

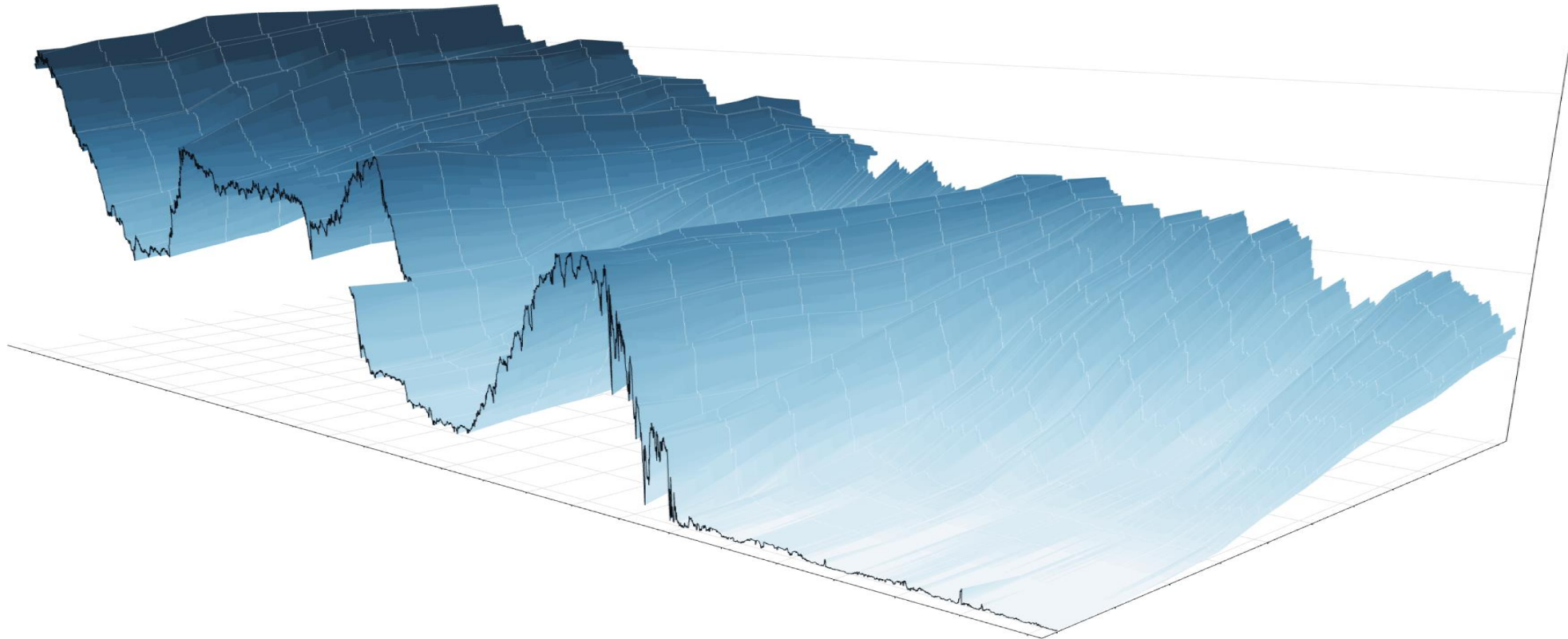
TERM STRUCTURE OF INTEREST RATE II: DYNAMIC YIELD CURVE

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Semester 1/2027

DISCUSSION THAT WE PLAN TO GO OVER TODAY

- ❑ What can we do with our understanding on the term structure theorem?
- ❑ Financial applications → understand how to extract *implied forward rate* from the market data → see exercise, very straightforward.
- ❑ Main focus will be its economic application → understand how yield curve evolves over time, i.e. *dynamic yield curve*.
- ❑ Discuss about ongoing literature from case studies in advanced economy, and also in Thailand.

DYNAMIC YIELD CURVE OF US GOVERNMENT BOND: WHAT DO WE SEE.

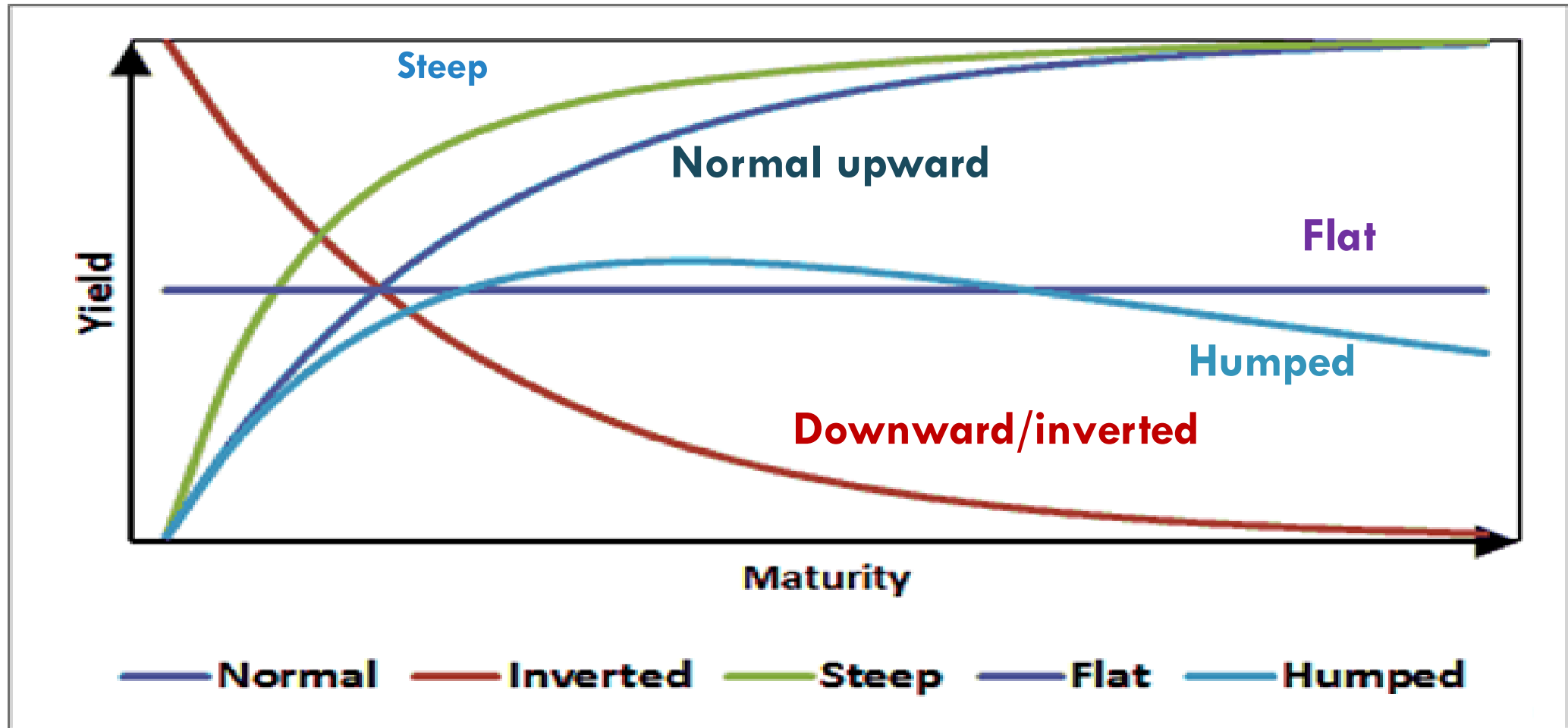


TWO OBSERVATIONS YOU SHOULD NOTE, AND WORTH EXPLAINING.

1) Yield curve moves over time; shape get changed from time-to-time.

2) Declining long-term interest rate...(to be discussed further with more international evidences.)

YIELD CURVES CLASSIFIED INTO 5 SHAPES.



FROM THE 5 SHAPES OF YIELD CURVES

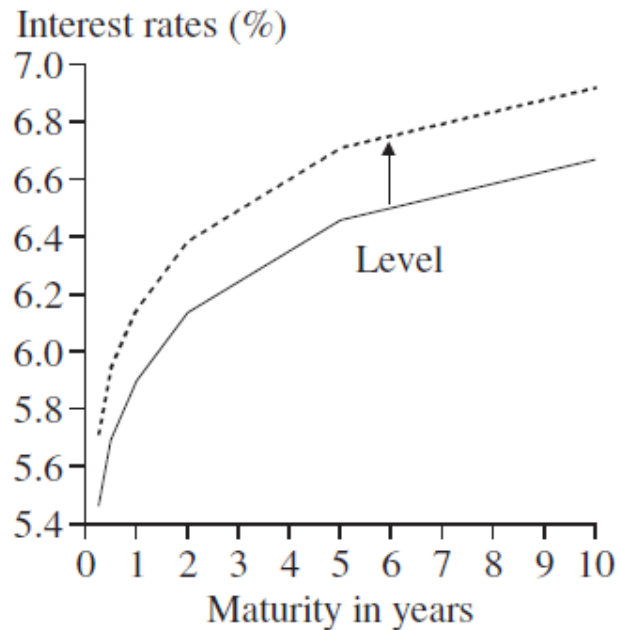
Normal upwards are commonly seen (observed) in the data.

As time goes by, normal upward gets changed into other shapes.

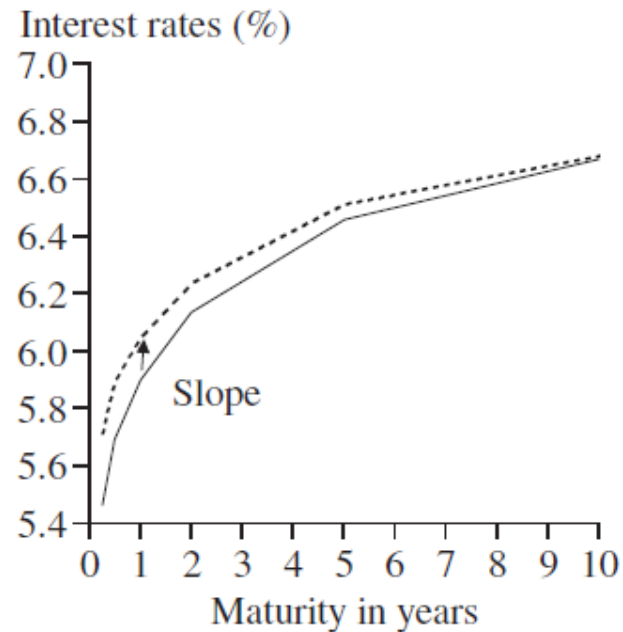
This implies another natural characteristic of yield curve that we call “dynamic yield curve”, i.e. dynamically evolving over time.

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 FACTORS, LEVEL, SLOPE, CURVATURE.

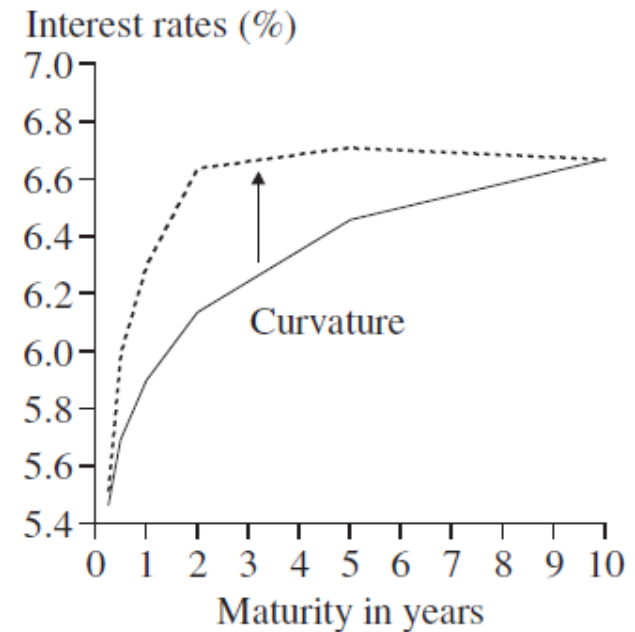
A. Level



B. Slope



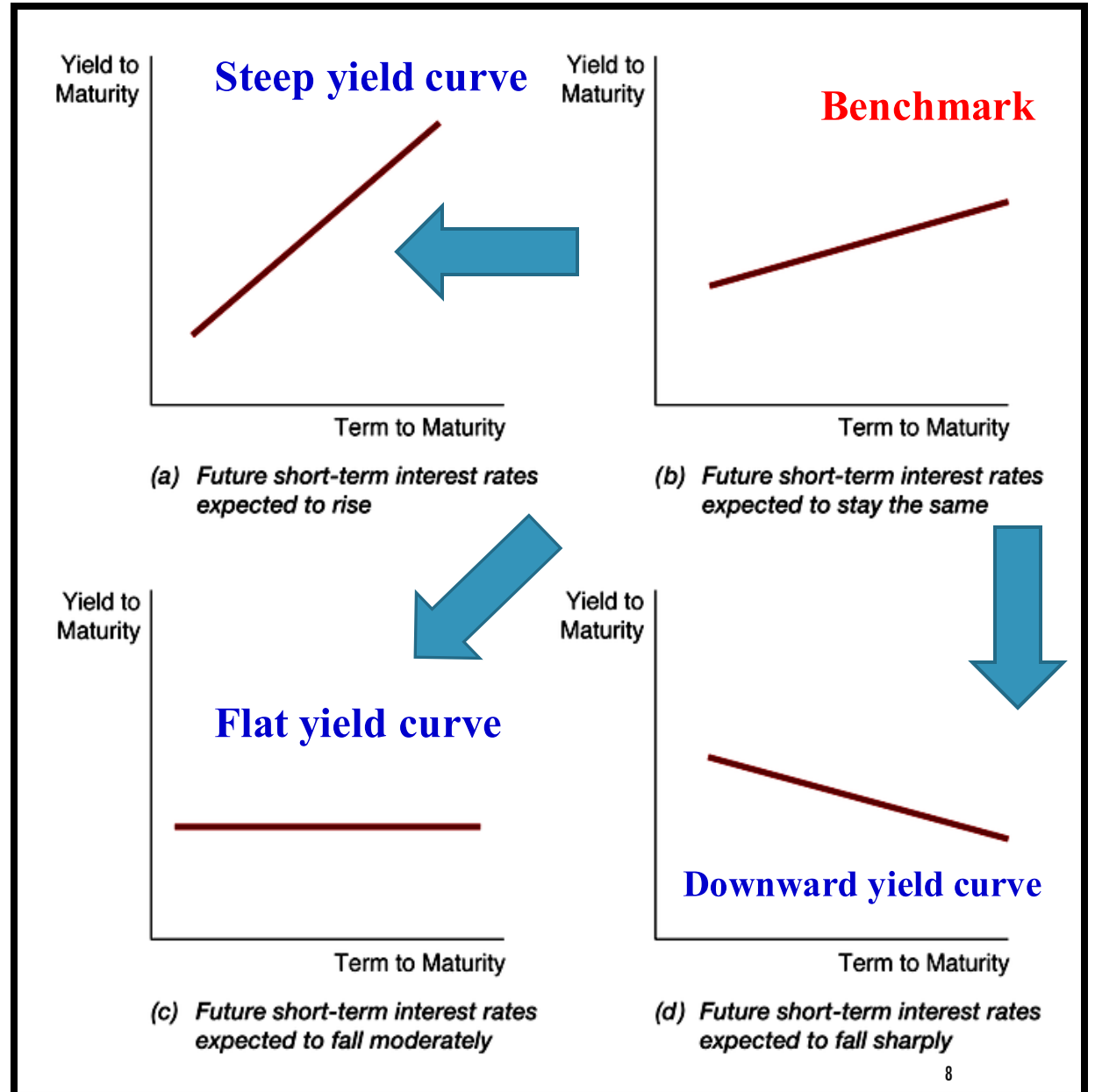
C. Curvature



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*.

$$\begin{aligned}
 & \dot{i}_{t=0,T} \\
 &= \frac{\dot{i}_{t=0,1} + \sum_{j=1}^{T-1} \dot{i}_{t=j,1}^e}{T} \\
 &+ \dot{i}(T)
 \end{aligned}$$



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

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

AS MOVEMENT OF YIELD CURVE MIGHT HAVE SOME PREDICTIVE POWER OVER THE COURSE OF FUTURE ECONOMICS ACTIVITIES, IN SOME APPLIED WORK, WE ESTIMATE THE REGRESSION RELATIONSHIP BETWEEN SPREAD AND SOME PROXIES OF ECONOMIC ACTIVITIES.

- Run regression
$$\Delta y_t = \alpha + \beta spread_{t-h} + \sum_{i=1}^N \gamma_i \Delta y_{t-i} + \varepsilon_t$$
- Try different definition of term-spread
 - 10yr – 3 month, 5yr- 2yr.
- Past spread to explain some proxies of economic variables observed today, i.e. GDP growth/MPI/employment.
- Try varying “h” to see the predictive performance.

Key findings: $\beta > 0$ and statistically significant → meaning? Economics, why?

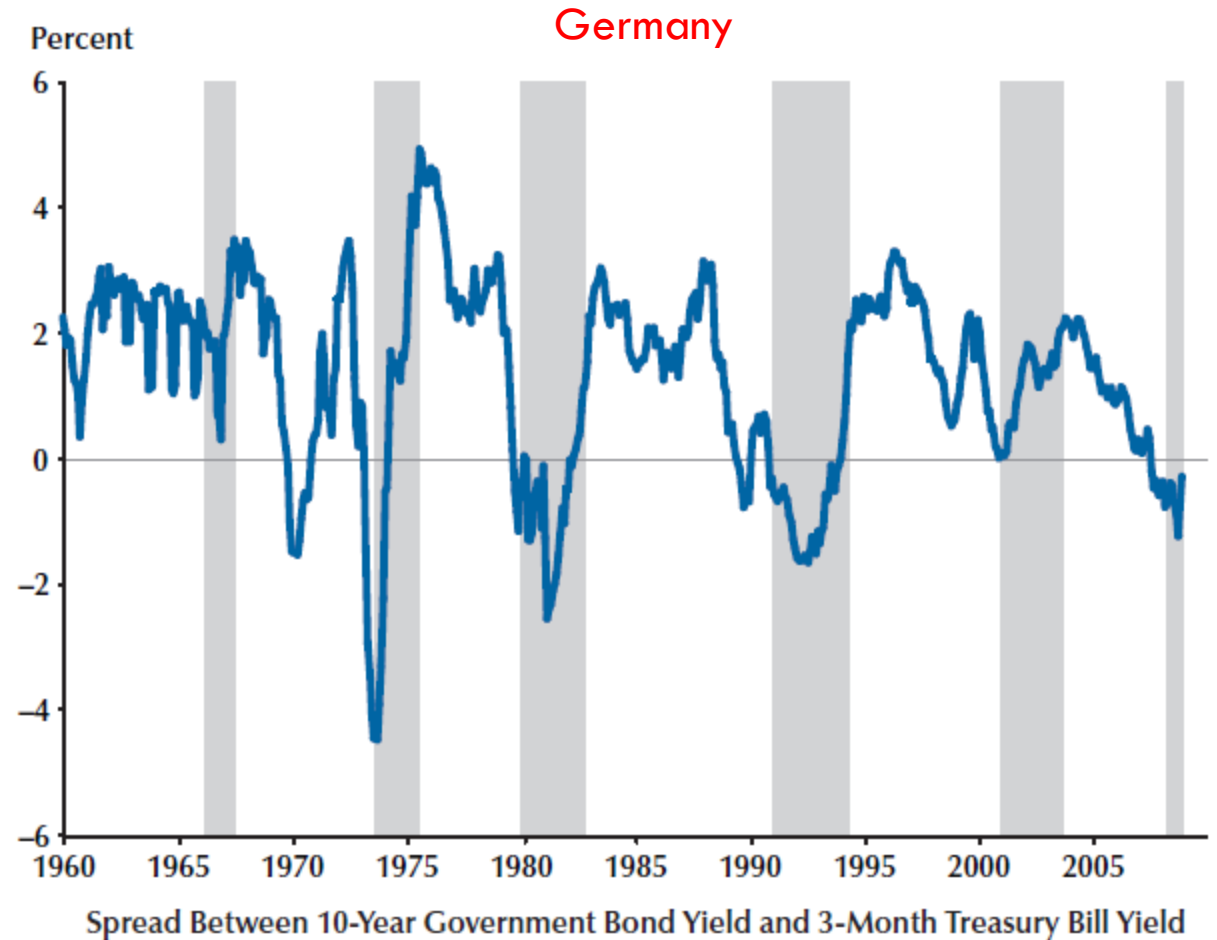
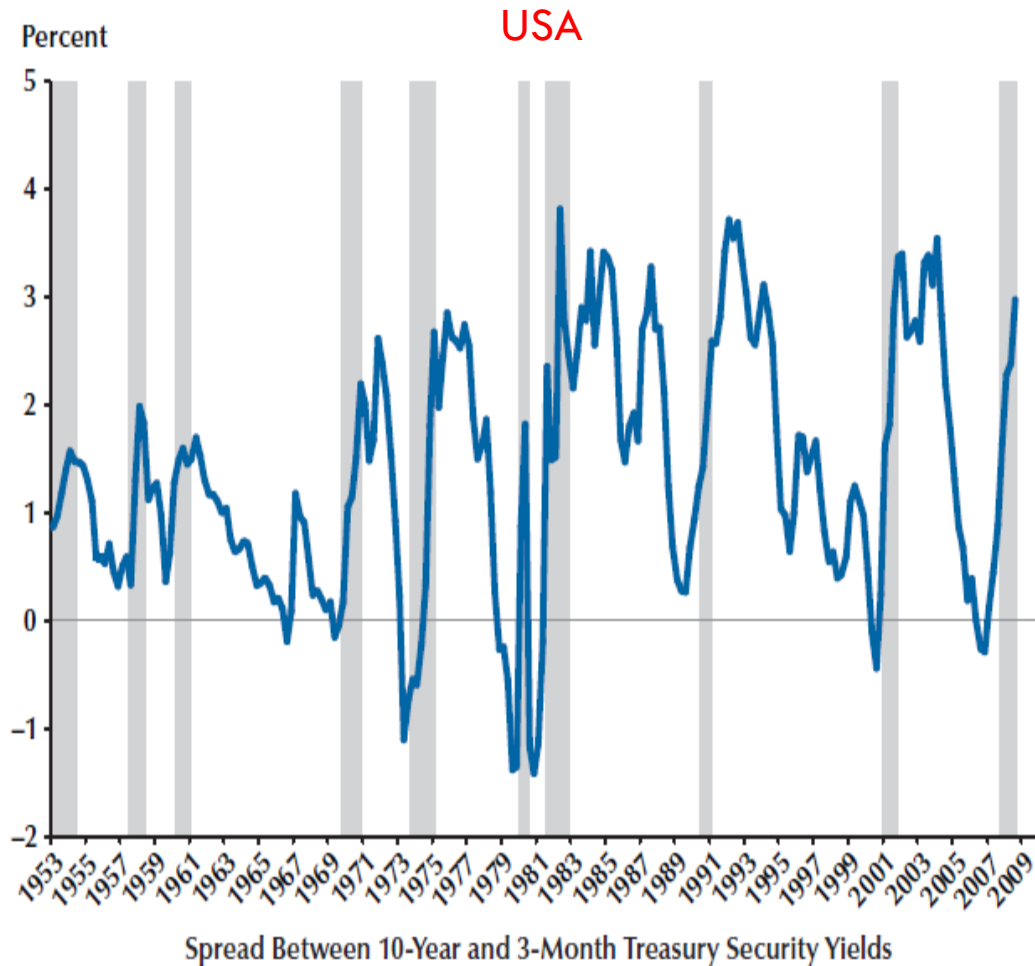
WHY DOES HIGHER (LOWER) TERM SPREAD SIGNAL AN IMPROVING (DECLINING) CONDITION IN REAL ECONOMIC ACTIVITIES?

- Anticipate booming:
 - Booming requires more use of funds in the future.
 - Securing long-term finance by corporate/government would be followed soon → better secure long-term loan now!
 - Given booming expected, financial traders believe yield would be on its rising trend. Uprising market yield would hurt their fixed income portfolio.
 - Investors thus *unwind* long-term bond, pushing down the price of long-term bond, and hence causing a rise in long-term yield.
- How about lower term spread? Predicting the decline in economic activities. How?

WHAT ABOUT NEGATIVE SPREAD?: PREDICTIVE POWER OF NEGATIVE TERM SPREAD ON RECESSION.

- Not all the decline in economic activities are classified as the recession.
- Recession is more costly than just a slow growth episode.
- 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 (however, that episode was followed by an increase in unemployment).

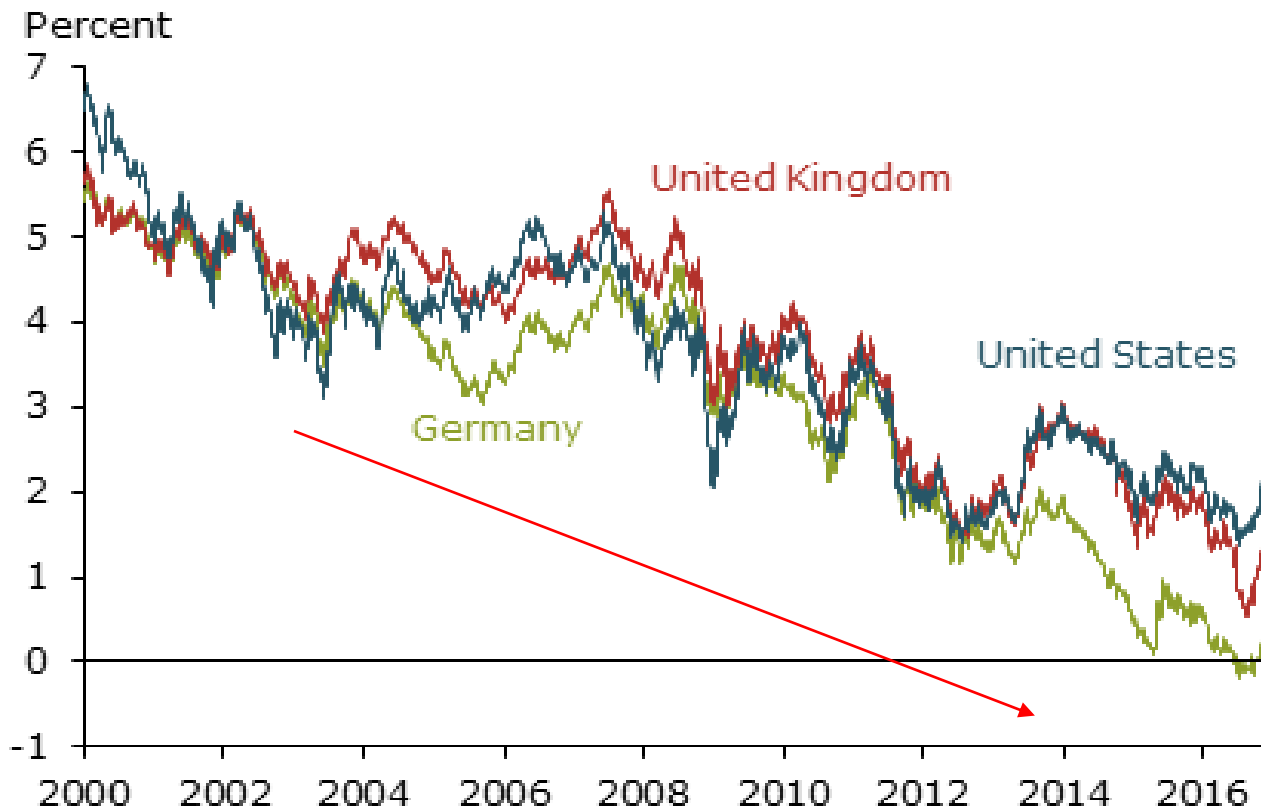
HOW ABOUT PREDICTING RECESSION! FLATTENING SLOPE/DOWNWARD SLOPING YIELD CURVE PREDICTING THE RECESSIONS.



SUM UP...

- Movement of yield curve reflects the perception of market participants over the course of future short-term interest rate.
- Future short-term interest rate tends to signal what investors believe over the economic outlook; leading indicator and procyclical.
- Term-spread has proven to give high predictive performance on future economic activities, and can be used as a leading indicator that detects the recession.

BACK TO THE 2ND OBSERVATION: 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.

3ND EXPLANATION: GLOBAL REAL INTEREST RATE AND GLOBAL SAVING GLUTS (STRUCTURAL CHANGE)

More saving; lower potential growth; lower population growth → lower natural rate of interest rate!

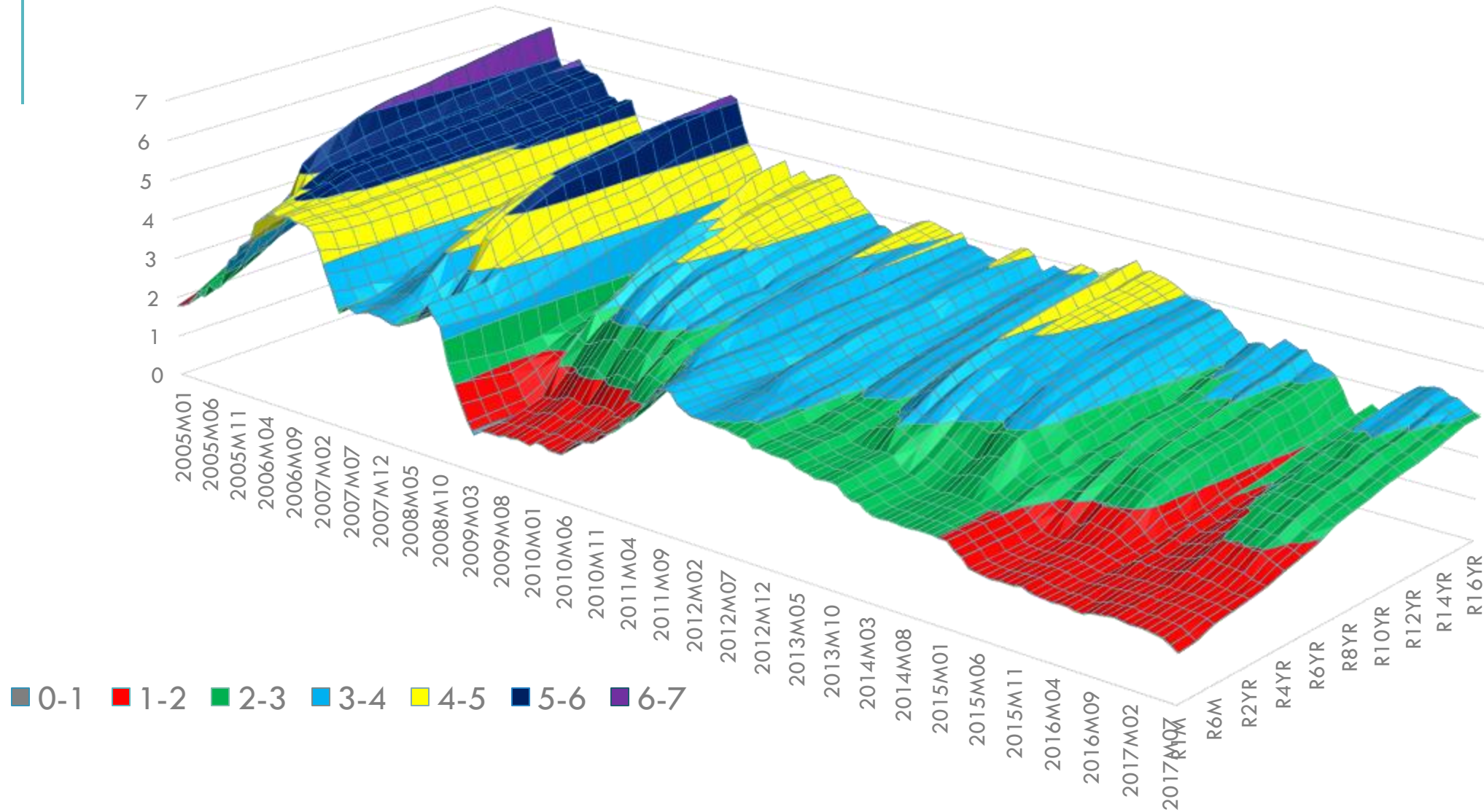
Real interest rates in dollars (in %)				Table 3
	1980–99	2000–03	2004–08	2010–15
Fed funds rate ¹	3.7	1.5	1.3	-2.9
Laubach-Williams (LW) natural rate	2.9	2.8	2.1	0.1
10-year yield of US Treasuries	4.7	3.2	2.0	0.2
World real long-term rate	4.4	3.1	1.8	0.2
<i>Memo:</i>				
Global savings rate	23.1	22.9	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).

BACK TO OUR COUNTRY... GETTING TO KNOW MORE ABOUT DYNAMIC YIELD CURVE.

- What do we know about the dynamic yield curve of Thailand?
- What do we know about predictive regression?

Dynamic yield curve: Thailand



PREDICTIVE REGRESSION IN THAILAND

- We never had an inverted yield curve...Puzzle; no idea why?
Good question.
- How about the research on predictive regression.
 - One of the BE students did a study on this issue. (Her paper got her a (2nd runner-up) BOT prize.)
 - Let's take a look at what she did, so you get some sense where the standard is.

THE PREDICTIVE POWER OF YIELD CURVE FOR OUTPUT AND INFLATION IN THAILAND

YUWANEE OUNONG
Faculty of Economics, Thammasat University

PROPOSED PREDICTIVE REGRESSION

For the output regression, she proposed that we estimate the following equation

$$Y_t^k = \beta_0 + \beta_1 \text{Spread}_t + \beta_3 Y_{t-1}^1 + \beta_4 \text{Lead}_t + \sum_{i=1}^c \phi_i \text{Monet}_{it} + \sum_{j=1}^d \delta_j D_{jt} + \varepsilon_t^k$$

k-period MPI growth Spread 10yr-3m Lag MPI growth Leading indicators Monetary policy variable Dummy

Leading indicators: From the list of candidate leading economic variables, she applies the PCA technique, and construct a single index variable as a problem.

What does the equation test?

- Marginal predictive power of “spread term”
- Idea behind: The “lead” variable can already predict; adding spread term can help increase the power of prediction.

1. Higher spread is positively associated with higher growth. Significant result!

HOW SHE PRESENTED HER RESULTS!

M-o-M growth v.s. Annualized growth

Table1: One-step ahead in-sample forecast for output

Model	m-o-m MPI Growth				y-o-y MPI Growth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Spread	2.736*** (1.573)	1.759** (0.847)	1.680** (0.752)	1.909** (0.927)	3.885*** (1.452)	1.260** (0.488)	1.134** (0.478)	1.457** (0.66)
Lagged Y		0.415*** (0.04)	0.382*** (0.035)	0.381*** (0.037)		0.806*** (0.063)	0.813*** (0.063)	0.785*** (0.049)
Lead			8.984* (5.195)	9.193* (5.129)			3.801* (2.276)	3.785*** (1.306)
RP				0.211 (0.777)				0.832 (0.636)
M1				-0.106 (0.082)				0.097 (0.156)
M2								-0.104 (0.167)
Constant	-3.007	-2.107	-2.278	-2.859	-2.182	-1.363	1.357	-4.052
Adj.R2	58.53	71.84	73.05	73.01	18.62	75.23	76.55	76.38

2. Other variable become Insignificant; unimportant!

3. Power of predictability 18.62% for Y-o-y MPI growth and 58.53% for M-o-M MPI growth

- Newey and West heteroskedasticity and autocorrelation consistent standard errors in parentheses.
- ***, ** and * denote statistically significant at the 1%, 5% and 10% level of confidence.
- All dummy variable coefficients are significant at 1% level, however, are not reported in table.

VARIATION OF PREDICTIVE POWER OVER MULT-PERIOD AHEAD

Table2: Multi-step ahead in-sample forecast for output

$$Y_t^k = \beta_0 + \beta_1 Spread_t + \beta_3 Y_{t-1}^1 + \beta_4 Lead_t + \sum_{j=1}^d \delta_j D_{jt} + \varepsilon_t^k$$

Forecasting period ahead (k =)	MPI response to spread (β_1)	
	MPI y-o-y growth	MPI m-o-m growth
3-month	3.454** (1.136)	4.096* (2.425)
6-month	4.091*** (1.223)	4.597* (2.497)
12-month	3.168*** (1.199)	3.587** (1.549)
24-month	1.116 (2.516)	2.534** 0.991

- Standard errors in parentheses.
- ***, ** and * denote statistically significant at the 1%, 5% and 10% level of confidence.

INFLATION EQUATION

Table3: One-step ahead in sample forecast for inflation

Model	Inflation equation (9)		Inflation change with 10yr-3m spread (10)		Inflation change with 2yr-3m spread (11)	
	Core	Headline	Core	Headline	Core	Headline
Spread	0.018 (0.029)	0.049** (0.025)	0.273 (0.129)	0.640** (0.290)	0.26 (0.162)	0.649* (0.362)
Lagged Y	0.969*** (0.032)	0.957*** (0.031)				
Constant	0.007	-0.033	6.22**	13.73**	6.34***	13.97***
Adjusted R2	91.35	88.25	3.5	3.9	1.65	2.28

- Standard errors in parentheses.

- ***, ** and * denote statistically significant at the 1%, 5% and 10% level of confidence.

INFLATION EQUATION

Table 4: Multi-step ahead in-sample forecast for inflation

Forecasting period ahead (k =)	Inflation response to spread (β_1)	
	Core inflation	Headline inflation
3-month	0.006 (0.057)	0.098** (0.043)
6-month	0.126 (0.079)	0.168** (0.066)
12-month	-0.109 (0.097)	-0.002 (0.067)
24-month	0.152 (0.095)	0.264 (0.076)

- Standard errors in parentheses.

- ***, ** and * denote statistically significant at the 1%, 5% and 10% level of confidence.

ROBUSTNESS CHECK: HOW DO WE KNOW THAT SPREAD WORKS?

Table 8: Robustness check across different term spread – output case

Model	Main(10yr-3m)	5yr-1m	5yr-3m	5yr-6m	10yr-1m	10yr-6m
Spread	1.134*** (0.430)	1.476** (0.602)	1.600** (0.639)	1.722** (0.719)	1.097** (0.417)	1.162** (0.480)
Lagged Y	0.813*** (0.038)	0.814*** (0.038)	0.814*** (0.038)	0.815*** (0.039)	0.812*** (0.038)	0.815*** (0.039)
Lead	3.801 (1.293)	3.721** (1.301)	3.733** (1.300)	3.866** (1.348)	3.781** (1.294)	3.928** (1.343)
Constant	-1.357	-1.059	-1.105	-1.119	-1.357	-1.311
Adj.R2	76.54	76.38	76.43	76.45	76.54	76.48

- The robustness check is based on model (7), the model with highest adjusted R-squared from table 1.
- Standard errors in parentheses.
- ***, ** and * denote statistically significant at the 1%, 5% and 10% level of confidence.

SUM UP

A nicely written paper; worth reading.

Please study; more details in the paper..

Finding provides a confirmed result that term-spread can be a good predictor for future economic activities, especially MPI growth.

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.