Fiscal and financial system in japan

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THE TERM STRUCTURE OF INTEREST RATES (1)
(MISHKIN, CHAPTER 6)

Term Structure of Interest Rates

Interest rates on government bonds
(As of May 11, 2009)

Maturity date (years to maturity)	Interest rate
May 2011 (2)	0.4%
March 2014 (5)	0.9%
March 2019 (10)	1.3%
March 2029 (20)	2.1%
March 2039 (30)	2.3%

Source: Nikkei Shinbun, May 11, 2009

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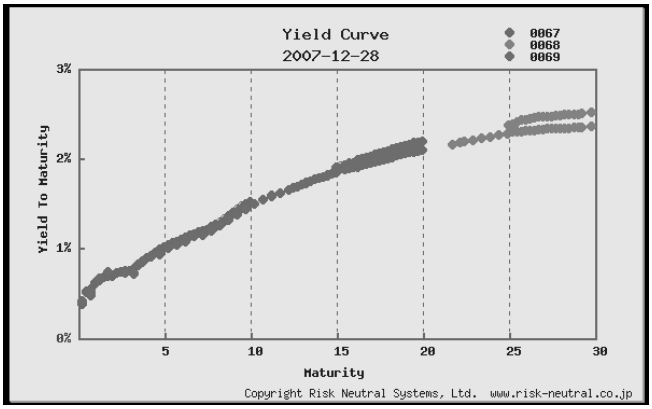
Yield Curve

A plot of the yields on bonds with different maturities, but the same risk and liquidity

An example of yield curve for government bonds



Source: Risk Neutral Systems, Ltd.

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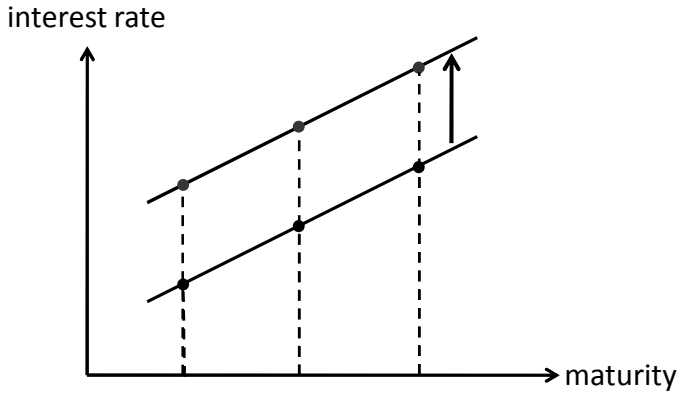
Three Empirical Facts

Fact 1 Interest rates on bonds of different maturities move together over time.



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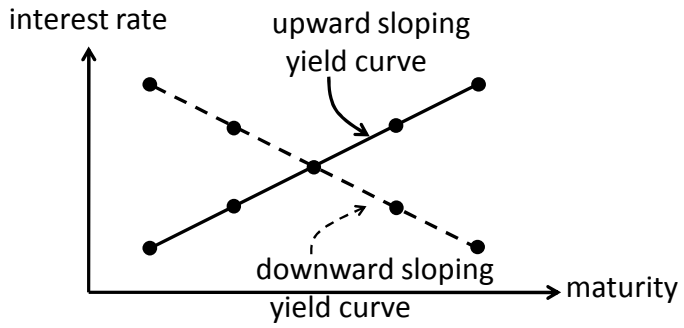
Fact 2 When short-term interest rates are low, yield curves tend to slope upward;
When short-term interest rates are high, yield curves tend to slope downward.

Fact 3 Yield curves almost always slope upward.



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Term Structure and Economic Theory

Any theory that explains all of these empirical facts CONSISTENTLY?

- Three theories advanced by economists
  1. **Expectations Theory**
  2. **Segmented Markets Theory**
  3. **Liquidity Premium Theory**

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Assumptions of the Expectations Theory

A.1 Perfect Substitutes

For investors, bonds with different maturities are "perfect substitutes".

Investors do not prefer bonds with one maturity to another.

A.2 Risk-Neutrality

Investors are "risk-neutral."

Investors are interested only in the expected return, neglecting the variability or uncertainty of the future short-term interest rates.

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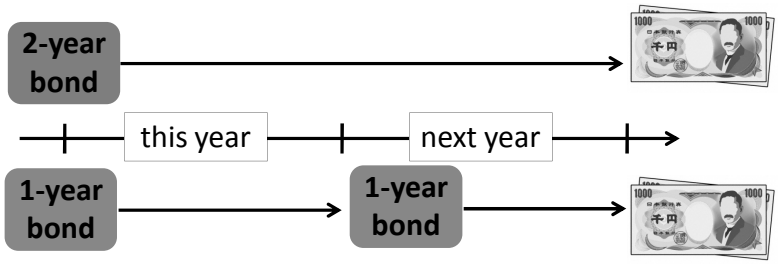
Perfect Substitutes

Buy-and-Hold Strategy



Roll-Over Strategy

For investors, two strategies are equivalent, and thus perfectly substitutable.

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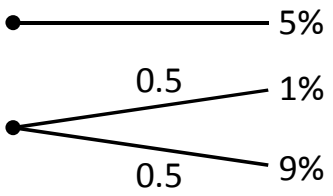
Risk-Neutrality



5% with certainty

$$1\% \times 0.5 + 9\% \times 0.5 = 5\%$$

5% on average

= Expected return

For investors, two investments are equivalent.

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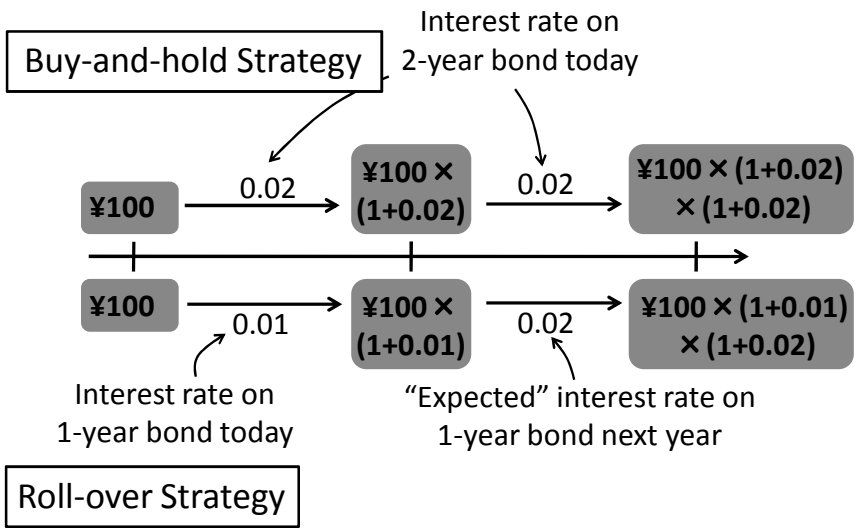

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Under the assumption of perfect substitutability and risk-neutrality …

Yield from roll-over < Yield from buy-and-hold

- Everyone substitutes 2-year bonds for 1-year bonds.
- Price of 2-year bond ↑ → Interest rate on 2-year bond ↓
  Price of 1-year bond ↓ → Interest rate on 1-year bond ↑

The yields from the two strategies must be equal, or the relationship among the three interest rates must ensure the equality.

Term structure of interest rates

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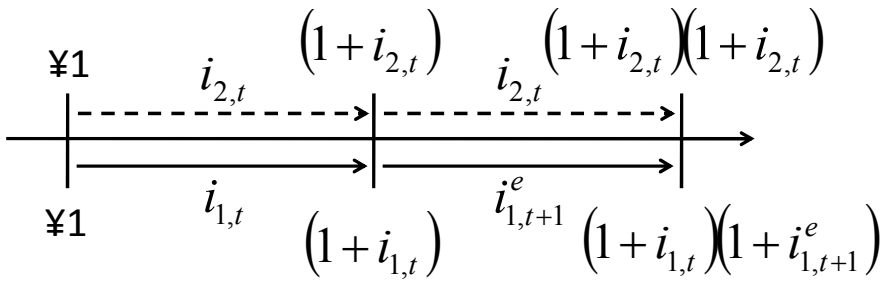
$= \quad (1+i_{2t})^2$



$i_{2,t}$ ⋯ today's interest rate on an 2-year bond

$i_{1,t}$ ⋯ today's interest rate on an 1-year bond

$i^e_{1,t+1}$ ⋯ interest rate on a one-year bond next year that we expect "today"

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$$(1+i_{1,t})(1+i^e_{1,t+1}) = (1+i_{2,t})^2$$

$$1+i_{1,t}+i^e_{1,t+1}+i_{1,t}i^e_{1,t+1} = 1+2i_{2,t}+(i_{2,t})^2$$

$$i_{1,t}+i^e_{1,t+1} = 2i_{2,t}$$

$$\frac{i_{1,t}+i^e_{1,t+1}}{2} = i_{2,t}$$

The two-period rate must equal the average of the two one-period rates.

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To be more general …

$$\frac{i_{1,t} + i^e_{1,t+1} + i^e_{1,t+2} + \cdots + i^e_{1,t+(n-1)}}{n} = i_{n,t}$$

n-year bond rate must equal the average of n one-year bond rates.

$i^e_{1,t+i}$ ⋯ interest rate on a one-year bond i year ahead that we expect "today"

$i_{n,t}$ ⋯ today's interest rate on an n-year bond

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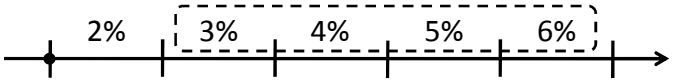
Numerical Example(1): Expect interest rates to rise



Today's interest rate on a 2-year bond is …

$(2\% + 3\%)/2 = 2.5\%$

For a 3-year bond

$(2\% + 3\% + 4\%)/3 = 3\%$

For a 4-year bond

$(2\% + 3\% + 4\% + 5\%)/4 = 3.5\%$

For a 5-year bond

$(2\% + 3\% + 4\% + 5\% + 6\%)/5 = 4\%$

Upward sloping yield curve

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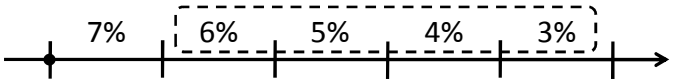
Numerical Example(2): Expect interest rates to fall



$$(7\% + 6\%)/2 = 6.5\%$$
$$(7\% + 6\% + 5\%)/3 = 6\%$$
$$(7\% + 6\% + 5\% + 4\%)/4 = 5.5\%$$
$$(7\% + 6\% + 5\% + 4\% + 3\%)/5 = 5\%$$

Downward sloping yield curve

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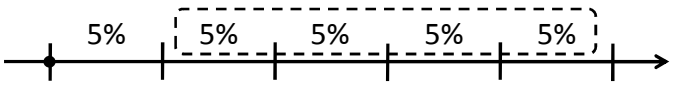
Numerical Example(3): Expect interest rates to stay



$$(5\% + 5\%)/2 = 5\%$$
$$(5\% + 5\% + 5\%)/3 = 5\%$$
$$(5\% + 5\% + 5\% + 5\%)/4 = 5\%$$
$$(5\% + 5\% + 5\% + 5\% + 5\%)/5 = 5\%$$

Flat yield curve

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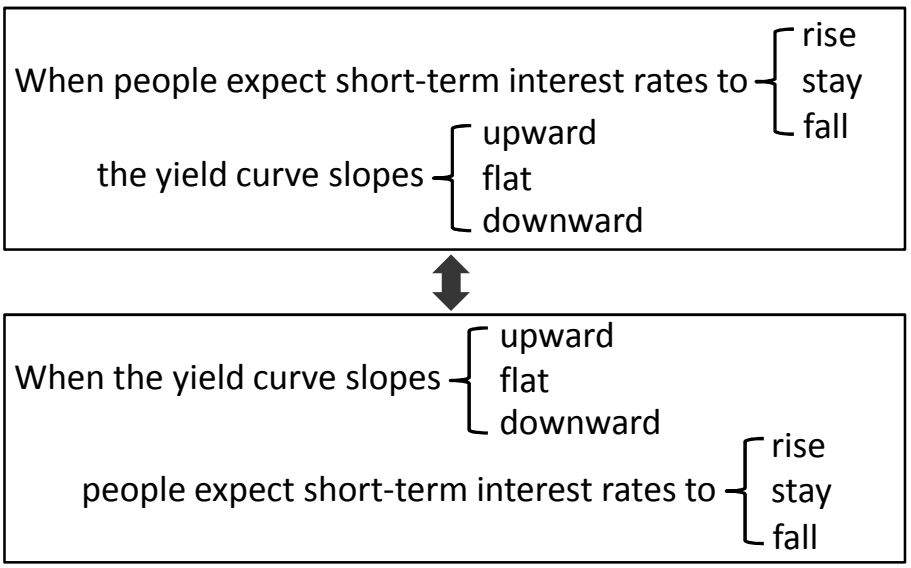

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Expectations Theory and "Fact 2"

Short-term rate is low today

- It is more likely to rise (back to some normal level)
- People expect short-term rates to rise
- **Upward sloping** yield curve occurs

Short-term rate is high today

- It is more likely to fall (back to some normal level)
- People expect short-term rates to fall
- **Downward sloping** yield curve occurs

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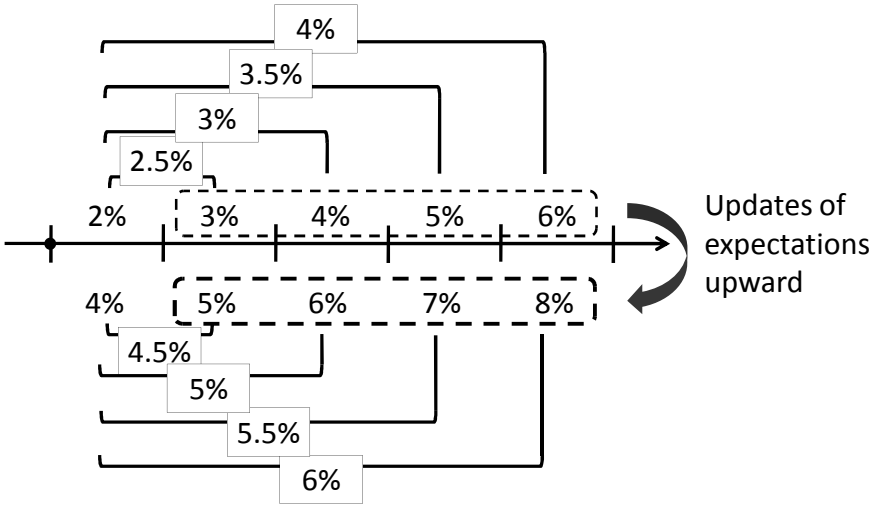
Expectations Theory and "Fact 1"



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Mid-Term Exam

- You will be mainly asked to explain how relationships among economic variables are derived.

  Ex. Derive the relationship between the price of a bond and its interest rate.

- You will also be asked to explain some important concepts in monetary economics.
- You can be asked to perform some simple calculation.
- I will not be strict in evaluation this time.
  My comments on your answers will help you to do better in the final exam.

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