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Derivative Markets

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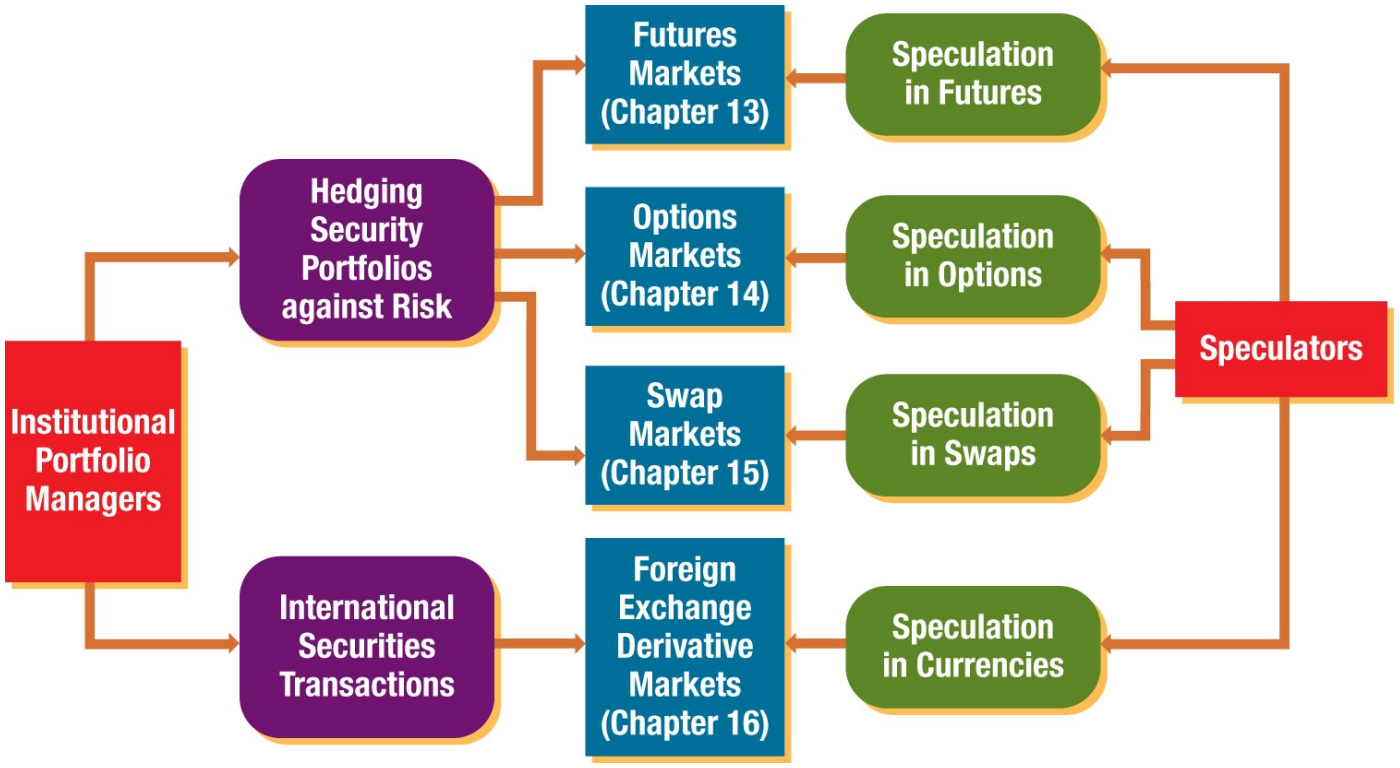
Financial Futures Markets

Derivative Security Markets



Background on Financial Futures

- A financial futures contract is a **standardized agreement** to deliver or receive a specified amount of a specified financial instrument at a specified price and date.
- Financial futures contracts are **traded on organized exchanges**, which establish and enforce rules for such trading.

- **Forward contract**

Background on Financial Futures

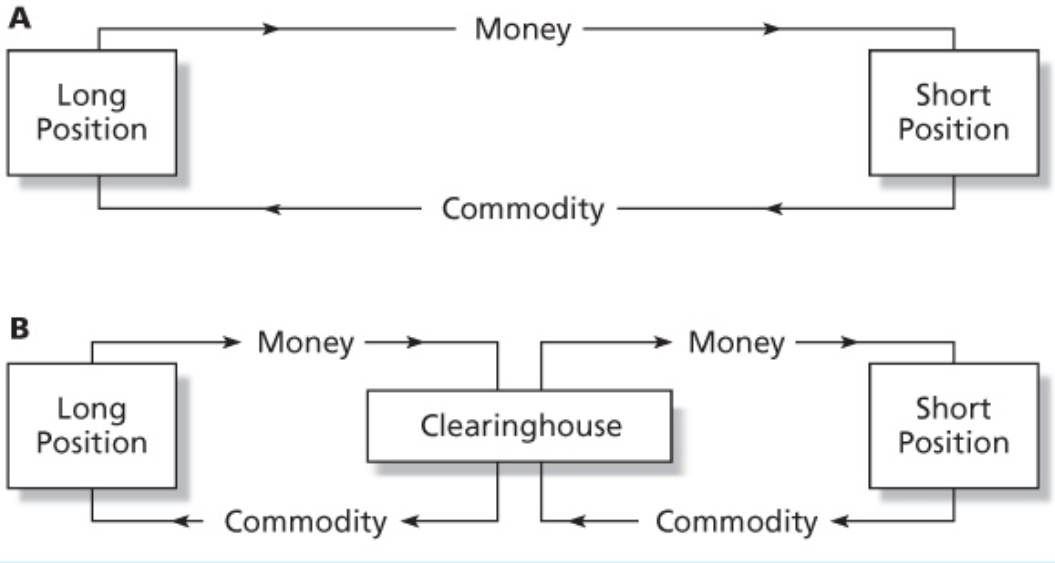


Figure 22.3 ***Panel A,*** Trading without a clearinghouse. ***Panel B,*** Trading with a clearinghouse.

Purpose of Trading Financial Futures

- Financial futures are traded to speculate on prices of securities or to hedge existing exposure.
- **Speculators** in financial futures markets take positions to profit from expected changes in the futures prices.
- **Day traders** attempt to capitalize on price movements during a single day.
- **Position traders** maintain their futures positions for longer periods of time.
- **Hedgers** take positions in financial futures to reduce their exposure to future movements in interest rates or stock or commodity prices.

Institutional Trading of Futures Contracts

- Financial institutions generally use futures contracts to reduce risk.

Hedge Example (open short position -> price decline is expected)

Investor **holds $1000** in a mutual fund indexed to the S&P 500.

Assume dividends of $20 will be paid on the index fund at the end of the year.

A **futures contract** with delivery in one year is available for **$1,010**.

The investor hedges by **selling** or shorting one contract .

Hedge Example – Perfect Hedge

Value of S_T	990	1,010	1,030
Payoff on Short			
$(1{,}010 - S_T)$	20	0	-20
Dividend Income	20	20	20
Total	1,030	1,030	1,030

Background on Financial Futures

Structure of the Futures Market

•Most financial futures contracts in the U.S. trade through the CME (Chicago Mercentile Exchange) Group, formed in July 2007 by the merger of the Chicago Board of Trade (CBOT) and the Chicago Mercantile Exchange (CME).

•**Over-the-Counter Trading** - a financial intermediary (such as a commercial bank or an investment bank) finds a counterparty or serves as the counterparty.

•**Electronic Trading** – e.g. Globex

Exhibit 13.2 Institutional Use of Futures Markets

TYPE OF FINANCIAL INSTITUTION	PARTICIPATION IN FUTURES MARKETS
Commercial banks	• Take positions in futures contracts to hedge against interest rate risk.
Savings institutions	• Take positions in futures contracts to hedge against interest rate risk.
Securities firms	• Execute futures transactions for individuals and firms. • Take positions in futures contracts to hedge their own portfolios against stock market or interest rate movements.
Mutual funds	• Take positions in futures contracts to speculate on future stock market or interest rate movements. • Take positions in futures contracts to hedge their portfolios against stock market or interest rate movements.
Pension funds	• Take positions in futures contracts to hedge their portfolios against stock market or interest rate movements.
Insurance companies	• Take positions in futures contracts to hedge their portfolios against stock market or interest rate movements.

Basics of Futures Contracts

Long – a commitment to purchase the commodity on the delivery date. (S_T-F_T)

Short – a commitment to sell the commodity on the delivery date.

Futures are traded on margin.

At the time the contract is entered into, no money changes hands.

(F_T-S_T)

Profits to Buyers and Sellers of Futures and Option Contracts

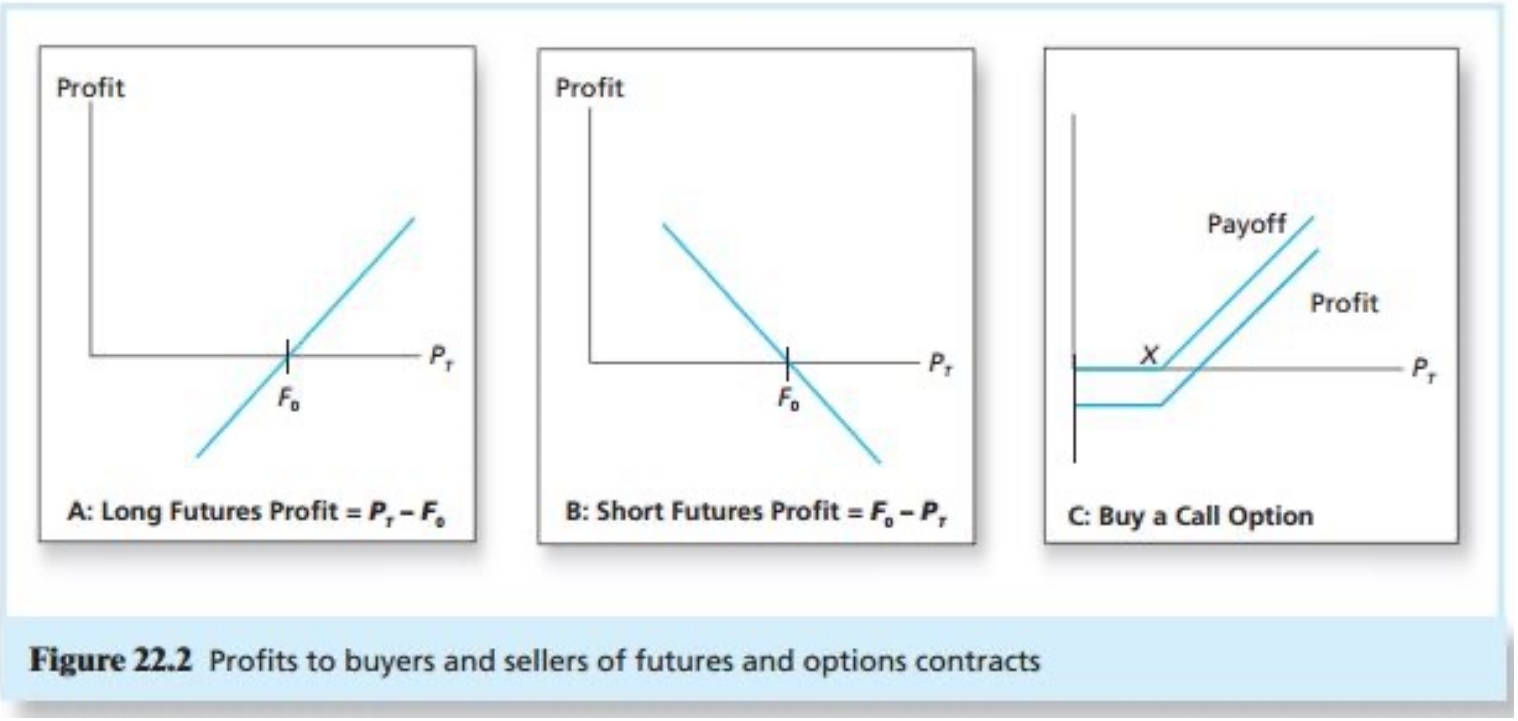


Figure 22.2 Profits to buyers and sellers of futures and options contracts

EXAMPLE 22.2 Marking to Market

Assume the current futures price for silver for delivery 5 days from today is $14.10 per ounce. Suppose that over the next 5 days, the futures price evolves as follows:

Day	Futures Price
0 (today)	$14.10
1	14.20
2	14.25
3	14.18
4	14.18
5 (delivery)	14.21

The spot price of silver on the delivery date is $14.21: The convergence property implies that the price of silver in the spot market must equal the futures price on the delivery day.

The daily mark-to-market settlements for each contract held by the long position will be as follows:

Day	Profit (Loss) per Ounce × 5,000 Ounces/Contract = Daily Proceeds	
1	14.20 – 14.10 = .10	$500
2	14.25 – 14.20 = .05	250
3	14.18 – 14.25 = –.07	–350
4	14.18 – 14.18 = 0	0
5	14.21 – 14.18 = .03	150
		Sum = $550

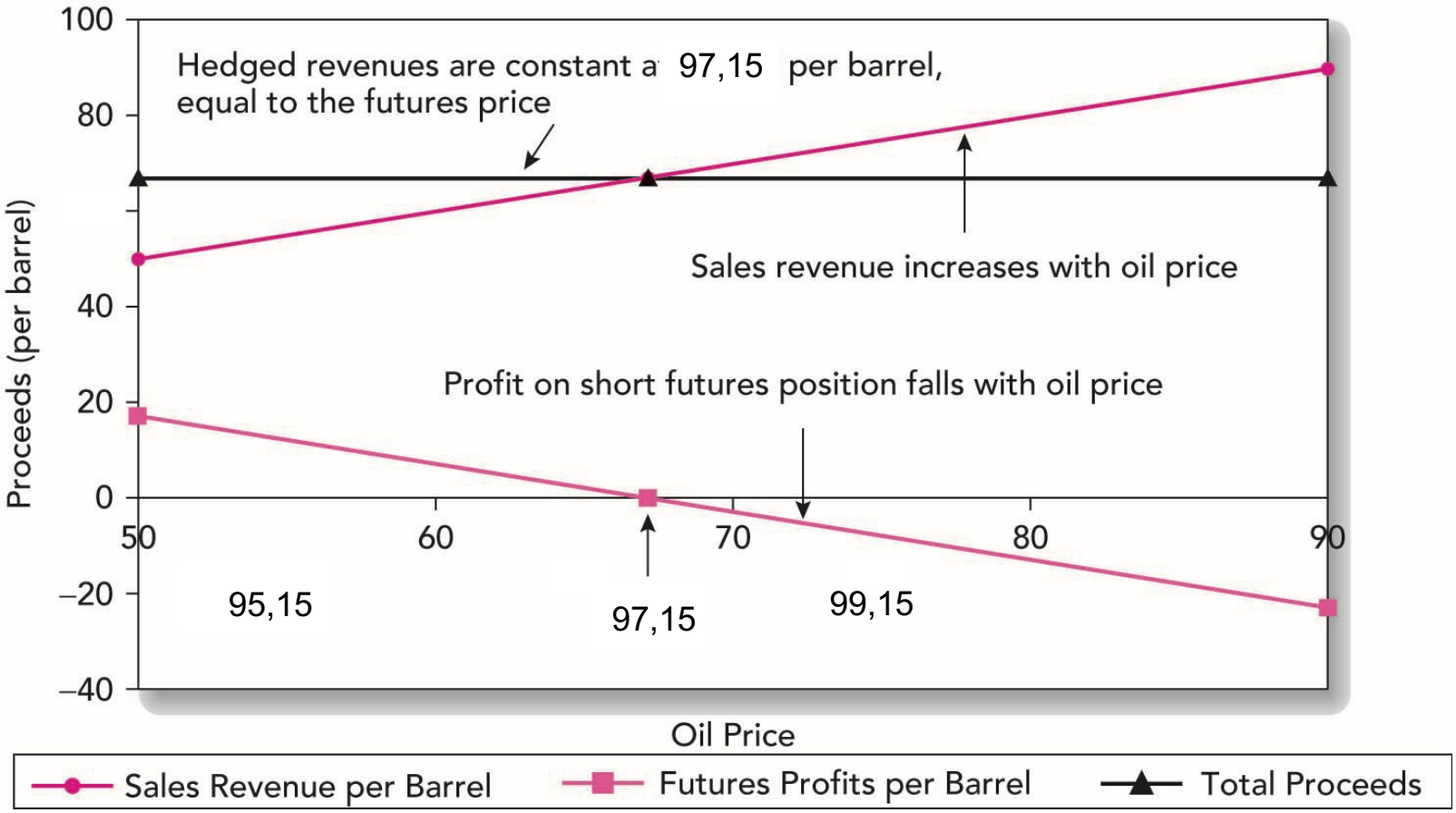
EXAMPLE 22.5 Hedging with Oil Futures

Consider an oil distributor planning to sell 100,000 barrels of oil in February that wishes to hedge against a possible decline in oil prices. Because each contract calls for delivery of 1,000 barrels, it would sell 100 contracts that mature in February. Any decrease in prices would then generate a profit on the contracts that would offset the lower sales revenue from the oil.

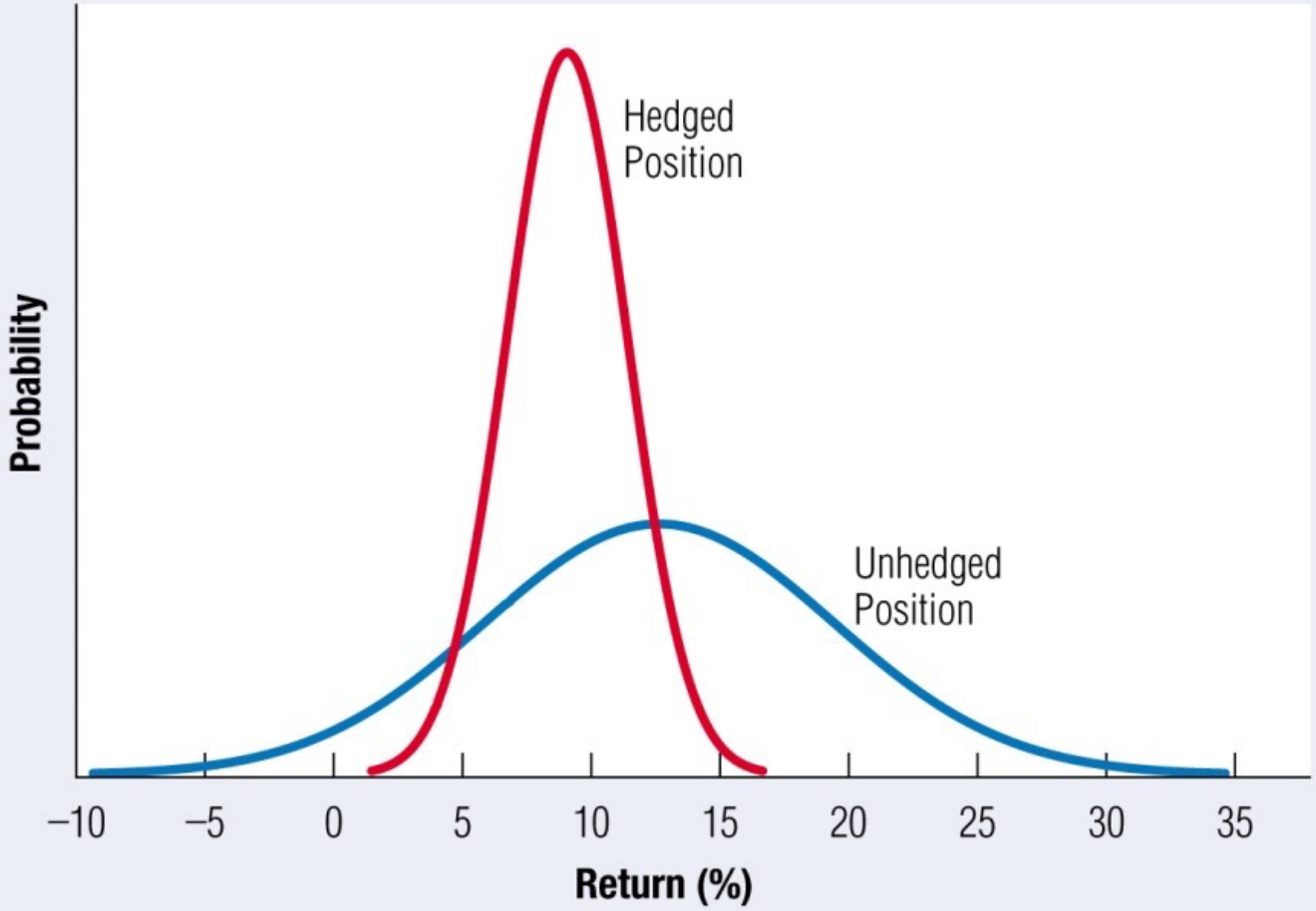
To illustrate, suppose that the only three possible prices for oil in February are \$95.15, \$97.15, and \$99.15 per barrel. The revenue from the oil sale will be 100,000 times the price per barrel. The profit on each contract sold will be 1,000 times any decline in the futures price. At maturity, the convergence property ensures that the final futures price will equal the spot price of oil. Therefore, the profit on the 100 contracts sold will equal $100{,}000 \times (F_0 - P_T)$, where P_T is the oil price on the delivery date, and F_0 is the original futures price, \$97.15.

Now consider the firm's overall position. The total revenue in February can be computed as follows:

	Oil Price in February, P_T		
	\$95.15	**\$97.15**	**\$99.15**
Revenue from oil sale: $100{,}000 \times P_T$	\$9,515,000	\$9,715,000	\$9,915,000
+ Profit on futures: $100{,}000 \times (F_0 - P_T)$	200,000	0	−200,000
TOTAL PROCEEDS	\$9,715,000	\$9,715,000	\$9,715,000


Hedged revenues are constant a 97,15 per barrel,
equal to the futures price
Sales revenue increases with oil price
Profit on short futures position falls with oil price
Proceeds (per barrel)
100
80
40
20
0
–20
–40
50
60
70
80
90
95,15
97,15
99,15
Oil Price
Sales Revenue per Barrel
Futures Profits per Barrel
Total Proceeds

Probability Distribution od Returns



Spot-Futures Parity Theorem

With a perfect hedge the futures payoff is certain -- there is no risk

A perfect hedge should return the riskless rate of return

This relationship can be used to develop futures pricing relationship

Suppose, for example, that the S&P 500 index currently is at 900 and an investor who holds $900 in a mutual fund indexed to the S&P 500 wishes to temporarily hedge her exposure to market risk. Assume that the indexed portfolio pays dividends totaling $20 over the course of the year, and for simplicity, that all dividends are paid at year-end. Finally, assume that the futures price for year-end delivery of the S&P 500 contract is 925.[6] Let's examine the end-of-year proceeds for various values of the stock index if the investor hedges her portfolio by entering the short side of the futures contract.

Final value of stock portfolio, S_T	$885	$905	$925	$945	$965	$985
Payoff from short futures position (equals $F_0 - F_T = \$925 - S_T$)	40	20	0	−20	−40	−60
Dividend income	20	20	20	20	20	20
TOTAL	$945	$945	$945	$945	$945	$945

$$\text{Rate of return on perfectly hedged stock portfolio} = \frac{(F_0 + D) - S_0}{S_0}$$

Rate of Return for the Hedge

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

$$\frac{(925 + 20) - 900}{900} = 5\%$$

General Spot-Futures Parity

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

Rearranging terms

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

$$d = D / S_0$$

Arbitrage Possibilities

If spot-futures parity is not observed, then arbitrage is possible

If the futures price is too high, short the futures and acquire the stock by borrowing the money at the riskfree rate

If the futures price is too low, go long futures, short the stock and invest the proceeds at the riskfree rate

Future Market Arbitraga

Suppose that parity were violated. For example, suppose the risk-free interest rate in the economy were only 4% so that according to parity, the futures price should be \$900(1.04) − \$20 = \$916. The actual futures price, F_0 = \$925, is \$9 higher than its "appropriate" value. This implies that an investor can make arbitrage profits by shorting the relatively overpriced futures contract and buying the relatively underpriced stock portfolio using money borrowed at the 4% market interest rate. The proceeds from this strategy would be as follows:

Action	Initial Cash Flow	Cash Flow in 1 Year
Borrow \$900, repay with interest in 1 year	+900	−900(1.04) = −\$936
Buy stock for \$900	−900	S_T + \$20 dividend
Enter short futures position (F_0 = \$925)	0	\$925 − S_T
TOTAL	0	\$9

Action	Initial Cash Flow	Cash Flow in 1 Year
1. Borrow S_0 dollars	S_0	$-S_0(1 + r_f)$
2. Buy stock for S_0	$-S_0$	$S_T + D$
3. Enter short futures position	0	$F_0 - S_T$
TOTAL	0	$F_0 - S_0(1 + r_f) + D$

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Option Markets

Option Terminology

Option types:

Call

Holder has the right to purchase an asset for a specified price

Put

Holder has the right to sell 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 (a day or a period)

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

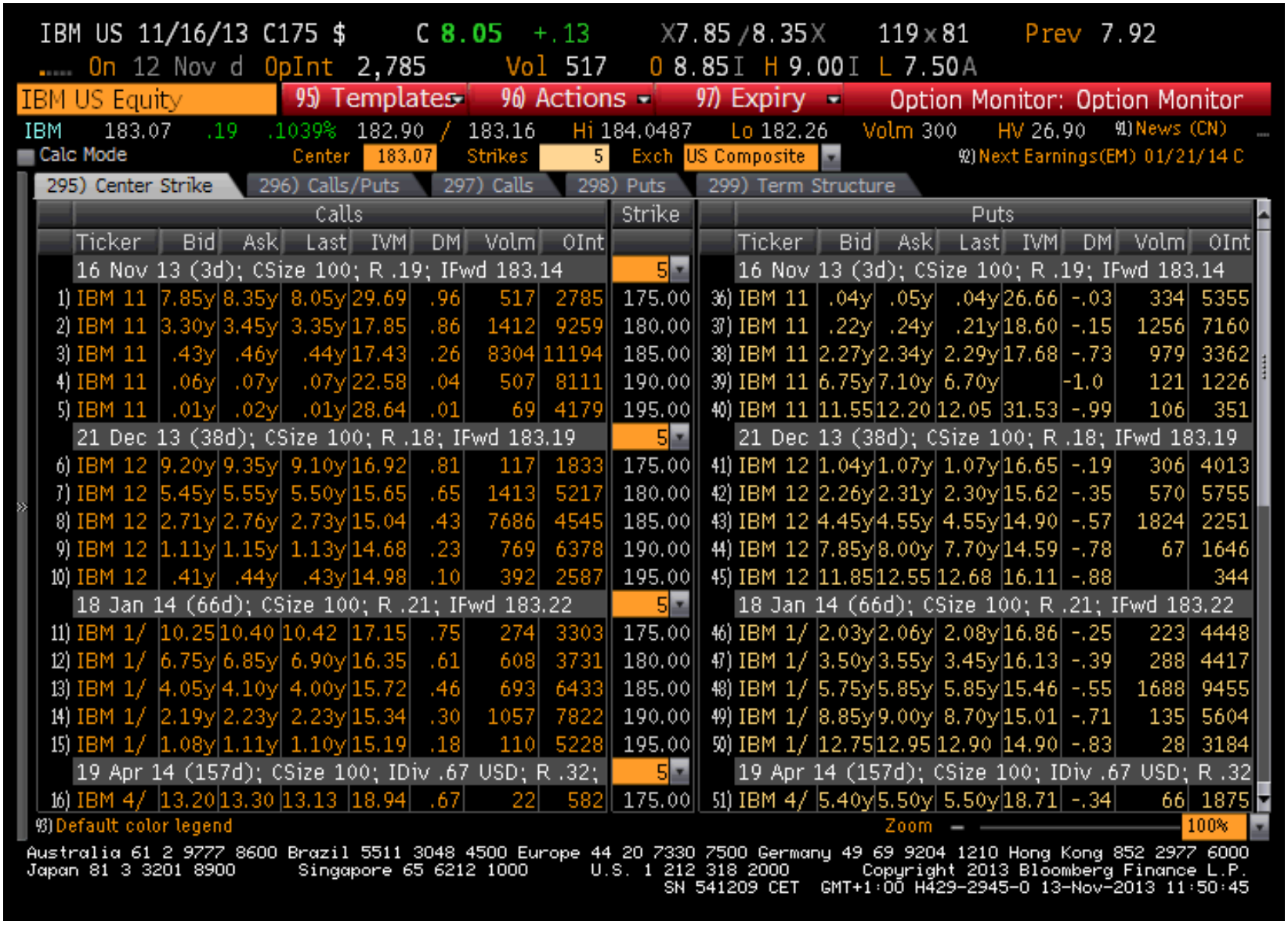
- 100 shares of stock
- Limited and uniform set of securities

Two benefits

- Ease of trading
- Liquid secondary market

OTC vs Listed derivatives

Type	Listed (Exchange Traded	OTC
Features	Standardised contracts •Strikes •Maturities •Contract size •Exercise type •Delivery •Pay outs	Terms are flexible and negotiable •Strikes at any level •Any maturity date •Varying contract size •American/ European •Physical/ cash •Payouts are flexible
Trading	Exchange Traded Highly liquid	Private agreement Limited liquidity
Guatrantee	Clearing Corporation of the Exchange	Issuer or writer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..... On 12 Nov d OpInt 2,785 Vol 517 O 8.85I H 9.00I L 7.50A
IBM US Equity
95) Templates
96) Actions
97) Expiry
Option Monitor: Option Monitor
IBM 183.07 .19 .1039% 182.90 / 183.16 Hi 184.0487 Lo 182.26 Volm 300 HV 26.90
91) News (CN)
Calc Mode
Center 183.07
Strikes 5
Exch US Composite
92) Next Earnings(EM) 01/21/14 C
295) Center Strike
296) Calls/Puts
297) Calls
298) Puts
299) Term Structure
Calls
Strike
Puts
Ticker Bid Ask Last IVM DM Volm OInt
16 Nov 13 (3d); CSize 100; R .19; IFwd 183.14
1) IBM 11 7.85y 8.35y 8.05y 29.69 .96 517 2785 175.00
2) IBM 11 3.30y 3.45y 3.35y 17.85 .86 1412 9259 180.00
3) IBM 11 .43y .46y .44y 17.43 .26 8304 11194 185.00
4) IBM 11 .06y .07y .07y 22.58 .04 507 8111 190.00
5) IBM 11 .01y .02y .01y 28.64 .01 69 4179 195.00
21 Dec 13 (38d); CSize 100; R .18; IFwd 183.19
6) IBM 12 9.20y 9.35y 9.10y 16.92 .81 117 1833 175.00
7) IBM 12 5.45y 5.55y 5.50y 15.65 .65 1413 5217 180.00
8) IBM 12 2.71y 2.76y 2.73y 15.04 .43 7686 4545 185.00
9) IBM 12 1.11y 1.15y 1.13y 14.68 .23 769 6378 190.00
10) IBM 12 .41y .44y .43y 14.98 .10 392 2587 195.00
18 Jan 14 (66d); CSize 100; R .21; IFwd 183.22
11) IBM 1/ 10.25 10.40 10.42 17.15 .75 274 3303 175.00
12) IBM 1/ 6.75y 6.85y 6.90y 16.35 .61 608 3731 180.00
13) IBM 1/ 4.05y 4.10y 4.00y 15.72 .46 693 6433 185.00
14) IBM 1/ 2.19y 2.23y 2.23y 15.34 .30 1057 7822 190.00
15) IBM 1/ 1.08y 1.11y 1.10y 15.19 .18 110 5228 195.00
19 Apr 14 (157d); CSize 100; IDiv .67 USD; R .32;
16) IBM 4/ 13.20 13.30 13.13 18.94 .67 22 582 175.00
36) IBM 11 .04y .05y .04y 26.66 -.03 334 5355
37) IBM 11 .22y .24y .21y 18.60 -.15 1256 7160
38) IBM 11 2.27y 2.34y 2.29y 17.68 -.73 979 3362
39) IBM 11 6.75y 7.10y 6.70y -1.0 121 1226
40) IBM 11 11.55 12.20 12.05 31.53 -.99 106 351
21 Dec 13 (38d); CSize 100; R .18; IFwd 183.19
41) IBM 12 1.04y 1.07y 1.07y 16.65 -.19 306 4013
42) IBM 12 2.26y 2.31y 2.30y 15.62 -.35 570 5755
43) IBM 12 4.45y 4.55y 4.55y 14.90 -.57 1824 2251
44) IBM 12 7.85y 8.00y 7.70y 14.59 -.78 67 1646
45) IBM 12 11.85 12.55 12.68 16.11 -.88 344
18 Jan 14 (66d); CSize 100; R .21; IFwd 183.22
46) IBM 1/ 2.03y 2.06y 2.08y 16.86 -.25 223 4448
47) IBM 1/ 3.50y 3.55y 3.45y 16.13 -.39 288 4417
48) IBM 1/ 5.75y 5.85y 5.85y 15.46 -.55 1688 9455
49) IBM 1/ 8.85y 9.00y 8.70y 15.01 -.71 135 5604
50) IBM 1/ 12.75 12.95 12.90 14.90 -.83 28 3184
19 Apr 14 (157d); CSize 100; IDiv .67 USD; R .32
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Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000
Copyright 2013 Bloomberg Finance L.P.
SN 541209 CET GMT+1:00 H429-2945-0 13-Nov-2013 11:50:45

CALL OPTIONS


IBM US 11/16/13 C175 $ C 8.05 +.13 X7.85 / 8.35X 119 x 81 Prev 7.92
On 12 Nov d OpInt 2,785 Vol 517 O 8.85I H 9.00I L 7.50A
IBM US 11/16/13
95) Save As
96) Actions
97) Edit
98) Table
Line Chart
08/23/2013 - 11/13/2013
11) Compare
Mov. Avgs
1D 3D 1M 6M YTD 1Y 5Y Max Daily
Security/Study
Event
Last Price
IBM US 11/16/13 C175 Equity (R1) 8.05
IBM US Equity (R2) 183.07
Aug 30
Sep 9
Sep 16
Sep 23
Sep 30
Oct 8
Oct 15
Oct 23
Oct 31
Nov 8
2013
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2013 Bloomberg Finance L.P.
SN 541209 CET GMT+1:00 H429-2945-0 13-Nov-2013 12:09:11


IBM US 11/16/13 C190 $ C .07 +.01 X.06 / .07 P 28 x 6 Prev .06
On 12 Nov d OpInt 8,111 Vol 507 O .06 I H .09 Q L .04 Q
IBM US 11/16/13
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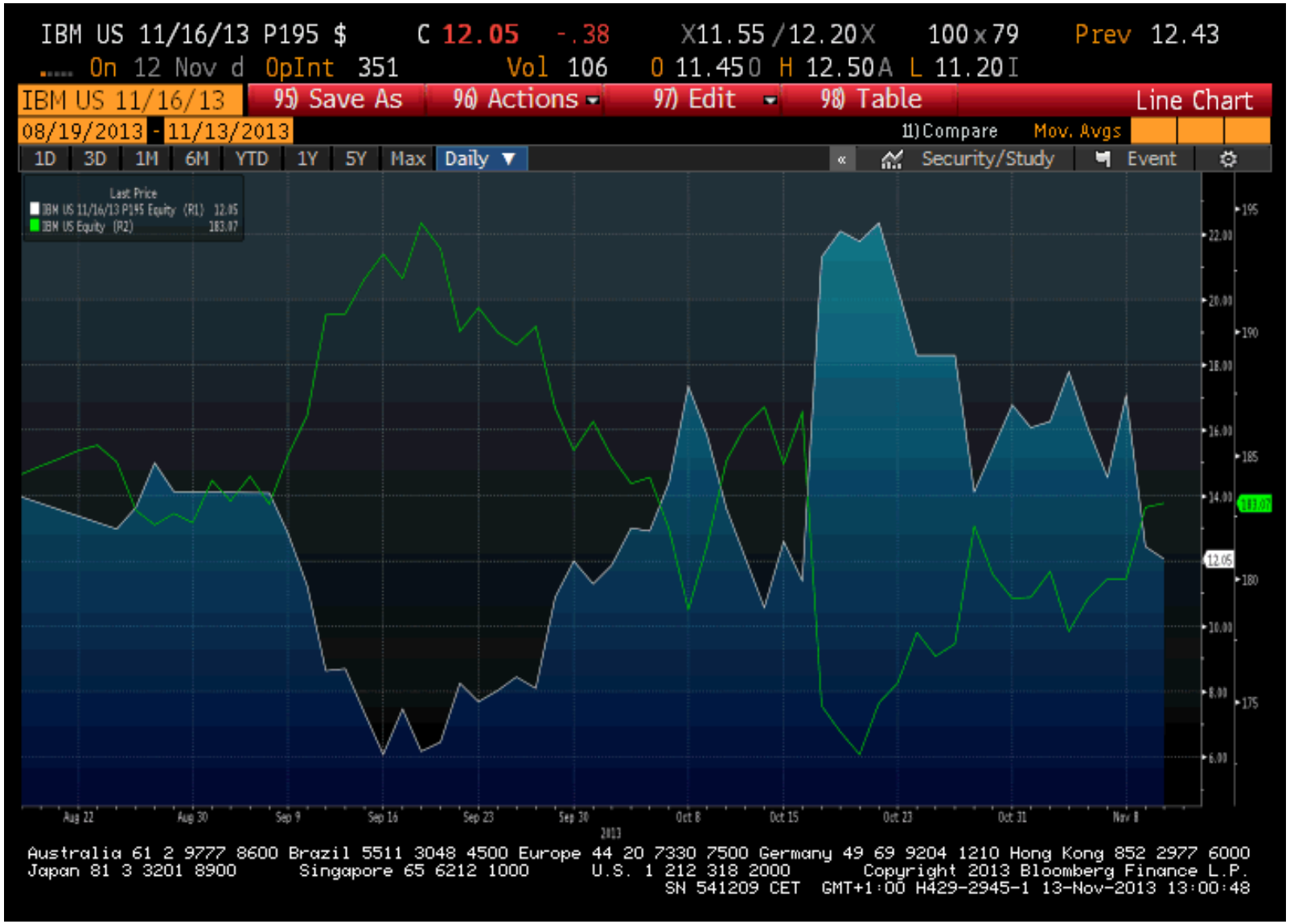
98) Table
Line Chart
08/23/2013 - 11/13/2013
11) Compare
Mov. Avgs
1D 3D 1M 6M YTD 1Y 5Y Max Daily
Security/Study
Event
Last Price
IBM US 11/16/13 C190 Equity (R1) 0.07
IBM US Equity (R2) 183.07
Aug 30
Sep 9
Sep 16
Sep 23
Sep 30
Oct 8
Oct 15
Oct 23
Oct 31
Nov 8
2013
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2013 Bloomberg Finance L.P.
SN 541209 CET GMT+1:00 H429-2945-0 13-Nov-2013 12:07:00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IBM US 11/16/13 95) Save As 96) Actions 97) Edit 98) Table Line Chart
08/19/2013 - 11/13/2013 11) Compare Mov. Avgs
1D 3D 1M 6M YTD 1Y 5Y Max Daily Security/Study Event
Last Price
IBM US 11/16/13 P195 Equity (R1) 12.05
IBM US Equity (R2) 183.07
Aug 22 Aug 30 Sep 9 Sep 16 Sep 23 Sep 30 Oct 8 Oct 15 Oct 23 Oct 31 Nov 8
2013
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2013 Bloomberg Finance L.P.
SN 541209 CET GMT+1:00 H429-2945-1 13-Nov-2013 13:00:48

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

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

$-(S_T - X)$ if $S_T > X$

0 if $S_T \leq X$

Profit to Call Writer

Payoff + Premium

Figure 20.3 Payoff and Profit to Call Option at Expiration

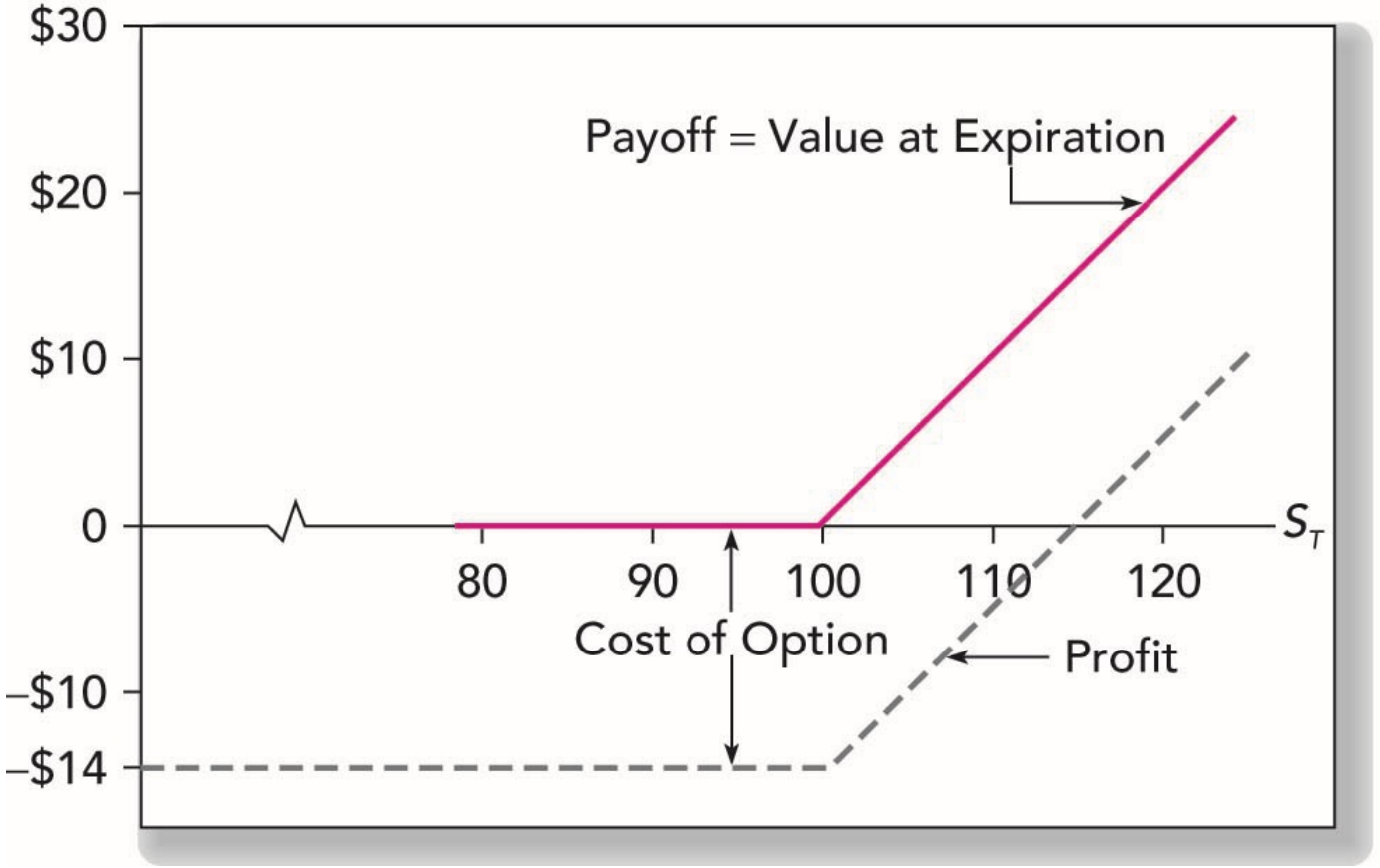
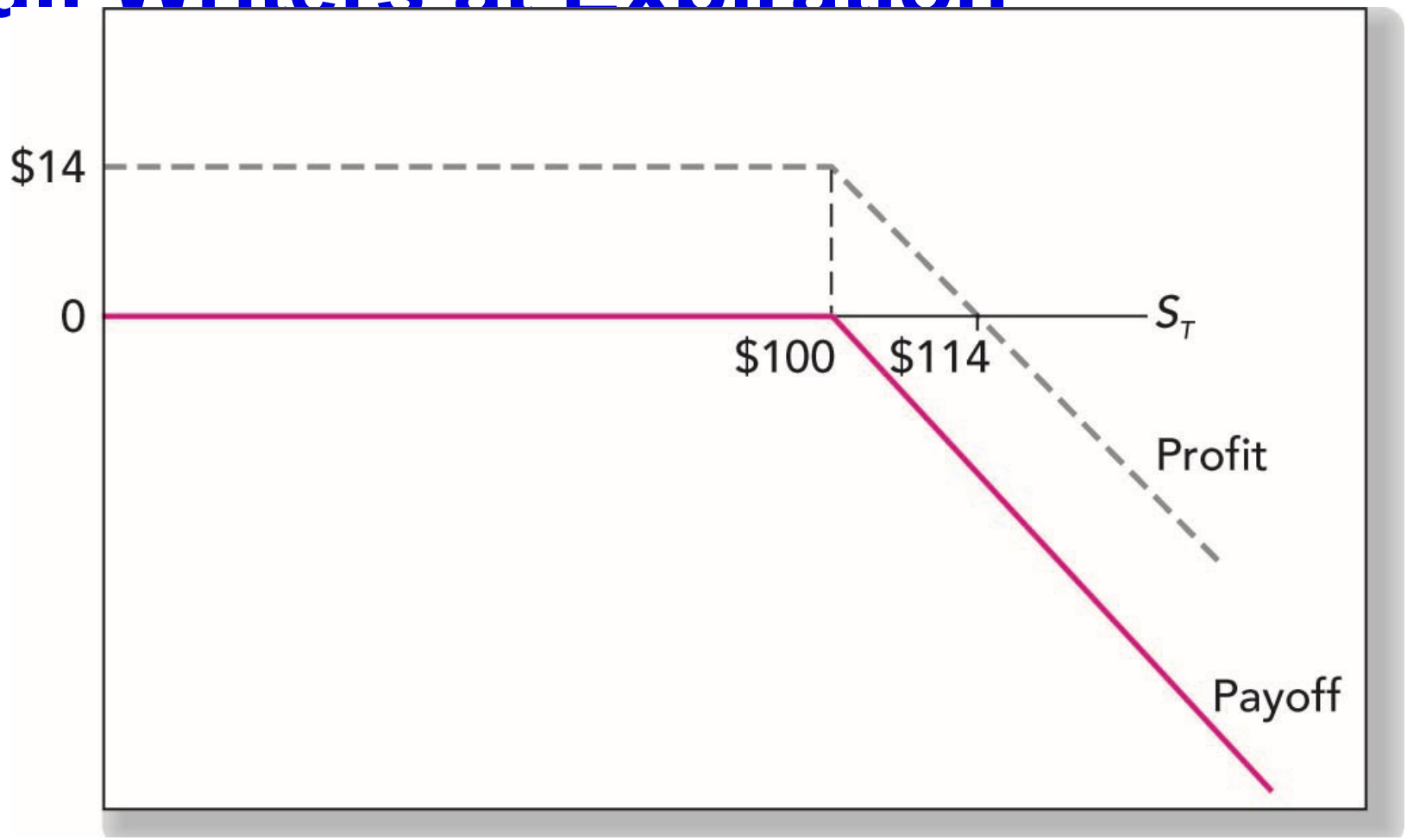


Figure 20.4 Payoff and Profit to Call Writers at Expiration



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

0	if $S_T \geq X$
$(X - S_T)$	if $S_T < X$

Profit to Put Holder

Payoff - Premium

Payoffs and Profits at Expiration - Puts

Payoffs to Put Writer

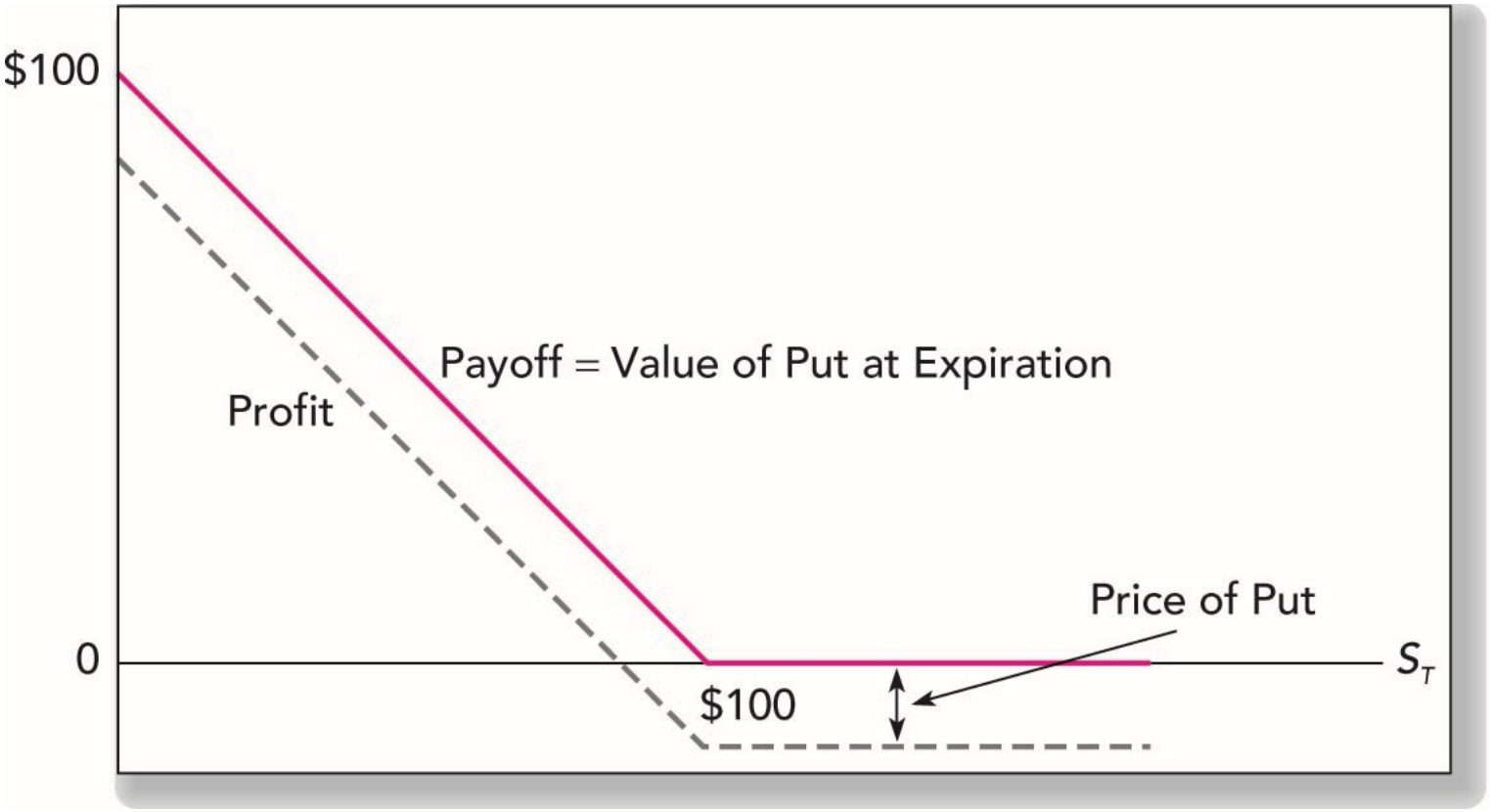
$$0 \quad \text{if} \quad S_T \geq X$$

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

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 Buy T-bills @ 3% Yield	100 options	$1,000 $9,000

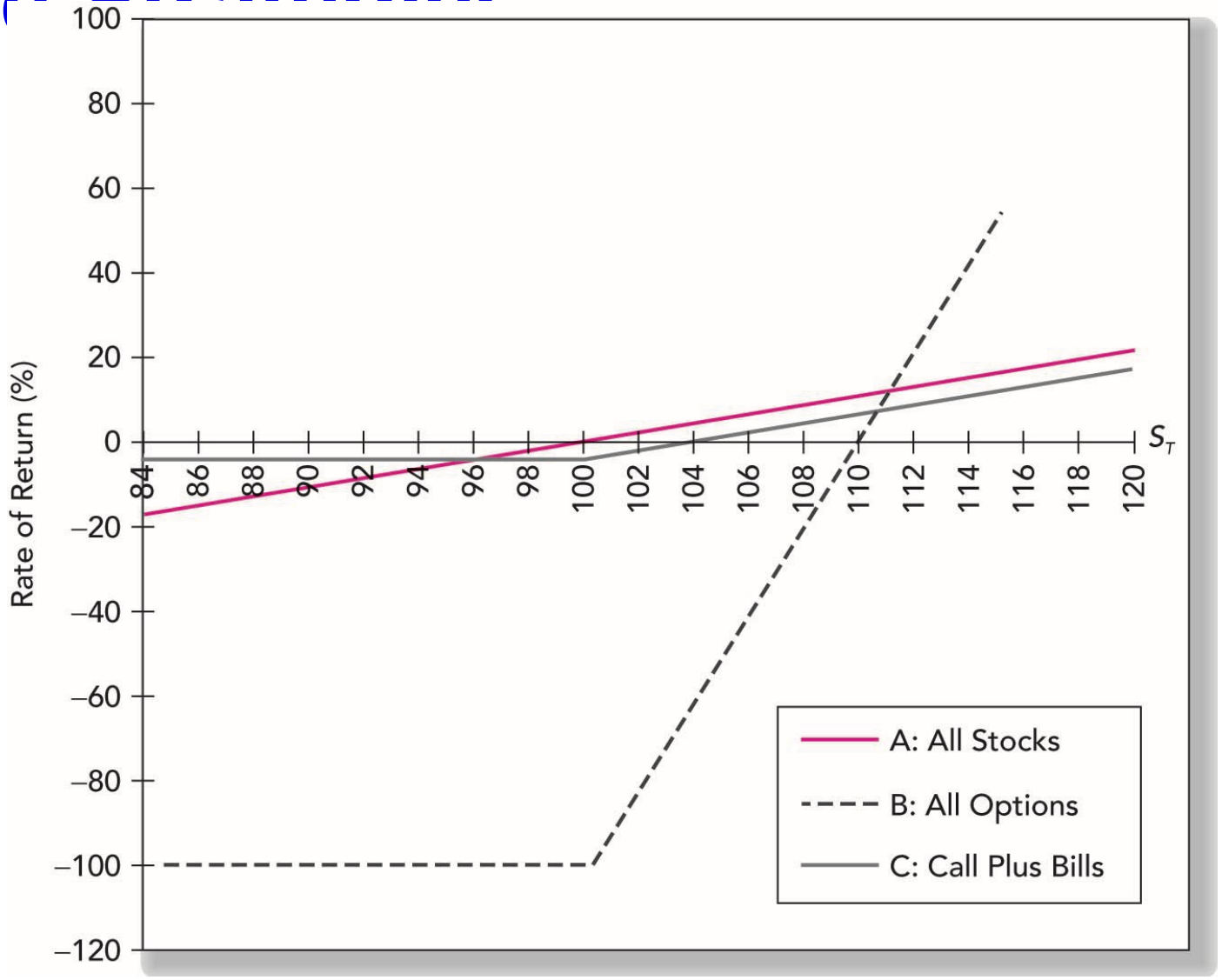
Equity, Options Leveraged Equity - Payoffs

	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



VIX ↑ 18.28 +0.26

At 11:11 d O 18.14 H 18.46 L 17.76 Prev 18.02

VIX Index | Security Description: Index

Chicago Board Options Exchange SPX Volatility Index | FIGI BBG000JW9B77

The Chicago Board Options Exchange Volatility Index reflects a market estimate of future volatility, based on the weighted average of the implied volatilities for a wide range of strikes. 1st & 2nd month expirations are used until 8 days from expiration, then the 2nd and 3rd are used.

3) Price Chart | GP »

Prices

4) Intraday | GIP »	Last	18.26 (11:11:02)
5) Bar | GPO »	52 Week High	50.30 (02/06/18)
	52 Week Low	8.56 (11/24/17)

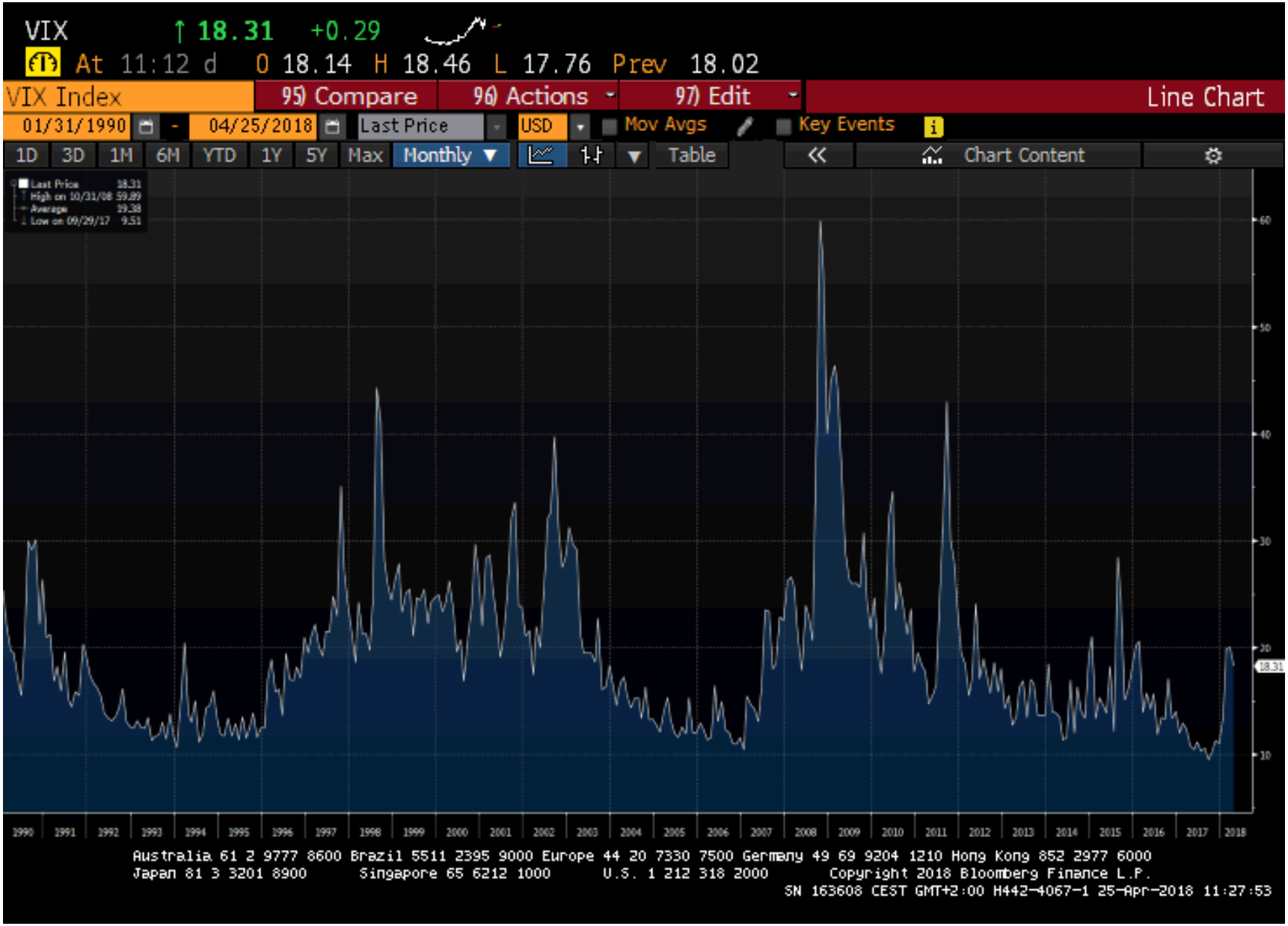
Index Information

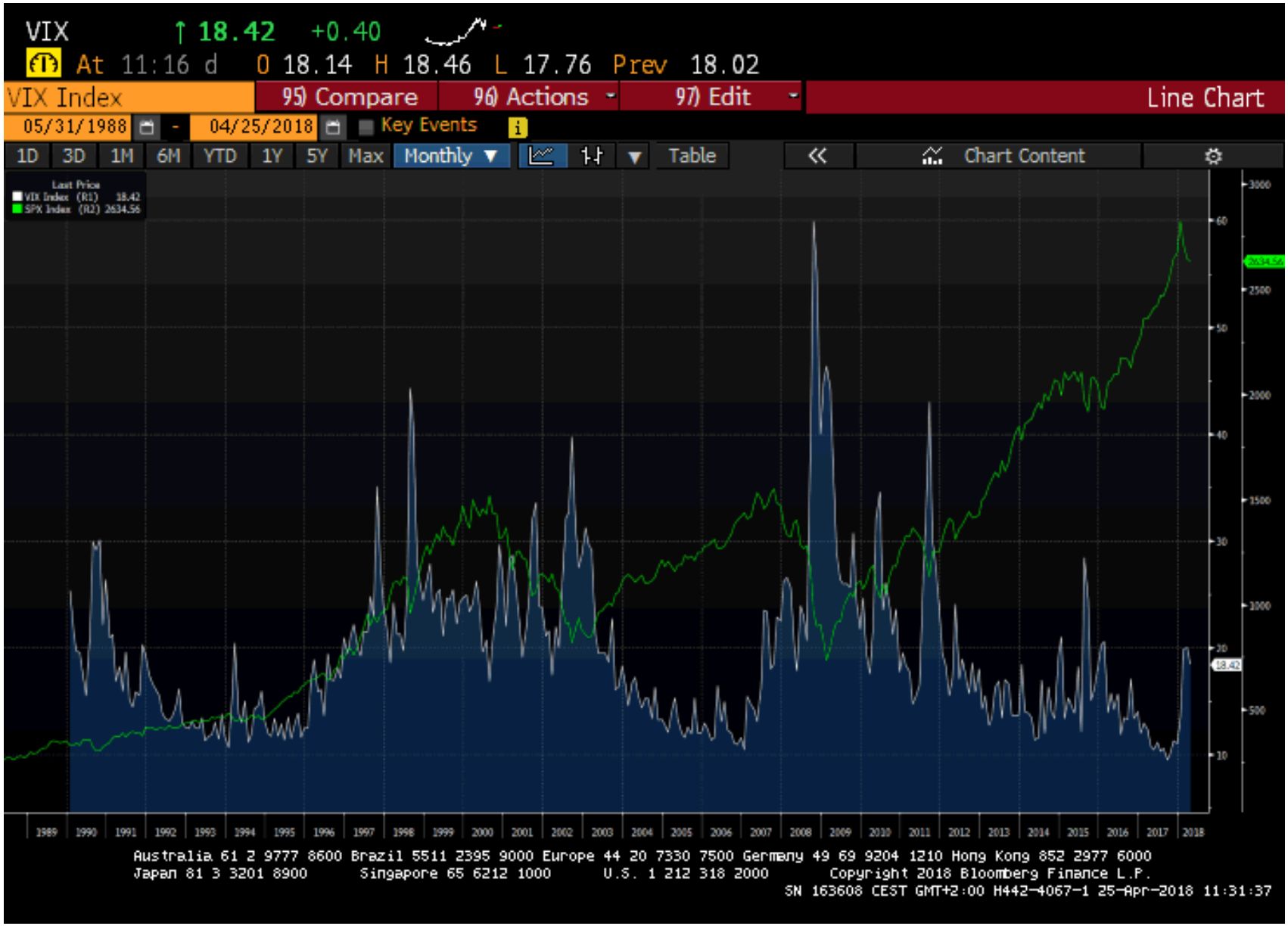
Trading Hours	09:15 - 22:15
Currency	USD
Volume	--

6) Return Analysis | TRA »

Period	Level	% Chg	Annual
1 Day	18.02	+1.33	+12.41k
5 Days	15.60	+17.05	+367.46k
MTD	19.97	-8.56	-70.18
QTD	19.97	-8.56	-70.18
YTD	11.04	+65.40	+380.56
1 Month	24.87	-26.58	-96.72
3 Month	11.58	+57.69	+534.10
6 Month	11.23	+62.60	+165.10
1 Year	10.76	+69.70	+69.70
2 Year	14.08	+29.69	+13.88
5 Year	13.62	+34.07	+6.04
Qtr 1:17	12.37	+47.62	+43.98
Qtr 2:17	11.18	+63.33	+82.01

$$\text{Expected Daily Swing (\%)} = \frac{\text{VIX Value}}{\sqrt{252}}$$


VIX ↑ 18.31 +0.29
At 11:12 d O 18.14 H 18.46 L 17.76 Prev 18.02
VIX Index 95) Compare 96) Actions 97) Edit Line Chart
01/31/1990 - 04/25/2018 Last Price USD Mov Avgs Key Events
1D 3D 1M 6M YTD 1Y 5Y Max Monthly Table Chart Content
Last Price 18.31
High on 10/31/08 59.89
Average 19.38
Low on 09/29/17 9.51
60
50
40
30
20
18.31
10
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2018 Bloomberg Finance L.P.
SN 163608 CEST GMT+2:00 H442-4067-1 25-Apr-2018 11:27:53


VIX ↑ 18.42 +0.40
At 11:16 d O 18.14 H 18.46 L 17.76 Prev 18.02
VIX Index 95) Compare 96) Actions 97) Edit Line Chart
05/31/1988 04/25/2018 Key Events
1D 3D 1M 6M YTD 1Y 5Y Max Monthly Table Chart Content
Last Price
VIX Index (R1) 18.42
SPX Index (R2) 2634.56
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2018 Bloomberg Finance L.P.
SN 163608 CEST GMT+2:00 H442-4067-1 25-Apr-2018 11:31:37