Lecture 7: Fixed Income Markets.

I. Reading.
II. Money Market.
III. Long Term Credit Markets.
IV. Repurchase Agreements (Repos).
Lecture 7: Fixed Income Markets.

I. Reading.
   A. BKM, Chapter 2, Sections 2.1 and 2.2.
   B. BKM, Chapter 14, Sections 14.1-14.3 and 14.5.

II. Money Market.
   A. Definition.
      1. Money market instruments are those with maturities of one year or less.
   B. U.S. Treasury Bills.
      1. Introduction.
         a. These are obligations backed by the "full faith and credit" of the U.S. government. Among all money market instruments, T-bills are regarded as safest with respect to default risk.
         b. T-bills (and most money-market instruments) are discount instruments. They do not explicitly pay an interest rate. Instead they are sold below their par (face) value.
      2. Maturities.
         a. Issued weekly with maturities of 91 or 182 days.
         b. Issued monthly with a maturity of 12 months.
3. Bank Discount Rate.
   a. T-bills are quoted on a 360-day discount basis using the bank discount rate.
   b. The (bank) discount rate is defined:

   \[ \text{Price} = \text{Par} \left(1 - \frac{nr_{BD}}{360}\right) \Rightarrow r_{BD} = \frac{360}{n} \frac{\text{Par} - \text{Price}}{\text{Par}} \]

   where \( r_{BD} \) is the quoted discount rate and \( n \) is the number of days from settlement to maturity. (A 360-day year is commonly used in pricing money market instruments.)

   c. The word "discount" is used in many different contexts in finance. It is sometimes used to denote any interest rate used in a present value calculation, as in "the cash flow in year ten was discounted at a rate of 5%." In money market analysis, however, it is used very precisely as the interest rate used to compute the price (as above).

   d. Example: See WSJ clipping 2/16/05 for Treasury Bills on 2/15/05.

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Days to Mat.</th>
<th>Bid</th>
<th>Asked</th>
<th>Chg</th>
<th>Ask Yld.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 07 05</td>
<td>50</td>
<td>2.34</td>
<td>2.33</td>
<td>-0.01</td>
<td>2.37</td>
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</tbody>
</table>

   Buying at the ask bank discount rate of 2.33% on Tuesday 2/15/05 the trade settles on 2/17/01. Hence 50 days to maturity. The price paid (for $100 face value) is $100 \( (1 - \{50 \times 0.0233/360\}) = $99.676. \)
4. Holding period return.
   a. The holding period return from holding a T-bill until maturity is given by:

\[ R_{\text{hold}}(0,n) = \frac{\text{Par} - \text{Price}}{\text{Price}}. \]

   b. Example (cont): Apr 07 ‘05 T-bill, if purchased on 2/15/05, offers a 50 day holding period return of \( \frac{100-99.676}{99.676} = 0.3247\% \).

5. Bond-equivalent yield.
   a. The bond equivalent yield for \( n<183 \) (if not a leap year) can be calculated as follows:

\[ r_{\text{BEY}} = \frac{365}{n} R_{\text{hold}}(0,n). \]

   b. Since there are 365 days in a year, the bond equivalent can be thought of as an annual percentage rate (APR) with \( n \)-day compounding.

   c. The quoted “Ask Yield” in the WSJ is the bond equivalent yield.
   d. Example (cont): The bond equivalent yield for the Apr 07 ‘05 T-bill purchased on 2/15/05 is \( \frac{365}{50} \times 0.3247\% = 2.370\% \) which agrees with the WSJ quote of 2.37\%.
6. Primary Market.
   a. T-bills are initially sold at an auction.
   b. Two sorts of bids are accepted.
      (1) A competitive bid specifies an amount and a price.
      (2) A non-competitive bid may be entered for an amount up to $1 million. No price is specified. A non-competitive bid is the easiest way for a retail investor to buy T-bills.
   c. The Fed arranges the competitive bids in order of descending price (ascending yield). It then works its way down this list until the total amount bid for (plus the non-competitive interest) is equal to the amount it wishes to sell.
      (1) All successful bids, both competitive and non-competitive, are filled at the lowest competitive bid price that is filled.
      (2) The auction is single-price: all successful bidders pay the same price.
      (3) The Treasury does not price discriminate.

WSJ 3/16/05
7. When-issued-market.
   a. This market trades instruments which obligate the delivery of T-bills not yet issued at a predetermined price at their time of issue.
   b. So investors can lock in a particular price prior to the auction date.
   c. This instrument is an example of a forward contract on the T-bill.

   a. This is a telephone dealer network. Some quotes are communicated via screens, but there is no centralized trade reporting.
   b. The Fed has designated some dealers as primary dealers. These are the dealers that the Fed itself uses when conducting open market operations.
   c. Spreads on T-bills are narrow.
C. Other Money Market Instruments.

   a. Short-term corporate debt (usually less than one or two months).
   b. Issued in multiples of $100,000.
   c. Most issued by finance companies.
      (1) Captive finance companies (GMAC, Ford Credit, Chrysler Financial, General Electric Credit).
      (2) Bank (and bank-related) finance companies.
      (3) Independent finance companies.
   d. Comparison with T-bills.
      (1) less liquid.
      (2) more credit risk.
      (3) subject to state & local taxation.

2. Certificates of Deposit (CD's).
   a. CDS are issued by banks.
   b. Types.
      (1) Domestic CD's.
      (2) Eurodollar CD's ($ denominated CDS issued by banks outside of U.S.).
      (3) Yankee CD's ($ denominated CDS issued by foreign banks with offices in U.S.).
   c. Large denomination ($100000 or larger).
   d. Negotiable/non-negotiable.

3. Federal Reserve Bank reserves.
   a. In the federal funds market, member banks of the Federal Reserve System with excess reserves lend to those with a shortage.
   b. These loans which are usually overnight are arranged at a rate of interest called the federal funds rate.

4. London Interbank Offered Rate (LIBOR) Rate.
   a. Rate on dollar-denominated deposits at large London Banks.
   b. Used as a reference rate for floating rate loans and in the swap market.
Money Rates

The key U. S. and foreign annual interest rates below are a guide to general levels but don't always represent actual transactions.

Commercial Paper

Yields paid by corporations for short-term financing, typically for daily operation.

| A2/P2-rated nonfinancial | (second/tier) | 2.25% |
| A3/P3-rated nonfinancial | (toy-tier) | 0.75% |

2004 2005

Source: Federal Reserve

Prime Rate: 5.50% (effective 02/02/05). The base rate on corporate loans posted by at least 75% of the nation's 30 largest banks.

Discount Rate (Primary): 3.50% (effective 02/02/05).

Federal Funds: 2.75% high, 2.30% low, 2.63% near closing bid, 2.50% offered. Effective rate: 2.63%. Source: Prebon Yamaone (USA) Inc. Federal-funds target rate: 2.50% (effective 02/02/05).

Call Money: 4.25% (effective 02/02/05).

Commercial Paper: Placed directly by General Electric Capital Corp.: 2.72% 30 to 60 days; 2.32% 61 to 99 days; 2.93% 90 to 119 days; 2.99% 120 to 149 days; 3.07% 150 to 179 days; 3.16% 180 to 209 days; 3.22% 210 to 239 days; 3.27% 240 to 265 days; 3.32% 266 to 279 days.

Euro Commercial Paper: Placed directly by General Electric

Tuesday, March 15, 2005

Capital Corp.: 2.07% 30 days; 2.08% two months; 2.10% three months; 2.12% four months; 2.13% five months; 2.14% six months.

Dealer Commercial Paper: High-grade unsecured notes sold through dealers by major corporations: 2.74% 30 days; 2.83% 60 days; 2.94% 90 days.

Certificates of Deposit: 2.77% one month; 2.97% three months; 3.23% six months.

Bankers Acceptances: 2.75% 30 days; 2.86% 60 days; 2.97% 90 days; 3.03% 120 days; 3.12% 150 days; 3.20% 180 days.

Source: Prebon Yamaone (USA) Inc.

Eurodollar: 2.79% - 2.75% one month; 2.99% - 2.85% two months; 2.99% - 2.96% three months; 3.06% - 3.03% four months; 3.15% - 3.12% five months; 3.24% - 3.21% six months.

Source: Prebon Yamaone (USA) Inc.

London Interbank Offered Rates (Libor): 2.83000% one month; 3.03000% three months; 3.29563% six months; 3.69000% one year. Effective rate for contracts entered into two days from date appearing at top of this column.

Euro Libor: 2.10225% one month; 2.13400% three months; 2.17869% six months; 2.20600% one year. Effective rate for contracts entered into two days from date appearing at top of this column.

Euro Interbank Offered Rates (Euribor): 2.103% one month; 2.139% three months; 2.177% six months; 2.308% one year.

Source: Reuters.

Foreign Prime Rates: Canada 4.25%; European Central Bank 2.00%; Japan 1.37%; Switzerland 2.64%; Britain 4.75%.

Treasury Bills: Results of the Monday, March 14, 2005, auction of short-term U. S. government bills, sold at a discount from face value in units of $1,000 to $1 million: 2.735% 13 weeks; 3.000% 25 weeks. Tuesday, March 15, 2005 auction: 2.646% 4 weeks.

Oversight Repurchase Rate: 2.56%. Source: Garban Inter-capital.

Freddie Mac: Posted yields on 30-year mortgage commitments. Delivery within 30 days 5.73%, 60 days 5.73%, standard conventional fixed-rate mortgages: 3.375%, 2% rate capped one-year adjustable rate mortgages.

Fannie Mae: Posted yields on 30 year mortgage commitments (priced at par) for delivery within 30 days 5.748%, 60 days 5.809%, standard conventional fixed-rate mortgages. Constant Maturity Debt Index: 2.349% three months; 2.222% six months; 3.534% one year.

Merrill Lynch Ready Assets Trust: 1.90%

III. Long Term Credit Markets.
   A. U.S. Treasury Notes and Bonds.
      1. Introduction.
         a. The distinction between notes and bonds is one of original maturity: notes have an original maturity of 1-10 years; bonds have a maturity>10 years.
         b. A plain-vanilla bond is characterized by:
            (1) Maturity: when the bond will be repaid.
            (2) Par or face value: the amount that will be repaid at maturity.
            (3) Coupon rate: the rate used in computing the semiannual coupon payments (0.5 x coupon rate x par value gives the semiannual coupon).
            (4) Coupons are either paid on the 15th or at the end of the month.
            (5) The quoted prices are on the basis of $100 par, in dollars + 1/32nds.
         c. Example: See WSJ clipping for Govt Bonds and Notes on 2/15/05.

<table>
<thead>
<tr>
<th>Rate</th>
<th>Maturity Mo/Yr</th>
<th>Bid</th>
<th>Asked</th>
<th>Chg</th>
<th>Ask Yld.</th>
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<td>97:24</td>
<td>97:25</td>
<td>-2</td>
<td>3.60</td>
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</table>

(1) The time line for this bond:

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<th>2/15/05</th>
<th>8/15/05</th>
<th>2/15/06</th>
<th>8/15/08</th>
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<td>1</td>
<td>2</td>
<td>7</td>
<td>8</td>
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<tr>
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<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>+100</td>
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</table>

(2) Coupons for this note are paid on the 15th of the month.
(3) The asked price is 97+25/32=97.78125.
(4) Chg is the change in the asked price from the previous day in 32nds.
### Treasury Bonds, Notes and Bills

#### Explanatory Notes

Treasuries are short- to intermediate-term debt obligations of the United States Government, issued by the Treasury Department. Treasury securities generally offer a lower risk of default than corporate debt, making them a popular choice for investors seeking a stable, low-risk investment. The rates on Treasury securities are often used as a benchmark for other fixed-income investments.

#### Treasury Bonds & Notes

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<th>MATURITY</th>
<th>TYPE</th>
<th>ISSUED</th>
<th>ASK</th>
<th>MATURITY</th>
<th>TYPE</th>
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<td>102</td>
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<tr>
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#### U.S. Treasury Strips

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<th>ASK</th>
<th>MATURITY</th>
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<td>10/15/04</td>
<td>102</td>
</tr>
</tbody>
</table>

#### Sources

- Federal Reserve Bank of New York
- Wall Street Journal
- Bloomberg L.P.
2. Accrued Interest and the Quoted Price.
   a. The quoted price does not include accrued interest; so the quoted price is not the invoice price unless a coupon has just been paid.
   b. To get the invoice price from the quoted price, need to add accrued interest.
   c. Example (cont): The quoted asked price for the 3 Feb 09 note in the WSJ for 3/1/05 is 96:24 or 96.75. What would be the accrued interest on the 3 Feb 09 note and the invoice price?

   (1) Accrued interest is given by

   \[
   w(3/1/05) \times \frac{C}{2} = \frac{14}{181} \times 1.5 = 0.2330
   \]

   where

   - \( C \) is the coupon rate; and,
   - \( w(3/1/05) \) is the period between the last coupon payment and now expressed as a fraction of 6 months (called the accrual period).

   (2) The quoted asked price for the 3 Feb 09 note in the WSJ of 96.75 can be converted into the invoice price by adding the accrued interest of 0.2330 to obtain 96.9830.
3. Yield to maturity (YTM).
   a. Definition.
      (1) YTM is the interest rate such that the present value of the remaining cash flows from the note/bond exactly equals the invoice price.
      (2) The “Ask Yld” in the WSJ is the YTM expressed as an APR with semiannual compounding.
   b. Calculation.
      (1) Suppose the bond has just paid a coupon. Then the YTM expressed as an APR with semi-annual compounding satisfies:

\[ V_0 = C \times PVAF_{T M/2,N} + 100 \times PVIF_{T M/2,N} \]

where \( N \) is the number of coupon payments to maturity and \( V_0 \) is the invoice price today.

(2) If the bond has not just paid a coupon, the calculation is more complicated.

   c. Example (cont): On 2/15/05, the 3 Feb 09 note has just paid a coupon. Thus, can use the formula to get the invoice price which will also equal the quoted price:

\[ V_0 = 1.5 \times PVAF_{(3.6/2)\%,8} + 100 \times PVIF_{(3.6/2)\%,8} = 11.083 + 86.700 = 97.783 \approx 97.25. \]

   a. YTM is expressed as an APR with semi-annual compounding.
   b. If the bond has just paid a coupon:
      (1) Coupon Rate<YTM then Par>Price; i.e, the bond is selling at a discount relative to par.
      (2) Coupon Rate>YTM then Par<Price; i.e., the bond is selling at a premium relative to par.
   c. Example: See WSJ clipping for Govt Bonds and Notes on 2/15/05.

\[ \text{Rate} \quad \text{Maturity Mo/Yr} \quad \text{Bid} \quad \text{Asked} \quad \text{Chg} \quad \text{Ask Yld.} \]
\[ 3.5 \quad \text{Aug 09n} \quad 99:13 \quad 99:14 \quad -2 \quad 3.63 \]
\[ 6 \quad \text{Aug 09n} \quad 109:21 \quad 109:22 \quad -2 \quad 3.64 \]

(1) For 3.5 Aug 09 note, Coupon Rate<YTM and so Par>Price.
(2) For 6 Aug 09 note, Coupon Rate>YTM and so Par<Price.
B. U.S. Treasury Zero Coupon Bonds.
   1. Definition.
      a. "Zeroes" are bonds which have no intermediate payments, and repay the principal amount at maturity.
      b. In this respect, they are the same as T-bills, except that they are for longer maturities.
   2. Creation of Zero Coupon Bonds.
      a. Zero coupon bonds are created by 'stripping' coupon issues: STRIPS (Separate Trading of Registered Interest and Principal Securities).
      b. Prior to 1982, zero coupon bonds were created by investment banks. A bank would buy coupon bonds, place them in a trust and sell off zero-coupon bonds as claims on the trust.
      c. In 1982, the U.S. Treasury got into the act by allowing ownership of interest and principal payments to be registered separately. They can then be traded and priced separately.
      d. Example: WSJ on 2/16/05 reports quotes for Feb 09 principal and for Feb 09 coupon strips separately.
   3. A coupon bond can be regarded as a portfolio of zero-coupon bonds, each maturing at a different payment date. This observation is sometimes useful in solving bond pricing problems.
C. Corporate Bonds.
   1. Most are coupon bonds: Usually with semi-annual coupons.
   2. Default risk: Can be substantial which is a major difference as compared to treasuries.
   3. Seniority: Senior debt gets paid before junior debt in the event of default.
   4. Security: Some bond are secured by specified assets of the firm which means that in the event of default the proceeds from those assets are used to pay the secured debt before any other debt is paid.
   5. Covenants: Some bonds place restrictions on additional issues, dividends, and other corporate actions to increase the likelihood that the bondholders will get paid.
   6. Callable bond
      a. Issuer can repurchase at a specified price, usually par.
      b. Issuer may want to do this if interest rates are low since it allows the issuer to buy back a bond that otherwise would have a high price. The issuer can refinance at a lower interest rate.
   7. Putable bond: After a certain period, bondholder has the right to demand payment of the loan before maturity.
      a. Bond is convertible into a number of shares of common stock. The number is fixed at the time the bond is issued. The conversion is “one-way”: you can convert to stock, but not back to a bond.
      b. The timing of the conversion is the decision of the bondholder. BUT, the issuer can sometimes force conversion by threatening to call back the bond.
      c. A conversion feature is attractive, so a convertible bond can generally be issued with a lower coupon rate than straight debt.
      a. A sinking fund is a provision for the orderly retirement of the debt. It may take one of several forms.
         (1) Firm must repurchase bonds in the open market.
         (2) Firm repurchases bonds with call provisions.
      b. Note that the repurchase is an obligation.
D. Mortgage-backed Securities
   1. Mortgage-backed securities are bonds whose payments are secured by mortgage payments.
   2. Two main issuing agencies: Freddie Mac and Fannie Mae, both government-sponsored agencies.
   3. Issuance:
      a. When interest rates go up, banks have a fixed income from their mortgage contracts but need to pay a higher interest rate on deposits, leaving them exposed to interest rate risk.
      b. To reduce this interest rate risk exposure, banks sell their portfolios of mortgages to an issuing agency: i.e., the issuing agency underwrites the mortgages.
      c. The agency pools these mortgages together and sells them off as securities (mortgage-backed securities) to the general public.
   4. Market for mortgage backed securities is currently worth 6 trillion dollars, 50% more than the 4 trillion for government bonds.

E. Interest Rate Swaps.
   1. Basic arrangement.
      a. An agreement between the buyer and seller of the swap.
      b. The buyer agrees to pay a fixed rate on the notional principal until maturity of the swap.
      c. The seller agrees to pay a floating rate (often determined by the LIBOR rate) on the notional principal until maturity.
      d. No money changes hands at the time that the swap is entered into: so the notional principal never changes hands.
      e. The fixed rate is referred to as the swap rate.

Fixed-rate Payer (bought the swap) fixed rate → Floating-rate Payer (sold the swap) floating rate
IV. Repurchase Agreements (Repos).

A. Basic arrangement.
   1. Repos are loans collateralized by securities.
      Initiation: lender $ (securities) borrower
      To settle: lender $(securities) borrower

B. Terminology.
   1. Dealer is the borrower (and so client is the lender):
      a. "repo".
      b. "reversing out".
      c. "selling collateral".
   2. Dealer is the lender (and so client is the borrower):
      a. "reverse repo".
      b. "reversing in"
      c. "buying collateral"
   3. Explains why Repo rate is less than Reverse Repo rate on Bloomberg.

C. Using Repos to sell short.
   1. The lender of $ can also be viewed as a borrower of securities (which will
      be returned when the loan is repaid).
   2. Thus, the lender could then “sell short” the security using the borrowed
      securities.
   3. The dealer uses a reverse repo to sell short the security.
   4. The client uses a repo to sell short the security.

D. Securities.
   1. Historically, the repo market developed for U.S. government securities.
   2. Now you can repo practically any kind of fixed income instrument, across
      currencies.
   3. You can also repo risky securities such as emerging market debt.