Readings and problems

- Readings
  - 14.1 Bond characteristics (par, maturity, coupon)
  - 14.2 Pricing
  - 14.3 Yields and realized compound returns
  - 14.4 Evolution of bond prices over time; holding period returns; zero-coupon bonds
  - 14.5 Default, credit ratings
- Practice problems 1-4, 9, 16, 19, 25, 26, 27; CFA 3
Useful links

- Fidelity.com → Research → Fixed [Income]
  - Fidelity also has yield curves
- Finra.org → Investors → Bonds
  - Finra also has trade data for corporate bonds
- TreasuryDirect.gov
  - For US Treasury bonds and auctions

Characteristics

- Bonds and notes are debt securities.
  - The issuer (seller), e.g. a government or corporation is the borrower.
  - The buyer (investor) is the lender.
- The maturity is when the loan is repaid.
  - Notes have 1-10 yr maturities;
  - Bonds have >10 yr maturities.
  - “Note” or “Bond” determined by the original maturity (at time of issue)
- Par or face value: the amount that will be repaid at maturity
  - Annual coupon payment = coupon rate \times \text{Par}.
    (For semiannual bonds, half the annual coupon is paid semiannually.)
- The cash flows to the owner of the bond are the stream of coupon payments and the repayment of the par value (at maturity)
- Next page: A certificate.
Characteristics (cont’d)

- Bonds and notes are *fixed income securities.*
  - “Fixed” refers to the *promised* cash flows
    - These promises might not be kept: the issuer might default.
    - Prices and returns aren’t fixed: they are determined in the market.
- Money market securities have a maturity of a year or less.
  - They do not pay an explicit interest.
  - Example: a T-bill is purchased at a discount from par. The buyer receives par value at maturity.
- Bonds and notes *do* pay an explicit interest.
Bond pricing conventions

- Bond prices are quoted as a percent of par
  - A quote of 98.346 for a bond with a par value of $1,000 means $983.46
- Market price < par
  - The bond is “selling at a discount”
- Price > par
  - ... “selling at a premium”


<table>
<thead>
<tr>
<th>Coupon</th>
<th>Maturity</th>
<th>Price</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.00</td>
<td>05/15/2037</td>
<td>112.734</td>
<td>4.206</td>
</tr>
<tr>
<td>4.38</td>
<td>02/15/2038</td>
<td>101.977</td>
<td>4.253</td>
</tr>
<tr>
<td>4.50</td>
<td>05/15/2038</td>
<td>104.102</td>
<td>4.248</td>
</tr>
<tr>
<td>3.50</td>
<td>02/15/2039</td>
<td>87.219</td>
<td>4.277</td>
</tr>
</tbody>
</table>

- These bonds have similar maturities, but different coupons and different prices.
- The yields (to maturity) are similar.
- What is the yield? How is it computed? What does it mean?
The yield to maturity \((y, \text{YTM})\)

- It is an implied rate of return that buyer would realize by
  - purchasing the bond today at its market price and
  - holding it to maturity.
- To compute the yield
  - Define the cash flows
  - Solve for the interest rate.

Example

- A bond has $100 par; 9% coupon, paid annually; 5 years remaining until maturity; the market price is 102.5 (percent of par)
- Timeline for bond CF’s

\[
\begin{array}{cccccc}
0 & 1 & \ldots & 4 & 5 \\
-102.5 & 9 & 9 & 9 & +100
\end{array}
\]

- Note: in discussing yields, we’ll usually assume that we’re buying the bond at the beginning of a coupon period.
Two TVM review problems

- I buy a CD for $80 today. It will mature in five years for $100. What is my rate of return?
  - $5 \rightarrow n \ -80 \rightarrow pv \ 100 \rightarrow fv$: $i \rightarrow 4.56%$
- I buy an annuity for $40 today. It will make five annual payments of $10. What is my rate of return?
  - $5 \rightarrow n \ -40 \rightarrow pv \ 10 \rightarrow pmt$: $i \rightarrow 7.93%$
- Both of these interest rates are special cases of the internal rates of return (IRR)

Back to the bond example

- Timeline for bond CF’s: 0 1 ... 4 5
  - $-102.5 \rightarrow 9 \rightarrow 9 \rightarrow +100$
- What is my rate of return?
  - There is both an annuity and a single payment.
  - $5 \rightarrow n \ -102.5 \rightarrow PV \ 9 \rightarrow PMT \ 100 \rightarrow fv$
    - *compute* $i = 8.37\% = ytm$
  - The *ytm* is also a special case of the internal rate of return (IRR).
Going from yields to prices

- In computing $y$ we take the price as given.
- Sometimes we work in the other direction
  - “If $y$ were $x\%$, then the price would be ...”
- What would the price be at a yield of 10%?
  - No need to reenter all the data.
  - $10 \rightarrow i \text{ solve for } PV = -96.21$
- ... at a yield of 7%?
  - $7 \rightarrow i \text{ solve for } PV = -108.20$

Figure 14.3: The Inverse Relationship Between Bond Prices and Yields

- A bond price is a present value.
- When the interest rate in a PV calculation goes up, the PV falls.
Semiannual bonds

- For most bonds
  - Coupon payments are semiannual
  - Half the annual coupon payment is made at 6-month intervals.
  - The *ytm* is an APR with semiannual compounding.
- With money-market securities, sometimes for comparison purposes, we also compute an APR with semiannual compounding (called the *bond equivalent yield*).

Example

- $1,000 par; 9% coupon, paid semiannually; 5 years remaining, selling at 1,025.
- Timeline (in 6-month periods)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>...</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1,025</td>
<td>45</td>
<td>45</td>
<td>45+1,000</td>
</tr>
</tbody>
</table>

- The yield to maturity
  - HP-10BII: 2 → p/yr → -1,025 → pv → 45 → pmt → 10 → n → 1000 → fv → i → 8.38%
  - HP-12c: -1,025 → pv → 45 → pmt → 10 → n → 1000 → fv → i → 4.19 per 6 months
  - ... x 2 = 8.38%
- These are APRs compounded semiannually.
In-class problems

- An 8% bond (semiannual) has a price of 110.20 and a maturity of 11.5 years.

- What is the ytm?

- At a price of 94.40, what is the ytm?

- At a ytm of 8.5%, what is the price?

Embedded problem

- A 5% semiannual bond has a maturity of 22 years.

- At a market price of 103.22, what is the ytm?

- At a ytm of 4.5%, what is the market price?
Embedded problem (answer)

- A 5% semiannual bond has a maturity of 22 years.
- At a market price of 103.22, what is the \( \text{ytm} \)?
  \[
  2 \rightarrow P/YR, \ 100 \rightarrow FV, \ 2.5 \rightarrow PMT, \ 44 \rightarrow n,
  \]
  \[-103.22 \rightarrow PV \Rightarrow I/YR = 4.76\%
  \]
- At a \( \text{ytm} \) of 4.5%, what is the market price?
  \[
  4.5 \rightarrow I/YR \Rightarrow PV = -106.94
  \]

Embedded problem

- A 9-year 11% coupon semiannual bond is selling at 96.23. What is the yield on the bond?
- If the yield does not change, what will be the bond’s price one year from now (when there are eight years remaining)?
- What is the bond’s percentage price change over the year?
Embedded problem (answer)

- A 9-year 11% coupon semiannual bond is selling at 96.23. What is the yield on the bond?
  - \(2 \rightarrow \text{P/YR}, 18 \rightarrow n, 5.5 \rightarrow \text{PMT}, 100 \rightarrow FV,\)
  - \(-96.23 \rightarrow PV \Rightarrow I/YR = 11.69\%\)
- If the yield does not change, what will be the bond’s price one year from now (when there are eight years remaining)?
  - \(16 \rightarrow n \Rightarrow PV = -96.48\)
- What is the bond’s percentage price change over the year?
  - \(\frac{96.48 - 96.23}{96.23} = 0.26\%\)

YTM calculation for the 3.5% bond (data from 6/4/2010)

<table>
<thead>
<tr>
<th>Issuer Name</th>
<th>Coupon</th>
<th>Maturity</th>
<th>Callable</th>
<th>Moody's</th>
<th>S&amp;P</th>
<th>Pitch</th>
<th>Price</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNITED STATES TREASURY</td>
<td>3.50</td>
<td>02/15/2039</td>
<td>No</td>
<td>Aaa</td>
<td>AAA</td>
<td>AAA</td>
<td>87.219</td>
<td>4.277</td>
</tr>
</tbody>
</table>

- No. of coupon pmts in 2010=1; in 2039,1; in 2011-2038,56
- \(1 + 56 + 1 = 58 \rightarrow n\)
- \(\frac{3.50}{2} = 1.75 \rightarrow \text{pmt}\)
- \(-87.219 \rightarrow PV\)
- \(100 \rightarrow FV\)
- \(i \rightarrow 2.1365\% \times 2 = 4.273\% = y\)
- Our calculation assumes that the next coupon on six months away (it is actually about two)
Real-world bond calculations

- Trades might take price in the middle of a coupon period (not just at the beginning).
- The purchase price is adjusted.
  - Invoice price = the quoted price + accrued interest.
  - Accrued interest is computed between coupon payment dates using simple interest (not compound interest).
- The yield calculation is also modified.

Accrued interest example

- On December 1, 2008, we buy a 10% coupon bond ("$100 par") that pays interest on January 15 and July 15.
- The last coupon payment was July 15, 2008.
- The next payment is Jan 15, 2009.
- The current coupon period has 184 days.
  - July 15, 2008 → Jan 15, 2009 = 184 days.
- We are 139 days in to the current period.
  - July 15, 2008 → Dec 1, 2008 = 139 days.
- The accrued interest is \((139 / 184) \times 5 = 3.78\)
- This is added to the quoted price of the bond.
- To simplify calculations, we usually assume that bonds are purchased and sold at the beginning of a coupon period, so that there is no accrued interest.
The price/yield relation in the middle of a coupon period (FYI Only)

How to interpret the ytm

- Example: An annual bond has $100 par; 9% coupon; 5 years remaining until maturity; the market price is 102.5.

- Timeline for bond CF’s

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>…</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>-102.5</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
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<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

- Ytm=8.37%

- “I deposit 102.5 in a bank account that pays 8.37%. In five years I’ll have …?”

- \( 1 \to \frac{P}{YR}, 5 \to n, -102.5 \to PV, 8.37 \to \frac{I}{YR} \Rightarrow FV = 153.20 \)

- Is this equivalent to the bond?
Reworking the yield

- A bond does not give us flexibility of “leaving money on deposit”.
- If you buy a coupon bond and you want to realize everything at maturity, the earlier coupon payments must be invested (somewhere else).
- The purchase-to-maturity return with reinvestment is called the Realized Compound Return (RCR)

Example (cont’d, with annual coupon)

- Suppose the coupon can be invested at 8.37% (the ytm)
- Then the FV of the bond’s payments is:
  - 5 → n, 90 → PMT, 8.37 → \( \frac{I}{YR} \) ⇒ FV = 531.90
- The timeline (net of this reinvestment) becomes:
  - 0 1 ... 5
  - -1025 0 531.90+1,000=1,531.90
- Realized compound return: \(-1025 \rightarrow PV, 5 \rightarrow n, 1531.90 \rightarrow FV \Rightarrow I/YR = 8.37\%\)
If the reinvestment rate is 4%, the RCR is ...

- The FV of the coupon payments is 487.37.
- The timeline reflecting the reinvestment is:
  
  \[
  \begin{array}{cccccc}
  0 & 1 & \ldots & 5 \\
  -1,025 & 0 & 1,487.37 \\
  \end{array}
  \]
- The RCR is:
- \[-1025 \rightarrow PV, \ 5 \rightarrow n, \ 1487.37 \rightarrow FV \Rightarrow I/YR = 7.73\% (< ytm)\]

Embedded Problem

- An annual 8% coupon bond, with 14 years remaining is selling at 110.
- What is the YTM?
- If the coupon payments can be reinvested at 4%, what is the realized compound yield?
An annual 8% coupon bond, with 14 years remaining is selling at 110. What is the YTM?

14 → n, 8 → PMT, 100 → FV, −110 → PV ⇒ I/YR = 6.87%

If the coupon payments can be reinvested at 4%, what is the realized compound yield?

The FV of the reinvested coupons is:

14 → n, 8 → PMT, 4 → I/YR ⇒ FV = 146.34

Total receipts at year 14 are 146.34 + 100 = 246.34

−110 → PV, 246.34 → FV, 14 → n ⇒ I/YR = 5.928

A bond’s price path depends on whether the YTM changes over the life of the bond.

The simplest case is when YTM does not change.
Bond prices over time if $y$ does not change

![Graph showing bond price evolution over time](image)

Figure 14.6 Prices over time of 30-year maturity, 6.5% coupon bonds. Bond price approaches par value as maturity approaches.

Holding period return (in these examples)

- The rate of return assuming
  - We buy immediately after a coupon payment
  - And sell immediately after the next coupon payment
The holding period return (HPR): An example

- 12 year, 1,000 par, 10% coupon, selling at 
  \( P_0 = 1071.61 \). Then the yield is \( y = 9\% \).
  - \(-1,071.61 \rightarrow pv \ 12 \rightarrow n \ 100 \rightarrow pmt \ 1,000 \rightarrow fv \ i \rightarrow 9\% \)

- Assume that \( y \) stays at 9%. In one year, 
  \( P_1 = 1,068.05 \)
  - This is the PV of the remaining cash flows. To get this number, don’t clear the calculator. Just change \( n \): 
    11 \( n \); \( pv \rightarrow 1,068.05 \)

- The HPR over the year is 
  \[
  \text{HPR} = \text{current yield (coupon/price) + capital gains (price appreciation)}
  \]
  \[
  = \frac{100}{1,071.61} + \frac{(1,068.05 - 1,071.61)}{1,071.61}
  \]
  \[
  = 9.33\% - 0.33\% = 9\% (= YTM)
  \]

- Suppose that \( y \) at the end of the year is 12%. What is \( P_1 \)?
  What is the HPR? 
  \[
  \frac{(881 - 1072)}{1072} - 17.8\%
  \]
  \[
  - 8.47\%
  \]
Zero coupon bonds

- If the coupon rate is zero, the entire return comes from price appreciation.
- Example a 10-year zero, $100 par, YTM=9%
  - $P_0 = PV of 100 @ 9% for 10 years = 42.241$
  - $P_1 = PV of 100 @ 9% for 9 years = 46.043$
- Zero coupon bonds avoid reinvestment risk (uncertainty about rates at which coupon receipts can be reinvested).

Creation of zeros.

- A coupon bond can be viewed as a portfolio of zeros
- 10-year, 10% coupon, 1,000 par bond =
  - 1-year, 100 par zero
  - + 2-year, 100 par zero
  - ...
  - + 10-year, 100 par zero
  - + 10-year, 1,000 par zero
- We’re taking the time-line and considering each cash flow separately:

0: 100
1: 100
2: 100
...:
10: 100
1,000
Creation of zeros (Stripping)

- Stripping is the process of spinning off each coupon and principal repayment as a separate zero.
- Prior to mid-1970’s there was little perceived need for zeros because interest rates were relatively stable.
- Prior to 1982, zeros were fashioned by investment banks (CATS, TIGRS, etc.).
- 1982. U.S. Treasury starts STRIPS program (Separate Trading of Registered Interest and Principal Securities)
- 1987. Treasury allows rebundling of components to recreate original bond (“reconstitutions”)

Price quotes for short- and long-maturity zeros (fidelity.com, 30 October 2013)

<table>
<thead>
<tr>
<th>Description</th>
<th>U.S. Treas Sec Stripped Int PMT 0.0000% 11/15/2013 Int PMT Trade</th>
<th>U.S. Treas Sec Stripped Int PMT 0.0000% 08/15/2042 Int PMT Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUSIP</td>
<td>Log in for CUSIP</td>
<td>Log in for CUSIP</td>
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<tr>
<td>Pay Frequency</td>
<td>AT MATURITY</td>
<td>AT MATURITY</td>
</tr>
<tr>
<td>Coupon</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Maturity Date</td>
<td>11/15/2013</td>
<td>08/15/2042</td>
</tr>
<tr>
<td>Moody’s Rating</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>S&amp;P Rating</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Material Events / Issuer Events</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Call Protection</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Sinking Fund Protection</td>
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<td>YES</td>
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<tr>
<td>Price/Yield</td>
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<td></td>
</tr>
<tr>
<td>Price (Ask)</td>
<td>99.990</td>
<td>32.935</td>
</tr>
<tr>
<td>Yield to Worst (Ask)</td>
<td>0.040</td>
<td>3.695</td>
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<tr>
<td>Third Party Price</td>
<td>Log in for Price</td>
<td>Log in for Price</td>
</tr>
<tr>
<td>Risk/Price Ratio</td>
<td>12</td>
<td>15</td>
</tr>
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</table>

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Original issue discount (OID) bonds

- Suppose that an investor buys a 12-year, $1,000 par bond for \( P_0 = \$496.97 \).
  - The YTM is 6%
- If the YTM does not change, then in one year the bond is worth \( P_1 = \text{PV of 1,000 in 11 years at 6\%} = 526.79 \).
- The “mark to market” appreciation is 29.82.
  - This is a 6% increase over the purchase price.
- The IRS views 29.82 as interest income.

Corporate bonds

- Marketable debt issued by corporations
- Differences relative to government bond
  - higher default risk
  - wider range of features
Call Provisions

- A call provision allows the issuer to repurchase the bond.
  - The repurchase price is stated when the bond is issued (par or higher).
- The call effectively repays the debt early.
- The issuer will usually want to do this if interest rates have fallen.
  - Compare: homeowner refinancing a mortgage
- Corporate bonds are often callable.
- US Treasury bonds are (currently) not callable.

Example (Fidelity.com, Wed., 2 Nov 2011)

<table>
<thead>
<tr>
<th>Offering</th>
<th>Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FEDERAL NATL MTG ASSN 5.17000% 02/09/2037 CALL</strong></td>
<td></td>
</tr>
<tr>
<td>CUSIP</td>
<td>3136F8FP5</td>
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<td>Pay Frequency</td>
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<tr>
<td>Moody's Rating</td>
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<td>S&amp;P Rating</td>
<td>AA+</td>
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<td>Issuer Events</td>
<td>NO</td>
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<tr>
<td>Call Protection</td>
<td>NO View Schedule</td>
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<td>Bond Type</td>
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<tr>
<td>Interest Accrual Date</td>
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</table>

Originally issued 30 Jan 2007
### FEDERAL NATL MTG ASSN 5.17000% 02/09/2037 CALL

#### Basic Analytics

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (Ask)</td>
<td>110.695</td>
</tr>
<tr>
<td>Yield to Worst (Ask)</td>
<td>2.961%</td>
</tr>
<tr>
<td>Yield to Maturity</td>
<td>4.459657%</td>
</tr>
<tr>
<td>Third Party Price</td>
<td>111.975</td>
</tr>
<tr>
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<td>T1</td>
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<td>Price Test</td>
<td>PP</td>
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<tr>
<td>Risk Test</td>
<td>RP</td>
</tr>
<tr>
<td>Spread to Treasuries</td>
<td>0.049</td>
</tr>
<tr>
<td>Treasury Benchmark</td>
<td>26 YR. (4.750% 02/15/2037)</td>
</tr>
</tbody>
</table>

#### Complex Analytics

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration to Worst</td>
<td>4.592</td>
</tr>
<tr>
<td>Option Adjusted Duration</td>
<td>9.561</td>
</tr>
<tr>
<td>Option Adjusted Spread</td>
<td>123.308</td>
</tr>
<tr>
<td>Convexity to Worst</td>
<td>0.251</td>
</tr>
<tr>
<td>Option Adjusted Convexity</td>
<td>2.748-</td>
</tr>
</tbody>
</table>

In Excel:

```
YIELD(DATE(2011,11,2), DATE(2017,2,9), 0.0517, 110.695, 100, 2, 3)
```

```
YIELD(DATE(2011,11,2), DATE(2037,2,9), 0.0517, 110.695, 100, 2, 3)
```

---

#### Call Schedule

**FEDERAL NATL MTG ASSN 5.17000% 02/09/2037 CALL**

<table>
<thead>
<tr>
<th>Call Date</th>
<th>Call Price</th>
<th>Call Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/09/2017</td>
<td>100.000</td>
<td>Par Call</td>
</tr>
<tr>
<td>08/09/2017</td>
<td>100.000</td>
<td>Par Call</td>
</tr>
<tr>
<td>02/09/2018</td>
<td>100.000</td>
<td>Par Call</td>
</tr>
<tr>
<td>06/09/2018</td>
<td>100.000</td>
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</tr>
<tr>
<td>02/09/2019</td>
<td>100.000</td>
<td>Par Call</td>
</tr>
<tr>
<td>08/09/2019</td>
<td>100.000</td>
<td>Par Call</td>
</tr>
</tbody>
</table>

- **Call Defased**: NO
- **Continuously Callable**: NO
- **Callable After**: --
Yield to worst (for a callable bond)

- Yield to maturity if bond is selling at a discount from the call price
  - Recall: a bond sells at a discount from par when \( ytm > \) coupon rate
- Yield to call if bond is selling at a premium to the call price
  - It is likely that the bond will be called.

21. A 30-year maturity, 8% coupon bond paying coupons semiannually is callable in 5 years at a call price of $1,100. The bond currently sells at a yield to maturity of 7% (3.5% per half-year).

   a. What is the yield to call?
   b. What is the yield to call if the call price is only $1,050?
   c. What is the yield to call if the call price is $1,100, but the bond can be called in 2 years instead of 5 years?

\[ \text{\texttt{60}} \rightarrow n \ \ 4 \rightarrow \text{PMT} \ 1,000 \rightarrow \text{FV} \ 1,000 \rightarrow \text{PV} = \ldots 1,124.72 \ \text{price} \]

\[ \text{\texttt{10}} \rightarrow n \ \ 1,100 \rightarrow \text{FV} \ \ 1,100 \rightarrow \text{I/YR} \ 6.736\% = \text{y to call} \]

\[ \text{\texttt{b. 1,050}} \rightarrow \text{FV} \ \ 1,050 \rightarrow \text{I/YR:} \ 5.953\% \ y+\text{to call} \]

\[ \text{\texttt{c. 1,100}} \rightarrow \text{FV} \ 4 \rightarrow n \ \ 1,100 \rightarrow \text{I/YR:} \ 6.062\% \ y+\text{to call}. \]
30. Masters Corp. issues two bonds with 20-year maturities. Both bonds are callable at $1,050. The first bond is issued at a deep discount with a coupon rate of 4% and a price of $580 to yield 8.4%. The second bond is issued at par value with a coupon rate of 8 ¾%.

a. What is the yield to maturity of the par bond? Why is it higher than the yield of the discount bond?
b. If you expect rates to fall substantially in the next 2 years, which bond would you prefer to hold?  
c. In what sense does the discount bond offer “implicit call protection”?

\[ y_{\text{par}} = 8 \frac{3}{4} \% < y_{\text{4\% bond}} (8.4\%) \]

b. Both ytm's fall to 6%  
\[ 8 \frac{3}{4} \% \rightarrow 6 \% \rightarrow n = 20 \rightarrow \text{I/YR} = 87.50 \rightarrow \text{PMT} \rightarrow FV = 1,000 \rightarrow FV \rightarrow \text{PV} = 1,315 \]

\[ \text{Price of the 4\% bond} = 771 \rightarrow \text{PV} = 1,074 \]

In this situation, it would make sense for the issuer to call the par bond (because its pv is > call price), but not the 4% bond (its pv is < call price).

c. For price of the 4% bond to hit 1050, the interest rate would have to fall to 3.81% (20 \rightarrow n, 40 \rightarrow \text{pmt}, 1050 \rightarrow \text{pv}, 1050 \rightarrow \text{fv}; i=3.81\%). So interest rates have to fall by a very large amount to render the 4% bond callable. The par bond will be called much sooner.
Puttable bonds

- The bond holder has the right to demand payment prior to maturity.
- This right can only be exercised on certain dates.
- The right may be valuable to the holder if the credit worthiness of the firm has deteriorate.

Extendable/extendible bonds

- The holder has the option to extend the term of the bond past the original maturity.
- Note: BKM use “extendable” synonymously with “puttable”. They are different.
Convertible bonds

- At the bondholder’s option, the bond may be converted into some other security (usually stock shares).
- The number of shares is set when the bond is issued.
- Conversion value: the market value of the stock (if the bond were to be converted).

Sinking funds

- A bond requires repayment of a large amount (the par) at maturity.
- A sinking fund spreads the repayment over the life of the bond.
- Each year, borrower repurchases some of the bonds
  - via open market purchase, or ...
  - calling the bonds
Other features

- Subordination
  - Requires that subsequent bond issues have lower seniority (priority).

- Collateral
  - Mortgage bonds are associated with (“secured by”) a specific asset (that can be seized and sold).
  - Debentures are unsecured

BKM Problem 14-25

25. Assume that two firms issue bonds with the following characteristics. Both bonds are issued at par.

<table>
<thead>
<tr>
<th></th>
<th>ABC Bonds</th>
<th>XYZ Bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue size</td>
<td>$1.2 billion</td>
<td>$150 million</td>
</tr>
<tr>
<td>Maturity</td>
<td>10 years *</td>
<td>20 years</td>
</tr>
<tr>
<td>Coupon</td>
<td>9%</td>
<td>10%</td>
</tr>
<tr>
<td>Collateral</td>
<td>First mortgage</td>
<td>General debenture</td>
</tr>
<tr>
<td>Callable</td>
<td>Not callable</td>
<td>In 10 years</td>
</tr>
<tr>
<td>Call price</td>
<td>None</td>
<td>11%</td>
</tr>
<tr>
<td>Sinking fund</td>
<td>None</td>
<td>Starting in 5 years</td>
</tr>
</tbody>
</table>

*Bond is extendible at the discretion of the bondholder for an additional 10 years.

Ignoring credit quality, identify four features of these issues that might account for the lower coupon on the ABC debt. Explain.
Default risk and ratings

- Debt is rated for safety by Standard & Poor’s and Moody’s.
- S&P Ratings
  - “Investment grade” AAA, AA, A, BBB
  - “Speculative” BB, B,
  - “Very poor” CCC
  - “In default” D
  - “Junk” / “High yield”: speculative or worse
- For some purposes (insurance company reserves) only investment grade bonds are allowed.

Ratings (S&P)

- AAA ("extremely strong capacity to meet ... obligations")
  - AA, A
- BBB, BB, B
- CCC, CC
- “Speculative” anything BB or lower
  ("large uncertainties or major exposures to adverse conditions")
- Next page: Benchmark yields (Wall St. Journal online, 30 March 2014)
Credit default swaps

- Commonly described as “insurance” against default.
- Example: insurance for $100 M worth of ABC corporate bonds, for five years.
  - $100M is the notional amount
  - ABC is the “reference entity”
  - The bond issue is the “reference obligation”
  - Five years is the “tenor” of the swap.
- One side (the protection buyer) makes fixed payments for the life of the contract
- The annual payment is quoted as a % of the notional value (“CDS spread”)
- Other side (the protection seller) makes a payment if and only if ABC experiences a “triggering event”
Typical triggering events

- ABC fails to make a promised payment on the bond
- ABC enters bankruptcy
- Debt is restructured
- ABC negotiates with its lender to change the terms of the loan

Payment in event of triggering event

- Physical settlement
  - Protection buyer ("the insured") delivers bonds to protection seller.
  - Protection seller ("the insurer") pays par value to the buyer.
- Cash settlement
  - Protection seller pays buyer (par value) – (market value)
  - This is intended to represent the economic loss.
- Note: both settlement conventions involve a cash payment.
Hedging and speculation

- With physical settlement, buyers are mostly institutions that already hold the debt.
- With cash settlement, anyone might speculate on the credit worthiness of the firm.
- We’re just buying a number that might go up or down.

To buy default insurance on Barrick debt, the annual cost would be $2.1088 per $100 par value.
Treasury Inflation Protected Securities (TIPS)

- Coupon and principal payments are indexed for inflation.
  - The nominal amounts rise with inflation (and fall with deflation).
  - These amounts depend on the actual inflation rate.
- Example: an annual TIPS with a 3-year maturity and a 4% coupon rate.

<table>
<thead>
<tr>
<th>Year</th>
<th>Inflation</th>
<th>Par Value</th>
<th>Coupon Payment</th>
<th>Principal Repayment</th>
<th>Total Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
<td>$1,000.00</td>
<td>Throughout</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>1</td>
<td>2%</td>
<td>$1,020.00</td>
<td>$40.80</td>
<td>$0</td>
<td>$1,060.80</td>
</tr>
<tr>
<td>2</td>
<td>3%</td>
<td>$1,050.60</td>
<td>$42.02</td>
<td>$0</td>
<td>$1,092.62</td>
</tr>
<tr>
<td>3</td>
<td>1%</td>
<td>$1,061.11</td>
<td>$42.44</td>
<td>$1,061.11</td>
<td>$1,103.55</td>
</tr>
</tbody>
</table>
Bond trading: US Treasuries

- Treasury bills, notes and bonds are originally sold in auctions (run by the Federal Reserve Bank of New York).
- Secondary trading
  - Electronic (limit order) platforms.
    - eSpeed (owned by NASDAQ)
    - BrokerTec (owned by ICAP)
  - Retail traders do not have access to these systems.
  - There is no consolidated last sale reporting.

Bond trading: corporates

- Almost all corporate debt is originally issued in the traditional investment banking process (book-building).
- Secondary markets
  - No significant electronic platforms have emerged.
  - Bids and asks are posted by dealers; to buy or sell, you contact a dealer.
  - Last sale prices are reported on FINRA's TRACE system.
  - Trading costs are generally high, especially for retail traders.
29. A large corporation issued both fixed- and floating-rate notes 5 years ago, with terms given in the following table:

<table>
<thead>
<tr>
<th></th>
<th>9% Coupon Notes</th>
<th>Floating-Rate Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue size</td>
<td>$250 million</td>
<td>$280 million</td>
</tr>
<tr>
<td>Original maturity</td>
<td>20 years</td>
<td>10 years</td>
</tr>
<tr>
<td>Current price (% of par)</td>
<td>93</td>
<td>98</td>
</tr>
<tr>
<td>Current coupon</td>
<td>9%</td>
<td>8%</td>
</tr>
<tr>
<td>Coupon adjusts</td>
<td>Fixed coupon</td>
<td>Every year</td>
</tr>
<tr>
<td>Coupon reset rule</td>
<td>—</td>
<td>1-year T-bill rate + 2%</td>
</tr>
<tr>
<td>Callable</td>
<td>10 years after issue</td>
<td>10 years after issue</td>
</tr>
<tr>
<td>Call price</td>
<td>106</td>
<td>102.50</td>
</tr>
<tr>
<td>Sinking fund</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Yield to maturity</td>
<td>9.9%</td>
<td>—</td>
</tr>
<tr>
<td>Price range since issued</td>
<td>$85–$112</td>
<td>$97–$102</td>
</tr>
</tbody>
</table>

a. Why is the price range greater for the 9% coupon bond than the floating-rate note?
b. What factors could explain why the floating-rate note is not always sold at par value?
c. Why is the call price for the floating-rate note not of great importance to investors?
d. Is the probability of a call for the fixed-rate note high or low?
e. If the firm were to issue a fixed-rate note with a 15-year maturity, what coupon rate would it need to offer to issue the bond at par value?
f. Why is an entry for yield to maturity for the floating-rate note not appropriate?