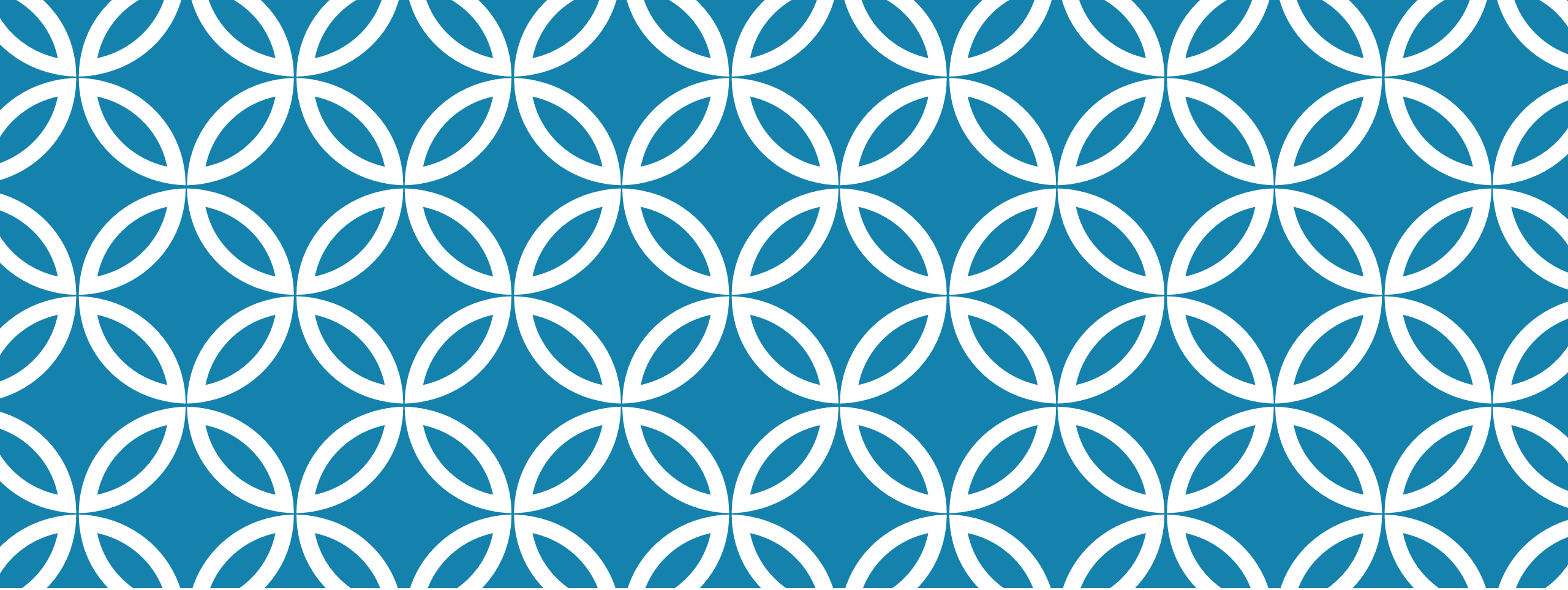

# THE RISK AND TERM-STRUCTURE OF INTEREST RATE

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**EE431 Semester 2/2017**

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# TOPICS

- ~~Bond pricing and yield to maturity~~
- ~~Bond returns and Interest rate risk.~~
- ~~Bond price and interest rate determination~~
- Risk and term structure of interest rates

Chapter 6 Mishkin

Also note/extra reading lists uploaded on the BE Moodle.

# PREVIOUSLY….ON BOND MODEL.

- Framework of price/interest rate determinations.
- Demand and supply → implied price and implied interest rate
- Apply the model to explain why interest rate has fluctuated over times; explaining some behaviors of interest rate (fisher effect, procyclical, leading indicator)

# PROBLEM OF THE BASIC MODEL…

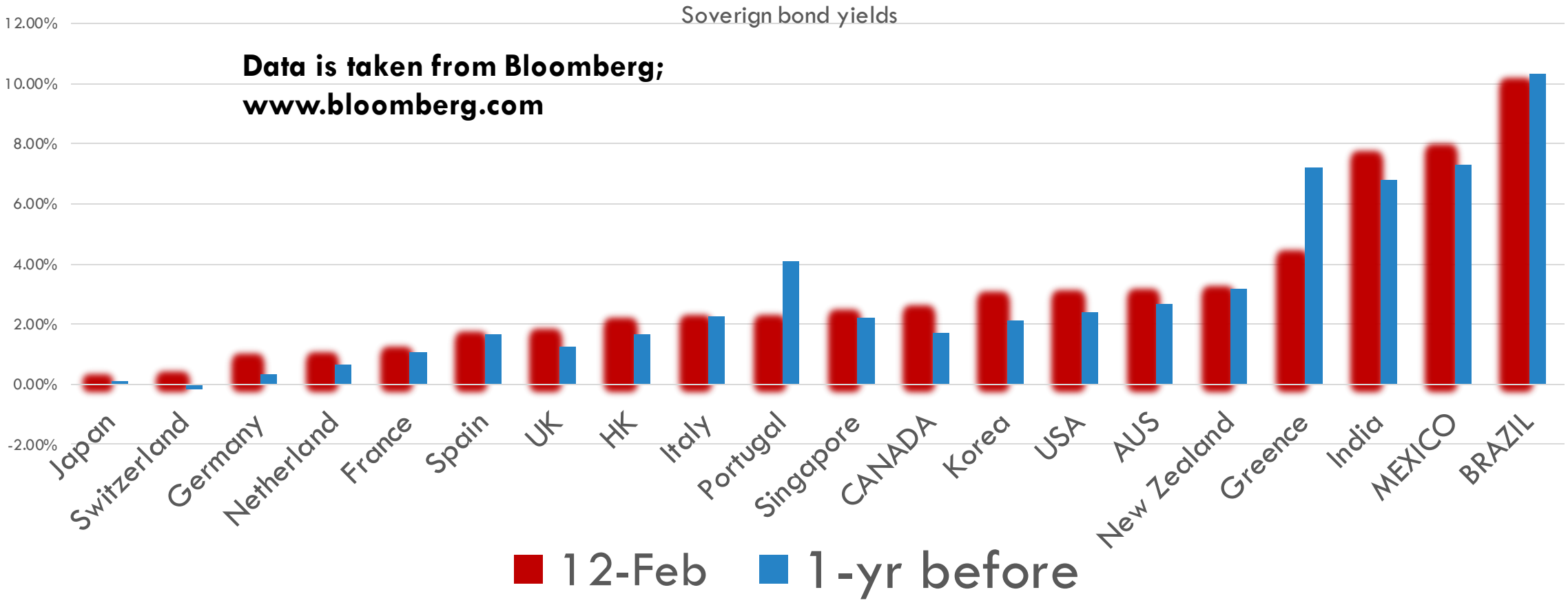
- All types of bond, by issuers and TTM, are treated the same. (identical)
  - So, we pick a representative bond and analyze its behavior.
- This assumption doesn't sound right as there are ***multiple interest rates*** in the market.
- More importantly, interest rates *vary* with respect to

  **(i) the issuers and**

  **(ii) term to maturity of bond.**

# OBSERVATION 1: VARIATIONS OF YIELDS ACROSS ISSUERS

## *10-year* Sovereign bond*



# OBSERVATION 2: YIELDS ACROSS TTM

| NAME | TTM | COUPON | PRICE | YIELD | 1 MONTH | 1 YEAR |
|---|---|---|---|---|---|---|
| GB3:GOV | 3 months | 0 | 1.56 | 1.59% | +15 | +105 |
| GB6:GOV | 6 months | 0 | 1.71 | 1.75% | +16 | +112 |
| GB12:GOV | 12 months | 0 | 1.85 | 1.90% | +12 | +111 |
| GT2:GOV | 2 years | 2 | 99.9 | 2.08% | +8 | +89 |
| GT5:GOV | 5 years | 2.38 | 99.2 | 2.55% | +20 | +66 |
| GT10:GOV | 10 years | 2.75 | 99.2 | 2.84% | +30 | +44 |
| GT30:GOV | 30 years | 3 | 97.6 | 3.12% | +28 | +12 |

**US yield (Feb 12 2018)**
**Col 1: Bonds by TTM**
**Col 2: Coupon rate**
**Col 3: Traded price**
**Col 4: Implied yield**
**Col 5: Change in yield (bps), compared to 1 month before**
**Col 6: Change in yield (bps), compared to a year before.**

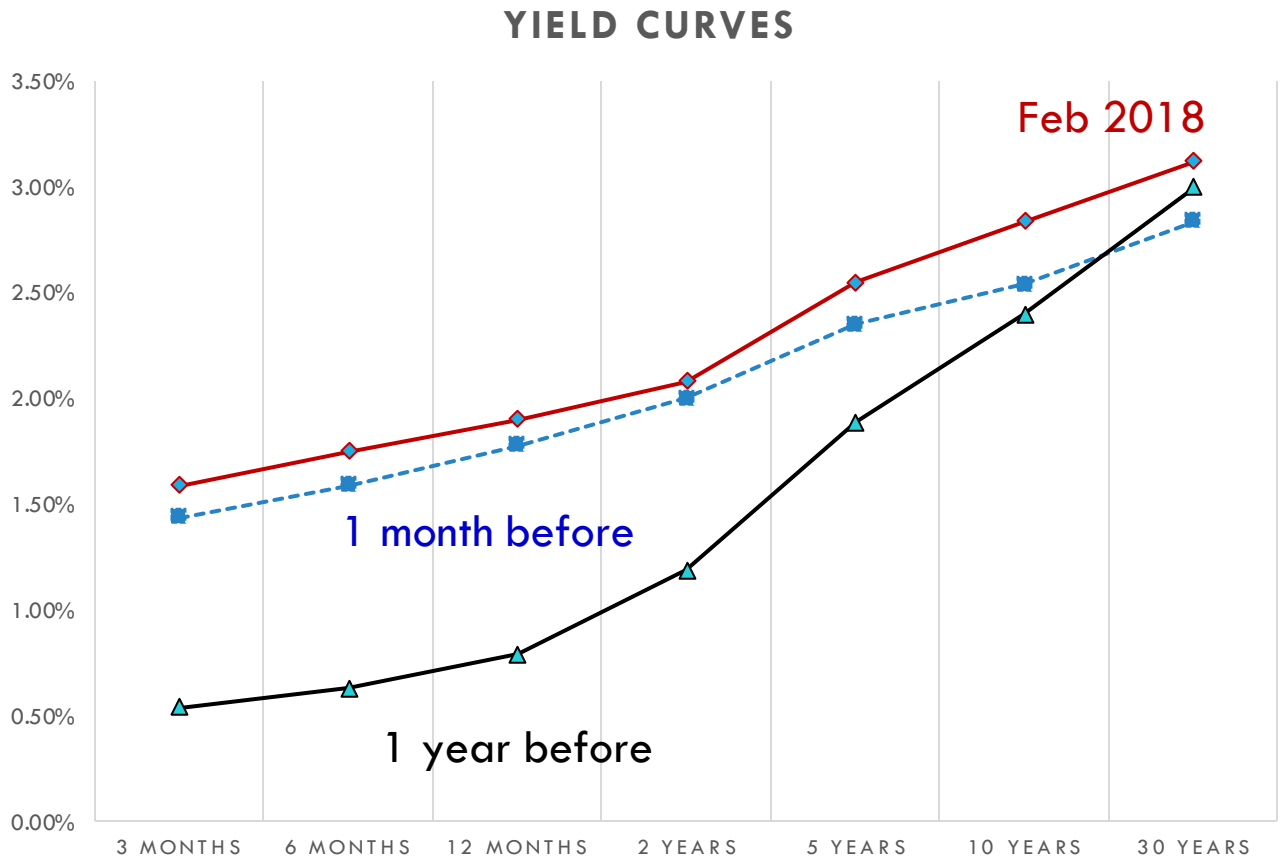
**Note that bond rates differ with respect to the TTM.**

**www.bloomberg.com**

# OBSERVATION 2: YIELDS ACROSS TTM

- The plotted schedule between TTM and YTM is called the "***yield curve***".

- Movement in yield curve is called "***dynamic yield curve***".



# THEORIES TO ACCOUNT FOR THE TWO STYLIZED FEATURES INCLUDE:

- **Risk Structure of Interest rate**
- **Term Structure of Interest rate**

# RISK STRUCTURE OF INTEREST RATE

- To explain why, *for the same remaining periods to maturity*, bond rates (yield / interest rate) vary with issuers, and, hence, there exists *bond spreads* in the market.

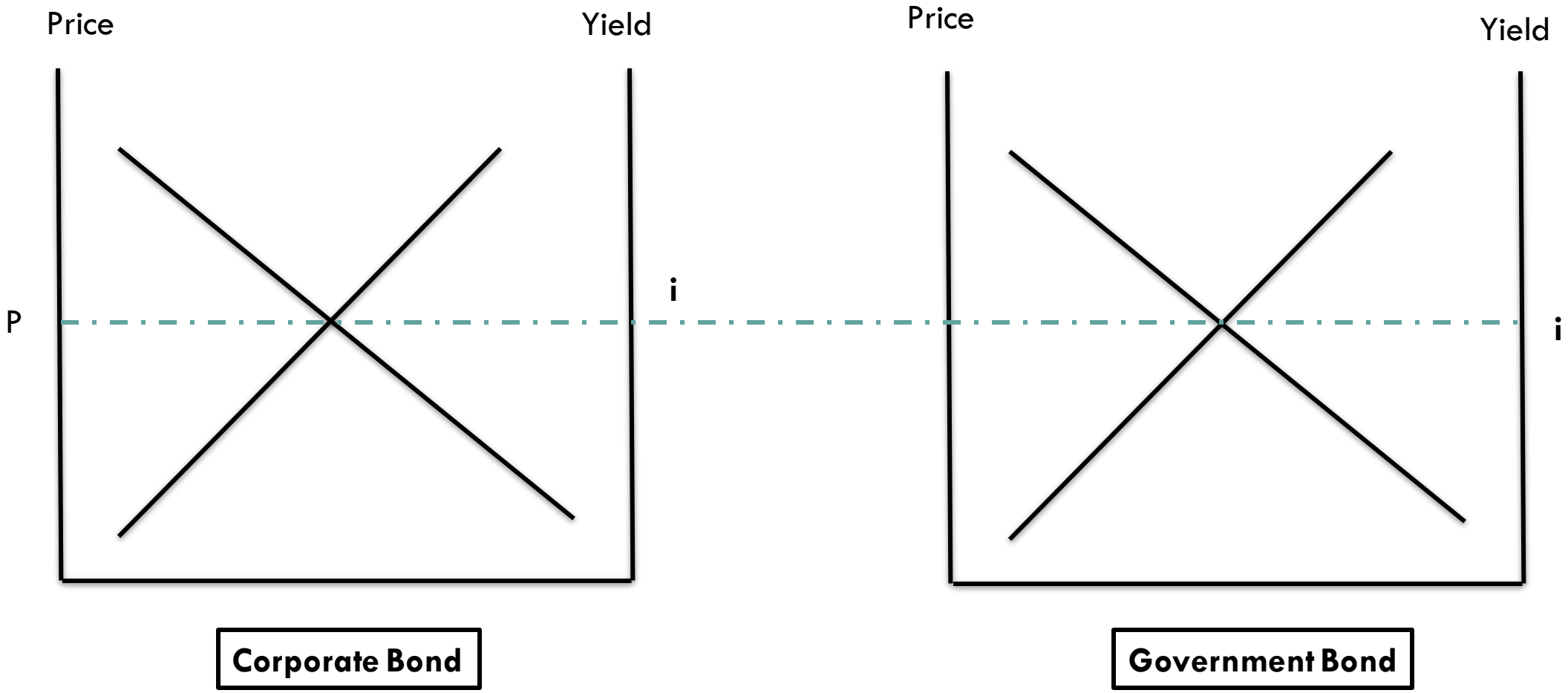
- In the other word, we ask "why does the spread exist?"
  - In a nut shell, answer is attributed to the difference in risk structures / some characteristic details of bonds

# RISK STRUCTURE OF INTEREST RATE

- Consider two types of bond: *Government Bond* and *Corporate Bond*

- We will apply the Bond demand/Bond supply model and show that Government Bond rate is lower than corporate bond rate.

# IF THE TWO BONDS ARE TREATED ALIKE OR IDENTICAL, THEY SHOULD BE EQUALLY PRICED: *SINGLE* INTEREST RATE AND PRICE!



# BOND SPREADS COULD OCCUR BECAUSE EACH BOND DIFFERS IN SOME SENSES.

- Level of risk associated (Risk factor)
  - Credit risk
  - Liquidity risk
- Tax privilege

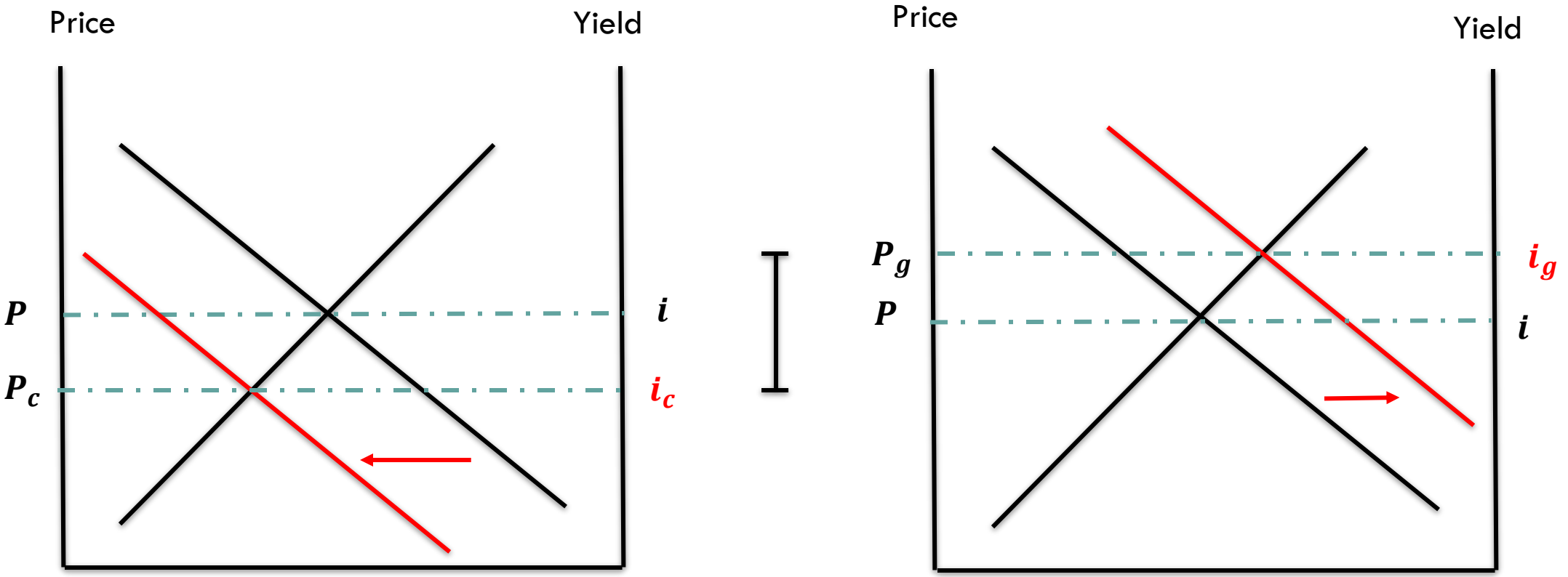
# CREDIT OR DEFAULT RISK

- The likelihood that the issuer will fail to honor the promise, and cannot repay either coupon/principal.

- Government bond, issued in domestic currency, is considered (credit) risk-free bond.

- Given the credit risk profile, demand for government bond is relatively higher than that for corporate bond.

# ACCOUNTING FOR CREDIT RISK ➔ SPREAD IS DETERMINED/DRIVEN BY CREDIT QUALITY OF ISSUERS ➔ *WEDGES OF INTEREST RATES*




Corporate Bond

$i_c - i_g$ = bond premium/spreads, (due to credit risk)

Default-free Government Bond

# HOW DOES THE MARKET FIGURE OUT THE CREDIT RISK OF A BOND?

- By relying for the information from credit-rating company: S&P, Moody's, Fitch's, Tris.

- Thai SEC requires that bond issuers must comply with the rating evaluation process; credit-rating letter must be acquired.
  - Rating scale measured in terms of relative riskiness.

| Company | Agency | Rating |
|---|---|---|
| DOUBLE A (1991) PUBLIC COMPANY LIMITED | TRIS | BBB- |
| ADVANCED INFO SERVICE PUBLIC COMPANY LIMITED | FITCH | AA+(tha) |
| AP (THAILAND) PUBLIC COMPANY LIMITED | TRIS | A- |
| BANPU PUBLIC COMPANY LIMITED | TRIS | A+ |
| BANGKOK BANK PUBLIC COMPANY LIMITED | FITCH | AA(tha) |
| BANK OF AYUDHYA PUBLIC COMPANY LIMITED | FITCH | AAA(tha) |
| CENTRAL PATTANA PUBLIC COMPANY LIMITED | TRIS | AA- |

*http://marketdata.set.or.th/tfx/bexcreditrating.do?locale=en_US

*** ???(tha): rating scale with Thai government bond as the benchmark risk-free**

# COMPARABILITY OF RATING SCALE GIVEN BY DIFFERENT RATING AGENCIES.

| | DBRS | S&P | Moody's | Fitch IBCA |
|---|---|---|---|---|
| | | | | |
| Rating Scales | AAA | AAA | Aaa | AAA |
| | AA (high) | AA+ | Aa1 | AA+ |
| | AA | AA | Aa2 | AA |
| | AA (low) | AA- | Aa3 | AA- |
| | A (high) | A+ | A1 | A+ |
| | A | A | A2 | A |
| | A (low) | A- | A3 | A- |
| | BBB (high) | BBB+ | Baa1 | BBB+ |
| | BBB | BBB | Baa2 | BBB |
| | BBB (low) | BBB- | Baa3 | BBB- |
| | BB (high) | BB+ | Ba1 | BB+ |
| | BB | BB | Ba2 | BB |
| | BB (low) | BB- | Ba3 | BB- |
| | B (high) | B+ | B1 | B+ |
| | B | B | B2 | B |
| | B (low) | B- | B3 | B- |
| | CCC (high) | CCC+ | Caa1 | CCC+ |
| | CCC | CCC | Caa2 | CCC |
| | CCC (low) | CCC- | Caa3 | CCC- |
| | CC | CC | Ca | CC |
| | C | C | C | C |
| | D | D | | D |

# WHAT DOES THE RATINGS TELL US ABOUT FIRM'S CREDIT QUALITY?

**Rating** → **Probability of default**

**Exposure at risk = ?**

**Prob default * Expected Loss given default**

**Expected Loss *Given* Default (recovery)**

**Default probability (S&P)**

| rating | % |
|---|---|
| AAA | 0.01 |
| AA | 0.03 |
| A | 0.10 |
| BBB | 0.30 |
| BB | 1.00 |
| B | 5.30 |
| CCC | 21.94 |

**What is shown in the table is unconditional default probability drawn from a study of JP-Morgan.**

# *SEVERITY OF CREDIT EVENT: EXPECTED LOSS RATE* BY MOODY'S CORPORATION (EXPECTED LOSS GIVEN DEFAULT)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Aaa | 0.0001% | 0.0002% | 0.0007% | 0.0018% | 0.0029% | 0.0040% | 0.0052% | 0.0066% | 0.0082% | 0.0100% |
| Aa1 | 0.0006% | 0.0030% | 0.0100% | 0.0210% | 0.0310% | 0.0420% | 0.0540% | 0.0670% | 0.0820% | 0.1000% |
| Aa2 | 0.0014% | 0.0080% | 0.0260% | 0.0470% | 0.0680% | 0.0890% | 0.1110% | 0.1350% | 0.1640% | 0.2000% |
| Aa3 | 0.0030% | 0.0190% | 0.0590% | 0.1010% | 0.1420% | 0.1830% | 0.2270% | 0.2720% | 0.3270% | 0.4000% |
| A1 | 0.0058% | 0.0370% | 0.1170% | 0.1890% | 0.2610% | 0.3300% | 0.4060% | 0.4800% | 0.5730% | 0.7000% |
| A2 | 0.0109% | 0.0700% | 0.2220% | 0.3450% | 0.4670% | 0.5830% | 0.7100% | 0.8290% | 0.9820% | 1.2000% |
| A3 | 0.0389% | 0.1500% | 0.3600% | 0.5400% | 0.7300% | 0.9100% | 1.1100% | 1.3000% | 1.5200% | 1.8000% |
| Baa1 | 0.0900% | 0.2800% | 0.5600% | 0.8300% | 1.1000% | 1.3700% | 1.6700% | 1.9700% | 2.2700% | 2.6000% |
| Baa2 | 0.1700% | 0.4700% | 0.8300% | 1.2000% | 1.5800% | 1.9700% | 2.4100% | 2.8500% | 3.2400% | 3.6000% |
| Baa3 | 0.4200% | 1.0500% | 1.7100% | 2.3800% | 3.0500% | 3.7000% | 4.3300% | 4.9700% | 5.5700% | 6.1000% |
| Ba1 | 0.8700% | 2.0200% | 3.1300% | 4.2000% | 5.2800% | 6.2500% | 7.0600% | 7.8900% | 8.6900% | 9.4000% |
| Ba2 | 1.5600% | 3.4700% | 5.1800% | 6.8000% | 8.4100% | 9.7700% | 10.7000% | 11.6600% | 12.6500% | 13.5000% |
| Ba3 | 2.8100% | 5.5100% | 7.8700% | 9.7900% | 11.8600% | 13.4900% | 14.6200% | 15.7100% | 16.7100% | 17.6600% |
| B1 | 4.6800% | 8.3800% | 11.5800% | 13.8500% | 16.1200% | 17.8900% | 19.1300% | 20.2300% | 21.2400% | 22.2000% |
| B2 | 7.1600% | 11.6700% | 15.5500% | 18.1300% | 20.7100% | 22.6500% | 24.0100% | 25.1500% | 26.2200% | 27.2000% |
| B3 | 11.6200% | 16.6100% | 21.0300% | 24.0400% | 27.0500% | 29.2000% | 31.0000% | 32.5800% | 33.7800% | 34.9000% |
| Caa1 | 17.3816% | 23.2342% | 28.6386% | 32.4788% | 36.3137% | 38.9667% | 41.3854% | 43.6570% | 45.6718% | 47.7000% |
| Caa2 | 26.0000% | 32.5000% | 39.0000% | 43.8800% | 48.7500% | 52.0000% | 55.2500% | 58.5000% | 61.7500% | 65.0000% |
| Caa3 | 50.9902% | 57.0088% | 62.4500% | 66.2420% | 69.8212% | 72.1110% | 74.3303% | 76.4853% | 78.5812% | 80.7000% |

## RATING: PROBABILITY OF DEFAULT + LOSS GIVEN DEFAULT
## → EXPOSURE AT RISK → *REQUIRED (CREDIT) PREMIUM*
## → IMPLIED CREDIT SPREADS

**Exposure at risk = Prob default * Expected Loss given default**

**Corporate bond (both financial firms and non-financial firms)**

| | AAA | AA | A | BBB | BB |
|---|---|---|---|---|---|
| Jan. 1989 | 50 | 80 | 100 | 125 | 270 |
| Jan. 1993 | 150 | 160 | 170 | 200 | 240 |
| Jan. 1998 | 75 | 80 | 90 | 110 | 280 |
| Jan. 2004 | 80 | 40 | 90 | 180 | 200 |
| Jan. 2008 | 340 | 375 | 500 | 720 | 1250 |

1. Bigger spread required fo lower-rated Bond.

2. For a fixed rating level, spread may not be constant over time.

3. **Typically, spread systematically increases during the recession!**

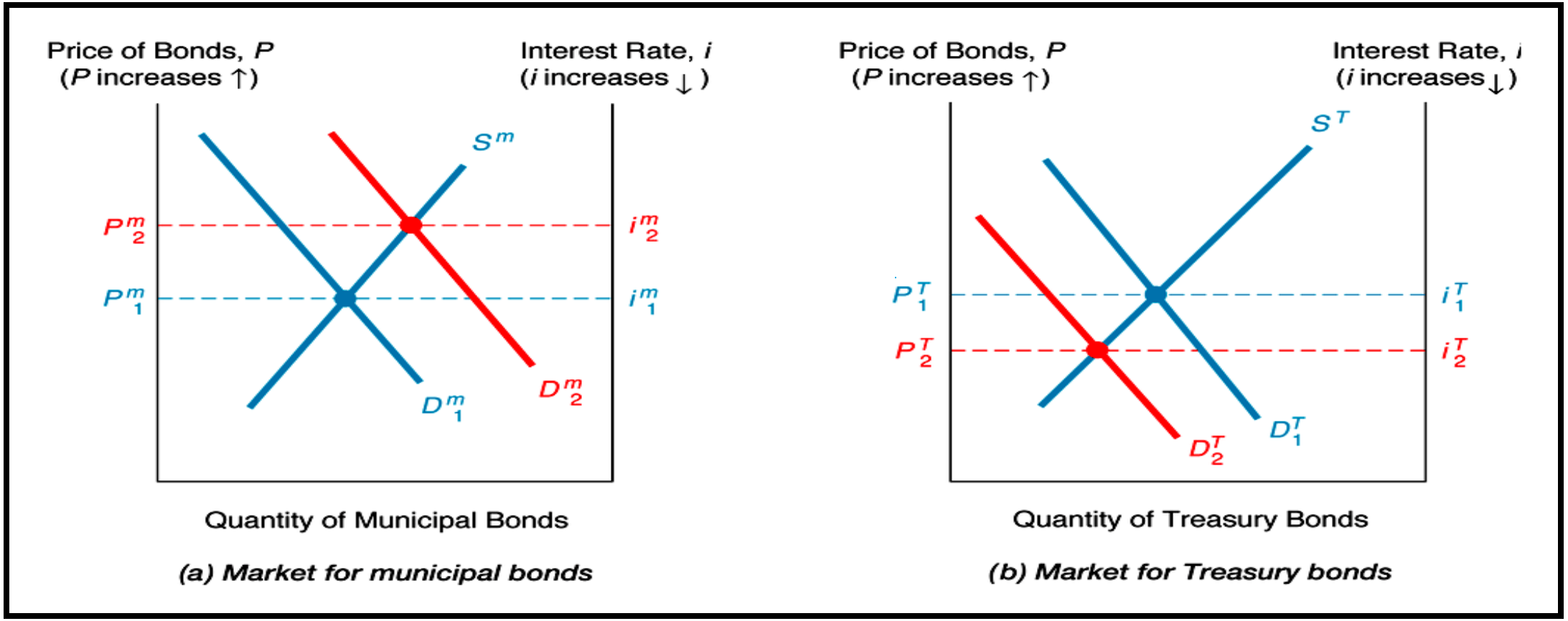
# LIQUIDITY RISK

- How fast/easy can you convert bond into cash?

- Government bond is generally more liquid than corporate bond because there are investors who actively trade government bond in the secondary market.

- Part of the realized corporate bond spreads therefore can be attributed to premium required to compensate the liquidity risk.

# BOND WITH TAX BENEFITS CAN OFFER LOWER YIELD, IN EXCHANGE OF GAINING THE BENEFIT.



# IN SUM…. BOND SPREADS…

Risky-bond = risk-free + observed spreads

**Observed spreads** = credit risk factor +
liquidity risk factor +
other types of risk factor +
unfavorable specific condition of bonds -
favorable specific condition of bonds