BACHELOR of ECONOMICS
International Program

Thammasat University | Thailand

Fixed Income (FN351)

Interest rate futures

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Learning Objectives

After reading this chapter, you will understand

- what a futures contract is
- the differences between a futures and a forward contract
- the basic features of various interest-rate futures contracts
- the cheapest-to-deliver issue for a Treasury bond futures contract and how it is determined
- how the theoretical price of a futures contract is determined
- how the theoretical price of a Treasury bond futures contract is affected by the delivery options
- how futures contracts can be used in bond portfolio management: speculation, changing duration, yield enhancement, and hedging
- how to calculate the hedge ratio and the number of contracts to short when hedging with Treasury bond futures contracts.

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Mechanics of Futures Trading

- A *futures contract* is a firm legal agreement between a buyer (seller) and an established exchange or its clearinghouse in which the buyer (seller) agrees to take (make) delivery of something at a specified price at the end of a designated period of time.
- The price at which the parties agree to transact in the future is called the *futures price*.
- The designated date at which the parties must transact is called the *settlement date.*
- The contract with the nearest settlement date is called the *nearby futures contract.*
- The next futures contract is the one that settles just after the nearby contract.
- The contract furthest away in time from settlement is called the *most distant futures contract*.

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Mechanics of Futures Trading (continued)

❑ Opening Position

- When an investor takes a position in the market by buying a futures contract, the investor is said to be in a *long position* or to be long futures.
- If, instead, the investor's opening position is the sale of a futures contract, the investor is said to be in a *short position* or short futures.

❑ Liquidating a Position

❑ A party to a futures contract has two choices on liquidation of the position.

i. First, the position can be liquidated prior to the settlement date.

ii. The alternative is to wait until the settlement date.

❑ For some futures contracts, settlement is made in cash only. Such contracts are referred to as *cash-settlement contracts*.

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Mechanics of Futures Trading (continued)

❑ Role of the Clearinghouse

- Associated with every futures exchange is a clearinghouse.
- A futures contract is an agreement between a party and a clearinghouse associated with an exchange.
- The clearinghouse makes it simple for parties to a futures contract to unwind their positions prior to the settlement date.
- When an investor takes a position in the futures market, the clearinghouse takes the opposite position and agrees to satisfy the terms set forth in the contract.
- Because the clearinghouse exists, the investor need not worry about the financial strength and integrity of the party taking the opposite side of the contract.
- Besides its guarantee function, the clearinghouse makes it simple for parties to a futures contract to unwind their positions prior to the settlement date.

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Mechanics of Futures Trading (continued)

Margin Requirements

- When a position is first taken in a futures contract, the investor must deposit a minimum dollar amount per contract as specified by the exchange.
- This amount, called the *initial margin*, is required as deposit for the contract.
- At the end of each trading day, the exchange determines the settlement price for the futures contract.
- This price is used to *mark to market* the investor's position, so that any gain or loss from the position is reflected in the investor's equity account.

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Mechanics of Futures Trading (continued)

Margin Requirements

- The *maintenance margin* is the minimum level (specified by the exchange) by which an investor's equity position may fall as a result of an unfavorable price movement before the investor is required to deposit additional margin.
- The additional margin deposited, called the *variation margin*, is the amount necessary to bring the equity in the account back to its initial margin level.
- The concept of margin differs for securities and futures.
- When securities are acquired on margin, the difference between the price of the security and the initial margin is borrowed from the broker with the security purchased serving as collateral for the loan.
- For futures contracts, the initial margin, in effect, serves as "good faith" money, an indication that the investor will satisfy the obligation of the contract.

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Mechanics of Futures Trading (continued)

❑ Commissions

- Commissions on futures contracts are fully negotiable.
- They are usually quoted on the basis of a round turn, a price that includes the opening and closing out of the futures contract.
- In most cases, the commission is the same regardless of the maturity date or type of the underlying instrument.
- Commissions for institutional accounts vary enormously, ranging from a low of about $11 to a high of about $30 per contract.

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Futures Versus Forward Contracts

- ❑ Just like a futures contract, a *forward contract* is an agreement for the future delivery of the underlying at a specified price at the end of a designated period of time.
- ❑ Futures contracts are traded on organized exchanges and are standardized agreements as to the delivery date (or month) and quality of the deliverable.
- ❑ A forward contract differs in that it has no clearinghouse, usually has nonstandardized contracts (i.e., the terms of each contract are negotiated individually between buyer and seller), and typically has nonexistent or extremely thin secondary markets.
- ❑ Because there is no clearinghouse that guarantees the performance of a counterparty in a forward contract, the parties to a forward contract are exposed to counterparty risk.

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Risk and Return Characteristics of Futures Contracts

- The buyer of a futures contract will realize a profit if the futures price increases; the seller of a futures contract will realize a profit if the futures price decreases.
- If the futures price decreases, the buyer of a futures contract realizes a loss while the seller of a futures contract realizes a profit.
- When a position is taken in a futures contract, the party need not put up the entire amount of the investment. Instead, only initial margin must be put up.
- Although the degree of leverage available in the futures market varies from contract to contract, the leverage attainable is considerably greater than in the cash market.
- Futures markets can be used to reduce price risk.
- Without the leverage possible in futures transactions, the cost of reducing price risk using futures would be too high for many market participants.

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Currently Traded Interest-Rate Futures Contracts

- Most major financial markets outside the United States have futures contracts similar to the U.S.
- Several of the more important interest-rate futures contracts in the United States are described in the following sections.
- For the first three–Treasury bills futures contract, Eurodollar futures contract, and federal funds futures contract–the underlying interest rate is a short-term (money market) interest rate.
- For the other contracts–Treasury bond futures, Treasury notes futures, and municipal note index futures–the underlying interest rate is a longer term interest rate.
- Most major financial markets outside the United States have similar futures contracts in which the underlying security is a fixed-income security issued by the central government.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Eurodollar Futures

- Eurodollar futures contracts are traded on both the International Monetary Market of the Chicago Mercantile Exchange and the London International Financial Futures Exchange.
- The Eurodollar certificate of deposit (CD) is the underlying for this contract.
- A Eurodollar CD is a dollar-denominated CD issued outside of the United States, typically by a European bank.
- Three-month LIBOR is the underlying for the Eurodollar futures contract.
- That is, the parties are agreeing to buy and sell "three-month LIBOR."

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Eurodollar Futures

- A Eurodollar futures contract is quoted on an index price basis.
- From the futures index price, the annualized futures three-month LIBOR is determined as follows: 100 minus the index price.
- For example, a Eurodollar futures index price of 94.52 means the parties to this contract agree to buy or sell the three-month LIBOR for 5.48%.
- Since the underlying is an interest that obviously cannot be delivered, this contract is a cash settlement contract.

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Currently Traded Interest-Rate Futures **Contracts** (continued)

❑ Eurodollar Futures

- The face value for a Eurodollar Futures contract is $1 million.
- A on-tick change in the index price for this contract is 0.01; that is, an index price change of, for example, 94.52 to 94.53 is 0.01 or one tick.
- An index price change from 94.52 to 94.53 changes the three-month LIBOR from 5.48% to 5.47%.
- In terms of basis points, a one-tick change in the index price means a1-basis-point (0.0001) change in the three-month LIBOR.
- The simple interest on $1 million for 90 days is equal to

$$\$1{,}000{,}000 \times (\text{LIBOR} \times 90/360)$$

- If LIBOR changes by 1 basis point (0.0001), then

$$\$1{,}000{,}000 \times (0.0001 \times 90/360) = \$25$$

- Hence, a one-tick change in the index price or, equivalently, a 1-basis-point change in the three-month LIBOR means a $25 change in the value of the contract.

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Currently Traded Interest-Rate Futures **Contracts** (continued)

❑ Eurodollar Futures

- The minimum price fluctuation for the index price is a half a tick, or $12.50.
- In the nearest trading month for this contract, the minimum index price fluctuation is a quarter tick, or $6.25.
- The contracts are listed for March, June, September, and December (referred to as the “March cycle”), 40 months in the March quarterly cycle, and the four nearest serial contract months.
- To understand this, see Exhibit 27-1, which shows the contracts listed on the CME on January 2, 2008. (*See truncated version of Exhibit 27-1 in Overhead 27-16.*)
- Also shown in the Exhibit 27-1 is the first day of trade, the last day of trade, the cash settlement date, and the date the contract will be deleted.

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Exhibit 27-1 Listed CME Eurodollar Futures Contracts on January 2, 2008

Seq. No.	Contract Month	First Trade Date	Last Trade Date	Cash Settlement Date	Contract Month
1	Jan 2008	07/16/07	01/14/08	01/14/08	01/18/08
2	Feb 2008	08/13/07	02/18/08	02/18/08	02/22/08
3	Mar 2008	03/19/98	03/17/08	03/17/08	03/20/08
4	Apr 2008	10/15/07	04/14/08	04/14/08	04/18/08
5	May 2008	11/19/07	05/19/08	05/19/08	05/23/08
6	Jun 2008	06/18/98	06/16/08	06/16/08	06/19/08
….	….	….	….	….	….
39	Sep 2016	09/18/06	09/19/16	09/19/16	09/22/16
40	Dec 2016	12/18/06	12/19/16	12/19/16	12/22/16
41	Mar 2017	03/19/07	03/13/17	03/13/17	03/16/17
42	Jun 2017	06/18/07	06/19/17	06/19/17	06/22/17
43	Sep 2017	09/17/07	09/18/17	09/18/17	09/21/17
44	Dec 2017	12/17/07	12/18/17	12/18/17	12/21/17

Source: Chicago Mercantile Exchange.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Eurodollar Futures

- ➔ The Eurodollar futures contract is a cash settlement contract.
- ➔ That is, the parties settle in cash based on three-month LIBOR at the settlement date.
- ➔ Suppose that a trade occurs at 94.52 and on the settlement date the settlement index price is 95.00.
- ➔ From the perspective of the buyer, the index price increased.
- ➔ Hence, the seller must pay the buyer 0.48.
- ➔ Since one tick is $25 and 0.48 is 48 ticks, the buyer receives from the seller 48 × $25 = $1,200.
- ➔ An alternative way of thinking about this is that the buyer contracted to receive a three-month interest rate of (100.00% - 94.52%) = 5.48%.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Eurodollar Futures

- At the settlement date, the index price is 95.00.
- This means a three-month LIBOR of 5.00% interest rate is available in the market.
- The compensation of $1,200 of the seller to the buyer is for the lower prevailing three-month LIBOR of 5.00% rather than the contracted amount of 5.48%.
- To see how this contract is used for hedging, suppose that a market participant is concerned that its borrowing costs six months from now are going to be higher.
- To protect itself, it takes a short (selling) position in the Eurodollar futures contract such that a rise in short-term interest rates will benefit.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Eurodollar Futures

- To see this, consider our previous illustration in the Eurodollar futures at 94.52 (5.48% rate).
- Suppose at the settlement date the three-month LIBOR increases to 6.00% and, therefore, the settlement index price is 94.00.
- This means that the seller sold the contract for 94.52 and purchased it for 94.00, realizing a gain of 0.52 or 52 ticks.
- The buyer must pay the seller 52 × $25 = $1,300.
- The gain from the short futures position is then used to offset the higher borrowing cost resulting from a rise in short-term interest rates.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ **Euribor Futures**

- For euro-denominated loans and derivatives, when a reference rate is used, it is typically the Euro Interbank Offered Rate (Euribor).
- Euribor is the rate on deposits denominated in euros.
- The Euribor futures contract, traded on the NYSE Euronext, and the Eurodollar futures contract are the most actively traded futures contracts in the world.
- The Euribor futures contract is similar to the Eurodollar futures contract.
  - The unit of trading is €1,000,000, and it is a cash-settled contract.
  - The underlying is 30-day Euribor.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ **Federal Funds Futures Contract**

- Depository institutions are required to maintain reserves at the Federal Reserve.
- Banks that have excess reserves do not earn interest on those funds.
- However, they can lend those funds through the Federal Reserve to other banks that need reserves.
- The funds lent are called *federal funds*.
- The interest rate at which banks lend balances at the Federal Reserve to other banks on an overnight basis called the *federal funds rate* or simply *fed funds rate*.
- The 30-day federal funds futures contract, traded on the CBOT, is designed for financial institutions and businesses that want to control their exposure to movements in the federal funds rate.
- These contracts are marked to market using the effective daily federal funds rate as reported by the Federal Reserve Bank of New York.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Treasury Bond Futures

- The Treasury bond futures contract is traded on the Chicago Board of Trade (CBOT).
- The underlying instrument for a Treasury bond futures contract is $100,000 par value of a hypothetical 20-year 6% coupon bond.
- The futures price is quoted in terms of par being 100.
- Quotes are in *32nds* of 1%. Thus, a quote for a Treasury bond futures contract of 97-16 means 97 and 16/32nds, or 97.50.
- So if a buyer and seller agree on a futures price of 97-16, this means that the buyer agrees to accept delivery of the hypothetical underlying Treasury bond and pay 97.50% of par value, and the seller agrees to accept 97.50% of par value.
- Because the par value is $100,000, the futures price that the buyer and seller agree to transact for this hypothetical Treasury bond is $97,500.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Treasury Bond Futures

- The minimum price fluctuation for the Treasury bond futures contract is a 32nd of 1%. The dollar value of a 32nd for a $100,000 par value (the par value for the underlying Treasury bond) is $31.25.
- The seller of a Treasury bond futures who decides to make delivery rather than liquidate his position by buying back the contract prior to the settlement date must deliver some Treasury bond.
- The CBOT allows the seller to deliver one of several Treasury bonds that the CBOT declares is acceptable for delivery.
- The specific bonds that the seller may deliver are published by the CBOT prior to the initial trading of a futures contract with a specific settlement date.

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Currently Traded Interest-Rate Futures Contracts (continued)

- **Treasury Bond Futures**
  - Exhibit 27-2 shows the Treasury issues that the seller can select from to deliver to the buyer of four. (*See truncated version of Exhibit 27-2 in Overhead 27-25.*)
  - Treasury bond futures contract by settlement month.
  - The CBOT makes its determination of the Treasury issues that are acceptable for delivery from all outstanding Treasury issues that meet the following criteria:

An issue must have at least 15 years to maturity from the date of delivery if not callable; in the case of callable Treasury bonds, the issue must not be callable for at least 15 years from the first day of the delivery month.

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Exhibit 27-2 Treasury Bonds Acceptable for Delivery and Conversion Factors for Treasury

		Settlement Month			
Coupon	**Maturity Date**	**June 2008**	**Sep. 2008**	**Dec. 2008**	**Mar. 2009**
4 1/2	02/15/36	0.7992	0.7998	0.8007	0.8013
4 3/4	02/15/37	0.8303	0.8308	0.8315	0.8320
5	05/15/37	0.8637	0.8642	0.8646	0.8652
5 1/4	11/15/28	0.9127	0.9133	0.9138	0.9145
5 1/4	02/15/29	0.9122	0.9127	0.9133	0.9138
5 3/8	02/15/31	0.9234	0.9237	0.9242	0.9245
….	….	….	….	….	….
6 5/8	02/15/27	1.0693	1.0686	1.0682	1.0676
6 3/4	08/15/26	1.0819	1.0811	1.0806	1.0798
6 7/8	08/15/25	1.0925	1.0915	1.0909	1.0899
7 1/8	02/15/23	—	—	—	—
7 1/2	11/15/24	1.1542	1.1529	1.1513	1.1500
7 5/8	02/15/25	1.1687	1.1671	1.1657	1.1640
No. of eligible issues		19	18	18	18

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Treasury Bond Futures

- In addition to the eligible issues shown in the Exhibit 27-2 (*in Overhead 27-25*), newly issued Treasury bonds would qualify for delivery.
- To make delivery equitable to both parties, the CBOT has introduced *conversion factors* for determining the invoice price of each acceptable deliverable Treasury issue against the Treasury bond futures contract.
- The conversion factor is determined by the CBOT before a contract with a specific settlement date begins trading.
- Exhibit 27-2 (*in Overhead 27-25*) shows for each of the acceptable Treasury issues for each contract the corresponding conversion factor.
- The conversion factor is constant throughout the trading period of the futures contract for a given settlement month.
- The short must notify the long of the actual bond that will be delivered one day before the delivery date.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Treasury Bond Futures

- The price that the buyer must pay the seller when a Treasury bond is delivered is called the *invoice price*, which is given as: ***invoice price*** = (***contract size*** × ***futures contract settlement price*** × ***conversion factor***) + ***accrued interest***
- In selecting the issue to be delivered, the short will select from all the deliverable issues the one that costs less.
- This issue is referred to as the *cheapest-to-deliver issue*; it plays a key role in the pricing of this futures contract.
- Knowing the price of the Treasury issue, the seller can calculate the return, which is called the *implied repo rate*.
- The cheapest-to-deliver issue is then the one issue among all acceptable Treasury issues with the highest implied repo rate because it is the issue that would give the seller of the futures contract the highest return by buying and then delivering the issue.
- This is depicted in Exhibit 27-3 (*see Overhead 27-28*).

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Exhibit 27-3 Determination of Cheapest-to-Deliver Issue Based on the Implied Repo Rate

Implied repo rate: Rate of return by buying an acceptable Treasury issue, shorting the Treasury bond futures, and ssue at the settlement date.

Buy this issue	delivering the iDeliver this issue at futures price	Calculate return (implied repo rate)
Acceptable Treasury issue #1	Deliver issue #1	Implied repo rate #1
Acceptable Treasury issue #2	Deliver issue #2	Implied repo rate #2
Acceptable Treasury issue #3	Deliver issue #3	Implied repo rate #3
….	….	….
Acceptable Treasury issue #N	Deliver issue #N	Implied repo rate #N

The cheapest-to-deliver issue is that which produces the maximum implied repo rate.

Currently Traded Interest-Rate Futures Contracts (continued)

❑ Treasury Bond Futures

- In addition to the choice of which acceptable Treasury issue to deliver – sometimes referred to as the *quality option* or *swap option* – the short position has two more options granted.

i. The short position is permitted to decide when in the delivery month delivery actually will take place. This is called the *timing option*.

ii. The other option is the right of the short position to give notice of intent to deliver up to 8:00 P.M. Chicago time on the date when the futures settlement price has been fixed. This option is referred to as the *wild card option*.

- The quality option, the timing option, and the wild card option (in sum referred to as the delivery options) mean that the long position can never be sure of which Treasury bond will be delivered or when it will be delivered.
- The delivery options are summarized in Exhibit 27-4 (*see Overhead 27-30*).

Exhibit 27-4 Delivery Option Granted to the Short (Seller) of a CBOT Treasury Bond Futures Contract

Delivery Option	Description
Quality or swap option	Choice of which acceptable Treasury issue to deliver
Timing option	Choice of when in delivery month to deliver
Wild card option	Choice to deliver after the closing price of the futures contract is determined

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ Treasury Notes Futures

- There are three Treasury note futures contracts: 10-year, five-year, and two-year.
- All three contracts are modeled after the Treasury bond futures contract and are traded on the CBOT.
- The underlying instrument for the 10-year Treasury note futures contract is $100,000 par value of a hypothetical 10-year 6% Treasury note.
- There are several acceptable Treasury issues that may be delivered by the short.
- An issue is acceptable if the maturity is not less than 6.5 years and not greater than 10 years from the first day of the delivery month.

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ **10-Year Municipal Note Index Futures Contract**

- A 10-year municipal note index futures contract is traded on the CBOT.
- The underlying for this contract is an index that includes between 100 and 250 high-grade tax-exempt securities.
- An issue can be callable or non-callable.
- The issues comprising the index include insured and uninsured bonds.
- In constructing the index, there are three noteworthy restrictions:

i. no more than 5% of the bond in the index can be from any one issuer
ii. no more than 15% can be from any one state or U.S. territory
iii. no more than 40% of the issues can be insured by any one issuer

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Currently Traded Interest-Rate Futures Contracts (continued)

❑ **10-Year Municipal Note Index Futures Contract**

- Every trading day the index is priced.
- FT Interactive Data Corporation provides prices for the individual issues and then calculates the closing value of the index.
- The final settlement price is calculated as follows:

final settlement value =

$$\$100,000[5/\boldsymbol{r} + (1 - 5/\boldsymbol{r})(1 + \boldsymbol{r}/200)^{-20}]$$

where ***r*** is equal to the *simple average yield-to-worst* of the component bonds in the index for the last day of trading, expressed in percent terms and calculated to the nearest *1/10* of a basis point.

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Currently Traded Interest-Rate Futures Contracts (continued)

- **Swap Futures Contracts**
  - The CBOT introduced a swap futures contract in 2001.
  - The underlying instrument is the notional price of the fixed-rate side of a 10-year interest rate swap that has a notional principal equal to $100,000 and that exchanges semiannual interest payments at a fixed annual rate of 6% for floating interest rate payments based on 3-month LIBOR.
  - This swap futures contract is cash-settled with a settlement price determined by the International Swap and Derivatives Association (ISDA) benchmark 10-year swap rate on the last day of trading before the contract expires.
  - The London International Financial Futures Exchange (LIFFE) introduced the first swap futures contract called Swapnote, which is referenced to the euro interest rate swap curve.

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Pricing and Arbitrage in the Interest-Rate Futures Market

- There are several different ways to price futures contracts with each approach relying on the "law of one price."
- The "law of one price" states that a given financial asset (or liability) must have the same price regardless of the means by which it is created.
- The law of one price implies that the synthetically created cash securities must have the same price as the actual cash securities.
- Similarly, cash instruments can be combined to create cash flows that are identical to futures contracts.
- By the law of one price, the futures contract must have the same price as the synthetic futures created from cash instruments.

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Pricing and Arbitrage in the Interest-Rate Futures Market (continued)

❑ Pricing of Futures Contracts

- ❑ The *theoretical price of a futures contract* is equal to the *cash* or *spot price* plus the *cost of carry*.
- ❑ The *cost of carry* is equal to the cost of financing the position less the cash yield on the underlying security. The shape of the yield curve will affect the cost of carry.
- ❑ There are several reasons why the actual futures price will depart from the theoretical futures price.
- ❑ In the case of the Treasury bond futures contracts, the delivery options granted to the seller reduce the actual futures price below the theoretical futures price suggested by the standard arbitrage model.

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Pricing and Arbitrage in the Interest-Rate Futures Market (continued)

❑ Theoretical Futures Price Based on Arbitrage Model

- The theoretical futures price may be at a premium to the cash market price (higher than the cash market price) or at a discount from the cash market price (lower than the cash market price), depending on ($r - c$).
- The term $r - c$ is called the *net financing cost* because it adjusts the *financing rate* (r) for the *coupon interest rate earned* (c).
- The net financing cost is more commonly called the *cost of carry*, or simply *carry*.
- *Positive carry* means that the current yield earned is greater than the financing cost.
- *Negative carry* means that the financing cost exceeds the current yield.

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Pricing and Arbitrage in the Interest-Rate Futures Market (continued)

❑ Closer Look at the Theoretical Futures Price

- The formula that can be used to obtain the upper boundary for the futures price is

$$F(\text{upper boundary}) = P[1 + t(rB - c)]$$

where **P** = *cash market price*, **t** = *time, in years, to the futures delivery date*, **rB** = *borrowing rate*, and **c** = *current yield (coupon rate divided by the cash market price).*

- The formula that can be used to obtain the lower boundary for the futures price is

$$F(\text{lower boundary}) = P[1 + t(rL - c)]$$

where **rL** = *lending rate*.

- Delivery options should result in a theoretical futures price given by:

$$F = P[1 + t(r - c)] - \text{delivery options}$$

where **r** is the *financing rate* and the *delivery options* are the *quality option*, the *timing option*, and the *wild card option*.

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Bond Portfolio Management Applications

❑ Speculating on the Movement of Interest Rates

- It is easier to sell short in the futures market than in the Treasury market.
- The leverage advantages in trading futures may encourage speculation on interest-rate movements; making speculation easier for investors is not the function of interest-rate futures contracts.

❑ Controlling the Interest-Rate Risk of a Portfolio

- A formula to approximate the number of futures contracts necessary to adjust the portfolio duration to a new level is

$$\text{approximate number of contracts} = \frac{(D_T - D_I)P_I}{D_F P_F}$$

where D_T = *target effective duration for the portfolio*; D_I = *initial effective duration for the portfolio*; P_I = *initial market value of the portfolio*; D_F = *effective duration for the futures contact*; and, P_F = *market value of the futures contract*.

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Leverage

- Recall:

$$\text{Margin } \% = \frac{\text{Current Margin Account Balance}}{\text{Current Absolute Value of Asset Position}}$$

- Suppose you have $50,000 to invest for one year
  - Index level = $1,000, Futures price = $1,000, r = d = 4%
  - Initial margin 20% for Futures, 50% for Index
  - Initial Asset Value = $50,000/.20 = $250,000 for Futures
  - Initial Asset Value = $50,000/.50 = $100,000 for Index

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Leverage

- In one day Index increases by 1%
  - Asset Value = $252,500 for Futures
    - ROE = $2,500/$50,000 = 5%
  - Asset Value = $101,000 for Index
    - ROE = $1,000/$50,000 = 2%
- What if Index decreased by 1% instead?
  - Asset Value = $247,500 for Futures
    - ROE = $-2,500/$50,000 = -5%
  - Asset Value = $99,000 for Index
    - ROE = $-1,000/$50,000 = -2%

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Hedging

- Hedging

  Interest rates

  Commodity prices

  Exchange rate

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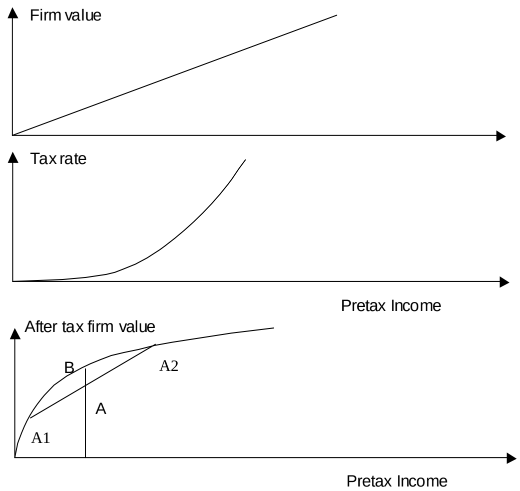
Risk management

- Tax incentives for hedging



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Bond Portfolio Management Applications (continued)

❑ **Creating Synthetic Securities for Yield Enhancement**

- The fundamental relationship for creating synthetic securities is

$$RSP = CBP - FBP$$

where ***RSP*** = *riskless short-term security position*, ***CB***P = *cash bond position*, and ***FBP*** = *bond futures position*.

- In an efficient market the opportunities for yield enhancement should not exist very long.
- But even in the absence of yield enhancement, money managers can use synthetic securities to hedge a portfolio position that they find difficult to hedge in the cash market either because of lack of liquidity or because of other constraints.

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Bond Portfolio Management Applications (continued)

❑ **Hedging**

- Hedging with futures calls for taking a futures position as a temporary substitute for transactions to be made in the cash market at a later date.
- When the net profit or loss from the positions is exactly as anticipated, the hedge is referred to as a *perfect hedge*.
- The difference between the cash price and the futures price is the *basis*.
- The risk that the basis will change in an unpredictable way is called basis risk.
- In bond portfolio management, typically, the bond to be hedged is not identical to the bond underlying the futures contract.
- This type of hedging is referred to as *cross hedging*.
- There may be substantial basis risk in cross hedging.

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Bond Portfolio Management Applications (continued)

❑ Hedging

- A *short* (or *sell*) *hedge* is used to protect against a decline in the cash price of a bond.
- A *long* (or *buy*) *hedge* is undertaken to protect against an increase in the cash price of a bond.
- The *hedge ratio* is chosen with the intention of matching the volatility (i.e., the dollar change) of the futures contract to the volatility of the asset.
- Assuming a fixed yield spread between the bond to be hedged and the cheapest-to-deliver issue, the hedge ratio is:

$$\textit{hedge ratio} = \frac{\textit{PVBP of bond to be hedged}}{\textit{PVBP of CTD}} \times \textit{conversion factor for CTD}$$

where ***PVBP*** or *price value of a basis point* refers to the *change in price for a one-basis-point change in yield*.

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Bond Portfolio Management Applications (continued)

❑ Hedging

- Given the hedge ratio, the number of contracts that must be short is:

$$\textit{number of contracts} = \textit{hedge ratio} \times \frac{\textit{par value to be hedged}}{\textit{par value of contact}}$$

- The formula for the hedge ratio to incorporate the impact of the yield beta is:

$$\textit{hedge ratio} = \frac{\textit{PVBP of bond to be hedged}}{\textit{PVBP of CTD}} \times \textit{conversion factor for CTD} \times \textit{yield beta}$$

where the yield beta is derived from the yield of the bond to be hedged regressed on the yield of the cheapest-to-deliver issue.

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Bond Portfolio Management Applications (continued)

❑ Allocating Funds between Stocks and Bonds

- To determine the approximate number of interest-rate futures contracts needed to change the market value of the portfolio allocated to bonds, assuming that the duration of the portfolio is to remain constant, we can use the formula:

$$\textbf{\textit{approximate number of contracts}} = \frac{(P_T - P_I)D_I}{D_F P_F}$$

where P_T is the *target market value allocated to bonds*: P_I = *initial market value of the portfolio*; D_I = *initial effective duration for the portfolio*; D_F = *effective duration for the futures contact*; and, P_F = *market value of the futures contract.*

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Summary

Common uses of futures contracts

- What is futures
- How are futures traded
- Different kinds of interest rate futures
- Uses of interest rate futures: Speculation and Hedging

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