Fiscal and Financial System in Japan

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INTEREST RATES
(MISHKIN, CHAPTER 4)
UPDATED ON MAY 12

Four Types of Credit Market Instruments

In terms of the timing of their cash flow payments, there are four types of credit market instruments.

(1) Simple Loan

(2) Discount Bond

(3) Coupon Bond

(4) Fixed-Payment Loan

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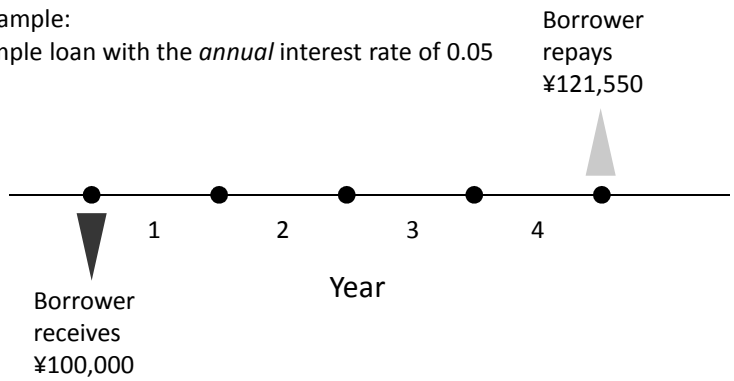
Four Types of Credit Market Instruments

(1) Simple Loan

example:
simple loan with the *annual* interest rate of 0.05



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At the end of the 1st year

$$100{,}000 + 100{,}000 \times 0.05 = \boxed{100{,}000 \times (1 + 0.05)}$$

At the end of the 2nd year

$$100{,}000 \times (1 + 0.05) \times (1 + 0.05) = \boxed{100{,}000 \times (1 + 0.05)^2}$$

At the end of the 3rd year

$$100{,}000 \times (1 + 0.05)^2 \times (1 + 0.05) = \boxed{100{,}000 \times (1 + 0.05)^3}$$

At the end of the 4th year

$$100{,}000 \times (1 + 0.05)^3 \times (1 + 0.05) = 100{,}000 \times (1 + 0.05)^4$$

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If you make a simple loan of P
with the annual interest rate of i (or $i \times 100$ %),
after n years, your money will turn into

$$P \times (1 + i)^n$$

The impact of compound interest

	year									
	1	2	3	4	5	6	7	8	9	10
0.01	1.01	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10
0.05	1.05	1.10	1.16	1.22	1.28	1.34	1.41	1.48	1.55	1.63
0.1	1.1	1.21	1.33	1.46	1.61	1.77	1.95	2.14	2.36	2.59

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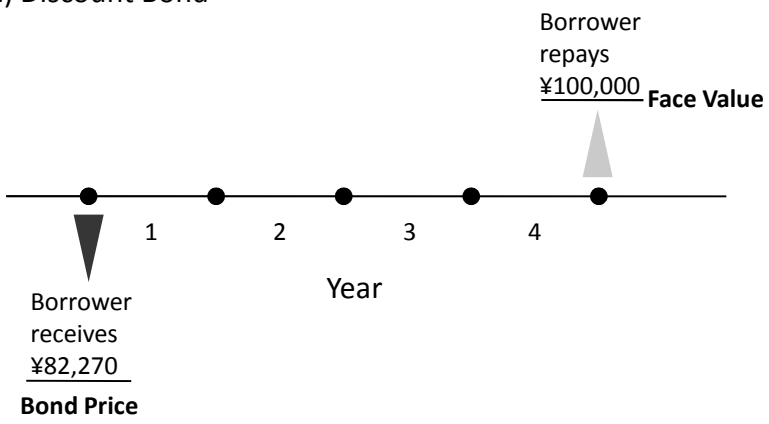
(2) Discount Bond



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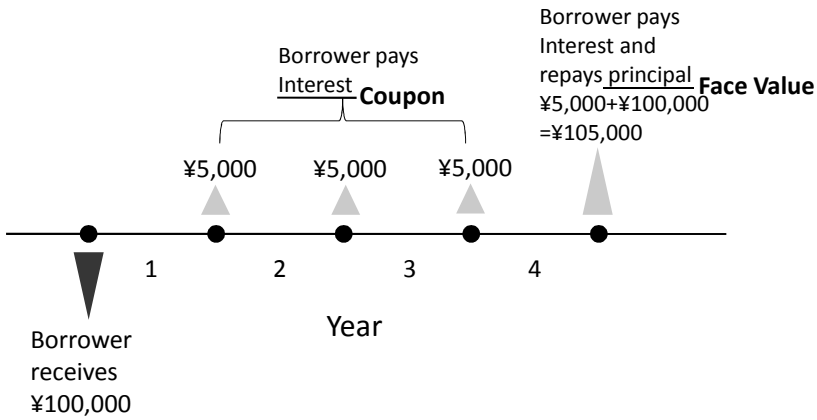
(3) Coupon Bond



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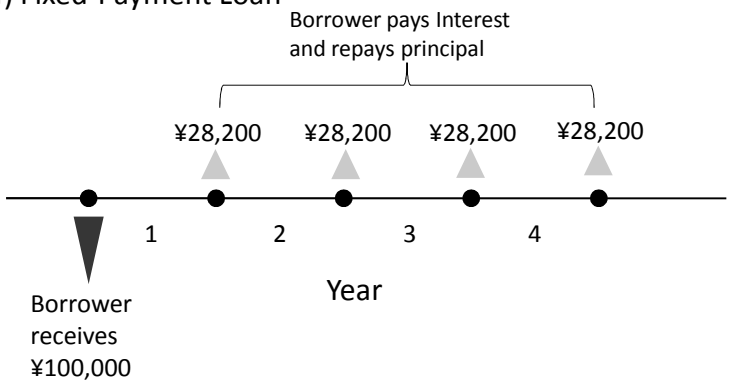
(4) Fixed-Payment Loan



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How to Compare the Instruments

How can we compare two instruments with different cash flows and different maturities, and how can we decide which to invest?

We need a **standard** by which the instruments with different cash flows and different maturities can be compared.

➡ Yield to Maturity (複利最終利回り)

We can decide which is the most profitable among various types of credit instruments by calculating their yields to maturity.

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Yield to Maturity

Today	1st Year	2nd Year	3rd Year	4th Year
$\frac{5,000}{1+i}$	5,000			
$\frac{5,000}{(1+i)^2}$	$\frac{5,000}{1+i}$	5,000		
$\frac{5,000}{(1+i)^3}$	$\frac{5,000}{(1+i)^2}$	$\frac{5,000}{1+i}$	5,000	
$\frac{5,000}{(1+i)^4}$	$\frac{5,000}{(1+i)^3}$	$\frac{5,000}{(1+i)^2}$	$\frac{5,000}{1+i}$	5,000
$\frac{100,000}{(1+i)^4}$	$\frac{100,000}{(1+i)^3}$	$\frac{100,000}{(1+i)^2}$	$\frac{100,000}{1+i}$	100,000

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$$100,000 = \frac{5,000}{1+i} + \frac{5,000}{(1+i)^2} + \frac{5,000}{(1+i)^3} + \frac{5,000}{(1+i)^4} + \frac{100,000}{(1+i)^4}$$

The interest rate i which satisfies this equation tells us …

To get the same cash flows at the same timing as the coupon bond by making a simple loan of the same amount, what rate of interest do we require?

Yield to Maturity

- The most accurate measure of interest rates
- When economists say "interest rates," they implicitly mean yield to maturity.

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Interest Rate and Bond Price

What is the relationship between a bond price and its interest rate?

$$\underbrace{100{,}000}_{\text{Bond Price}} = \frac{5{,}000}{1+i} + \frac{5{,}000}{(1+i)^2} + \frac{5{,}000}{(1+i)^3} + \frac{5{,}000}{(1+i)^4} + \frac{100{,}000}{(1+i)^4}$$

Interest Rate (or Yield to Maturity)

Rise in Bond Price ⟷ **Fall** in Interest Rate

Fall in Bond Price ⟷ **Rise** in Interest Rate

Negative relationship between a bond price and its interest rate

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Example: Bond Price and Interest Rate

A coupon bond
coupon : ¥5,000
maturity : 4 years
face value : ¥100,000

Price of Bond (¥)	Interest Rate or Yield to Maturity(%)
90,000	8.02
95,000	6.46
100,000	5
105,000	3.63
110,000	2.35

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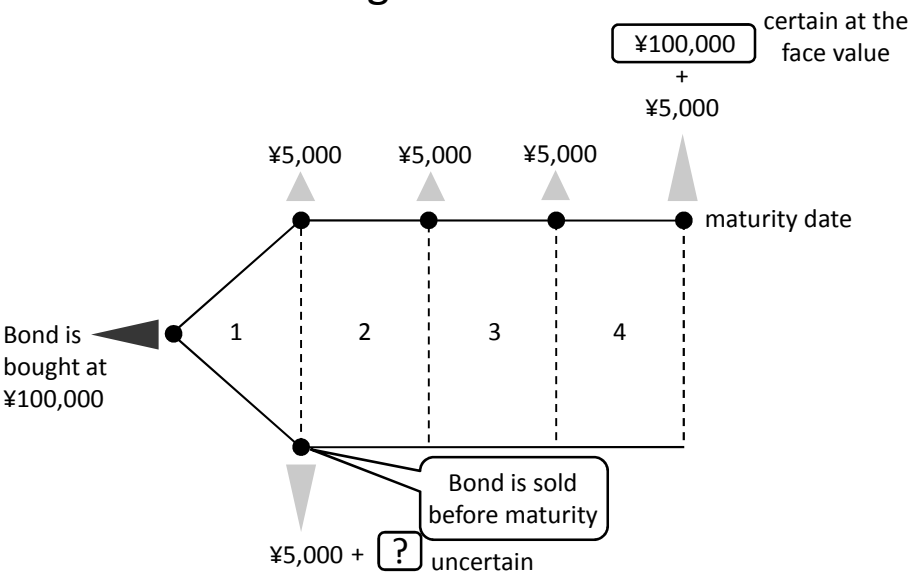
How Long to Hold a Bond?



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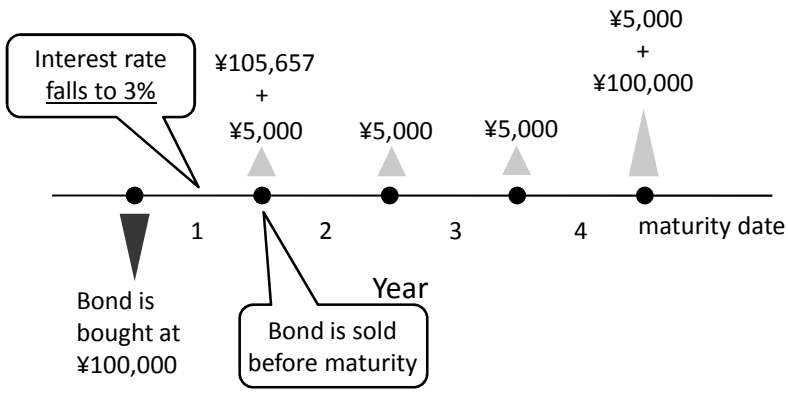
"Return" on a Bond



Remember the negative relationship between the price and the interest rate of a bond.

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"Return" on a Bond

$$\text{Rate of Return} = \frac{105{,}657 + 5{,}000 - 100{,}000}{100{,}000}$$

$$= \frac{\boxed{(105{,}657 - 100{,}000)} + 5{,}000}{100{,}000}$$

Capital Gain
Rise in Bond Price

$$= 0.1657\ (16.57\%)$$

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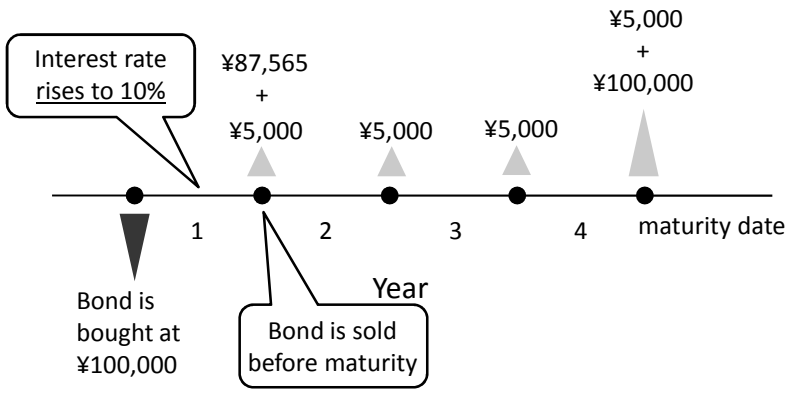
"Return" on a Bond



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"Return" on a Bond

$$\text{Rate of Return} = \frac{87{,}565 + 5{,}000 - 100{,}000}{100{,}000}$$

$$= \frac{(87{,}565 - 100{,}000) + 5{,}000}{100{,}000}$$

Capital Loss
Fall in Bond Price

$$= -0.0744\ (-7.44\%)$$

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If your holding period does not match the years to maturity, the yield to maturity and the rate of return on the bond is different.

The bond price at any other point before the maturity is uncertain, which makes the cash flows from holding the bond uncertain.

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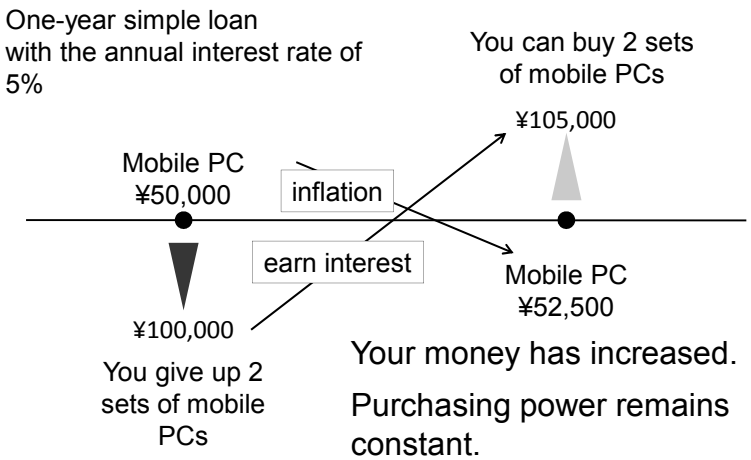
Interest Rate and Price Level



Your money has increased.

Purchasing power remains constant.

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Real/Nominal Interest Rate

Important is:

how much interest your money earns <u>in terms of goods and services</u>,

or how much your <u>purchasing power</u> increases.

➡ **Real Interest Rate**

Interest rate adjusted for changes in prices (inflation / deflation)

If your money earns 10% interest, and prices rise by 10%, the purchasing power remains constant.

If your money earns no interest, and prices fall by 10%, the purchasing power increases by 10%.

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Schedule, updated on May 12

4/21 Money
4/28 (Canceled)
5/12 Interest rates
5/19 Behavior of interest rates
5/26 Term structure of interest rates
6/2 Money supply processes
6/9 **Midterm Exam**
6/16 Tools of monetary policy
6/23 Demand for money
6/30 Aggregate demand and supply analysis(1)
7/7 Aggregate demand and supply analysis(2)
7/14 Money and inflation
7/21 **Final Exam**

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