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## Chapter 12

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### Financial Derivatives

#### CHAPTER OBJECTIVES

By the end of this chapter, students should be able to:

1. Define financial derivative and explain the economic functions that financial derivatives fulfill.
2. Define and describe the four major types of derivatives: forwards, futures, options, and swaps.
3. Explain the economic functions of hedging and speculating.

## 12.1 Derivatives and Their Functions

### LEARNING OBJECTIVE

1. What are financial derivatives and what economic needs do they fulfill?

Financial derivatives are special types of **financial instruments**<sup>1</sup>, the prices of which are ultimately *derived from* the price or performance of some underlying **asset**<sup>2</sup>. Investors use derivatives to hedge (*decrease return volatility*<sup>3</sup>) or to speculate (*increase the volatility of returns*).

Although often derided in the press and movies, *derivatives are inherently neither good nor bad, they are merely tools used to limit losses (hedge) or to multiply gains and losses (speculate)*. Speculation has a bad rep but in fact it makes hedging possible because *investors can hedge only if they can find a speculator willing to assume the risks that they wish to eschew*.

Ultimately, the prices of derivatives are a function of supply and demand, both of which are subject to valuation models too mathematically complex to address here. The basic forms and functions of the four main types of derivatives—forwards, futures, options, and swaps—are easily narrated and understood, however, and form the basis of this chapter.

1. Contracts for the payment of money or other assets.
2. A thing owned.
3. The statistical dispersion of financial returns on an investment.

### Stop and Think Box

If you could, would you receive a guaranteed grade of B for this course? Or would you rather have a chance of receiving an A even if that meant that you might fail the course?

If you take the guaranteed B, you are hedging or reducing your return (grade) variability. If you are willing to accept an A or an F, you are acting like a speculator and may end up on the dean's list or on academic probation. Neither choice is wrong or bad but is merely a tool by which you can achieve your preferences.

### KEY TAKEAWAYS

- Derivatives are instruments, the price of which derives from the price or performance of some underlying asset.
- Derivatives can be used to hedge (reduce risk) or to speculate (increase risk).
- Derivatives are just tools that investors can use to increase or decrease return volatility and hence are not inherently bad. Speculation is the obverse of hedging, which would be impossible to do without speculators serving as counterparties.

## 12.2 Forwards and Futures

### LEARNING OBJECTIVES

1. What is a forward contract and what is it used for?
2. What is a futures contract and what is its economic purpose?

Imagine you want to throw a party at the end of the semester and have a budget of \$100 for beer. (If you are underage or a teetotaler think about root beer instead.) You know your buddies will drink up any (root) beer you bring into the house before the party so you have to wait until the day of the event to make your purchases. The problem is that the price of your favorite beer jumps around. Sometimes it costs \$20 per case but other times it is \$30. Having 5 cases of the good stuff would mean an awesome party but having 3 cases of the good stuff and a case of (insert your favorite word for bad \$10/case beer here) would be...like totally lame. What to do?

Buyers naturally fear increases in the prices of the things they want to own in the future. Sellers, by contrast, fear price decreases. Those mutual fears can lead to the creation of a financial instrument known as a forward. In a forward contract, a buyer and a seller agree *today* on the price of an asset to be purchased and delivered in the future. That way, the buyer knows precisely how much he will have to pay and the seller knows precisely how much she will receive. You could sign a forward contract with your beer distributor pegging the price of your favorite beer at \$25 per case and thus ensure that you will have 4 cases of the good stuff at your end of semester bash. Similarly, a farmer and a grocer could contract at planting to fix the price of watermelons, corn, and so forth at harvest time.

Agricultural forward contracts like that just described have been used for centuries if not millennia. Their use is limited by three major problems with forward contracts: (1) it is often costly/difficult to find a willing counterparty; (2) the market for forwards is illiquid due to their idiosyncratic nature so they are not easily sold to other parties if desired; (3) one party usually has an incentive to break the agreement. Imagine, for example, that the price of your favorite beer dropped to only \$15 per case. You might feel cheated at having to pay \$25 and renege on your promise. Conversely, if your beer went to \$40 per case the distributor might tell you to get lost when you tried to pay \$25 under the forward contract.

Exchanges like the Chicago Board Options Exchange (CBOE), Chicago Mercantile Exchange (CME), Chicago Board of Trade (CBOT), and Minneapolis Grain Exchange (MGEX) developed futures to obviate the difficulties with forward contracts by: (1) efficiently linking buyers and sellers; (2) developing standardized weights, definitions, standards, and expiration dates for widely traded commodities, currencies, and other assets; (3) enforcing contracts between counterparties. Each contract specifies the underlying asset (which ranges from bonds to currencies, butter to orange juice, ethanol to oil, and gold to uranium), its amount and quality grade, and the type (cash or physical) and date of settlement or contract expiration. CME, for example, offers a futures contract on copper in which physical settlement of 25,000 pounds of copper is due on any of the last three business days of the delivery month. [www.cmegroup.com/trading/metals/base/copper\\_contract\\_specifications.html](http://www.cmegroup.com/trading/metals/base/copper_contract_specifications.html) In many contracts, especially for financial assets, physical delivery is not desired or demanded. Instead, a cash settlement representing the difference between the contract price and the spot market price on the expiration date is made.

To lock in the price that it will have to *pay* for an asset in the future, a business should *purchase a futures contract*, thereby committing another party to supply it at the contract price. To lock in the price it will *receive* for an asset in the future, a business should *sell a futures contract*, thereby committing a buyer to purchase it at the contract price.

Here is a concrete example of how a futures contract can be used to hedge against price movements in an underlying asset: If you wanted to hedge the sale of 1 million barrels of crude oil you could sell a 3-month futures contract for \$100 per barrel. If the market price of crude was \$90 per barrel at the expiration date, you would get \$10 per barrel from the buyer of the contract plus the market price (\$90), or \$100 per barrel. If the market price of crude was \$110 at the end of the contract, by contrast, you would have to pay \$10 per barrel to the buyer of the contract. Again, you would net \$100 per barrel, \$110 in the market minus the \$10 paid to the contract counterparty.

To ensure that you would not renege in the latter case by not paying \$10 per barrel to the counterparty, futures exchanges require **margin accounts**<sup>4</sup> and other safeguards. As the contract and market prices diverge, the incentive to default increases and exchanges know it. So they require investors to post bonds or to increase the deposits in their margin accounts or they will pay the money in the margin account to the counterparty and close the contract.

4. Accounts in which a futures trader deposits cash equal to the difference between the value of the futures contract and the underlying asset.

### Stop and Think Box

Could a futures contract price ever be lower than the current market price? If not, why not? If so, how?

Futures contract prices will be lower than current market prices if market participants anticipate lower future prices due to deflation, changes in relative prices, or changes in supply or demand conditions. Cold weather in Florida, for example, can make orange juice futures soar on the expectation of a damaged crop (decreased supply) but unexpectedly mild weather in climatically marginal groves can have the opposite effect. Similarly, the expected completion of a new refinery might make gasoline futures decline.

### KEY TAKEAWAYS

- Buyers and sellers can hedge or lock in the price they will pay/receive for assets in the future by contracting for the price today.
- Such contracts, called forwards, are costly to consummate, illiquid, and subject to high levels of default risk.
- Standardized forward contracts, called futures, were developed by exchanges to reduce the problems associated with forwards and have proliferated widely across asset classes.

## 12.3 Options and Swaps

### LEARNING OBJECTIVES

1. What are options and how can they be used to hedge and speculate?
2. What are swaps and how are they used to hedge and speculate?

Options are aptly named financial derivatives that give their holders the option (which is to say the right, but not the obligation) to purchase (call) or sell (put) an underlying asset at a predetermined strike price, on (if a so-called European option) or before (if a so-called American option) a predetermined expiration date. Options are most often written on stocks (equities) but can be linked to other types of assets as well. To induce investors to issue an option and thereby obligate themselves to make a disadvantageous trade, option holders must pay a premium to the option issuer based on the option type, strike price, expiration date, interest rates, and volatility of the underlying asset. (The most famous option valuation model is called Black-Scholes. [en.wikipedia.org/wiki/Black-Scholes](http://en.wikipedia.org/wiki/Black-Scholes) It is rather complicated, but various online calculators will painlessly compute the option premium for users who input the values of the key variables. [www.money-zine.com/Calculators/Investment-Calculators/Black-Scholes-Calculator](http://www.money-zine.com/Calculators/Investment-Calculators/Black-Scholes-Calculator))

Options can be used to hedge or speculate in various ways. An investor might buy a call option on a stock in the hopes that the stock price will rise above the strike price, allowing her to buy the stock at the strike price (e.g., \$90) and immediately resell it at the higher market price (e.g., \$100). Or an investor might buy a put option to minimize his losses. If the stock fell from \$100 to \$50 per share, for example, a put option at \$75 would be profitable or “in the money” because the investor could buy the stock in the market at \$50 and then exercise his option to sell the stock to the option issuer at \$75 for a gross profit of \$25 per share.

Buying and selling calls and puts can be combined to create a variety of investment strategies with colorful names like bear put spreads and bull collars. Do yourself a favor and study the subject more thoroughly before dabbling in options, especially before selling them. The purchaser of an option can never lose more than the premium paid because the worst case scenario is that the option remains “out of the money.” For example, if the market price of a share on which you hold a European call option is below the option’s strike price on the expiration date the option would expire valueless. (If the market price was \$15 you would not want to exercise your right to buy at \$20.) Similarly, if the market price (e.g., \$25 to \$30

range) of an American put option remains above the strike price (e.g., \$15) for the entire term of the contract, the option would be out of the money. (Why exercise your right to sell something for \$15 that you could sell for \$25 plus?!) The seller of an option, by contrast, can lose a large sum if an option goes a long way into the money. For example, the seller of a call option with a strike price of \$50 would lose \$950 per share if the price of the underlying share soared to \$1,000. (The holder of the option would exercise its right to call or buy the shares from the option issuer at \$50.) Such large movements are rare, of course, but it would only take one instance to ruin most individual option issuers.

### Stop and Think Box

All else equal, what should cost more to purchase, an American or a European option? Why?

American options are more valuable than European options, *ceteris paribus*, because the American option is more likely to be valuable or “in the money” as it can be exercised on numerous days, not just one.

Swaps are very different from options (though they can be combined to form a derivative called a swaption, or an option to enter into a swap). As the name implies, swaps are exchanges of one asset for another on a predetermined, typically repeated basis. A savings bank, for example, might agree to give \$50,000 per year to a finance company in exchange for the finance company’s promise to pay the savings bank \$1 million times a variable interest rate such as **LIBOR**<sup>5</sup>. Such an agreement, called an interest rate swap, would buffer the bank against rising interest rates while protecting the finance company from lower ones, as in the following table:

Table 12.3 Payments Under an Interest Rate Swap

Year	Savings bank owes (\$)	LIBOR (%)	Finance company owes (\$)	Net payment to/from bank (\$)	Net payment to/from finance company (\$)
1	50,000	5.00	50,000	0	0

5. The London Interbank Offered Rate, or the variable interest rate at which banks lend to each other overnight in the London wholesale money market.

Year	Savings bank owes (\$)	LIBOR (%)	Finance company owes (\$)	Net payment to/from bank (\$)	Net payment to/from finance company (\$)
2	50,000	6.00	60,000	10,000	-10,000
3	50,000	4.00	40,000	-10,000	10,000
4	50,000	1.25	12,500	-37,500	37,500

A credit default swap (CDS) is a type of swap used to create an unregulated form of insurance against a default by a bond issuer such as a country or corporation. In a CDS, the holder of bonds promises to make a relatively small payment (similar to an insurance premium) to a counterparty in exchange for a large payment if the bond issuer does not pay principal or interest on its bonds as promised. CDSs exacerbated the financial crisis of 2008 because many counterparties failed to make good on their promise to indemnify bondholders in case of default. CDSs are still largely unregulated and present systemic risks that most other derivatives do not.

#### KEY TAKEAWAYS

- Options are financial derivatives that in exchange for a premium provide holders with the option (the right but not the obligation) to buy or sell a stock or other underlying asset at a predetermined price up to or on a predetermined date.
- Option holders/buyers can never lose more than the premium paid for the option, the value of which is a function of interest rates, the strike price, the expiration date, and the volatility of the underlying asset.
- Swaps are derivatives in which two parties agree to swap or exchange one asset for another at one or more future dates. Like options, they can be used to hedge or speculate.
- Credit Default Swaps are a special form of swap akin to an insurance policy on bonds. Despite their ability to increase systemic volatility, they remain largely unregulated.

## 12.4 Suggested Reading

Durbin, Michael. *All About Derivatives*. 2nd ed. New York: McGraw-Hill, 2010.

Kolb, Robert and James Overdahl. *Financial Derivatives: Pricing and Risk Management*. Hoboken, NJ: John Wiley and Sons, 2009.