Term Paper

- Submitted in APA style formatting, font size 11 or 12.
  Guideline: 5-8 pages, longer if you feel like you need more space due to figures and tables.
- Attach the Excel spreadsheet in which you performed your analysis
  - **You have to create your own Excel spreadsheet!**

Term Paper

- **Presentation of the company:**
  business model; industry, its peers and the company's position within that group; history; leadership; etc.
- **Fundamentals of the company:**
  past performance of the stock; revenue and earnings and their development over the years; appropriate financial ratios.

Term Paper

- **Price and price expectations**: based on the previous section, run a DCF analysis to arrive at your best estimate for the intrinsic value of the company and your best estimate for the share price. Clearly explain your assumptions and provide two alternate scenarios. The report should contain the main table of the DCF for readers to observe your calculations and assumptions. For your DCF you need to find beta which you can do with a regression analysis, as well as the credit rating. Feel free to reach out to me if you need help with the credit rating and its implication for cost of debt.

Term Paper

- **Risks and headwinds**:
  your DCF is based on assumptions about the future of the company, its industry environment, and the market and business environment. How sensitive is your analysis to this? More specifically, what are the headwinds and risks that the company faces in its operations in the near and medium-term future?
- **Conclusion and recommendation for three investors**

Term Paper

Bryant is a 25-year old young professional, employed in a major city in the northeast. Since joining the workforce three years ago, he contributes as much money as possible to his retirement accounts which is invested in a diverse set of index funds. An avid fan of Benjamin Graham's "The Intelligent Investor", he has decided to consider a few individual stocks of companies with good and stable long-term prospects as well as a great management. Explain and justify your recommendation for Bryant. If you choose to not recommend your stock, propose an alternative from the same industry.

Term Paper

Nicole is 52 years old, and a few months ago, she retired from her well-paying job after aggressively saving and investing her money prudently for much of her life. While she could go back to work if necessary, she prefers her financial independence. In order to maintain a steady cash-flow, her portfolio is heavily geared towards high yielding stocks, allowing her and her family to live of dividend payments for the most part. Aware of the recent downturn of General Electric and their dividend cut, she focuses on companies from which she expects a solid and steady dividend growth. Explain and justify your recommendation for Nicole. If you choose not to recommend your stock, propose and alternative from the same industry.

Term Paper

Pete is in his mid 30s. Starting late to contribute to his retirement fund, he wants to complement his investments in ETFs in his 401k. For this purpose he sets aside $10000 every year for the next ten years to seek out riskier, but potentially much more profitable high-growth opportunities. Similarly, he is open to shorting stock for fundamental or hedging reasons, if the opportunity presents itself. After the ten years of active portfolio management, he wishes to wind down his positions to seek more stable investments. Explain and justify your recommendation for Paul. If you choose not to recommend your stock, propose and alternative from the same industry.

AD 717:
Investment Analysis and Portfolio Management

Section A1

What are Options?

- Options are **derivatives**, meaning that these securities derive their value from the price of other securities.
- Useful for hedging and speculation
- Buyer or holder of option has the right to purchase or sell asset at a pre-agreed price; seller or write of option receives a payment for this.

Main terms:

- Exercise Price or Strike Price
- Expiration Date
- Premium

Call Options

A European style call option gives its holder the right to buy an asset:

- At the exercise price
- On the expiration date

Exercise the option if:

- market value > exercise price.

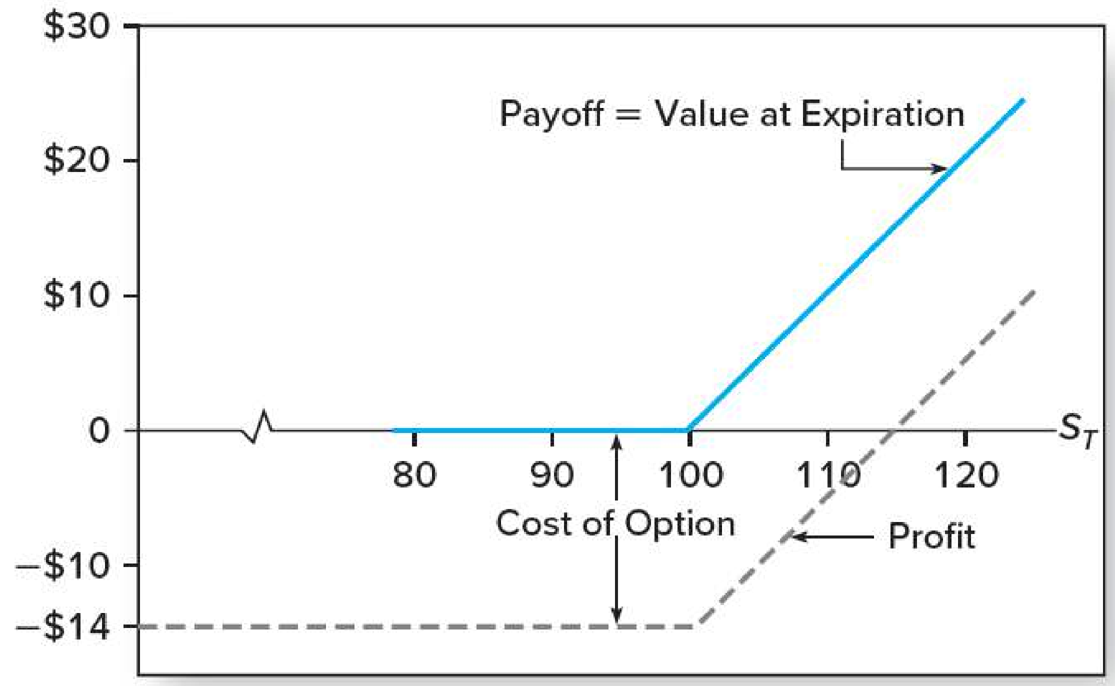


Figure 20.2 Payoff and profit to call option at expiration

Call Options – Example

- Amazon is trading at $1870.
- Purchase a May call on AMZN
  - **Exercise Price** $1900
  - **Premium** (on April 17th, end of day): $43.10
- Option expires on the third Friday of the month.
  - **Expiration Date:** May 17th, 2019

If AMZN remains below $1900, the call expires worthless.

Call Options – Example

Purchase a December call on AMZN

- **Exercise Price** $1900
- **Premium** (today): $43.10
- **Expiration Date:** May 17th, 2019

AMZN sells for $1963.90 on the expiration date and we exercise.

- Option value = Stock Price – Exercise Price
  = $1963.90 - $1900.00 = $63.90
- Profit = $63.90 – $43.10 = $20.80
- Holding Period Return = $20.80/$43.10 = 48.3%

Put Options

A European style put option gives its holder the right to sell an asset:

- At the exercise price
- On the expiration date

Exercise the option if:

- market value < exercise price.

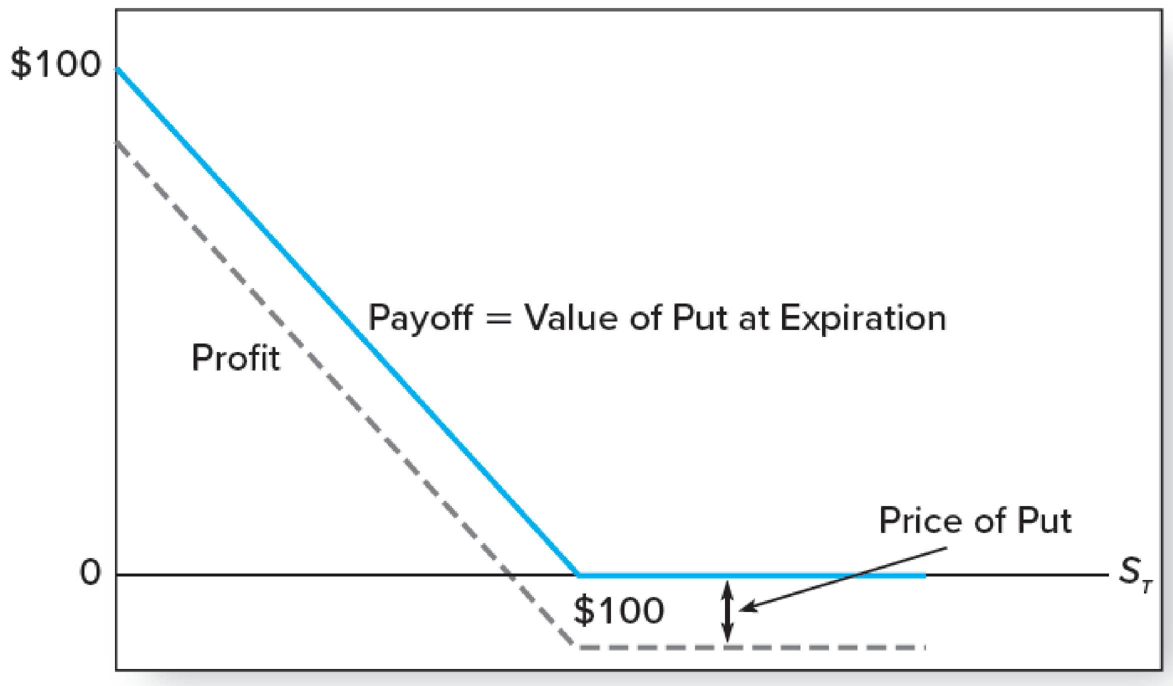


Figure 20.4 Payoff and profit to put option at expiration

Put Options – Example

- Apple is trading at $202.50.
- Purchase a June put on AAPL
  - **Exercise Price** $200
  - **Premium** (today): $6.90
- Option expires on the third Friday of the month.
  - **Expiration Date:** June 21st, 2019

If AAPL remains above $200, the put expires worthless.

Put Options – Example

Purchase a February put on AAPL

- **Exercise Price** $200
- **Premium** (today): $6.90
- **Expiration Date:** June 21st, 2019

AAPL sells for $195.50 on the expiration date and we exercise:

- Option value = Exercise Price – Stock Price
  = $200.00 – 195.50 = $4.50
- Profit = $4.50 – $6.90 = -$2.40
- Holding Period Return: -$2.40/$6.90= -34.8%

More Options Lingo

<u>In the Money</u> - exercise of the option produces a positive cash flow

Call: exercise price < asset price

Put: exercise price > asset price

<u>Out of the Money</u> - exercise of the option would not be profitable

Call: asset price < exercise price.

Put: asset price > exercise price.

<u>At the Money</u> - exercise price = asset price

Exercising Options

American Options:

The option can be exercised at any time before expiration

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

European Options:

The option can only be exercised on the expiration date

Protective Put – Hedging with Options

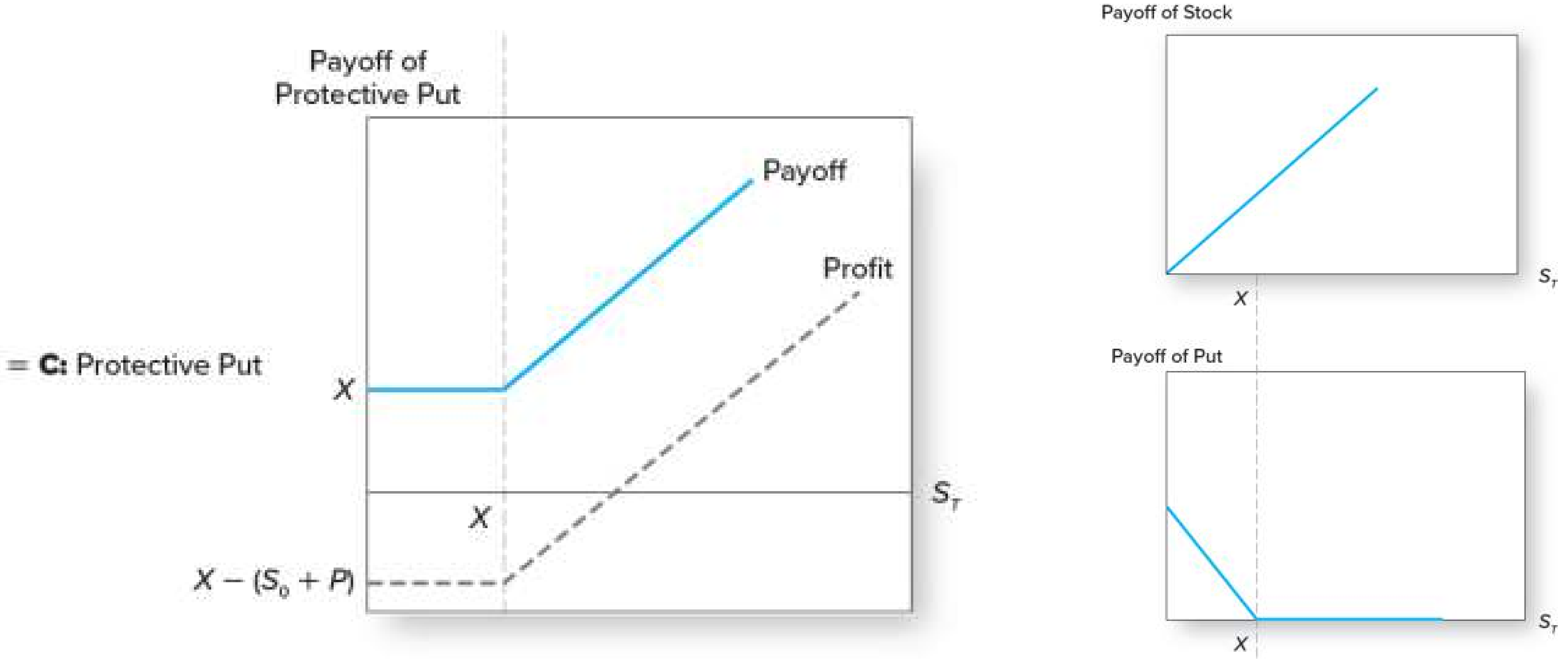
- Puts can be used as insurance against stock price declines.
  - Protective puts lock in a minimum portfolio value.
  - The cost of the insurance is the put premium.
- Options can be used for risk management, not just for speculation.

Table 20.1

Value of a 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

Protective Put



Covered Calls – Yield Enhancement

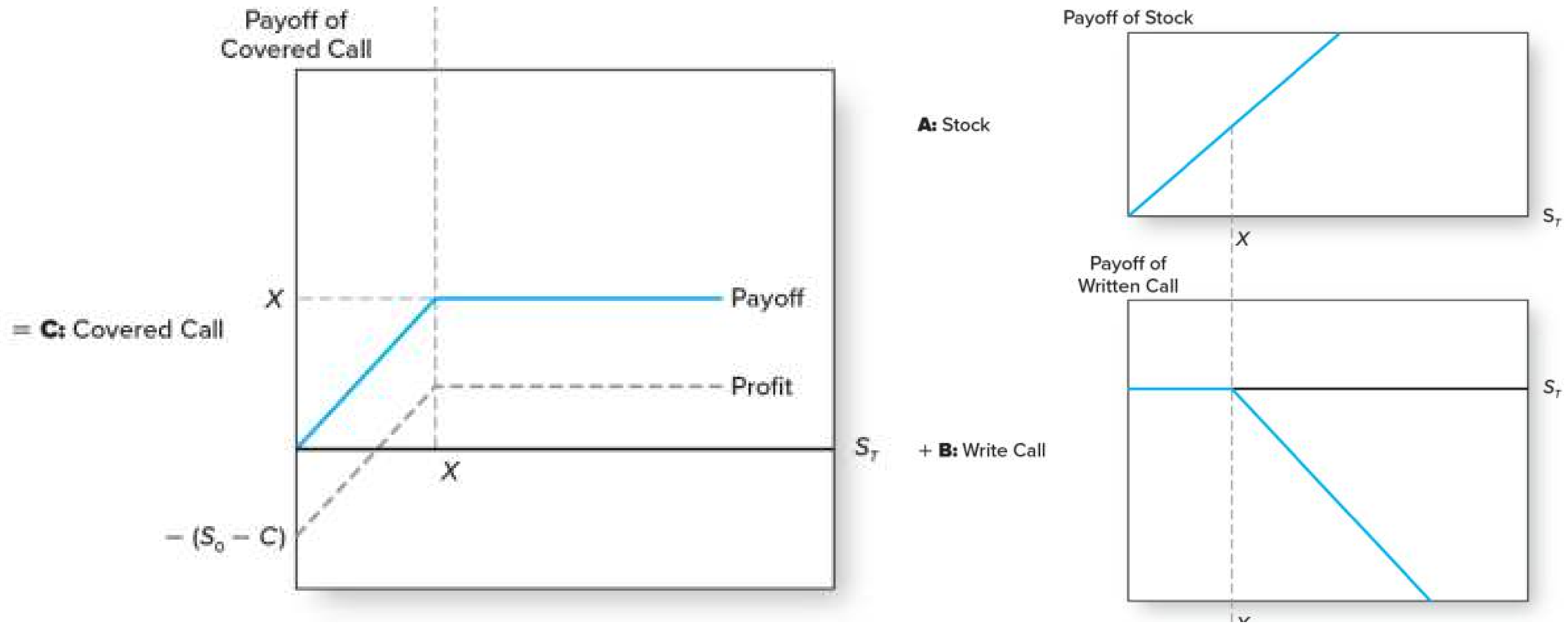
- Purchase stock and write calls against it.
  - Call writer gives up any stock value above X in return for the initial premium.
- If you planned to sell the stock when the price rises above X anyway, the call imposes "sell discipline."

Table 20.2

Value of a covered call position at option expiration

	$S_T \le X$	$S_T > X$
Payoff of stock	S_T	S_T
+ Payoff of written call	-0	$-(S_T - X)$
Total	S_T	X

Covered Calls – Yield Enhancement



Straddle

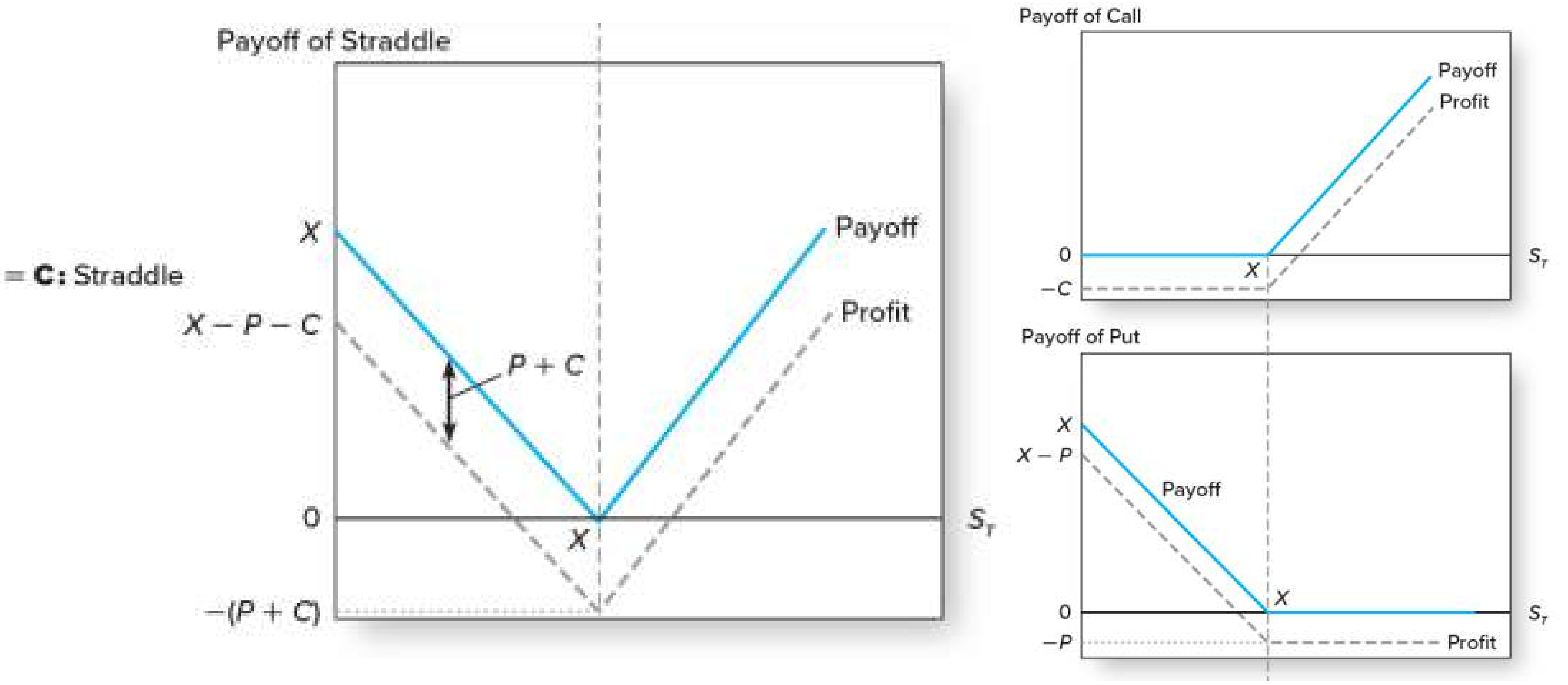
- Long straddle: Buy call and put with same exercise price and maturity.
- The straddle is a bet on volatility.
  - To make a profit, the change in stock price must exceed the cost of both options.
  - You need a strong change in stock price in either direction.
- The writer of a straddle is betting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

Table 20.3

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
Total	$X - S_T$	$S_T - X$

Straddle



Payoff of Straddle
= C: Straddle
X
X – P – C
P + C
0
X
–(P + C)
Payoff
Profit
S_T
Payoff of Call
Payoff
Profit
0
X
–C
S_T
Payoff of Put
X
X – P
Payoff
X
0
–P
Profit
S_T

Spread

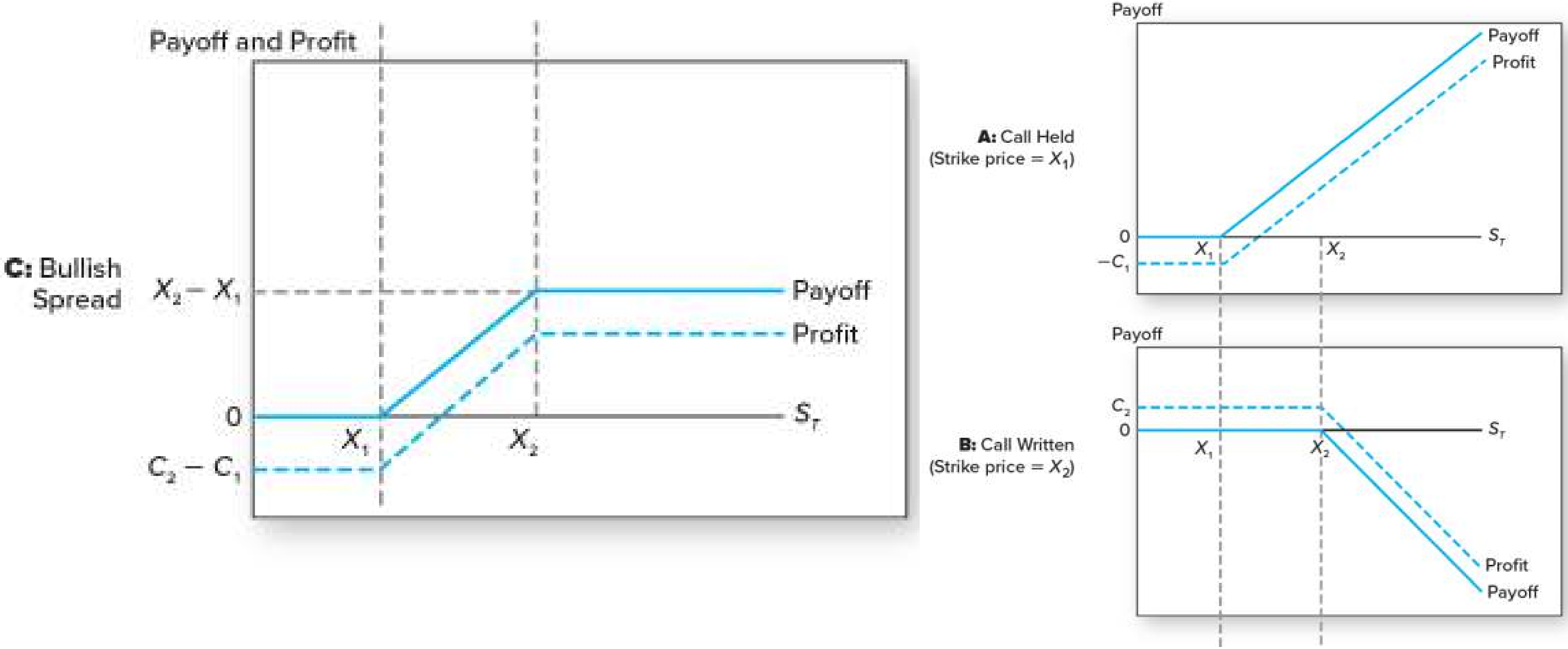
- A spread is a combination of two or more calls (or puts) on the same stock with
  - Differing exercise prices or
  - Times to maturity.
- Some options are bought, whereas others are sold, or written.
- A bullish spread is a way to profit from stock price increases.

Table 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	$-(S_T - X_2)$
Total	0	$S_T - X_1$	$X_2 - X_1$

Spread

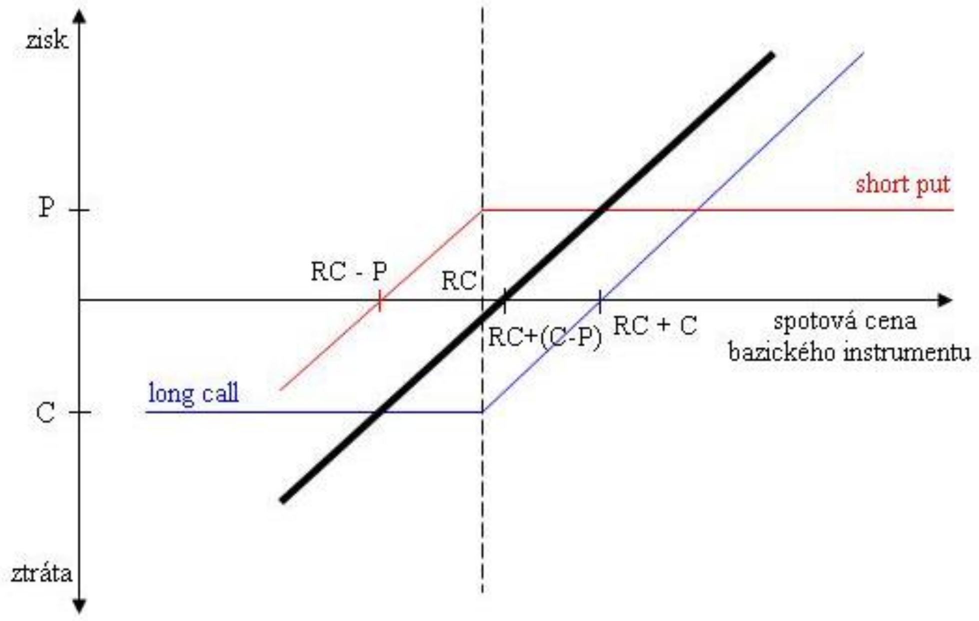

Payoff and Profit
C: Bullish Spread
$X_2 - X_1$
0
$C_2 - C_1$
X_1
X_2
Payoff
Profit
S_T
A: Call Held
(Strike price = X_1)
Payoff
Payoff
Profit
0
$-C_1$
X_1
X_2
S_T
B: Call Written
(Strike price = X_2)
Payoff
C_2
0
X_1
X_2
S_T
Profit
Payoff

Put-Call Parity

Consider an asset and corresponding put and call options (European style) with the same strike price and expire.
Let's use SPX trading at 2,740 points as an example.

- December call at $50.50.   Buy 1.
- December put at $47.50.   Sell 1.

Total cost: $ 3.00.



<u>We created a forward / synthetic long stock position from two options.</u>

Put-Call Parity

Synthetic stock position from buying a call and selling a put for $3

- If SPX settles above 2740, we exercise the call.
- If SPX settles below 2740, the put is exercised.

In other words:
We only have to commit $2.60 today to be exposed to the movement of the SPX over the next weeks – instead of spending $2740.

- We can use the difference and invest it in a risk-free asset with maturity December 21st.
- If put and call prices would not account for this scenario, we could profit – therefore, *put-call parity* has to hold.

Put-Call Parity

Written mathematically:

$$C - P = S - \frac{X}{(1+r)^T}$$

where:

- C is the value of the call and P is the value of the put.
- S is the current price of the asset and X is the strike price.
- Side note: If interest rate r is constant and we use continuous compounding, then the discount over time period T amounts to e^{-rT}

Put-Call Parity – Disequilibrium Example

Stock Price = \$110 Call Price = \$17 Put Price = \$ 5

Risk Free Rate = 5% Maturity = 1 yr Strike Price = \$105

$$\$17 - \$5 = \$110 - \frac{\$105}{(1+0.05)^1} \;??$$

We instead find: $\$12 > \$110 - \$100 = \$10$

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

Put-Call Parity – Disequilibrium Example

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
Total	2	0	0

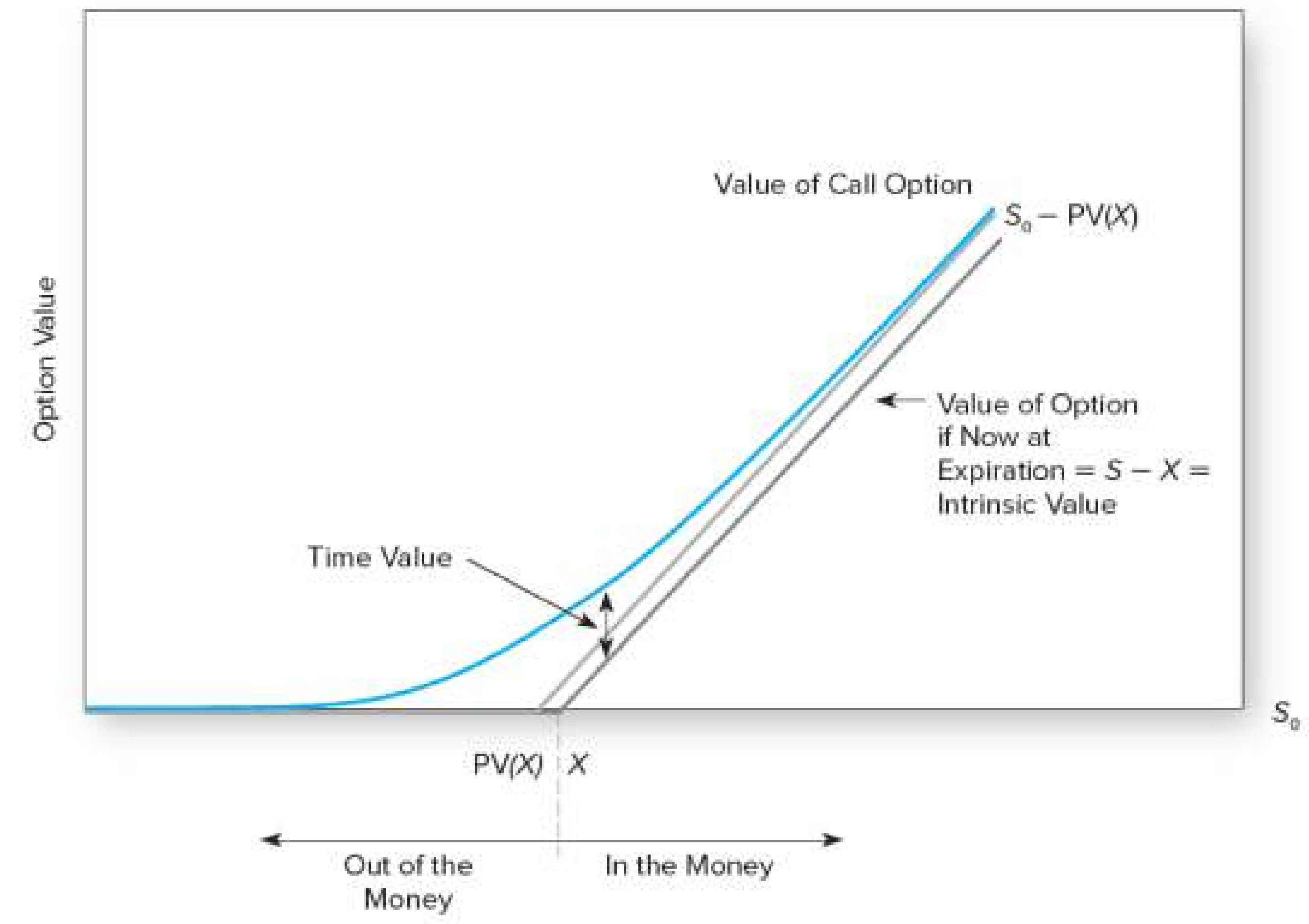
Option Valuation

We can distinguish between two parts of the value of an option:

- Intrinsic Value:
  If exercised today, what would be the difference between stock price and exercise price?
- Extrinsic Value or Time Value:
  Difference between option price and intrinsic value.

Why would we have something like time value?

Option Valuation – Call Option



Option Valuation – Call Option

What makes a call option more or less valuable, other things equal?

Increase in Stock Price S	More valuable
Increase in Exercise Price X	Less valuable
Increase in Volatility	More valuable
Increase in Time to Expiration T	More valuable (usually)
Increase in Interest Rate r	More valuable
Increase in Dividend Payouts	Less valuable

When to Exercise

- The right to exercise an American call <u>early</u> is has no value if stock pays no dividends until the option expires
  - Value of American Call = Value of European call
- The call gains value as the stock price rises
  - The call is “worth more alive than dead”

- American puts are worth more than European puts, all else equal
- Early exercise has value because:
  - The value of the stock cannot fall below zero
  - Once the firm is bankrupt, it is optimal to exercise the American put immediately because of the time value of money

Call Option Values

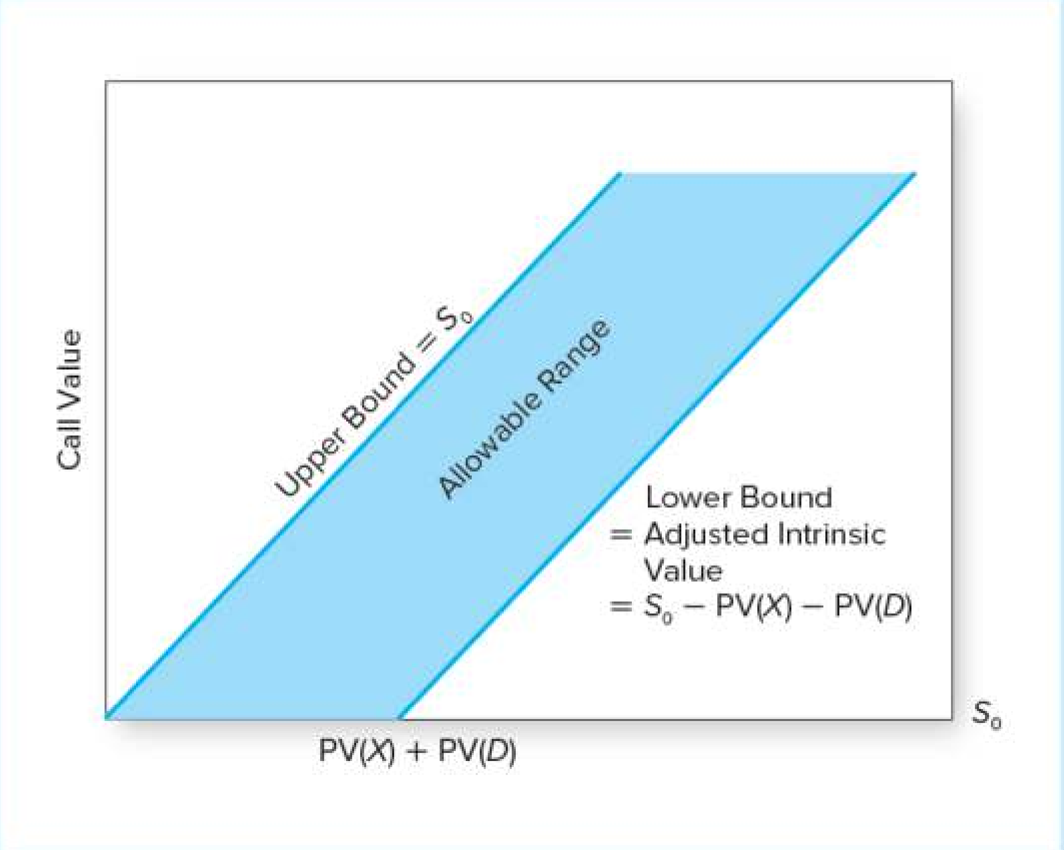


Figure 21.2 Range of possible call option values

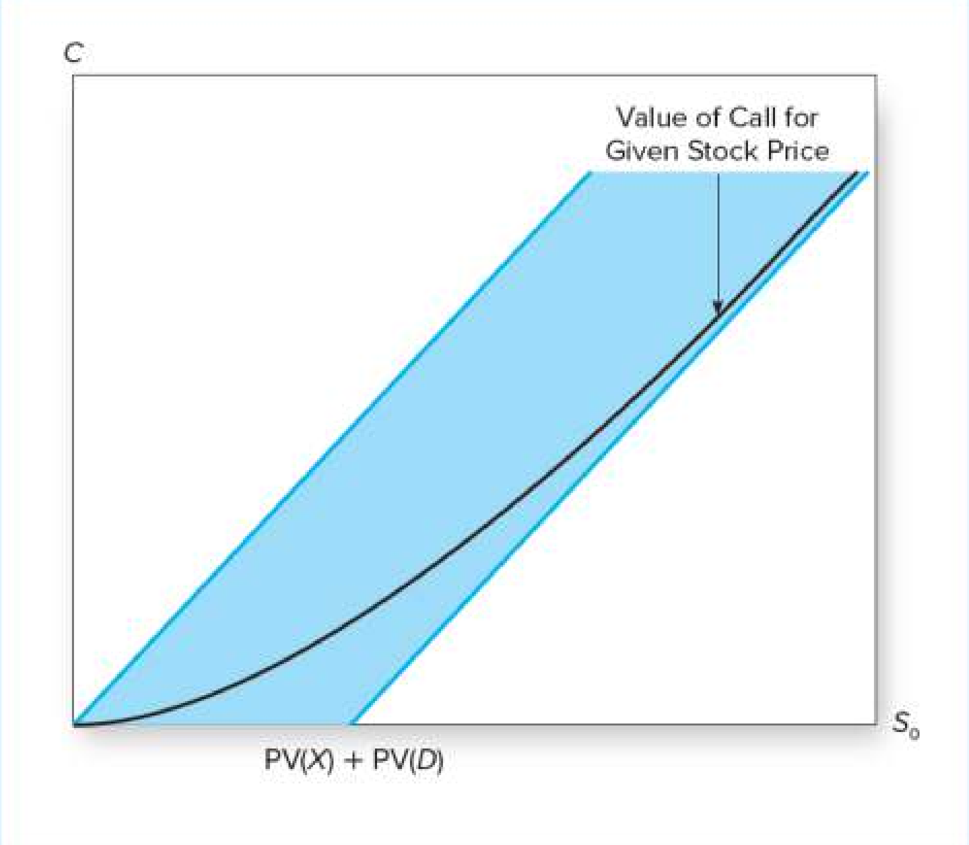


Figure 21.3 Call option value as a function of the current stock price

Put Option Values

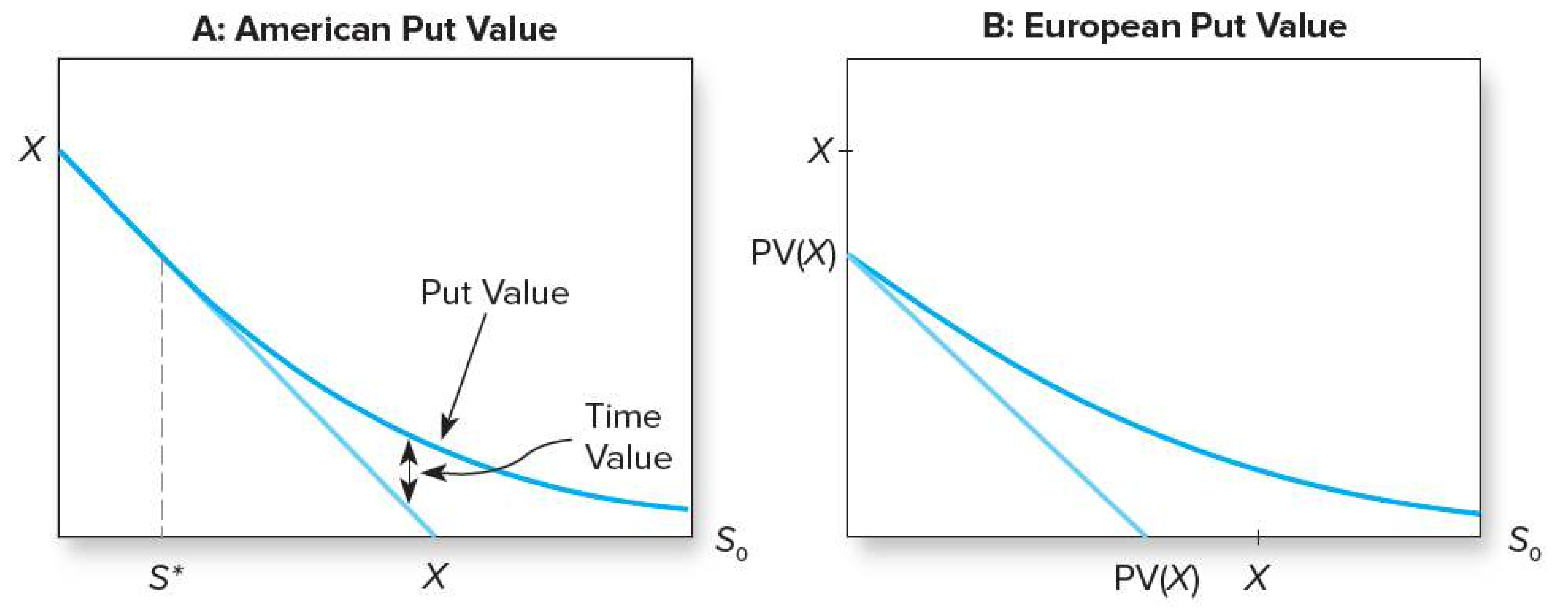


Figure 21.4 Put option values as a function of the current stock price

Where do these curves come from?

Black-Scholes Option Valuation – Imagine the following:

- We can invest money at a risk free rate.
- Log-returns of stock prices follow a random walk with drift.
- Stock does not pay a dividend
- We can buy and borrow everything without transaction costs, and it is possible to buy fractions of cash or shares.

Then the log-returns are normally distributed and we are able to think about how the value of options changes as the stock price changes.

Black-Scholes Option Valuation

If we do the necessary computations (for which we need stochastic calculus and continuous compounding), we get the following value for a call option:

$$C_0 = S_0 \times N(d_1) - Xe^{-rT} \times N(d_2)$$

with

$$d_1 = \frac{\ln\left(\frac{S_0}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}, \qquad d_2 = d_1 - \sigma\sqrt{T}$$

where we need to know σ, the standard deviation or volatility.
(Side note: We can expand the model if there are dividends.)

Black-Scholes Option Valuation

Now that we have valued call options as a function of stock price, strike price, time until expiration, volatility, and interest rate, how can we find the price for a put option?

- Use the put-call parity!

$$P = C + X\,\mathrm{e}^{-rT} - S_0$$

When to Exercise

Let's go back to our AMZN example from earlier in class!

- **Exercise Price** \$1900
- **Premium** (today): \$43.10
- **Expiration Date:** May 17th, 2019 (one month)
- **Risk-free Rate: 2.5%.**

- $P \ = \ C + X\, e^{-rT} \ - S_0$

- $P = \$43.10 + \$1900\, e^{-(2.5\%)(1/12)} - \$1870 \ = \$69.15$
- Pretty close to actual price of just about \$70

Options allow to trade volatility

- Implied volatility is the expectation of the market based on the option valuation.
  - If an investor believes implied volatility in an option's price is too low, a profitable trade is possible.
  - Performance depends on option price relative to the implied volatility.
- Profit must be hedged against a decline in the value of the stock.
- This is called delta-hedging or a delta-neutral position:

$$\Delta = \frac{Change\ in\ Option\ Value}{Change\ in\ Stock\ Value}$$

Options allow to trade volatility

$$\Delta = \frac{Change\ in\ Option\ Value}{Change\ in\ Stock\ Value}$$

If we only wish to trade volatility, we want to be immune against the change in stock value.

- Our option position has a non-zero delta.
  - “Like how many stocks does the option move in price?”
  - Puts have negative delta and calls have positive delta.
- To be delta-neutral, we supplement the portfolio by stock.

Options allow to trade volatility

Example:

• Implied volatility	= 33%
• Investor’s estimate of true volatility	= 35%
• Option maturity	= 60 days
• Put price *P*	= \$4.495
• Exercise price and stock price	= \$90
• Risk-free rate	= 4%
• Delta	= -0.453

Options allow to trade volatility

Table 21.3

Profit on hedged put portfolio

A. Cost to Establish Hedged Position

1,000 put options @ $4.495/option	$ 4,495
453 shares @ $90/share	40,770
Total outlay	$45,265

B. Value of Put Option as a Function of the Stock Price at Implied Volatility of 35%

Stock price:	**89**	**90**	**91**
Put price	$ 5.254	$ 4.785	$ 4.347
Profit (loss) on each put	0.759	0.290	(0.148)

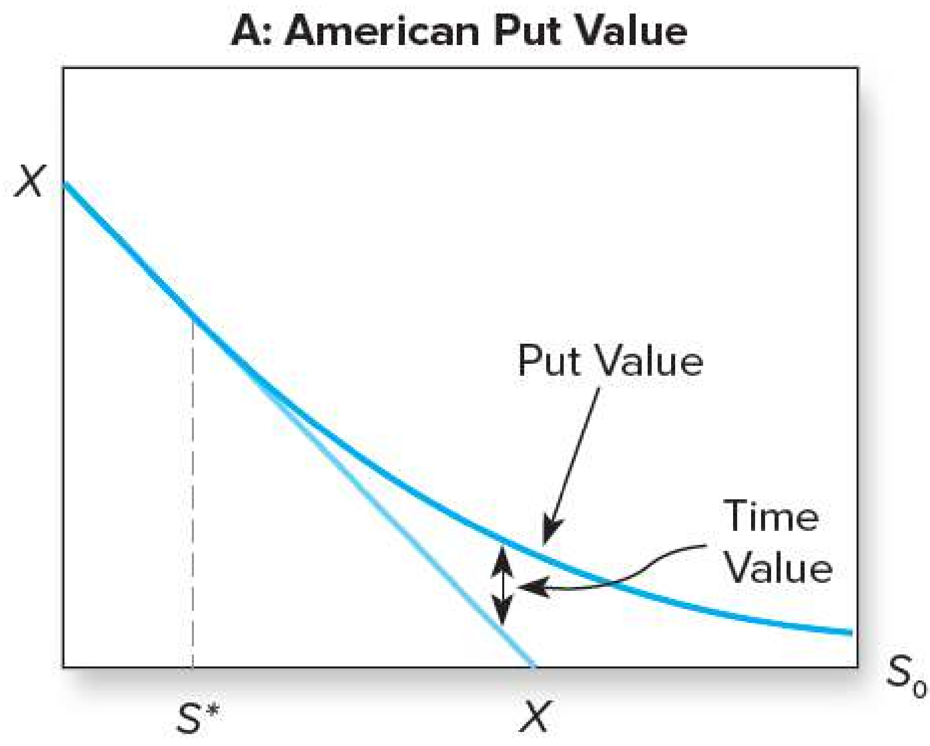
C. Value of and Profit on Hedged Put Portfolio

Stock price:	**89**	**90**	**91**
Value of 1,000 put options	$ 5,254	$ 4,785	$ 4,347
Value of 453 shares	40,317	40,770	41,223
Total	$45,571	$45,555	$45,570
Profit (= Value – Cost from Panel A)	306	290	305

Options allow to trade volatility

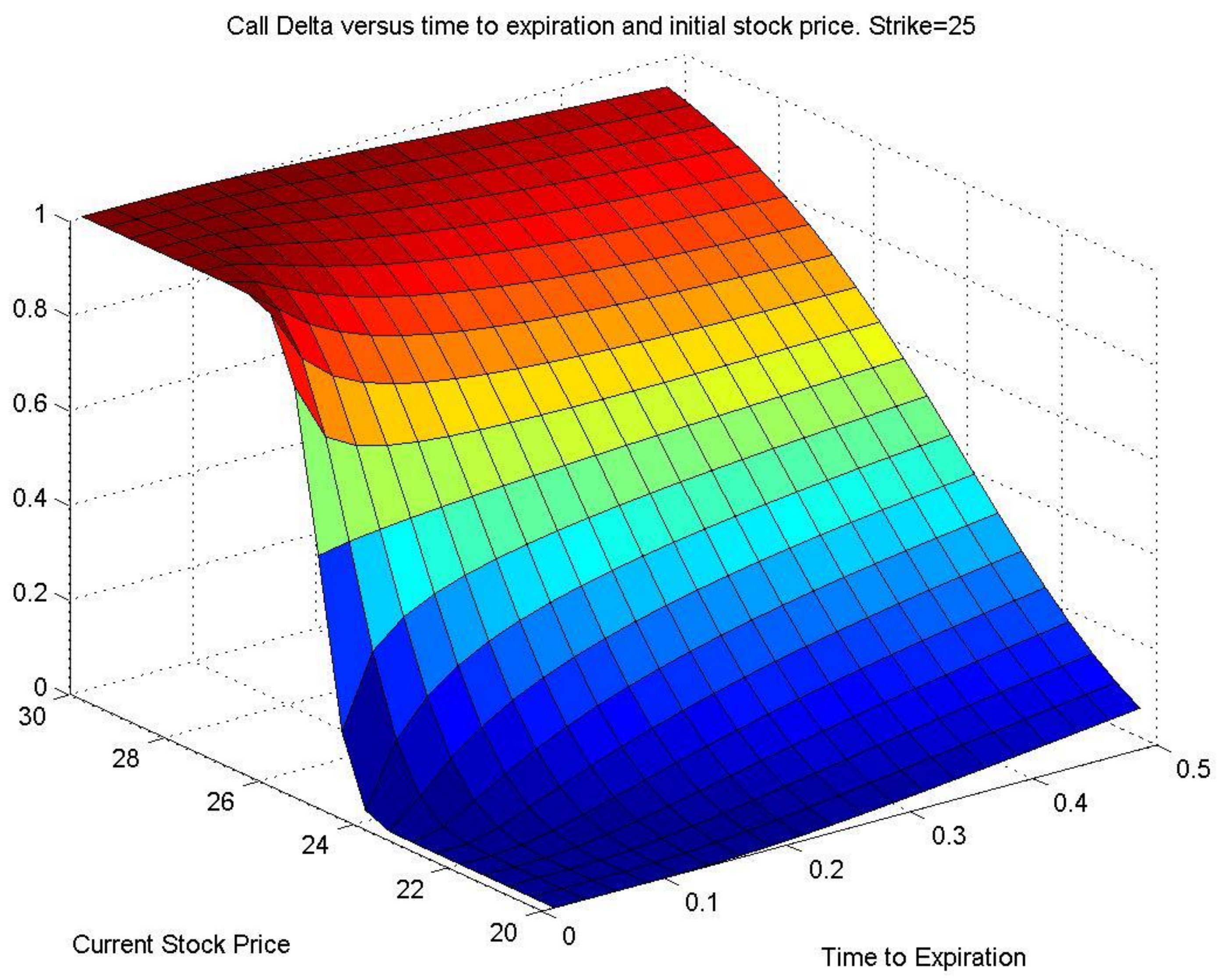
- If the stock price changes, then also the Deltas used to calculate the hedge ratio change
- We use the Greek letter Gamma (Γ) to describe the sensitivity of Delta to the stock price.
  - Gamma is similar to bond convexity
  - The hedge ratio changes with market conditions
  - Rebalancing is necessary

- In summary: Delta is the slope of the curve of the value, and Gamma is the slope that describes how Delta changes.



Time Decay

- As the time to expiration gets shorter and shorter, the likelihood of a big move in the underlying security gets less and less likely in general.
- Options *decay* in value until they only have their intrinsic value left on the day of expiration (which may be as low as 0).



Chapter 22

Futures

Futures and Forwards

- Forward —
  a deferred-delivery sale of an asset with the sales price agreed on now
- Futures —
  similar to forward but feature formalized and standardized contracts.
- Key difference in futures compared to forwards:
  - Standardized contracts create liquidity
  - Marked to market
  - Exchange mitigates credit risk

Futures and Forwards

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Futures and Forwards

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Futures and Forwards

- Profit to long = Spot price at maturity - Original futures price
- Profit to short = Original futures price - Spot price at maturity
- The futures contract is a zero-sum game, which means gains and losses net out to zero

- Profit is zero when the ultimate spot price, P_T equals the initial futures price, F_0

- The payoff to the long position can be negative because the futures trader cannot walk away from the contract if it is not profitable

Futures and Forwards

Foreign Currencies	Agricultural	Metals and Energy	Interest Rate Futures	Equity Indexes
British pound	Corn	Copper	Eurodollar	S&P 500 index
Canadian dollar	Oats	Aluminum	Euroyen	Dow Jones Industrials
Japanese yen	Soybeans	Gold	Euro-denominated bond	S&P Midcap 400
Euro	Soybean meal	Platinum	Euroswiss	NASDAQ 100
Swiss franc	Soybean oil	Palladium	Sterling	NYSE index
Australian dollar	Wheat	Silver	British government bond	Russell 2000 index
Mexican peso	Barley	Crude oil	German government bond	Nikkei 225 (Japanese)
Brazilian real	Flaxseed	Heating oil	Italian government bond	FTSE index (British)
	Palm oil	Gas oil	Canadian government bond	CAC-40 (French)
	Rye	Natural gas	Treasury bonds	DAX-30 (German)
	Cattle	Gasoline	Treasury notes	All ordinary (Australian)
	Hogs	Propane	Treasury bills	Toronto 35 (Canadian)
	Pork bellies	Kerosene	LIBOR	Dow Jones Euro STOXX 50
	Cocoa	Fuel oil	EURIBOR	Industry indexes:
	Coffee	Iron ore	Interest rate swaps	• Banking
	Cotton	Electricity	Federal funds rate	• Telecom
	Milk	Weather	Bankers' acceptance	• Utilities
	Orange juice			• Health care
	Sugar			• Technology
	Lumber			
	Rice			

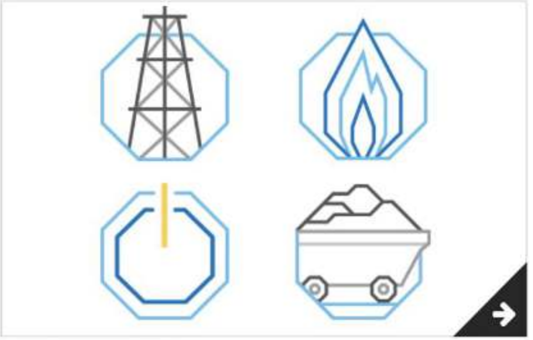
Futures Trading

- Electronic trading has mostly displaced floor trading
- CBOT and CME merged in 2007 to form CME Group
  - The exchange acts as a clearing house and counterparty to both sides of the trade
  - The net position of the clearing house is zero
- Open interest is the number of contracts outstanding
- If you are currently long, you simply instruct your broker to enter the short side of a contract to close out your position
  - Most futures contracts are closed out by reversing trades
  - Only 1-3% of contracts result in actual delivery of the underlying commodity

What Is Henry Hub?

Henry Hub refers to the central delivery location (or, hub) located near the Louisiana's Gulf Coast, connecting several intrastate and interstate pipelines. Henry Hub has been used as a pricing reference for the futures since April 1990.

Product Symbol	CME Globex/ClearPort/Clearing: NG
Contract Months	All calendar months
Price Quotation	U.S. dollars and cents per MMBtu
Contract Size	10,000m British thermal units (MMBtu)
Trading Venue	**CME Globex:** Electronically trade nearly 24 hours/6 days a week **CME ClearPort:** Clear nearly 24 hours/6 days a week
Trading Hours	5:00pm – 4:00pm (Sun–Fri) CT with a 60-minute break each day beginning at 4:00pm CT
Minimum Tick	$0.001 per MMBtu
Dollar Value of Tick	$10.00 U.S. dollars



Energy Home

NG Market Snapshot

PRODUCT	LAST	CHANGE	CHART	GLOBEX VOL
NGF9	4.583	-0.116		179,176

Futures and Forwards

- Convergence of Price — As maturity approaches the spot and futures price converge
- Marking to Market — Each day the profits or losses from the new futures price are paid over or subtracted from the account

- Margin Call: Since futures are bought on market, you have to deposit capital for loss absorption. If funds fall below maintenance level, you get a margin call.

Futures Trading

Speculators

- Seek to profit from price movement
  - Long — believe price will rise
  - Short — believe price will fall

Hedgers

- Seek protection from price movement
  - Long hedge — protecting against a rise in purchase price
  - Short hedge — protecting against a fall in selling price

Futures Pricing

- Spot-futures parity theorem — two ways to acquire an asset for some date in the future:
    1. Purchase it now and store it
    2. Take a long position in futures
- These two strategies must have the same market determined costs.
- With a perfect hedge, the futures payoff is certain — there is no risk
- A perfect hedge should earn the riskless rate of return

Futures Pricing – Spot-Futures Parity

$$\frac{(F_0 + D) - S_0}{S_0} = r_f$$

Rearranging terms

$$F_0 = S_0(1 + r_f) - D = S_0(1 + r_f - d)$$

$$d = D/S_0$$

Futures Pricing – Term Spreads

$$F(T_1) = S_0 \times (1 + r_f - d)^{T_1}$$

$$F(T_2) = S_0 \times (1 + r_f - d)^{T_2}$$

$$F(T_2) = F(T_1) \times (1 + r_f - d)^{(T_2 - T_1)}$$

Futures Pricing – Term Spread

- **Expectation Hypothesis:** Futures price is expected spot price at futures date.
- **Backwardation:** Hedgers want to go short futures and offer incentive.
- **Contango:** Hedgers want to go long.

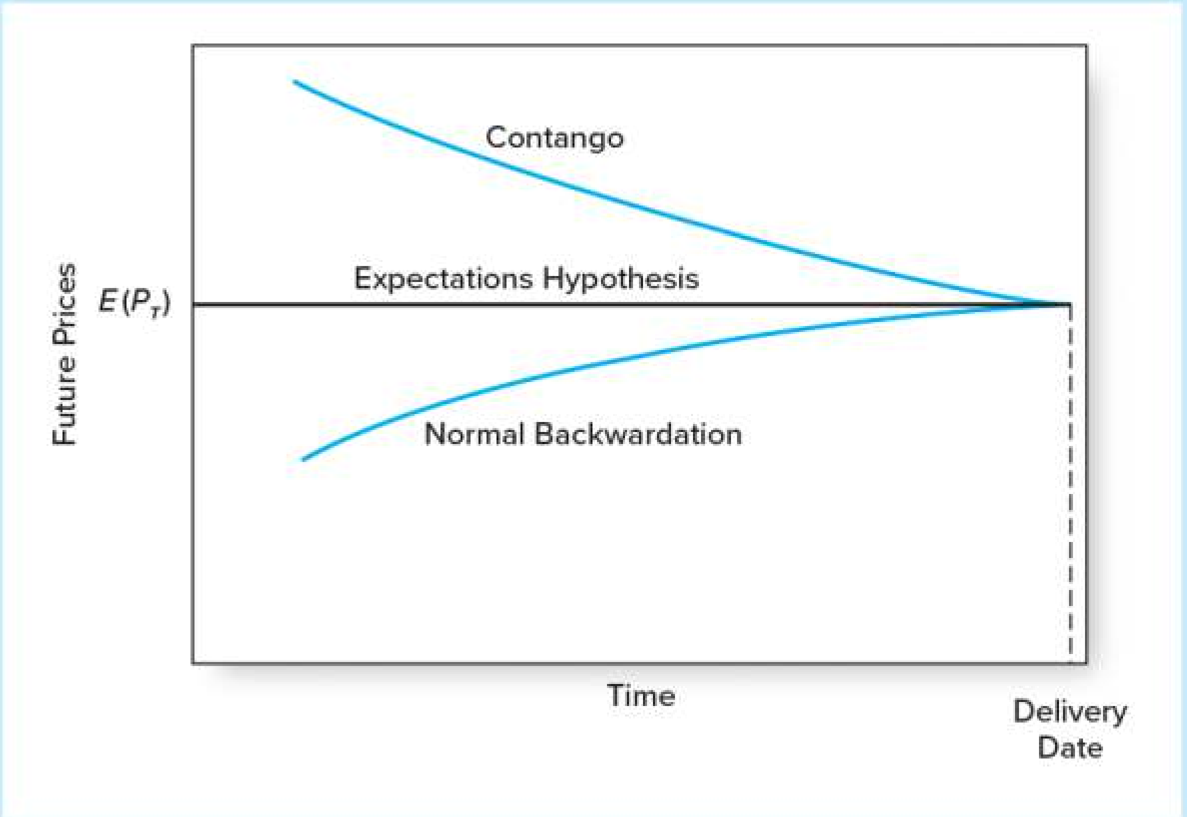


Figure 22.7 Futures price over time, in the special case that the expected spot price remains unchanged

Course Evaluation

- https://bu.campuslabs.com/courseeval/ce/ad/717/d1

- Thank you ☺