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# Hedging with Financial Derivatives

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# Hedging

- Financial derivatives are so effective in reducing risk because they enable financial institutions to **hedge**
  - Engage, in financial transaction that reduces or eliminates risk
- If a financial institution has bought an asset, it is said to have taken a **long position**
  - And this exposes the institution to risk if the returns on the asset are uncertain
- On the other hand, if it sold an asset that it has agreed to deliver to another party at a future date, it is said to have taken a **short position**
  - and this can also expose the institution to risk

# Hedging

- Financial derivatives can be used to reduce risk by invoking the following basic principle of hedging
  - Hedging risk involves engaging in a financial transaction that offsets a long position by taking an additional short position, or offsets a short position by taking an additional long position
    - If a financial institution has bought a security and has therefore taken a long position, it conducts a hedge by contracting to sell that security – take a short position at some future date
    - Alternatively, if it has taken a short position by selling a security that it needs to deliver at a future date, then it conducts a hedge by contracting to buy that security – take a long position at a future date

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# Forward Markets

- Forward contracts are agreements by two parties to engage in a financial transaction at a future – forward point in time
    - Interest-rate forward contracts
    - Forward contracts for foreign currencies
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# Interest-Rate Forward Contracts

- Interest-rate forward contracts involve the future sale or purchase of a debt instrument and have several dimensions
    - Specification of the actual debt instrument that will be delivered at the future date
    - Amount of the debt instrument to be delivered
    - Price – interest rate on the debt instrument when it is delivered
    - Date on which delivery will take place
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# Interest-Rate Forward Contracts

- An example of an interest-rate forward contract
  - Agreement for the First National Bank to sell to the Rock Solid Insurance Company, one year from today, \$5 million face value of the 6s of 2029 Treasury bonds – coupon bonds with a 6% coupon rate that mature in 2029 at a price that yields the same interest rate on these bonds at today's, say 6%.
    - Rock Solid will buy the security at a future date – long position
    - The First National Bank will sell the security a future date – short position
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# Interest-Rate Forward Contracts

- The First National Bank have previously bought \$5 million of the 6s of 2029 Treasury bonds, which currently sell at par value and so their yield to maturity is 6%
  - Because these are long-term bonds you recognize that you are exposed to substantial interest-rate risk and worry that if interest rates rise in the future, the price of these bonds will be fall
    - How to hedge a risk?
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# Interest-Rate Forward Contracts

- Knowing the basic principle of hedging, you see that your long position in these bonds must be offset by an equal short position for the same bonds with a forward contract
  - That is, you need to contract to sell these bonds at a future date at the current par value price
  - As a result, you agree with another party, in this case, Rock Solid Insurance Company, to sell them the \$5 million of the 6s of 2029 Treasury bonds at par one year from today
  - By entering into this forward contract, you have locked in the future price and so have eliminated the price risk First National Bank faces from interest-rate changes
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# Interest-Rate Forward Contracts

- Why would the Rock Solid Insurance Company want to enter into the forward contract with the First National Bank?
    - Rock Solid Insurance Company expects to receive premiums of \$5 million in one year's time that it will want to invest in the 6s of 2029 but worries that interest rates on these bonds will decline now and next year
    - By using the forward contract, it is able to lock in the 6% interest rates on the Treasury bonds
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# Pros and Cons of Forward Contracts

- The advantage of forward contracts is that they can be flexible as the parties involved in want to be
  - However, forward contracts suffer from two problems that severely limit their usefulness
    - The first is that it may be very hard for an institution to find another party – counterparty to make the contract with
      - There are brokers to facilitate the matching up of parties
      - But this mean that it may prove impossible to find a counterparty when a financial institution want to make a specific type of forward contract
      - Furthermore, even if the institution finds a counterparty, it may not get as high a price as it wants because there may not be anyone else to make the deal with
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# Pros and Cons of Forward Contracts

- A serious problem for the market in interest-rate forward contract, then, is that it may be difficult to make the financial transaction of that it will have to be made at a disadvantage price
  - This market suffers from a lack of liquidity
  - The second problem with forward contracts is that they are subject to default risk
    - The presence of default risk in forward contracts means that parties to these contracts must check each other out to be sure that the counterparty is both financial sound and likely to be honest and live up to its contractual obligations
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# Pros and Cons of Forward Contracts

- Because this is a costly process and because all the adverse selection and moral hazard problems
    - Default risk is a major barrier to the use of interest-rate forward contracts
    - When the default risk is combined with a lack of liquidity, we see that these contracts may be of limited usefulness to financial institutions
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# Financial Futures Markets

- Given the default risk and liquidity problems in the interest-rate forward market, another solution to hedging interest-rate risk was needed
  - This solution was provided by development of financial futures contracts by the Chicago Board of Trade starting in 1975
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# Financial Futures Contracts

- A financial futures contract is similar to an interest-rate forward contract in that it is specified that a financial instrument must be delivered by one party to another on a stated future date
    - However, it differs from an interest-rate forward contract in several ways that overcome some of the liquidity and default problems of forward markets
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# Financial Futures Contracts

- To understand what financial futures contracts are all about, let's look at one of the most widely traded futures contracts, that for Treasury bonds, which are traded on the Chicago Board of Trade
    - The contract value is for \$100.000 face value of bonds
    - Prices are quoted in points, with each point equal to \$1.000
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# Financial Futures Contracts

- This contract specifies that the bonds to be delivered must have at least 15 years to maturity at the delivery date
  - If the Treasury bonds delivered to settle the future contract have a coupon rate different from the 6% specified in the future contract, the amount of bonds to be delivered is adjusted to reflect the difference in the value between the delivered bonds and the 6% coupon bond
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# Financial Futures Contracts

- In line with the terminology used for forward contracts, parties who have bought a future contract and thereby agreed to buy of the bond are said to have taken a long position
  - Parties who have sold a future contract and thereby agreed to sell – deliver bonds have taken a short position
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# Financial Futures Contracts

- Let's consider what happens when you buy or sell one of these Treasury bond futures contracts
  - On February 1, you sell one \$100.000 June contract at a price of 115 (that is \$115.000)
  - By selling this contract, you agree to deliver \$100.000 face value of the long-term Treasury bonds to the contract's counterparty at the end of June for \$115.000
  - By buying the contract at a price of 115, the buyer has agreed to pay \$115.000 for the \$100.000 face value of bonds when you deliver the, at the end of June
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# Financial Futures Contracts

- If interest rates on long-term bonds rise so that when the contract mature at the end of June the price of these bonds has fallen to 110 (\$110.000 per \$100.000 of face value), the buyer of the contract will have lost \$5.000 because he paid \$115.000 for the bonds but he can sell them only for the market price of \$110.000
  - But you the seller of the contract, will have gained \$5.000 because you can now sell the bonds to the buyer for \$115.000 but have to pay only \$110.000 for them in the market
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# Financial Futures Contracts

- It is even easier to describe what happens to the parties who have sold futures contracts if we recognize the following fact:
    - At the expiration date of a future contract, the price of the contract converges to the price of the underlying asset to be delivered
  - On the expiration date of the June contract at the end of June, when the price of the underlying \$100.000 face value Treasury bond is 110 (\$110.000)
    - If the futures contract is selling below 110, say, at 109
      - A trader can buy the contract for \$109.000, take delivery of the bond, and immediately sell it for \$110.000, thereby earning a quit profit of \$1.000
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# Financial Futures Contracts

- Because this profit involves no risk, it is a great deal that everyone would like to get it on
  - That means that everyone will try to buy the contract, and as a result, its price will rise
  - Only when the price rises to 110 will the profit opportunity cease to exist and the buyer pressure disappear
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# Financial Futures Contracts

- Conversely, if the price of the futures contract is above 110, say at 111, everyone will want to sell the contract
  - Now the sellers get \$111.000 from selling the futures contract but have to pay only \$110.000 for the Treasury bonds that they must deliver to the buyer of the contract
    - \$1.000 difference is their profit
    - Because this profit involves no risk, traders will continue to sell the futures contract until its price falls back down to 110, at which price there are no longer any profits to be made
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# Financial Futures Contracts

- The elimination of riskless profit opportunities in the futures market is referred to as arbitrage, and it guarantees that the price of a futures contract at expiration equals the price of the underlying asset to be delivered
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# Financial Futures Contracts

- The hedge just described is called a **micro hedge**
    - Because the financial institution is hedging the interest rate risk for a specific asset it is holding
  - A second type of hedge that financial institution engage in is called a **macro hedge**
    - In which the hedge is for institution's entire portfolio
    - E.g., if a bank has more rate-sensitive liabilities than assets
      - By selling interest-rate future contracts that will yield a profit when interest rate rise, the bank can offset the losses on its overall portfolio from an interest-rate rise and thereby hedge its interest-rate risk
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# Organization of Trading in Financial Futures Markets

- Financial futures contracts are traded on organized exchanges such as the Chicago Board of Trade, the Chicago Mercantile Exchange, the New York Futures Exchange, etc
  - These exchanges are highly competitive with one to another, and each organization tries to design contracts and set of rules that will increase the amount of futures trading on its exchange
  - The futures exchanges and all trades in financial futures in the U.S. are regulated by the Commission CFTC, which was created in 1974 to take over the regulatory responsibilities for futures markets from the Department of Agriculture
    - The CFTC oversees futures trading and the futures exchanges to ensure that prices on the market are not manipulated
    - In addition, the CFTC approves proposed futures contracts to make sure that they serve to public interest
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# Globalization on Financial Futures Market

- Because American futures exchanges were the first to develop financial futures, they dominated the trading of financial futures in the early the 1980's
- With rapid growth of financial futures markets and the resulting high profits made by American exchanges, foreign exchanges saw a profit opportunity and began to enter this business
  - By the 1990's, Eurodollar contracts traded on the London International Financial Futures Exchange
  - Japanese government bond contracts and Euroyen contracts traded on the Tokyo Stock Exchange, etc.
  - Even developing countries are getting into the act.
    - In 1996, seven developing countries also referred as a emerging market countries established futures exchanges

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# Globalization on Financial Futures Market

- Foreign competition has also knockoffs of the most popular financial futures contracts initially developed in the U.S.
  - These contracts traded on foreign exchanges are virtually identical to those traded in the U.S. and have an advantage that they can be traded when the American exchanges are closed
  - The movement to 24-hour-a-day trading in financial futures had been further stimulated by the development of the GLOBEX – electronic trading platform, that allows traders throughout the world to trade futures even when the exchanges are not officially open
  - Financial futures trading has thus become completely international
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# Explaining the Success of Futures Markets

- Several features of futures contracts were designed to overcome the liquidity problem inherent in forward contracts
  - In contrast to forward contracts, the quantities delivered and the delivery dates of futures contracts are standardized
    - Making more likely that different parties can be matched up in the futures market, thereby increasing the liquidity of the market
  - After the futures contract has been bought or sold, it can be traded – sold or bought again at any time until the delivery date
  - Trading on the futures market has been organized differently from trading on forward markets to overcome the default risk problems arising in forward contracts

# Explaining the Success of Futures Markets

- In both types, for every contract there must be a buyer who is taking a long position and a seller who is taking a short position
- However, the buyer and seller of a futures contract make their contract not with each other but with the clearing house associated with the futures exchange
  - This setup means that the buyer of the futures contract does not need to worry about the financial health of the seller and vice versa, as in the forward market
  - As long as the clearing house is financially solid. Buyers and sellers of futures contracts do not have to worry about default risk

# Explaining the Success of Futures Markets

- To make sure that the clearinghouse is financially sound and does not run into financial difficulties that might jeopardize its contracts, buyers or sellers of futures contracts must put an initial deposit, called a **margin requirement**
- Futures contracts are then **marked to market** every day
  - At the end of every trading day, the change in the value of the futures contracts is added to or subtracted from the margin account
  - If the amount in this margin account falls below the maintenance margin requirement, the trader is required to add money to the account

# Explaining the Success of Futures Markets

- A final advantage that futures markets have over forward markets is that most futures contracts do not result in delivery of underlying asset on the expiration date, whereas forward contract do
  - A trader who sold a futures contract is allowed to avoid delivery on the expiration date by making an offsetting purchase of a futures contracts
  - Because the simultaneous holding of the long and short position means that the trader would in effect be delivering the bonds to itself, under the exchange rules the trader is allowed to cancel both contracts
    - In this way lowers the cost of conducting trades in the futures market relative to the forward market in that that futures trader can avoid the costs of physical delivery, that is not so easy with forward contracts

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# Summary

- Interest-rate forward contracts, which are an agreement to sell a debt instrument at a future (forward) point in time, can be used to hedge interest rate risk
    - The advantage of forward contract is that it is flexible
    - Disadvantages are that they are the subject of default risk and their market is illiquid
  - A financial futures contract is similar to forward contract
    - However, it has advantages over a forward contract in that it is not subject to default risk and is more liquid
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# Options

- Another vehicle for hedging
    - Interest-rate risk
    - Stock market risk
  - Options
    - Contracts that give the purchaser the option, or right, to buy or sell the underlying financial instrument
      - at a specified price – exercise price or strike price
      - within a specific period of time
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# Options

- The seller – the **writer** of the option is **obligated** to buy or sell the financial instrument to the purchaser if the **owner** of the option **exercises** the right to sell or buy
  - The owner or buyer of an option does not have to exercise the option he or she **can let option expire without using**
  - The seller of an option, by contrast, has no choice, he or she must buy or sell the financial instrument if the owner exercise the option

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# Options

- Because the right to buy or sell a financial instrument the owner of an option is willing to pay an amount for it called a **premium**
  - There are two types of option contracts
    - American options
      - Can be exercised at any time up to the expiration date of the contract
    - European options
      - Can be exercised only on the expiration date
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# Options

- Option contracts are written on a number of financial instruments
  - Individual stocks – stock option that existed for long time
  - Financial futures – financial futures option or futures option
- Why option contracts are more likely to be written on financial futures than on underlying debt instruments such as bonds or certificates of deposit?
  - The price of the futures contract and of the deliverable debt instrument will be the same because of arbitrage
  - So investor should be indifferent about having the option written on the debt instrument or on the futures contract
  - However, financial futures contracts have been so well designed that their markets are often more liquid than the markets in the underlying debt instruments
    - Investors would rather have the option contract written on the more liquid instrument, in this case the futures contract

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# Option Contracts

- A call option is a contract that gives the owner the right to buy a financial instrument at the exercise price within a specific period of time
  - A put option is a contract that gives the owner the right to sell a financial instrument at a exercise price within a specific period of time
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# Examination how profits and losses occur

- Major difference between a futures contract and an option contract
  - Futures contract has a **linear profit function**
    - Profits grow by an equal dollar amount for every point increase in the price of the underlying financial instrument
  - The option contract is highly non linear
    - Profits do not always grow by the same amount for a given change in the price of the underlying financial instrument
      - The reason for this nonlinearity is that the call option protects the investor from having losses that are greater than the amount of the \$2.000 premium
      - This insurance-like feature of option contracts explains why their purchase price is referred **as a premium**
      - Once the underlying financial instrument's price rise **above the exercise price**, the investor's profit grow linearly

# Examination how profits and losses occur

- Two other differences between options and futures contracts must be mentioned
    - The first is that the **initial investment** on the contracts **differs**
      - When a futures contract is purchase, the investor must put up a fixed amount, the margin requirement, in a margin account
      - When an option contract is purchased, the initial investment is the premium that must be paid for the contract
    - The second important difference between the contracts is that
      - the futures contract requires money to change hands daily when contract is marked to market
      - the option contract requires money to change only when it is exercised
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# Factors Affecting the prices of Option Premiums

- When the strike (exercise) price for a contract is set at a higher level
    - The premium for the **call option is lower** and the premium for the **put option is higher**
      - The higher the strike price, the lower the profits on the call option contract and the lower the premium that investor are willing to pay
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# Factors Affecting the prices of Option Premiums

- The period of time over which the option can be exercised gets longer, the premiums for both call and put options rise
  - The fact that premiums increase with the term to expiration is also explained by the nonlinear profit function for option contracts
    - At the term to expiration lengthens, there is a greater chance that the **price** of the underlying financial instrument **will be very high or very low by the expiration date**
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# Factors Affecting the prices of Option Premiums

- If the price becomes very high and goes well above the exercise price, the call option will yield a high profit
    - If the price becomes very low and goes well below the exercise prices, the losses will be small because the owner of call option will simply decide not to exercise the option
  - Similar, the put option will become more valuable as the term to expiration increases, because of the possibility of greater price variability of the underlying financial instrument increases as the term to expiration increases
  - When the volatility of the price of the underlying instrument is great, the premiums for both call and put options will be higher
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# Interest-Rate Swaps

- Swaps are financial contracts that obligate each party to the contract exchange (swap) a set of payments it owns for another set of payments owned by another party
  - Currency swaps
    - Exchange of a set a payments in one currency for a set of payments in another currency
  - Interest-rate swaps
    - The exchange of one set of interest payments for another set of interest payments, all denominated on the same currency
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# Interest-rate Swap Contracts

- Important tool for managing interest-rate risk
- First appeared in the U.S. in 1982 when there was an increase in the demand for financial instruments that could be used to reduce interest-rate risk
- The most common type of interest-rate swap – plain vanilla swap specified
  - The interest rate on the payment that are being exchanged
  - The type of interest payments
    - Variable or fixed
  - The amount of **notional principal**, which is the amount on which the interest is being paid
  - Time period over which the exchange continue to be made

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# Advantages of Interest-Rate Swaps

- Financial institutions can also hedge interest-rate risk with other financial derivatives such as futures contracts or futures options
  - Interest-rate swaps have one big advantage over hedging with these derivatives
    - They can be written for very long horizons, sometimes as long as 20 years, whereas financial futures and futures options typically have much shorter horizons, not much more than a year
      - If a financial institutions needs to hedge interest-rate risk for a long horizon, financial futures and option markets may not do it much good
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# Disadvantages of Interest-Rate Swaps

- Swap markets like forward markets can suffer from a lack of liquidity
    - It might be difficult to arrange the swap
    - It might not be able to negotiate a good deal because it could not find any institutions to negotiate with
    - Swap contracts are subject to default risk
      - If interest rates rise up a particular company would love to get out of the swap contract because the fixed-rate interest payments it receives are less than it could get in the open market
      - It might then default on the contract, exposing the other company to the loss
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# Major concerns about derivatives

- Financial derivatives allow financial institutions to increase their leverage
    - They can in effect hold an amount of the underlying asset is many time greater than the amount of money they have had to put up
    - Increasing their leverage enables them to take huge bets on currency and interest-rate movements, which if they are wrong can bring down banks
    - The concern is valid
      - The amount of money places in margin accounts is only a small fraction of the price of futures contract, meaning that small in the price of the contact can produce losses that are many times the size of the initial amount put in the margin account
  - Although, financial derivatives can be used to hedge risk, they can be used by financial institutions to take on excessive risk
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# Major concerns about derivatives

- The second concern is that financial derivatives are too sophisticated for managers of financial institutions because they are so complicated
  - A third concern is that banks have holding of huge national amounts of financial derivatives, particularly swaps, that greatly exceed the amount of bank capital and so these derivatives expose the banks to serious risk of failure
  - The conclusion is that financial derivatives do have their danger for financial institutions, but some of these dangers have been overplayed. The biggest danger occurs in trading activities of financial institutions, and regulators have been paying increased attention to this danger
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# Summary

- An option contract gives the purchaser the right to buy (call option) or sell (put option) a security at the exercise (strike) price within the specific period of time
  - Interest-rate swaps involve the exchange of one set of interest payments for another set of interest payments and have default risk and liquidity problems similar to those of forward contracts
    - As a result, interest-rate swaps often involve intermediaries such as large commercial banks and investment banks that make a market in swaps
    - Interest-rate swaps have one big advantage over financial futures and options, they can be written for very long horizons
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Thank you for your attention

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