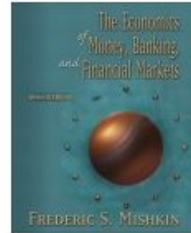


ECON 354 Money and Banking

Professor Yamin Ahmad

Lecture 13

- Risk
- Term Structure
- Theories to explain facts

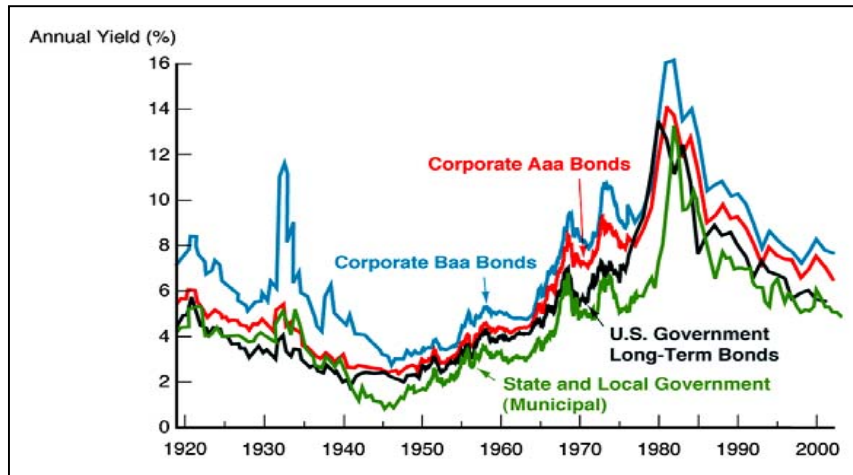


Big Concepts

- The Term Structure
- Incorporating risk
- Premiums:
 - Risk
 - Liquidity

Note: These lecture notes are incomplete without having attended lectures.

Risk Structure of Long-Term Bonds in the United States



Note: These lecture notes are incomplete without having attended lectures.

Effects of Increase in Default Risk on Corporate Bonds

Corporate Bond Market

- R^e on corporate bonds \downarrow , $D^c \downarrow$, D^c shifts left
 - Risk of corporate bonds \uparrow , $D^c \downarrow$, D^c shifts left
- $\Rightarrow P^c \downarrow, i^c \uparrow$

Treasury Bond Market

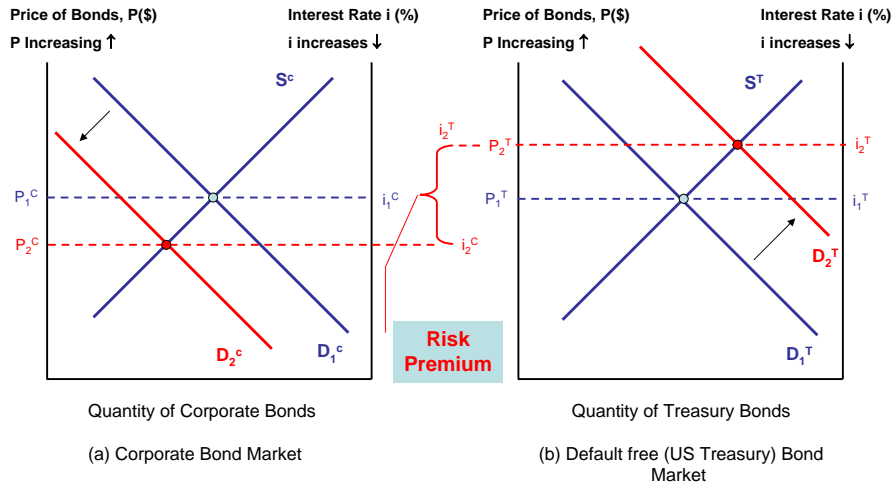
- Relative R^e on Treasury bonds \uparrow , $D^T \uparrow$, D^T shifts right
 - Relative risk of Treasury bonds \downarrow , $D^T \uparrow$, D^T shifts right
- $\Rightarrow P^T \uparrow, i^T \downarrow$

Outcome:

Risk premium, $i^c - i^T$, rises

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Increase in Default Risk on Corporate Bonds



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Bond Ratings

Table 1 Bond Ratings by Moody's and Standard and Poor's

Moody's	Standard and Poor's	Descriptions	Examples of Corporations with Bonds Outstanding in 2003
Aaa	AAA	Highest quality (lowest default risk)	General Electric, Pfizer Inc., North Carolina State, Mobil Oil
Aa	AA	High quality	Wal-Mart, McDonald's, Credit Suisse First Boston
A	A	Upper medium grade	Hewlett-Packard, Anheuser-Busch, Ford, Household Finance
Baa	BBB	Medium grade	Motorola, Albertson's, Pennzoil, Weyerhaeuser Co., Tommy Hilfiger
Ba	BB	Lower medium grade	Royal Caribbean, Levi Strauss
B	B	Speculative	Rite Aid, Northwest Airlines Inc., Six Flags
Caa	CCC, CC	Poor (high default risk)	Revlon, United Airlines
Ca	C	Highly speculative	US Airways, Polaroid
C	D	Lowest grade	Enron, Oakwood Homes

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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. $P^T \uparrow$, $i^T \downarrow$

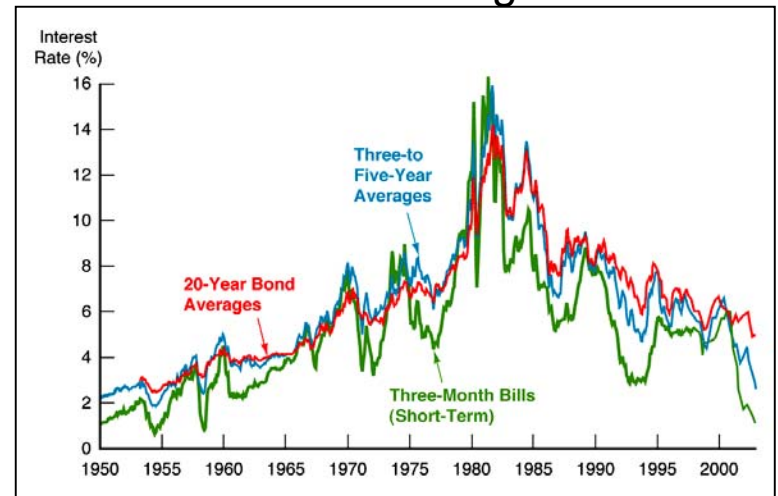
Outcome:

Risk premium, $i^c - i^T$, rises

Risk premium reflects not only corporate bonds' default risk, but also lower liquidity

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Interest Rates on Different Maturity Bonds Move Together



Note: These lecture notes are incomplete without having attended lectures.

Term Structure Facts

We would wish to explain the following facts:

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

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Three Theories of Term Structure

1. Expectations Theory
2. Segmented Markets Theory
3. Liquidity Premium (Preferred Habitat) Theory

Note: These lecture notes are incomplete without having attended lectures.

What We Can Explain...

- Expectations Theory explains 1 and 2, but not 3
- Segmented Markets explains 3, but not 1 and 2
- Solution: Combine features of both Expectations Theory and Segmented Markets Theory to get Liquidity Premium (Preferred Habitat) Theory and explain all facts

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Yield Curves

- What do Yield Curves Look Like?

... Charting The Curves ...



Note: These lecture notes are incomplete without having attended lectures.

Expectations Hypothesis

Key Assumption: Bonds of different maturities are perfect substitutes

Implication: RET^e 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

Note: These lecture notes are incomplete without having attended lectures.

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 $2(i_{2t})$

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Expected Return from Strategy 1

$$\frac{(1 + i_t)(1 + \hat{r}_{t+1}) - 1}{1} = \frac{1 + i_t + \hat{r}_{t+1} + i_t(\hat{r}_{t+1}) - 1}{1}$$

Since $i_t(\hat{r}_{t+1})$ is also extremely small, expected return is approximately

$$i_t + \hat{r}_{t+1}$$

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

$$2(i_{2t}) = i_t + \hat{r}_{t+1}$$

Solving for i_{2t}

$$i_{2t} = \frac{i_t + \hat{r}_{t+1}}{2}$$

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Expected Return from Strategy 1

More generally for n -period bond:

$$i_{nt} = \frac{i_t + \hat{r}_{t+1} + \hat{r}_{t+2} + \dots + \hat{r}_{t+(n-1)}}{n}$$

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%.

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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

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Expectations Hypothesis (cont...)

- Expectations Hypothesis explains Fact 1 that short and long rates move together
1. Short rate rises are persistent
 2. If $i_t \uparrow$ today, \hat{r}_{t+1} , \hat{r}_{t+2} 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

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

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

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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

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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

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- 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

Note: These lecture notes are incomplete without having attended lectures.

Liquidity Premium (Preferred Habitat) Theories

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

Implication: Modifies Expectations Theory with features of Segmented Markets Theory

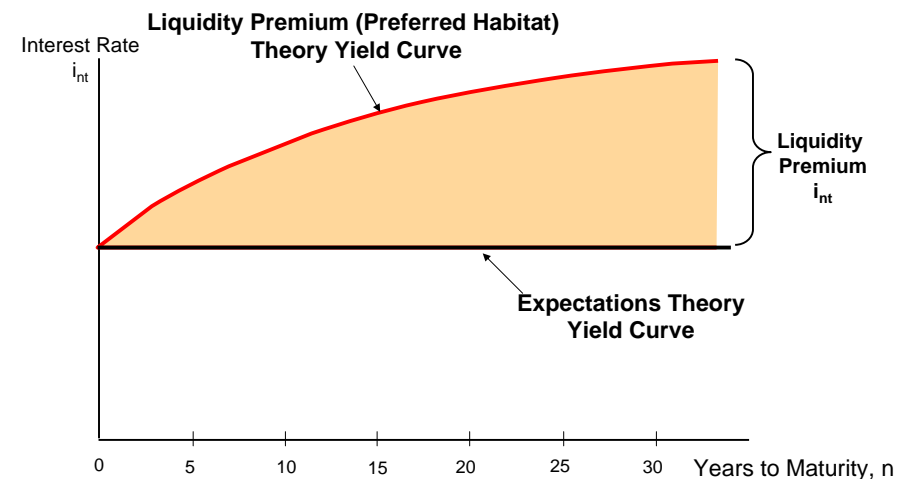
Investors prefer short rather than long bonds \Rightarrow must be paid positive liquidity (term) premium, I_{nt} , to hold long-term bonds

Results in following modification of Expectations Theory

$$i_{nt} = \frac{i_t + i^e_{t+1} + i^e_{t+2} + \dots + i^e_{t+(n-1)}}{n} + I_{nt}$$

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Relationship Between the Liquidity Premium (Preferred Habitat) and Expectations Theories



Note: These lecture notes are incomplete without having attended lectures.

Numerical Example

- One-year interest rate over the next five years: 5%, 6%, 7%, 8% and 9%
- 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 (preferred habitat) theories produce yield curves more steeply upward sloped

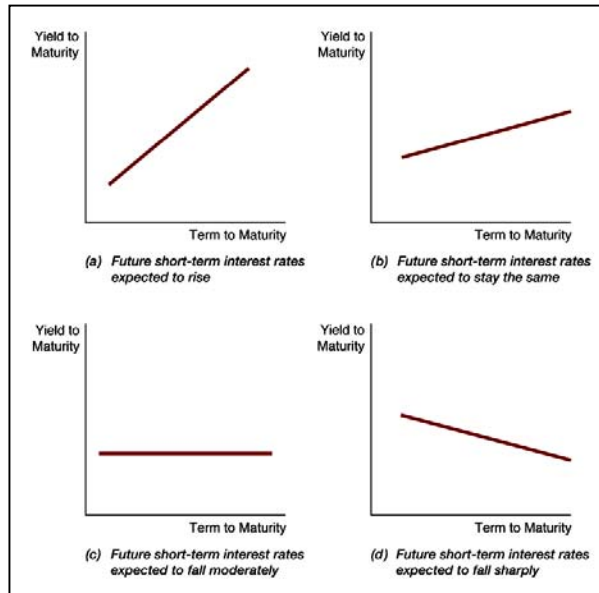
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Liquidity Premium (Preferred Habitat) Theories: Term Structure Facts

- **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

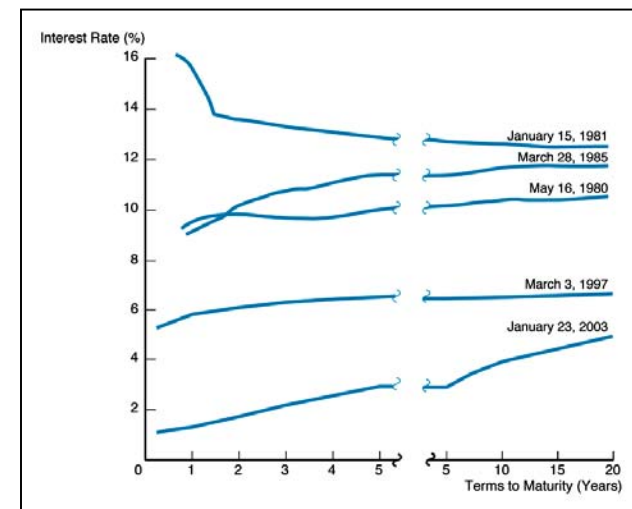
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Market Predictions of Future Short Rates



Note: These lecture notes are incomplete without having attended lectures.

Interpreting Yield Curves 1980–2000



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