from this portfolio as a function of CISCO stock price.

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a. Step #1: Generate a payoff table

Security	CISCO Stock Price		
	$0 \leq S_T \leq 50$	$50 \leq S_T \leq 150$	$150 \leq S_T \leq \infty$
Bond			
Short Call			
Long Call			
Total			

b. Step #2

b. Question: Would you have to pay or be paid to hold this portfolio? Why?

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III. Why buy or sell derivative securities?

- A. **Arbitrage.** In an efficient capital market, options are priced such that arbitrage opportunities do not exist. If significant market inefficiencies exist, investors can lock in risk free profits by buying and selling combinations of stocks and derivative securities.
- B. **Risk Management.** By building portfolios with various combinations of stocks and derivative securities, investors can tailor the portfolio's risk profile.
- C. **Speculation**

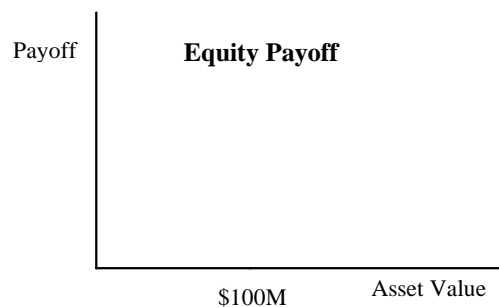
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IV. Application to Corporate Securities

A. **Options are imbedded in many corporate securities.**

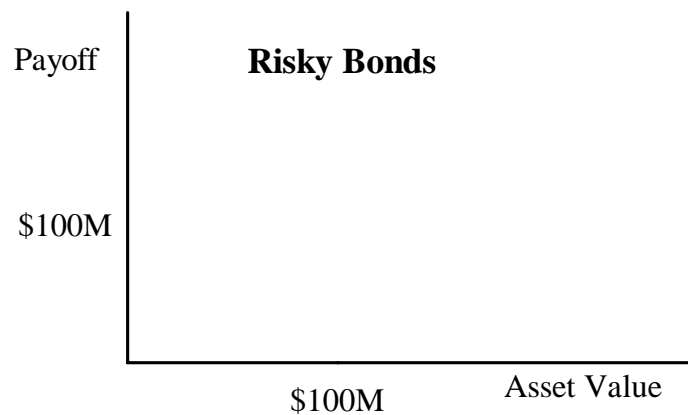
B. **Payoff to Equity.** Consider a firm with \$200M in assets, half of which is financed with debt due in 1 year and the other half financed with equity.

What is the payoff to equity holders one year hence as a function of the value of the firm's assets?



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c. Payoff of a corporate bond. What is the payoff of the bond as a function of the value of the firm's assets?



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Takeaway

- Basic instruments (bonds, stocks, forward)
 - Basic terminology, and payoff diagrams
- Option terminology
 - Basic terminology, and payoff diagrams
- Portfolios of options
 - Payoff diagrams
- Reasons for buying and selling options
 - Hedging (value of info) and speculation
- Applications to corporate securities

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