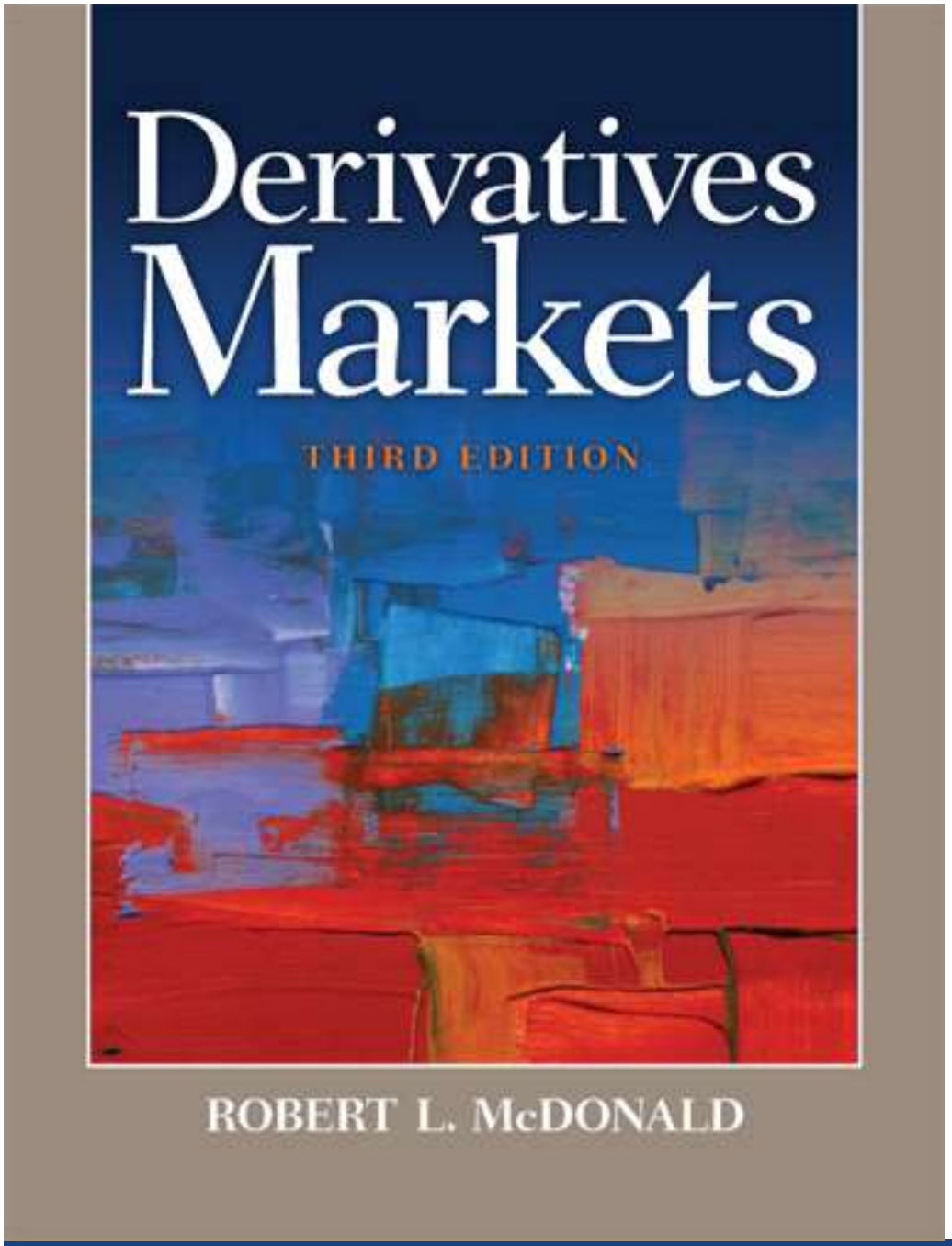


Chapter 1
(Chapter 2 in the textbook)

An Introduction to Forwards and Options

Points to Note

1. Definition of financial derivatives, see P. 3.
2. What is the short selling? Why short-sell? See P.4 - 5.
3. Basic financial derivatives, see P.6.
4. Structure of forward contracts, see P. 7 to 8.
5. The payoff of a forward contract – Long/Short position, see P. 9 to 12.
6. Comparison of long a forward contract and outright purchase, see P. 13 to 16.
7. Structure of a call option, see P. 17 to 19.
8. Payoff/Profit of the call option – Long/Short position, see P. 20 to 23.
9. Put option, see P. 24 to 26.
10. Additional items of the options, see P. 27.
11. Comparison of forward, call and put options, see P. 28 to 32.

What Is a Financial Derivative?

- Definition
  - A financial instrument that has a value determined by the price of something else.

Short-Selling

- When price of an asset is expected to fall
  - First: borrow and sell an asset (get $$)
  - Then: buy back and return the asset (pay $)
  - If price fell in the mean time: Profit $ = $$ – $
  - The lender must be compensated for dividends received (lease-rate)
- Example: short-sell IBM stock for 90 days

TABLE 1.4 Cash flows associated with short-selling a share of IBM for 90 days. S_0 and S_{90} are the share prices on days 0 and 90. Note that the short-seller must pay the dividend, D, to the share-lender.

	Day 0	Dividend Ex-Day	Day 90
Action	Borrow shares	—	Return shares
Security	Sell shares	—	Purchase shares
Cash	$+S_0$	$-D$	$-S_{90}$

Short-Selling (cont'd)

- Why short-sell?
  - Speculation
  - Financing
  - Hedging
- Credit risk in short-selling

Basic Derivatives Contracts

- 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.

Forward Contracts

- The time at which the contract settles is called the **expiration date**.
- The asset or commodity on which the forward contract is based is called the **underlying asset**.
- The agreed price at the outset of the forward contract is called the **forward price**.

The Payoff on a Forward Contract

- Buyer: **Long** forward position
  Seller: **Short** forward position
- Payoff for a contract is its value at expiration.
- Payoff (Cash inflow at the expiration) for
  - Long forward = Spot price at expiration – Forward price
  - Short forward = Forward price – Spot price at expiration

The Payoff on a Forward Contract

- 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)

The Payoff on a Forward Contract (cont'd)

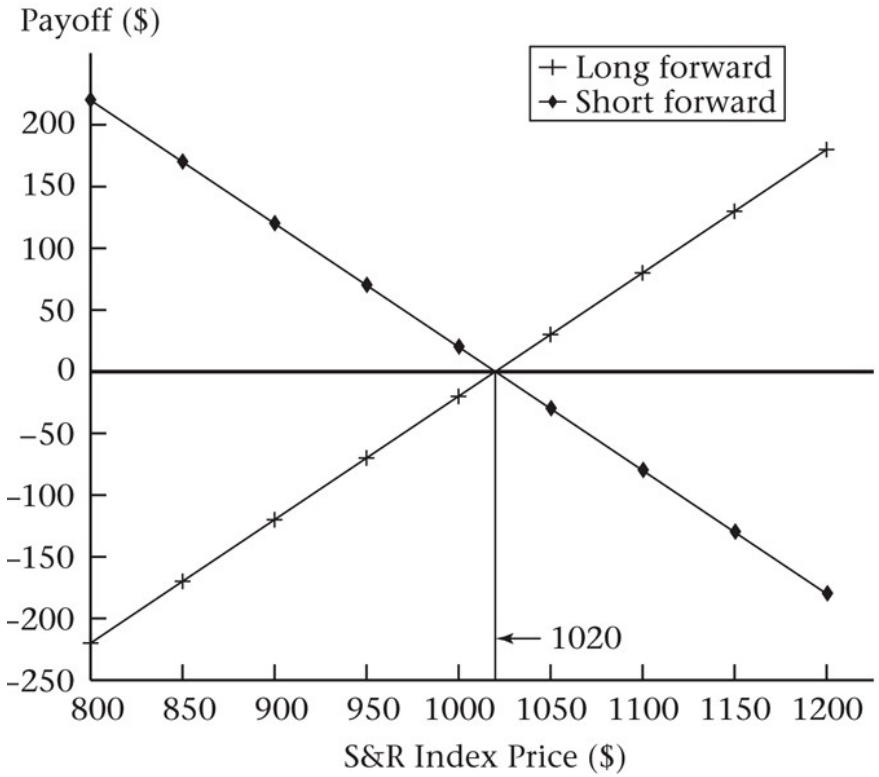
TABLE 2.2

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

Payoff Diagram for Forwards

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



Forward Versus Outright Purchase

- Consider a portfolio which consists of:
  - Long a forward contract with the forward price of K and with the expiration date at T.
  - A zero-coupon bond with the face value of K and the maturity date at T.
- The payoff of the above portfolio at T is

$$S_T - K + K = S_T$$

which is the same as the payoff to directly investing in the underlying asset.

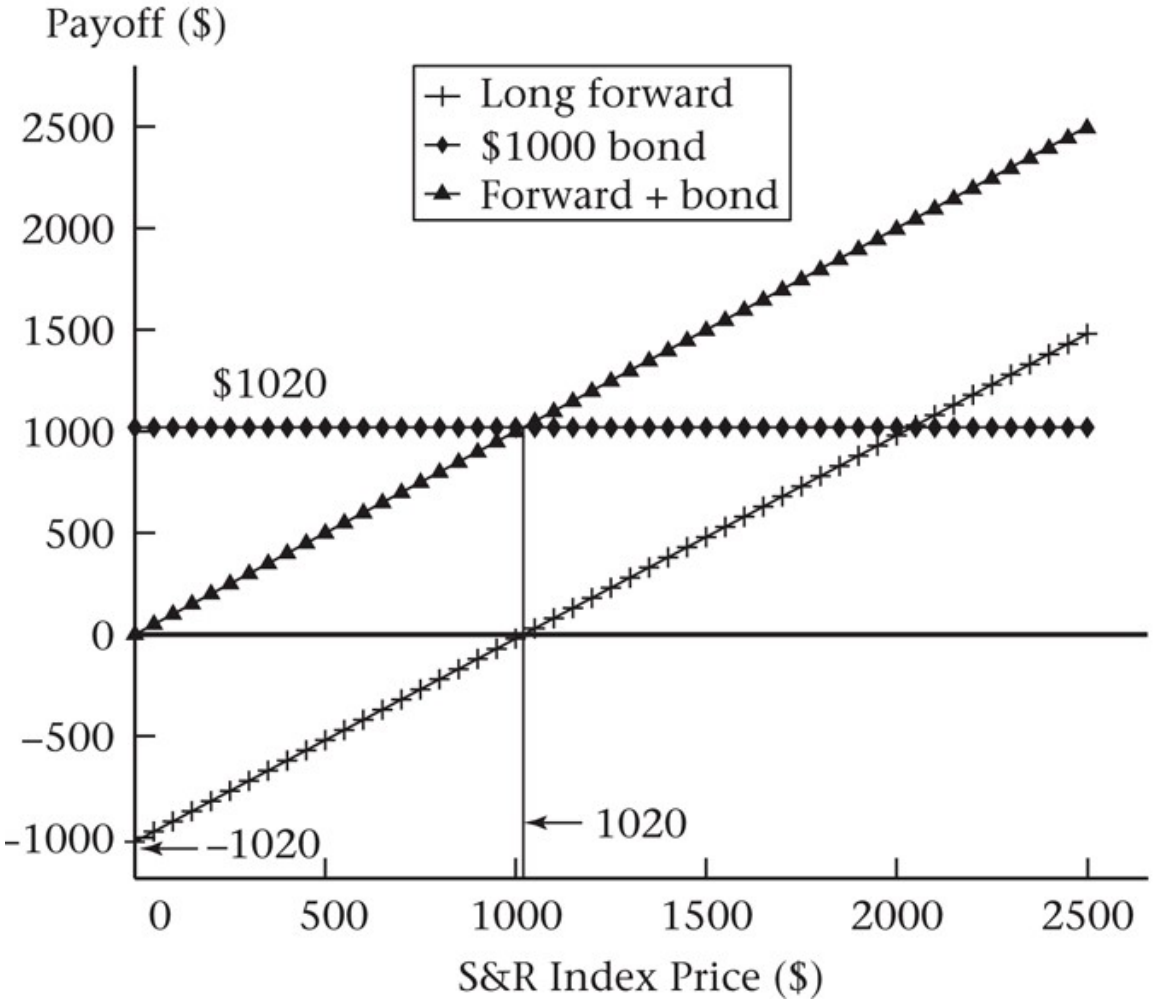
Forward Versus Outright Purchase (cont'd)

- **Example**
  1. Long a S&R index forward by paying $1020 after 6 months and invest $1,000 to a 6-month zero coupon bond with the 6-month interest rate of 2%.
  2. Directly investing to the S&R index with the current price of $1,000.

  At the end of 6-month, the payoff of (1)

  $$S_{0.5} - 1020 + 1000(1.02) = S_{0.5} = \text{Payoff of (2)}$$

Forward Versus Outright Purchase (cont'd)



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?

  The buyer must pay the seller an initial price (premium).

Definition and Terminology

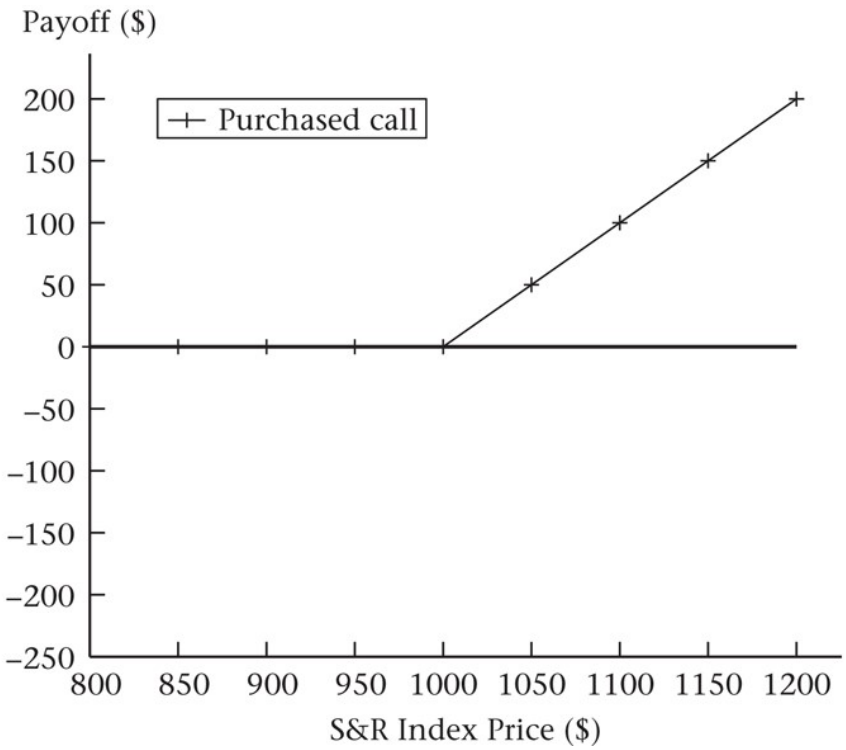
- A call option gives the owner the right but not the obligation to buy the underlying asset at a predetermined price during a predetermined time period.
- Strike (or exercise) price: the amount paid by the option buyer for the asset if he/she decides to exercise.
- Exercise: the act of paying the strike 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

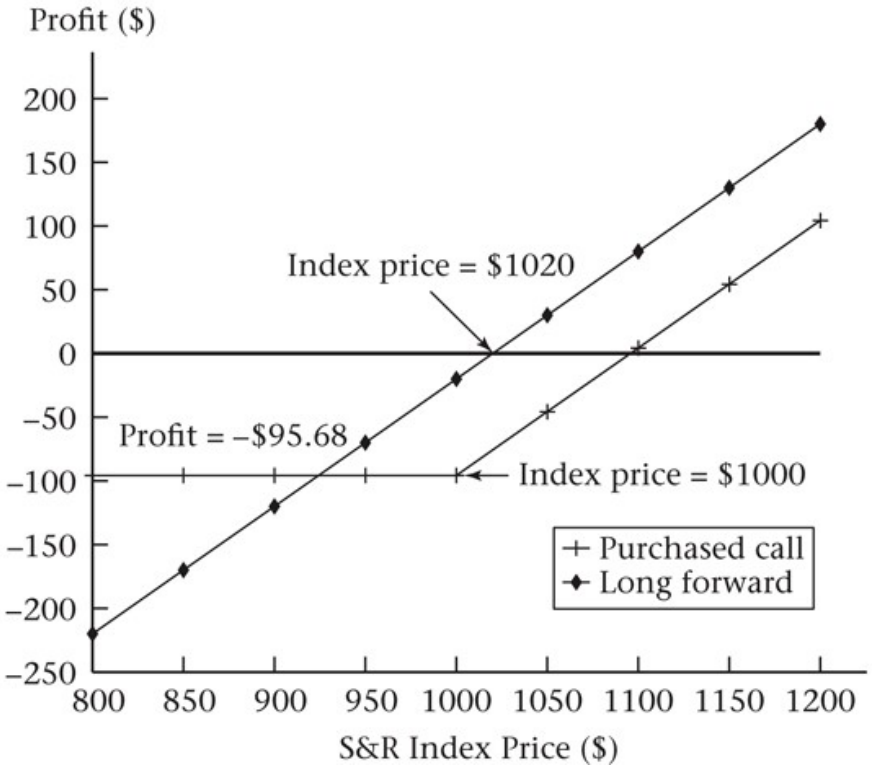
Payoff/Profit of a Purchased Call

- 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





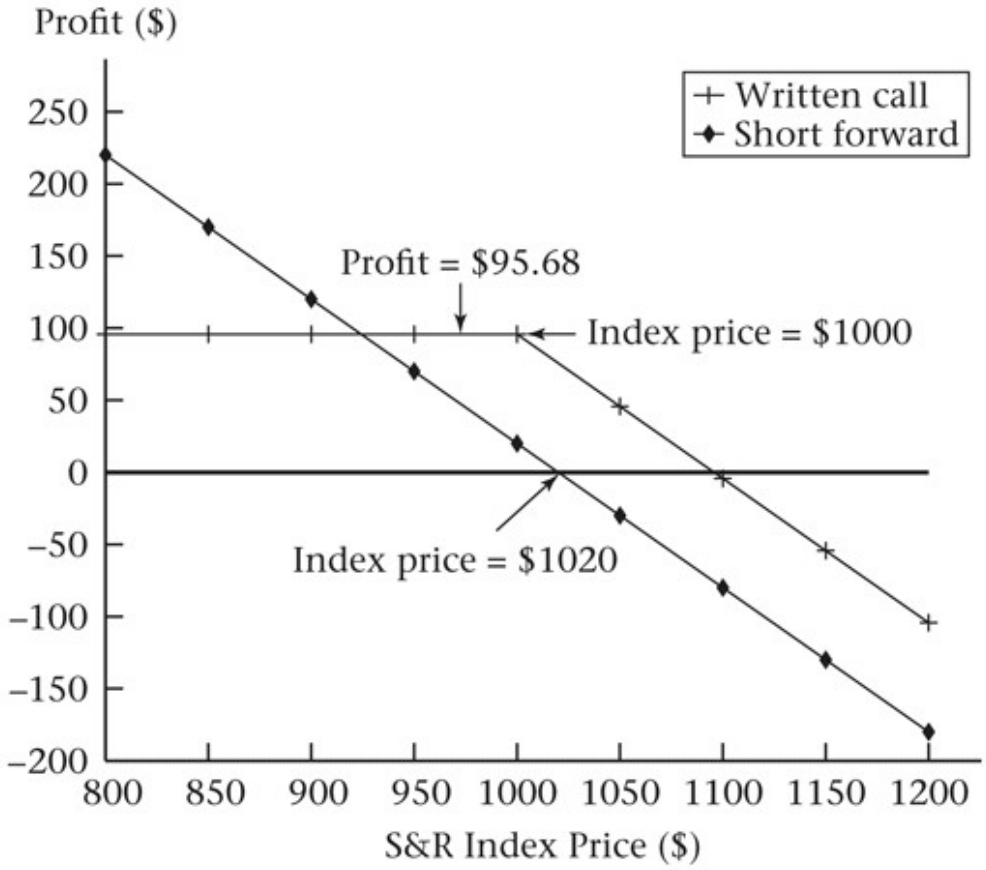
Payoff/Profit of a Written Call

- 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

Payoff/Profit of a Written Call (cont'd)

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.



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

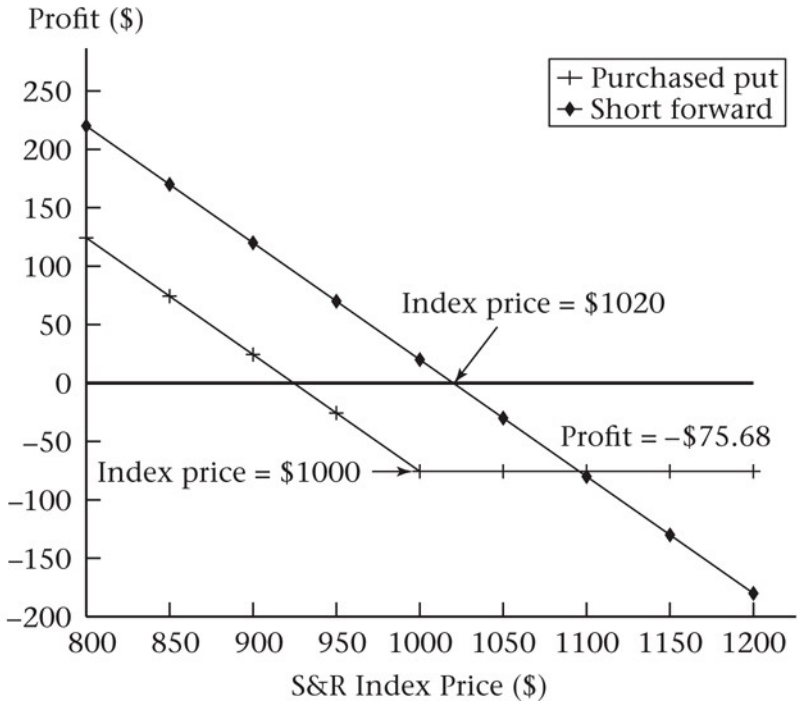
Profit for a Long Put Position

- Profit table

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

- Profit diagram



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.

Summary of Forward and Option Positions

- Gain and Loss

Position	Max. Loss	Max. 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)

Summary of Forward and Option Positions (cont'd)

- Position Long with respect to the Index

  Long forward: An obligation to buy at a fixed price.

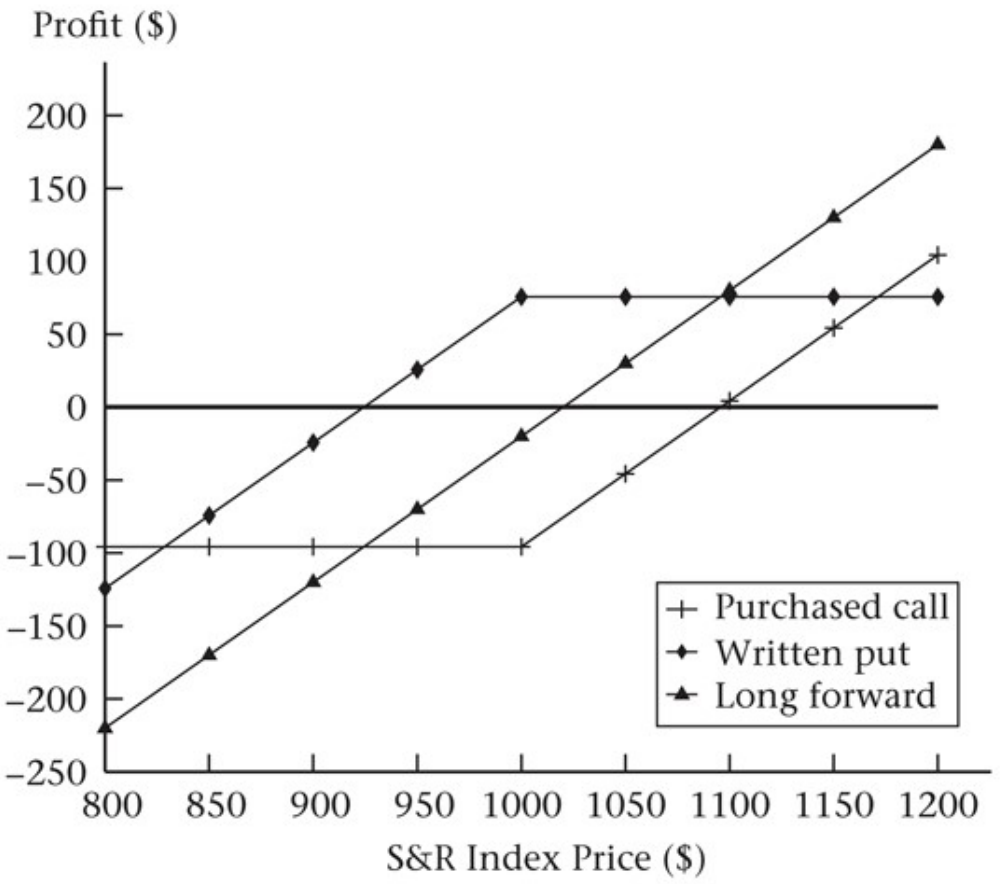
  Purchased call: The right to buy at a fixed price if it is advantageous to do so.

  Written put: An obligation of the put writer to buy the underlying asset at a fixed price if it is advantageous to the option buyer to sell at that price.

Summary of Forward and Option Positions (cont'd)

FIGURE 2.10

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



Summary of Forward and Option Positions (cont'd)

- Position Short with respect to the Index

  Short forward: An obligation to sell at a fixed price.

  Written call: An obligation of the call writer to sell the underlying asset at a fixed price if it is advantageous to the option holder to buy at that price.

  Purchased put: The right to sell at a fixed price if it is advantageous to do so.

Summary of Forward and Option Positions (cont'd)

FIGURE 2.11

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