Material for lecture 12 will use following transparencies. All tables and figures are from chapter 6 of the textbook.
Risk Structure of Long Bonds in the United States
Increase in Default Risk on Corporate Bonds

(a) Corporate bond market

(b) Default-free (U.S. Treasury) bond market
Analysis of Figure 2: Increase in Default Risk on Corporate Bonds

Corporate Bond Market
1. $RET^e$ on corporate bonds $\uparrow$, $D^c \downarrow$, $D^c$ shifts left
2. Risk of corporate bonds $\uparrow$, $D^c \downarrow$, $D^c$ shifts left
3. $P^c \downarrow$, $i^c \uparrow$

Treasury Bond Market
4. Relative $RET^e$ on Treasury bonds $\uparrow$, $D^T \downarrow$, $D^T$ shifts right
5. Relative risk of Treasury bonds $\downarrow$, $D^T \uparrow$, $D^T$ shifts right
6. $P^T \uparrow$, $i^T \downarrow$

Outcome:
Risk premium, $i^c - i^T$, rises
## Bond Ratings

### Table 1: Bond Ratings by Moody’s and Standard and Poor’s

<table>
<thead>
<tr>
<th>Rating</th>
<th>Moody’s</th>
<th>Standard and Poor’s</th>
<th>Descriptions</th>
<th>Examples of Corporations with Bonds Outstanding in 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaa</td>
<td>AAA</td>
<td>Highest quality</td>
<td>(lowest default risk)</td>
<td>Bristol-Myers, Johnson and Johnson, Merck</td>
</tr>
<tr>
<td>Aa</td>
<td>AA</td>
<td>High quality</td>
<td></td>
<td>McDonald’s, Mobil Oil, Procter and Gamble</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>Upper medium grade</td>
<td></td>
<td>Anheuser-Busch, AT&amp;T, Boeing</td>
</tr>
<tr>
<td>Baa</td>
<td>BBB</td>
<td>Medium grade</td>
<td></td>
<td>Goodyear Tire, Ralston Purina</td>
</tr>
<tr>
<td>Ba</td>
<td>BB</td>
<td>Lower medium grade</td>
<td></td>
<td>Cablevision Systems, Phillips-Van Heusen</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>Speculative</td>
<td></td>
<td>Chiquita Brands, Sega Enterprises</td>
</tr>
<tr>
<td>Caa</td>
<td>CCC, CC</td>
<td>Poor (high default risk)</td>
<td></td>
<td>Del Monte Foods, Shoney’s Inc.</td>
</tr>
<tr>
<td>Ca</td>
<td>C</td>
<td>Highly speculative</td>
<td></td>
<td>Planet Hollywood</td>
</tr>
<tr>
<td>C</td>
<td>D</td>
<td>Lowest grade</td>
<td></td>
<td>Sun Healthcare</td>
</tr>
</tbody>
</table>
Corporate Bonds Become Less Liquid

Corporate Bond Market
1. Less liquid corporate bonds $D^c \downarrow$, $D^c$ shifts left
2. $P^c \downarrow$, $i^c \uparrow$

Treasury Bond Market
1. Relatively more liquid Treasury bonds, $D^T \uparrow$, $D^T$ shifts right
2. $P^T \uparrow$, $i^T \downarrow$

Outcome:
Risk premium, $i^c - i^T$, rises
Risk premium reflects not only corporate bonds’ default risk, but also lower liquidity
Tax Advantages of Municipal Bonds

(a) Market for municipal bonds

(b) Market for Treasury bonds
Analysis of Figure 3: Tax Advantages of Municipal Bonds

Municipal Bond Market
1. Tax exemption raises relative $RETe$ on municipal bonds, $D^m \uparrow$, $D^m$ shifts right
2. $P^m \uparrow$, $i^m \downarrow$

Treasury Bond Market
1. Relative $RETe$ on Treasury bonds $\downarrow$, $DT \downarrow$, $DT$ shifts left
2. $PT \downarrow$, $iT \uparrow$

Outcome:
$i^m < iT$
Term Structure Facts to be Explained

1. Interest rates for different maturities move together
2. Yield curves tend to have steep slope when short rates are low and downward slope when short rates are high
3. Yield curve is typically upward sloping

Three Theories of Term Structure
1. Expectations Theory
2. Segmented Markets Theory
3. Liquidity Premium Theory
   A. Expectations Theory explains 1 and 2, but not 3
   B. Segmented Markets explains 3, but not 1 and 2
   C. Solution: Combine features of both Expectations Theory and Segmented Markets Theory to get Liquidity Premium Theory and explain all facts
Interest Rates on Different Maturity Bonds Move Together
The *Wall Street Journal* publishes a daily plot of the yield curves for Treasury securities, an example of which is presented here. It is typically found next to the “Credit Markets” column.

The numbers on the vertical axis indicate the interest rate for the Treasury security, with the maturity given by the numbers on the horizontal axis. For example, the yield curve marked “Yesterday” indicates that the interest rate on the three-month Treasury bill yesterday was 5.45%, while the one-year bill had an interest rate of 6.00% and the ten-year bond had an interest plot have the typical upward slope.

Expectations Hypothesis

**Key Assumption:** Bonds of different maturities are perfect substitutes

**Implication:** $RET^e_2$ on bonds of different maturities are equal

Investment strategies for two-period horizon
1. Buy $1$ of one-year bond and when it matures buy another one-year bond
2. Buy $1$ of two-year bond and hold it

**Expected return from strategy 2**

$$
\frac{(1 + i_{2t})(1 + i_{2t}) - 1}{1} = \frac{1 + 2(i_{2t}) + (i_{2t})^2 - 1}{1}
$$

Since $(i_{2t})^2$ is extremely small, expected return is approximately $2(i_{2t})$
Expected return from strategy 1

\[
\frac{(1 + i_t)(1 + i_{e_{t+1}}) - 1}{1} = \frac{1 + i_t + i_{e_{t+1}} + i_t(i_{e_{t+1}}) - 1}{1}
\]

Since \(i_t(i_{e_{t+1}})\) is also extremely small, expected return is approximately

\[i_t + i_{e_{t+1}}\]

From implication above expected returns of two strategies are equal: Therefore

\[2(i_{2t}) = i_t + i_{e_{t+1}}\]

Solving for \(i_{2t}\)

\[i_{2t} = \frac{i_t + i_{e_{t+1}}}{2}\]
More generally for \( n \)-period bond:

\[
i_{nt} = \frac{i_t + i^e_{t+1} + i^e_{t+2} + \ldots + i^e_{t+(n-1)}}{n}
\]

**In words:** Interest rate on long bond = average short rates expected to occur over life of long bond

**Numerical example:**
One-year interest rate over the next five years 5%, 6%, 7%, 8% and 9%,

**Interest rate on two-year bond:**
\[(5\% + 6\%)/2 = 5.5\%\]

**Interest rate for five-year bond:**
\[(5\% + 6\% + 7\% + 8\% + 9\%)/5 = 7\%\]

**Interest rate for one to five year bonds:**
5%, 5.5%, 6%, 6.5% and 7%. 
Expectations Hypothesis and Term Structure Facts

Explains why yield curve has different slopes:
1. When short rates expected to rise in future, average of future short rates $= i_{nt}$ is above today’s short rate: therefore yield curve is upward sloping
2. When short rates expected to stay same in future, average of future short rates are same as today’s, and yield curve is flat
3. Only when short rates expected to fall will yield curve be downward sloping

Expectations Hypothesis explains Fact 1 that short and long rates move together
1. Short rate rises are persistent
2. If $i_t \uparrow$ today, $i_{t+1}^e$, $i_{t+2}^e$ etc. $\uparrow \Rightarrow$ average of future rates $\uparrow \Rightarrow i_{nt} \uparrow$
3. Therefore: $i_t \uparrow \Rightarrow i_{nt} \uparrow$, i.e., short and long rates move together
1. When short rates are low, they are expected to rise to normal level, and long rate = average of future short rates will be well above today’s short rate: yield curve will have steep upward slope.

2. When short rates are high, they will be expected to fall in future, and long rate will be below current short rate: yield curve will have downward slope.

**Explains Fact 2 that yield curves tend to have steep slope when short rates are low and downward slope when short rates are high**

**Doesn’t explain Fact 3 that yield curve usually has upward slope**

Short rates as likely to fall in future as rise, so average of future short rates will not usually be higher than current short rate: therefore, yield curve will not usually slope upward.
Segmented Markets Theory

Key Assumption: Bonds of different maturities are not substitutes at all

Implication: Markets are completely segmented: interest rate at each maturity determined separately

Explains Fact 3 that yield curve is usually upward sloping

People typically prefer short holding periods and thus have higher demand for short-term bonds, which have higher price and lower interest rates than long bonds

Does not explain Fact 1 or Fact 2 because assumes long and short rates determined independently
Liquidity Premium Theory

**Key Assumption:** Bonds of different maturities are substitutes, but are not perfect substitutes

**Implication:** Modifies Expectations Theory with features of Segmented Markets Theory

Investors prefer short rather than long bonds $\Rightarrow$ must be paid positive liquidity (term) premium, $l_{nt}$, to hold long-term bonds

Results in following modification of Expectations Theory

$$i_{nt} = \frac{i_t + i^e_{t+1} + i^e_{t+2} + \ldots + i^e_{t+(n-1)}}{n} + l_{nt}$$
Relationship Between the Liquidity Premium and Expectations Theories

Liquidity Premium Theory Yield Curve

Expectations Theory Yield Curve

Interest Rate, $i_{nt}$

Years to Maturity, $n$

Liquidity Premium, $\epsilon_{nt}$
Numerical Example:

1. One-year interest rate over the next five years:
   5%, 6%, 7%, 8% and 9%

2. Investors’ preferences for holding short-term bonds, liquidity premiums for one to five-year bonds:
   0%, 0.25%, 0.5%, 0.75% and 1.0%.

Interest rate on the two-year bond:
\[(5\% + 6\%) / 2 + 0.25\% = 5.75\%\]

Interest rate on the five-year bond:
\[(5\% + 6\% + 7\% + 8\% + 9\%) / 5 + 1.0\% = 8\%\]

Interest rates on one to five-year bonds:
5%, 5.75%, 6.5%, 7.25% and 8%.

Comparing with those for the expectations theory, liquidity premium theory produces yield curves more steeply upward sloped.
Liquidity Premium Theory: Term Structure Facts

Explains all 3 Facts

Explains Fact 3 of usual upward sloped yield curve by investors’ preferences for short-term bonds

Explains Fact 1 and Fact 2 using same explanations as expectations hypothesis because it has average of future short rates as determinant of long rate
Market Predictions of Future Short Rates

(a) Future short-term interest rates expected to rise

(b) Future short-term interest rates expected to stay the same

(c) Future short-term interest rates expected to fall moderately

(d) Future short-term interest rates expected to fall sharply