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UNIVERSITÉ PARIS

CHAPTER 4: THE RISK AND TERM STRUCTURE OF INTEREST RATES

MONEY & BANKING

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OUTLINE

- Risk Structure of Interest Rates

- Term Structure of Interest Rates and the Yield curve
  - Expectations Theory
  - Segmented Markets Theory
  - Liquidity Premium & Preferred Habitat Theories

RISK STRUCTURE OF INTEREST RATES

- Bonds with the same maturity have different interest rates due to:
  - Default risk
  - Liquidity
  - Tax considerations

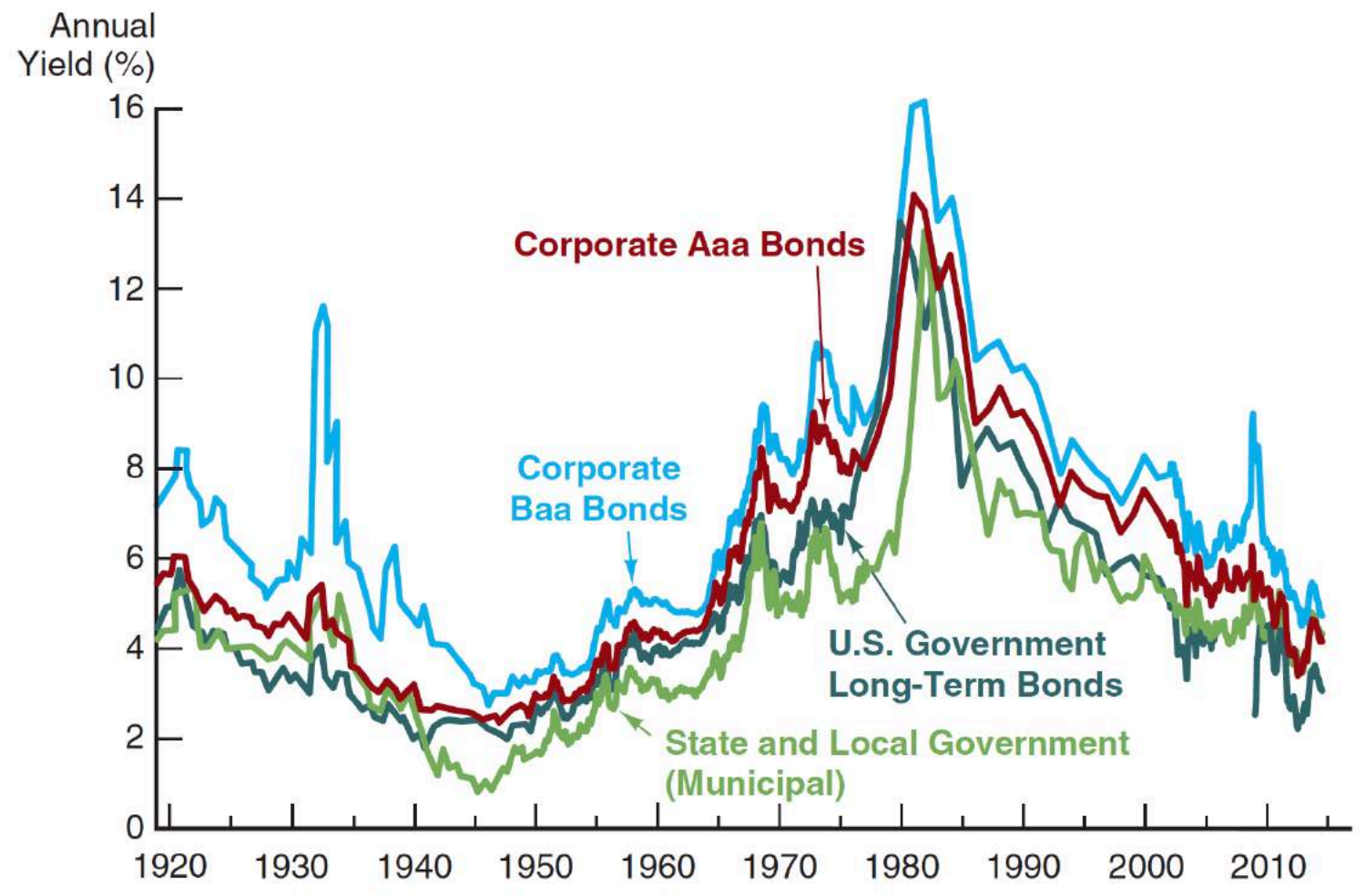
The risk structure of interest rates :
the relationship among interest rates on bonds with the same maturity

RISK STRUCTURE OF INTEREST RATES

- **Default risk**: probability that the issuer of the bond is unable or unwilling to make interest payments or pay off the face value
  - U.S. Treasury bonds are considered default free (government can raise taxes).

Risk premium: the spread between the interest rates on bonds with default risk and the interest rates on (same maturity) Treasury bonds

LONG-TERM BOND YIELDS, 1919–2014



Sources: Board of Governors of the Federal Reserve System, *Banking and Monetary Statistics, 1941–1970*; Federal Reserve Bank of St. Louis FRED database: http://research.stlouisfed.org/fred2

BOND RATINGS BY MOODY'S, STANDARD AND POOR'S, AND FITCH

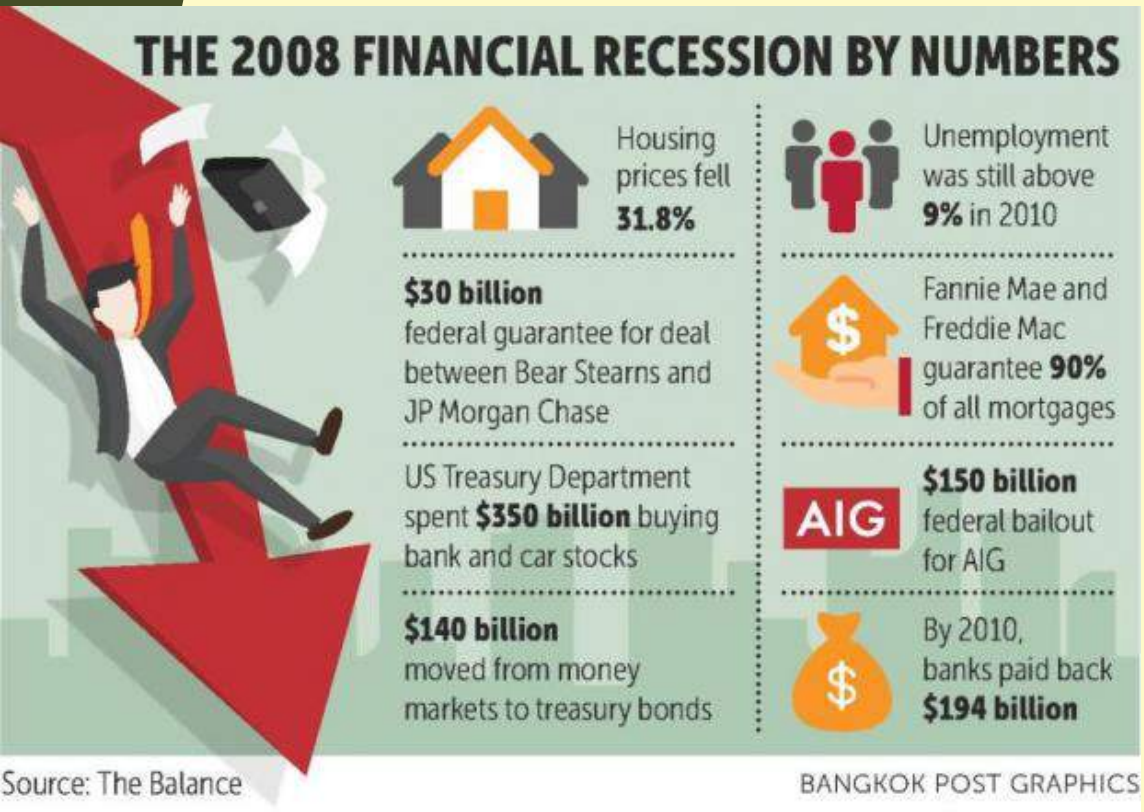
TABLE 1 Bond Ratings by Moody's, Standard and Poor's, and Fitch

Rating Agency			
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+	Noninvestment 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
—	—	D	
—	D	D	

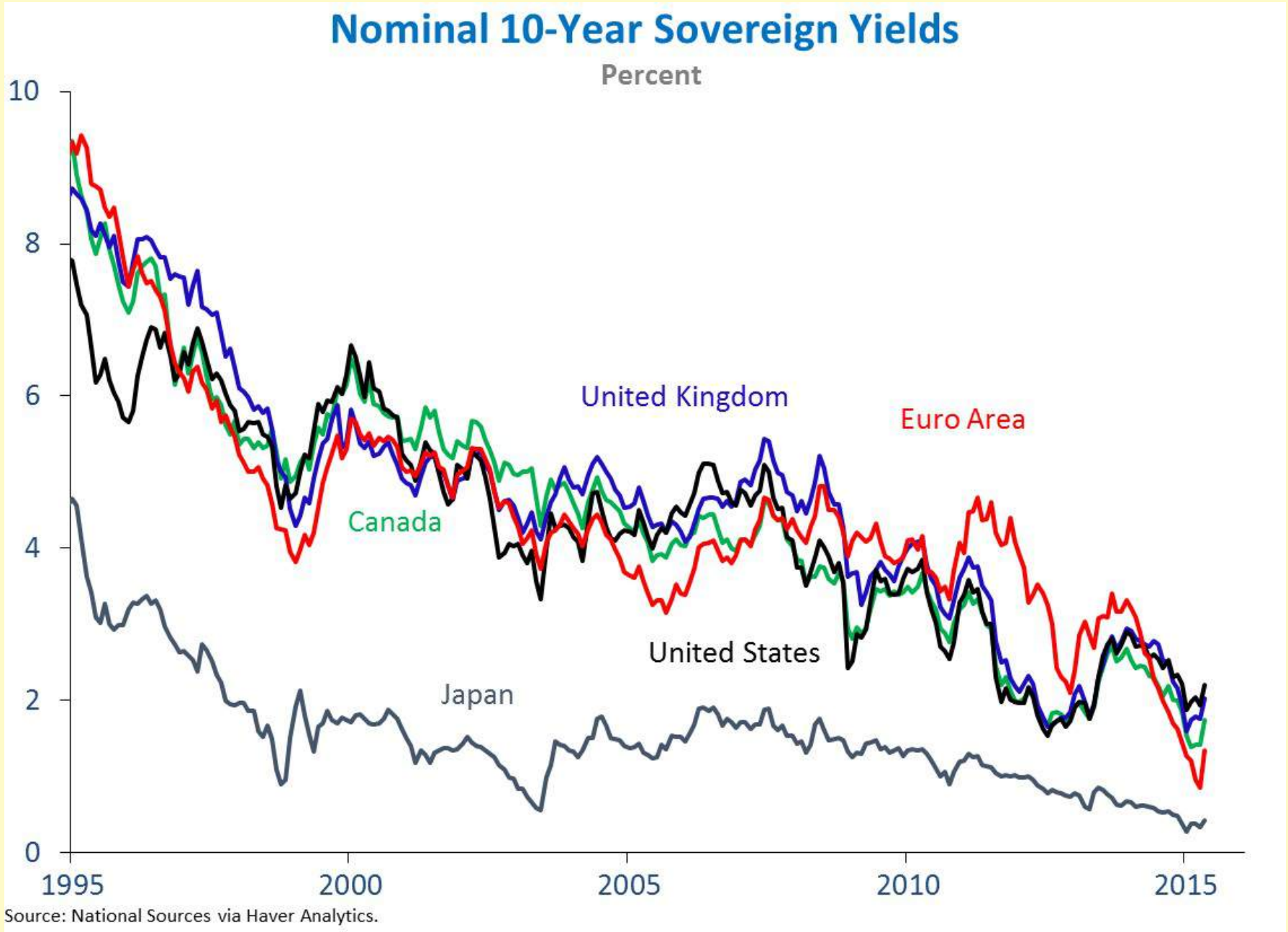
BONDS NICKNAMES ACCORDING TO THEIR DEFAULT RISK

- **Investment-grade securities :** Bonds with relatively low risk of default that have a rating of BBB and above.
- **Speculative-grade / Junk bonds** : Bonds with ratings below BBB that have higher default risk
- Because these bonds always have higher interest rates than investment-grade securities, they are also referred to as **high-yield bonds**.
- **Fallen angels:** Investment-grade securities whose rating has fallen to junk levels

US SUBPRIME CRISIS



- Starting in August 2007, the collapse of the subprime mortgage market in the U.S. led to large losses in American financial institutions
- Many investors began to doubt the financial health of corporations with low credit ratings, such as BAA, and even the reliability of the ratings themselves
- The perceived increase in default risk for BAA bonds made them less desirable at any given interest rate, decreased the quantity demanded
- Interest rates on BAA bonds rose from 6.63% at the end of July 2007 to 9.43% in mid October 2008.
- Higher demand for Treasury bonds → interest rates fell from 4.78% at the end of July 2007 to 3.98% in mid-October 2008
- The spread between interest rates on BAA and Treasury bonds rose from 1.85% before the crisis to 5.45% afterward.


Nominal 10-Year Sovereign Yields
Percent
10
8
6
4
2
0
1995
2000
2005
2010
2015
United Kingdom
Euro Area
Canada
United States
Japan
Source: National Sources via Haver Analytics.

RISK STRUCTURE OF INTEREST RATES

Liquidity: the relative ease with which an asset can be converted into cash

- Cost of selling a bond
- Number of buyers/sellers in a bond market

- **Income tax considerations**
  - Interest payments on municipal bonds are exempt from federal income taxes.

EFFECTS OF THE OBAMA TAX INCREASE ON BOND INTEREST RATES

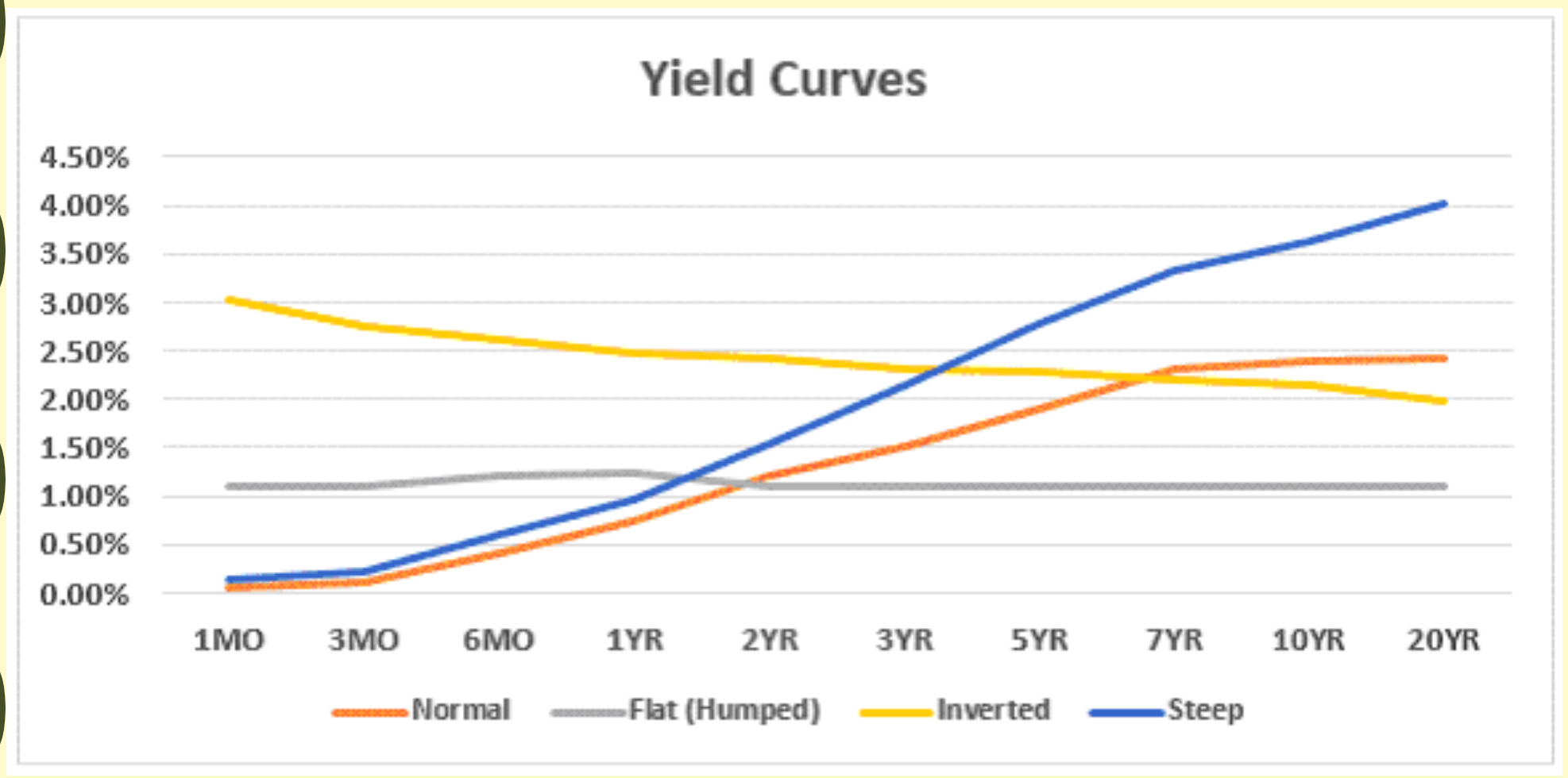
- In 2013, Congress approved legislation favored by the Obama administration to increase the income tax rate on high-income taxpayers from 35% to 39%. Consistent with supply and demand analysis, the increase in income tax rates for wealthy people helped to lower the interest rates on municipal bonds relative to the interest rate on Treasury bonds.

TERM STRUCTURE OF INTEREST RATES

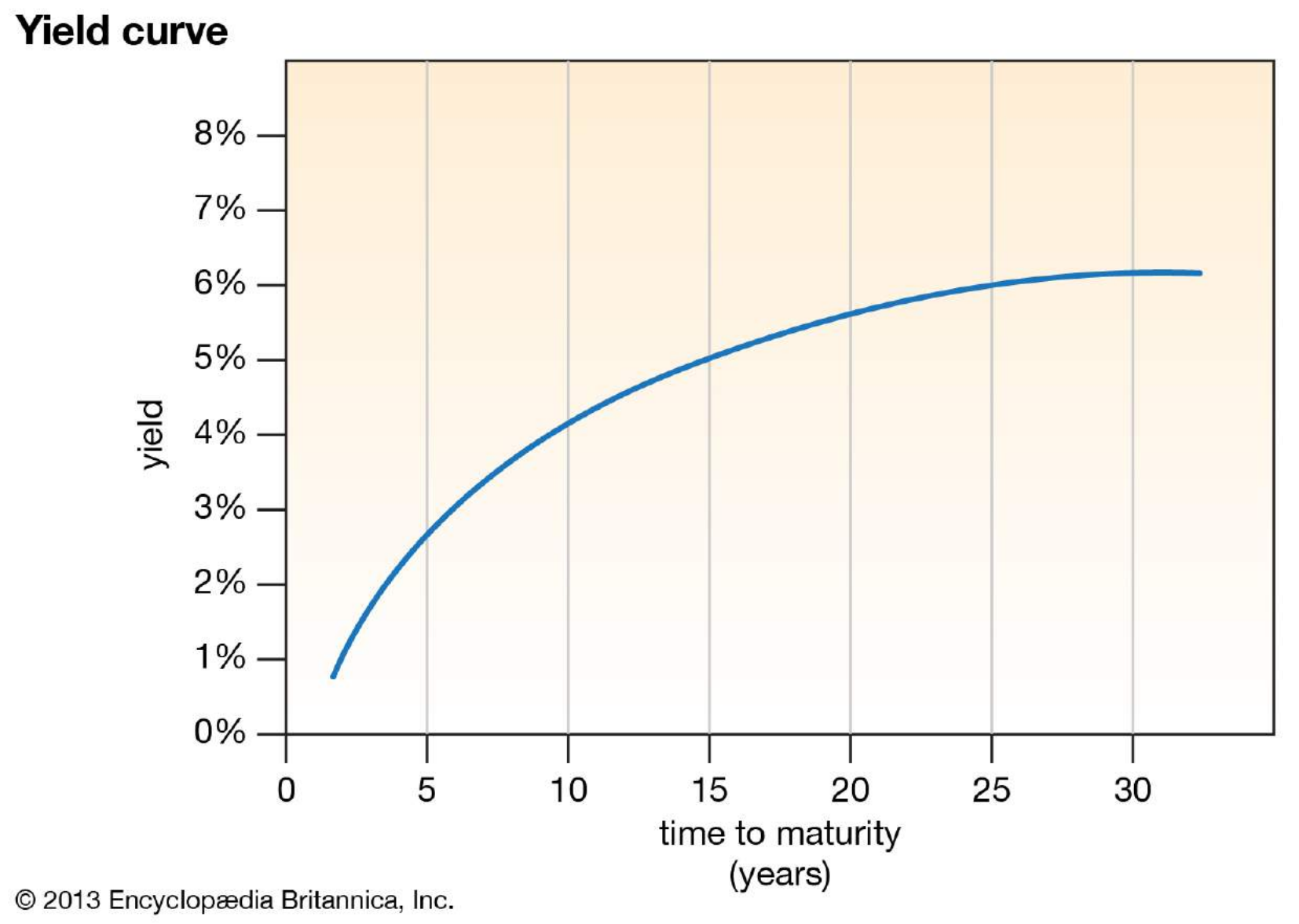
- Bonds with identical risk, liquidity, and tax characteristics may have different interest rates because the time remaining to **maturity** is different

TERM STRUCTURE OF INTEREST RATES

- **Yield curve**: a plot of the yield on bonds with differing terms to maturity but the same risk, liquidity and tax considerations
  - **Upward-sloping**: long-term rates are above short-term rates
  - **Flat**: short- and long-term rates are the same
  - **Inverted**: long-term rates are below short-term rates



Source: https://www.investopedia.com/articles/economics/08/yield-curve.asp


Yield curve
8%
7%
6%
5%
4%
3%
2%
1%
0%
yield
0
5
10
15
20
25
30
time to maturity
(years)
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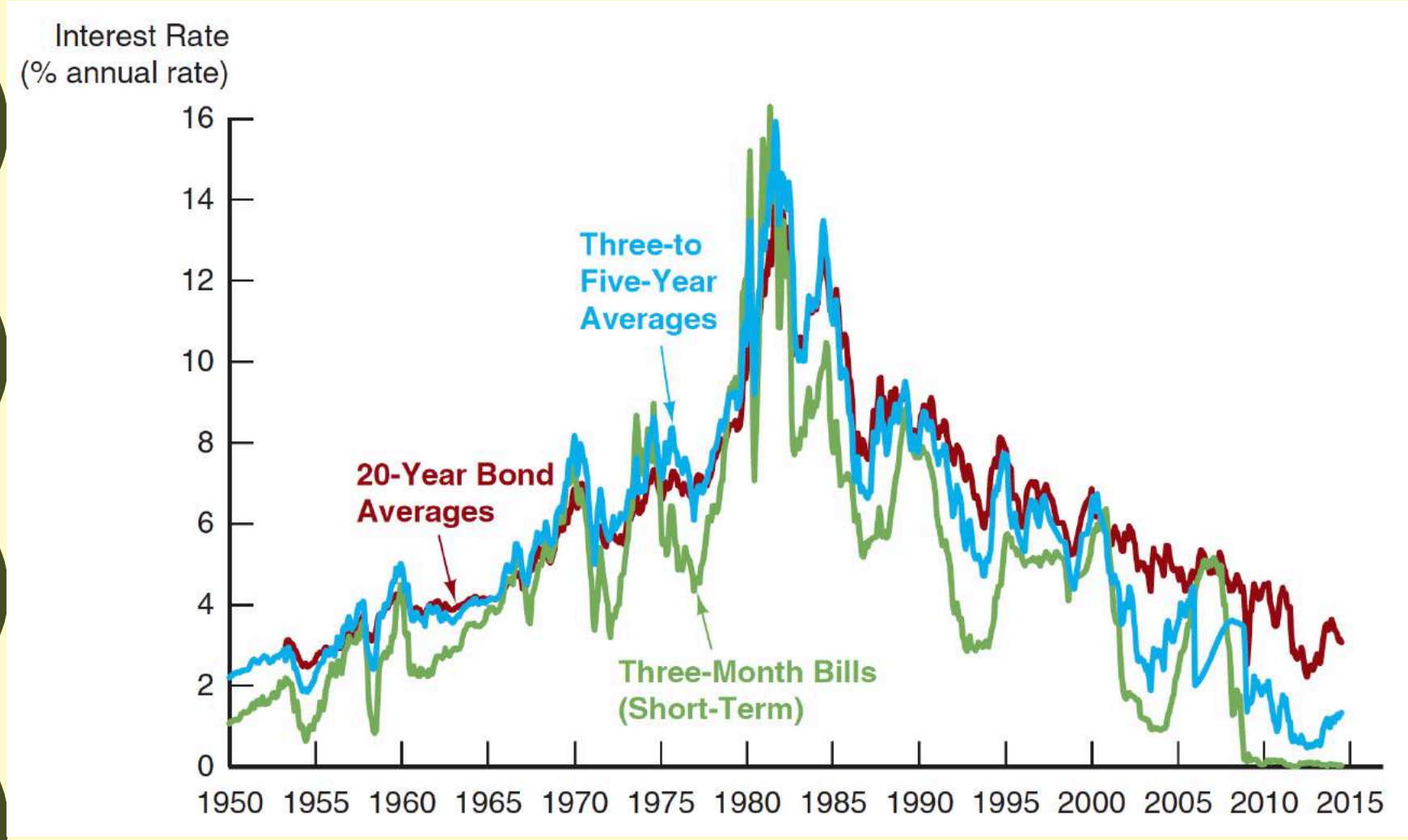
TERM STRUCTURE OF INTEREST RATES

The theory of the term structure of interest rates must explain the following facts:

1. Interest rates on bonds of different maturities move together over time.
2. When short-term interest rates are low, yield curves are more likely to have an upward slope; when short-term rates are high, yield curves are more likely to slope downward and be inverted.
3. Yield curves almost always slope upward.

MOVEMENTS OVER TIME OF INTEREST RATES ON U.S. GOVERNMENT BONDS WITH DIFFERENT MATURITIES



Sources: Federal Reserve Bank of St. Louis FRED database: http://research.stlouisfed.org/fred2/

TERM STRUCTURE OF INTEREST RATES

three theories to explain the three facts:

1. Expectations theory explains the first two facts but not the third.
2. Segmented markets theory explains the third fact but not the first two.
3. Liquidity premium theory combines the two theories to explain all three facts.
4. The preferred habitat theory

EXPECTATIONS THEORY

The interest rate on a long-term bond will equal an average of the short-term interest rates that people expect to occur over the life of the long-term bond.

- Key assumptions:
  - Buyers of bonds do not prefer bonds of one maturity over another; they will not hold any quantity of a bond if its expected return is less than that of another bond with a different maturity.
  - Bond holders consider bonds with different maturities to be perfect substitutes.

EXPECTATIONS THEORY

An example:

- Let the current rate on one-year bond be 6%.
- You expect the interest rate on a one-year bond to be 8% next year.
- Then the expected return for buying two one-year bonds averages (6% + 8%)/2 = 7%.
- The interest rate on a two-year bond must be 7% for you to be willing to purchase it.

EXPECTATIONS THEORY

For an investment of \$1

i_t = today's interest rate on a one-period bond

i^e_{t+1} = interest rate on a one-period bond expected for next period

i_{2t} = today's interest rate on the two-period bond

EXPECTATIONS THEORY

For a two-period bond we have:

Expected return over the two periods from investing \$1 in the two-period bond and holding it for the two periods

$$(1 + i_{2t})(1 + i_{2t}) - 1$$

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

$$= 2i_{2t} + (i_{2t})^2$$

Since $(i_{2t})^2$ is very small

the expected return for holding the two-period bond for two periods is

$$2i_{2t}$$

EXPECTATIONS THEORY

Holding a one-period bond over 2 perids:

If two one-period bonds are bought with the \$1 investment

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

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

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

$i_t(i^e_{t+1})$ is extremely small

Simplifying we get

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

EXPECTATIONS THEORY

Assumption: Two strategies end up with same return:

Both bonds will be held only if the expected returns are equal

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

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

The two-period rate must equal the average of the two one-period rates

For bonds with longer maturities

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

The n-period interest rate equals the average of the one-period interest rates expected to occur over the n-period life of the bond

EXPECTATIONS THEORY

- Expectations theory explains:
  - Why the term structure of interest rates changes at different times.
  - Why interest rates on bonds with different maturities move together over time (fact 1).
  - Why yield curves tend to slope up when short-term rates are low and slope down when short-term rates are high (fact 2).
- Cannot explain why yield curves usually slope upward (fact 3)

SEGMENTED MARKETS THEORY

- Bonds of different maturities are not substitutes at all.
- The interest rate for each bond with a different maturity is determined by the demand for and supply of that bond.
- Investors have preferences for bonds of one maturity over another.
- If investors generally prefer bonds with shorter maturities that have less interest-rate risk, then this explains why yield curves usually slope upward (fact 3).

LIQUIDITY PREMIUM THEORY

The interest rate on a long-term bond will equal an average of short-term interest rates expected to occur over the life of the long-term bond plus a liquidity premium/ term premium

- Bonds of different maturities are partial (not perfect) substitutes.

LIQUIDITY PREMIUM THEORY

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

where l_{nt} is the liquidity premium for the n-period bond at time t

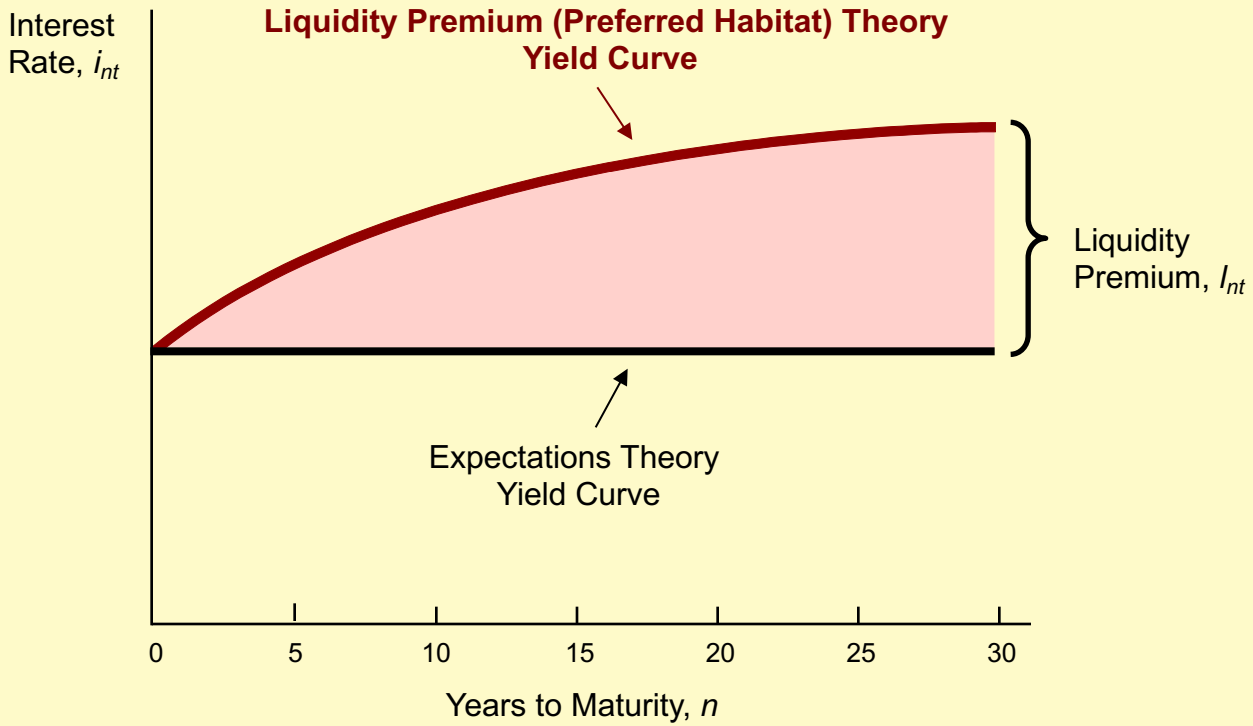
l_{nt} is always positive

Rises with the term to maturity

PREFERRED HABITAT THEORY

- 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.
- Investors are likely to prefer short-term bonds over longer-term bonds.

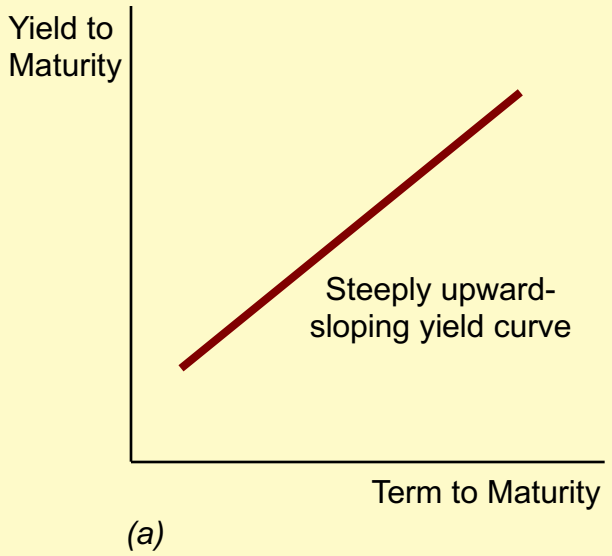
THE RELATIONSHIP BETWEEN THE LIQUIDITY PREMIUM (PREFERRED HABITAT) AND EXPECTATIONS THEORY



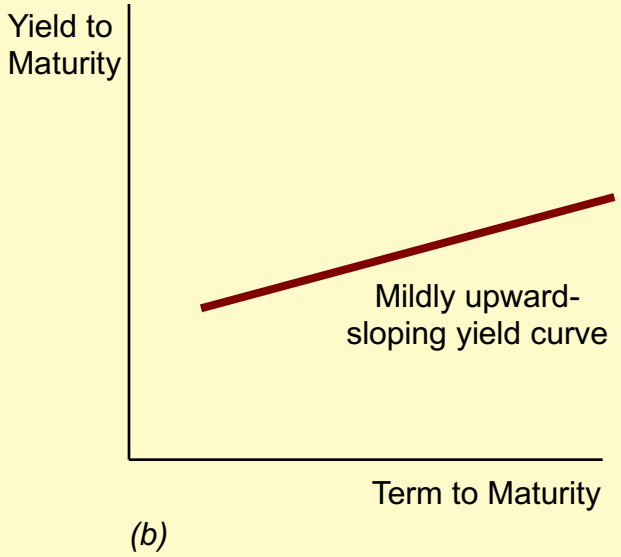
LIQUIDITY PREMIUM & PREFERRED HABITAT THEORY

- Interest rates on different maturity bonds move together over time; explained by the first term in the equation
- Yield curves tend to slope upward when short-term rates are low and to be inverted when short-term rates are high; explained by the liquidity premium term in the first case and by a low expected average in the second case
- Yield curves typically slope upward; explained by a larger liquidity premium as the term to maturity lengthens

YIELD CURVES AND THE MARKET'S EXPECTATIONS OF FUTURE SHORT-TERM INTEREST RATES ACCORDING TO THE LIQUIDITY PREMIUM (PREFERRED HABITAT) THEORY



(a)



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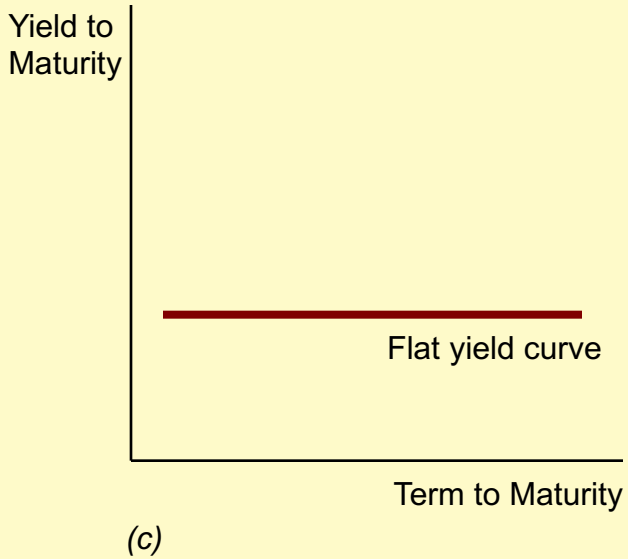
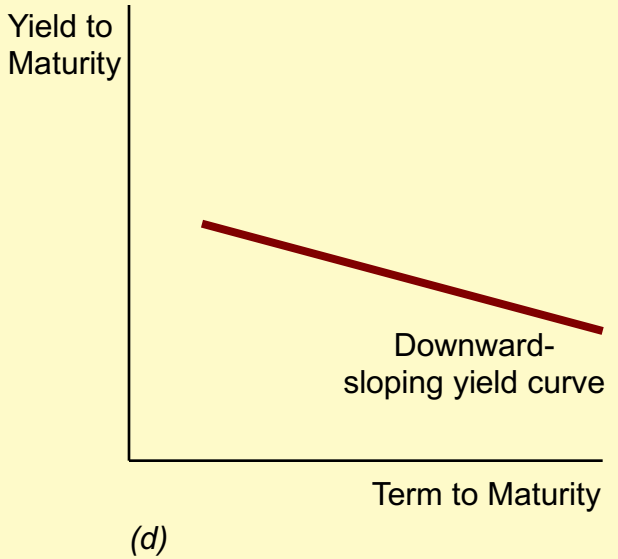


(c)



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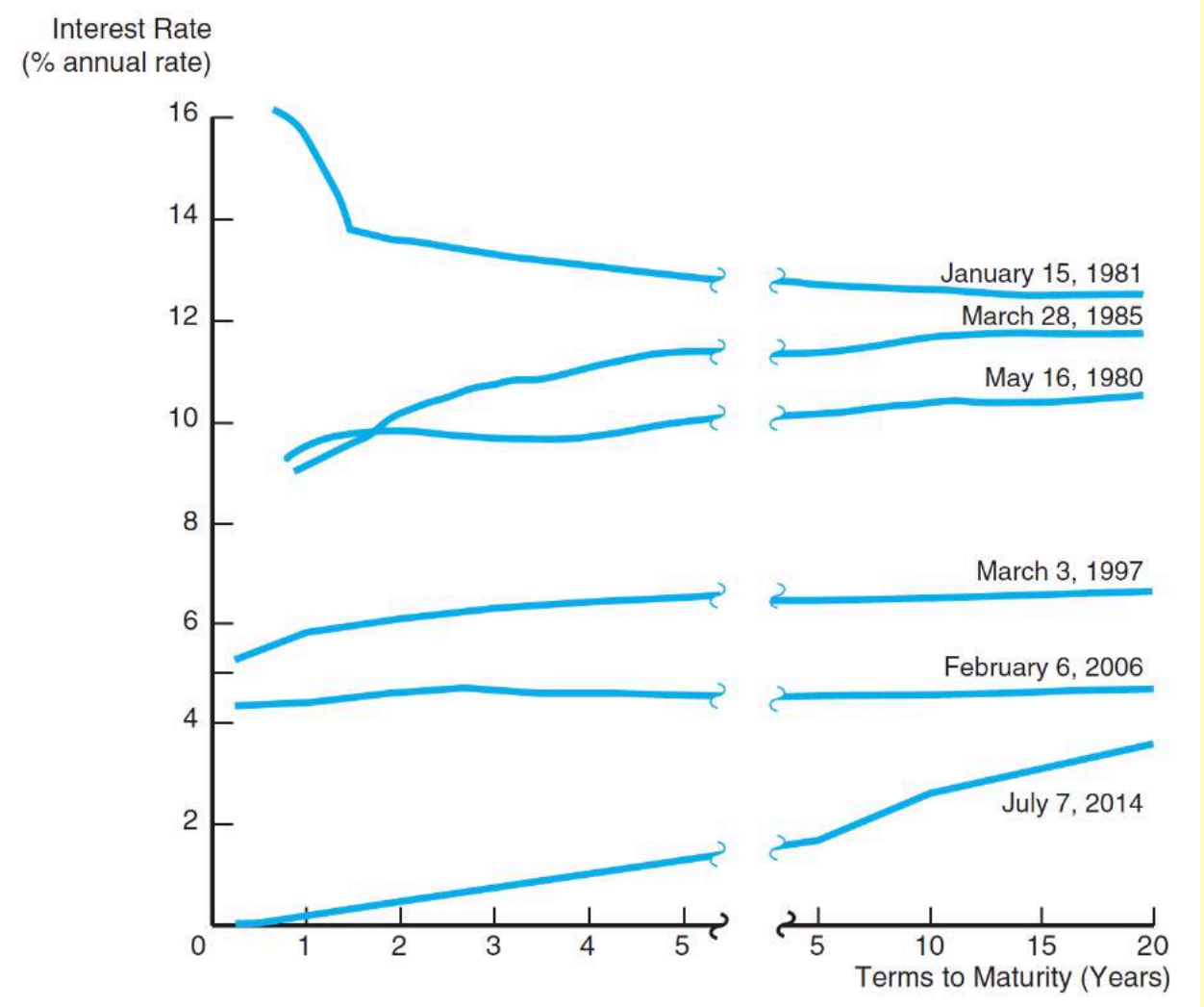
YIELD CURVES FOR U.S. GOVERNMENT BONDS



REFERENCES

- The Economics of Money, Banking and Financial Markets (8th edition, 2015) Frederic S. Mishkin (Chapter 6) / also chapter 6 in the 12th edition