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

EE431/438

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 2013

Outline

1. Measuring Interest Rates (part 1)
2. Nominal Interest Rates (i) and Real Interest Rates (r) (part 2)
3. The Behavior of Interest Rate (part 2)
4. 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 begining of the year $=PI_0 = 100$. At the end of the year inflation rate is 0%.
  - Price level at the begining of the year $=PI_0 = 100$. 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)

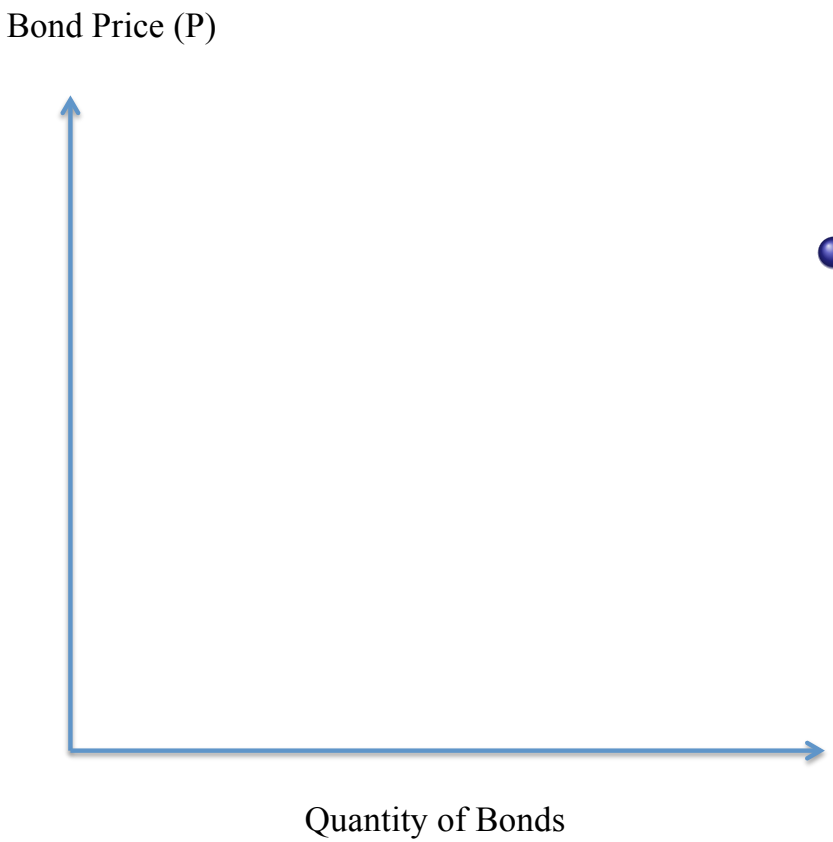
3. The Behavior of Interest Rates

- 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 $\uparrow \Longleftrightarrow$ Interest Rate $\downarrow$, Bond Price $\Longleftrightarrow$ Interest Rate $\uparrow$.

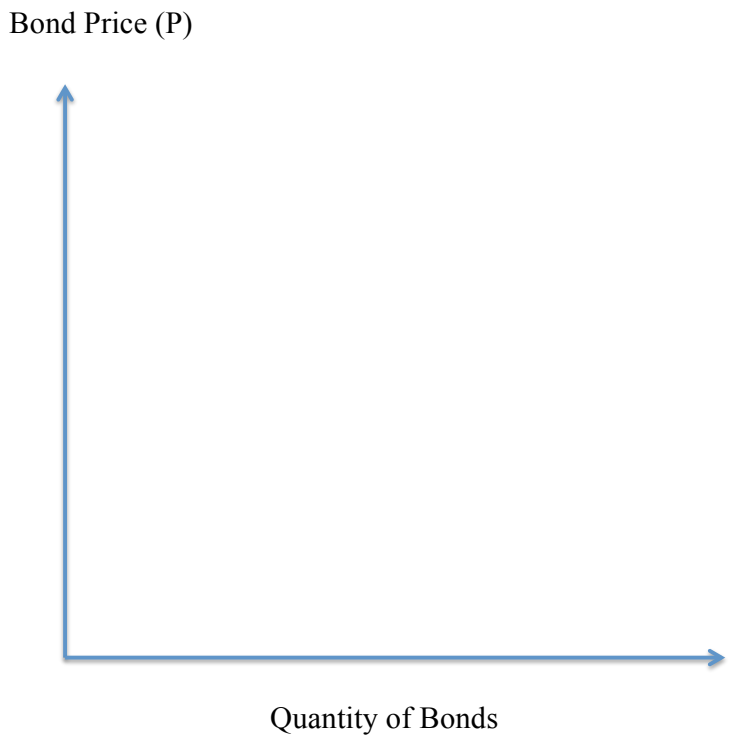
3.1 Loanable Fund Theory : Interest Rate $\Leftarrow$ Bond Demand (loanable fund supply) and Bond Supply (loanable fund demand)

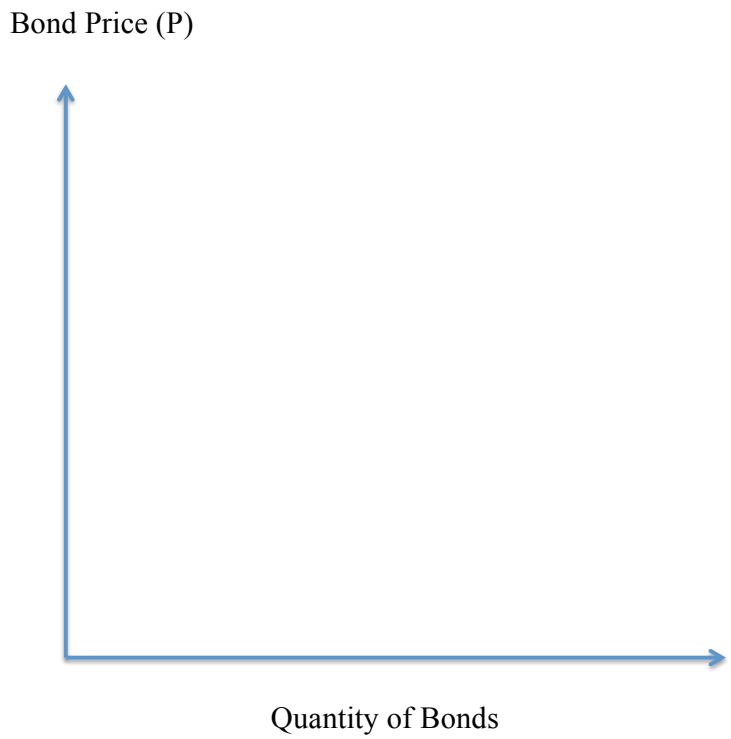
Determinants of Bond Demand (B^d)
1. Wealth $\uparrow$, B^d.....
2. Expected return on bonds relative to other assets $\uparrow$, B^d.....
$r \uparrow$, B^d.....
*** π^e **constant,** $i \uparrow$ **Bond Price ....,** r **.....** B^d**.....,** ***
i constant , $\pi^e \uparrow$**,** r ....., B^d.....
3. Liquidity relative to other asset s$\uparrow$, B^d.....
4. Riskiness relative to other assets $\uparrow$, B^d.....

- Shift in Bond Demand : example



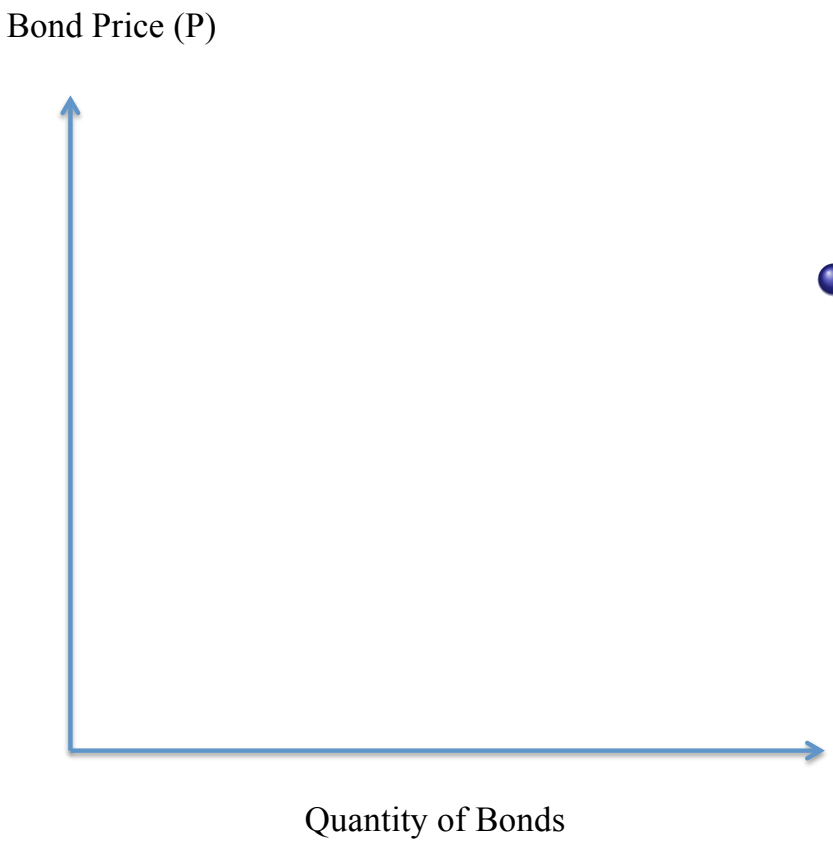
- Suppose Bond demand shift to the right,
  - total wealth.....
  - liquidity of bonds relative to the other assets .....
  - risk relative to other assets .....


Bond Price (P)
Quantity of Bonds


Bond Price (P)
Quantity of Bonds

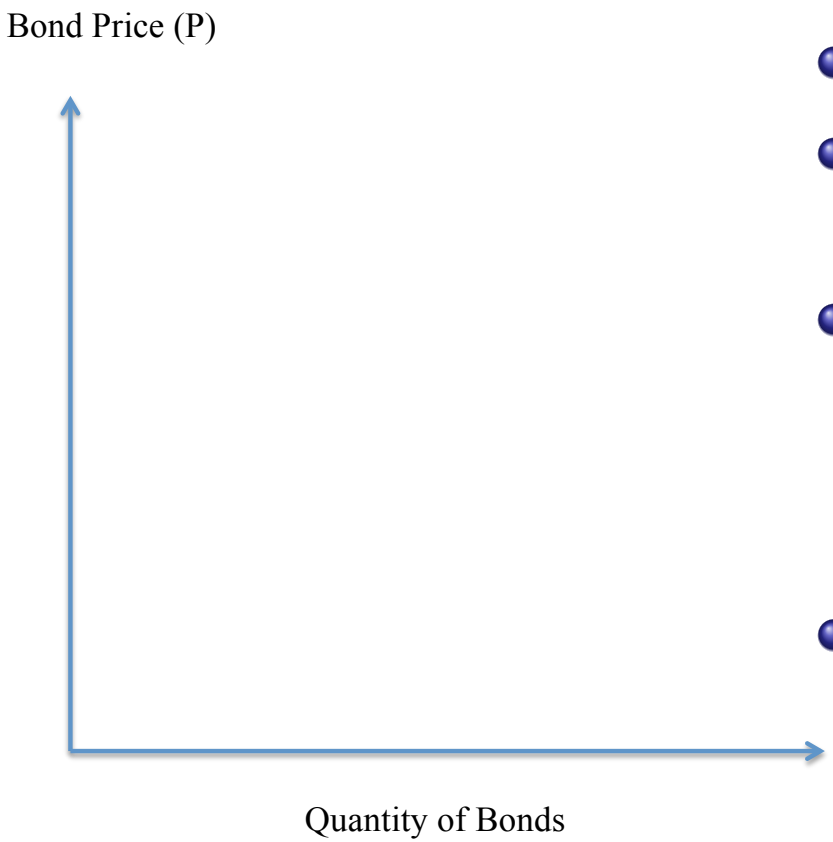
Determinants of Bond Supply (B^s)
1. Expected Profitability $\uparrow$, B^s.....
2. Expected Inflation
$\pi^e \uparrow$, r ....., all i, B^s.....
*** π^e **constant,** $i \uparrow$ **Bond Price ... ,** r **....,**$i \uparrow$, r ...., B^s...., ***
3. Government Borrowing
Government Borrowing $\uparrow$, B^s.....

- Shift in Bond Supply



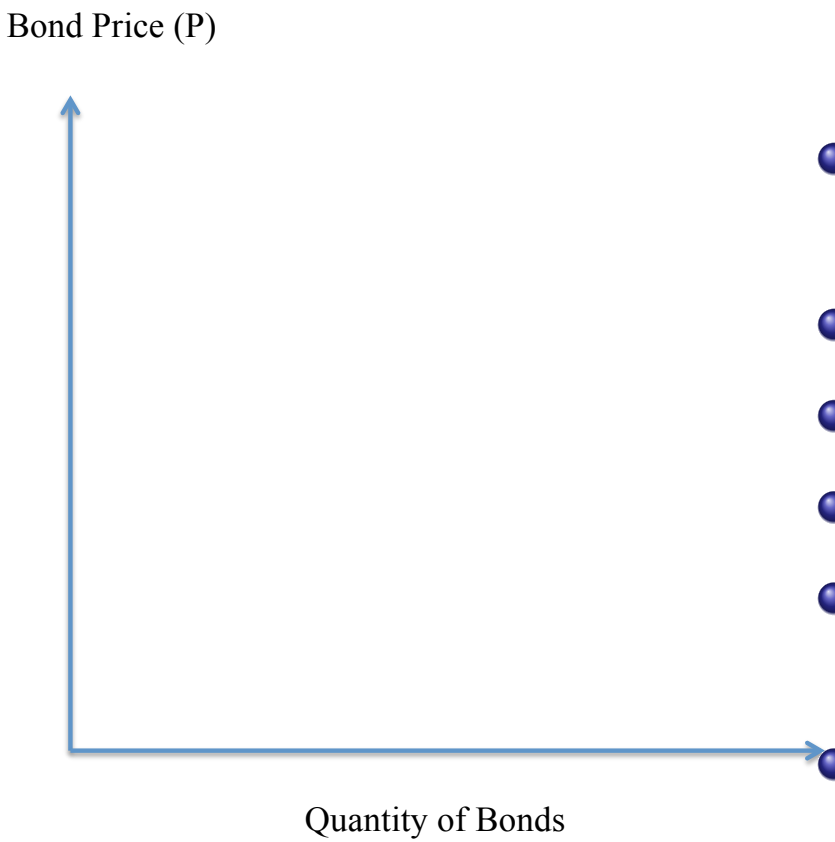
- Suppose Bond Supply shift to the right,
  - profitability of investments .....
  - expected inflation ......
  - government deficit .....

- A change in π^e



- 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 $\Rightarrow i = r +$ ..... , implying $\pi^e \uparrow$, i .....
- "Fisher effect"

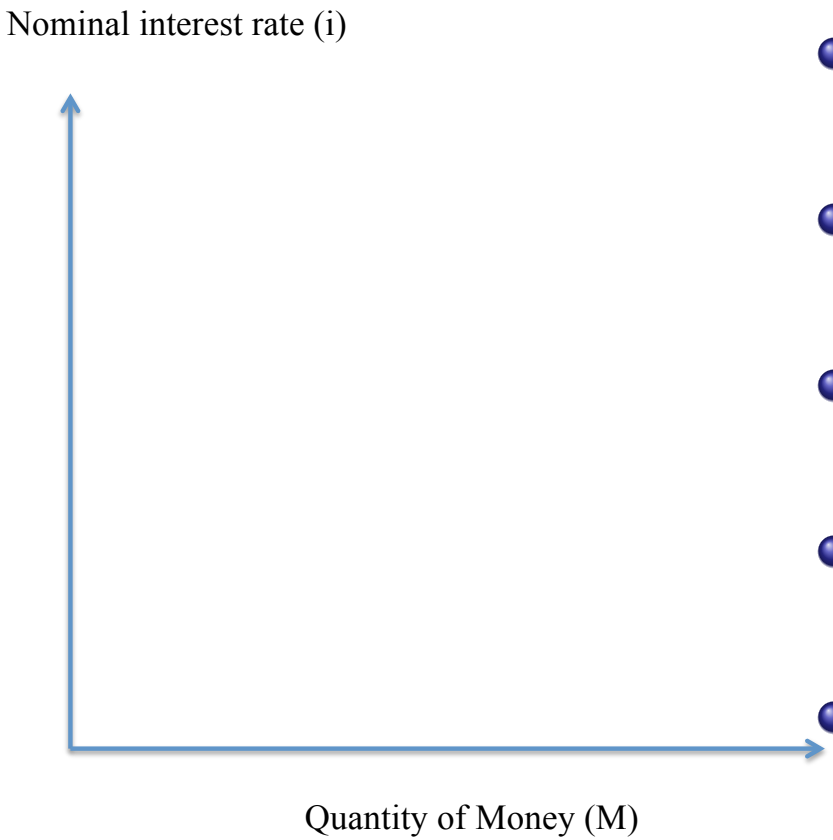
- Reponse to a business cycle expansion



- 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 .....

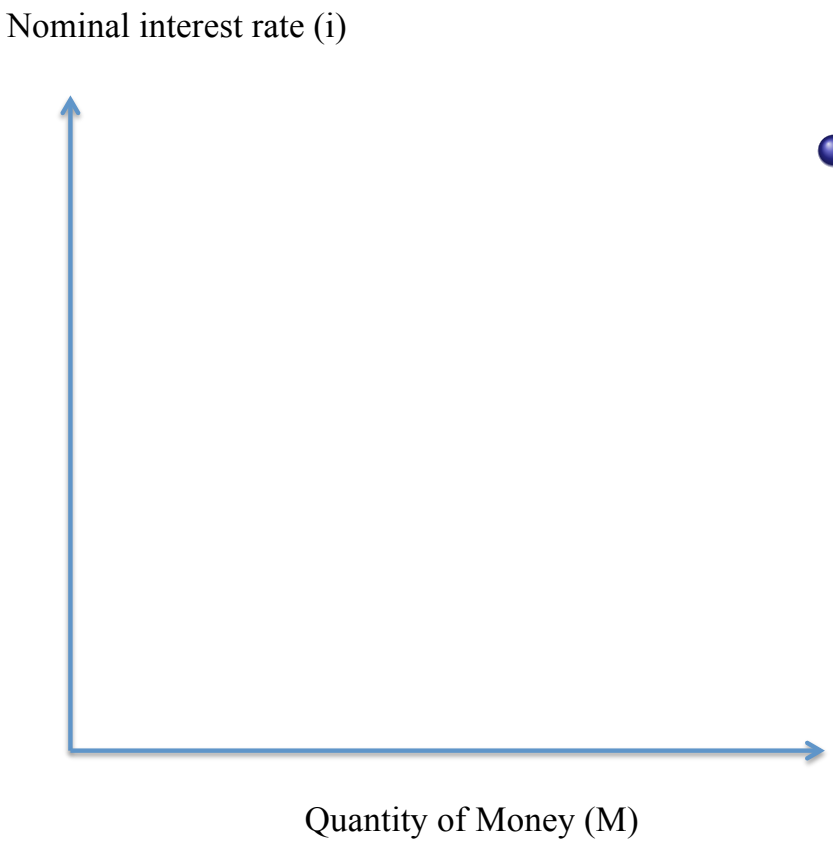
3.2 Liquidity Preference Framework (Keynesian)

- two main assets people use to store their wealth : Money and Bonds
- $M^d + B^d = M^s + B^s =$ 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



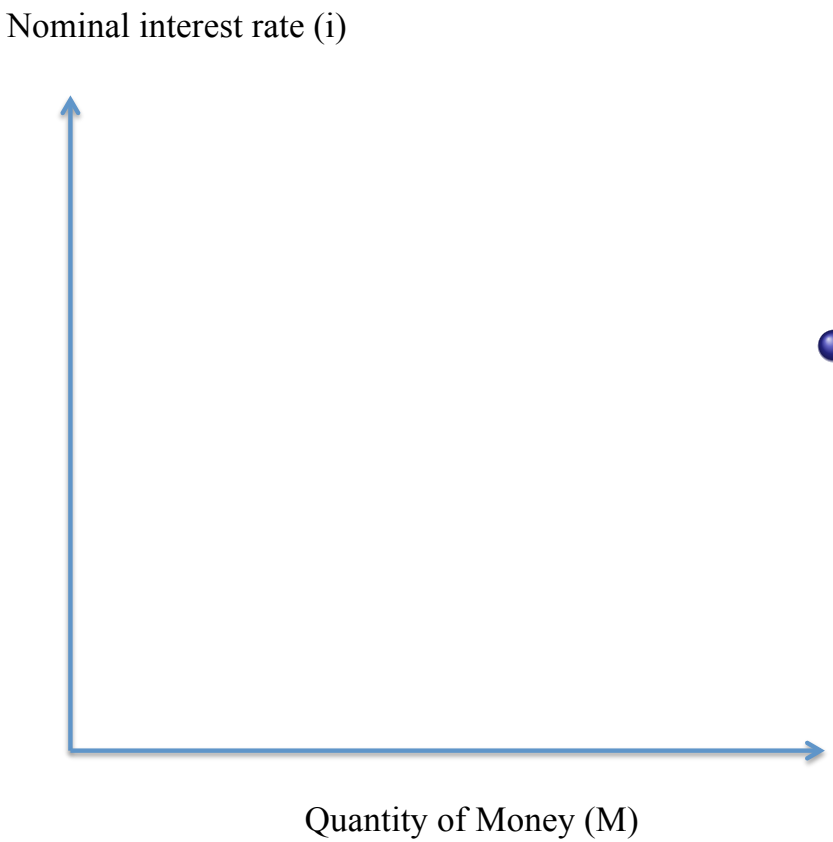
- If interest rate is lower than the equilibrium interest rate,
- there will be excess money .....
- agents will ..... (buy/sell) more bonds,
- then bond price..... (increases/decreases),
- therefore the interest rate ..... (increases/decreases)

- Shift in money supply



- 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



- 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 increases taxes (however, in the international debt market, government bonds are not considered risk-free. We focuses 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:	
THAI13OA: Bt2,556.79 million senior debentures due 2013	A+
THAI14OA: 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+
THAI17OA: 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+
THAI19OA: 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+
THAI22OA: 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.

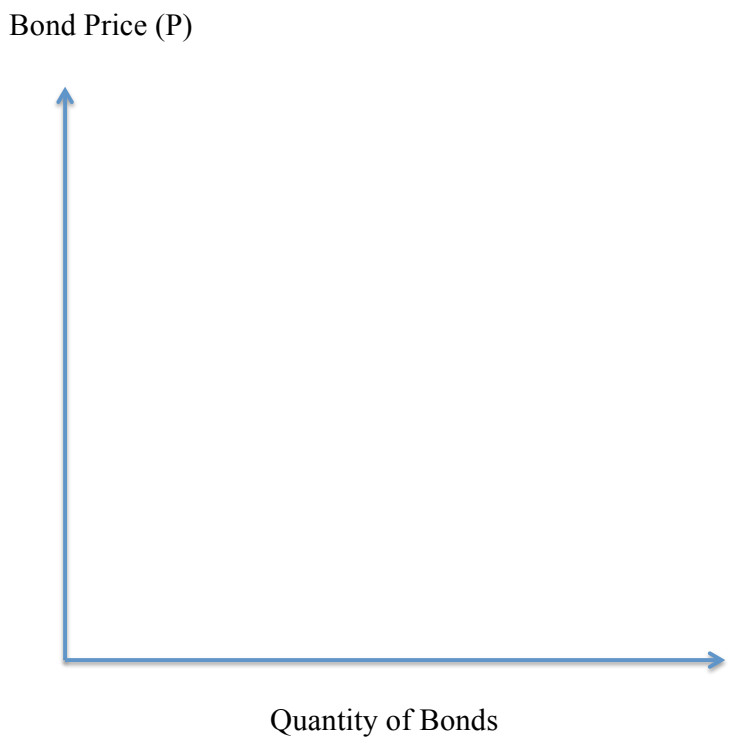
3. Income tax considerations

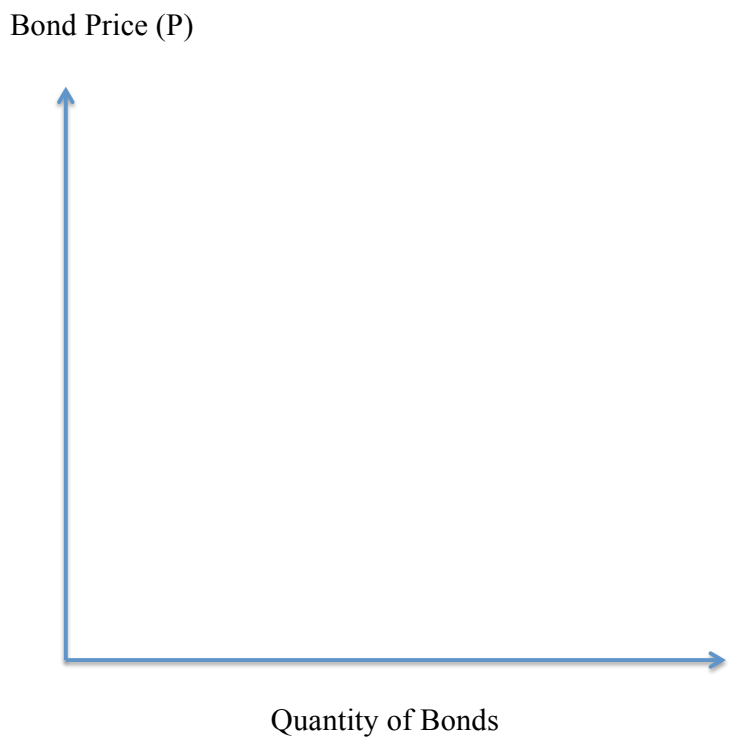
- some bonds are exempt from income taxes
- buyers consider their returns after taxes
- therefore, those bonds which are tax-free will pay a lower interest rate than it should do if they are not tax-free

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?





- 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 maturies 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

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

- Consider a n years investment period

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

- 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 $\rightarrow$ the market expects the interest rate to .....
  - downward sloping yield curve $\rightarrow$ the market expects the interest rate to .....
  - flat yield curve $\rightarrow$ the market expects the interest rate to .....
- How well the theory can explain the two findings?
  - 1. yield curve usually slopes upwards $\rightarrow$ .....
  - 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 $i_{2,t}$, $i_{3,t}$, $i_{4,t}$, ... $\uparrow$.

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

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

$$i_{n.t} = \frac{i_{1,t} + i^e_{1,t+1} + i^e_{1,t+2} + \ldots + + i^e_{1,t+n-1}}{n} + \eta_{n,t}$$

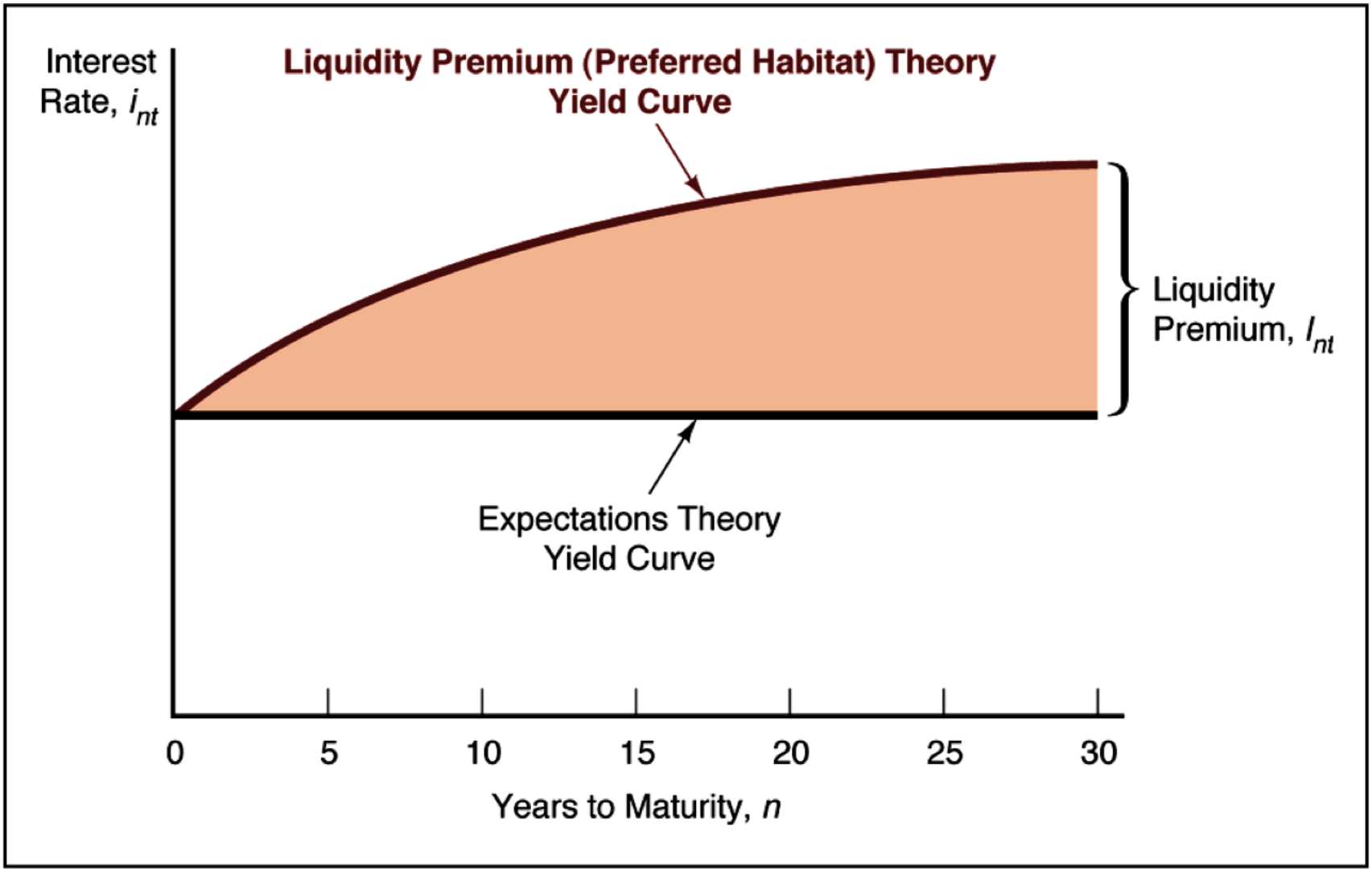
$\eta_{n,t}$ is term premium for bonds with n time to maturity at time t
η is ..... for bonds with the time to maturity that the investor likes the most, it is ..... bonds with a different time to maturity

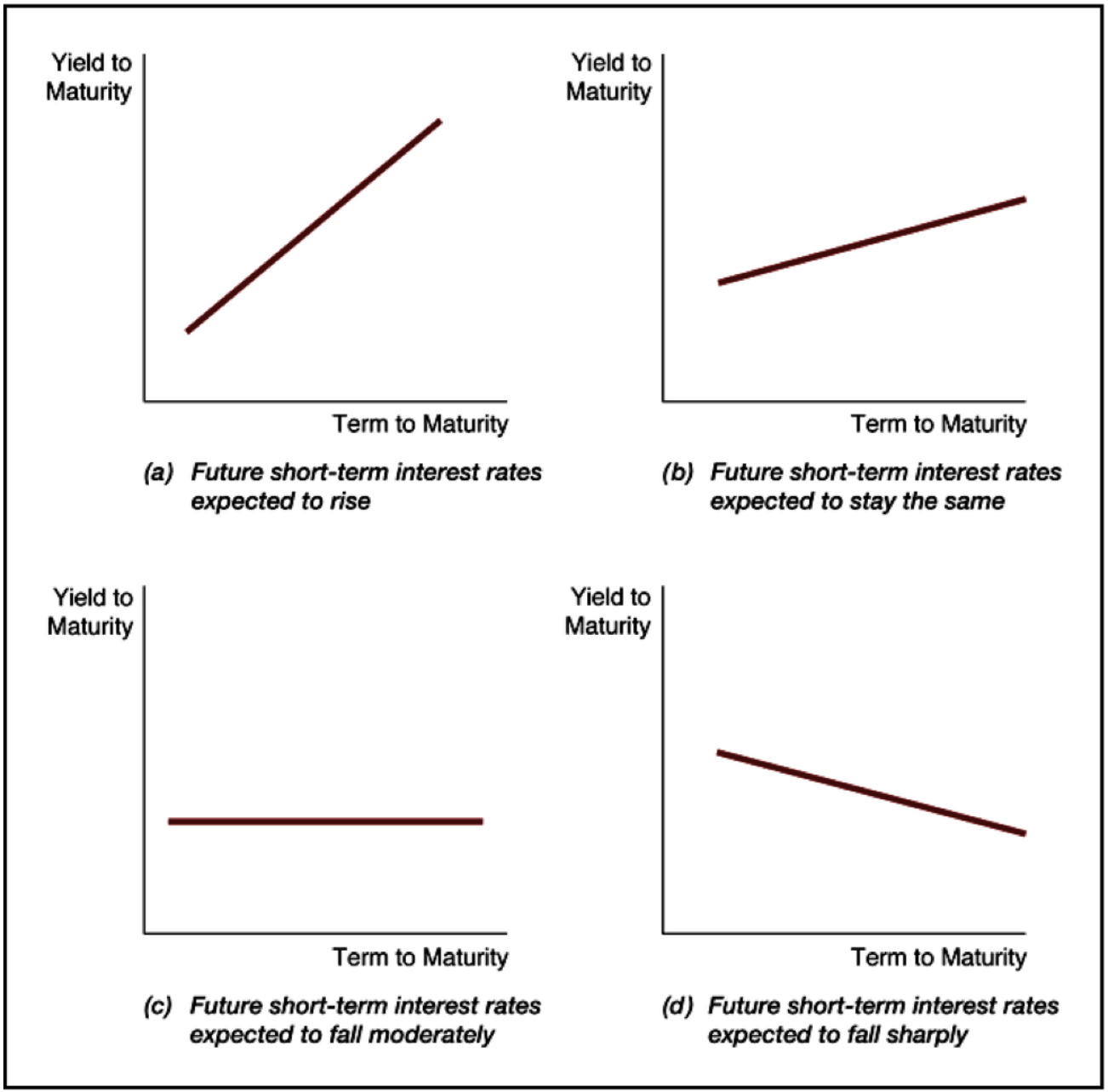
4.2.3.2 Liquidity Premium

- 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.

$$i_{n.t} = \frac{i_{1,t} + i^e_{1,t+1} + i^e_{1,t+2} + \ldots + + i^e_{1,t+n-1}}{n} + \eta_{n,t}$$

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


Interest Rate, i_{nt}
Liquidity Premium (Preferred Habitat) Theory Yield Curve
Liquidity Premium, l_{nt}
Expectations Theory Yield Curve
0
5
10
15
20
25
30
Years to Maturity, n


Yield to Maturity
Term to Maturity
(a) Future short-term interest rates expected to rise
Yield to Maturity
Term to Maturity
(b) Future short-term interest rates expected to stay the same
Yield to Maturity
Term to Maturity
(c) Future short-term interest rates expected to fall moderately
Yield to Maturity
Term to Maturity
(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 $\rightarrow$ .....
  - 2. the yields on bond with different maturity usually move together?

$$i_{n.t} = \frac{i_{1,t} + i^e_{1,t+1} + i^e_{1,t+2} + ... + + i^e_{1,t+n-1}}{n} + \eta_{n,t}$$

- 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.