Financial Markets and Products

Chapter 4:

Introduction to Derivatives

Bionic Turtle
A CeriFi Company

Chapter 4:
Introduction to Derivatives

Key Concepts:

- What are Derivatives?
- Derivative Features (Linear vs. Non-Linear, Exchange vs. OTC)
- Derivative Types (Forwards, Futures, Options)
- Derivative Traders (Speculators, Hedgers, Arbitrageurs)
- Derivative Risks
- Payoff Calculations

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What are Derivatives?

"Derivatives allow people who have risk and don't want it to transfer it to people who want risk and don't have it." **– Yours Truly**

Derivatives are contracts whose value depends on one or more underlying values. Some types of underlying include equities, commodities, currencies, any indices, and even the weather.

Some uses include:

- Businesses manage risks of input or output prices
- Make bonds more favorable to buyers or sellers
- Used as employee incentives
- Part of capital investment opportunities
- Allow mortgages to be pre-paid

Often misunderstood and criticized. There are many kinds, simple to complex, exchange-listed, and over-the-counter.

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Derivative Features (Linear vs. Non-Linear)

Linear

- Profits and losses rise and fall one-to-one with the underlying (Forwards and Futures)

Non-Linear

- The rate of change of the derivative's price, varies with the underlying's price. (Options)

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Derivative Features (Exchange vs. OTC)

Exchange Traded (Listed)

- Standardized contracts – Dates, Contract Sizes, Strikes,
- Physical Trading Floors → Now electronic
- Centralized Clearing
- Collateral (Margin) required
- Daily Settlement on Futures
- Liquid

Over-the-Counter (OTC)

- Non-Standardized contracts – Make any terms you like
- Trade anytime, often by phone.
- Can use a central clearing house, but not always required.
- Counterparty risk
- Periodic Settlement – Sometimes
- Collateral Posted – Sometimes
- Illiquid

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Derivative Types (Forwards and Futures)

Forwards

OTC contracts where one party agrees to buy something at a specified price in the future, and another party sells it at specified price in the future. The payoff changes linearly with the future price.

If the agreed price is K, and the spot price at settlement is S, the payoff to the buyer is S-K, and the loss to the seller is K-S

Futures

Futures are exchange-listed forwards that have the same payoff profile as forwards. However, futures require daily settlement of profits and losses.

- Commodities - agriculture, energy, metals.
- Financial futures - treasury bonds, popular stock market indices.
- Weather Futures

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Derivative Types (Options)

Options – Call (put) buyer has the right to buy (sell), the call (put) seller has the obligation to sell (buy) if assigned. Offered on exchanges and over-the-counter.

- Calls – Contracts to buy an underlying at a predetermined strike price K.
- Puts – Contracts to sell an underlying at a predetermined strike price K.
- Values are non-linear. To one side of the strike the payoffs are 0.
- Buyers of options pay a premium at initiation of the trade.
- European/American
- Exotics (aka non-standard or not *plain vanilla*)

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Derivative Types (Options) (cont.)

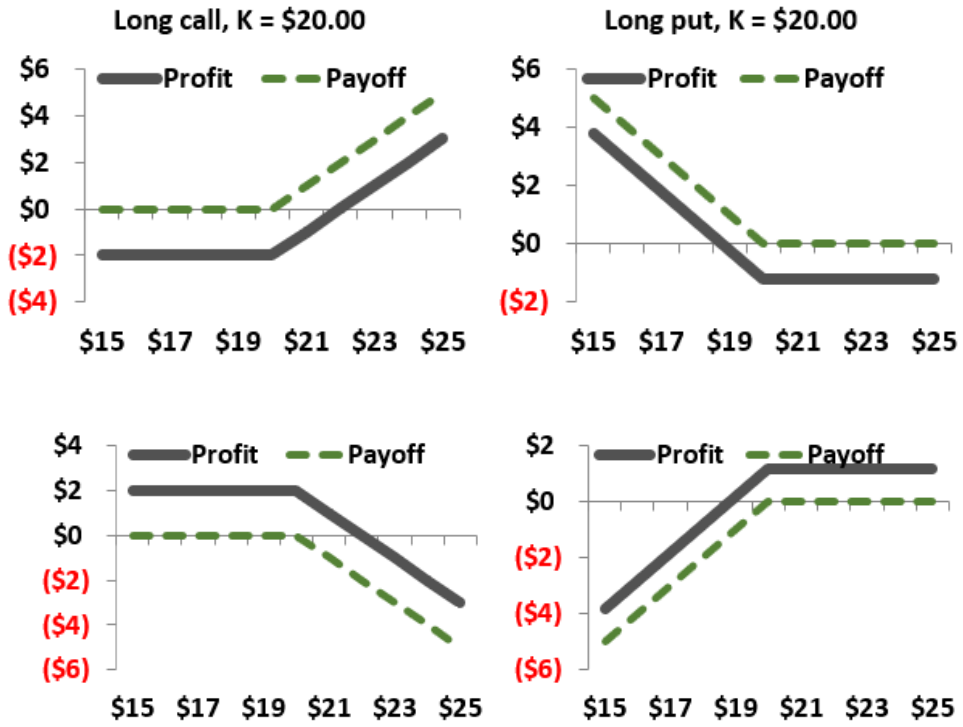
Payoffs at expiration

Call buyer: max(S-K,0)

Call seller: -max(S-K,0)

Put buyer: max(K-S,0)

Put seller: -max(K-S,0)



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Derivative Traders (Speculators, Hedgers, and Arbitrageurs)

- **Speculators**

  Make bets, typically directional, (sometimes on volatility) on price movements for less up front capital than buying or selling the underlying.

- **Hedgers**

  Reduce or eliminate risk. Lock in future prices or protect themselves from adverse price movements.

- **Arbitrageurs (Arbs)**

  Take advantage of price discrepancies between derivatives, and between derivatives and underlying. Typically use models and sometimes leg into positions.

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Derivative Risks

- Derivatives are inherently levered positions. For zero to little money up front you can take a position in almost anything that trades.

- Market Risk

- Counterparty Risk (OTC)

- Liquidity Risk (mainly OTC but listed as well)

- Operational Risk – The buyer or seller doesn't understand the specifics of what they have bought or sold.

- Operational Risk – Settlement Risk; failing to close out a commodity contract before delivery and being forced to take delivery.

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Payoff Calculations (XLS)

Forwards

Long Payoff = S-K

Short Payoff = K-S

	Strike	Long/Short
Forward #1	18	1 Long
Forward #2	22	0 Short

	Future Stock Price										
	$15	$16	$17	$18	$19	$20	$21	$22	$23	$24	$25
	Forward Payoff										
Forward #1	-3	-2	-1	0	1	2	3	4	5	6	7
Forward #2	7	6	5	4	3	2	1	0	-1	-2	-3

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Payoff Calculations (XLS) (Cont.)

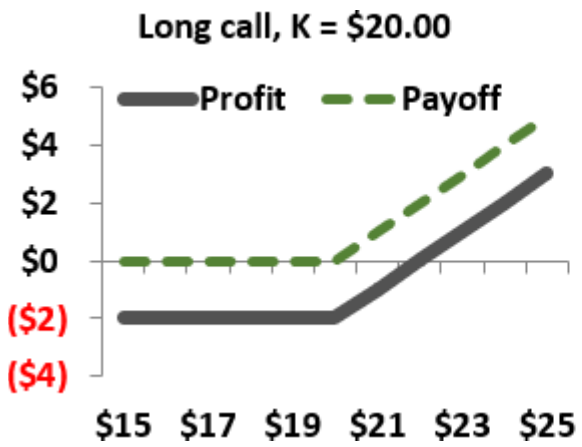
Options (Calls)

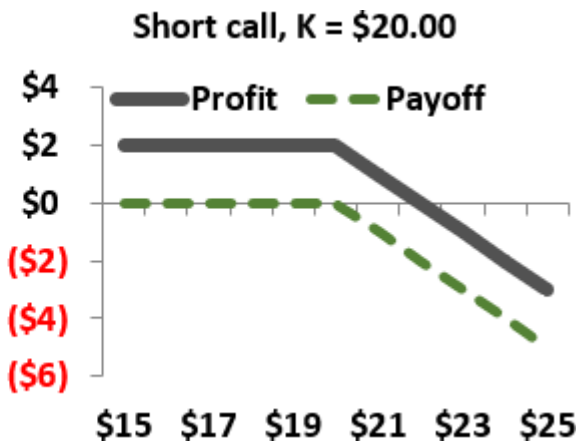
Long Payoff = max(S-K,0)

Short Payoff = -max(S-K,0)

Call Price: $1.99

						Future Stock Price										
Riskless rate	4.0%					$15	$16	$17	$18	$19	$20	$21	$22	$23	$24	$25
	Strike	c/p?		L/S?		Option Payoff										
Option (1st)	$20.00	1	call	1	long	0	0	0	0	0	0	1	2	3	4	5
Option (2nd)	$20.00	1	call	0	short	0	0	0	0	0	0	-1	-2	-3	-4	-5





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Payoff Calculations (XLS) (Cont.)

Options (Puts)

Long Payoff = max(K-S,0)

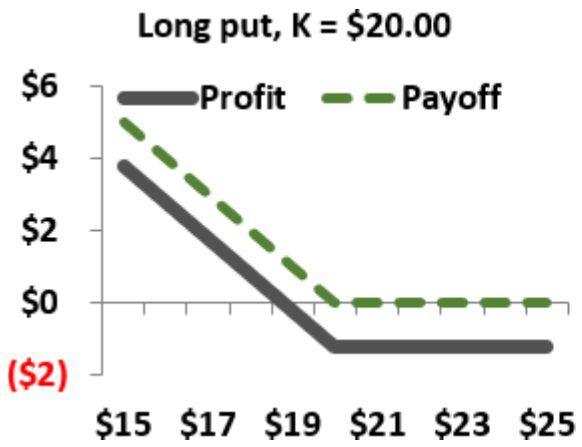
Short Payoff = -max(K-S,0)

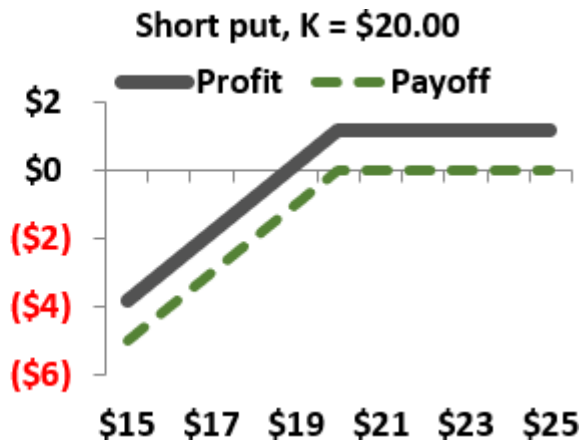
Put Price: $1.20

Riskless rate	4.0%				

	Strike	c/p?		L/S?	
Option (1st)	$20.00	0	put	1	long
Option (2nd)	$20.00	0	put	0	short

Future Stock Price	$15	$16	$17	$18	$19	$20	$21	$22	$23	$24	$25
Option Payoff	5	4	3	2	1	0	0	0	0	0	0
	-5	-4	-3	-2	-1	0	0	0	0	0	0





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Payoff Calculations (XLS) (Cont.)

Arbitrage – Futures vs. Spot

Commodity spot, S(0)	**$900.00**	
Interest rate, Rf	**10%**	
Maturity (years)	**1.0**	*Annual compounding*
Theorectical COC price	**$990.00**	

Scenario #1: Futures "trades rich" (greater than theoretical price)

Observed futures price	**$1,000.00**

Cash and Carry	**Time 0**	**Time 1.0**	**Net**
Buy commodity	-$900.00		
Borrow cash (to buy commodity)	$900.00	-$990.00	
Short futures contract		$1,000.00	
Net Cash Flow	$0.00	$10.00	$10.00

Scenario #2: Futures "trades cheap" (less than theoretical price)

Observed futures price	**$980.00**

Reverse cash and carry	**Time 0**	**Time 1.0**	**Net**
Short commodity	$900.00		
Lend cash (collected from short)	-$900.00	$990.00	
Long futures contract		-$980.00	
Net Cash Flow	$0.00	$10.00	$10.00

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