Risk and Term Structure of Interest Rates

Economics 301: Money and Banking

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1.1 Goals

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.

1.2 Reading

Reading

- Hubbard and O'Brien, Chapter 5.

2 Risk and Liquidity Structure

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
  - Differences in tax rules

2.1 Default Risk

Default Risk

- **Risk-free bonds** aka **default-free bonds:** bonds that have zero chance of default. Treasury bonds are often considered risk-free bonds.

- **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.

Credit Rating Agencies

- 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.

- "Junk bonds" or "high-yield" bonds have ratings below Baa/BBB.

Credit Rating Agencies

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

2.2   Liquidity

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.

- What is called "risk structure" of interest rates: more appropriately should be called risk *and liquidity* structure.

2.3   Income Tax

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.

- Supply and demand analysis of Treasury bonds vs. municipal bonds demonstrates effect on interest rates.
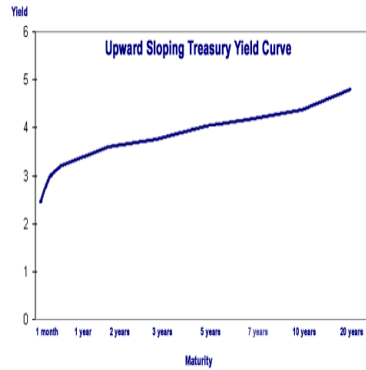
3   Term Structure

3.1   Yield Curve

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.

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.

3.2   Expectations Theory

Expectations Theory

- Bonds with different maturity dates, but otherwise similar features, should be nearly perfect substitutes to one another. $\rightarrow$ 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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Expectations Theory

- Expected net return on holding one-year securities:

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

- Expected net return on holding two-year security:

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

- Perfect substitutes - set returns equal to another:

$$
E_t R_1 = R_2 \qquad i_{2,t} = \frac{i_t + E_t i_{t+1}}{2}
$$

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

Expectations Theory

- When should yield curve be...

    - upward sloping?
    - downward sloping?
    - flat?

- Yield curves are almost always upward sloping. What explains that?

3.3 Liquidity Theory

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?