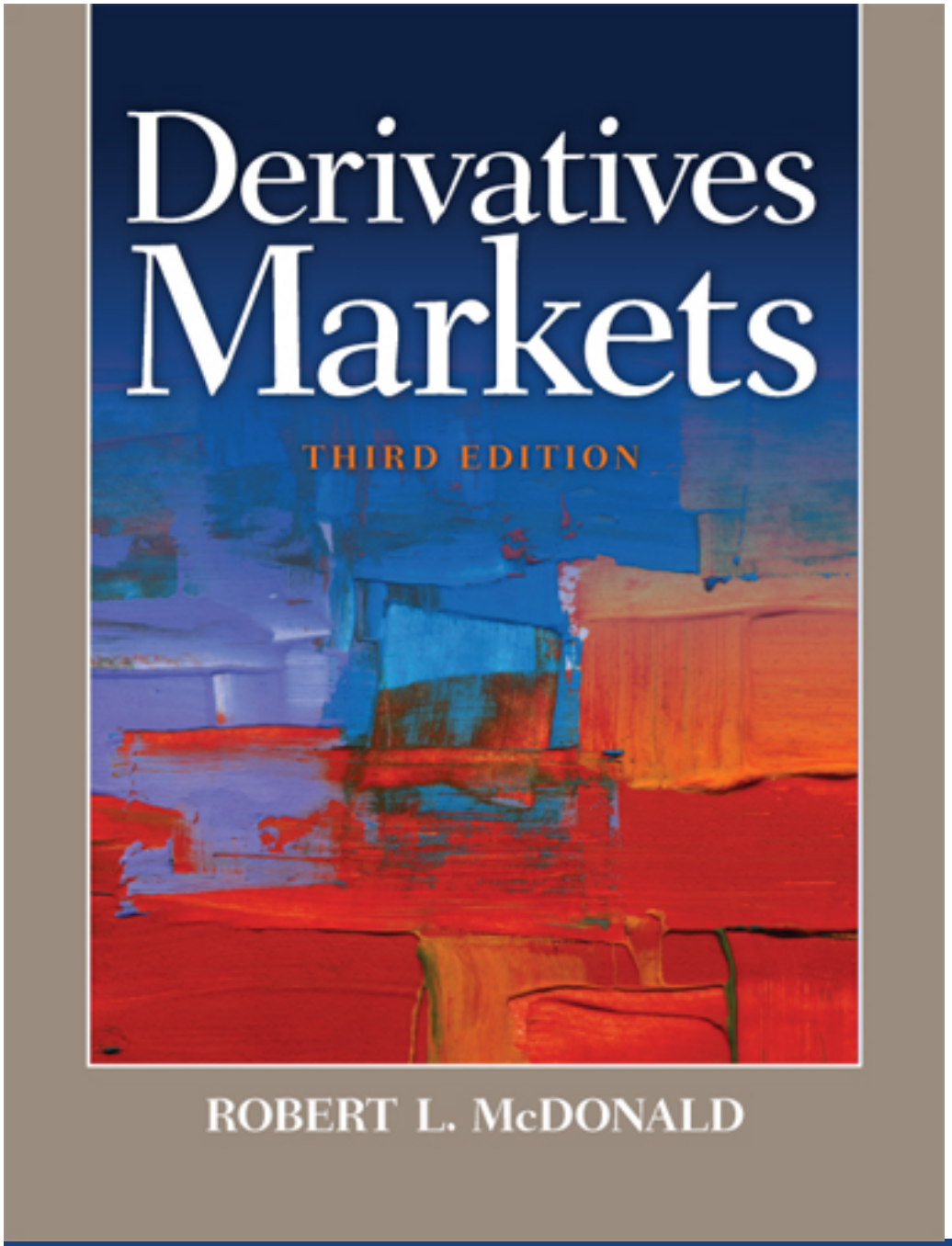


Chapter 2

An Introduction
to Forwards
and Options

Introduction

- Basic derivatives contracts
  - Forward contracts
  - Call options
  - Put Options
- Types of positions
  - Long position
  - Short position
- Graphical representation
  - Payoff diagrams
  - Profit diagrams

Forward Contracts

- Definition: a binding agreement (obligation) to buy/sell an underlying asset in the future, at a price set today
- Futures contracts are the same as forwards in principle except for some institutional and pricing differences.
- A forward contract specifies
  - The features and quantity of the asset to be delivered
  - The delivery logistics, such as time, date, and place
  - The price the buyer will pay at the time of delivery

Reading Price Quotes

Lifetime *low*

Lifetime *high*

The *open* price

Expiration month

Settlement price

Daily change

Open interest

FIGURE 2.1

Index futures price listings.

Contract	Open	High	hilo	Low	Settle	Chg	Open Interest
Index Futures							
DJ Industrial Average (CBT)—$10 x index							
June	10981	11070	▲	10977	**11065**	102	6,972
Sept	10977	10977	▲	10977	**11002**	103	13
Mini DJ Industrial Average (CBT)—$5 x index							
June	10979	11072	▲	10975	**11065**	102	84,086
S&P 500 Index (CME)—$250 x index							
June	1195.30	1207.00		1194.50	**1206.60**	13.50	313,917
Dec	1193.00	1197.60	▲	1192.00	**1197.10**	13.50	3,301
Mini S&P 500 (CME)—$50 x index							
June	1195.50	1207.25	▲	1194.50	**1206.50**	13.50	2,412,904
Sept	1190.50	1202.00	▲	1190.00	**1201.75**	13.50	11,460
Nasdaq 100 (CME)—$100 x index							
June	2010.00	2027.00	▲	2007.25	**2026.50**	25.25	16,139
Mini Nasdaq 100 (CME)—$20 x index							
June	2009.8	2026.8	▲	2006.8	**2026.5**	25.3	308,163
Sept	2005.8	2024.0	▲	2005.0	**2024.3**	25.5	377
Mini Russell 2000 (ICE-US)—$100 x index							
June	706.50	721.00	▲	705.80	**720.10**	15.40	373,776
Sept	706.70	718.00	▲	706.30	**717.70**	15.40	2,835
Mini Russell 1000 (ICE-US)—$100 x index							
June	661.50	665.70	▲	659.50	**665.30**	7.50	19,004
U.S. Dollar Index (ICE-US)—$1,000 x index							
June	80.56	80.52	▲	80.14	**80.29**	–.33	44,534
Sept	80.81	80.86	▲	80.51	**80.57**	–.34	2,231

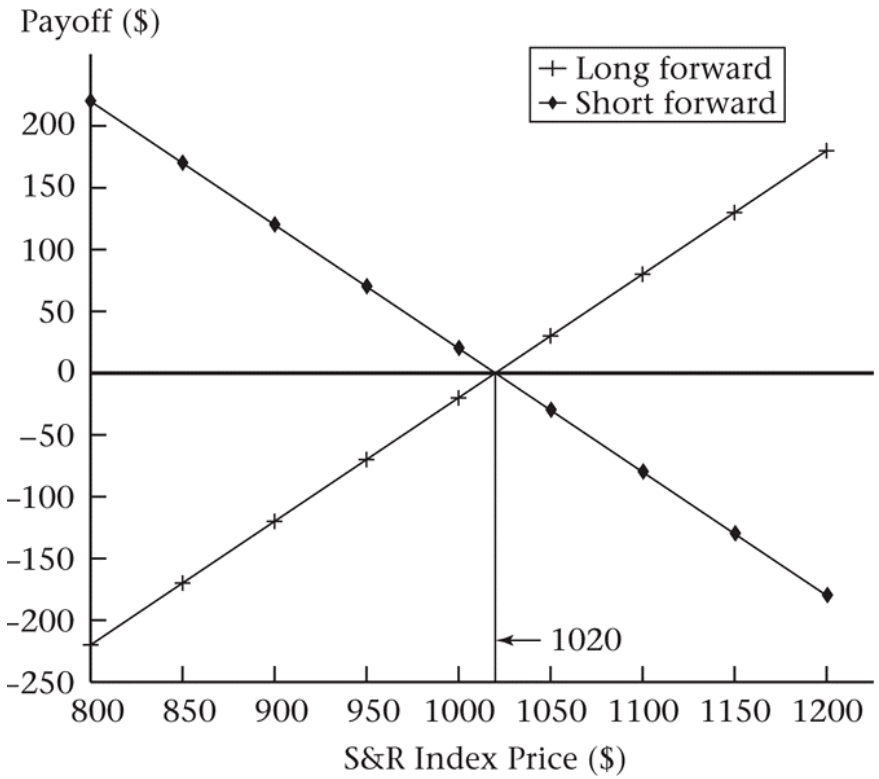
Data from the *Wall Street Journal*, April 15, 2010, p. C-7.

The Payoff on a Forward Contract

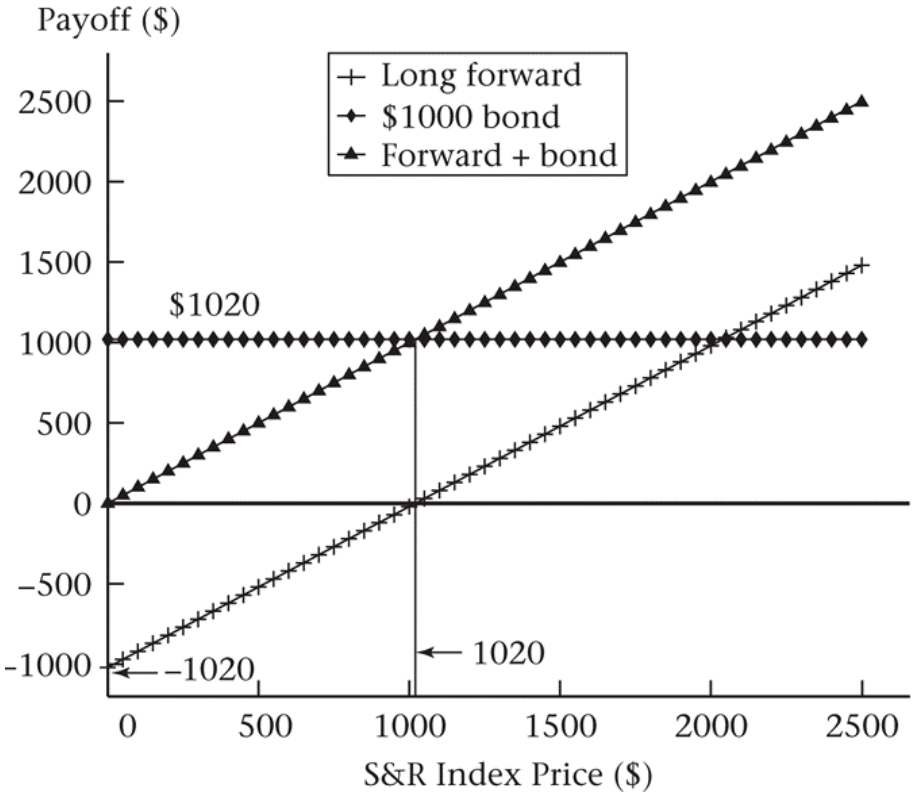
- Payoff for a contract is its value at expiration
- Payoff for
  - Long forward = Spot price at expiration – Forward price
  - Short forward = Forward price – Spot price at expiration
- Example 2.1: S&R (special and rich) index:
  - Today: Spot price = $1,000, 6-month forward price = $1,020
  - In six months at contract expiration: Spot price = $1,050
    - Long position payoff = $1,050 – $1,020 = $30
    - Short position payoff = $1,020 – $1,050 = ($30)

Payoff Diagram for Forwards

- Long and short forward positions on the S&R 500 index



Forward Versus Outright Purchase



Forward payoff

Bond payoff

- Forward + bond = Spot price at expiration – $1,020 + $1,020
  = Spot price at expiration

Additional Considerations

- Type of settlement
  - Cash settlement: less costly and more practical
  - Physical delivery: often avoided due to significant costs
- Credit risk of the counter party
  - Major issue for over-the-counter contracts
    - Credit check, collateral, bank letter of credit
  - Less severe for exchange-traded contracts
    - Exchange guarantees transactions, requires collateral

Call Options

- A non-binding agreement (right but not an obligation) to buy an asset in the future, at a price set today
- Preserves the upside potential, while at the same time eliminating the unpleasant downside (for the buyer)
- The seller of a call option is obligated to deliver if asked

Examples

- Example 2.3: S&R index
  - Today: call buyer acquires the right to pay $1,020 in six months for the index, but is not obligated to do so
  - In six months at contract expiration: if spot price is
    - $1,100, call buyer's payoff = $1,100 – $1,020 = $80
    - $900, call buyer walks away, buyer's payoff = $0
- Example 2.4: S&R index
  - Today: call seller is obligated to sell the index for $1,020 in six months, if asked to do so
  - In six months at contract expiration: if spot price is
    - $1,100, call seller's payoff = $1,020 – $1,100 = ($80)
    - $900, call buyer walks away, seller's payoff = $0
- Why would anyone agree to be on the seller side?

Definition and Terminology

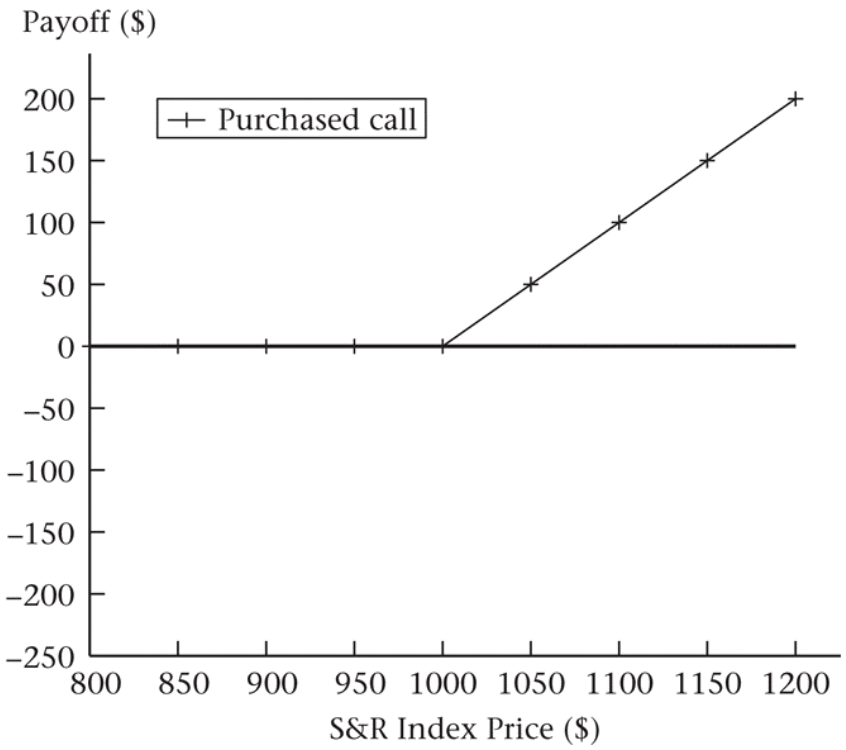
- A call option gives the owner the right but not the obligation to buy the underlying asset at a predetermined price during a predetermined time period
- Strike (or exercise) price: the amount paid by the option buyer for the asset if he/she decides to exercise
- Exercise: the act of paying the strike price to buy the asset
- Expiration: the date by which the option must be exercised or become worthless
- Exercise style: specifies when the option can be exercised
  - European-style: can be exercised only at expiration date
  - American-style: can be exercised at any time before expiration
  - Bermudan-style: Can be exercised during specified periods

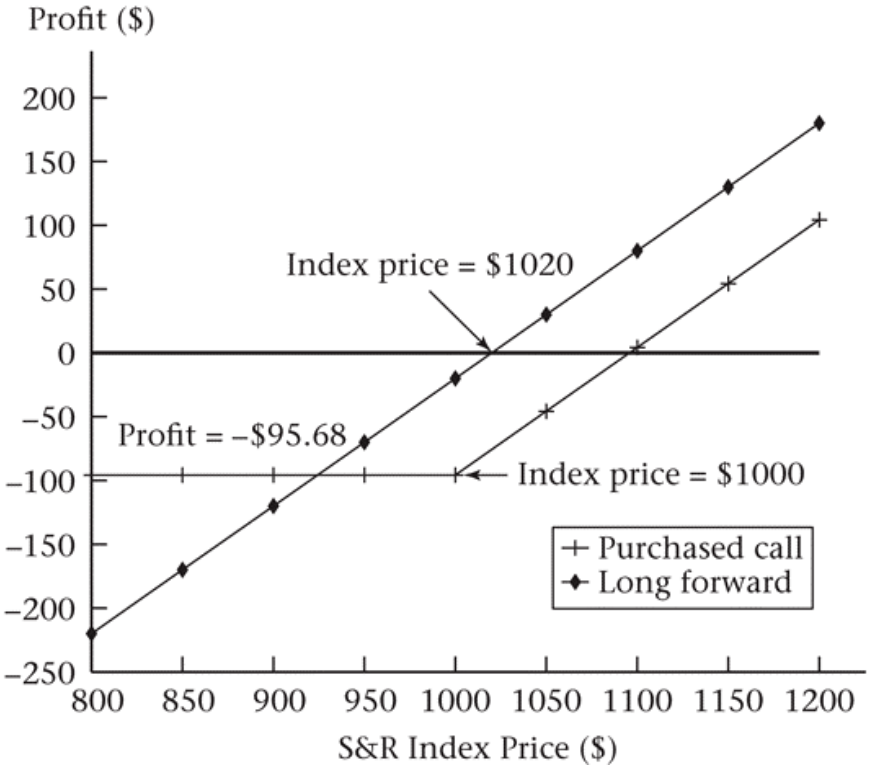
Payoff/Profit of a Purchased Call

- Payoff = Max [0, spot price at expiration – strike price]
- Profit = Payoff – future value of option premium
- Examples 2.5 & 2.6:
  - S&R Index 6-month Call Option
    - Strike price = $1,000, Premium = $93.81, 6-month risk-free rate = 2%
  - If index value in six months = $1100
    - Payoff = max [0, $1,100 – $1,000] = $100
    - Profit = $100 – ($93.81 x 1.02) = $4.32
  - If index value in six months = $900
    - Payoff = max [0, $900 – $1,000] = $0
    - Profit = $0 – ($93.81 x 1.02) = – $95.68

Diagrams for Purchased Call

- Payoff at expiration
- Profit at expiration





Payoff/Profit of a Written Call

- Payoff = – max [0, spot price at expiration – strike price]
- Profit = Payoff + future value of option premium
- Example 2.7
  - S&R Index 6-month Call Option
    - Strike price = $1,000, Premium = $93.81, 6-month risk-free rate = 2%
  - If index value in six months = $1100
    - Payoff = – max [0, $1,100 – $1,000] = – $100
    - Profit = – $100 + ($93.81 x 1.02) = – $4.32
  - If index value in six months = $900
    - Payoff = – max [0, $900 – $1,000] = $0
    - Profit = $0 + ($93.81 x 1.02) = $95.68

Put Options

- A put option gives the owner the right but not the obligation to sell the underlying asset at a predetermined price during a predetermined time period
- The seller of a put option is obligated to buy if asked
- Payoff/profit of a purchased (i.e., long) put
  - Payoff = max [0, strike price – spot price at expiration]
  - Profit = Payoff – future value of option premium
- Payoff/profit of a written (i.e., short) put
  - Payoff = – max [0, strike price – spot price at expiration]
  - Profit = Payoff + future value of option premium

Put Option Examples

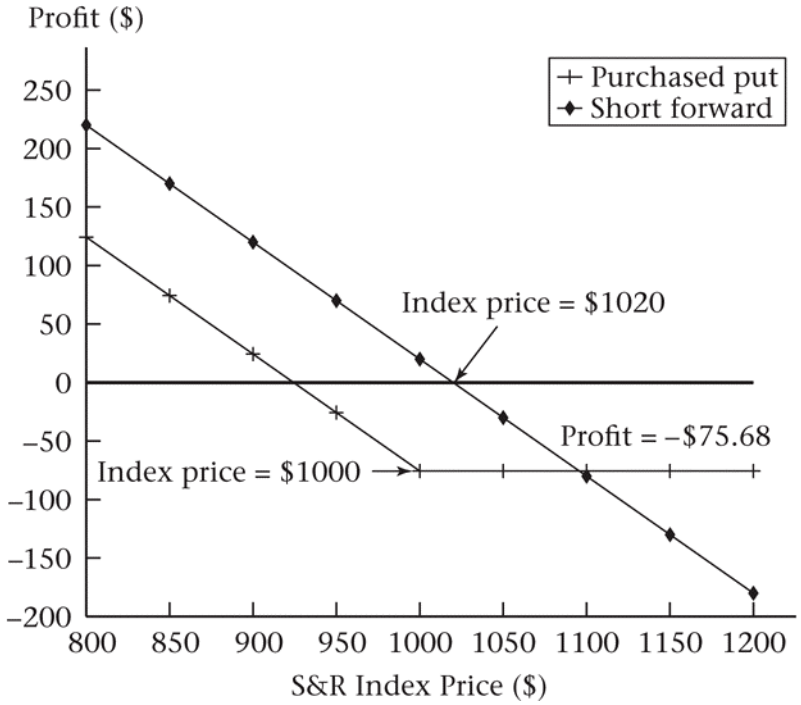
- Examples 2.9 & 2.10
  - S&R Index 6-month Put Option
    - Strike price = $1,000, Premium = $74.20, 6-month risk-free rate = 2%
  - If index value in six months = $1100
    - Payoff = max [0, $1,000 – $1,100] = $0
    - Profit = $0 – ($74.20 x 1.02) = – $75.68
  - If index value in six months = $900
    - Payoff = max [0, $1,000 – $900] = $100
    - Profit = $100 – ($74.20 x 1.02) = $24.32

Profit for a Long Put Position

- Profit table
- Profit diagram

TABLE 2.4 Profit after 6 months from a purchased 1000-strike S&R put option with a future value of premium of $75.68.

S&R Index in 6 Months	Put Payoff	Future Value of Premium	Put Profit
$800	$200	−$75.68	$124.32
850	150	−75.68	74.32
900	100	−75.68	24.32
950	50	−75.68	−25.68
1000	0	−75.68	−75.68
1050	0	−75.68	−75.68
1100	0	−75.68	−75.68
1150	0	−75.68	−75.68
1200	0	−75.68	−75.68

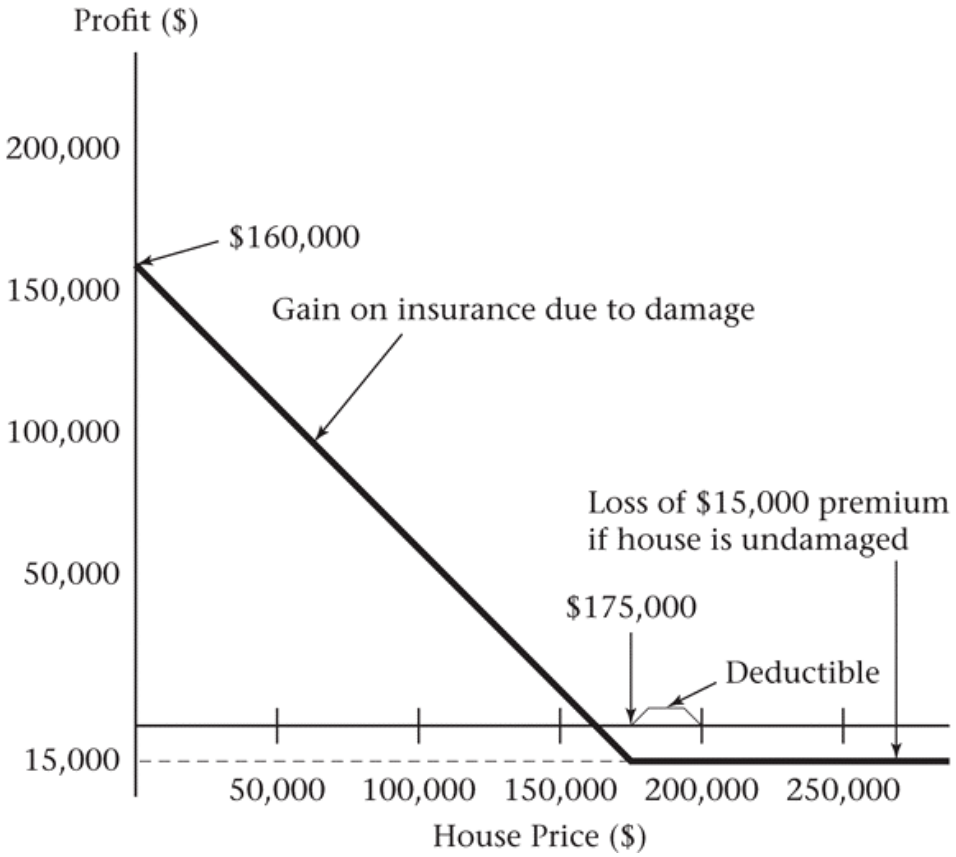


A Few Items to Note

- A call option becomes more profitable when the underlying asset appreciates in value
- A put option becomes more profitable when the underlying asset depreciates in value
- Moneyness
  - In-the-money option: positive payoff if exercised immediately
  - At-the-money option: zero payoff if exercised immediately
  - Out-of-the money option: negative payoff if exercised immediately

Options are Insurance

- Homeowner's insurance is a put option

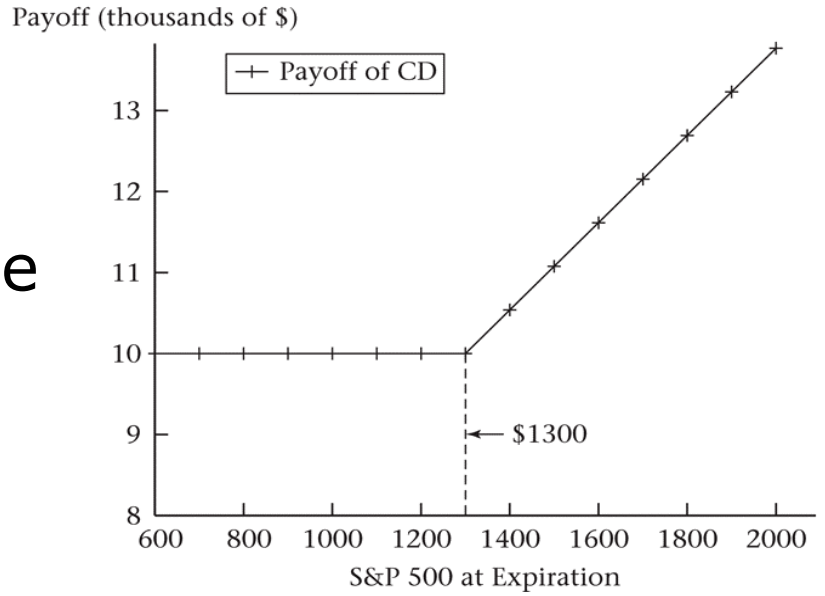


Equity Linked CDs

- The 5.5-year CD promises to repay initial invested amount and 70% of the gain in S&P 500 index
  - Assume $10,000 invested when S&P 500 = 1300
  - Final payoff =

$$\$10{,}000 \times \left(1 + 0.7 \times max\left[0, \frac{S_{final}}{1300} - 1\right]\right)$$

  - Where S_{final}= value of the S&P 500 after 5.5 years



Option and Forward Positions: A Summary

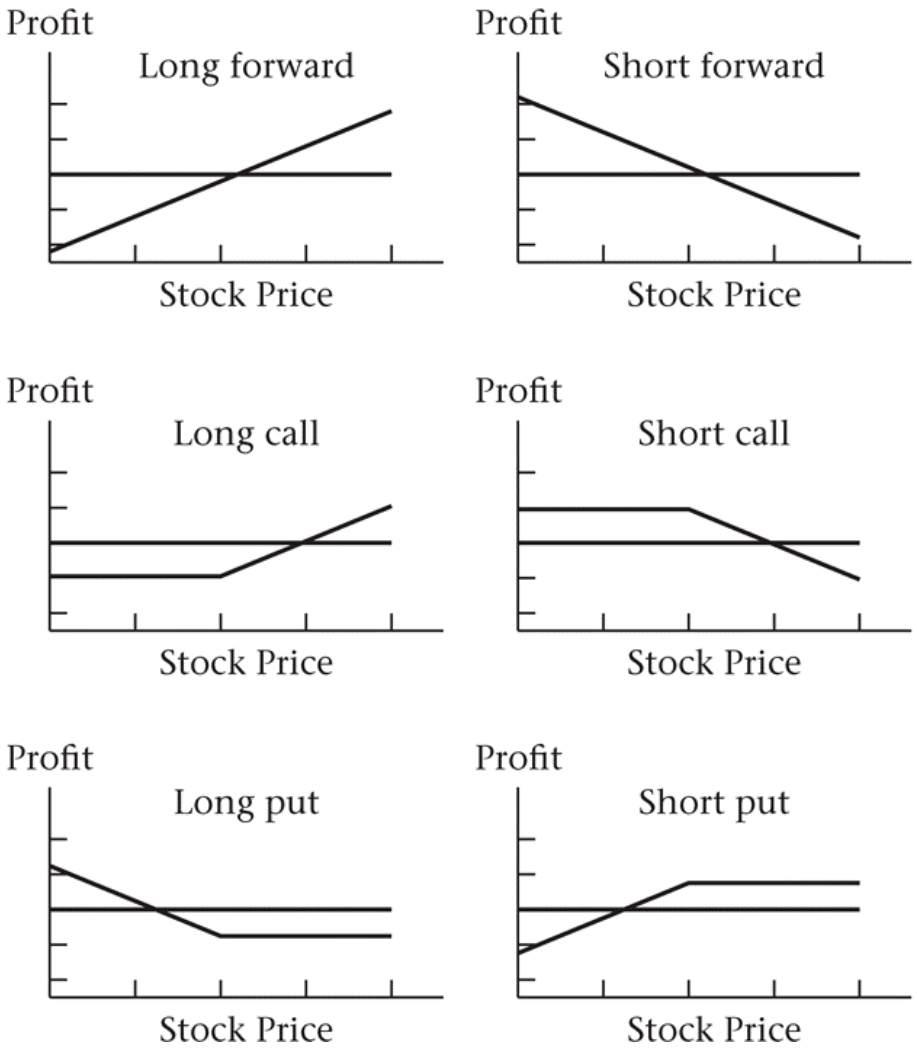


TABLE 2.1 Some indexes on which futures contracts are traded.

Index	Exchange	Weights	Description
S&P 500 Index	CME	Market	500 large U.S. stocks
DJ Industrial Average	CME	Price	30 large U.S. stocks
NASDAQ 100	CME	Market	100 large global non-financial firms listed on Nasdaq
S&P Midcap 400	CME	Market	400 mid-cap U.S. stocks
Russell 1000	ICE	Market	Largest 1000 U.S. companies
Russell 2000	ICE	Market	2000 small-cap U.S. companies
MSCI World	LIFFE	Market	1500 stocks from 23 developed countries
MSCI EAFE (Europe, Australasia, Far East)	LIFFE, CME	Market	Stocks from 21 developed countries, excluding Canada and the U.S.
Euro Stoxx 50	Eurex	Market	50 blue-chip Eurozone stocks
Nikkei 225	SGX, OSE, CME	Price	225 stocks listed on the Tokyo Stock Exchange
Hang Seng	HKEx	Market	43 of the largest companies on the Hong Kong Stock Exchange
DAX	Eurex	Market	30 large German companies listed on the Frankfurt Stock Exchange
S&P Goldman Sachs Commodity Index	CME	Production	Wide range of commodities on which futures contracts are traded

Abbreviations: CME = Chicago Mercantile Exchange, ICE = Intercontinental Exchange, LIFFE = London International Financial Futures Exchange, SGX = Singapore Exchange, OSE = Osaka Stock Exchange, HKEx = Hong Kong Exchange and Clearing. For the weights, "market" means weights are proportional to market capitalization, "price" means weights are proportional to the stock price, "production" means weights are proporational to global production.

TABLE 2.2

Payoff after 6 months from a long S&R forward contract and a short S&R forward contract at a forward price of $1020. If the index price in 6 months is $1020, both the long and short have a 0 payoff. If the index price is greater than $1020, the long makes money and the short loses money. If the index price is less than $1020, the long loses money and the short makes money.

S&R Index	S&R Forward	
in 6 Months	Long	Short
900	−$120	$120
950	−70	70
1000	−20	20
1020	0	0
1050	30	−30
1100	80	−80

FIGURE 2.3

Comparison of payoff after 6 months of a long position in the S&R index versus a forward contract in the S&R index.

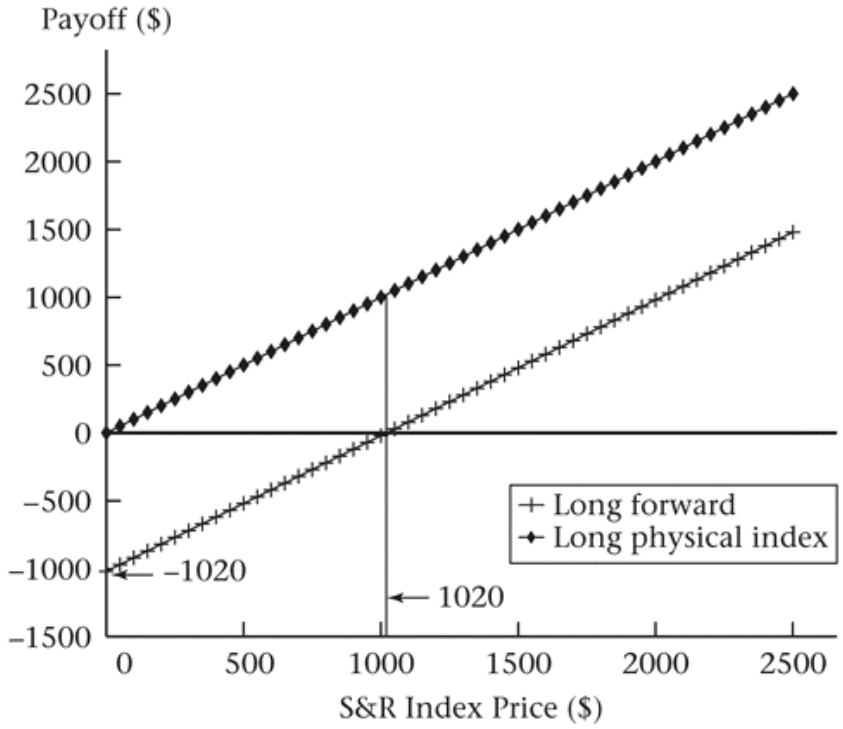


FIGURE 2.7

Profit for the writer of a 6-month S&R call with a strike of $1000 versus profit for a short S&R forward.

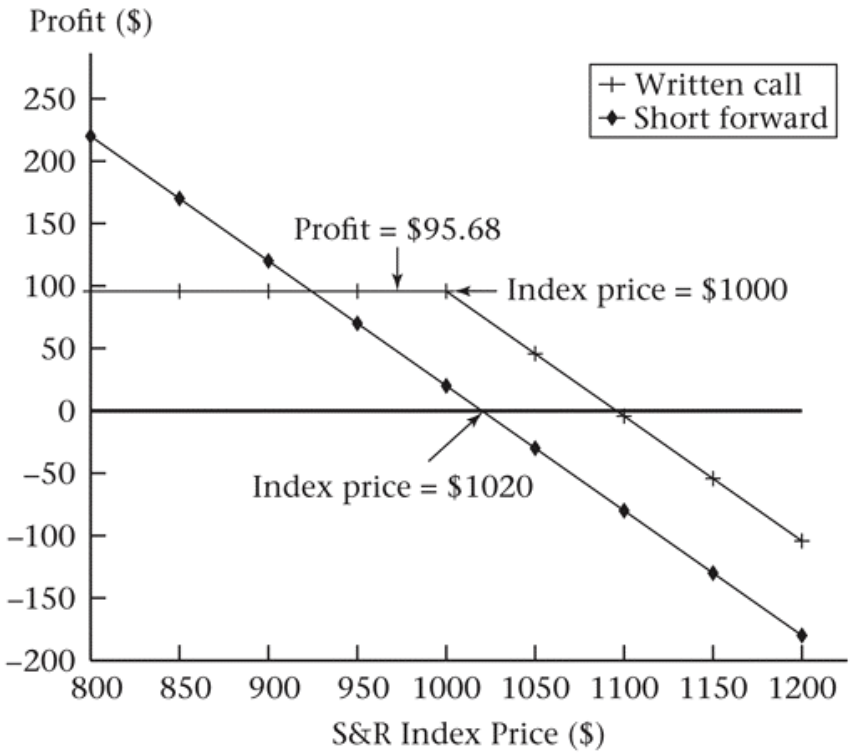


FIGURE 2.9

Written S&R index put option with a strike of $1000 versus a long S&R index forward contract.

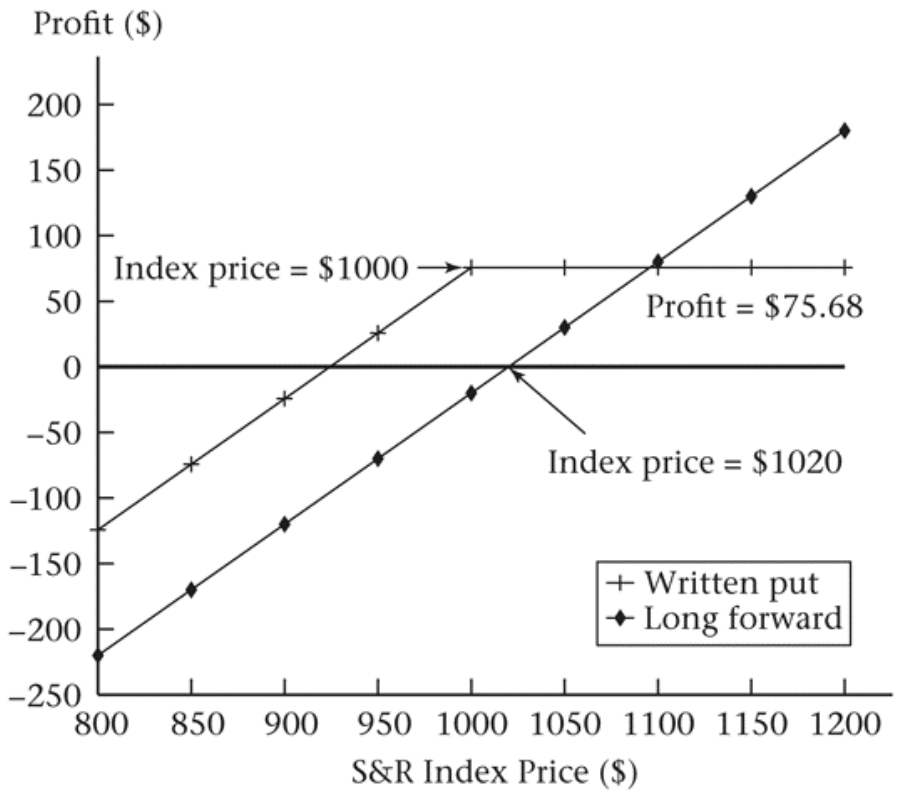


TABLE 2.5 Maximum possible profit and loss at maturity for long and short forwards and purchased and written calls and puts. FV(*premium*) denotes the future value of the option premium.

Position	Maximum Loss	Maximum Gain
Long forward	−Forward price	Unlimited
Short forward	Unlimited	Forward price
Long call	−FV(*premium*)	Unlimited
Short call	Unlimited	FV(*premium*)
Long put	−FV(*premium*)	Strike price − FV(*premium*)
Short put	FV(*premium*) − Strike price	FV(*premium*)

FIGURE 2.10

Profit diagrams for the three basic long positions: long forward, purchased call, and written put.

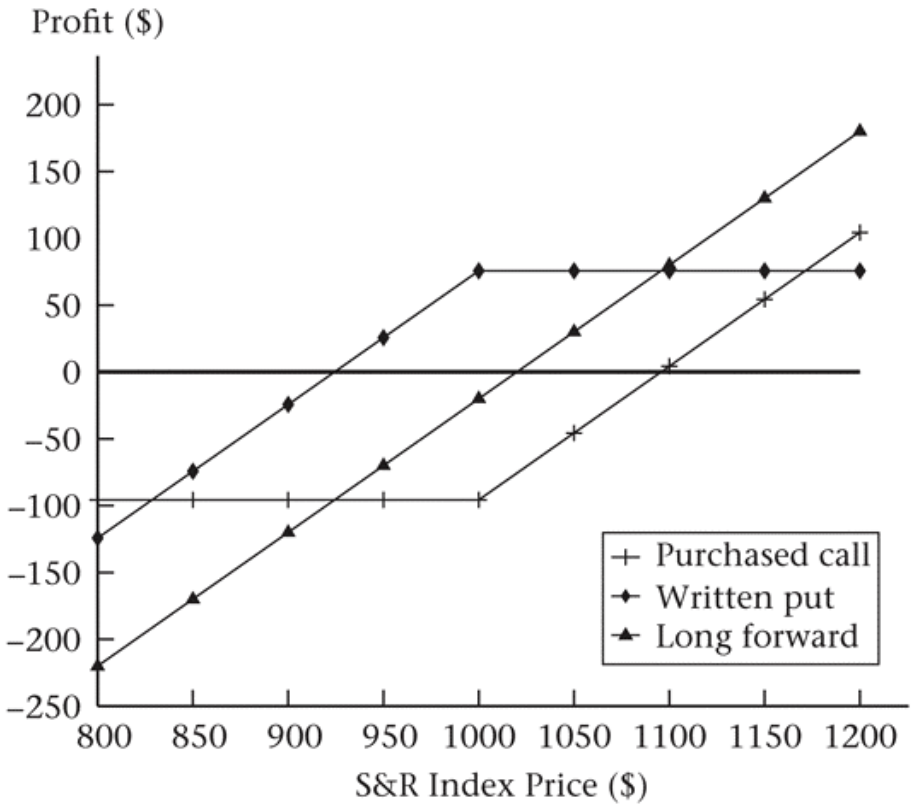


FIGURE 2.11

Profit diagrams for the three basic short positions: short forward, written call, and purchased put.

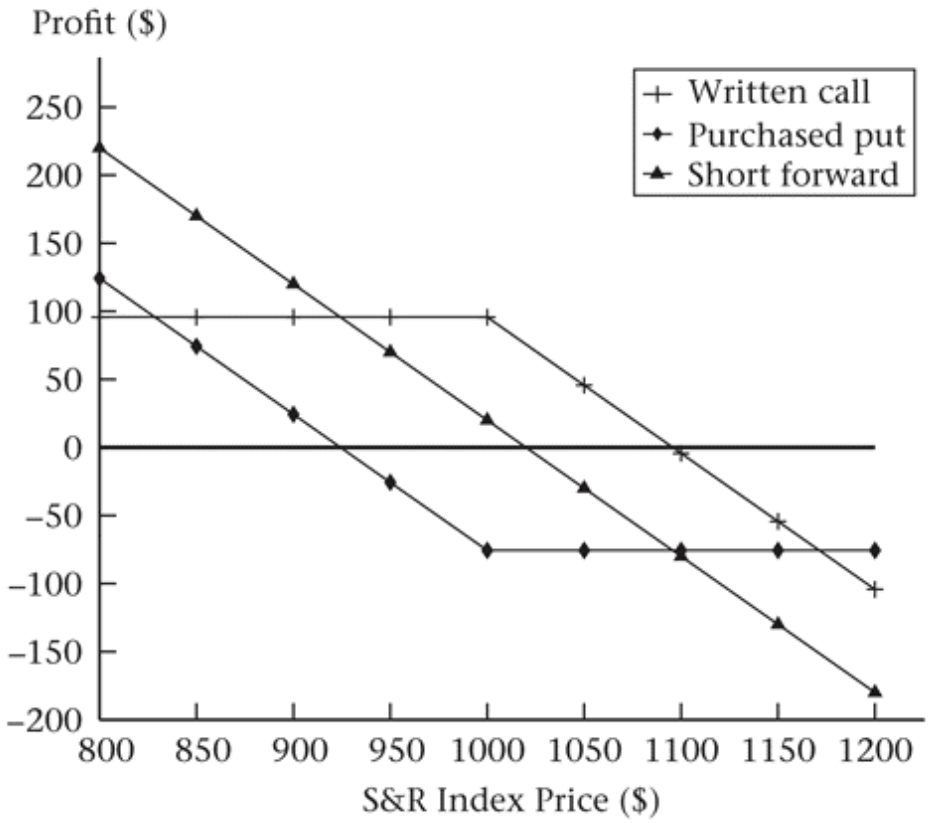


TABLE 2.6 Payoff of equity-linked CD at expiration.

S&P Index After 5.5 Years	CD Payoff
500	$10,000.00
1000	10,000.00
1500	11,076.92
2000	13,769.23
2500	16,461.54
3000	19,153.85

TABLE 2.7 Forwards, calls, and puts at a glance: A summary of forward and option positions.

Derivative Position	Position with Respect to Underlying Asset	Asset Price Contingency	Strategy
Long forward	Long (buy)	Always	Guaranteed purchase price
Short forward	Short (sell)	Always	Guaranteed sale price
Long call	Long (buy)	> Strike	Insures against high price
Short call	Short (sell)	> Strike	Sells insurance against high price
Long put	Short (sell)	< Strike	Insures against low price
Short put	Long (buy)	< Strike	Sells insurance against low price