

# Class 4: Interest Rate Swaps

Financial Markets, Spring 2021, SAIF

**Jun Pan**

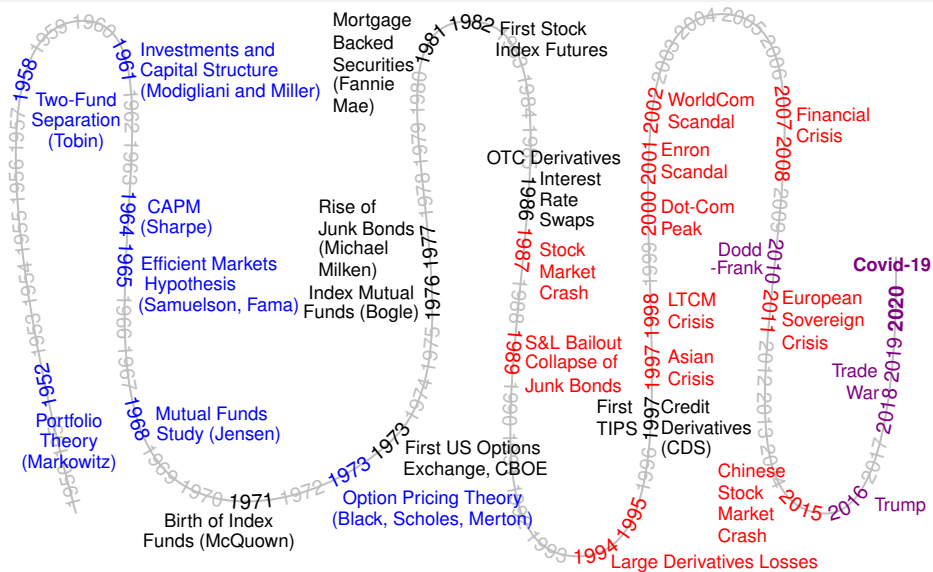
**Shanghai Advanced Institute of Finance (SAIF)  
Shanghai Jiao Tong University**

**June 5-6, 2021**

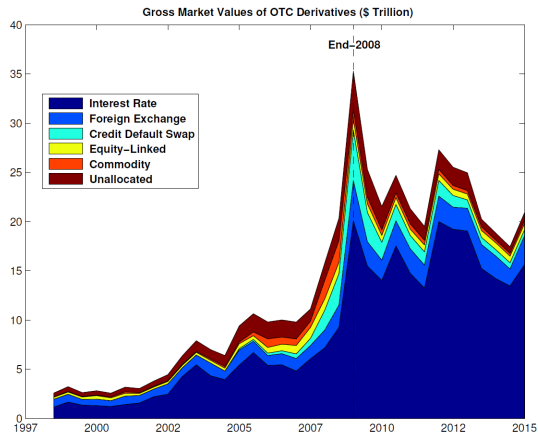
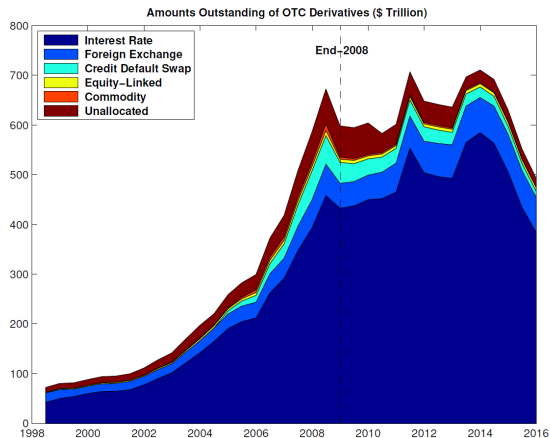
# Outline

- Global OTC derivatives: notional amounts \$640T and gross market value \$12.1T.
  - ▶ An important component of the market infrastructure.
  - ▶ The preferred hedging instruments for interest-rate and currency risks.
- Interest-rate swaps, notional amounts of \$524T.
  - ▶ Reference floating rates: LIBOR and SOFR.
  - ▶ TED spread: 3M LIBOR minus 3M Treasury bill.
  - ▶ Swap spread: swap rate minus Treasury yield of the same maturity.
- Mortgage lenders and their interest rate exposures:
  - ▶ The prepayment options by mortgage borrowers.
  - ▶ Negative convexity of MBS.
  - ▶ Hedging interest-rate exposures using interest-rate swaps.
  - ▶ Mortgage lenders in 2020.

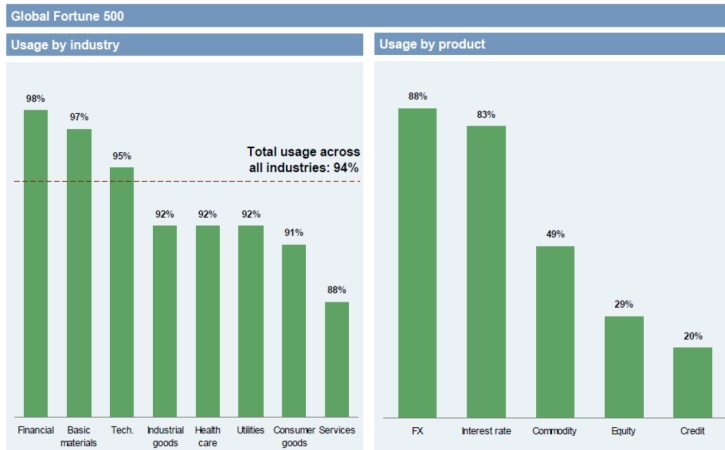
# Modern Finance: Theory, Practice, and Lessons



# Global OTC Derivatives



## Derivatives Usage by Global Fortune 500 Firms



Source: ISDA 2009 Survey

# Interest Rate Swaps



Ticker: DES

Benchmarked against  
USD 3m Libor  
- Quarterly  
- ACT / 360

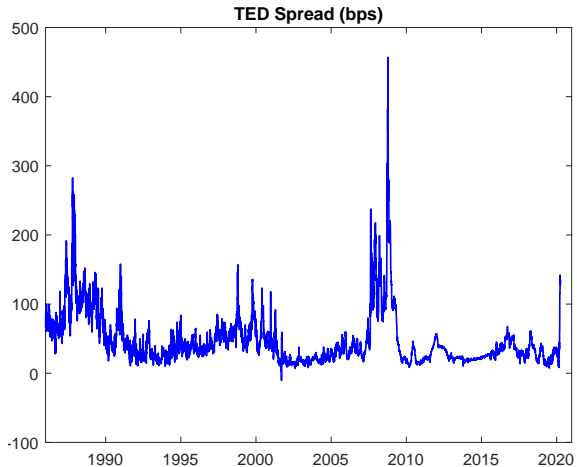
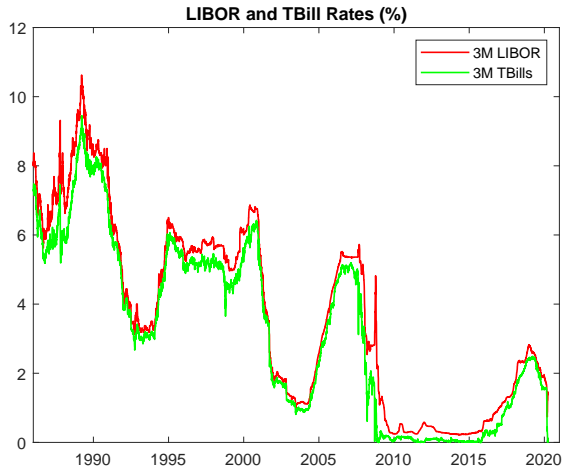
5Y Swap Rate:  
2.417% (p.a.)  
- Semi-Annual  
- 30/360

# Interest-Rate Swap Pricing

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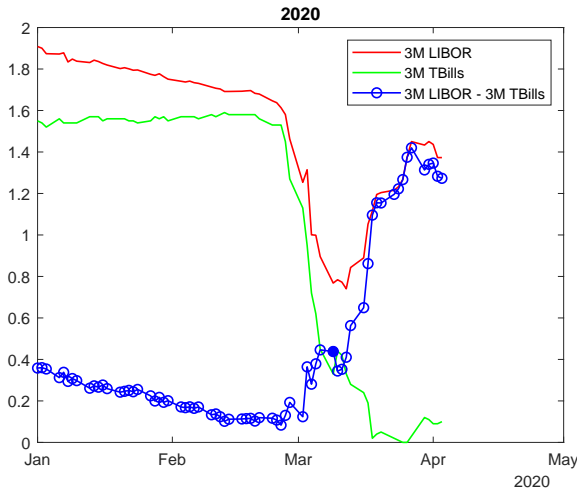
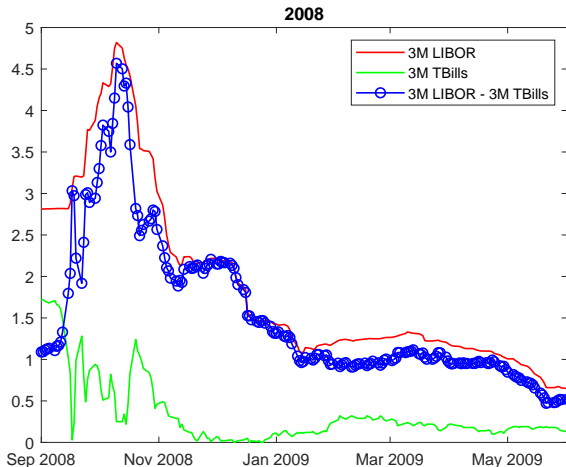
**Fixed**  
**Floating**

# TED Spread: 3M LIBOR - 3M Treasury Bills

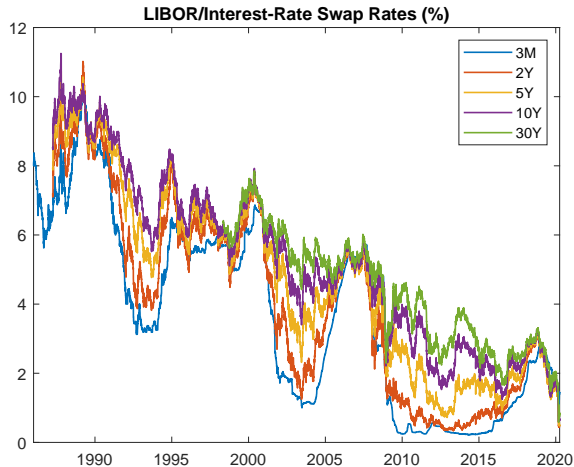
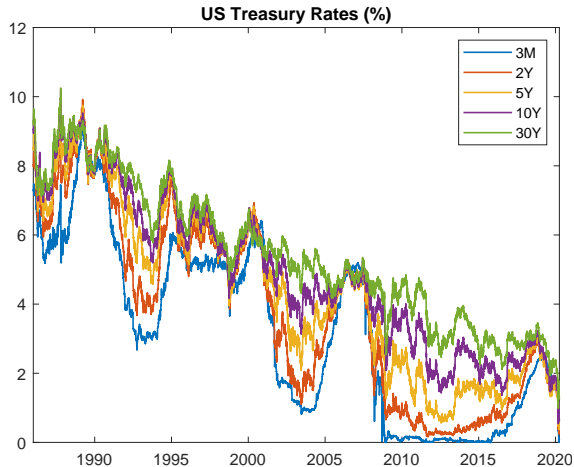




# TED Spreads in 2008 and 2020



# LIBOR/IRS and UST Curves



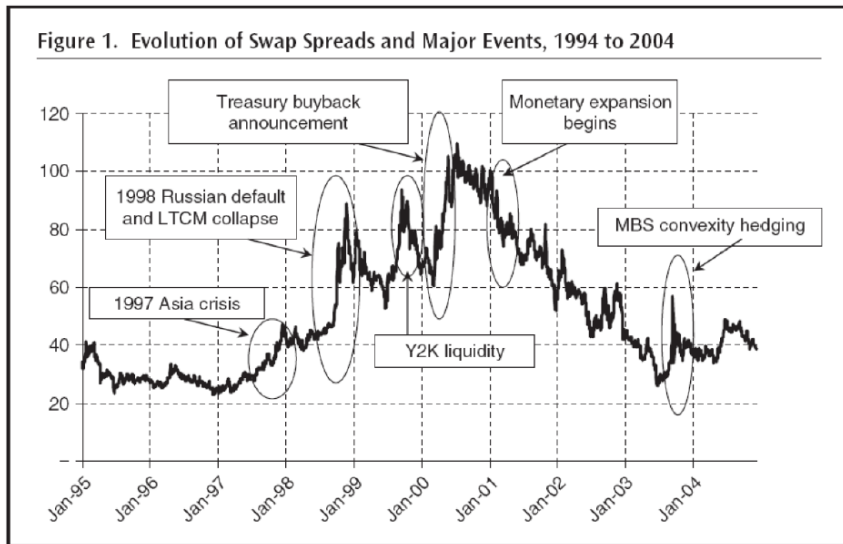
## Exposure to Counterparty Risk in OTC Derivatives

- At inception, swaps have zero dollar value to either parties.
- Interest rates fluctuate during the life of a swap:
  - ▶ Swap value turns positive for one counterparty and negative to the other.
  - ▶ The positive-value counterparty now has a credit exposure to his counterparty.
  - ▶ The total sum is always zero.
- To limit such counterparty credit risk:
  - ▶ Marked to the market on a monthly/daily basis.
  - ▶ Ask the negative-value counterparty to post collateral (cash or Treasury bonds).
  - ▶ Minimum rating requirements for counterparties.
  - ▶ Weaker counterparties: denied access or tighter collateral requirements.
  - ▶ Tightened collateral requirements in the event of a downgrading.

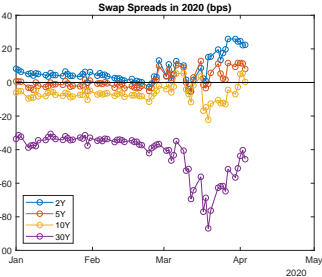
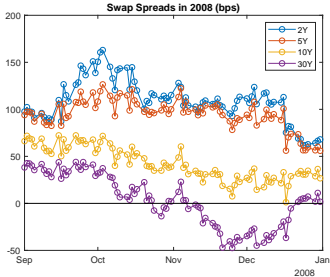
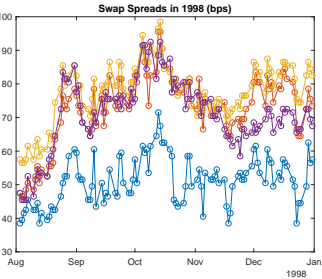
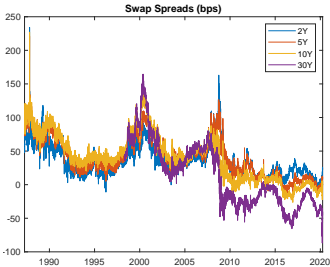
# Determinants of Swap Spreads

- Counterparty risk
- Credit risk
  - ▶ The spread of three-month LIBOR (unsecured borrowing) over three-month general collateral term repo (secured borrowing).
  - ▶ The AA credit spreads
- Liquidity convenience yield of treasury bonds
  - ▶ On-off-the-run treasury bond yield differential
- Treasury supply
- Mortgage backed securities (MBS) and hedging activities

# Swap Spread and Major Events



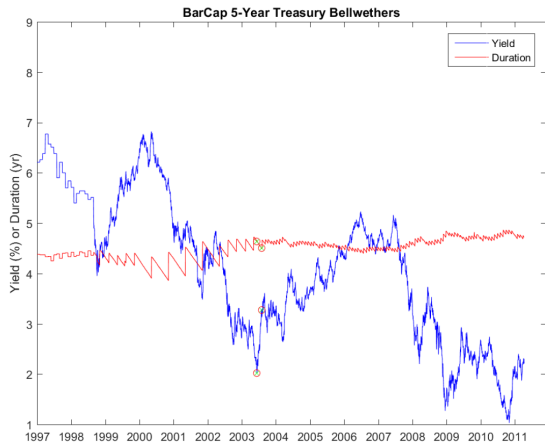
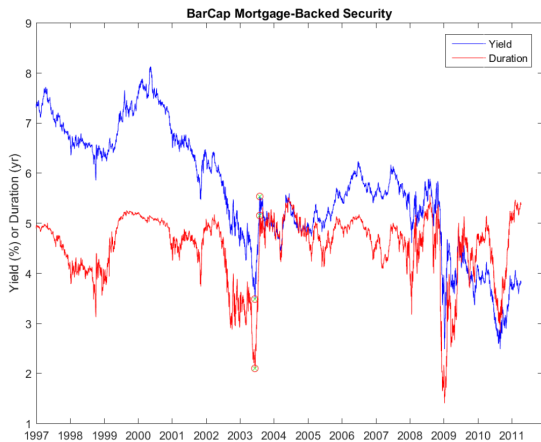
# Swap Spreads



## MBS Negative Convexity Hedging

- Mortgage borrowers in the US have the option to prepay:
  - ▶ Falling interest rates leads to increased re-financing activities.
  - ▶ With higher probabilities of prepayment, MBS duration shortens.
- Convexity: the direction and speed at which duration moves with interest rates.
- With falling interest rates:
  - ▶ MBS: shortening duration. Negative convexity.
  - ▶ Treasuries: lengthening duration. Positive convexity.
- GSEs (Fannie Mae and Freddie Mac) are the largest buyers of US mortgages:
  - ▶ Their objective: minimize interest-rate exposures by shrinking the duration gap.
  - ▶ Use interest rate swaps and other OTC derivatives (swaptions, floors, caps):
    - ★ Falling interest rates: buy duration via adding receive-fixed.
    - ★ Increasing interest rates: off load duration via adding pay-fixed.

# Yield and Duration, MBS vs UST





# Risk Management Derivatives, Fannie Mae 2010 10K

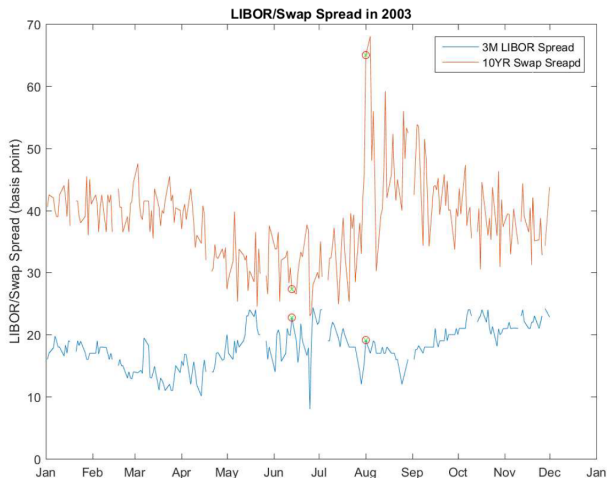
	Interest Rate Swaps				Interest Rate Swaptions		Interest Rate Caps	Futures	Other <sup>(5)</sup>	Total
	Pay-Fixed	Receive-Fixed <sup>(2)</sup>	Basis <sup>(3)</sup>	Foreign Currency <sup>(4)</sup>	Pay-Fixed	Receive-Fixed				
	(Dollars in millions)									
Notional balance as of										
December 31, 2008	\$ 546,916	\$ 451,081	\$ 24,560	\$ 1,652	\$ 79,500	\$ 93,560	\$ 500	\$ —	\$ 827	\$ 1,198,596
Additions	297,379	279,854	2,765	577	32,825	19,175	6,500	—	13	639,088
Terminations <sup>(6)</sup>	(461,695)	(455,518)	(24,100)	(692)	(13,025)	(37,355)	—	—	(92)	(992,477)
Notional balance as of										
December 31, 2009	\$ 382,600	\$ 275,417	\$ 3,225	\$ 1,537	\$ 99,300	\$ 75,380	\$ 7,000	\$ —	\$ 748	\$ 845,207
Additions	212,214	250,417	55	636	51,700	51,025	—	598	—	566,645
Terminations <sup>(6)</sup>	(317,587)	(301,657)	(2,795)	(613)	(53,850)	(47,790)	—	(353)	(59)	(724,704)
Notional balance as of										
December 31, 2010	\$ 277,227	\$ 224,177	\$ 485	\$ 1,560	\$ 97,150	\$ 78,615	\$ 7,000	\$ 245	\$ 689	\$ 687,148
Future maturities of notional amounts: <sup>(7)</sup>										
Less than 1 year	\$ 70,656	\$ 14,200	\$ 50	\$ 386	\$ 20,750	\$ —	\$ —	\$ 125	\$ 75	\$ 106,242
1 to less than 5 years	90,788	168,000	35	—	35,300	4,500	7,000	120	593	306,336
5 to less than 10 years	96,400	29,632	100	511	10,200	20,970	—	—	21	157,834
10 years and over	19,383	12,345	300	663	30,900	53,145	—	—	—	116,736
Total	\$ 277,227	\$ 224,177	\$ 485	\$ 1,560	\$ 97,150	\$ 78,615	\$ 7,000	\$ 245	\$ 689	\$ 687,148

# Interest Rate Sensitivity of Net Portfolio, Fannie Mae 2014

	As of December 31, <sup>(2)</sup>	
	2014	2013
	(Dollars in billions)	
Rate level shock:		
-100 basis points .....	\$ 0.4	\$ 0.1
-50 basis points .....	0.1	0.0
+50 basis points .....	(0.1)	(0.1)
+100 basis points .....	(0.1)	(0.5)
Rate slope shock:		
-25 basis points (flattening) .....	0.0	0.0
+25 basis points (steepening) .....	(0.0)	0.0

	For the Three Months Ended December 31, 2014 <sup>(3)</sup>		
	Duration Gap	Rate Slope Shock 25 bps	Rate Level Shock 50 bps
	(In months)	Exposure	
		(Dollars in billions)	
Average .....	0.1	\$ 0.1	\$ 0.0
Minimum .....	(0.3)	0.0	—
Maximum .....	0.5	0.1	0.1
Standard deviation .....	0.2	0.0	0.0

# MBS Footprints on Swaps



- MBS hedging: 5-10yr IRS.
- Sharp increase in 10yr in 2003:
  - ▶ Sudden spike in MBS duration.
  - ▶ Large amount of fixed-payers.
  - ▶ A temporary liquidity spike in the 10yr swap spread.