

CHAPTER 11

DERIVATIVES

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LEARNING OUTCOMES

After completing this chapter, you should be able to do the following:

- a** Define a derivative contract;
- b** Describe uses of derivative contracts;
- c** Describe key terms of derivative contracts;
- d** Describe forwards and futures;
- e** Distinguish between forwards and futures;
- f** Describe options and their uses;
- g** Define swaps and their uses.

INTRODUCTION

1

When you plan a vacation, you do not usually wait until you get to your planned destination to book a room. Booking a hotel room in advance provides assurance that a room will be available and locks in the price. Your action reduces uncertainty (risk) for you. It also reduces uncertainty for the hotel. Now imagine that you are a wheat farmer and want to reduce some of the risk of farming. You might presell some of your crop at a fixed price. In fact, contracts to reduce the uncertainty of agricultural products have been traced back to the 16th century. These contracts on agricultural products may be the oldest form of what are known as derivatives contracts or, simply, derivatives.

Derivatives are contracts that *derive* their value from the performance of an underlying asset, event, or outcome—hence their name. Since the development of derivatives contracts to help reduce risk for farmers, the uses and types of derivatives contracts and the size of the derivatives market have increased significantly. Derivatives are no longer just about reducing risk, but form part of the investment strategies of many fund managers.

The size of the global derivatives market is now around \$800 trillion. To put this figure in context, the combined value of every exchange-listed company in the United States is around \$23 trillion.¹ Given their sheer volume, derivatives are very important to financial markets and the work of investment professionals.

USES OF DERIVATIVES CONTRACTS

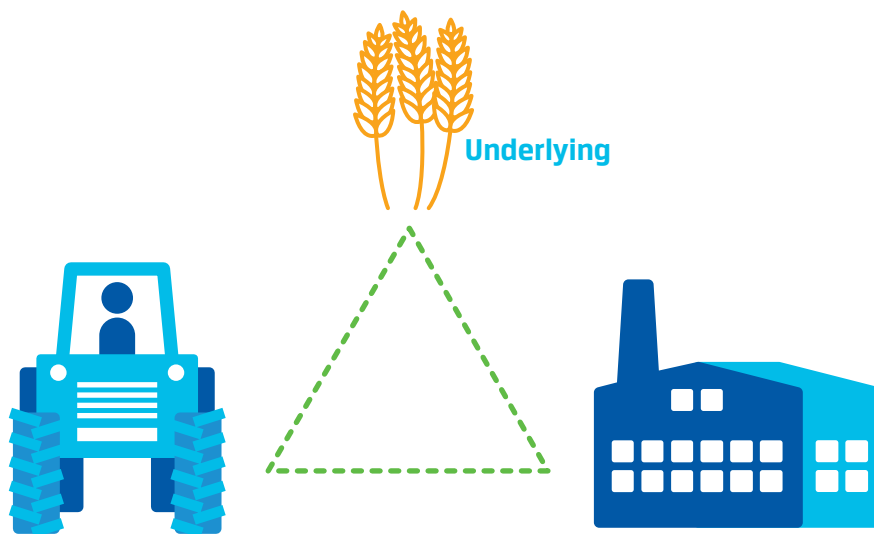
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Derivatives can be created on any asset, event, or outcome, which is called the **underlying**. The underlying can be a real asset, such as wheat or gold, or a financial asset, such as the share of a company. The underlying can also be a broad market index, such as the S&P 500 Index or the FTSE 100 Index. The underlying can be an outcome, such as a day with temperatures under or over a specified temperature (also known as heating and cooling days), or an event, such as bankruptcy. Derivatives can be used to manage risks associated with the underlying, but they may also result in increased risk exposure for the other party to the contract.

Let us continue the story of the wheat farmer. The farmer anticipates having at least 50,000 bushels of wheat available for sale in mid-September, six months from now. Wheat is currently trading in the market at \$9.00 per bushel, which is the spot price. The farmer has no way of knowing what the market price of wheat will be in six months. The farmer finds a cereal producer that needs wheat and is willing to contract to buy

¹ Information from “Centrally Cleared Derivatives: Clear and Present Danger,” *Economist* (4 April 2012).
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50,000 bushels of wheat at a price of \$8.50 per bushel in six months. The contract provides a **hedge** for both the farmer and the cereal producer. A hedge is an action that reduces uncertainty or risk.



But what if the farmer cannot find someone who actually needs the wheat? The farmer might still find a counterparty that is willing to enter into a contract to buy the wheat in the future at an agreed on price. This counterparty may anticipate being able to sell the wheat at a higher price in the market than the price agreed on with the farmer. This counterparty may be called a speculator. This counterparty is not hedging risk but is instead taking on risk in anticipation of earning a return. But there is no guarantee of a return. Even if the price in the market is lower than the price agreed on with the farmer, the counterparty has to buy the wheat at the agreed on price and then may have to sell it at a loss.

Derivatives allow companies and investors to manage future risks related to raw material prices, product prices, interest rates, exchange rates, and even uncontrollable factors, such as weather. They also allow investors to gain exposure to underlying assets while committing much less capital and incurring lower transaction costs than if they had invested directly in the assets.

3

KEY TERMS OF DERIVATIVES CONTRACTS

There are four main types of derivatives contracts: forward contracts (forwards), futures contracts (futures), option contracts (options), and swap contracts (swaps). Each of these will be discussed in the following sections. All derivatives contracts specify four key terms: the (1) underlying, (2) size and price, (3) expiration date, and (4) settlement.

3.1 Underlying

Derivatives are constructed based on an underlying, which is specified in the contract. Originally, all derivatives were based only on tangible assets, but now some contracts are based on outcomes. Examples of underlyings include the following:

- Agricultural products (such as wheat, rice, soybeans, cotton, butter, and milk)
- Livestock (such as hogs and cattle)
- Currencies
- Interest rates
- Individual shares and equity indices
- Bond indices
- Economic factors (such as the inflation rate)
- Natural resources (such as crude oil, natural gas, gold, silver, and timber)
- Weather-related outcomes (such as heating or cooling days)
- Other products (such as electricity or fertilisers)

A derivative's underlying must be clearly defined because quality can vary. For example, crude oil is classified by specific attributes, such as its American Petroleum Institute (API) gravity, specific gravity, and sulphur content; Brent crude oil, light sweet crude oil, and crude oil are different underlyings. Similarly, there is a difference between Black Sea Wheat, Soft Red Winter Wheat No. 1 and No.2, and KC Hard Red Winter Wheat No. 1 and No. 2.

3.2 Size and Price

The contract must also specify size and price. The size is the amount of the underlying to be exchanged. The price is what the underlying will be purchased or sold for under the terms of the contract. The price specified in the contract may be called the **exercise price** or the **strike price**. Note that the price specified in the contract is not the current or spot price for the underlying but a price that is good for future delivery.

3.3 Expiration Date

All derivatives have a finite life; each contract specifies a date on which the contract ends, called the expiration date.

3.4 Settlement

Settlement describes how a contract is satisfied at expiration. Some contracts require settlement by physical delivery of the underlying and other contracts allow for or even require cash settlement. If physical delivery to settle is possible, the contract will

specify delivery location(s). Contracts with underlying outcomes, such as heating or cooling days, cannot be settled through physical delivery and must be settled in cash. In practice, most derivatives contracts are settled in cash.

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FORWARDS AND FUTURES

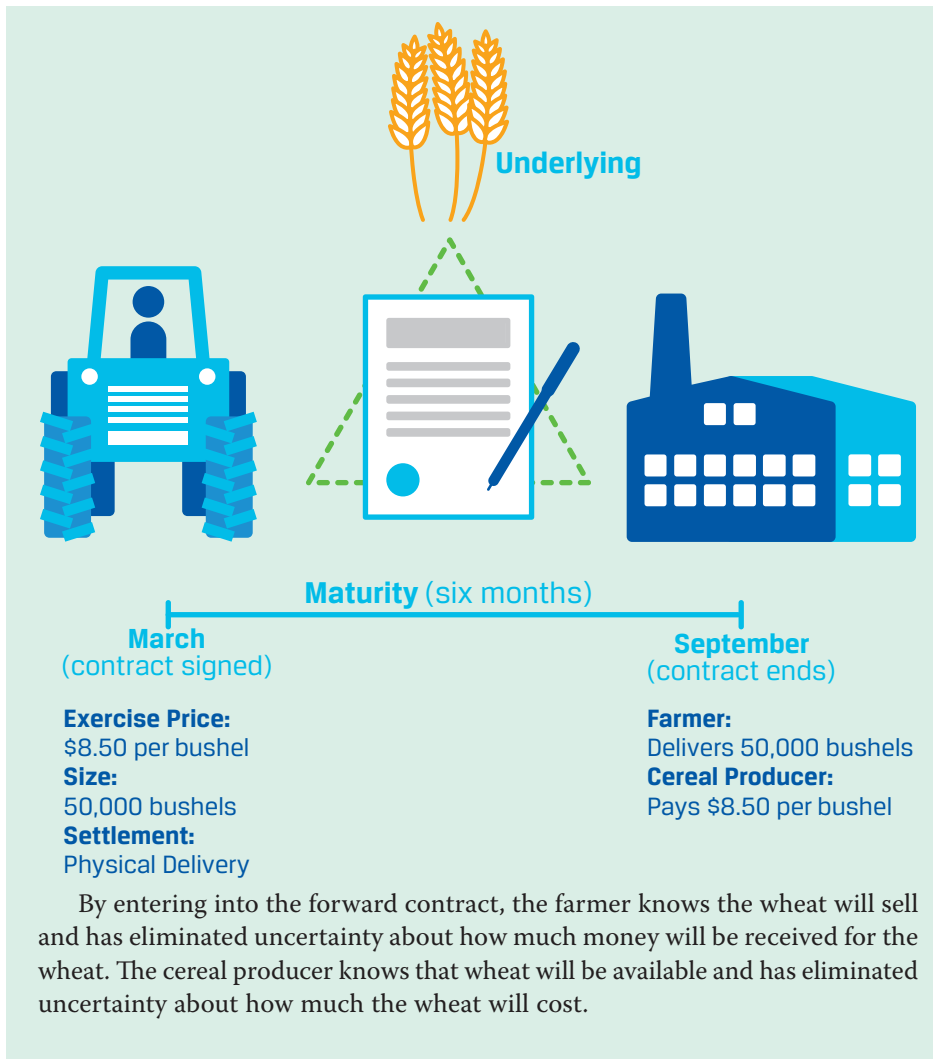
Forwards and futures involve obligations in the future on the part of both parties to the contract. Forward and futures contracts are sometimes termed forward commitments or bilateral contracts because both parties have a commitment in the future. Bilateral contracts expose each party to the risk that the other party will not fulfil the contractual agreement.

4.1 Forwards

A **forward contract** is an agreement between two parties in which one party agrees to buy from the seller an underlying at a later date for a price established at the start of the contract. The future date can be in one month, in one year, in five years, or at any other specified date. Investors primarily use forward contracts to lock in the price of an underlying and to gain certainty about future financial outcomes. Example 1 continues the story of the farmer and describes a forward contract between the farmer and a cereal producer.

EXAMPLE 1. FORWARD CONTRACT BETWEEN FARMER AND CEREAL PRODUCER

The contract between the farmer and cereal producer for 50,000 bushels of wheat in mid-September, six months from now, at \$8.50 per bushel is a forward contract. The underlying is wheat, the size is 50,000 bushels, the exercise price is \$8.50 per bushel, the expiration date is mid-September, and settlement will be with physical delivery. In September, the farmer will deliver the wheat to the cereal producer and receive \$8.50 per bushel.



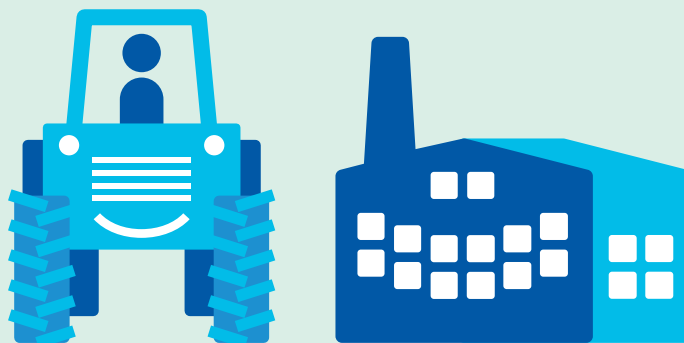
Forward contracts transact in the over-the-counter market—that is, the agreement is made directly between two parties, a buyer and a seller—although a dealer may help arrange the agreement.² The risk that the other party to the contract will not fulfil its contractual obligations is called **counterparty risk**. To reduce counterparty risk, the parties to a forward contract evaluate the default risk of the other party before entering into a contract. If the risk of default is significant, the parties may not agree to a forward contract. Or one or both parties may require a **performance bond**. A performance bond is a guarantee, usually provided by a third party, such as an insurance company, to ensure payment in case a party fails to fulfil its contractual obligations (defaults). As an alternative to a performance bond, collateral may be requested. Collateral refers to pledged assets. That is, if one party cannot fulfil its contractual obligations, the other party can keep the collateral as compensation.

² Over-the-counter markets are also called quote-driven markets and dealer markets. They are called over-the-counter markets because in the past, securities literally traded over a counter in a dealer's office. Traders call them quote-driven and dealer markets because customers trade at the prices quoted by dealers. More information about dealer markets, quote-driven markets, and dealers is provided in The Functioning of Financial Markets chapter.

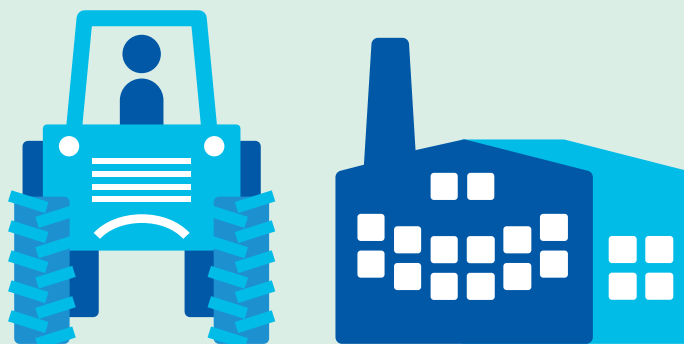
No payment on the contract is required by either party prior to delivery. At expiration, forward contracts usually settle with physical delivery. At settlement, one party will lose and the other party will gain relative to the spot price at the expiration date—this price variance also serves to increase counterparty risk. Example 2 uses the forward contract between the farmer and the cereal producer to illustrate how one party's gains on a forward contract are the other party's losses.

EXAMPLE 2. GAINS AND LOSSES ON A FORWARD CONTRACT

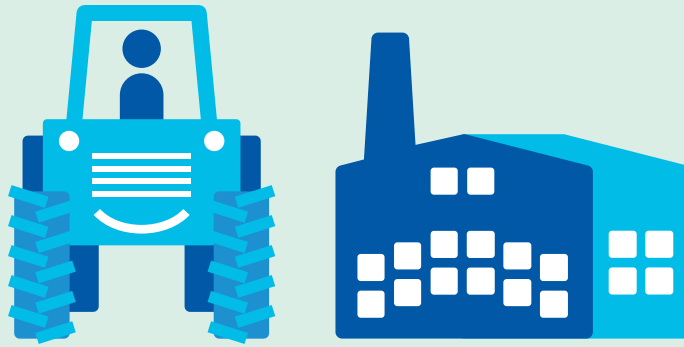
If at expiration of the forward contract, the price in the market for a bushel of wheat is \$8.50 per bushel, neither the farmer nor the cereal producer would be better off transacting in the spot market, but neither lost anything.



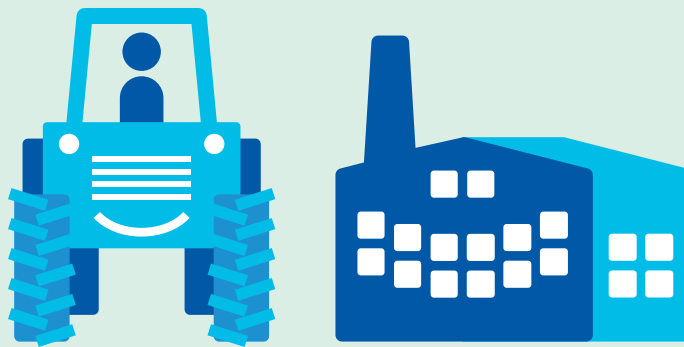
But if at expiration of the forward contract, the price in the market for a bushel of wheat is \$9.00 per bushel, the farmer loses \$0.50 per bushel relative to the spot price. In other words, the farmer could have sold the wheat for \$9.00 per bushel rather than the \$8.50 per bushel agreed on in the forward contract. The cereal producer gains \$0.50 per bushel relative to the spot price because the producer only pays \$8.50 per bushel rather than the \$9.00 spot price.



Similarly, if at expiration of the forward contract the price in the market for a bushel of wheat is \$8.00 per bushel, the farmer gains and the cereal producer loses \$0.50 per bushel relative to the spot price.



Given the possibility of losing money relative to the future spot price, why do the farmer and cereal producer enter into the forward contract? Because each is more concerned about eliminating the uncertainty related to the sale price and purchase price of wheat in six months, which is valuable in making investment and production decisions. This certainty is more important to them than winning or losing relative to the future spot price.



4.2 Futures

What if the farmer could not identify a party that wanted to be on the other side of the contract? Futures markets may provide the solution. A **futures contract** is similar to a forward contract in that it is an agreement that obligates the seller, at a specified future date, to deliver to the buyer a specified underlying in exchange for the specified futures price. The buyer of the contract is obligated to take delivery of the underlying, and the seller of the contract is obligated to deliver the underlying, although settlement may be with cash. The main difference is that futures contracts are standardised contracts that trade on exchanges. The buyers and sellers do not necessarily know who is on the other side of the contract. Because the contracts are traded on exchanges, they are liquid and it is possible for a buyer or seller to close out a position by taking the opposite side. In other words, the buyer of a contract can sell the same contract and the seller of a contract can buy the same contract.

The presence of an exchange as an intermediary between buyers and sellers helps reduce counterparty risk. Counterparty risk cannot be eliminated completely, however, because there is always a remote chance that the exchange fails to fulfil its own contractual obligations. To protect itself against one of the parties defaulting, the exchange typically requires that parties to the contract deposit funds as collateral. The depositing of funds as collateral is called posting margin.

The amount deposited on the day that the transaction occurs is called the **initial margin**. The initial margin should be sufficient to protect the exchange against movements in the underlying's price. The exchange sets the margin amount depending on the underlying's price volatility—the greater the underlying's price volatility, the higher the margin.

Another way of reducing the counterparty risk for futures contracts is by **marking to market** daily. Marking to market means that profits or losses on futures contracts are settled at the end of every business day, which has the effect of resetting the contract price and cash flows to buyers and sellers. At the end of each day, the exchange establishes a settlement price based on the closing trades and determines the difference between the current settlement price and the previous day's settlement price. The buyer's and seller's margin accounts are adjusted to reflect the change in settlement price and whether it was to their advantage or disadvantage. Marking to market continues until the contract expires.

If at any time the balance in an account falls below a pre-specified amount, the exchange will ask the customer to submit additional funds. If the customer does not do so, the futures position is closed. Daily marking to market reduces counterparty risk and administrative overhead for the exchange. The result is enhanced trading, increased liquidity, and reduced transaction costs on futures contracts.

Standardised terms of futures contracts include the underlying; size, price, and expiration date of the contract; and settlement. A number of different standardised contracts may trade for an underlying on an exchange, but standardisation of futures contracts reduces the number of contract types available for the same underlying. Typically, each of the contracts is the same with respect not only to the underlying but also to size and settlement. Exercise price and expiration date may vary among contracts.

Specifying the underlying in a futures contract includes defining the quality of the asset so that the buyer and seller have little room for confusion regarding pricing and physical delivery. Certain deviations from the default quality standards are permitted with adjustments in price. In addition, the contract specifies the delivery locations and the period within which delivery must be made. The size of a futures contract is set by the exchange to ensure a tradable quantity of adequate value.

The other terms may vary across the different contracts. Futures typically expire every quarter, usually on the third Wednesday of March, June, September, and December. In addition, many end-of-month futures are available. Standardised contracts may exist that only differ on the specified price. A contract's net initial value to each party should be zero; cash may be paid by one of the parties to enter into the contract depending on how the exercise price compares with the current settlement price.

Example 3 describes futures contracts on wheat along with actions of and cash flows for the farmer and cereal producer. The cash flows include those in the marking-to-market process. For simplicity, the price of wheat changes only twice over the life of the contract and at expiration. In reality, the price is likely to change daily, with resulting changes to the accounts of the farmer and cereal producer.

EXAMPLE 3. FUTURES CONTRACTS ON WHEAT

Futures contracts trade on a number of exchanges globally, including the Chicago Mercantile Exchange. The standard terms of a futures contract on wheat on the Chicago Mercantile Exchange include the following:

- *Underlying*: #2 Soft Red Winter at contract price, #1 Soft Red Winter at a 3 cent premium, other deliverable grades listed in Rule 14104.
- *Size*: 5,000 bushels (approximately 136 metric tons)
- *Settlement*: cash settlement
- *Pricing unit*: cents per unit
- *Expiration*: March (H), May (K), July (N), September (U), and December (Z)

The farmer and the cereal producer find contracts that expire in September with exercise prices ranging from 550.0 cents to 1100.00 cents. The farmer decides to sell 10 contracts with an exercise price of 850.0 cents. This means the farmer has a contract for the delivery of 50,000 bushels of wheat or their cash settlement equivalent. The cereal producer decides to buy 10 contracts with an exercise price of 850.0 cents.

The farmer and the cereal producer do not transact directly with each other, but through an exchange. The current spot price of wheat is 900.0 cents per bushel. Because a contract's net initial value to each party should be zero, the farmer has to give the exchange 50.0 cents per bushel and the exchange puts 50.0 cents into the cereal producer's account. The effective receipt to the farmer and cost to the cereal producer is 850.0 cents per bushel if the contract expires today. In addition, each is required to deposit an additional amount as collateral with the exchange to protect the exchange, which takes on the counterparty risk to the contract.

The price of wheat remains unchanged for two months and then changes to 875.0 cents per bushel, a decrease of 25.0 cents from the initial spot price of 900.0 cents. The farmer's account is increased by 25.0 cents per bushel and the cereal producer's account is reduced by 25.0 cents per bushel. After another two months, the price per bushel increases to 925.0 cents per bushel, an increase of 50.0 cents from the previous spot price of 875.0 cents. So, the farmer's account is reduced by 50.0 cents per bushel and the cereal producer's account is increased by 50.0 cents per bushel.

At expiration, the price per bushel is 910.0 cents per bushel, a decrease in price of 15.0 cents from the previous spot price of 925.0 cents. The farmer's account is increased by 15.0 cents per bushel and the cereal producer's account is reduced by 15.0 cents per bushel. The farmer has settled over time by paying in net 60 cents ($= -50.0 + 25.0 - 50.0 + 15.0$). The cereal producer has received over time net 60 cents. Each will receive back the additional amount deposited to protect the exchange.

The farmer and the cereal producer are each in the same position as they would have been under the forward contract. The farmer can sell the wheat in the spot market for 910.0 cents per bushel and paid 60 cents per bushel to settle the futures contract. The farmer has a net receipt of 850.0 cents per bushel. Similarly, the cereal producer can buy the wheat in the spot market for 910.0 cents per bushel and received 60 cents per bushel to settle the futures contract. So, the cereal producer has a net cost of 850.0 cents per bushel.

4.3 Distinctions between Forwards and Futures

Forwards and futures differ in how they trade, the flexibility of key terms in the contract, liquidity, counterparty risk, transaction costs, timing of cash flows, and settlement.

Trading and Flexibility of Terms. Forward contracts transact in the over-the-counter market and terms are customised according to the contracting parties' needs. Futures contracts trade on exchanges. Each exchange typically sets the terms of the contracts that trade on it. Futures contracts are standardised regardless of buyers' and sellers' specific needs. As a result, the expiration date or contract size may not match that desired by the buyer or seller of the futures contract.

For hedgers that are trying to reduce or eliminate risk, standardisation makes it difficult to precisely hedge a position. For non-hedging investors who are entering into contracts expecting compensation for taking the opposite side of a hedge or who are taking a position based on expectations about future performance of an underlying, standardisation of the contracts is not problematic.

Liquidity. Forward contracts trade in the over-the-counter market and are illiquid. Futures contracts are relatively liquid; they trade on exchanges and can be bought and sold at times other than initiation. An investor can close out (cancel) a position using futures contracts relatively easily.

Counterparty Risk. Counterparty risk is potentially very high in forward contracts. That is, the risk that one party may be unwilling or unable to fulfil its contractual obligations. Futures contracts have lower counterparty risk. The presence of an exchange or a clearing house as the intermediary for all buyers and all sellers helps reduce counterparty risk. Counterparty risk cannot be eliminated completely, however, because there is always a remote chance that the exchange fails to fulfil its own contractual obligations.

Transaction Costs. There can be significant costs to arrange a forward contract. Transaction costs usually are embedded in forward contracts and are not easily visible to the customer. Futures contracts, however, are traded on exchanges through brokerage firms or brokers (agents authorised to trade directly with the exchange), and the transaction costs are visible. So, there is more transparency in the futures markets. A broker typically earns the difference between the bid and ask prices as a commission to arrange the trade.³ Because futures contracts are standardised, transaction costs are relatively low.

³ Recall from the Economics of International Trade chapter that the bid price is the price at which a dealer is prepared to buy, and the ask (or offer) price is the price at which a dealer is prepared to sell.

Timing of Cash Flows. Forward contracts have no cash flows except at maturity. Futures contracts are marked to market daily. It is important to note that if forward and futures contracts with identical terms are held to maturity, the final outcome is the same. For a forward contract, the entire effect of changing prices is taken into account at maturity, whereas for a futures contract, the effect of changing prices is taken into account on an ongoing basis.

Settlement. Forward contracts may settle with physical delivery or cash settlement. Futures contracts are typically settled with cash.

Exhibit 1 provides a comparison of forward and futures contracts.

Exhibit 1 Comparison of Forward and Futures Contracts	
Similarities	Differences
<ul style="list-style-type: none">■ Both types of contracts exist on a wide range of underlyings, including shares, bonds, agricultural products, and precious and industrial metals, among others.■ For both types of contracts, both the buyer and seller have obligations.■ Both types of contracts allow locking in a price today for a transaction that will occur in the future.	<ul style="list-style-type: none">■ Forwards are customised contracts that trade in private over-the-counter markets, whereas futures are standardised contracts that trade on exchanges.■ Counterparty risk is high with forward contracts, but limited with futures contracts. Requirements imposed by exchanges, such as initial and maintenance margins and daily marking to market, reduce the counterparty risk associated with futures contracts.■ It is easier to exit a position prior to the settlement date with a futures contract than with a forward contract. A position in a futures contract can be settled (closed) by taking an opposite position in the same contract.

OPTION CONTRACTS

5

What if the farmer does not want to lock in the price because the farmer thinks the price of wheat is going to increase? But the farmer does want to make sure that at least a certain amount is received for the wheat. Similarly, the cereal producer thinks that the price of wheat is going to decrease, but wants to make sure that no more than a certain amount is paid. Option markets may provide the solution for both parties.

Options give one party (the buyer) to the contract the right to demand an action from the other party (the seller) in the future. In an **option contract**, the buyer of the option has the right, but not the obligation, to buy or sell the underlying. Options are termed

unilateral contracts because only one party to the contract (the seller) has a future commitment that, if broken, represents a breach of contract. Unilateral contracts expose only the buyer to the risk that the seller will not fulfil the contractual agreement.

The buyer of the contract will exercise the right or option if conditions are favourable or if specified conditions are met. For this reason, options are also known as contingent claims—that is, claims are dependant on future conditions. If the buyer decides to use (exercise) the option, the seller is obligated to satisfy the option buyer's claim. If the buyer decides not to exercise the option, it expires without any action by the seller.

Options may trade in the over-the-counter market, but they trade predominantly on exchanges. In this chapter, we focus on options traded on exchanges. Options in the over-the-counter market are similar, except that they are customisable.

An option contract specifies the underlying, the size, the price to trade the underlying in the future (called the **exercise price** or **strike price**), and the expiration date. Option contracts typically expire in March, June, September, or December, but options are available for other months as well.

A buyer chooses whether to exercise an option based on the underlying's price compared with the exercise price. A buyer will exercise the option only when doing so is advantageous compared with trading in the market, which puts the seller at a disadvantage. Because of the unilateral future obligation (only the seller has an obligation), options have positive value for the buyer at the inception of the contract. The option buyer pays this value, or **option premium**, to the option seller at the time of the initial contract. The premium paid by the option buyer compensates the option seller for the risk taken; the option seller is the only party with a future obligation. The maximum benefit to the option seller is the premium. The option seller hopes the option will not be exercised.

5.1 Call Options and Put Options

There are two basic types of options: options to buy the underlying, known as call options, and options to sell the underlying, known as put options.

- An investor who buys a **call option** has the right (but not the obligation) to buy or call the underlying from the option seller at the exercise price until the option expires.
- An investor who buys a **put option** has the right (but not the obligation) to sell or put the underlying to the option seller at the exercise price until expiration.

The cereal producer may buy a call option to secure the right, but not the obligation, to buy wheat at the exercise price. The farmer may buy a put option to secure the right, but not the obligation, to sell wheat at the exercise price. Note that the cereal producer and farmer enter into totally different option contracts to manage their risks.

Example 4 describes how a call option works in practice.

EXAMPLE 4. ILLUSTRATION OF A CALL OPTION

Consider a call option in which the underlying is 1,000 shares of hypothetical Company A trading on the London Stock Exchange (LSE).⁴ The call option's exercise price is £6.00 per share, which means that the call option buyer can buy 1,000 shares of Company A at £6.00 per share until expiration, regardless of Company A's share price in the market. Note that the buyer will exercise this option only if Company A's price on the LSE is more than £6.00 per share. If Company A's share price at expiration is £7.00 per share, the buyer exercises the option, pays £6,000, and receives 1,000 shares of Company A. The call option buyer can then sell those shares in the market for a profit of £1,000 (ignoring transaction costs, such as the premium paid for the call option and trading costs). The seller of the call option is obligated to sell the shares at £6.00 per share to the call option buyer, even though the market price is £7.00 per share, incurring a loss of £1,000 (ignoring the premium received for the call option).

If Company A's share price is less than £6.00 per share, the call option buyer has no incentive to exercise the option; it would not make sense to voluntarily pay more than the market price. In this case, the buyer will let the option expire. Because an option buyer is not forced to exercise an option, an option's value cannot be negative.

Example 4 illustrates that, ignoring the premium paid, an option buyer's payoff is never negative. Option buyers pay premiums to option sellers to compensate option sellers for their risk. But if an option seller underestimates the risk associated with the option, the premiums paid may be far less than the losses they incur on exercise.

Call options protect the buyer by establishing a maximum price the option buyer will have to pay to buy the underlying; the maximum price is the exercise price.

- A call option is said to be “in the money” if the market price is greater than the exercise price. In this case, the option would be exercised.
- A call option is “out of the money” if the market price is less than the exercise price. In this case, the option would not be exercised.
- A call option is “at the money” if the market price and exercise price are the same. In this case, the option may be exercised.

Put options protect the buyer by establishing a minimum price the option buyer will receive when selling the underlying; the minimum price is the exercise price.

- A put option is said to be “in the money” if the market price is less than the exercise price. In this case, the option would be exercised.

⁴ The number of shares associated with an option varies with the exchange.

- A put option is “out of the money” if the market price is greater than the exercise price. In this case, the option would not be exercised.
- A put option is “at the money” if the market price and exercise price are the same. In this case, the option may be exercised.

An option’s in- or out-of-the-money designation, also known as “moneyness”, reflects whether it would be profitable for the buyer to exercise the option at the current time.

5.2 Factors that Affect Option Premiums

Option premiums are expected to compensate option sellers for their risk. The option premium represents the maximum profit that the option seller can make. If an option seller underestimates the risk associated with the option, the premiums may be far less than the losses incurred if the option is exercised.

The lower the exercise price for a call option relative to the current spot price, the higher the premium because the likelihood that it will be exercised is greater. The higher the exercise price for a put option relative to the current spot price, the higher the premium because the likelihood that it will be exercised is greater.

The longer the time to expiration of an option, the higher the option premium because the likelihood is greater that the underlying will change in favour of the option buyer and that it will be exercised. Similarly, the greater the volatility of the underlying, the higher the option premium because the likelihood is greater that the underlying will change in favour of the option buyer and that it will be exercised.

In summary, an option’s premium depends on the current spot price of the underlying, exercise price, time to expiration, and volatility of the underlying. Exhibit 2 shows the effects on an option’s premium for a call option and a put option of an increase in each factor.

Exhibit 2 Effects on Premiums for a Call Option and a Put Option of an Increase in a Factor

Factor Increasing	Call Option Premium	Put Option Premium
Underlying’s price	Increases	Decreases
Exercise price	Decreases	Increases
Time to expiration	Increases	Increases
Underlying’s volatility	Increases	Increases

SWAP CONTRACTS

6

Swaps are typically derivatives in which two parties exchange (swap) cash flows or other financial instruments over multiple periods (months or years) for mutual benefit, usually to manage risk.

Swaps of this type involve obligations in the future on the part of both parties to the contract. These swaps, like forwards and futures, are forward commitments or bilateral contracts because both parties have a commitment in the future. Similar to forwards and futures, a contract's net initial value to each party should be zero and as one side of the swap contract gains the other side loses by the same amount.

Swaps in which two parties exchange cash flows include interest rate and currency swaps. An **interest rate swap**, the most common type, allows companies to swap their interest rate obligations (usually a fixed rate for a floating rate) to manage interest rate risk, to better match their streams of cash inflows and outflows, or to lower their borrowing costs. A **currency swap** enables borrowers to exchange debt service obligations denominated in one currency for equivalent debt service obligations denominated in another currency. By swapping future cash flow obligations, the two parties can manage currency risk.

As an example of a currency swap, Company C, a US firm, wants to do business in Europe. At the same time, Company D, a European firm, wants to do business in the United States. The US firm needs euros and the European firm needs dollars, so the companies enter into a five-year currency swap for \$50 million. Assume that the exchange rate is \$1.25 per euro. On this basis, Company C pays Company D \$50 million, and Company D pays €40 million to Company C. Now each company has funds denominated in the other currency (which is the reason for the swap). The two companies then exchange monthly, quarterly, or annual interest payments. Finally, at the end of the five-year swap, the parties re-exchange the original principal amounts and the contract ends.

Credit default swaps (CDS) are not truly swaps. Like options, credit default swaps are contingent claims and unilateral contracts. One party buys a CDS to protect itself against a loss of value in a debt security or index of debt securities; the loss of value is primarily the result of a change in credit risk. The seller is providing protection to the buyer against declines in value of the underlying. The seller does this in exchange for a premium payment from the buyer; the premium compensates the seller for the risk of the contract. The contract will specify under what conditions the seller has to make payment to the buyer of the CDS. Similar to sellers of options, sellers of CDS may misjudge the risk associated with the contracts and incur losses far in excess of payments received to enter into the contracts.

The use of swaps has grown because they allow investors to manage many kinds of risks, including interest rate risk, currency risk, and credit default risk. In addition, investors can use swaps to reduce borrowing and transaction costs, overcome currency exchange barriers, and manage exposure to underlying assets.

SUMMARY

Derivatives have grown remarkably since their introduction because they help to provide innovative investment products and to manage risk at a considerably lower cost. For example, by using options, investors can gain exposure to stock or bond markets with a fraction of the capital needed to invest directly in stocks or bonds. Also, the transaction costs of trading derivatives are considerably smaller compared with direct investments. Derivatives thus can effectively substitute for direct investments in underlying assets.

Derivatives also provide ways to manage future risk. For example, an airline company cannot hedge the risk of volatile jet fuel prices in a cost-effective manner except through derivatives. Theoretically, it is possible to buy and store millions of gallons of jet fuel for next year's operations. But the capital investment and storage costs required for such an undertaking would be formidable. In addition to hedging the risk of movements in raw material prices, derivatives can be used to hedge other kinds of risk, including currency risk, product price risk, and economic risk.

Finally, exchange-traded derivatives improve financial market efficiency. They help market prices become better indicators of value, which improves resource allocation, an important benefit provided by the financial services industry and discussed in *The Investment Industry: A Top-Down View* chapter. For example, if a particular share is undervalued in the stock market relative to the futures market, an investor can buy it in the stock market and sell the related futures contract. Futures and spot market prices will adjust and become better indicators of value.

The following points recap what you have learned in this chapter about derivatives:

- Derivatives are contracts (agreements to do something in the future) that derive their value from the performance of an underlying asset, event, or outcome.
- Derivatives are used to manage risks of various types, to earn compensation for taking the opposite side of a hedge, and to potentially benefit an investor based on expectations about the future performance of an underlying.
- There are four main types of derivatives contracts: forwards, futures, options, and swaps.
- Derivatives are characterised by certain common features, including the (1) underlying, (2) maturity, (3) size and price, and (4) settlement.
- Forwards, futures, and most swaps involve obligations in the future on the part of both parties to the contract. These contracts are sometimes termed forward commitments or bilateral contracts because both parties have a commitment in the future.
- Options and credit default swaps are unilateral contracts and provide contingent claims. They give one party to the contract the right to extract an action from the other party under specified conditions.
- Forwards and futures are similar; both represent an agreement to buy or sell a specified underlying at a specified date in the future for a specified price.

- Forwards are customised and trade in the over-the-counter market, whereas futures are standardised and trade on exchanges. Futures are more liquid and have less counterparty risk.
- Options give the option buyer the right, but not the obligation, to buy (in the case of a call option) or sell (in the case of a put option) a specified amount of the underlying at a prespecified price (exercise price) until the option expires.
- A call option ensures that the option buyer will pay, ignoring transaction costs, no more than the exercise price. A put option ensures that the option buyer will receive, ignoring transaction costs, no less than the exercise price.
- The option seller is paid a premium for providing the option. The premium is the maximum benefit to the option seller. An option's premium depends on spot and exercise prices for the underlying, the time to expiration, and volatility of the underlying. The effect of an increase in each on an option premium is shown in the following table.

Factor Increasing	Call Option Premium	Put Option Premium
Underlying's price	Increases	Decreases
Exercise price	Decreases	Increases
Time to expiration	Increases	Increases
Underlying's volatility	Increases	Increases

- Swaps are typically derivatives in which two parties exchange (swap) cash flows or other financial instruments over multiple periods (months or years) for mutual benefit, usually to manage risk.
- Interest rate swaps, the most common type, allow companies to swap their interest rate obligations to manage interest rate risk, to better match their streams of cash inflows and outflows, or to lower their borrowing costs.
- A currency swap enables borrowers to exchange debt service obligations denominated in one currency for equivalent debt service obligations denominated in another currency. By swapping future cash flow obligations, the two parties can manage currency risk.
- A credit default swap (CDS) is a contingent claim and unilateral contract. One party buys a CDS to protect itself against the loss of value in a debt security or index of debt securities. The contract will specify under what conditions the other party has to make payment to the buyer of the credit default swap.

CHAPTER REVIEW QUESTIONS

- 1 The value of a derivatives contract is *most likely* to be directly affected by the:
 - A price of the underlying.
 - B supply of the underlying.
 - C demand for the underlying.
- 2 Counterparty risk is *most likely* lowest for:
 - A swap contracts.
 - B futures contracts.
 - C forward contracts.
- 3 A farmer will harvest his corn crop in six months but wants to lock in a price today. The farmer will *most likely*:
 - A buy a corn futures contract.
 - B sell a corn futures contract.
 - C buy a corn forward contract.
- 4 Forward contracts and futures contracts, with otherwise identical terms, are similar with respect to:
 - A counterparty risk.
 - B payoffs at maturity.
 - C customisation of contracts.
- 5 Relative to a futures contract, an advantage of a forward contract is:
 - A greater liquidity.
 - B lower counterparty risk.
 - C the ability to customise the contract.
- 6 Which of the following parties to an option contract on a company's shares has the right to buy shares at the exercise price?
 - A Put seller
 - B Call seller
 - C Call buyer

- 7 Which of the following parties to an option contract on a company's shares is obligated to buy shares at the option strike price if the option is exercised?
- A Put seller
 - B Put buyer
 - C Call seller
- 8 Which of the following options would be described as being in the money?
- A A put option in which the underlying's price is lower than the exercise price.
 - B A call option in which the underlying's price is lower than the exercise price.
 - C A put option in which the underlying's price is higher than the exercise price.
- 9 A call option contract on shares of Company A has an exercise price of €50. The option is in the money when the share price of Company A is:
- A €45.
 - B €50.
 - C €55.
- 10 A put option on shares of Company B has an exercise price of £40. The option is out of the money when the share price of Company B is:
- A £35.
 - B £40.
 - C £45.
- 11 Swap contracts:
- A are mostly traded on exchanges.
 - B have an initial net value of zero.
 - C are not susceptible to counterparty risk.

ANSWERS

- 1 A is correct. Derivatives are contracts that derive their value from the performance, such as price, of an underlying. B and C are incorrect because although the supply of and demand for the underlying will affect the price of the underlying, they will indirectly rather than directly affect the value of the derivatives.
- 2 B is correct. Futures contracts are exchange traded. Margin requirements and daily marking to market reduce counterparty risk for investors in futures contracts. A and C are incorrect because forward contracts and swap contracts are traded in private, over-the-counter markets. Consequently, counterparty risk is higher in forward contracts and swap contracts than in futures contracts.
- 3 B is correct. The seller of a forward or futures contract is obligated to make delivery of the underlying. By selling a corn futures contract, the farmer is agreeing to sell corn in six months at the contract price locked in today. A and C are incorrect because buying (taking a long position in) a corn futures contract or a corn forward contract, respectively, would require the farmer to buy, not sell, corn in the future, which is not the farmer's objective.
- 4 B is correct. If a forward contract and a futures contract with identical terms are held to maturity, the final outcome is the same. For a forward contract, the entire effect of changing prices is taken into account at maturity, whereas for a futures contract, the effect of changing prices is taken into account on an ongoing basis. A is incorrect because counterparty risk is much higher for investors in forward contracts. C is incorrect because forward contracts are customised contracts, whereas futures contracts are standardised contracts.
- 5 C is correct. An advantage of forward contracts is the ability of the investor to create customised contracts that meet his or her needs. Futures contracts are standardised contracts with contract terms established by the exchange and are not customisable. A is incorrect because futures contracts have greater liquidity. It is easier to exit a position prior to the settlement date with futures than with forwards. B is incorrect because futures contracts have lower counterparty risk.
- 6 C is correct. The buyer of a call option has the *right to buy* shares at the exercise price. A is incorrect because the seller of a put option has an *obligation to buy* shares at the exercise price. B is incorrect because the seller of a call option has an *obligation to sell* shares at the exercise price if the call buyer exercises the option.
- 7 A is correct. The seller of a put option has an *obligation to buy* shares at the strike or exercise price if the put buyer exercises the option. B is incorrect because a put buyer has the *right to sell* shares at the exercise price. C is incorrect because a call seller has an *obligation to sell* shares at the exercise price if the call buyer exercises the option.
- 8 A is correct. A put option is in the money when the underlying's price is lower than the exercise price. The put buyer has the right to sell the underlying at the exercise price, which is higher than the current market price of the underlying. B is incorrect because a call option in which the underlying's price is lower

than the exercise price is out of the money. C is incorrect because a put option in which the underlying's price is higher than the exercise price is out of the money.

- 9** C is correct. A call option is in the money when the underlying's price exceeds the exercise price. A is incorrect because the call option is out of the money when the underlying's price is less than the exercise price. B is incorrect because the call option is at the money when the underlying's price equals the exercise price.
- 10** C is correct. A put option contract is out of the money when the underlying's price is higher than the exercise price. A is incorrect because the put option contract is in the money when the underlying's price is less than the exercise price. B is incorrect because the put option contract is at the money when the underlying's price equals the exercise price.
- 11** B is correct. The initial net value of a swap contract is zero. Over time, the swap changes in value as the underlying changes in value. One side of the swap contract loses while the other side gains. A and C are incorrect because swap contracts mostly trade in private, over-the-counter (OTC) markets and not on exchanges; consequently, the parties to swap contracts are susceptible to counterparty risk.