

Options, Futures and other ^{1.1} Derivatives

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Monday, Tuesday and Thursday

**YOU WILL NEED A
CALCULATOR**

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WHAT DO YOU EXPECT TO LEARN
IN THIS CLASS ?

INTRODUCTION

The Nature of Derivatives

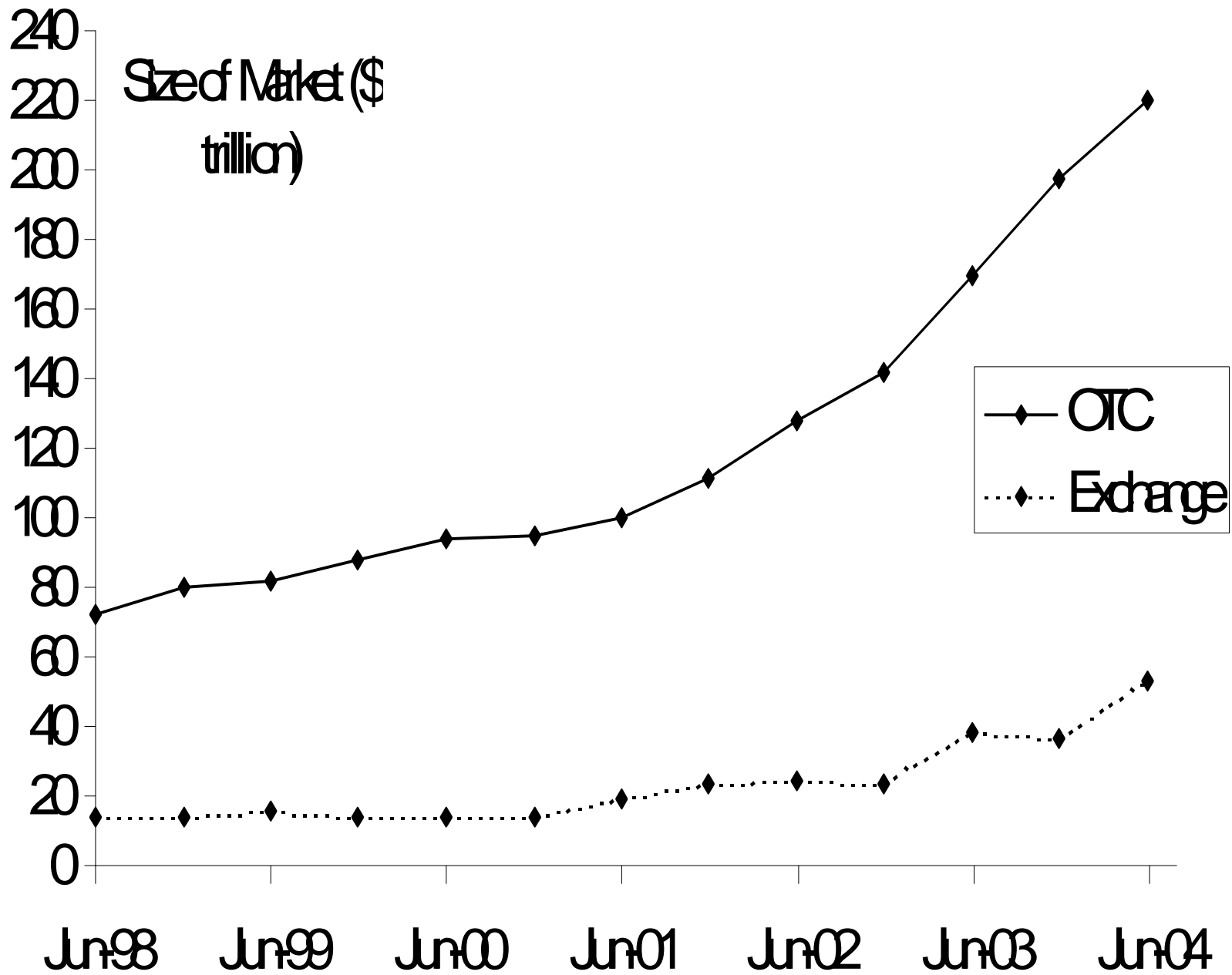
A derivative is a financial instrument whose value depends on the values of other more basic underlying variables

Examples of Derivatives

- Forward Contracts
- Options
- Futures Contracts
- Swaps
- Credit Derivatives (CDS , CDOs)

Derivatives Markets

- Exchange Traded (futures, options)
 - standard products
 - trading floor
 - virtually no credit risk
- Over-the-Counter (forwards, swaps, options, CDS)
 - non-standard products
 - telephone market
 - some credit risk



Ways Derivatives are Used

- To hedge risks
- To reflect a view on the future direction of the market
- To lock in an arbitrage profit
- To change the nature of a liability
- To change the nature of an investment without incurring the costs of selling one portfolio and buying another

Forward Contracts

- A forward contract is an agreement to buy or sell an asset at a certain time in the future for a certain price (the delivery price)
- It can be contrasted with a spot contract which is an agreement to buy or sell immediately

How a Forward Contract Works

- The contract is an over-the-counter (OTC) agreement between 2 companies
- The delivery price is usually chosen so that the initial value of the contract is zero
- No money changes hands when contract is first negotiated and it is settled at maturity

The Forward Price

- The forward price for a contract is the delivery price that would be applicable to the contract if it were negotiated today
- The forward price may be different for contracts of different maturities (depending on...?) %

The Forward Price of Gold

If the spot price of gold is S and the **theoretical** forward price for a contract deliverable in T years is F , then

$$F = S (1+rt) \quad \text{when } < 1 \text{ year}$$

$$F = S (1+r)^t \quad \text{when } > 1 \text{ year}$$

where r is the 1-year (domestic currency) risk-free rate of interest.

In our examples, $S=875$, $T=1$, and $r=0.05$ so that

$$F = 875 [(1+(0.05 \times 1)) = \$918.75$$

1. Gold: An Arbitrage Opportunity?

- Suppose that:
 - The **spot** price of gold is US\$875
 - The 6-month **forward price** of gold trades at US\$895 on the market
 - The 1-year US\$ interest rate is 5% per annum
- Is there an arbitrage opportunity?

What is arbitrage ?

A transaction that generates risk free profit

The theoretical forward price is :

$$875 (1 + 0.05 \times 0.5) = \$896.88$$



Buy Future and Sell the Spot

The theoretical price is not a price you can trade on

2. Gold: Another Arbitrage Opportunity?

- Suppose that:
 - The spot price of gold is US\$750
 - The 1-year forward price of gold is US\$768
 - The 1-year US\$ interest rate is 5% per annum
- Is there an arbitrage opportunity?

What 2-year forward price would eliminate any arbitrage possibility?

$$750 (1 + 0.05)^2 = \$827$$

If the 2-year forward rate on gold is \$827, there would
Not be any arbitrage opportunities.

Terminology

- The party that has agreed to buy has what is termed a long position (going LONG)
- The party that has agreed to sell has what is termed a short position (going SHORT)

**IN GENERAL, THE PAYOFF FROM A LONG POSITION IN
A FORWARD CONTRACT ON ONE UNIT OF AN ASSET IS**

$$F - S$$

**IN GENERAL, THE PAYOFF FROM A SHORT POSITION IN
A FORWARD CONTRACT ON ONE UNIT OF AN ASSET IS**

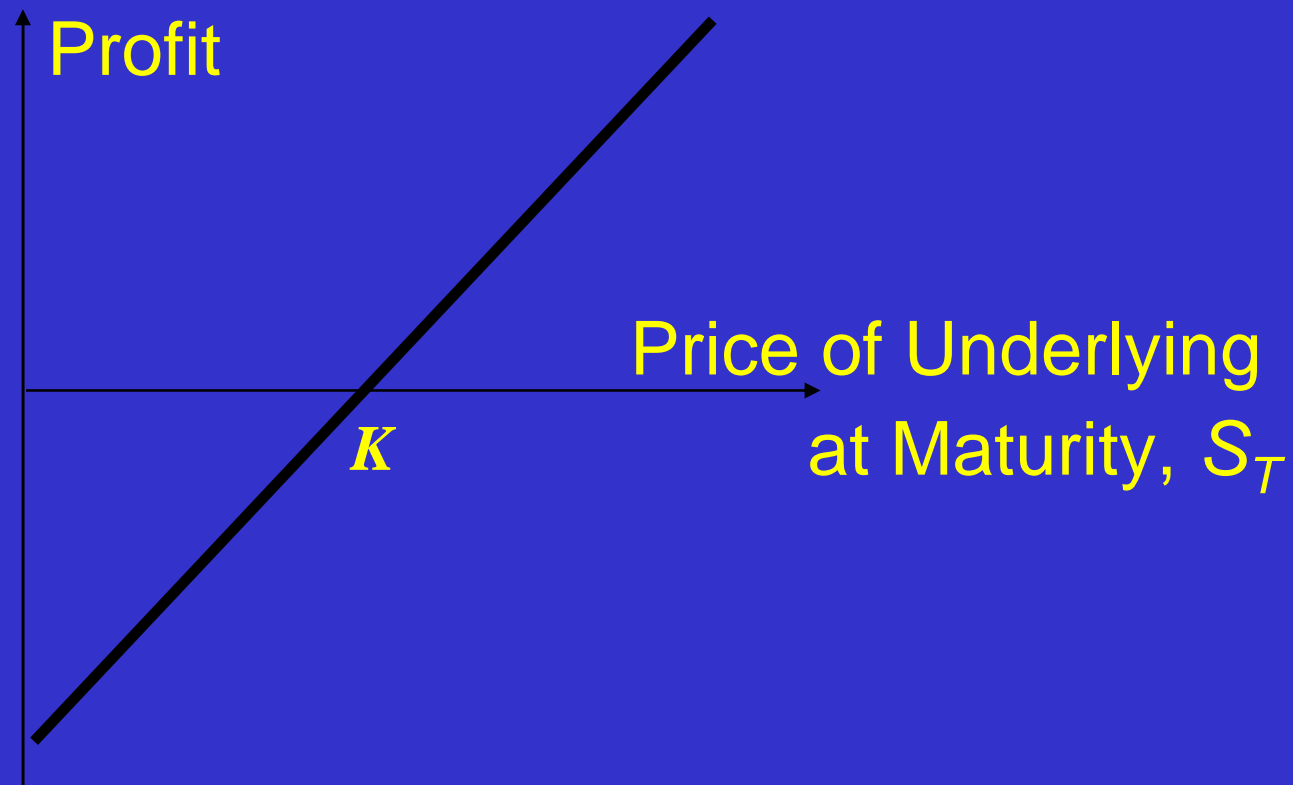
$$S - F$$

**(F IS THE DELIVERY OR FORWARD PRICE AND
S IS THE SPOT PRICE)**

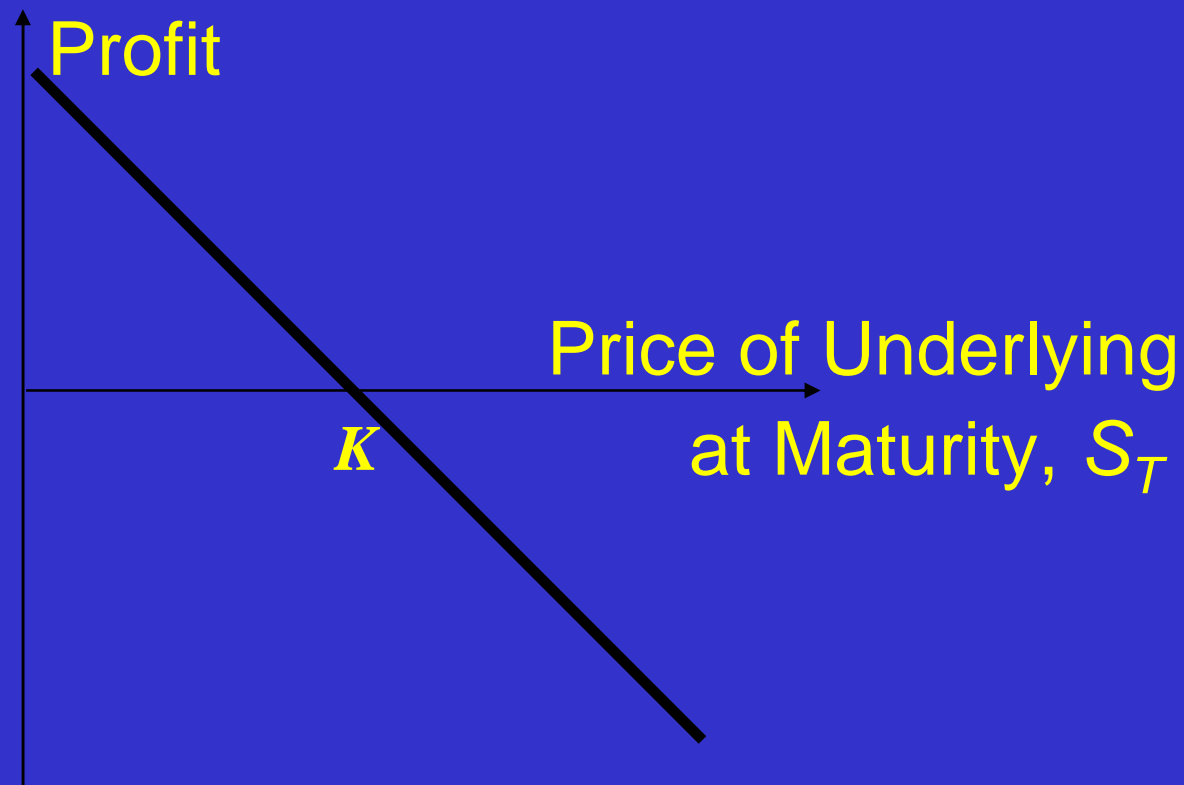
Example

- On Sept 25, 2007 a trader enters into an agreement to buy €1 million in 3 months at an exchange rate of \$1.4720 (F)
- This obligates the trader to pay \$1,472,000 for €1 million on December 25, 2007
- What are the possible outcomes?

Profit from a Long Forward Position



Profit from a Short Forward Position



THIS IS IT FOR

FORWARDS

OK?

NOT OVER YET

A speculator thinks the dollar will go back up in the next 3 months. What can he do, using the forward market?

GOES LONG OR BUYS DOLLAR FORWARD

THE DOLLAR/EURO RATE IS AT 1.47 TODAY
(that is \$1.47 for 1 €).

You decide to buy 3-months forward 1 Million euros.

What is his profit/loss if the Dollar/EURO rate goes to...

You are buying €1 million that is selling \$1,470,000

$$1.45 ? \quad 1.45 - 1.47 = 0.02 * 1\text{MM} = \$20\ 000$$

$$1.41 ? \quad 1.41 - 1.47 = -0.06 * 1\text{MM} = -\$60\ 000$$

WELCOME TO THE WORLD OF

FUTURES

1.28

AN ANXIOUS
← TRADER



CHICAGO (CBOT)

Derivatives, 4th edition © 1999 by John C. Hull

Futures Contracts

- Agreement to buy or sell an asset for a certain price at a certain time
- Similar to forward contract
- Whereas a forward contract is traded OTC a futures contract is traded on an exchange

Exchanges Trading Futures

- Chicago Board of Trade (grains, bonds)
- Chicago Mercantile Exchange(curr.)
- New York Cotton Exchange
- International Petroleum Exchange (IPE)
- LIFFE (London)
- TIFFE (Tokyo)
- and many more...

1. Oil: An Arbitrage Opportunity?

Suppose that:

- The **spot** price of oil is US\$106
 - The quoted 1-year futures price of oil is US\$
 - The 1-year US\$ interest rate is 5% per annum
 - The storage costs of oil are \$2 per annum
- Is there an arbitrage opportunity?

2. Oil: Another Arbitrage Opportunity?

- Suppose that:
 - The spot price of oil is US\$80
 - The quoted 1-year futures price of oil is US\$75
 - The 1-year US\$ interest rate is 5% per annum
 - The storage costs of oil are \$2 per annum
- Is there an arbitrage opportunity?

MORE IN-DEPTH ANALYSIS OF

FUTURES

NEXT WEEK ...

Options

- A call option is an option to buy a certain asset by a certain date for a certain price (the strike price)
- A put option is an option to sell a certain asset by a certain date for a certain price (the strike price)

Exchanges Trading Options

- Chicago Board Options Exchange
- American Stock Exchange
- Philadelphia Stock Exchange
- Pacific Stock Exchange
- European Options Exchange
- Australian Options Market
- and many more (see list at end of book)

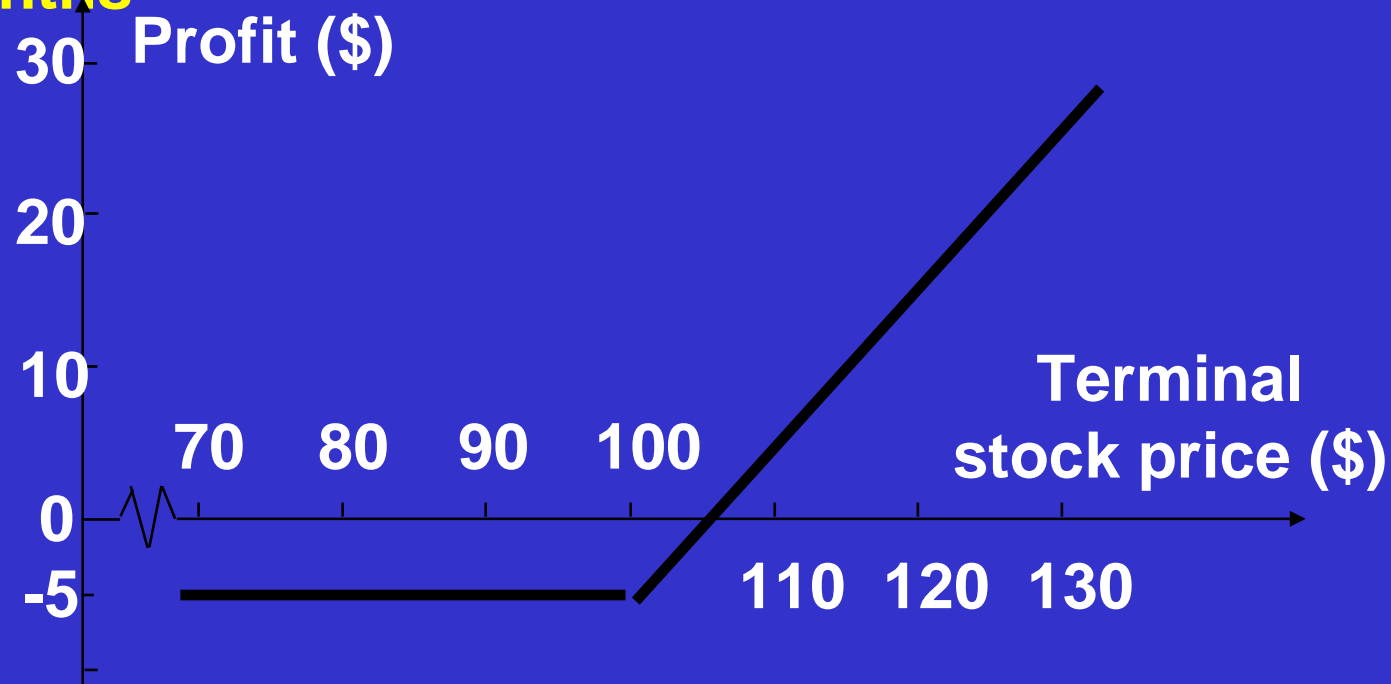
Difference between an option
and a forward (or futures) contract ?

Options vs Futures/Forwards

- A futures/forward contract gives the holder the **obligation** to buy or sell at a certain price
- An option gives the holder the **right** to buy or sell at a certain price

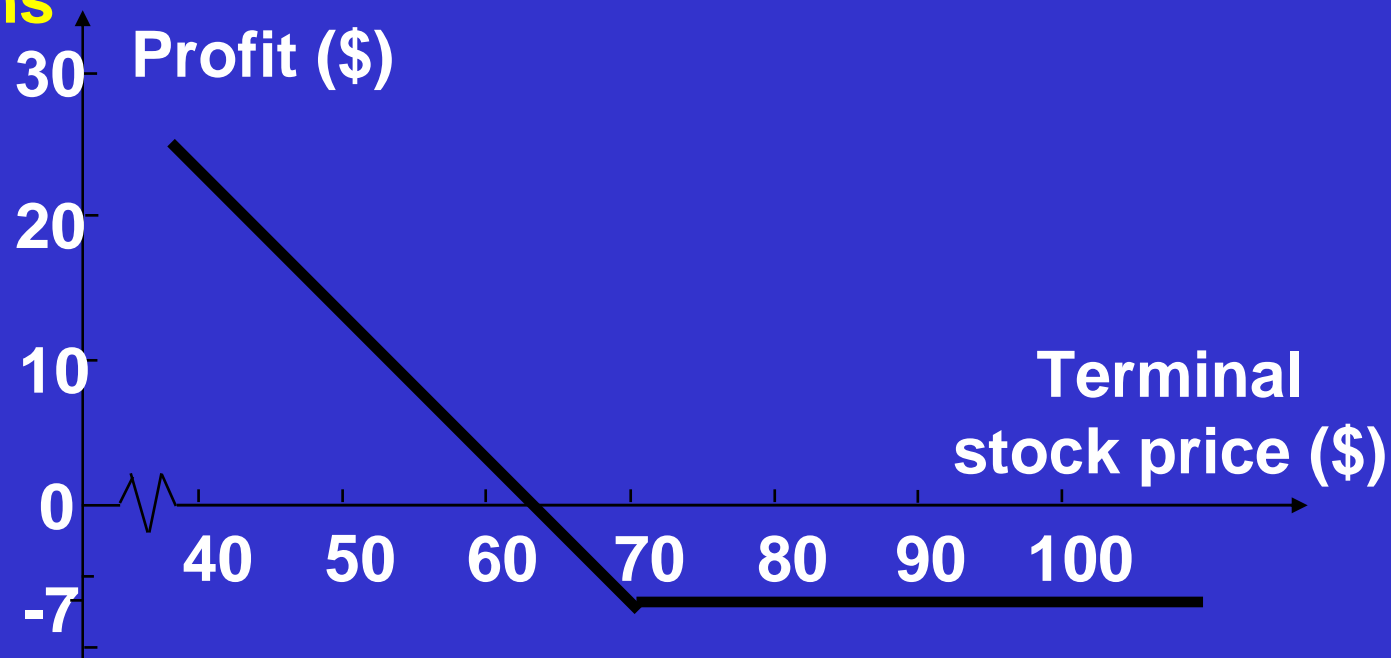
Long Call on IBM

Profit from buying an IBM European call option:
option price = \$5, strike price = \$100, option life = 2 months



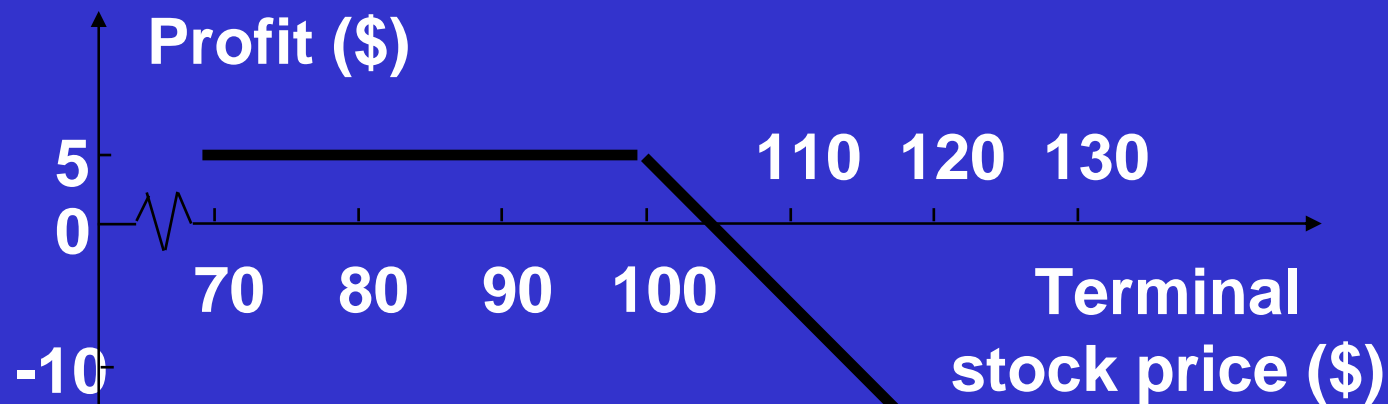
Long Put on Exxon

Profit from buying an Exxon European put option:
option price = \$7, strike price = \$70, option life = 3
mths



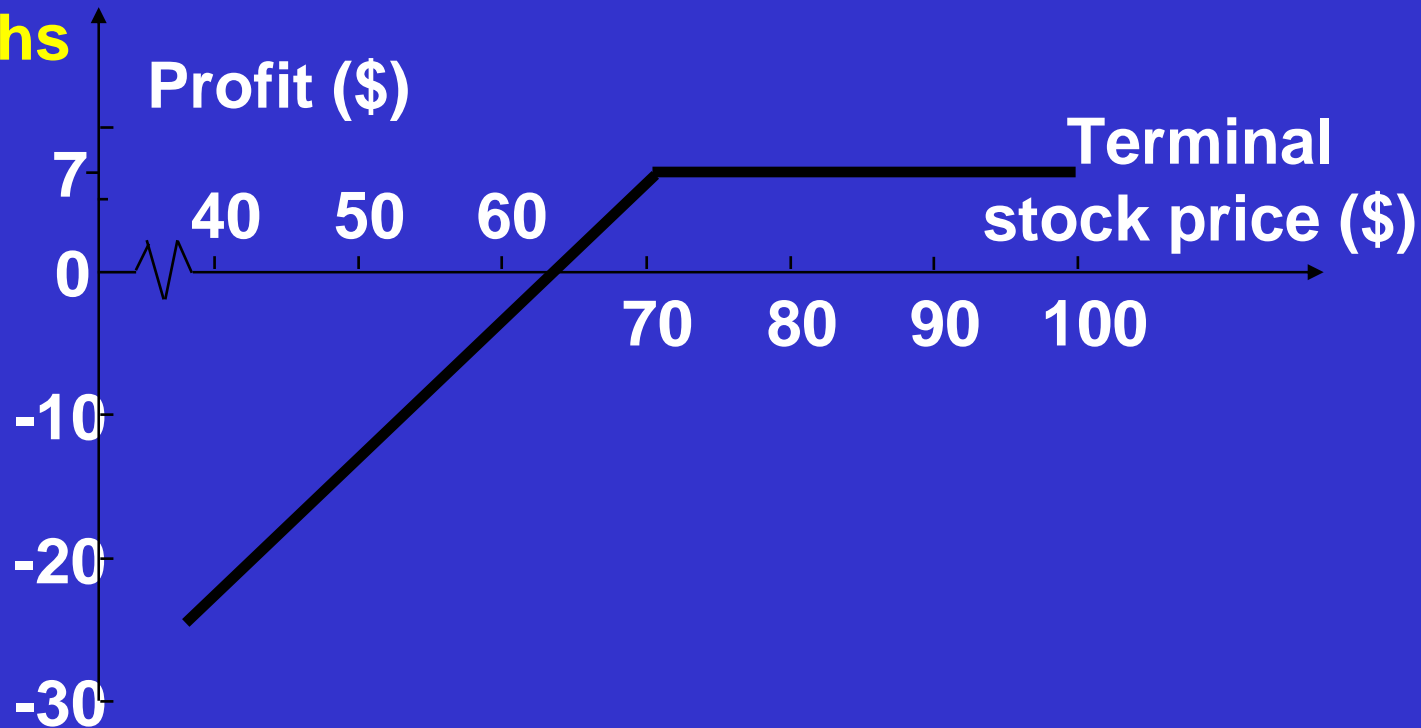
Short Call on IBM

Profit from writing an IBM European call option:
option price = \$5, strike price = \$100, option life = 2 months



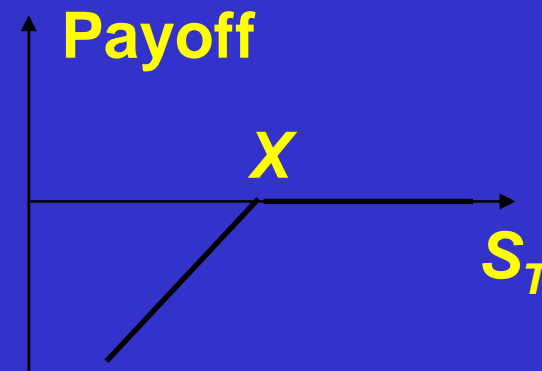
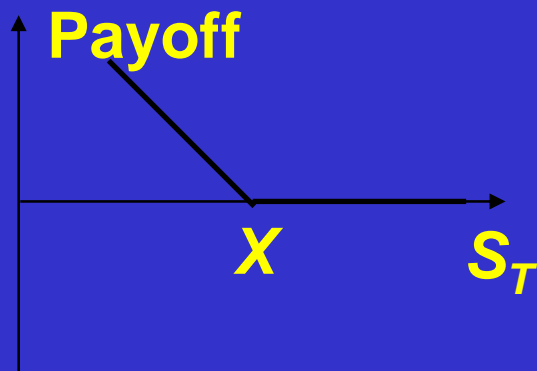
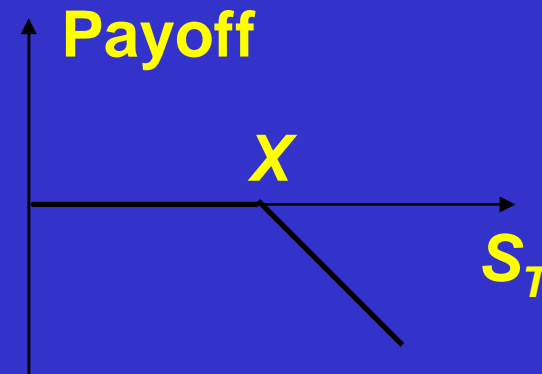
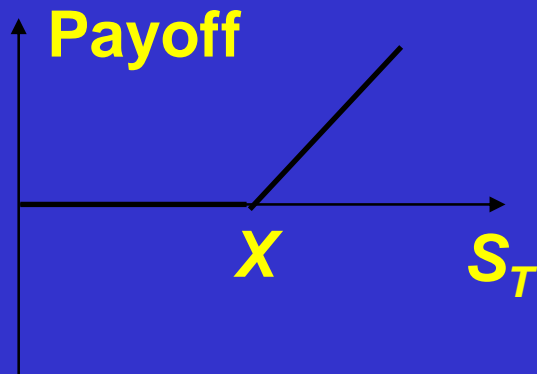
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Profit from writing an Exxon European put option:
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Payoffs from Options

What is the Option Position in Each Case?
 X = Strike price, S_T = Price of asset at maturity



Types of Traders

- Hedgers
- Speculators
- Arbitrageurs

Some of the large trading losses in derivatives occurred because individuals who had a **mandate** to hedge risks switched to being speculators (Barings case)


Hedging Examples

- A US company will pay £1 million for imports from Britain in 6 months and decides to hedge using a **long/short** position in a forward contract ? **long**
- An investor owns 500 IBM shares currently worth \$95 per share. A two-month put with a strike price of \$90 costs \$2. The investor decides to hedge by **buying/selling** 5 puts ? **buy**

Speculation Example

- An investor with \$7,800 to invest feels that Exxon's stock price will increase over the next 3 months. The current stock price is \$78 and the price of a 3-month call option with a strike of 80 is 3 (which means \$300)
- What are the alternative strategies?

OUTCOME

STRATEGY	70	90
BUY SHARES	(800)	1200
BUY CALL OPTIONS	(7800)	18,200
		

$$[(90-80) \times 2600] - 7800$$

Arbitrage Example

- A stock price is quoted as £100 in London and \$200 in New York
- The current exchange rate is 1.90 dollars per pound
- What is the arbitrage opportunity?

**YOU BUY THE STOCK IN London at \$190
DOLLARS**

AND

YOU SELL IT IN NY AT \$200 DOLLARS

NET PROFIT = 10 DOLLARS/SHARE

Hedge Funds

1.49

VS. mutual funds

- Hedge funds are not subject to the same rules as mutual funds and cannot offer their securities publicly.
- Mutual funds must
 - disclose investment policies,
 - makes shares redeemable at any time,
 - limit use of leverage
 - take no short positions.
- Hedge funds are not subject to these constraints.
- Hedge funds use complex trading strategies are big users of derivatives for hedging, speculation and arbitrage

BREAK TIME !