

THE RISK AND TERM-STRUCTURE OF INTEREST RATE

EE431 Semester 1/2017
Kittichai Saelee

Main reading

- Chapter 6 Mishkin
- See extra reading lists at the end of lecture slide.

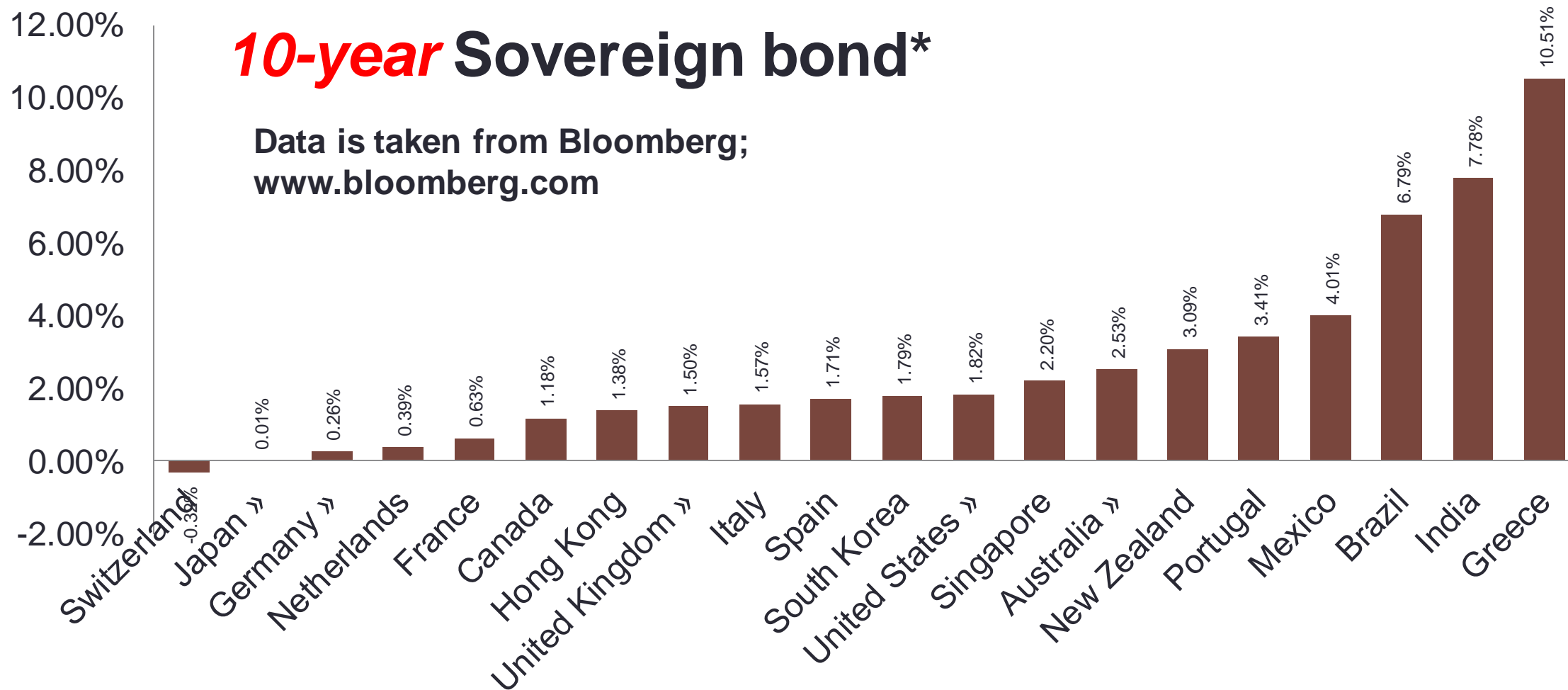
Previously....on bond model.

- 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 *multipliers 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 Yield across issuers



Observation 2: Yield across TTM

NAME	COUPON	PRICE	YIELD	1 MONTH	1 YEAR
GB3:GOV 3 Month	0.00	1.02	1.04%	+4	+86
GB6:GOV 6 Month	0.00	1.16	1.18%	+8	+79
GB12:GOV 12 Month	0.00	1.26	1.29%	+7	+72
GT2:GOV 2 Year	1.25	99.64	1.44%	+11	+71
GT5:GOV 5 Year	1.63	98.93	1.85%	+9	+73
GT10:GOV 10 Year	2.25	100.13	2.24%	+7	+65
GT30:GOV 30 Year	2.75	99.45	2.78%	+3	+45

US yield (Sept 26 2017)

Col 1: Bonds by TTM

Col 2: Coupon rate

Col 3: Traded price

Col 4: Implied yield

Col 5: Change in yield,
compared to 1 month before

Col 6: Change in yield,
compared to a year before.

Note that bond rates differ with respect to the TTM.

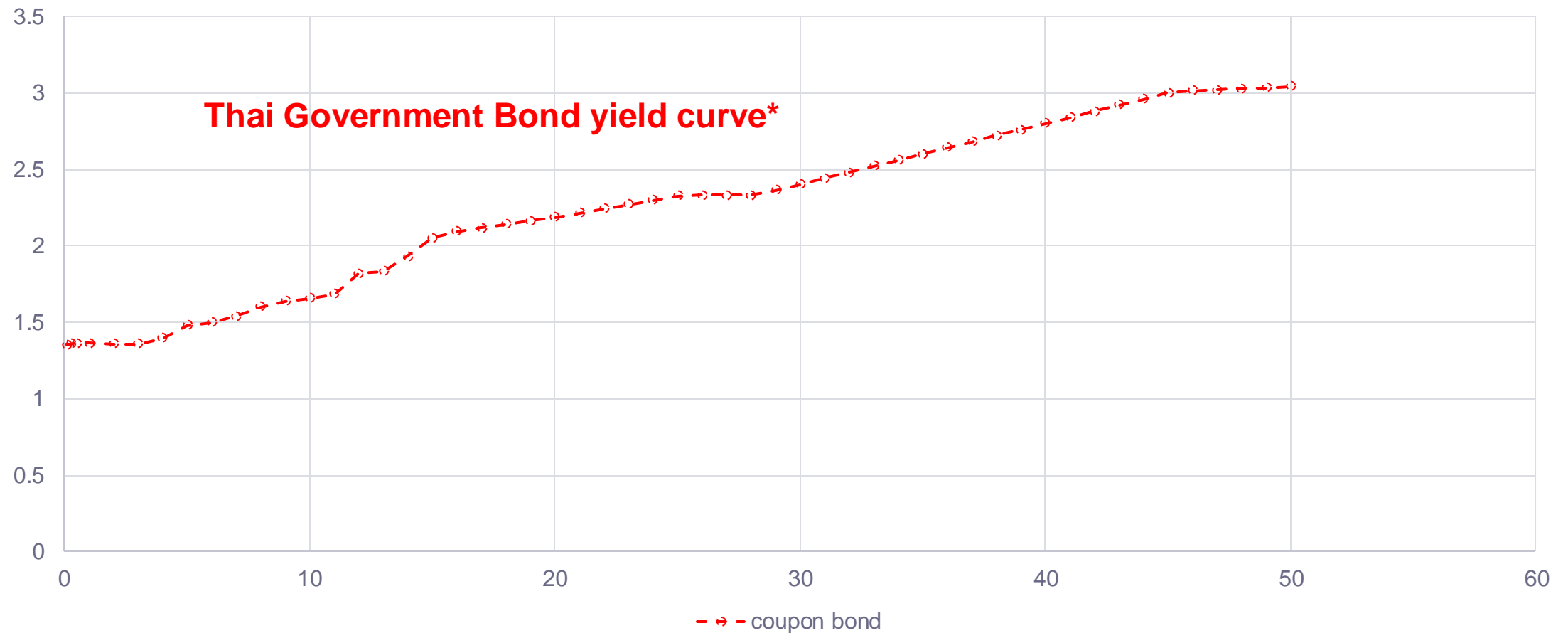
www.bloomberg.com

Observation 2: Yield across TTM

- One way to summarize the detailed information for bond rates that can be varied with respect to TTM is to plot YTM against TTM.
- The plotted schedule results in *“yield curve”*.

Observation 2: Yield across TTM (Yield curve)

Yield curve (Aug,2017)



Theories to account for the two stylized features include:

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

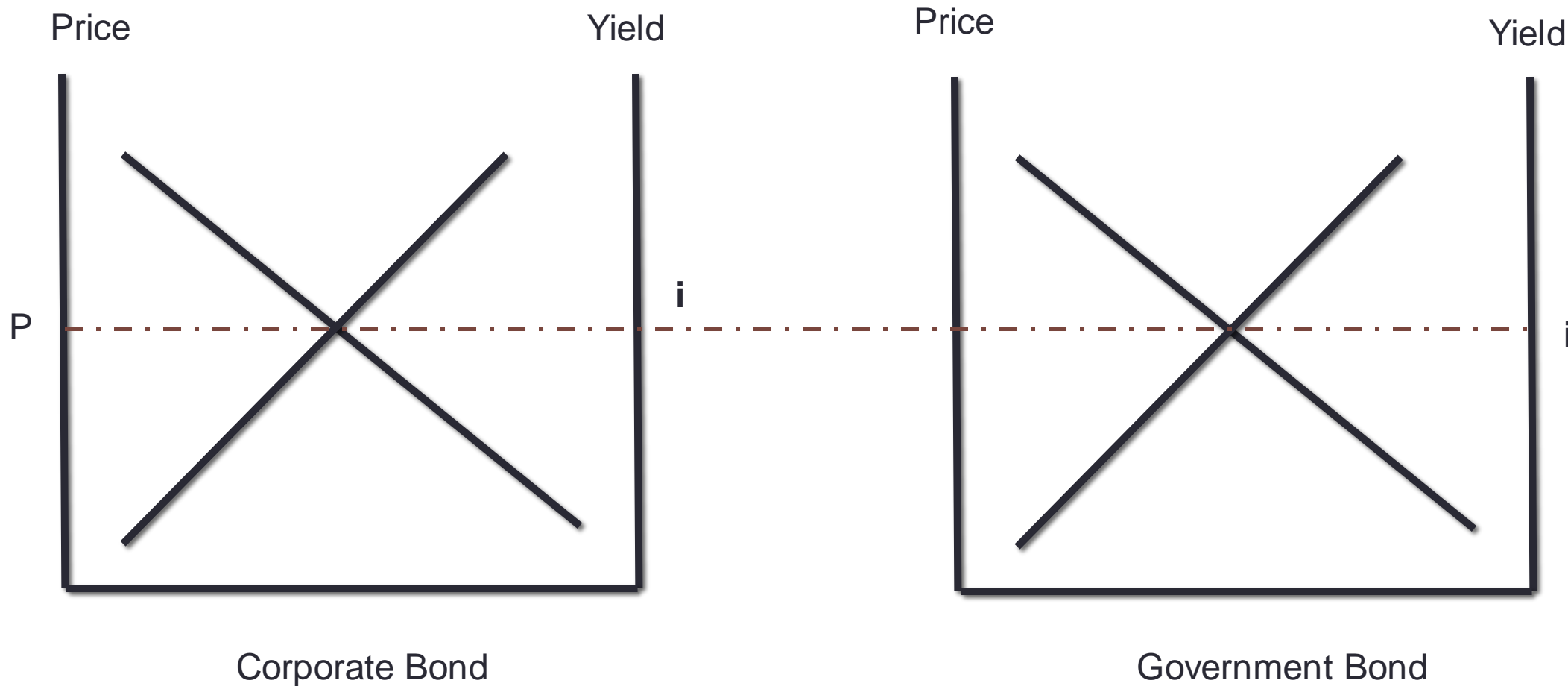
Risk Structure of Interest Rate

- 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 bond

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!



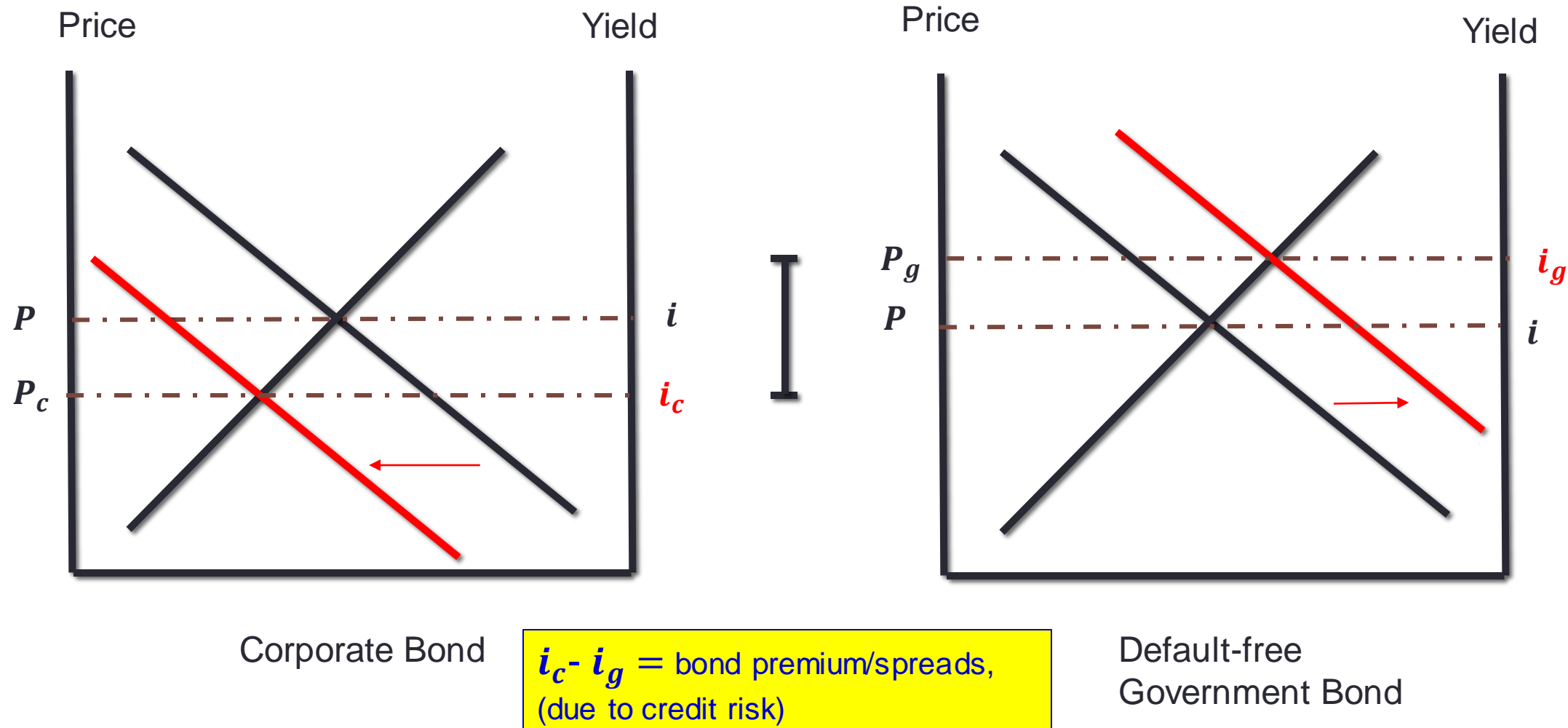
Bond spreads could occur because each bond differs in some senses.

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

Credit or default risk

- Chance that the issuer will fail to honor the promise, and repay either coupon/principal.
- Government bond, **issued in domestic currency**, is considered (credit) risk-free bond.

Accounting for credit risk → spread is determined/driven by credit quality of issuers → *Wedges of interest rates*



How does the market figure out the credit risk of a bond?: Credit-Ratings Agency

-
- 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 in the USA

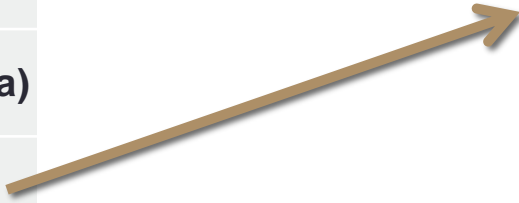
Table 1 Bond Ratings by Moody's and Standard and Poor's

Rating		Descriptions	
Moody's	Standard and Poor's		
Aaa	AAA	Highest quality (lowest default risk)	General Electric, Pfizer Inc., North Carolina State, Mobil Oil
Aa	AA	High quality	Wal-Mart, McDonald's, Credit Suisse First Boston
A	A	Upper medium grade	Hewlett-Packard, Anheuser-Busch, Ford, Household Finance
Baa	BBB	Medium grade	Motorola, Albertson's, Pennzoil, Weyerhaeuser Co., Tommy Hilfiger
Ba	BB	Lower medium grade	Royal Caribbean, Levi Strauss
B	B	Speculative	Rite Aid, Northwest Airlines Inc., Six Flags
Caa	CCC, CC	Poor (high default risk)	Revlon, United Airlines
Ca	C	Highly speculative	US Airways, Polaroid
C	D	Lowest grade	Enron, Oakwood Homes


Rating in Thailand: Relative scale!!!

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(th)
BANK OF AYUDHYA PUBLIC COMPANY LIMITED	FITCH	AAA(th)
CENTRAL PATTANA PUBLIC COMPANY LIMITED	TRIS	AA-

Relative to default-free
Global bond, i.e. US govt bond.



with (tha)
relative to default-free
domestic bond, i.e. Thai
Govt bond

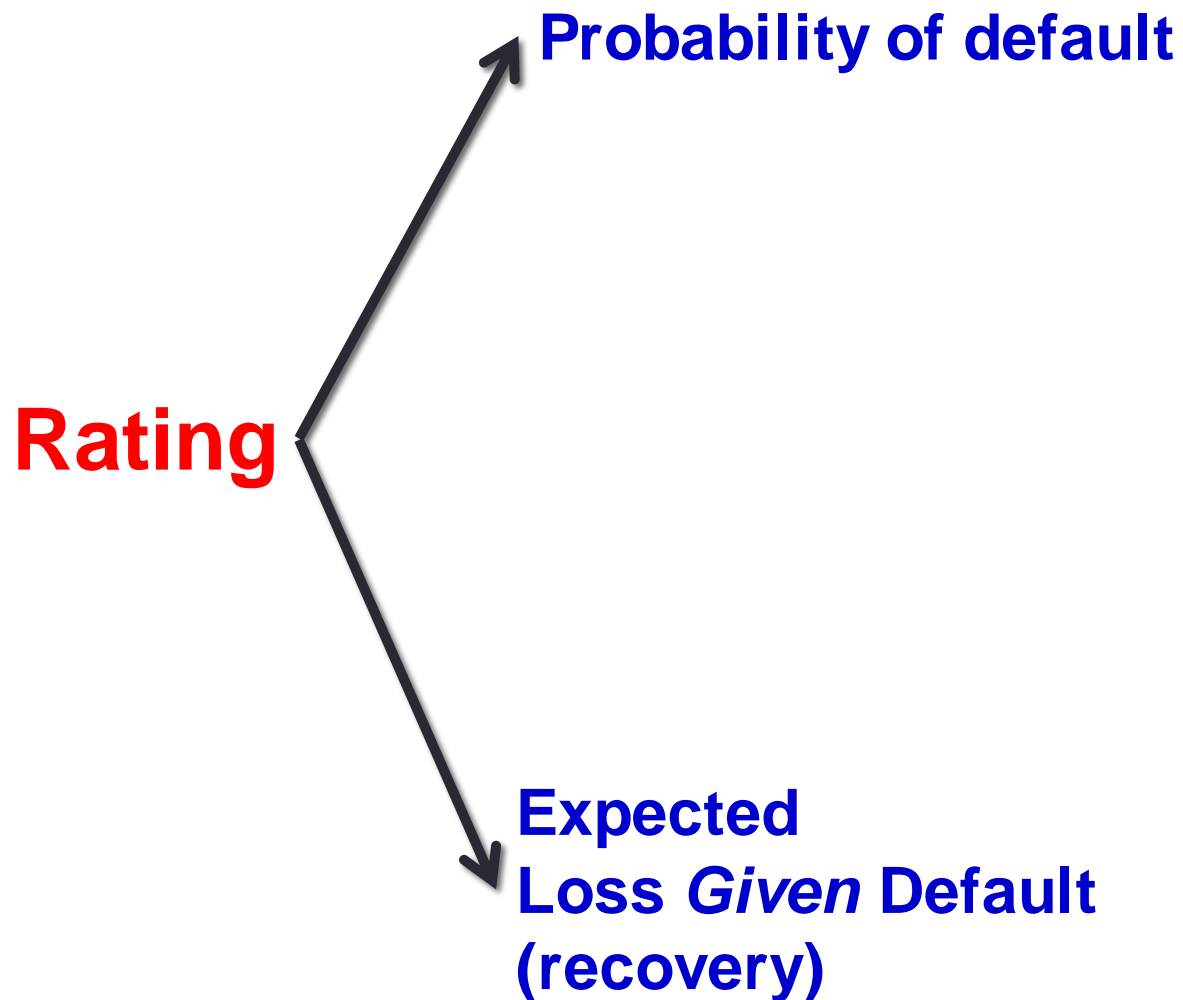


*http://marketdata.set.or.th/tfx/bexcreditrating.do?locale=en_US

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?



Historical default probability

- Lower-scaled rating implies greater likelihood of default.
- Default probability for the same rating of different industries might be different.
- What is shown in the table is unconditional default probability drawn from a study of JP-Morgan.
 - You can do this on your own if you know what logistic/probit estimation method is. (Take 426)

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

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 → *required (credit) premium* → implied credit spreads

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

	<u>AAA</u>	<u>AA</u>	<u>A</u>	<u>BBB</u>	
Jan. 1989	50	80	100	125	1. Bigger spread required for lower-rated Bond.
Jan. 1993	150	160	170	200	2. For a fixed rating level, spread may not be constant over time.
Jan. 1998	75	80	90	110	
Jan. 2004	80	40	90	180	3. Typically, spread increases during the recession! Why???
Jan. 2008	340	375	500	720	

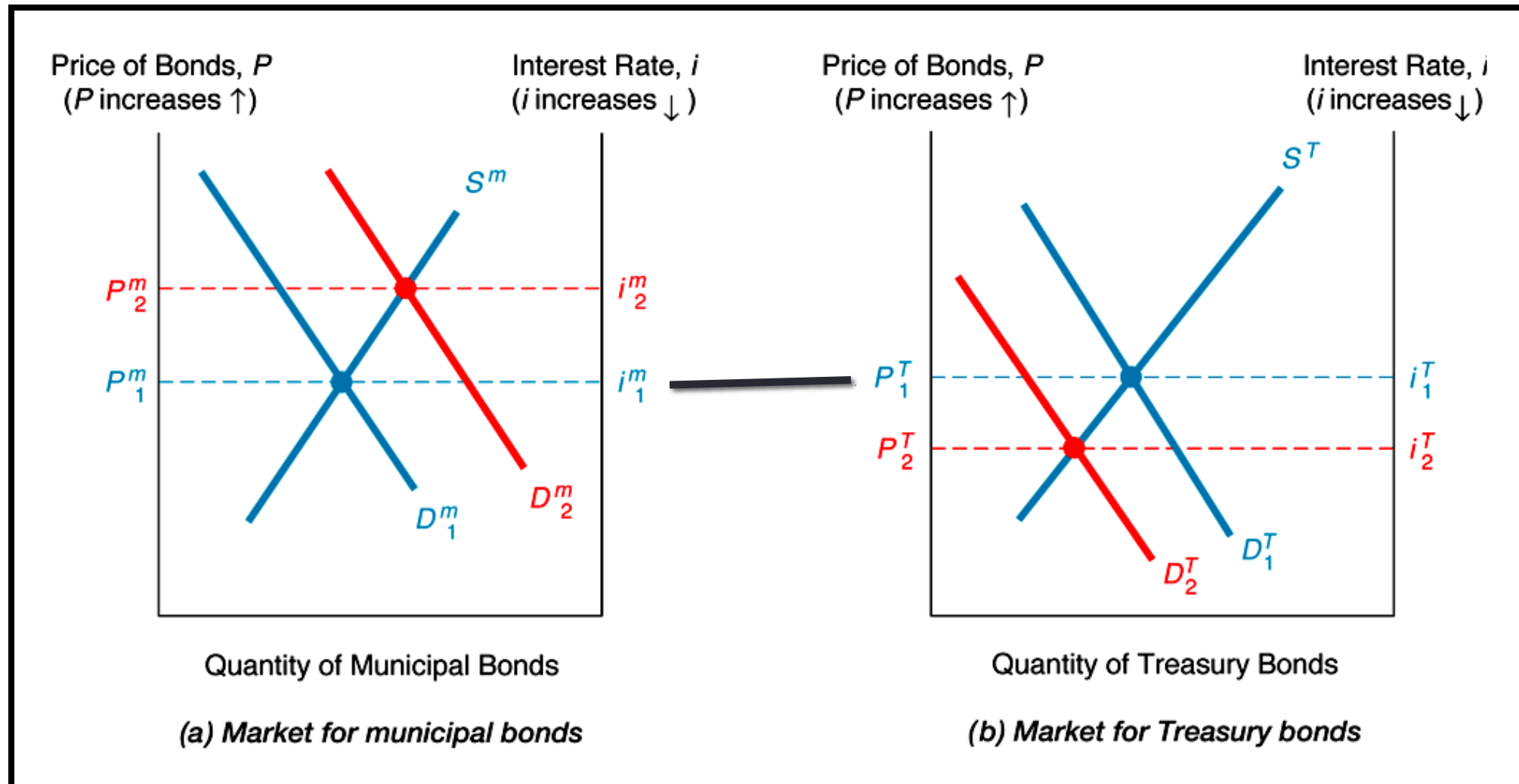
Factors that cause Bond spreads:

- Risk factor
 - Credit risk
 - Liquidity risk
- Tax privilege

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