Financial Derivative Markets

Definition of Derivatives

- A derivative is a financial instrument whose value is derived from the price of a more basic asset called the underlying asset.

- Examples of underlying assets: shares, commodities, currencies, credits, stock market indices, weather temperatures, results of sport matches or elections, etc.

- Examples of derivatives are: Options – put and call options, forwards, futures, and swaps

Derivative Markets

- Derivative markets are markets for contractual instruments whose performance is determined by how another instrument or asset performs

  - Cash market or spot market → maximum delivery two working days
  - Forward markets → related to forward and/or futures contract

The Role of Derivative Markets

1. risk management → hedging

Because derivative prices are related to the prices of the underlying spot market goods, they can be used to reduce or increase the risk of investing in the spot items

2. Price discovery

futures and forward markets are an important means of obtaining information about investors' expectations of future prices

3. Operational advantages

Lower transaction cost, have greater liquidity than spot markets (futures & options), allow investors to sell short more easily

4. Market efficiency

5. Speculation

Types of Derivative Securities:

- Options Contract
- Forward Contract
- Futures Contract
- Swap

The objectives of the chapter are to provide an understanding of:

o Forward contracts.

o Futures contracts.

o Options.

o Interest rate and currency swaps.

o Credit derivatives.

Market Overview

- Derivative security
  - A contract with its value derived from asset or an index that trades both on the exchanges and in the over-the-counter (OTC) market.
  - Are contracts used to transfer credit risk from one party to another.
  - **Exchange-traded derivatives** have more standardization and offer greater liquidity
  - **OTC contracts** are tailored to meet the needs of particular buyers and sellers.
  - Financial derivatives include futures, options, swaps, and credit derivatives.

Types of Derivative Securities

- Futures contracts
  - Represent the right to buy or sell a standard quantity and quality of an asset or a security at a specified date and price.

- Options
  - Represent the right to buy (**call**) or sell an asset (**put**) during a given time for a specified price, called the **strike price**.

Risks Associated with Derivatives

- ## Market risk
  - ➢ The instrument's sensitivity to changes in market conditions, such as fluctuations in interest rates or currency exchange rates may be considerable, depending on the degree of leverage and the nature of the security.

- ## Liquidity risk
  - ➢ The chance that the instrument cannot be sold at a reasonable price within a reasonable time frame.
  - ➢ Liquidity may decrease or evaporate entirely during unfavorable markets.

Risks Associated with Derivatives (cont'd)

- Credit risk
  - ➢ The risk mainly involves OTC instruments in which the counterparty fails to service or repay a debt.
  - ➢ Exchange-traded derivatives are not subject to risk related to the counterparty's creditworthiness.
- Hedging risk
  - ➢ The possibility that the use of derivatives may limit total returns when anticipated risks do not develop.

Notional Principal

- Notional principal defined
  - The size of a particular derivative contract that is the amount used to calculate the payoff; it does not change hands and is not a measure of risk.
  - The amount that is the basis for calculating interest and other payments.
- Replacement-cost credit exposure
  - The cost of replacing the contract at the current market value should the counterparty default before the settlement date.

Types of Derivatives (cont'd)

- Forward contracts
  - Agreements to buy or sell an asset on a certain future date for a certain price.
  - Trade in the OTC market, usually between two financial institutions or a financial institution and its clients.
    - One party takes a long position and agrees to buy the underlying asset on a specific date for a specific price.
    - The other party assumes a short position and agrees to sell on the same date for the same price.
    - The price specified in a forward contract is the delivery price.

Types of Derivatives (cont'd)

- Futures contracts
  - Represents the agreement to trade a standard quantity and quality of an asset at a specified date and price.
  - The size, delivery procedures, expiration dates, and other terms of futures are the same for all contracts.
  - Standardization allows futures to be traded on exchanges, which provides liquidity to market participants.

Futures Terms

- Basis
  - The difference between the cash market price and the futures price.

- Basis risk
  - The widening or narrowing of the basis difference that affects the effectiveness of a hedge.
  - If the asset to be hedged and the asset underlying the futures contract are the same, the basis should be zero at the expiration of the futures contract.

$$Basis = Current\ Cash\ Price - Futures\ Price$$

Types of Futures Contracts

- Commodity Futures
  - Agricultural
  - Petroleum
  - Metallurgical futures
- Foreign Exchange
  - British pound
  - Euro
  - Japanese yen
  - Swiss franc

- Interest rate futures
  - Treasury bills, notes, and bonds
  - Eurodollars
- Major market indexes
- S&P 500 index
- Individual stocks
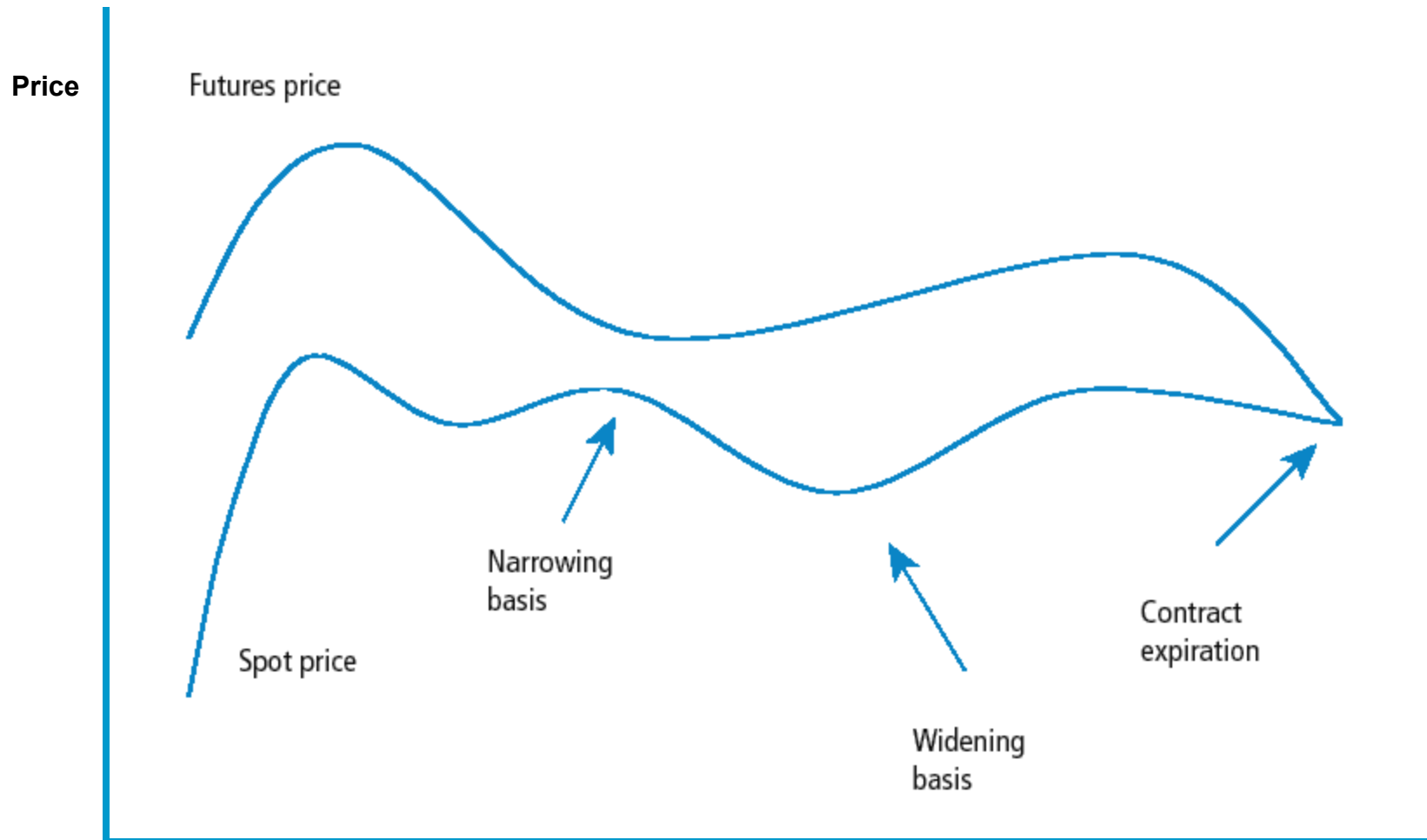- Weather

Spot Price and Futures Price

Price

Futures price

Spot price

Narrowing basis

Widening basis

Contract expiration

FIGURE 14.1a

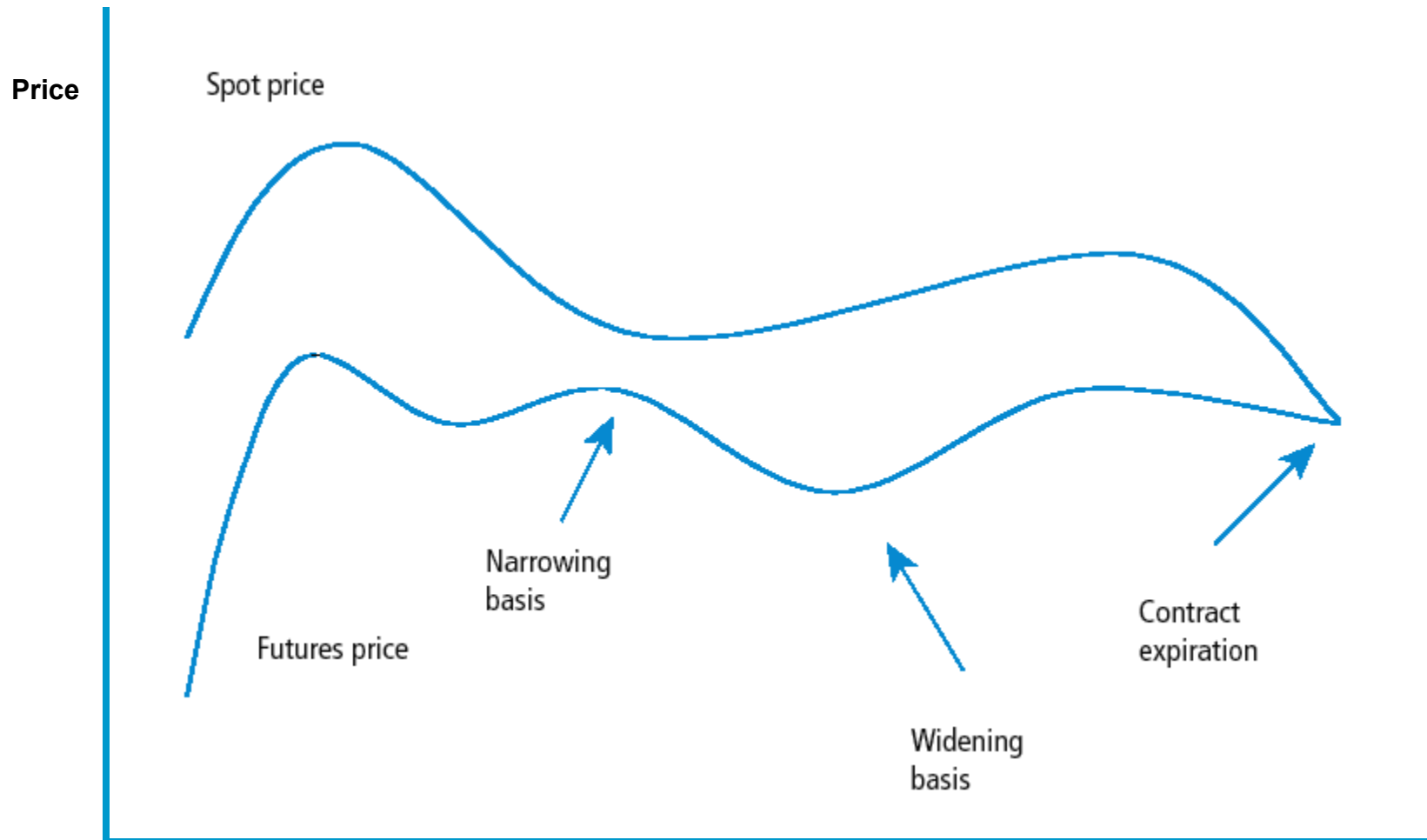# Spot Price and Futures Price

FIGURE 14.1b

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Standardization of Futures Contracts

- Standard futures contract specifications:
  - The underlying asset
  - Contract size
  - Delivery arrangements
  - The quoting of prices
  - Daily price movement,and position limits
  - Alternatives for the delivered asset
  - Alternative delivery arrangements.

Margin Requirements

- The cash deposit a trader must post with a broker to be allowed to trade a futures contract.
  - The margin can be cash, a bank letter of credit, or a short-term U.S.Treasury security.
  - **Initial margin:** the amount a trader must deposit before trading any contracts.
  - **Maintenance margin:** the minimum amount (variation margin) that must be kept in the margin account to prevent a *margin call* for additional funds or the closing of the position by selling the contract.

Hedging

- Hedging
  - ➢ Reduction of risk by taking an opposite position in the futures market from the trader's cash market position.

- Hedge ratio
  - ➢ The number of contracts needed to hedge a position in the spot market. Determined by:
    - ❖ The size of the spot or cash market position.
    - ❖ The size of the futures contract.
    - ❖ The sensitivity of the spot price and the futures price to some external factor such as changes in the interest rate.

Speculation

- Speculators
  - ➢ Attempt to earn profits by assuming the risks of holding only the futures contract and make a profit when prices move in the direction they predicted.
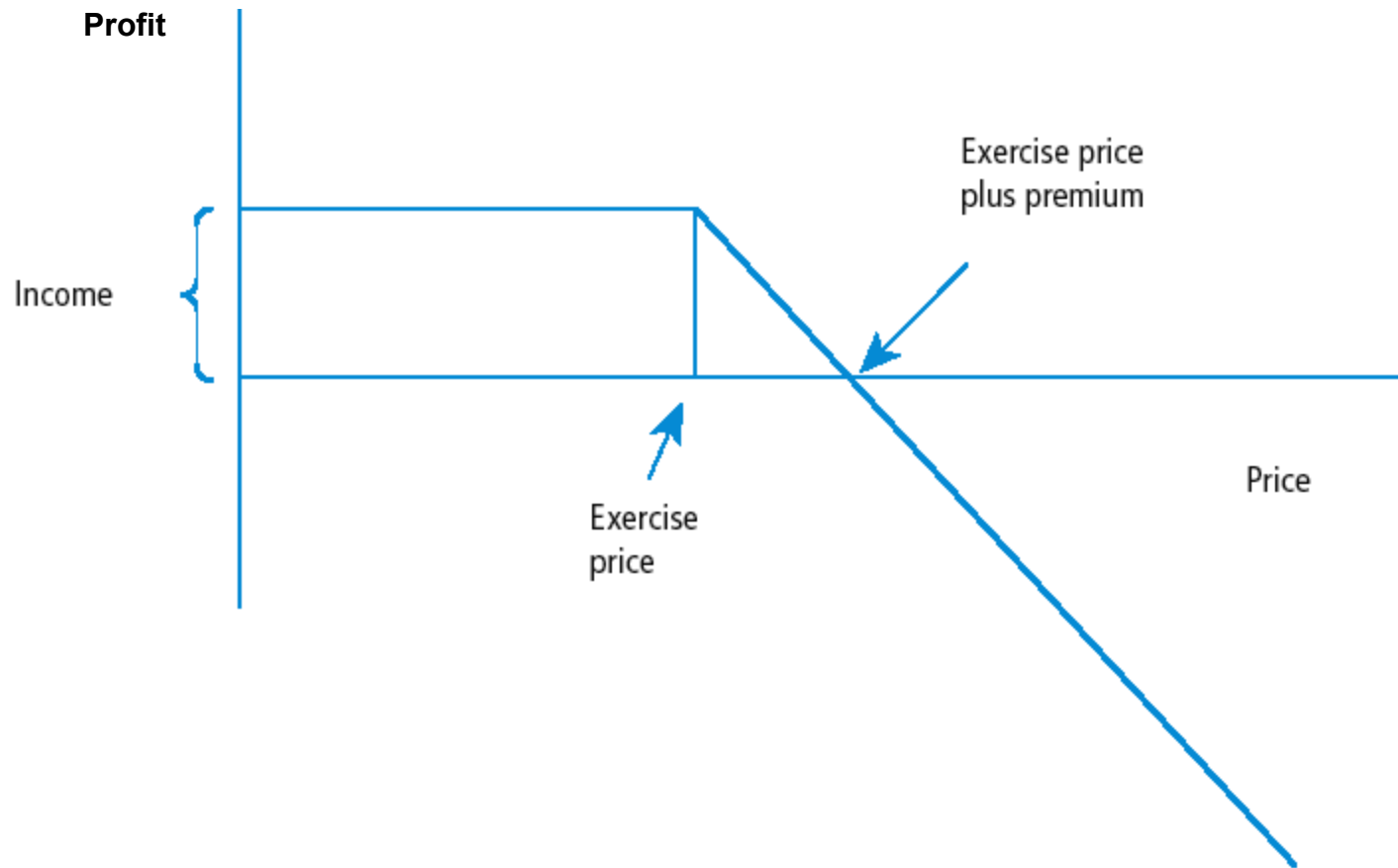
Options

- Option
  - Gives the option holder the right, but not the obligation, to buy an asset (a call option), or sell an asset (a put option), at a pre-specified price (the exercise or strike price) during a specific time period.
- Types of options:
  - **American option** allows the holder to exercise the option any time up to expiration.
  - **European option** allows the holder to exercise the option only at its expiration.

Payoff Diagrams for Calls and Put Options
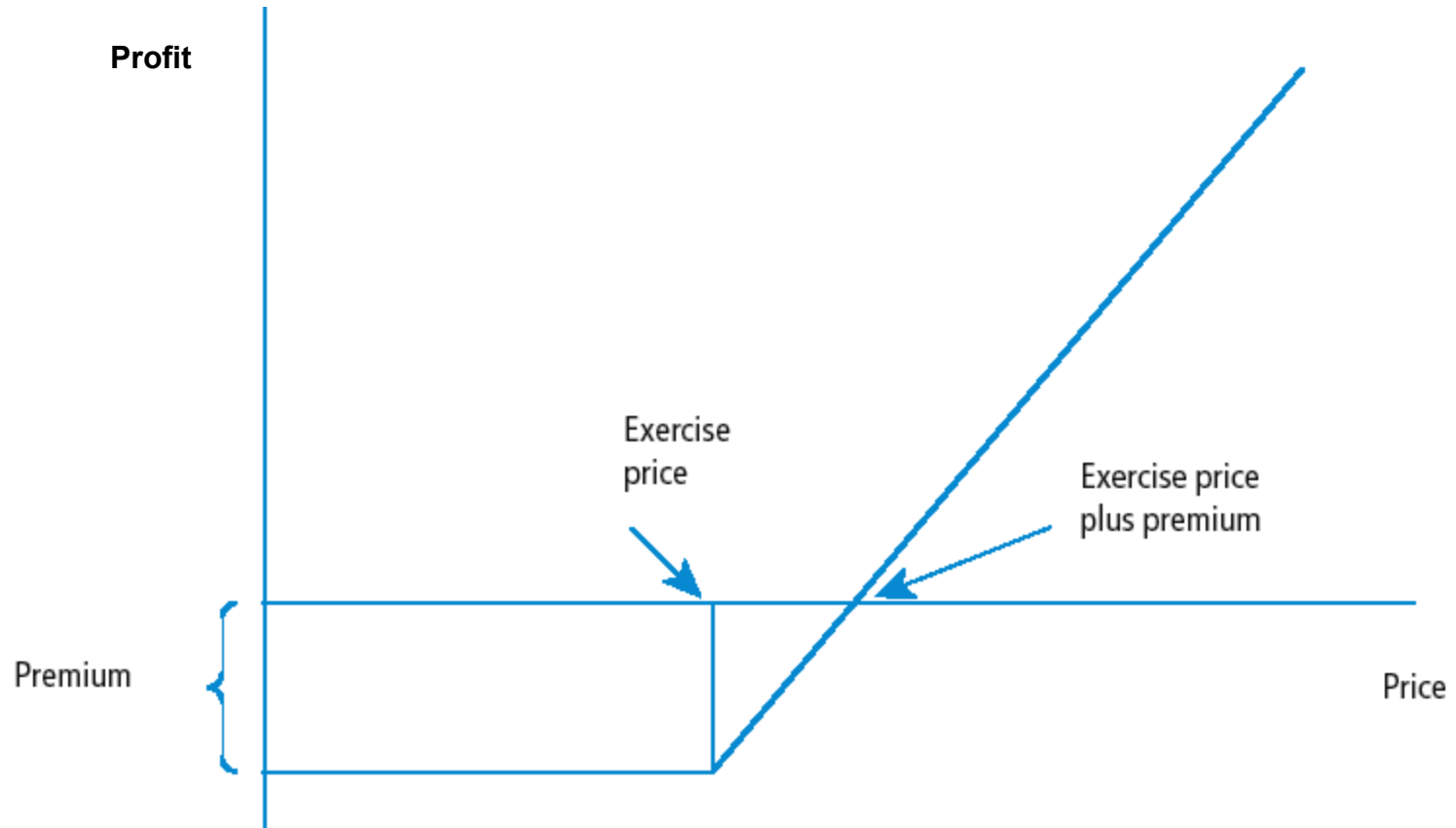
(A) Payoff for a long call

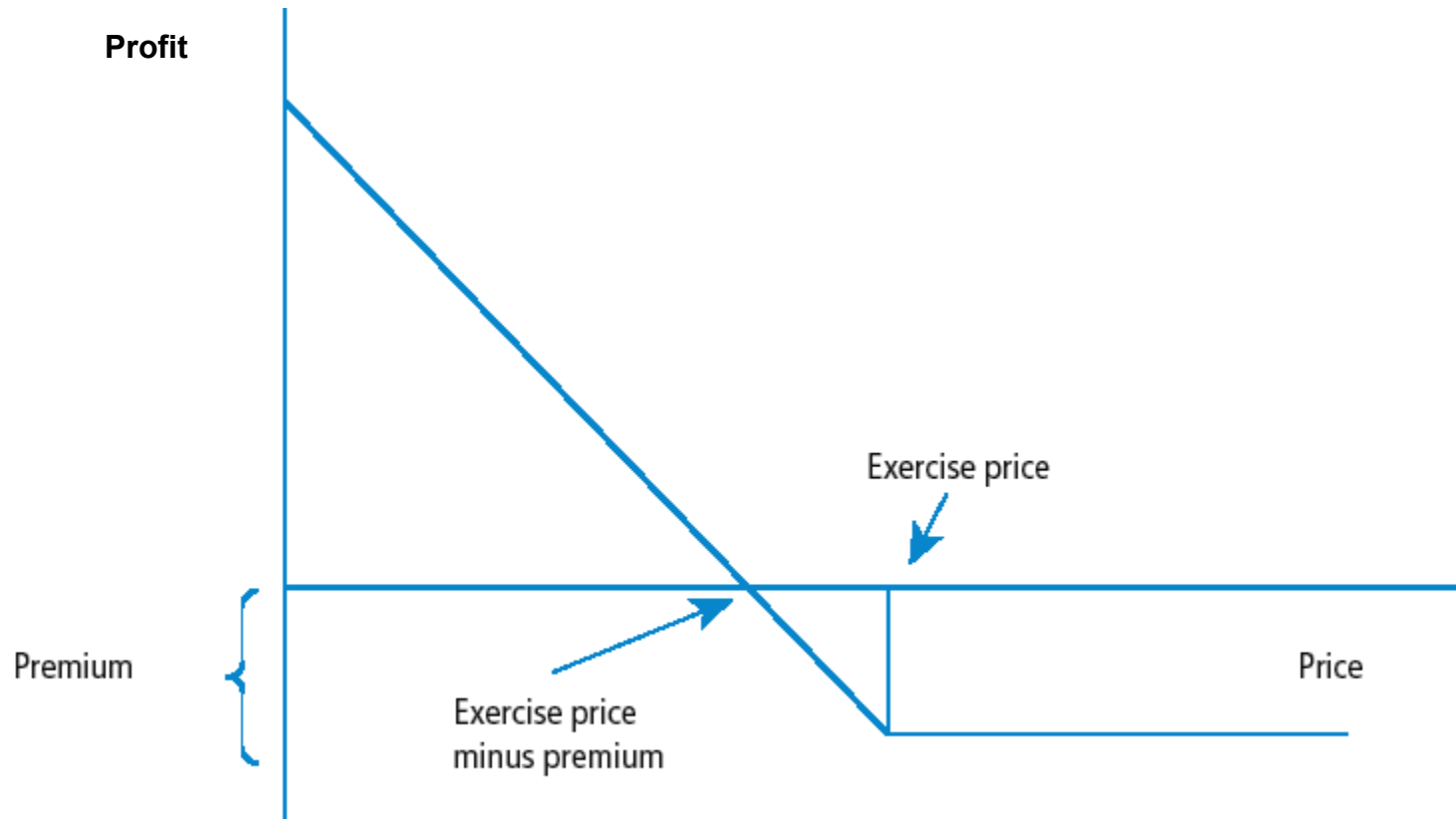FIGURE 14.2a

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Payoff Diagrams for Calls and Put Options

(B) Payoff for a short call

FIGURE 14.2b

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Payoff Diagrams for Calls and Put Options

Premium

Profit

Exercise price

Exercise price minus premium

Price

(C) Payoff for a long put

FIGURE 14.2c

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Payoff Diagrams for Calls and Put Options
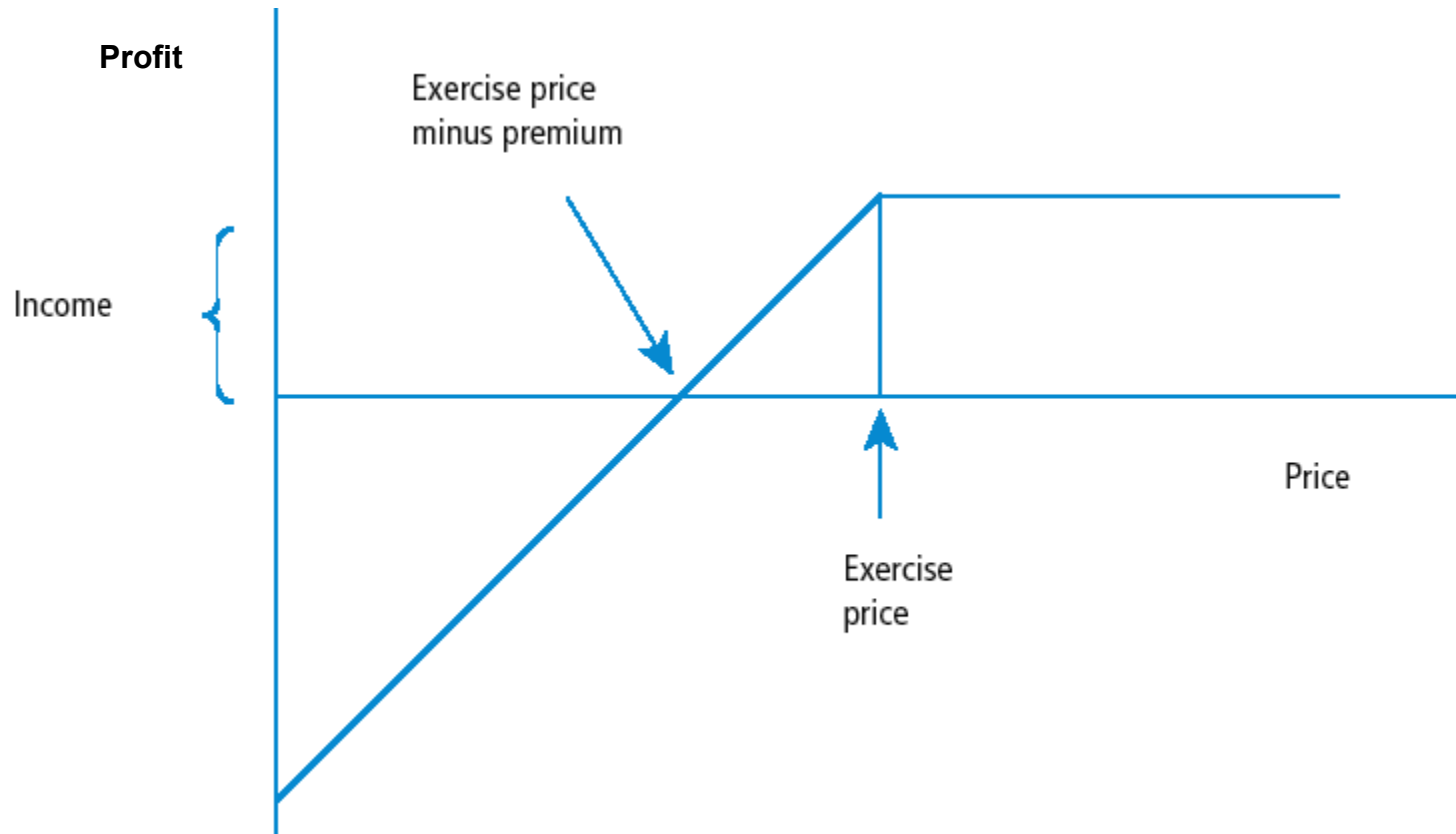
FIGURE 14.2d

Effects of Changing One Variable on the Price of an Option

Variable	Call	Put
Stock price	Positive	Negative
Exercise price	Negative	Positive
Time to expiration	Positive	Positive
Volatility	Positive	Positive
Risk-free rate	Positive	Negative

TABLE 14.2

Black-Scholes Model

- An option-pricing model of a European call option in which the value (C) depends on five factors:

  - ➤ S = The current price of the stock.

  - ➤ E = The exercise or strike price of the option.

  - ➤ T = The time until the option expires.

  - ➤ σ^2 = The volatility of the stock's returns.

  - ➤ r = The risk-free rate of interest.

Black-Scholes Model (cont'd)

$$C = S \times N(d_1) - E \times e^{-rT} \times N(d_2)$$

$$d_1 = \frac{\ln(S\,/\,E) + (r + 0.5\sigma^2) \times T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

Put Options

- Pricing a put option by applying the same concept of arbitrage as the Black-Scholes model.

  ➢ This relationship is known as put-call parity (p is the put value):

$$p = C - S + Ee^{-rT}$$

Option Pricing Example

The stock price six months from the expiration of an option is $21, the strike price is $20, the risk-free rate is 6% per annum, and the variance of the stock's returns is 20% per year.

$$d_1 = \frac{\ln(1.05) + (0.06 + 0.5 \times 0.2) \times 0.5}{\sqrt{0.2} \times \sqrt{0.5}} = 0.40727$$

$$d_2 = 0.40727 - 0.31623 = 0.09104$$

$$Ee^{-rT} = 20 \times e^{-0.03} = 19.4089$$

Option Pricing Example (cont'd)

European Call Value:

$$C = 21 \times N(0.40727) - 19.4089 \times N(0.09104)$$

$$= 21 \times 0.6591 - 19.4089 \times 0.5359$$

$$= 3.43987$$

Put Value:

$$P = 3.43987 - 21 + 19.4089 = 1.84877$$