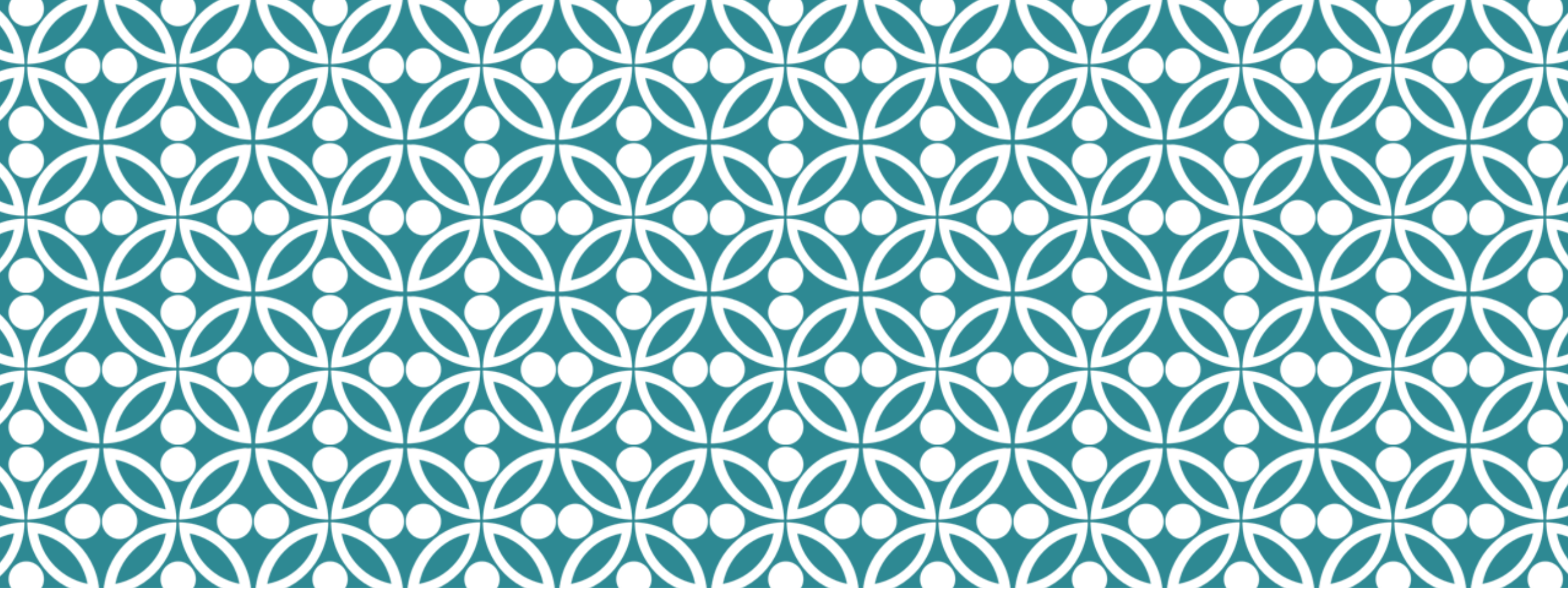




RISK AND TERM STRUCTURE OF INTEREST RATE

Kittichai Saelee
Semester 2/2017
Faculty of economics
Thammasat university

STATE OF YOUR KNOWLEDGE ON FIXED INCOME MARKET

- Knowing about bond pricing / yield to maturity / bond price volatility / interest rate risk.
- Understanding the determination of bond price and interest rate / movements over the course of business cycles.
- What account for **interest rate spreads**, categorized by **issuers** and **TTM** – **risk structure and term structure of interest rates**.

WHAT CAN WE DO WITH OUR UNDERSTANDING ON THE RISK AND TERM STRUCTURE THEOREM?

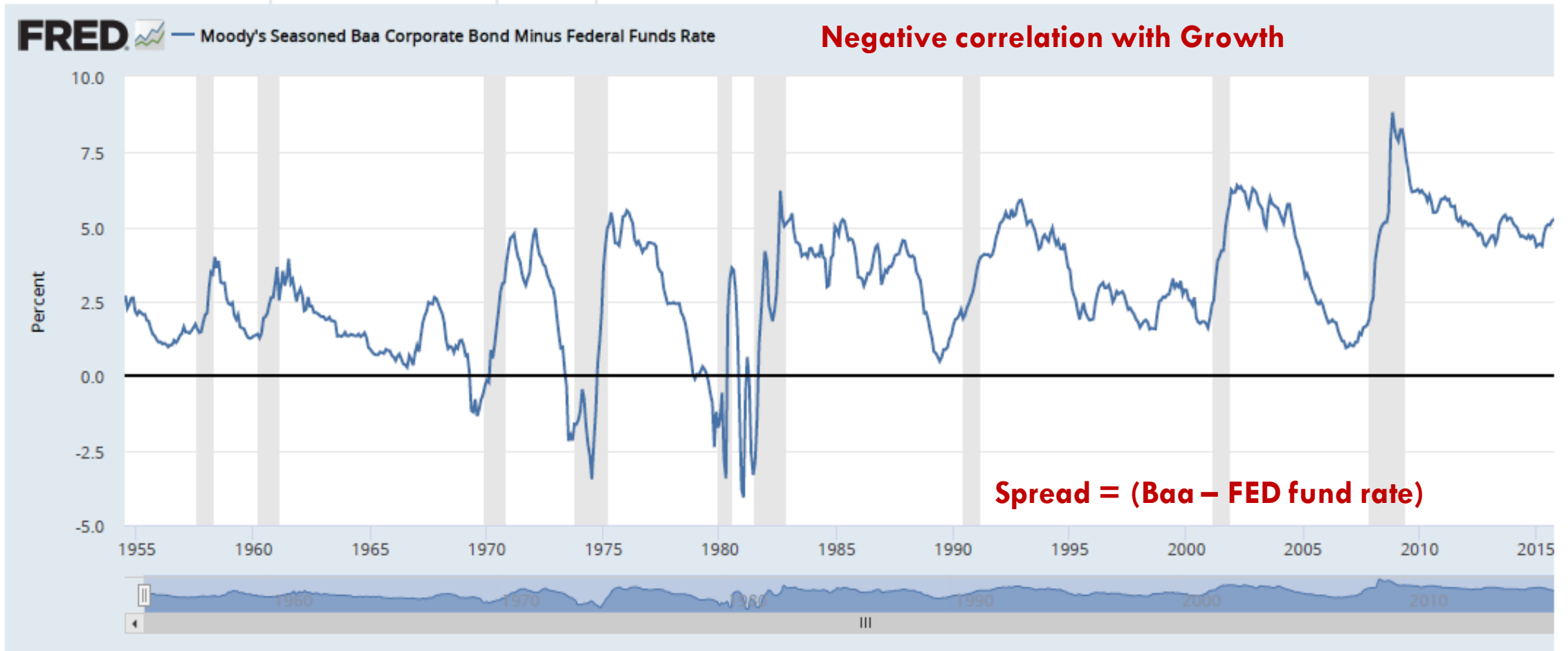
- Financial applications: **Spread decomposition; implied forward rate.**
- What else? Any broader, bigger, more policy-oriented questions?
 - Determinants of credit spread and term spread over the course of business cycles, i.e. **dynamic yield curve and credit spread dynamic.**
 - Application: constructing some financial indicators **to predict future economics activities**, i.e. **leading indicator.**

ECONOMICS OF LEADING INDICATOR

➤ Common *Leading Indicators*

- Housing starts
- Building permits
- Orders for consumer goods
- “Junk bond” or “High Yield” spread (credit spread): *Difference between rates on low-grade and high grade bonds, typically corporate*
- Term spread (interest rate spread): *Difference between Long Rate and Short Rate*

BEHAVIOR OF CREDIT SPREAD IN THE US



Shaded areas indicate U.S. recessions (<https://fredhelp.stlouisfed.org/fred/data/understanding-the-data/recession-bars/>)

Source: Federal Reserve Bank of St. Louis

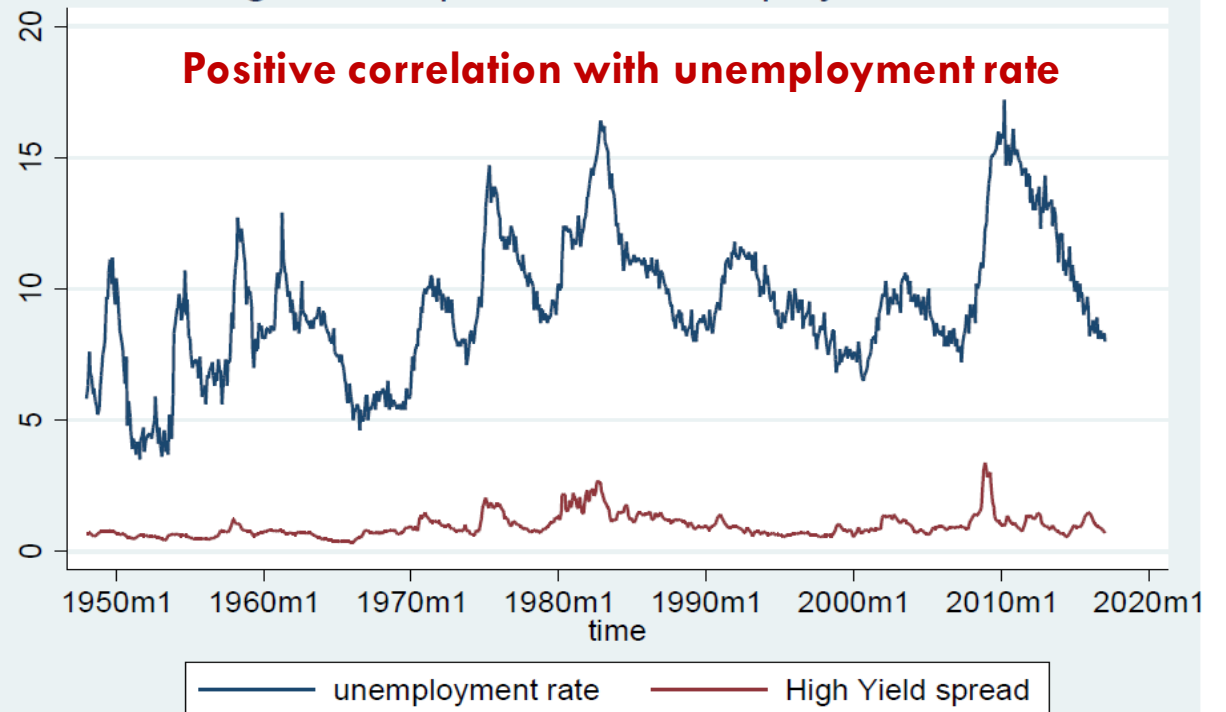
HIGH-YIELD SPREAD AND UNEMPLOYMENT RATES

AAA and BAA Corporate Bond Rates



High Yield Spread and Unemployment Rate

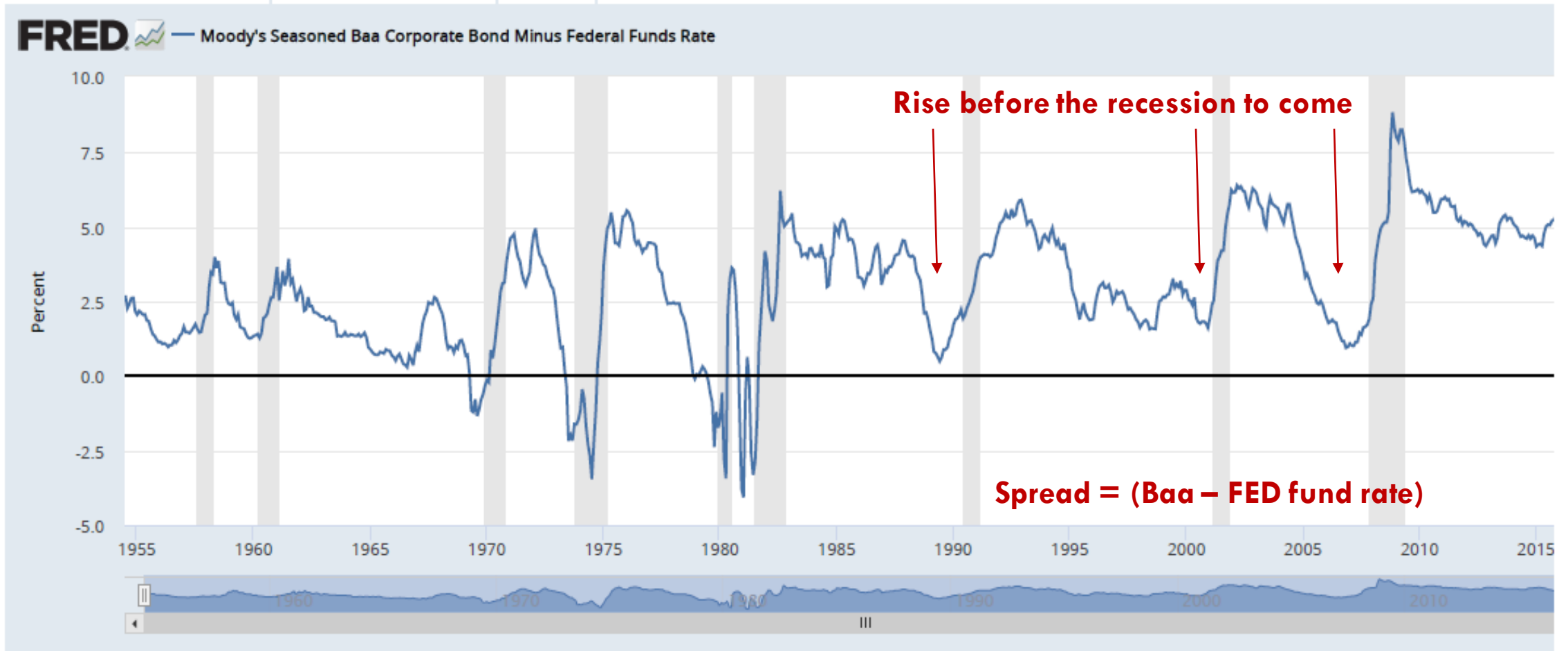
Positive correlation with unemployment rate



CREDIT SPREAD OVER BUSINESS CYCLES

- Obviously, credit spreads behave counter cyclically with respect to GDP;
 - Tends to rise under the low growth (high unemployment) whereas falls under the high growth (low unemployment).
- Why is it so? Recall our discussion.
 - Exposure at risk = Prob of default * Expected Loss given default
 - Both rise under downturns
- What's more?
 - Tends to move a quarter or two before economic downturn actually occurs.

BEHAVIOR OF CREDIT SPREAD IN THE US



Shaded areas indicate U.S. recessions (<https://fredhelp.stlouisfed.org/fred/data/understanding-the-data/recession-bars/>)

Source: Federal Reserve Bank of St. Louis

CREDIT SPREAD AS A LEADING INDICATOR: THE FLIGHT TO QUALITY STORY

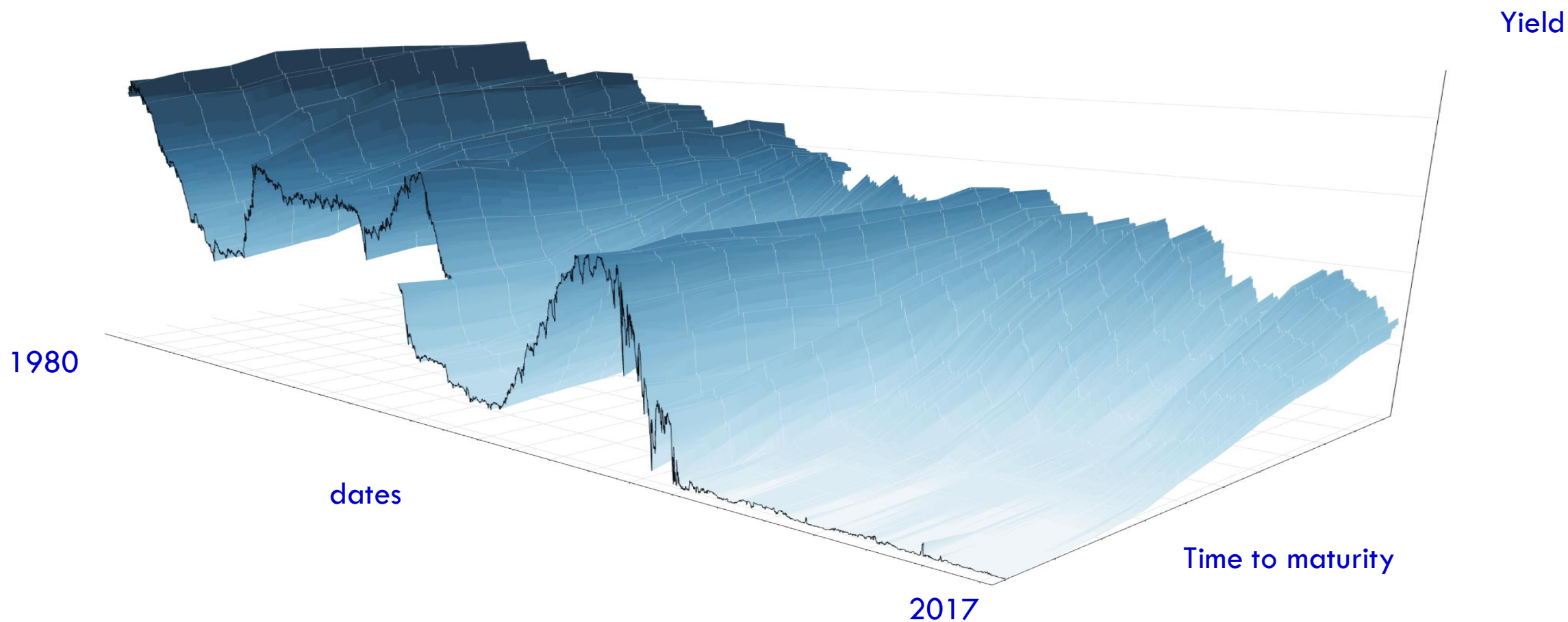
- Naturally, investors make use a large set of information when they make trading decisions.
 - Information usually contains **some signal or expectation** that investors believe that something will occur.
- When the investors expect a downturn in the near by future, **perceived risks on corporate bond investment will rise.**
- Investors then reshuffle their investment portfolio; the **flight to quality** occurs. (Bernanke and Lowe 1990, Bernanke 1996)
- **Credit spreads react ahead of time, i.e. useful for predicting future.**

ECONOMICS OF LEADING INDICATOR

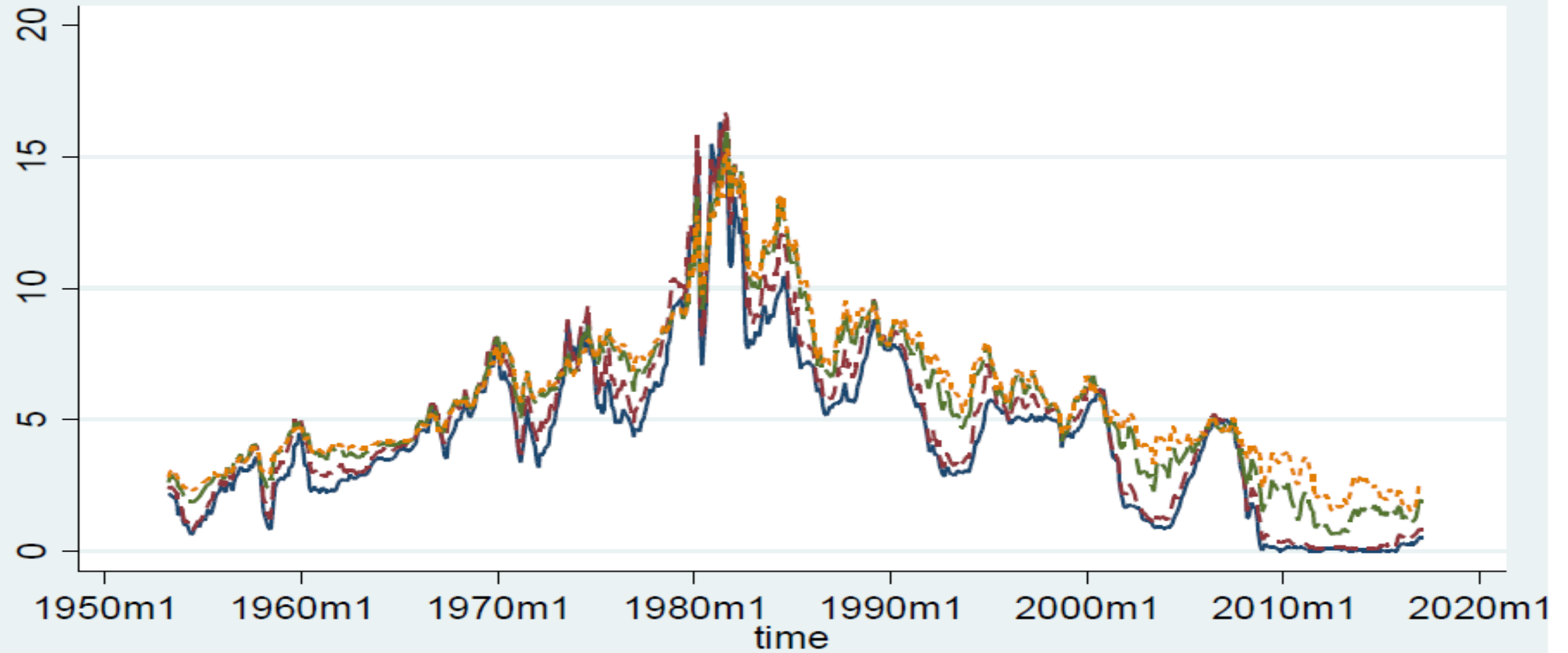
➤ Common *Leading Indicators*

- Housing starts
- Building permits
- Orders for consumer goods
- ~~“Junk bond” or “High Yield” spread: Difference between rates on low-grade and high grade bonds, typically corporate~~
- Term spread (interest rate spread): Difference between Long Rate and Short Rate

DYNAMIC YIELD CURVE OF US GOVERNMENT BOND IN 3D VISUALIZATION

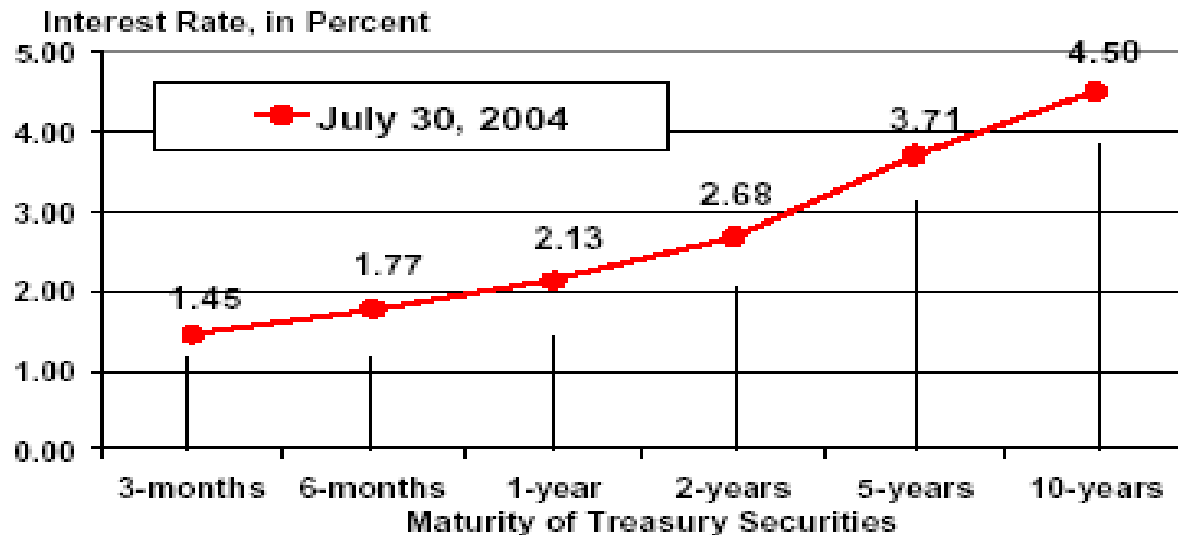


Interest Rates



— 3-Month Treasury	- - - One-Year Treasury
- - - 5-Year Treasury	- - - 10-Year Treasury

U.S. Treasury Security Yield Curve

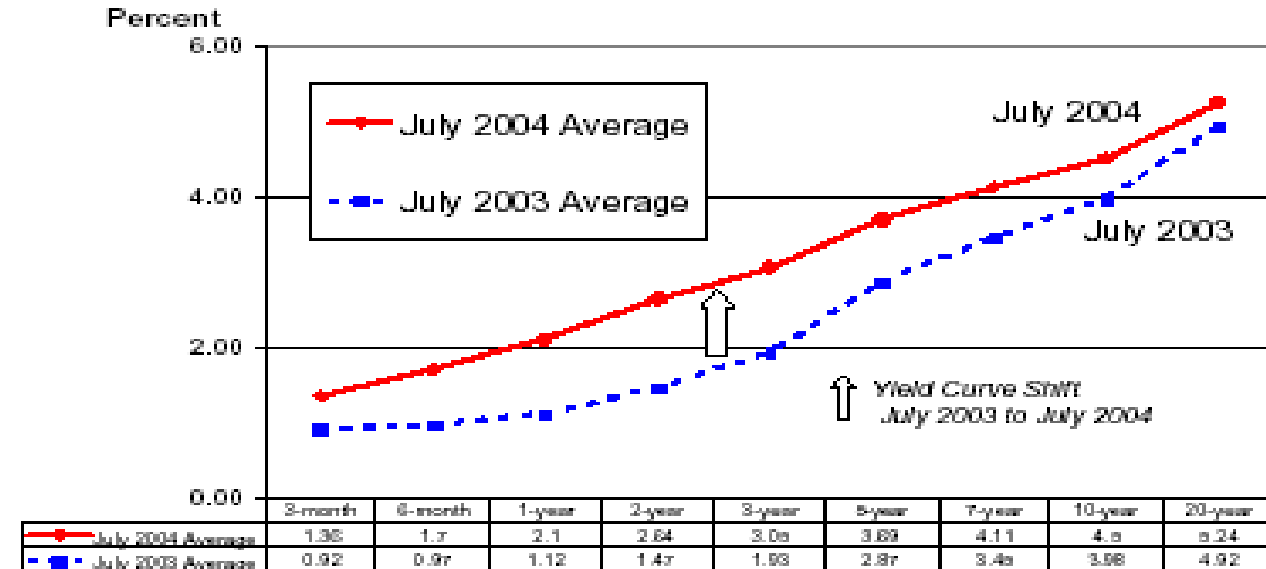


Source: Federal Reserve Board, H. 15 Statistical Release, Bond yield equivalent basis, constant maturity

Upward Sloping Yield Curves Are Typical

Interest Rates Rise as Maturity Lengthens

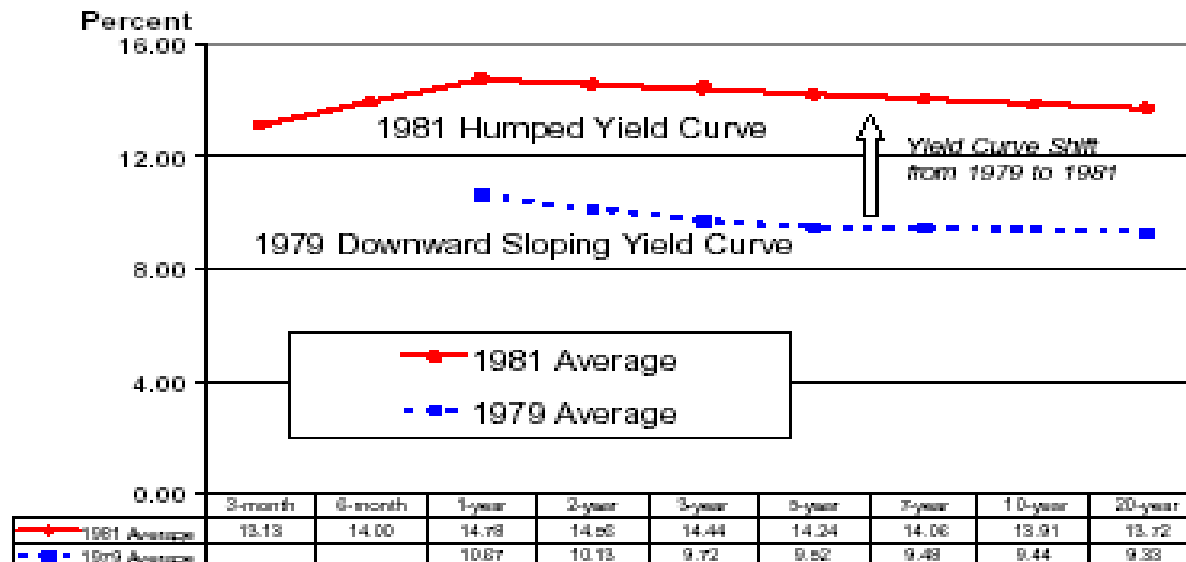
(Monthly Yield Curve Based on U.S. Treasury Securities Interest Rates, Constant Maturities)



Downward Sloping Yield Curves Are Unusual

Interest Rates Fall as Maturity Lengthens

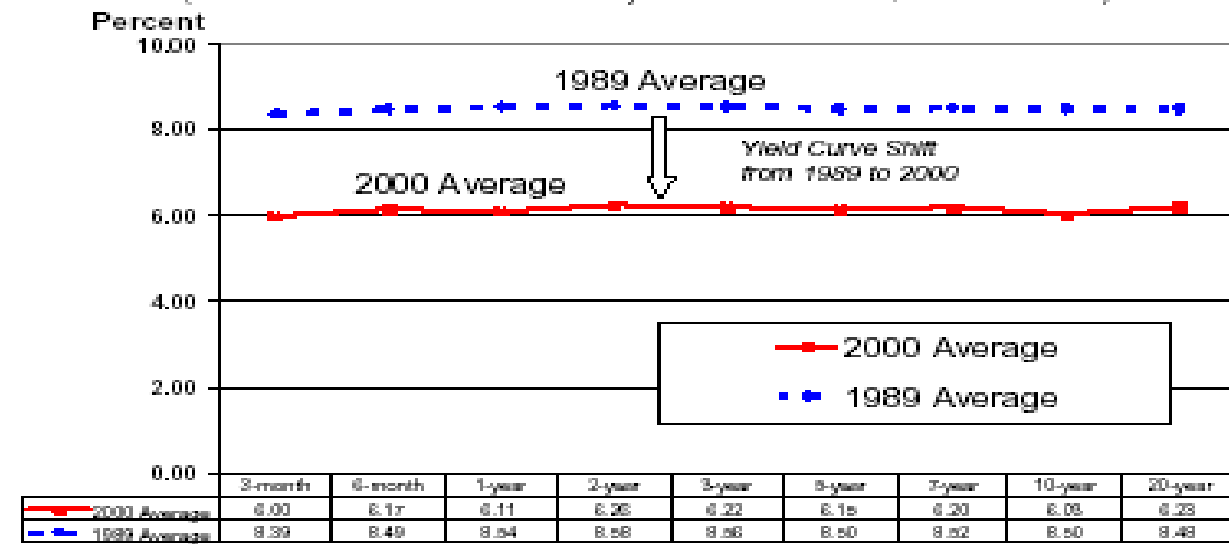
(Annual Yield Curve Based on U.S. Treasury Securities Interest Rates, Constant Maturities)



1989 and 2000 Yield Curves Were Essentially Flat

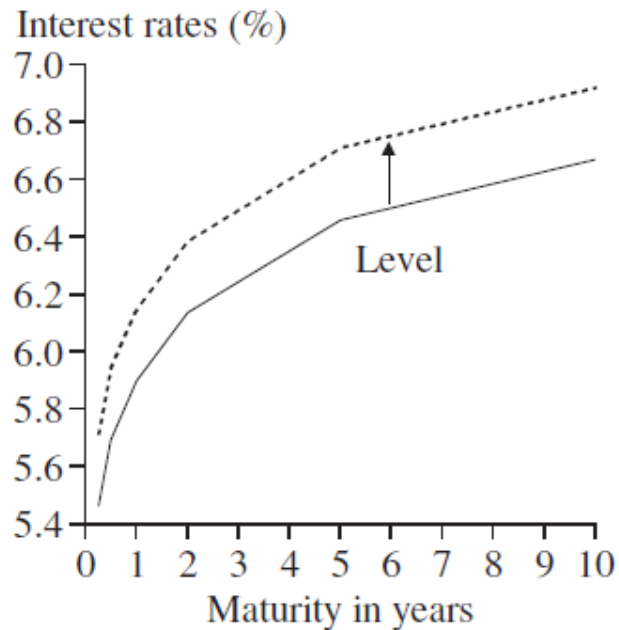
Little Change in Interest Rates as Maturity Lengthens

(Annual Yield Curve Based on U.S. Treasury Securities Interest Rates, Constant Maturities)

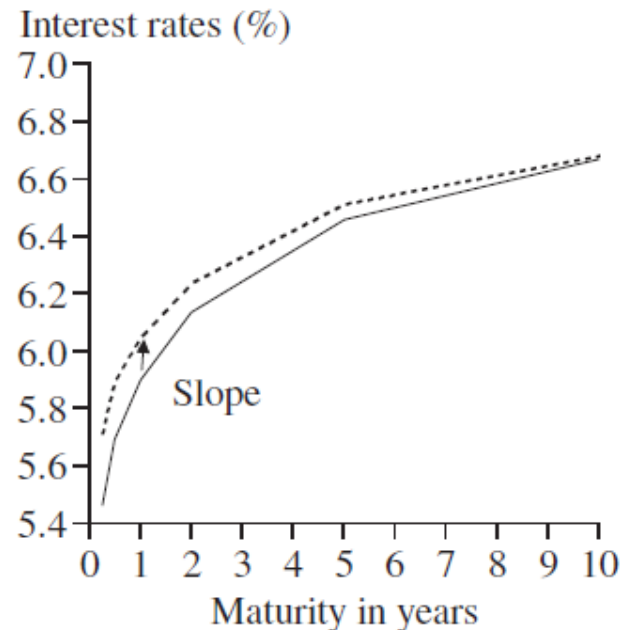


1. IN THE LITERATURE, ECONOMISTS HAVE DOCUMENTED/CLASSIFIED THE COMMON PATTERN IN WHICH YIELD CURVE EVOLVES INTO *THREE PATTERNS*.
2. EACH OF THESE PATTERNS IS NAMED WITH THE LABELED THREE HIDDEN FACTORS: **LEVEL, SLOPE, CURVATURE**.

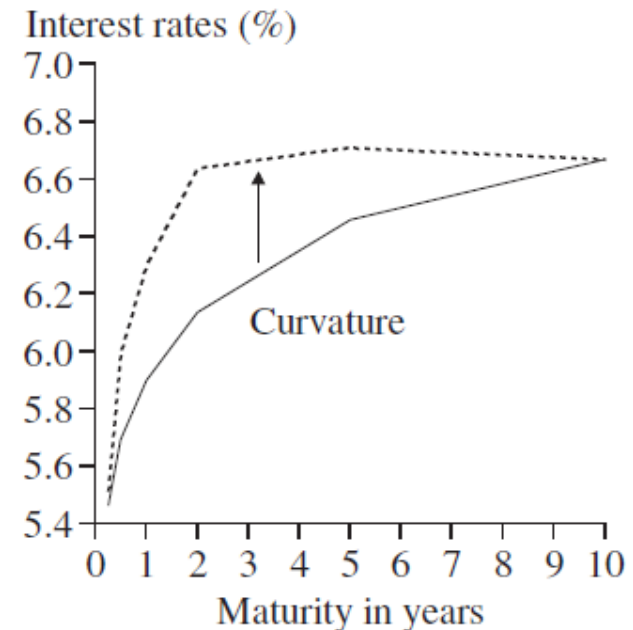
A. Level



B. Slope



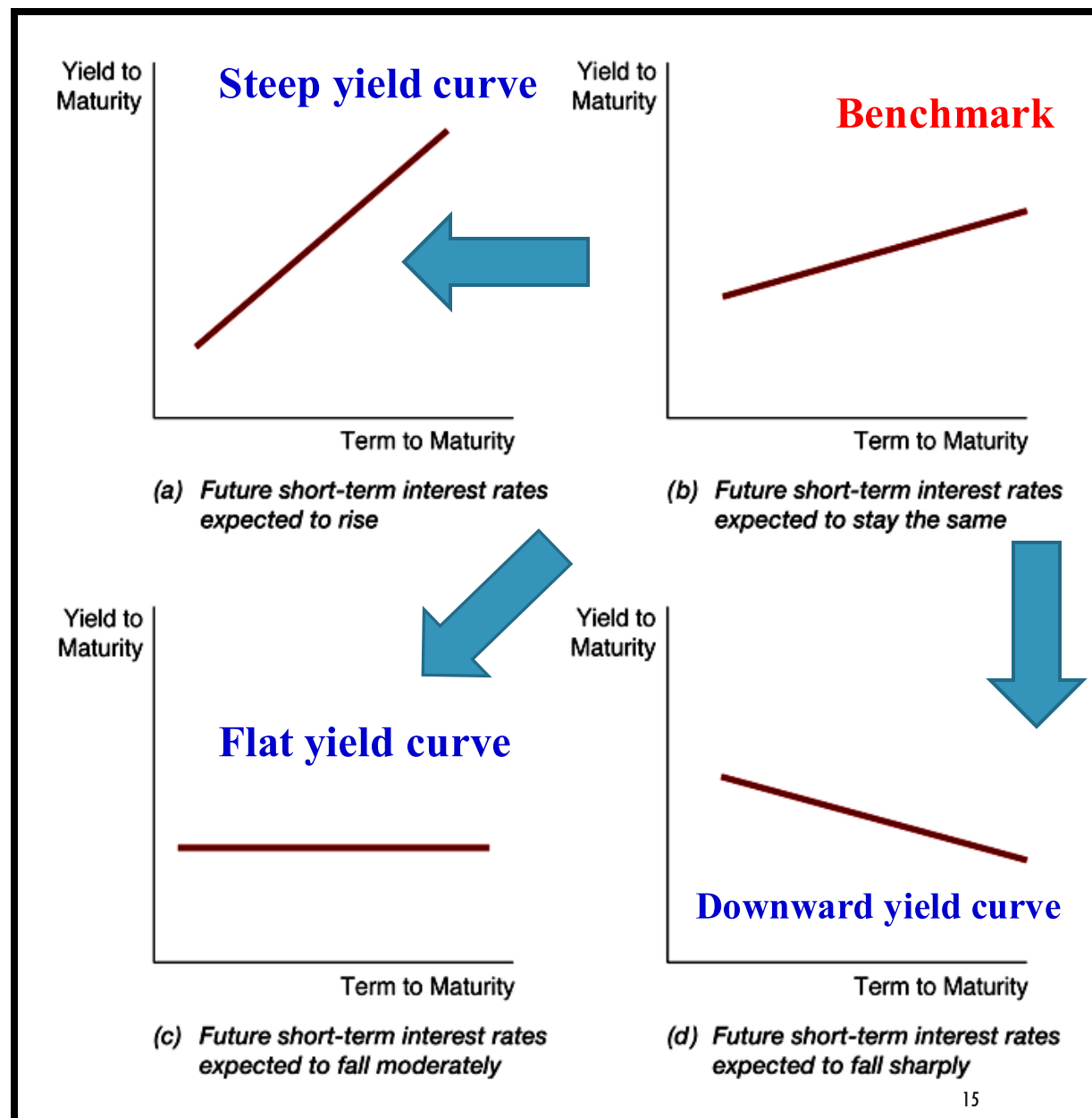
C. Curvature



What does the movement in the yield curve reflect?

From the term structure theory, the movement of yield curve represents the change in (i) *market sentiments over the expected path of future short-term interest rate*, and (ii) *term premium*.

$$i_{t=0,T} = \frac{i_{t=0,1} + \sum_{j=1}^{T-1} i_{t=j,1}^e}{T} + i(T)$$



WHAT CAUSES THE CHANGE IN MARKET EXPECTATION OF FUTURE SHORT-TERM INTEREST RATE?

- Again!! **Market information** → gets reflected in terms of how yield curve moves over time.
- What information?
 - Future economic outlook and future prospect of business activities
 - Stance of monetary policy, easing/contracting.

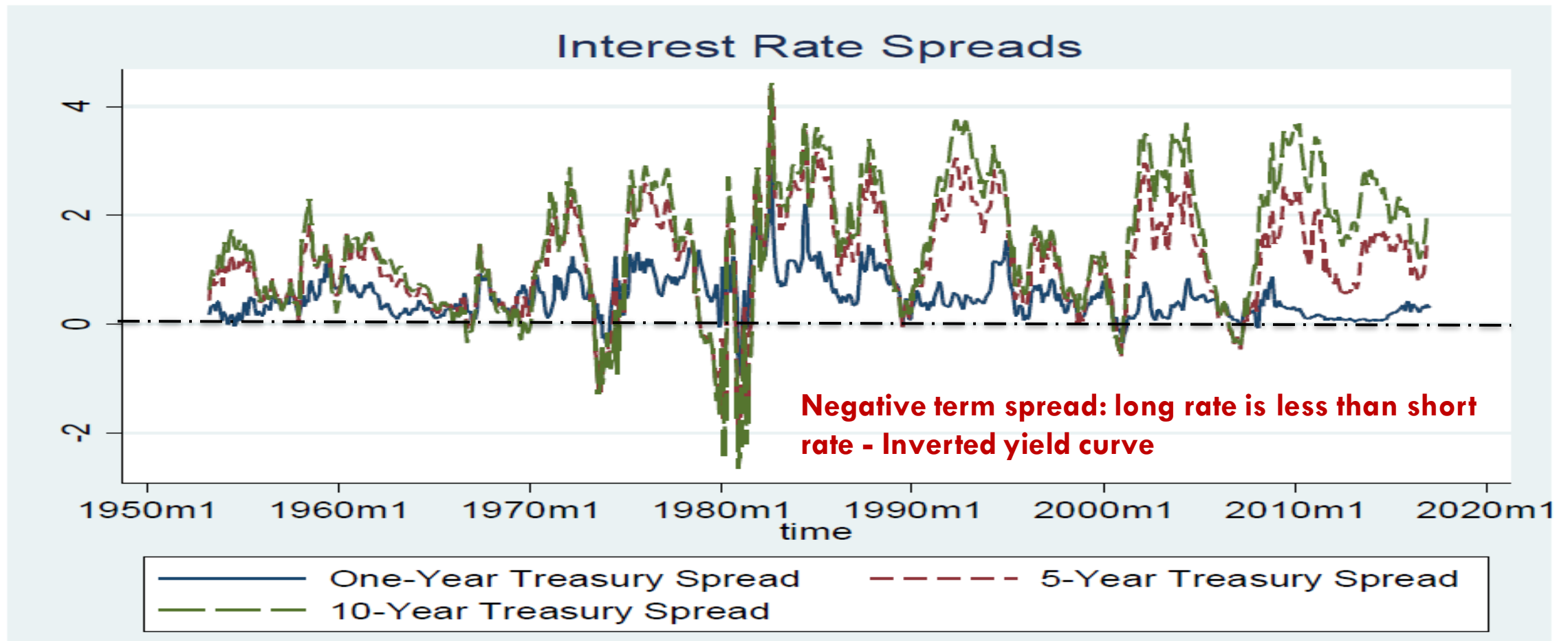
LEVELING SHIFT UP/ STEEPENING YIELD CURVE

- If market expects a **growingly boom economy** in the future, one would anticipate that overall market interest rates will rise up.
 - Demand for findings would rise rapidly, and typically outpace the supply for findings.
 - Central bank normally raises policy rate with respect to inflation and output growth.
- This basically shifts up the yield curve as investors are likely selling of fixed income instrument; **Investors anticipate future loss if market rate increases, and hence react accordingly.**

LEVELING SHIFT UP/ STEEPENING YIELD CURVE

- Stronger growth would typically induce more response on long-term demand for financing; long-term rate will tend to rise more.
 - Not only we see level up, but also slope might be steeper than before.
- Term spread then can be a leading indicator for future economic activities. (Sign of prediction?)
- Develop your intuition for the case of downturns.

NEGATIVE TERM SPREAD

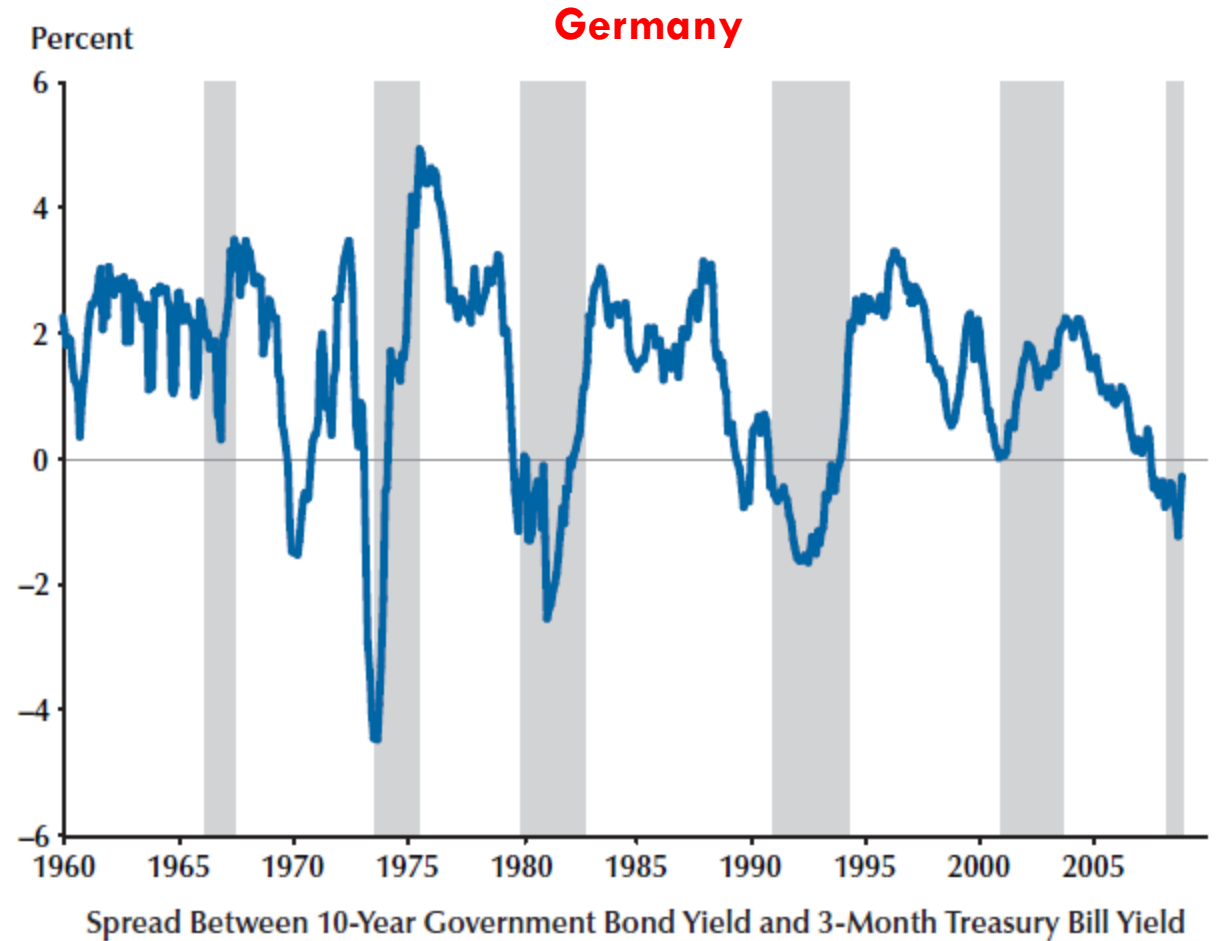
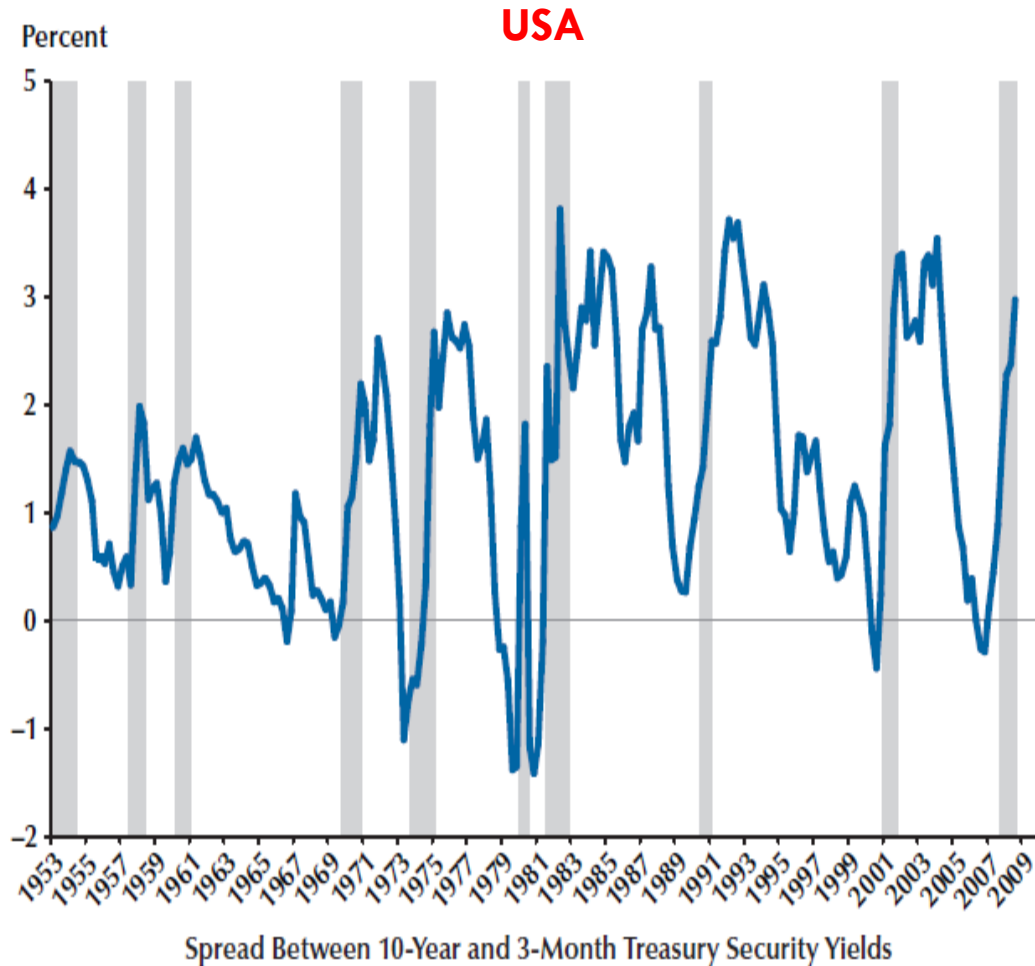


WHAT ABOUT NEGATIVE SPREAD?

PREDICTIVE POWER OF NEGATIVE TERM SPREAD ON RECESSIONS.

- Not all the decline in economic activities are classified as the recession.
- Recession is more costly than just a slow growth episode, i.e. downturn.
- **Since 1955, twelve recessions have occurred, each of which has been preceded by an inversion of the yield curve.**
 - Conversely, there has only been one episode in the United States since 1955 where an inversion of the yield curve in 1966 was not followed by a recession.

NEGATIVE TERM SPREAD AND RECESSION



TESTING THE PREDICTIVE PERFORMANCE

- Running regression:
$$\Delta y_t = \alpha + \beta_1 TS_{t-h} + \beta_2 CS_{t-h} + \sum_{i=1}^N \gamma_i \Delta y_{t-i} + \varepsilon_t$$
- TS: term spread and CS: Credit spread
- Try different definition of TS and CS.
 - 10yr – 3 month, 5yr- 2yr, Baa – AAA ,Baa – Fed fund
- *Past* spreads to explain some proxies of economic variables observed today (at time “t”), i.e. GDP growth/MPI/employment.
- Try varying “h” to see the predictive performance.
- Checking the statistical significance of β_1 and β_2 .

GILCHRIST AND ZARKRAJSEK (2012)

CREDIT SPREADS AND ECONOMICS FLUCTUATIONS, AER

- Forecasting specification (h -periods ahead):

$$\nabla^h Y_{t+h} = \alpha + \sum_{i=0}^p \beta_i \nabla Y_{t-i} + \gamma_1 TS_t + \gamma_2 RFF_t + \gamma_3 CS_t + \epsilon_{t+h}$$

- ▶ $\nabla^h Y_{t+h} \equiv \frac{c}{h} \ln \left(\frac{Y_{t+h}}{Y_t} \right)$, where ($c = 400/1, 200$)
 - ▶ Y_t = measure of economic activity
 - ▶ TS_t = term spread (Treas3mo – Treas10yr)
 - ▶ RFF_t = real federal funds rate (nominal FFR – core PCE infl.)
 - ▶ CS_t = credit spread (paper-bill, Baa-Aaa, GZ)
- Estimated by OLS w/ Hodrick (1992) SEs.

ECONOMIC INDICATOR: PAYROLL EMPLOYMENT

(Sample period: Jan1973–Jun2010)

Financial Indicator	Forecast Horizon: 3 months				Forecast Horizon: 12 months			
Term spread	-0.082 [1.94]	-0.087 [2.05]	-0.086 [2.06]	-0.099 [2.39]	-0.238 [4.82]	-0.239 [4.79]	-0.219 [4.71]	-0.267 [5.54]
Real FFR	-0.083 [1.82]	-0.011 [0.18]	-0.077 [1.67]	-0.132 [2.84]	-0.125 [2.38]	-0.111 [1.75]	-0.157 [3.15]	-0.208 [4.09]
CP-bill spread	-	-0.108 [2.40]	-	-	-	-0.022 [0.64]	-	-
Baa–Aaa spread	-	-	-0.020 [0.52]	-	-	-	0.111 [2.31]	-
GZ spread	-	-	-	-0.272 [6.61]	-	-	-	-0.457 [12.4]
Adj. R^2	0.661	0.667	0.660	0.705	0.448	0.447	0.456	0.577

NOTE: Parameter estimates are standardized; absolute t -statistics in brackets.

ECONOMIC INDICATOR: REAL GDP

(Sample period: 1973:Q1–2010:Q2)

Financial Indicator	Forecast Horizon: 1 quarter				Forecast Horizon: 4 quarters			
Term spread	-0.143 [1.38]	-0.175 [1.63]	-0.158 [1.36]	-0.200 [1.95]	-0.382 [2.86]	-0.385 [2.85]	-0.371 [2.62]	-0.423 [3.39]
Real FFR	-0.103 [0.97]	0.110 [0.76]	-0.093 [0.87]	-0.162 [1.57]	-0.066 [0.50]	-0.032 [0.19]	-0.072 [0.54]	-0.155 [1.16]
CP-bill spread	-	-0.254 [2.33]	-	-	-	-0.048 [0.42]	-	-
Baa–Aaa spread	-	-	-0.059 [0.51]	-	-	-	0.052 [0.44]	-
GZ spread	-	-	-	-0.327 [3.98]	-	-	-	-0.348 [3.66]
Adj. R^2	0.176	0.191	0.173	0.235	0.239	0.235	0.236	0.325

NOTE: Parameter estimates are standardized; absolute t -statistics in brackets.

THE ISSUE ON DECLINING LONG-TERM INTEREST RATE



1. Cyclical fluctuation might be rising or falling. But look at the trend
2. Common phenomena that has occurred since 2000, and taken place in most countries.

WHY HAVE WE SEEN A DECLINING TREND IN LONG-TERM INTEREST RATE?

- Bernanke first discussed about this issue in 2005.
- 1st explanation : **Global imbalance!**
- Reserve holding among emerging market and Petrol dollar recycle. → long-term interest rate decline because of capital influx...
- Story sounds convincing but why then has it been so persistent?
Why not reversal?

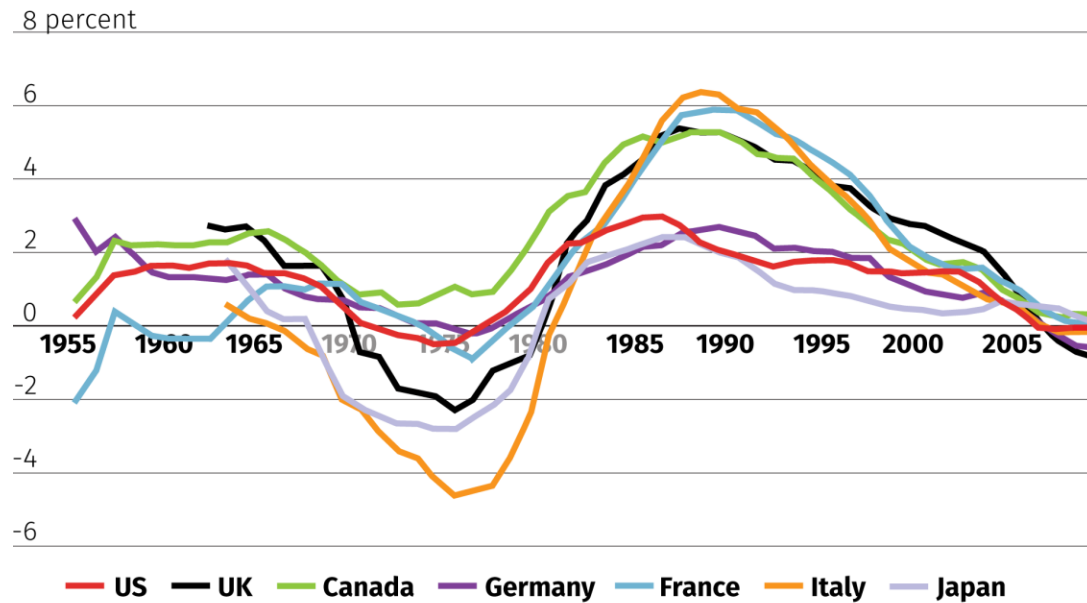
2ND EXPLANATION: INFLATION TARGETING.

- Most countries have adopted the inflation targeting policy by early or 2000s' (NZ first... UK Canada followed); Numerical inflation target announced.
- Inflation rate has become gradually decline since the adoption.
- More importantly, inflation rate has been less volatile.
- Credible monetary policy **reduces inflation risk!**.
- Term premium has “structurally” decreased then.

RECENT DISCUSSION: GLOBAL DECLINE OF *REAL* INTEREST RATE

Real interest rates in G7 nations:
Since late 1980s, decline and convergence

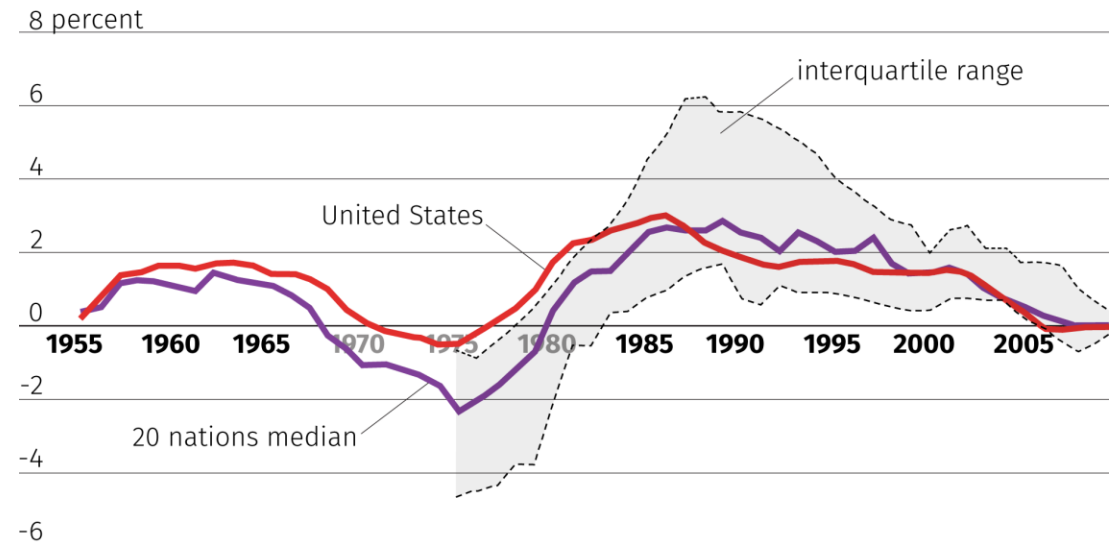
1



Note: 11-year centered moving average
Source: IMF, Haver and authors' calculations

Real interest rates, 20 largest nations:
Since late 1980s, decline and convergence

2

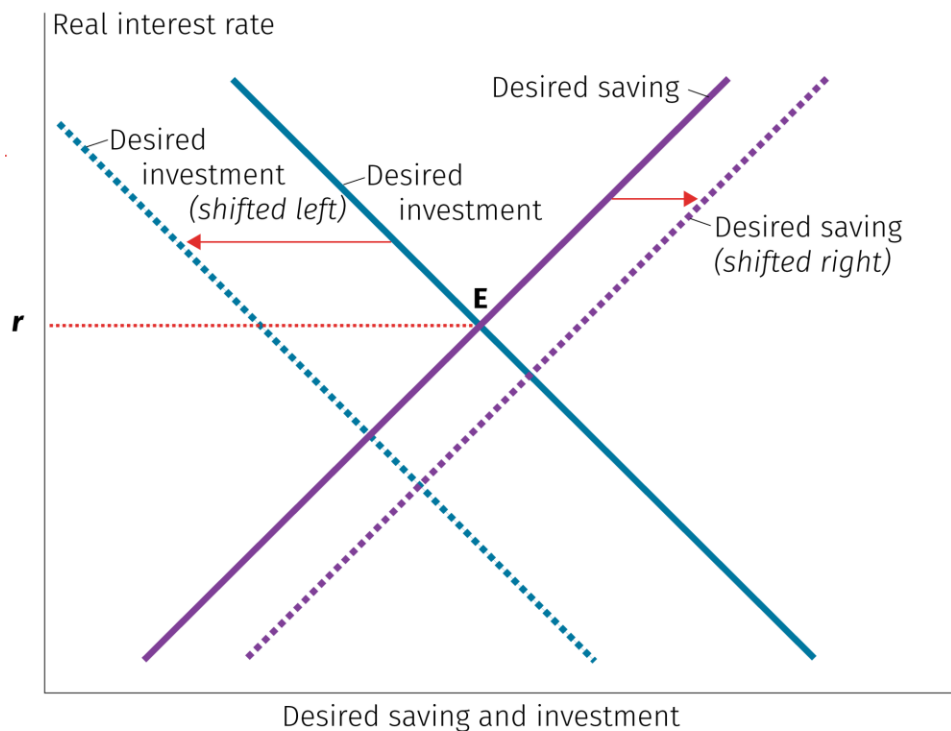


Note: 11-year centered moving average
Source: IMF, Haver and authors' calculations

WHAT CONTRIBUTE TO THE DECLINE?

A simple saving-investment framework

3



Real interest rates in dollars (in %)

Table 3

	1980-99	2000-03	2004-08	2010-15
Fed funds rate ¹	3.7	1.5	1.3	-2.9
Laubach-Williams (LW) natural rate	2.9	2.8	2.1	0.1
10-year yield of US Treasuries	4.7	3.2	2.0	0.2
World real long-term rate	4.4	3.1	1.8	0.2
<i>Memo:</i>				
Global savings rate	23.1	22.9	24.6	25.5
Global growth trend	3.2	3.9	4.1	3.5
US potential growth rate	3.1	3.4	2.4	1.5

¹ Deflated by the year-on-year US core CPI (from 2008, the shadow Lombardi/Zhu rate has been used).

SUM UP...

- Movement of the financial variables provide some useful information content about future economic outlook.
 - Movement in the credit spreads reflects the information about expected bankruptcy risk (default risk) of firms.
 - Future short-term interest rate tends to signal what investors believe over the economic outlook; and hence alter the shape of yield curve.

- Both credit-spread and term-spread have been empirically proven to give high predictive performance on future economic activities, and can be used as a leading indicator that detects the recession.

SUM UP...

- While we extensively focus on business cycles perspective, financial data also reveals some slowly progressed and development that has been occurring in the macroeconomy.
- Long-run interest rates have structurally declined across the world; some contributing factors are saving demand, low investment, low potential growth, and demographic issue.

EXTRA READINGS

Wu, Tao (2003), “What makes Yield curve move?” FRBSF Economics Letter

Bernanke (2005) “Monetary Policy and Yield Curve”

Bernanke (2005) “Why does yield curve flat internationally?”

Adrian, Estrella, Shin (2009) “Monetary Cycles, Financial Cycles, and the Business Cycle”

Bernanke, Ben S., and Cara Lown. 1991. “The Credit Crunch.” *Brookings Papers on Economic Activity*, 2: 205-247.

Bernard, Henri, and Stefan Gerlach. 1996. “Does the Term Structure Predict Recessions? The International Evidence.” Working Paper No. 37, Bank for International Settlements.

Estrella, Arturo, and Gikas Hardouvelis. 1991. “The Term Structure as a Predictor of Real Economic Activity.” *Journal of Finance*, 46: 555-576.