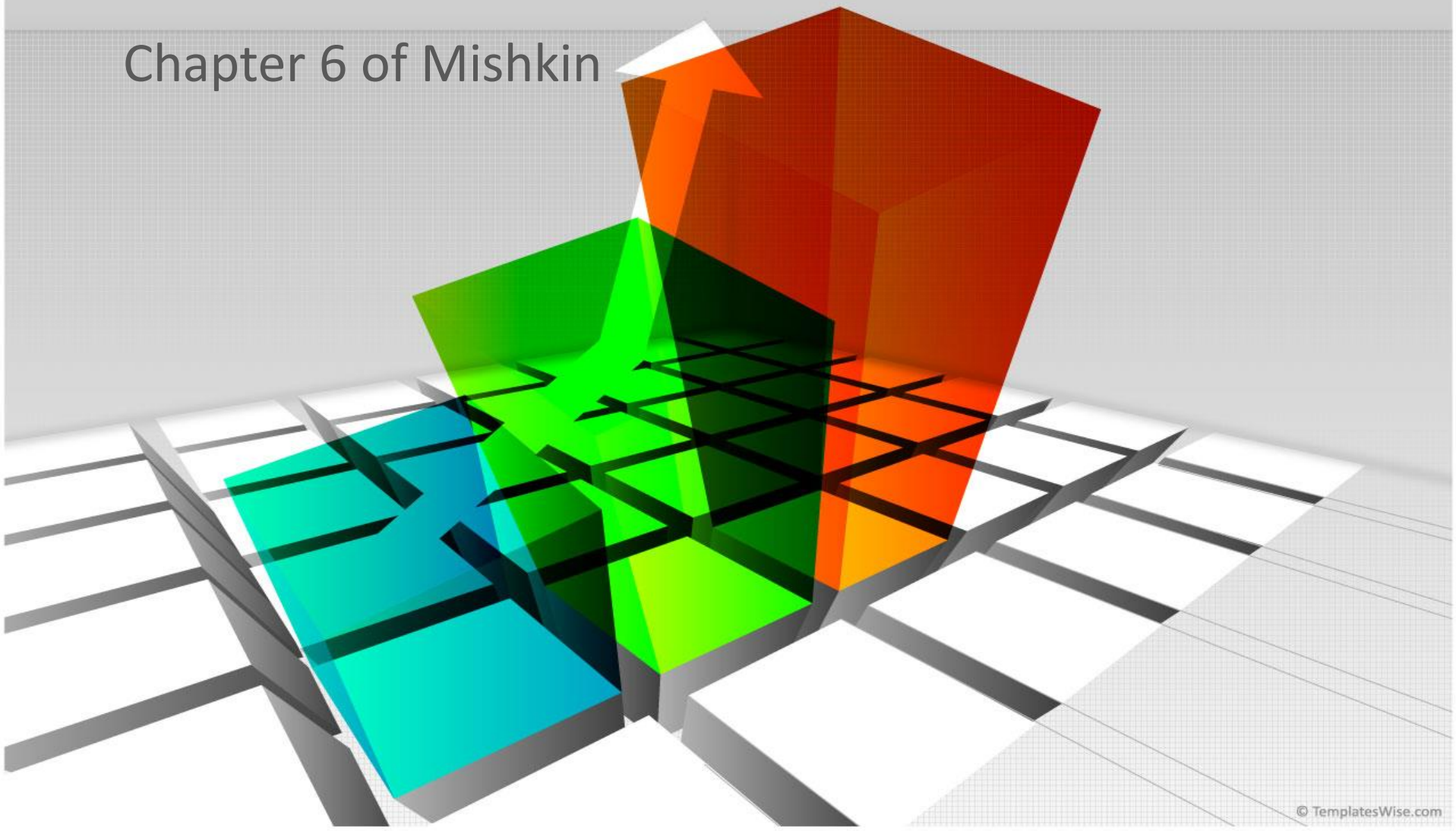
The Risk and Term Structure of Interest Rates

Chapter 6 of Mishkin

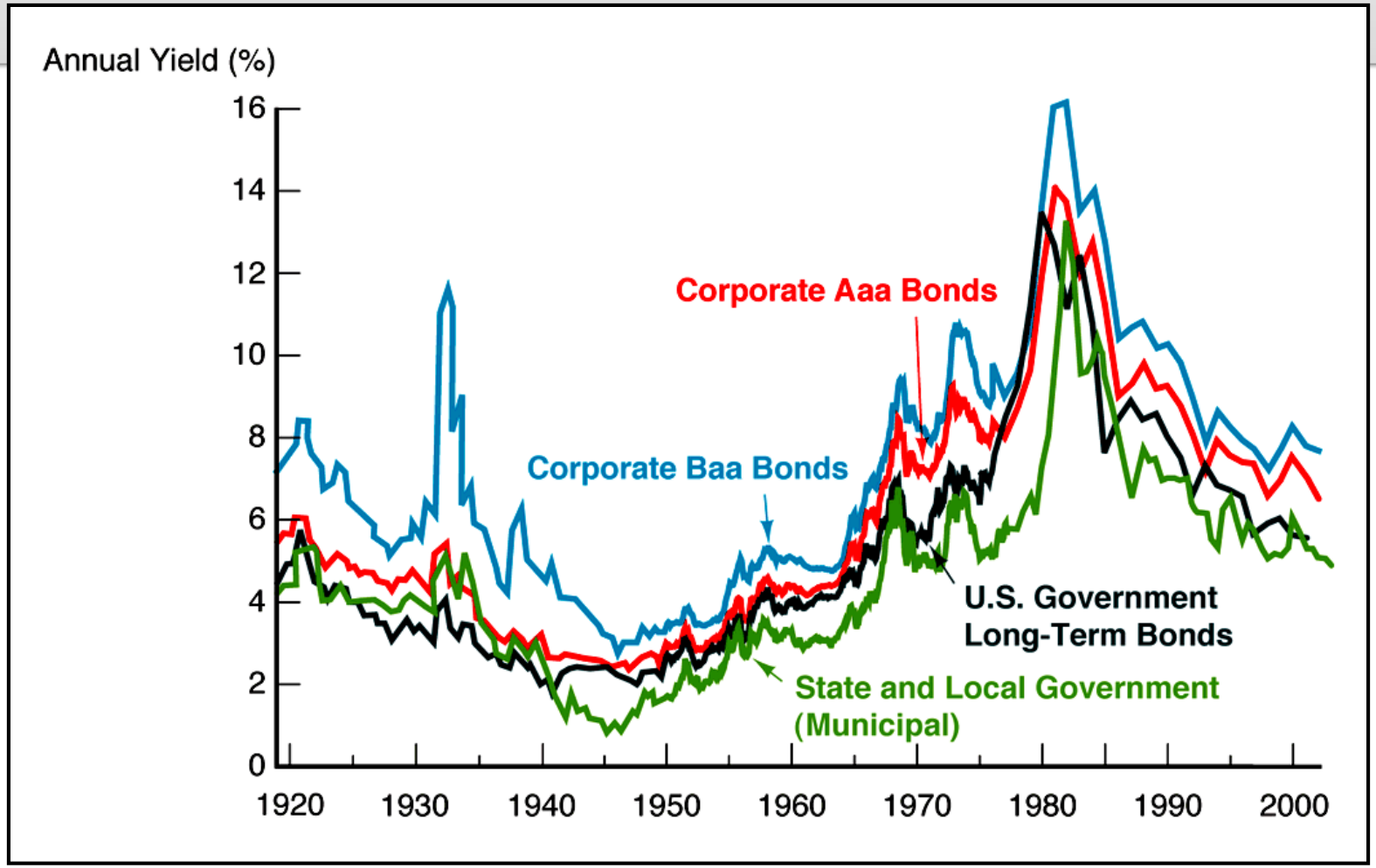


Risk Structure of Interest Rates (1)

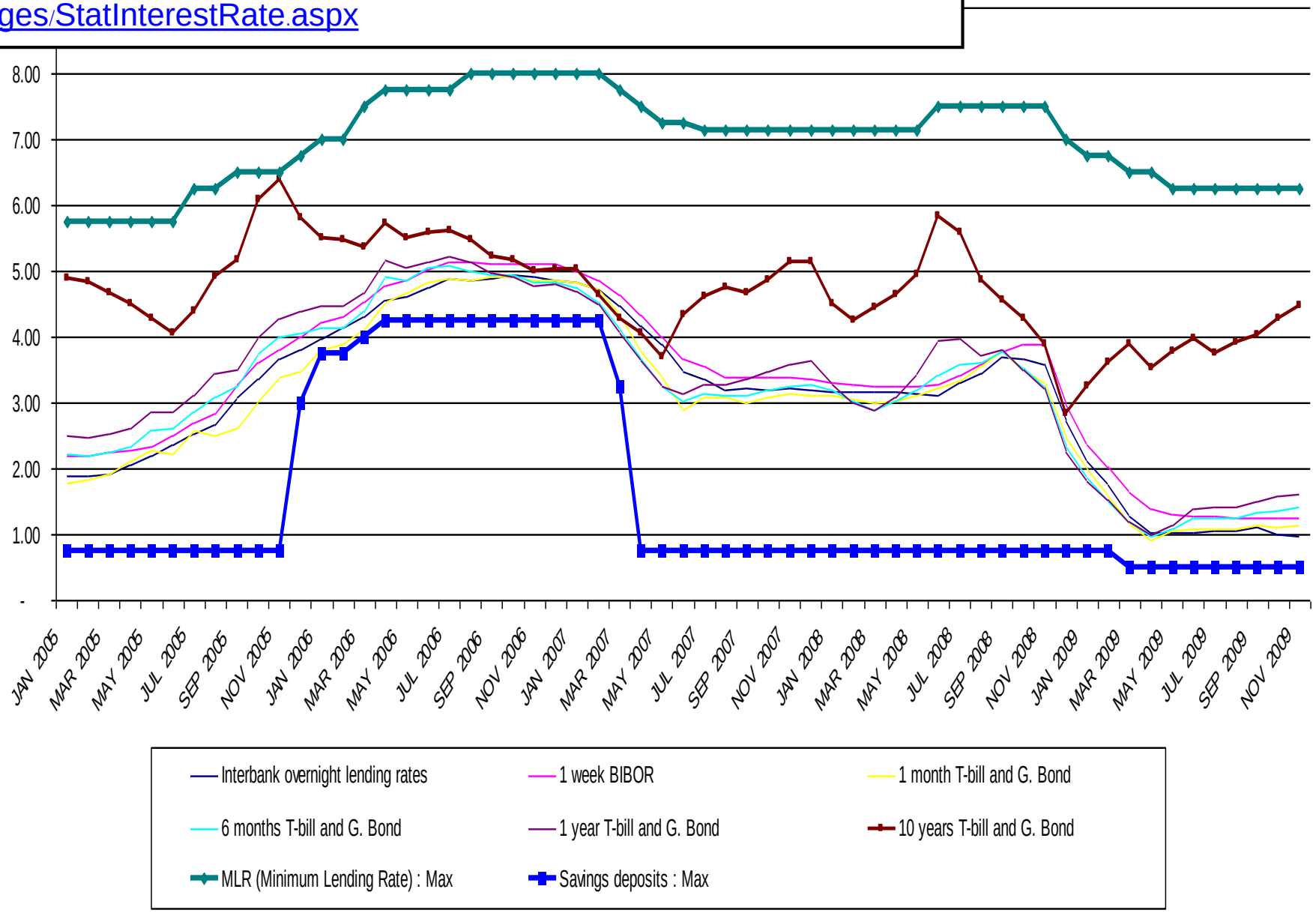
- Suppose there are 3 options in the market:
  - Option 1: Government bond with 4 % interest rate
  - Option 2: PTTEP bond with 4 % interest rate
  - Option 3: TRUE bond with 4 % interest rate.

  Assume that they have the same maturity date.
- Which one is your 1st choice?
- Which one is your 2nd choice?
- Why?

Risk Structure of Interest Rates (2)



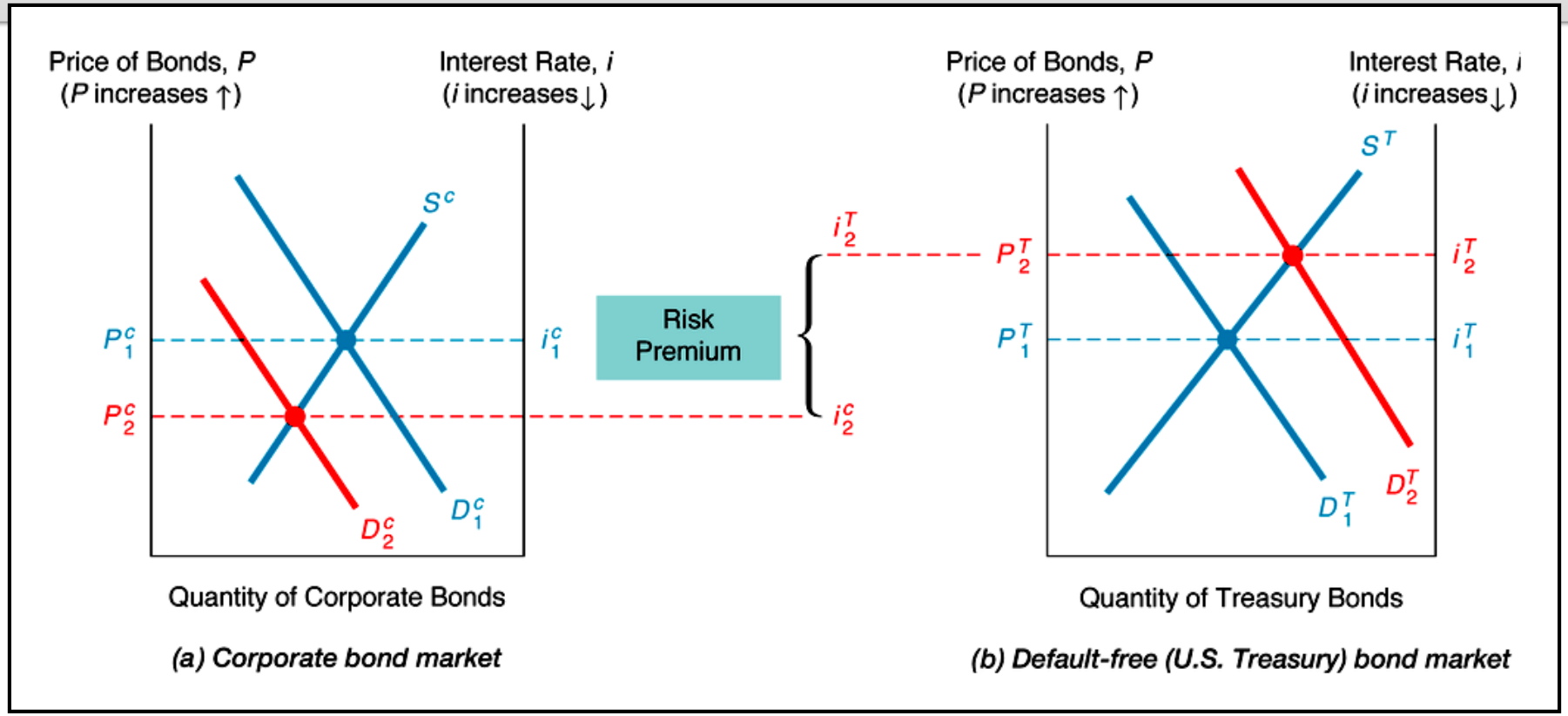
Source:
http://www.bot.or.th/English/Statistics/FinancialMarkets/InterestRate/Pages/StatInterestRate.aspx



Risk Structure of Interest Rates (3)

- Default Risk
  - ***Default*** occurs when the issuer of the bond is unable or unwilling to make payments when promised.
  - Corporate suffering big losses might be more likely to suspend interest payments on its bonds. This means its bonds have high default risk.
  - Treasury or BOT bonds are usually considered to have no default risk. They are called ***default-free bonds***.
  - The spread is called ***risk premium***.

Risk Structure of Interest Rates (4)



Risk Structure of Interest Rates (5)

Corporate Bond Market

1. Risk of corporate bonds ↑ (Rel expected return ↓), D^c ↓, D^c shifts left
2. P^c ↓, i^c ↑

Treasury Bond Market

3. Relative risk of Treasury bonds ↓ (Rel expected return ↑), D^T ↑, D^T shifts right
4. P^T ↑, i^T ↓

Outcome:

Risk premium, $i^c - i^T$, rises

Risk Structure of Interest Rates (6)

Source: http://www.trisrating.com/

PTT Exploration and Production PLC	Corporate	Oil & gas integrated, exploration and production	Issuer credit rating	AAA	29-03-2018	Stable
True Corporation PLC	Corporate	ICT	Issuer credit rating	BBB+	26-06-2018	Stable
True Move H Universal Communication Co., Ltd.	Corporate	ICT	Issuer credit rating	BBB+	26-06-2018	Stable

Risk Structure of Interest Rates (7)

TRIS Rating uses eight letter rating symbols for announcing medium- and long-term credit ratings. The ratings range from AAA, the highest rating, to D, the lowest rating. The medium- and long-term debt instrument covers the period of time from one year up. The definitions are:

AAA	The highest rating, indicating a company or a debt instrument with smallest degree of credit risk. The company has extremely strong capacity to pay interest and repay principal on time, and is unlikely to be affected by adverse changes in business, economic or other external conditions.
BBB	The rating indicates a company or a debt instrument with moderate credit risk. The company has adequate capacity to pay interest and repay principal on time, but is more vulnerable to adverse changes in business, economic or other external conditions and is more likely to have a weakened capacity to pay interest and repay principal than debt in higher-rated categories.
BB	The rating indicates a company or a debt instrument with a high credit risk. The company has less than moderate capacity to pay interest and repay principal on time, and can be significantly affected by adverse changes in business, economic or other external conditions, leading to inadequate capacity to pay interest and repay principal.

Risk Structure of Interest Rates (8)

- Liquidity
  - As before, a liquid asset is one that can be quickly and cheaply converted into cash.
  - The more liquid an asset is, the more desirable it is (holding everything else constant).

Risk Structure of Interest Rates (9)

If corporate bonds become less liquid:

Corporate Bond Market

1. Less liquid corporate bonds $D^c \downarrow$, D^c shifts left
2. $P^c \downarrow$, $i^c \uparrow$

Treasury Bond Market

1. Relatively more liquid Treasury bonds, $D^T \uparrow$, D^T shifts right
2. $P^T \uparrow$, $i^T \downarrow$

Outcome:

Risk premium, $i^c - i^T$, rises

Risk premium reflects not only corporate bonds' default risk, but also lower liquidity

Term Structure of Interest Rates (1)

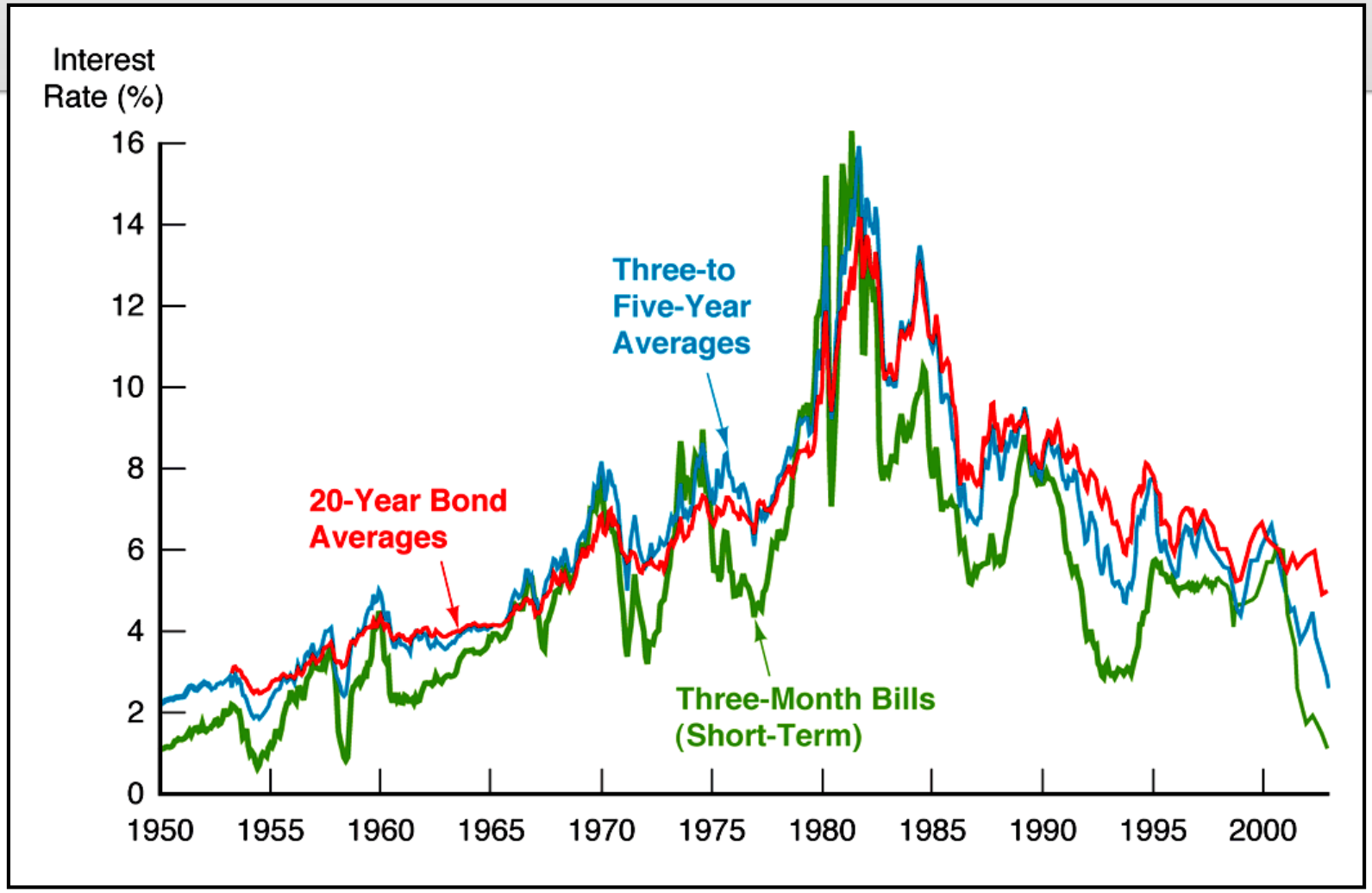
- Suppose there are 3 options in the market:
  - Option 1: 1-Year G. bond with 3 % interest rate
  - Option 2: 3-Year G. bond with 3 % interest rate
  - Option 3: 10-Year G. bond with 3 % interest rate.
- Which one is your 1st choice?
- Which one is your 2nd choice?
- Why?

Term Structure of Interest Rates (2)

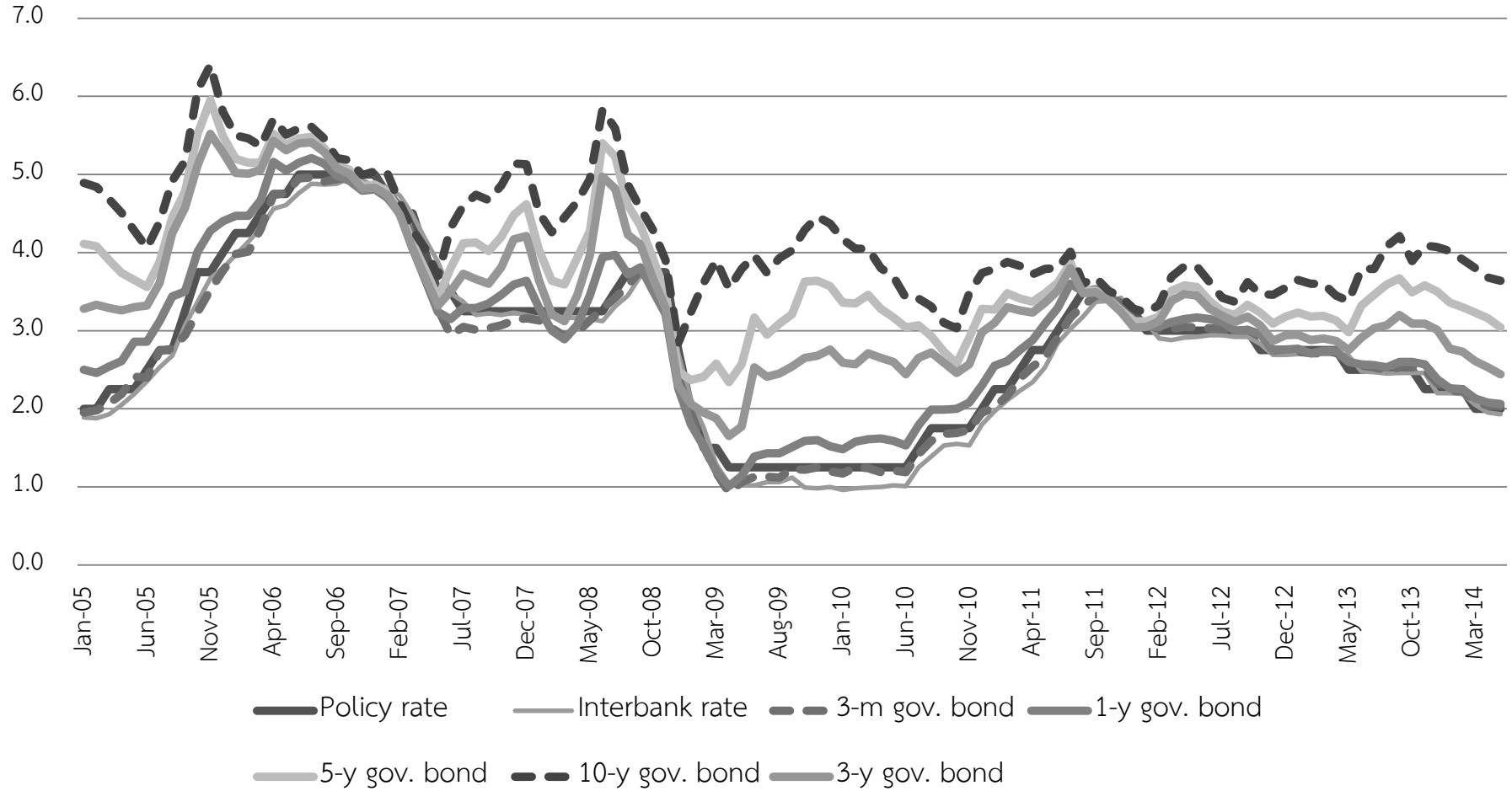
TTM (Yrs.)	Yield (%)	TTM (Yrs.)	Yield (%)	TTM (Yrs.)	Yield (%)	TTM (Yrs.)	Yield (%)	TTM (Yrs.)	Yield (%)
0.08	1.174004	9.00	2.705739	20.00	3.308384	31.00	3.449148	42.00	3.686320
0.25	1.292832	10.00	2.752370	21.00	3.329985	32.00	3.470709	43.00	3.705117
0.50	1.495729	11.00	2.877006	22.00	3.351585	33.00	3.492270	44.00	3.712464
1.00	1.683580	12.00	2.936362	23.00	3.369113	34.00	3.513831	45.00	3.719811
2.00	1.889961	13.00	3.002963	24.00	3.371893	35.00	3.535393	46.00	3.727159
3.00	2.010160	14.00	3.087809	25.00	3.374673	36.00	3.556954	47.00	3.734506
4.00	2.153425	15.00	3.133419	26.00	3.377242	37.00	3.578515	48.00	3.760072
5.00	2.284501	16.00	3.179028	27.00	3.378798	38.00	3.600076		
6.00	2.395330	17.00	3.224637	28.00	3.384465	39.00	3.621637		
7.00	2.513320	18.00	3.265182	29.00	3.406026	40.00	3.643198		
8.00	2.599122	19.00	3.286783	30.00	3.427587	41.00	3.664759		

Source: http://www.thaibma.or.th/EN/Market/YieldCurve/Government.aspx

Term Structure of Interest Rates (3)



Term Structure of Interest Rates (4)

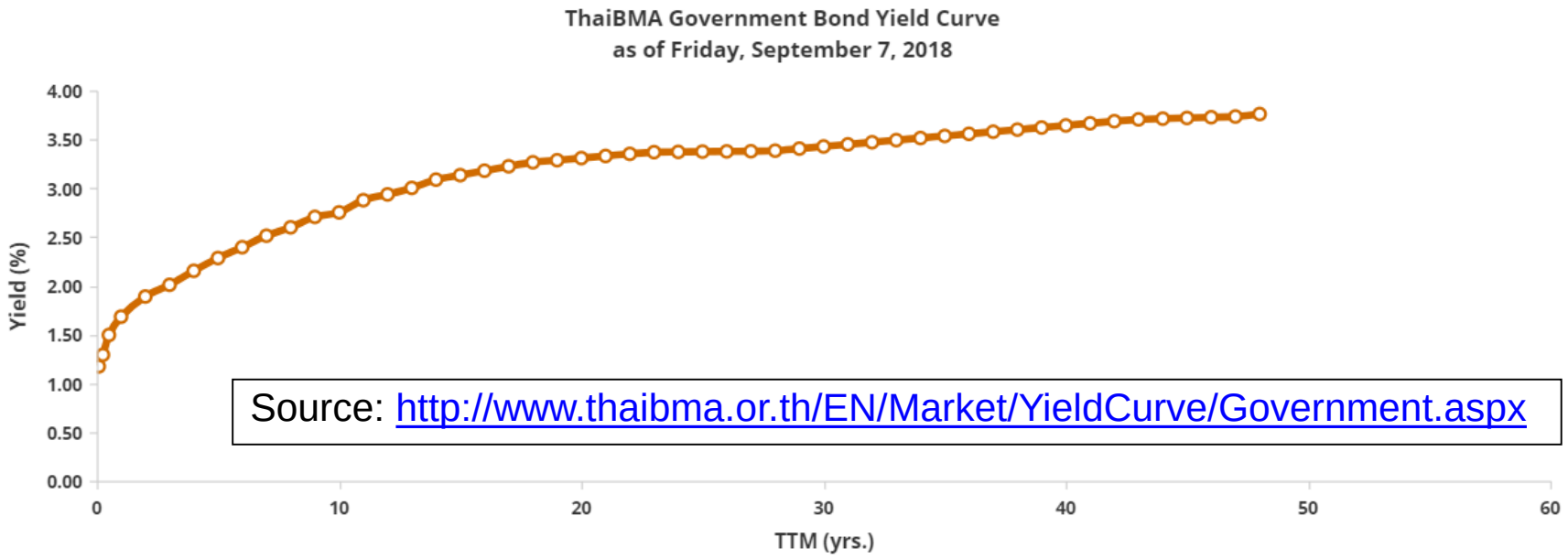


Term Structure of Interest Rates (5)

Yield curve is a plot of the yields on the same bonds with differing terms to maturity.

1. Interest rates for different maturities move together over time.
2. Yield curves tend to have steep upward slope when short rates are low and downward slope when short rates are high.
3. Yield curve is typically upward sloping.

Term Structure of Interest Rates (6)



Source: http://www.thaibma.or.th/EN/Market/YieldCurve/Government.aspx

TTM (Yrs.)	Yield (%)	TTM (Yrs.)	Yield (%)	TTM (Yrs.)	Yield (%)	TTM (Yrs.)	Yield (%)	TTM (Yrs.)	Yield (%)
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3.00	2.010160	14.00	3.087809	25.00	3.374673	36.00	3.556954	47.00	3.734506
4.00	2.153425	15.00	3.133419	26.00	3.377242	37.00	3.578515	48.00	3.760072
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Term Structure of Interest Rates (7)

Three Theories of Term Structure

1. Expectations Theory
2. Segmented Markets Theory
3. Liquidity Premium (Preferred Habitat) Theory
   A. Expectations Theory explains 1 and 2, but not 3
   B. Segmented Markets explains 3, but not 1 and 2
   C. Solution: Combine features of both Expectations Theory and Segmented Markets Theory to get Liquidity Premium (Preferred Habitat) Theory and explain all facts

Expectations Hypothesis (1)

Key Assumption: Bonds of different maturities are perfect substitutes

Implication: RET^e on bonds of different maturities are equal

Investment strategies for two-period horizon

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

Expected return from strategy 2

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

Since $(i_{2t})^2$ is extremely small, expected return is approximately $2(i_{2t})$

Expectations Hypothesis (2)

Expected Return from Strategy 1

$$\frac{(1 + i_t)(1 + i^e_{t+1}) - 1}{1} = \frac{1 + i_t + i^e_{t+1} + i_t(i^e_{t+1}) - 1}{1}$$

Since $i_t(i^e_{t+1})$ is also extremely small, expected return is approximately

$$i_t + i^e_{t+1}$$

From implication above expected returns of two strategies are equal:

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

Solving for i_{2t}

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

Expectations Hypothesis (3)

More generally for *n*-period bond:

$$i_{nt} = \frac{i_t + i^e_{t+1} + i^e_{t+2} + \ldots + i^e_{t+(n-1)}}{n}$$

In words: Interest rate on long bond = average short rates expected to occur over life of long bond

Numerical example:

One-year interest rate over the next five years 5%, 6%, 7%, 8% and 9%:

Interest rate on two-year bond:

(5% + 6%)/2 = 5.5%

Interest rate for five-year bond:

(5% + 6% + 7% + 8% + 9%)/5 = 7%

Interest rate for one to five year bonds:

5%, 5.5%, 6%, 6.5% and 7%.

Expectations Hypothesis and Term Structure Facts (1)

Explains why yield curve has different slopes:

1. When short rates expected to rise in future, average of future short rates = i_{nt} is above today's short rate: therefore yield curve is upward sloping
2. When short rates expected to stay same in future, average of future short rates are same as today's, and yield curve is flat
3. Only when short rates expected to fall will yield curve be downward sloping

Expectations Hypothesis and Term Structure Facts (2)

Expectations Hypothesis explains Fact 1 that short and long rates move together

1. Short rate rises are persistent
2. If $i_t \uparrow$ today, i^e_{t+1}, i^e_{t+2} etc. $\uparrow \Rightarrow$ average of future rates $\uparrow \Rightarrow i_{nt} \uparrow$
3. Therefore: $i_t \uparrow \Rightarrow i_{nt} \uparrow$, i.e., short and long rates move together

Expectations Hypothesis and Term Structure Facts (3)

Explains Fact 2 that yield curves tend to have steep slope when short rates are low and downward slope when short rates are high

1. When short rates are low, they are expected to rise to normal level, and long rate = average of future short rates will be well above today's short rate: yield curve will have steep upward slope
2. When short rates are high, they will be expected to fall in future, and long rate will be below current short rate: yield curve will have downward slope

Expectations Hypothesis and Term Structure Facts (4)

Doesn't explain Fact 3 that yield curve usually has upward slope

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

Segmented Markets Theory

Key Assumption: Bonds of different maturities are not substitutes at all

Implication: Markets are completely segmented: interest rate at each maturity determined separately

Explains Fact 3 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

Does not explain Fact 1 or Fact 2 because assumes long and short rates determined independently

Liquidity Premium Theories (1)

Key Assumption: Bonds of different maturities are substitutes, but are not perfect substitutes

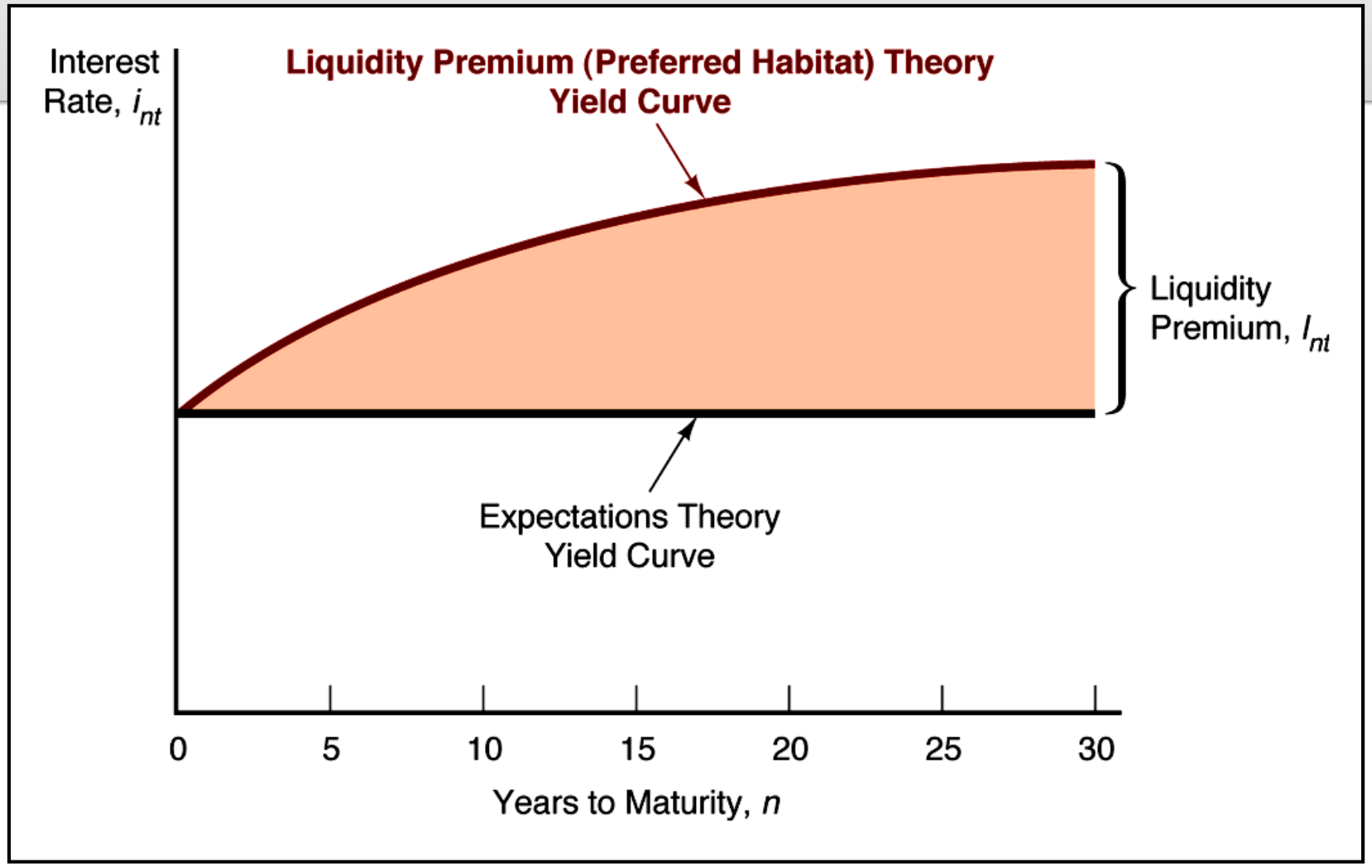
Implication: Modifies Expectations Theory with features of Segmented Markets Theory

Investors prefer short rather than long bonds $\Rightarrow$ must be paid positive liquidity (term) premium, l_{nt}, to hold long-term bonds

Results in following modification of Expectations Theory

$$i_{nt} = \frac{i_t + i^e_{t+1} + i^e_{t+2} + \ldots + i^e_{t+(n-1)}}{n} + l_{nt}$$

Liquidity Premium Theories (2)



Liquidity Premium Theories (3)

Explains all 3 Facts

Explains Fact 3 of usual upward sloped yield curve by investors' preferences for short-term bonds

Explains Fact 1 and Fact 2 using same explanations as expectations hypothesis because it has average of future short rates as determinant of long rate

Market Predictions of Future Short Rates