

Topic 2 : Debt Market and The Structure of Interest Rate (Part 2)

EE431

Federic Mishkin, The Economics of Money, Banking and Financial Markets Chapter 4 - 6
(available at the reserve section of the library, HG173 .M57 2007)

August 2014

- ➊ Measuring Interest Rates (part 1)
- ➋ Nominal Interest Rates (i) and Real Interest Rates (r) (part 2)
- ➌ The Behavior of Interest Rate (part 2)
- ➍ Risk and Term Structure of Interest Rate (part 2)

2. Nominal Interest Rates (i) and Real Interest Rates (r)

- Real Value VS. Nominal Value
- Which one the effect of a change in the price level is eliminated?
- For example, real GDP VS. nominal GDP
- Changes in the price level $\Rightarrow$ a difference between “real” and “nominal value”
- Price $\uparrow$, Purchasing power
- Nominal value may $\uparrow$ but real value $\downarrow \Rightarrow$ “Money Illusion”
- Bond : pay the price to day , receive cash flow payment in the future
- Price $\uparrow$, the purchasing power of the cash flow received $\downarrow$

- Nominal interest rate : the effect of a change in the price level is not eliminated
- Real interest rate : the effect of a change in the price level is eliminated
- YTM = interest rates
- Example: Lend your friend 1000 Baht, 1 year, your friend returns you (principal + interest) 1100 Baht. $PI_0 = 100$, $PI_1 = 125$. What is the nominal interest rate you charge your friend? What is the real interest rate you get ?

- Example: Lend your friend 1000 Baht, 1 year, and you want 10% real interest rate. What is the nominal interest rate you will charge your friend?
 - Price level at the beginning of the year $=P|_0 = 100$. At the end of the year inflation rate is 0%.
 - Price level at the beginning of the year $=P|_0 = 100$. At the end of the year inflation rate is 25%.

- $(1 + r)(1 + \pi^e) = (1 + i)$
- $i = r + \pi^e$
- Fisher Equation : Nominal Interest Rate (i) = Real Interest Rate(r) + Expected Inflation Rate(π^e)

3. The Behavior of Interest Rates

- The price of a corporate bond may fluctuate until the maturity date.
- Changes in overall interest rates in the economy are the primary cause of most bond price fluctuations.
- The value of corporate bonds decreases when overall interest rates increase.
- In contrast, the value of corporate bonds rises when overall interest rates decrease.
- The market value of a bond may also be affected by the financial condition of the company.
- This section will talk about the behaviour of interest rates, how overall interest rates in the economy change.
- Two main approaches considered : 1. loanable fund theory and 2. liquidity preference framework.
- Bond Price = $\sum_t \frac{CF_t}{(1+k)^t}$; k is yield to maturity.
- Bond Price $\uparrow \iff$ Interest Rate $\downarrow$, Bond Price $\downarrow \iff$ Interest Rate $\uparrow$.

3.1 Loanable Fund Theory : Interest Rate $\Leftarrow$ Bond Demand (loanable fund supply) and Bond Supply (loanable fund demand)

Determinants of Bond Demand (B^d)

1. Wealth $\uparrow$, B^d

2. Expected return on bonds relative to other assets $\uparrow$,
 B^d

$r \uparrow$, B^d

*** π^e **constant**, $i \uparrow$ **Bond Price**, r , B^d , ***

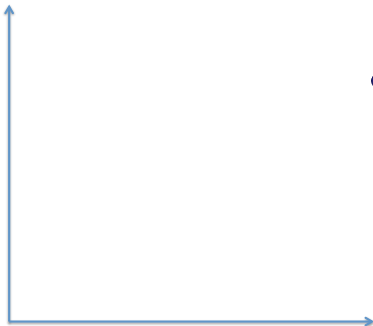
i constant, $\pi^e \uparrow$, r , B^d

3. Liquidity relative to other assets $\uparrow$, B^d

4. Riskiness relative to other assets $\uparrow$, B^d

- Shift in Bond Demand : example

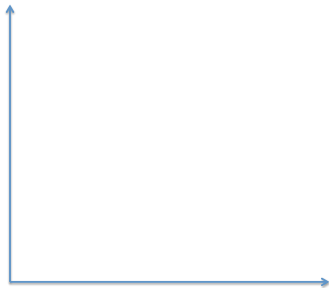
Bond Price (P)



Quantity of Bonds

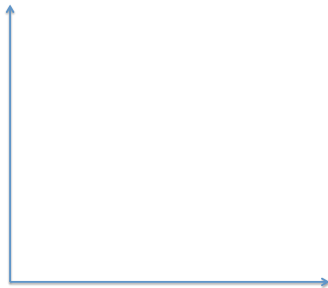
- Suppose Bond demand shift to the right,
 - total wealth.....
 - liquidity of bonds relative to the other assets
 - risk relative to other assets

Bond Price (P)



Quantity of Bonds

Bond Price (P)



Quantity of Bonds

Determinants of Bond Supply (B^s)

1. Expected Profitability $\uparrow$, B^s

2. Expected Inflation

$\pi^e \uparrow$, r , all i , B^s

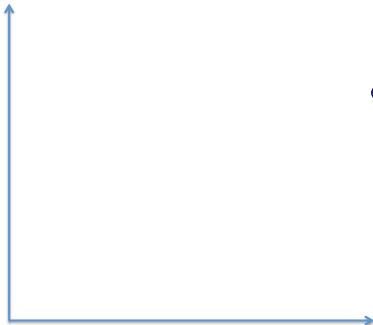
*** π^e **constant**, $i \uparrow$ **Bond Price** ... , r , $i \uparrow$, r , B^s , ***

3. Government Borrowing

Government Borrowing $\uparrow$, B^s

- Shift in Bond Supply

Bond Price (P)

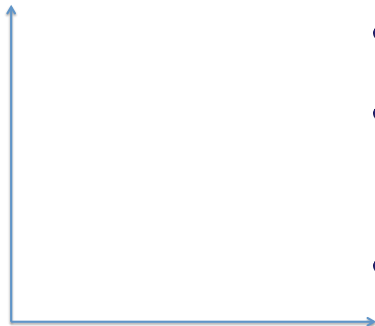


Quantity of Bonds

- Suppose Bond Supply shift to the right,
 - profitability of investments
.....
 - expected inflation
 - government deficit

- A change in π^e

Bond Price (P)

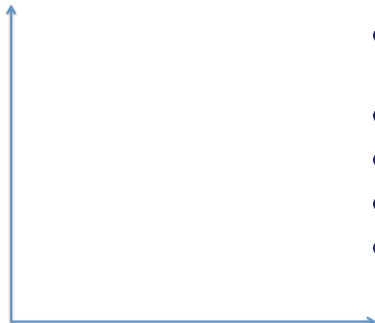


Quantity of Bonds

- Suppose $\pi^e \uparrow$
- Bond Demand shift to and Bond Supply shift to
- Equilibrium Bond Price , Equilibrium nominal interest rate Equilibrium quantity
- Recall : Fisher equation
 $\Rightarrow i = r + \dots$, implying $\pi^e \uparrow, i \dots$
- “Fisher effect”

- Reponse to a business cycle expansion

Bond Price (P)



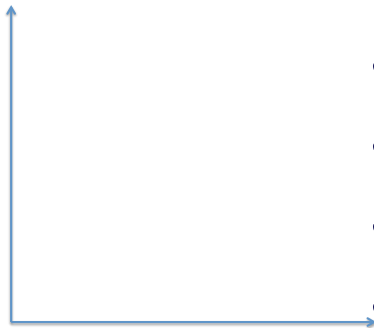
Quantity of Bonds

- In a business cycle expansion, income and wealth are rising.
- Bond Demand shift to
- and Bond Supply shift to
- Equilibrium Bond Price,
- Equilibrium nominal interest rate
- Equilibrium quantity

3.2 Liquidity Preference Framework (Keynesian)

- two main assets people use to store their wealth : Money and Bonds
- $M^d + B^d = M^s + B^s = \text{total wealth}$
- $M^d = M^s \rightarrow B^d = B^s$. Whenever money market is in equilibrium, bond market must be in equilibrium.
- Analysing money market is equivalent to analysing bond market
- Liquidity preference framework $\rightarrow$ analyse the money market
- Money Demand
 - Transaction demand
 - Precautionary demand
 - Speculative demand
- Money Supply
 - controlled by the central bank

Nominal interest rate (i)

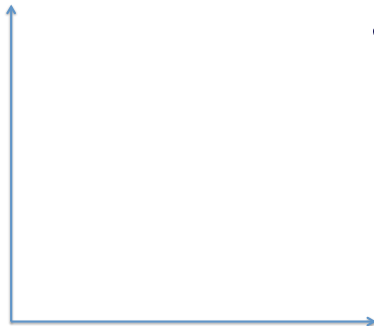


Quantity of Money (M)

- If interest rate is lower than the equilibrium interest rate,
- there will be excess money
.....
- agents will (buy/sell) more bonds,
- then bond price..... (increases/decreases),
- therefore the interest rate
.....
(increases/decreases)

- Shift in money supply

Nominal interest rate (i)

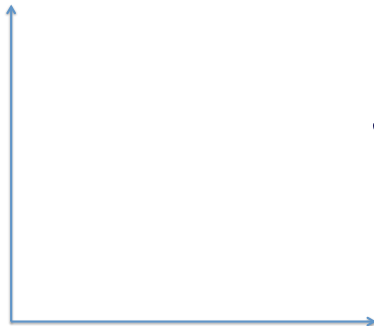


Quantity of Money (M)

- Suppose money supply shift to the right, caused by
 - the central bank money supply
 - How does the central bank raise the money supply?
 - open market operation, securities
 - policy interest rates

- Shift in money demand

Nominal interest rate (i)



Quantity of Money (M)

- Suppose money demand shift to the right, caused by
 - income
 - price level

4. Structure of Interest Rates

- In practice, there are many rates of interest; deposit rates (saving, time deposits), lending rates, government bonds, corporate bonds
- Interest rates varies because different levels of risk of the borrowers and/or different borrowing periods
- Why bonds with the same term to maturity have different interest rates $\Leftarrow$ the risk structure of interest rate
- Bond's term to maturity $\Rightarrow$ interest rates $\Rightarrow$ the term structure of interest rates

4.1 Risk Structure of Interest Rate

Why bonds with the same term to maturity have different interest rates?

- Suppose there are 3 options in the market:
- Option 1 : Government bond with 4 % interest rate
- Option 2 : PTT bond with 4 % interest rate
- Option 3 : THAI bond with 4 % interest rate.
- Assume that they have the same maturity date.
- Which one is your 1st choice? Which one is your 2nd choice? Why?

Why bonds with the same term to maturity have different interest rates? 4 important factors

1. Default Risk:

- the risk which occurs when the issuer of the bond is unable or unwilling to make interest rate payment when promised or the face value when the bond matures
 - Corporate suffering big losses might be more likely to suspend interest payments on its bonds. This means its bonds have high default risk.
 - Default-free bonds = government bonds : because government can always increase taxes (however, in the international debt market, government bonds are not considered risk-free. We focus on the case where government bonds are risk-free.)
 - The spread between interest rates and risk-free rate is called

- a bond with default risk (any corporate bonds) always have risk premium 0 and an increase in its default risk will the risk premium
- default risk $\rightarrow$ interest rate : the information is important for both buyers and sellers to price the bond correctly
- information $\rightarrow$ market efficiency
- Information about default risk is provided by “credit rating agencies” ; Standard and Poor’s , Moody’s, TRIS

Rating			
Moody's	S&P	Fitch	Definitions
Aaa	AAA	AAA	Prime Maximum Safety
Aa1	AA-	AA-	High Grade High Quality
Aa2	AA	AA	
Aa3	AA-	AA-	
A1	A+	A+	Upper Medium Grade
A2	A	A	
A3	A-	A-	
Baa1	BBB+	BBB+	Lower Medium Grade
Baa2	BBB	BBB	
Baa3	BBB-	BBB-	
Ba1	BB+	BB+	Non Investment Grade
Ba2	BB	BB	Speculative
Ba3	BB-	BB-	
B1	B-	B-	Highly Speculative
B2	B	B	
B3	B-	B-	
Caa1	CCC+	CCC	Substantial Risk
Caa2	CCC	—	In Poor Standing
Caa3	CCC-	—	
Ca	—	—	Extremely Speculative
C	—	—	May be in Default
—	—	DDD	Default
—	—	DD	—
—	D	D	

● Examples of TRIS ratings (www.trisrating.com)

PTT EXPLORATION AND PRODUCTION PLC

29/04/2013

Company Rating:

AAA

Issue Ratings:

PTTEP135A: Bt5,000 million senior debentures due 2013

AAA

PTTEP145A: Bt11,700 million senior debentures due 2014

AAA

PTTEP183A: Bt2,500 million senior debentures due 2018

AAA

PTTEP195A: Bt5,000 million senior debentures due 2019

AAA

PTTEP12PA: Bt5,000 million subordinated capital debentures

AA

Rating Outlook:

Stable

THAI AIRWAYS INTERNATIONAL PUBLIC COMPANY LIMITED

10/05/2013

Company Rating:

A+

Issue Ratings:

THAI130A: Bt2,556.79 million senior debentures due 2013

A+

THAI140A: Bt3,000 million senior debentures due 2014

A+

THAI155A: Bt3,000 million senior debentures due 2015

A+

THAI165A: Bt2,000 million senior debentures due 2016

A+

THAI16DA: Bt2,000 million senior debentures due 2016

A+

THAI170A: Bt4,000 million senior debentures due 2017

A+

THAI185A: Bt1,555 million senior debentures due 2018

A+

THAI185B: Bt1,445 million senior debentures due 2018

A+

THAI192A: Bt1,000 million senior debentures due 2019

A+

THAI190A: Bt1,500 million senior debentures due 2019

A+

THAI215A: Bt833 million senior debentures due 2021

A+

THAI215B: Bt2,167 million senior debentures due 2021

A+

THAI222A: Bt2,000 million senior debentures due 2022

A+

THAI220A: Bt1,500 million senior debentures due 2022

A+

THAI243A: Bt1,500 million senior debentures due 2024

A+

Up to Bt5,000 million senior debentures due within 2018

A+

Rating Outlook:

Stable

2. Liquidity :

- liquidity = how easy an asset can be quickly converted in to the medium of exchange, with a little loss of value
- The more liquid an asset is, desirable it is.
- Which one is more liquid, government bonds or corporate bonds?
- The difference between government bond yields and corporate bond yields reflects both bond's default risk and liquidity.

3. Income tax considerations

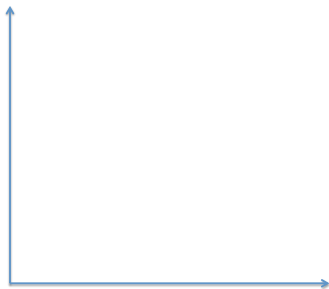
- some bonds are exempt from income taxes
- buyers consider their returns after taxes
- therefore, those bonds which are tax-free will pay a lower interest rate than it should do if they are not tax-free

Interest rate risk premium of a bond = Interest rate on the bond - interest rate on default free bonds with the same maturity

What will happen to the risk premium if

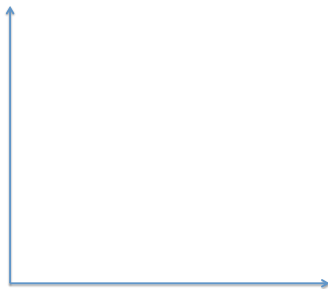
- default risk of a corporate bond increase?
- liquidity of a corporate bond decrease relative to the government bonds?
- income tax on the bond interest increases?

Bond Price (P)



Quantity of Bonds

Bond Price (P)



Quantity of Bonds

- Corporate Bond Market

- Risk of corporate bonds $\uparrow$
- Risk of corporate bonds relative to Treasury bonds $\Rightarrow$
Demand for corporate bonds (B_C^d), B_C^d shifts to the
- Price of corporate bonds

- Treasury Bond Market

- Relative risk of Treasury bonds
- Demand for Treasury bonds (B_G^d), B_G^d shifts to the
- Price of Treasury bonds

- Outcome: Risk premium, $i_C - i_G$,

4.2 Term Structure of Interest Rates

- Bonds with identical risk, liquidity, and tax characteristics may have different interest rates because the time remaining to maturity is different
- Yield curve: a plot of the yield on bonds with differing terms to maturity but the same risk, liquidity and tax considerations
- Generally, when talking about the yield curve, it refers to the yield on government bonds
- In most cases (normal situations),
 - ① Shape : Yield curve slopes
 - ② Shiftness of Yield Curve (Movement): Interest rates on bonds of different maturities move together over time
- three theories explain why bonds with differing terms to maturity have different yields to maturity: which one can explain the two findings the best
- note that what information the yield curve does contain remains a topic of debate in economics

4.2.1 Segmented Market Theory

- Assumption : bonds of different maturities are not substitutes at all
- Result
 - market for bonds with different maturities are totally separated from one another
 - interest rates (YTM) and bond prices for each bonds with different maturities are determined by the demand and supply of the bonds in each market only
- Does segmented market theory can explain the first fact, the yield curve usually slopes upward?
 - yields on bonds with longer maturity is
 - yield on bonds with shorter maturity is
 - This means the demand for bonds with maturity is higher
- Does segmented market theory can explain the second fact, the yields on bond with different maturity usually move together?
 - Yes/No.. why?

- Segmented Market Theory explains Fact 1 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.
- Segmented Market Theory does not explain Fact 2 because assumes long and short rates determined independently.

4.2.2 Expectation Theory

- Assumption: bonds of different maturities are perfect substitutes (with the same level of risk, liquidity, taxation)
- Result : For a given investment period, at equilibrium, the returns from investment in bonds with different maturities must be equal.
- Let $i_{n,t}$ is the interest rate on bonds with n years time to maturity, at time t
- Consider a two-years investment period
 - 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

$$\begin{aligned}\text{Buy and hold} &= \text{Roll Over} \\ (1 + i_{2,t})^2 &= \end{aligned}$$

- Consider a n years investment period

$$i_{n,t} = \frac{i_{1,t} + i_{1,t+1}^e + i_{1,t+2}^e + \dots + i_{1,t+n-1}^e}{n}$$

- In words: Interest rate on long bond = average short rates expected to occur over life of long bond
- Example : One-year interest rate over the next five years 5%, 6%, 7%, 8% and 9%
 - Interest rate on two-year bond =
 - Interest rate for five-year bond =
 - Interest rate for one to five year bonds: 5%, 5.5%, 6%, 6.5% and 7%.

Example: Given the following information, in 2013

- Government bond, ttm = 3 years, YTM = 6%
- Government bond, ttm = 2 years, YTM = 4%
- Government bond, ttm = 1 years, YTM = 2%

What is the expected YTM on a government bond with 1 year time to maturity in 2014 and 2015?

Example: Given the following information, in 2013

- Government bond, ttm = 3 years, YTM = 5%
- Government bond, ttm = 2 years, YTM = 6%
- Government bond, ttm = 1 years, YTM = 8%

What is the expected YTM on a government bond with 1 year time to maturity in 2014 and 2015?

- According to Expectation Theory,
 - upward sloping yield curve → the market expects the interest rate to
 - downward sloping yield curve → the market expects the interest rate to
 - flat yield curve → the market expects the interest rate to
- How well the theory can explain the two findings?
 - 1. yield curve usually slopes upwards →
 - 2. the yields on bond with different maturity usually move together?

- Expectations Hypothesis cannot explain Fact 1 that yield curves are usually upward.
 - 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. There is no clear evidence that investors usually anticipate increases in interest rates.
- Expectations Hypothesis explains Fact 2 that short and long rates move together.
 - If $i_{1,t} \uparrow$, then $i_{2,t}, i_{3,t}, i_{4,t}, \dots \uparrow$.

$$i_{n,t} = \frac{i_{1,t} + i_{1,t+1}^e + i_{1,t+2}^e + \dots + i_{1,t+n-1}^e}{n}$$

4.2.3 Liquidity Premium & Preferred Habitat Theories

4.2.3.1 Preferred Habitat Theory

- Assumption : Bonds of different maturities are partial (not perfect) substitutes
- Result: Investors have a preference for bonds of one maturity over another. They will be willing to buy bonds of different maturities only if they earn a somewhat higher expected return

$$i_{n,t} = \frac{i_{1,t} + i_{1,t+1}^e + i_{1,t+2}^e + \dots + i_{1,t+n-1}^e}{n} + \eta_{n,t}$$

$\eta_{n,t}$ is term premium for bonds with n time to maturity at time t

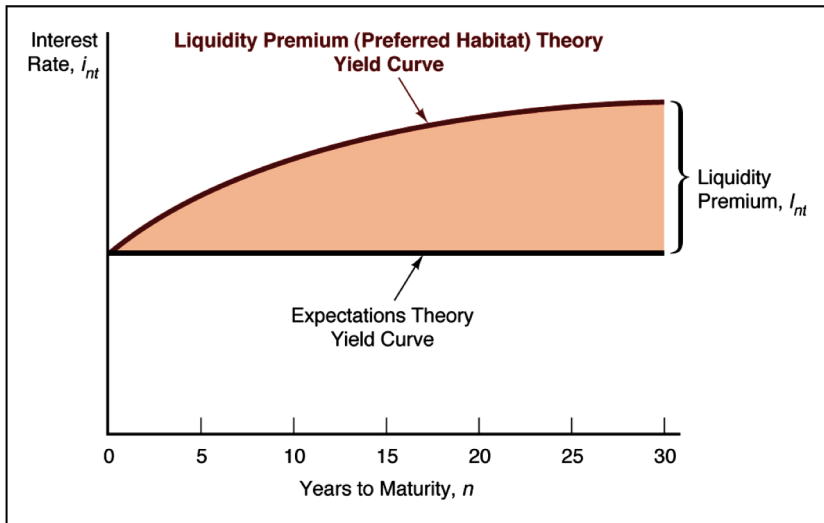
η is for bonds with the time to maturity that the investor likes the most, it is bonds with a different time to maturity

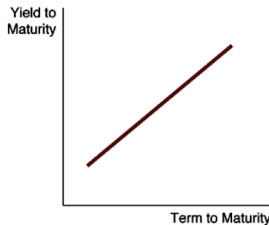
4.2.3.2 Liquidity Premium

- Assumption : Bonds of different maturities are partial (not perfect) substitutes. Investors prefer short-term bonds over long-term ones because short-term bonds are more liquid
- Result: Investors will be willing to buy bonds of longer term maturities only if they earn a somewhat higher expected return.

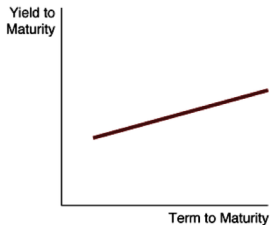
$$i_{n,t} = \frac{i_{1,t} + i_{1,t+1}^e + i_{1,t+2}^e + \dots + i_{1,t+n-1}^e}{n} + \eta_{n,t}$$

- Therefore, η is for long-term bonds, it is for short-term bonds.
- The liquidity premium is predicted to be positive.

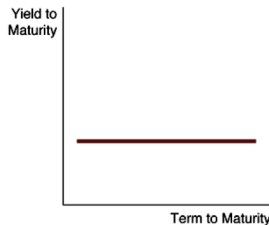




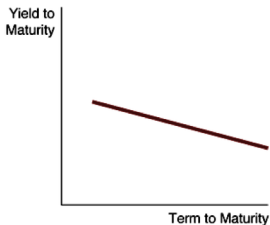
(a) *Future short-term interest rates expected to rise*



(b) *Future short-term interest rates expected to stay the same*



(c) *Future short-term interest rates expected to fall moderately*



(d) *Future short-term interest rates expected to fall sharply*

- How well the theory can explain the two findings?

- 1. yield curve usually slopes upwards →
- 2. the yields on bond with different maturity usually move together?

$$i_{n,t} = \frac{i_{1,t} + i_{1,t+1}^e + i_{1,t+2}^e + \dots + i_{1,t+n-1}^e}{n} + \eta_{n,t}$$

- Liquidity Premium Theory explains Fact 1 of usual upward sloped yield curve by investors' preferences for short-term bonds. Liquidity premium is predicted to be positive.
- It also explains Fact 2 using same explanations as expectations hypothesis because it has average of future short rates as determinant of long rate.