Risk and Term Structure of Interest Rates

Economics 301: Money and Banking

Goals and Learning Outcomes

- Goals:
  - Explain factors that can cause interest rates to be different for bonds of different risk, liquidity, and maturity.
- Learning Outcomes:
  - LO3: Predict changes in interest rates using fundamental economic theories including present value calculations, behavior towards risk, and supply and demand models of money and bond markets.

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Reading

- Hubbard and O'Brien, Chapter 5.

Risk Structure

- **Risk structure of interest rates:** explanation for why different securities with the same maturity have different prevailing interest rates in secondary market.
- Examples:
  - Federal government bonds.
  - Municipal bonds.
  - Aaa corporate bonds.
  - Baa corporate bonds.
- "Risk" structure actually includes multiple factors:
  - Default risk
  - Capital gains risk
  - Differences in liquidity
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Default Risk

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- **Default risk premium:** additional interest above risk-free bonds paid for securities with a risk of default.
- Use a supply/demand analysis for two securities: Treasury bonds and Baa corporate bonds
- Higher risk of default $\rightarrow$ higher risk premium.

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- Three major credit rating agencies determine risk of default for many corporate and government bonds.
  - Moody's Investor Service
  - Standard and Poor's Corporation
  - Fitch Ratings
- "Investment-grade" securities have ratings Baa/BBB or above.
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Moody's	**S&P** and **Fitch**	**Definition**
Aaa	AAA	Prime Maximum Safety
Aa1, Aa2, Aa3	AA+, AA, AA-	High Grade High Quality
A1, A2, A3	A+, A, A-	Upper Medium Grade
Baa1, Baa2, Baa3	BBB+, BBB, BBB-	Lower Medium Grade
Ba1, Ba2, Ba3	BB+, BB, BB-	Speculative
B1, B2, B3	B+, B, B-	Highly Speculative
Caa1, Caa2, Caa3	CCC+, CCC, CCC-	Extremely Speculative

Liquidity

- Bonds that differ on risk, usually also differ on liquidity.
- Treasury bonds are most highly liquid - traded worldwide.
- For a given corporation, far fewer bonds are traded, many financial investors may not be familiar with security.
- Credit rating agencies help increase liquidity.
- Supply and demand analysis of Treasury bonds vs. corporate bonds again demonstrates premium paid for liquidity.
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Municipal Bonds and Income Tax

- Municipal bonds have higher risk, lower liquidity than Treasury bonds.
- Yet, municipal bonds often have lower interest rates than risk-free Treasury bonds.
- Earnings on holding municipal bonds are exempt from Federal income taxes.
- Example - consider two hypothetical, one year maturity, discount bonds:
  - Treasury bond: Face value = \$1000, Price = \$952.
  - Municipal bond: Face value = \$1000, Price = \$961.50.
  - Your marginal income tax rate = 25%
  - Compute before-tax and after-tax yield to maturity.
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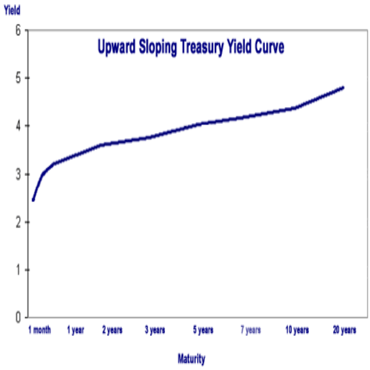
Yield Curve

- Bonds with otherwise identical risk, liquidity and tax rules may have different interest rates due to different times remaining to maturity.
- **Yield curve:** illustration of how interest rates for a particular type of bond differ for different maturity dates.



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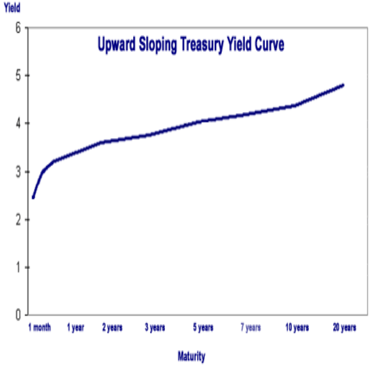

Yield Curve

- Yield curve shape:
  - Yield curves are often, but not always, upward sloping.
  - Inverted yield curve: downward sloping.
  - Sometimes have more complicated shape.
- Theories that explain shape:
  - Expectations theory.
  - Liquidity theory.

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Expectations Theory

- Bonds with different maturity dates, but otherwise similar features, should be nearly perfect substitutes to one another. → Consequently, interest rates should be the same.
- Simple example: compare return of one-year security (rolled over for a second year) and a two-year security.
  - Let i_t denote today's (time t) interest rate for a one year security.
  - Let $E_t i_{t+1}$ denote today's (time t) *expectation* of tomorrow's (time $t+1$ interest rate) on a one-year security.
  - Let $i_{2,t}$ denote the interest rate negotiated today (t) over the life of a two-year bond.

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- Expected net return on holding one-year securities:

$$\begin{aligned} E_t R_1 &= (1 + i_t)(1 + E_t i_{t+1}) - 1 \\ &= i_t + E_t i_{t+1} + i_t E_t i_{t+1} \\ &\approx i_t + E_t i_{t+1} \end{aligned}$$

- Expected net return on holding two-year security:

$$\begin{aligned} R_2 &= (1 + i_{2,t})(1 + i_{2,t}) - 1 \\ &= 2 i_{2,t} + i_{2,t}^2 \\ &\approx 2 i_{2,t} \end{aligned}$$

- Perfect substitutes - set returns equal to another:

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- Return on long-term bond is approximately equal to average expected interest rates until maturity date.

Expectations Theory

- Expected net return on holding one-year securities:

$$\begin{aligned} E_t R_1 &= (1 + i_t)(1 + E_t i_{t+1}) - 1 \\ &= i_t + E_t i_{t+1} + i_t E_t i_{t+1} \\ &\approx i_t + E_t i_{t+1} \end{aligned}$$

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  - upward sloping?
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Liquidity Theory

- Long term bonds are subject to *interest rate risk*.
  - Holders of long-term bonds seldom plan to hold security.
  - Even if they did, higher interest rates in the future increase the opportunity cost of holding the bond.
- **Liquidity theory**: short-term and long-term bonds are close, but not perfect substitutes.
- In addition to paying interest equal to the average expected interest rate, bond issuers must pay a **liquidity premium**.
- The further is the maturity date, the larger is the interest rate risk, the larger is the liquidity premium.
- Suppose the current interest rate is equal to the long-run average expected interest rate. What should be the shape of the yield curve under expectations theory and liquidity theory?

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