



Interest Rate Swaps

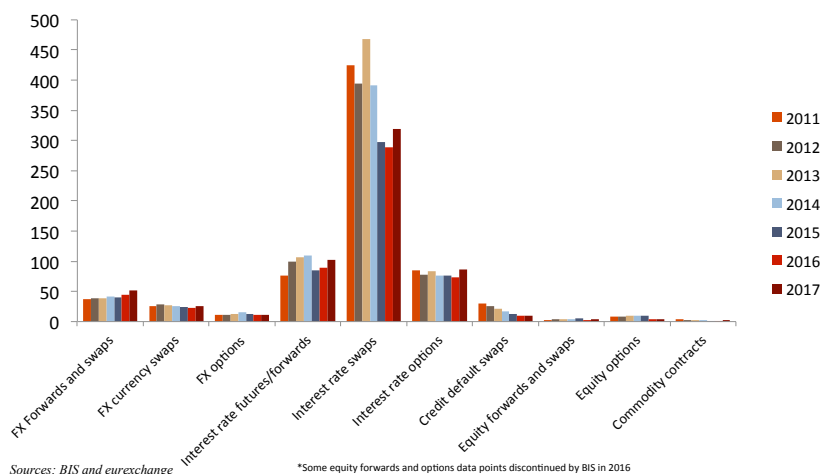
Outline and Reading

- Outline
 - Interest Rate Swap Contract
 - Synthetic Duration
 - Typical Market Participants
 - Swap Rates as Par Rates
 - LIBOR, LIBOR Swaps, LIBOR Swap Spreads
 - Post-Crisis Negative Swap Spreads
 - Limits to Arbitrage
 - China's Developing Interest Rates Swaps Market
 - Reading
 - Tuckman and Serrat, Chapter 16
 - <https://www.moneyandbanking.com/commentary/2017/9/3/eclipsing-libor>
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Interest Rate Swaps Market

The market for interest rate swaps is the biggest derivatives market in the world. This is where interest rate risk, DV01, is traded wholesale.

Notional Amounts of Derivatives Outstanding
\$Trillions



Interest Rate Swap Contract

- An *interest rate swap* commits two counterparties to exchange, over an agreed period, two streams of coupon payments, each calculated using a different interest rate index, but applied to a common notional principal amount.
- A plain vanilla fixed-for-floating swap involves the exchange of semi-annual fixed coupons for floating coupons based on a constant notional principal.
- The **swap rate** is the contractual fixed rate.
- In class, we'll say the fixed receiver is "long" the swap and the fixed payer is "short" the swap.
- As we'll see, swaps are related to floating rate notes and swap markets are related to repo markets.

Basic Swap Cash Flows

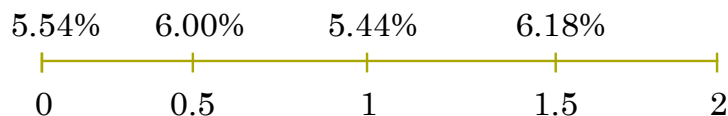
- Every six months until maturity, the party who is long the swap receives a fixed rate k , and pays the 6-month rate set 6-months earlier.
- In practice, in a LIBOR swap, the floating side pays quarterly, but in class, for ease of illustration, we will assume it pays semi-annually.
- If the notional amount of the swap is N and the maturity is T , the time t cash flow to this party is

$$N(k_{t-0.5}r_t)/2 \quad \text{for } t = 0.5, 1, 1.5, \dots, T.$$
- Note that no principal is exchanged.

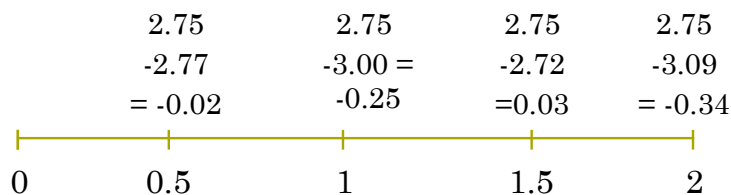


Example: 2-Year 5.5% Swap

- Consider a long position in 5.5% 2-year swap with \$100 notional amount.
- Suppose the future path of 0.5-year rates over the life of the swap turn out as follows:



- What are the cash flows to the long swap position?



Swap = Bond minus Floater

- Consider again the cash flows of the plain vanilla swap with fixed rate k , notional amount N and maturity T :

$$N(k - r_t) \text{ for } t=0.5, 1, 1.5, \dots, T.$$

- These are the same as the cash flows from a portfolio consisting of
 - a long position in a T -year fixed rate note with par amount N and coupon rate k , and
 - a short position in a T -year floating rate note with par amount N .
- The difference between the coupons of the two notes equals the swap payment, and the difference between their principal payments is zero.

$$\Rightarrow \text{swap}(k, T) = \text{fixed rate note}(k, T) - \text{floating rate note}$$

Swap Value and “Synthetic Duration”

- Swap = Long a fixed rate bond, short a floater.
- This model completely determines the swap value and interest rate risk:
 - \Rightarrow Swap value = Bond value – Floater value
 - \Rightarrow Swap value = Bond value – Par
 - \Rightarrow Swap \$Dur = Bond \$Dur – Floater \$Dur
- Example: Consider \$100 par of each security below.

Debt Instrument	Price	Duration	\$Dur
30-year 4%-coupon bond	100	17	1700
Floater ~ 0.5-yr par bond	100	~0.5	50
30-year 4% swap	0		1650

- The swap is essentially a levered bond position.
- Trading in swaps allows institutions to adjust interest rate exposure without moving capital.

Class Problem

- Consider \$100 par of each security below.


Debt Instrument	Price	Duration	\$Dur
30-year 4%-coupon bond	100	17	1700
Floater ~ 0.5-yr par bond	100	~0.5	50
30-year 4% swap	0		1650

- At inception, the swap is worth zero.
- What will this swap be worth if rates rise 100 bp?


Typical Swap Market Participants

- **Banks** with long-term assets (loans) and short-term liabilities (deposits) sell swaps (DV01) to hedge interest rate risk.
- **Corporate bond and mortgage funds** also use swaps to hedge interest rate risk and isolate bets on credit, volatility, and prepayment.
- **Pension funds** buy swaps to hedge their long term liabilities (active and retired lives).

Swap Rates as Par Rates

- The fixed rate in the swap is called the **swap rate**.
- The swap rate in a newly negotiated swap is set to make the contract worth zero at inception.
- Recall: $\text{Swap}(k, T) = \text{Fixed rate note}(k, T) - \text{Floater}$
- Recall: The value of the floater is par.
- So to make the swap worth zero, the swap rate must make the fixed rate bond worth par as well:
- New $\text{swap}(T) = \text{Par bond}(T) - \text{Floater}$
because only then do you get $0 = 100 - 100$.
- ⇒ The swap rate must be the par rate for maturity T .
- ★ But swap rates don't match Treasury rates—why? 

LIBOR and LIBOR Swaps

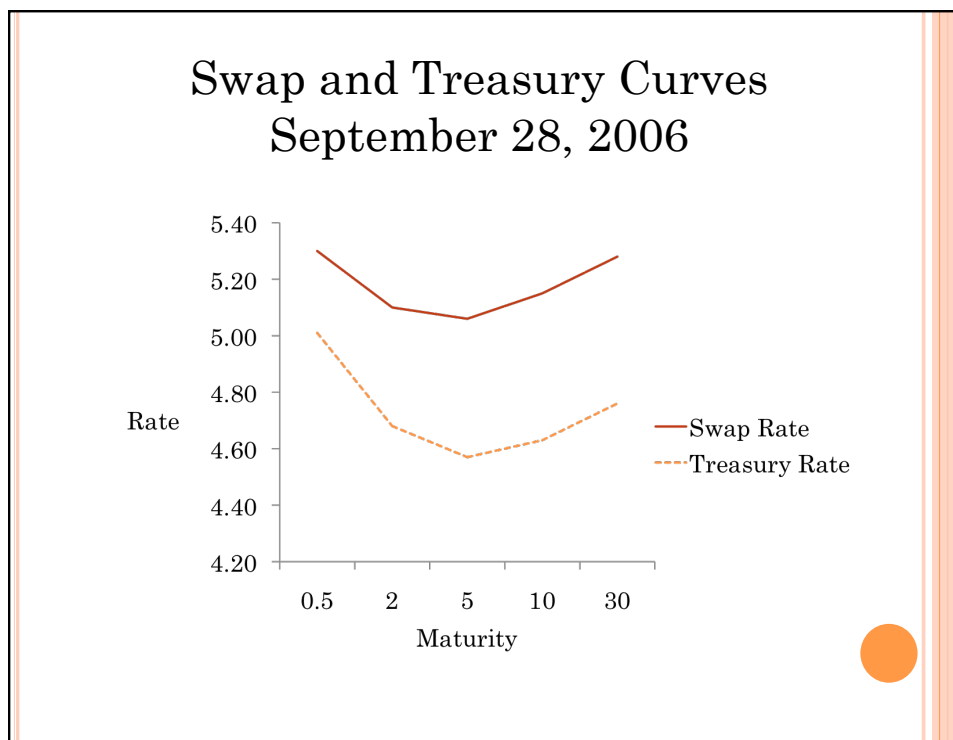
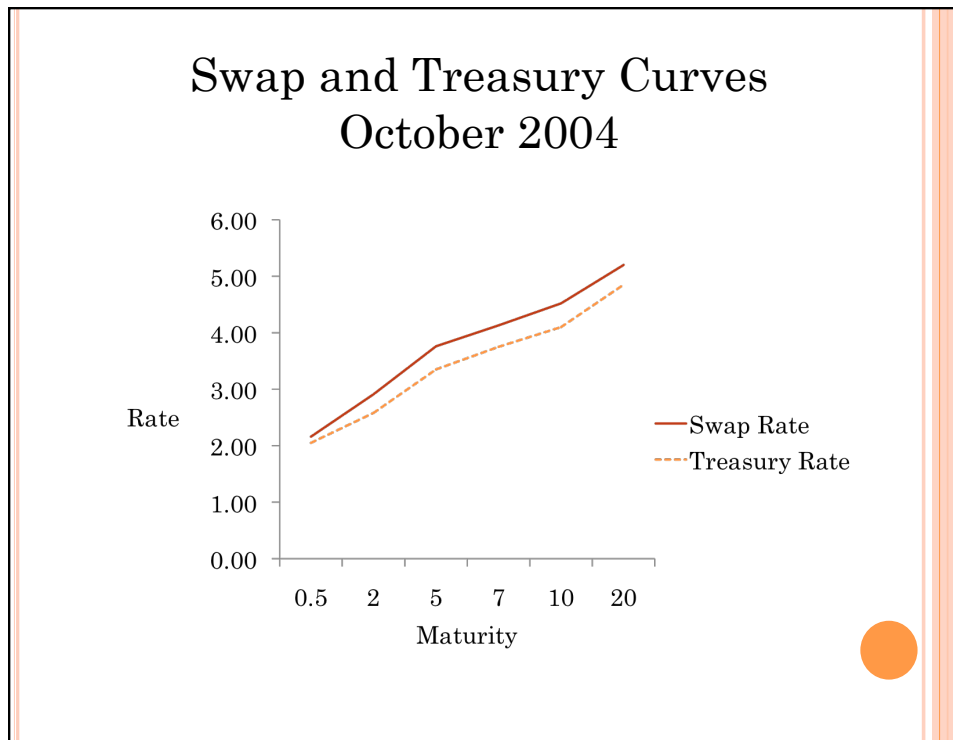
- So far, we have assumed that the floating rate in the swap is the riskless 6-month rate.
- In a LIBOR swaps, which are the most standard, the floating rate is LIBOR, the so-called London Interbank Offered Rate (typically 3-month LIBOR vs. semi-annual fixed payments).
- ICE LIBOR (formerly BBA LIBOR) is the average of the middle 9 of the quoted short-term borrowing rates of 17 Contributor Banks:
- See <https://www.theice.com/iba/libor> for the current list of contributor banks. 

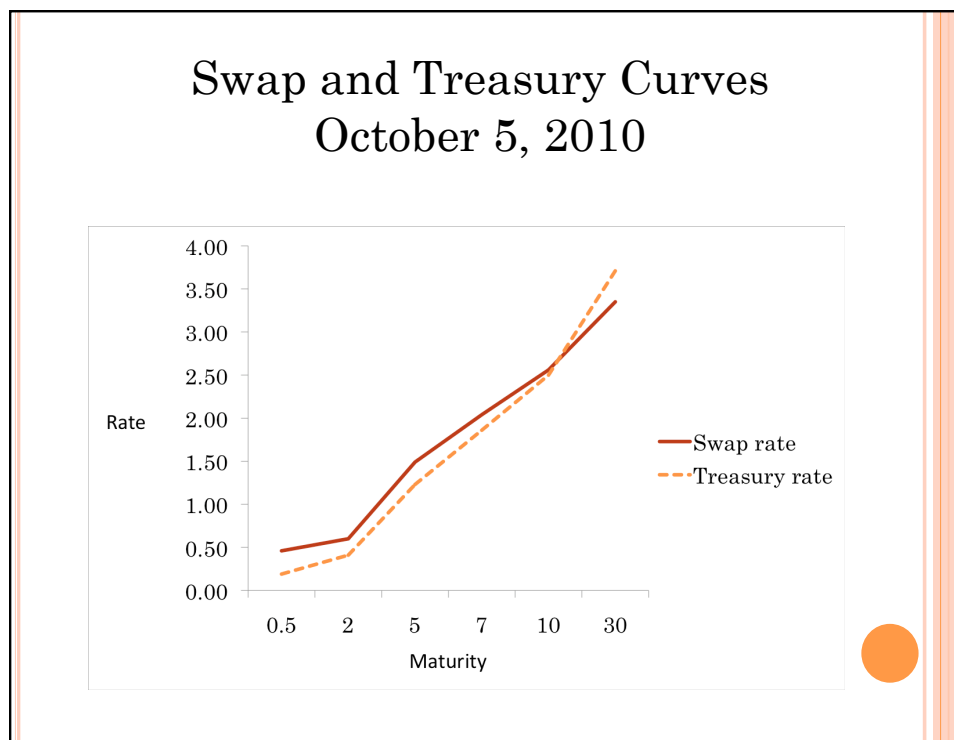
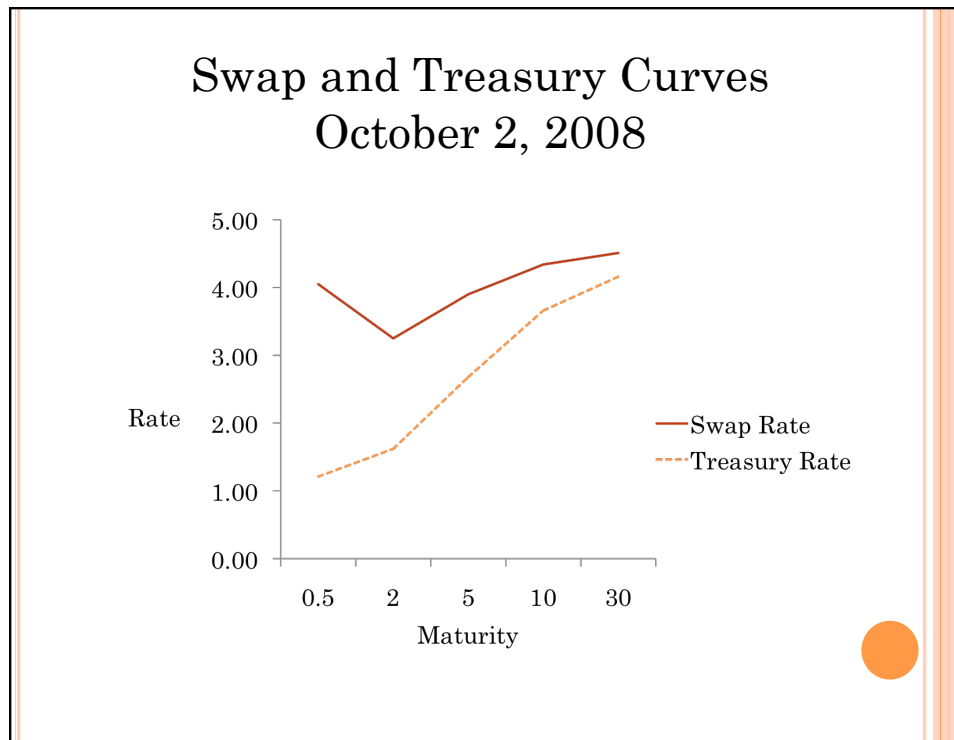
LIBOR Scandal and Reform

- LIBOR is the basis of an wide range of financial instruments, including mortgages, Eurodollar futures, and interest rate caps, as well as swaps.
- Revelations in 2012 by Barclays regarding manipulation of LIBOR quotes sparked a broad investigation of quoting practices at contributor banks and lead to large fines: Barclays £290M, UBS \$1.5B, RBS £390M, ICAP...
- The UK Financial Services Authority moved control of LIBOR to ICE NYSE Euronext in Feb 2014.
- Economists and regulators have called for replacing the existing LIBOR with a rate based on actual trades.
- Challenges – Trade-based rates are less prone to manipulation but may not reflect user funding costs as well as quotes? On the other hand, banks might refuse to participate in surveys because of legal risk?

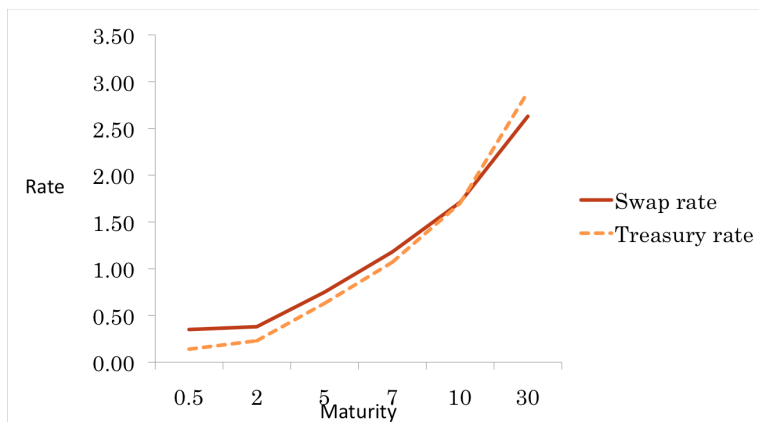
LIBOR Swap Spreads

- LIBOR swap rates (the fixed rate in the swap) differ from Treasury rates. See, for example, swap rates here: <http://www.interestrateswapstoday.com/swap-rates.html> and constant-maturity par Treasury rates here: <https://www.federalreserve.gov/releases/h15/>
- The conventional wisdom is that in the absence of arbitrage, the LIBOR swap rate for a given maturity should **exceed** the Treasury rate for the same maturity.
- This is because the fixed swap rate is in exchange for floating LIBOR, which is an average of banks **uncollateralized** short-term borrowing rates.
- By contrast, we can think of the Treasury rate as the fixed rate in a synthetic swap constructed by buying a Treasury and funding it with **repo**, a **collateralized** borrowing rate which is thus **lower** than LIBOR.
- In the “synthetic Treasury swap” the floating rate is lower, so the fixed Treasury rate should also be lower...?

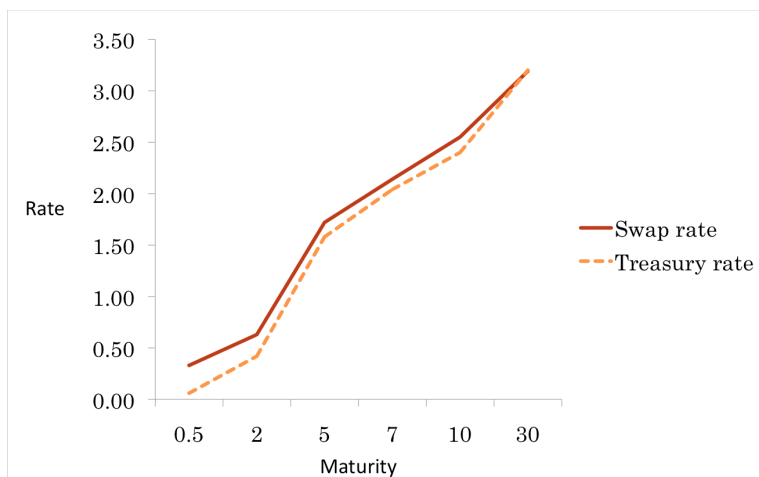




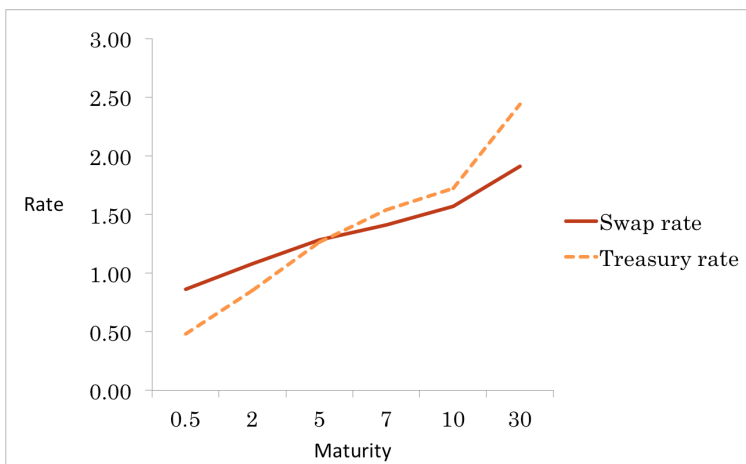
Swap and Treasury Curves October 4, 2012



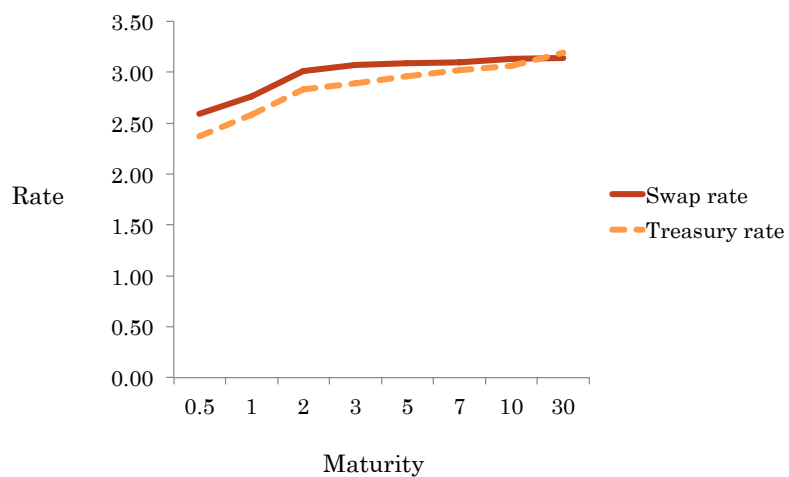
Swap and Treasury Curves August 14, 2014



Swap and Treasury Curves October 6, 2016



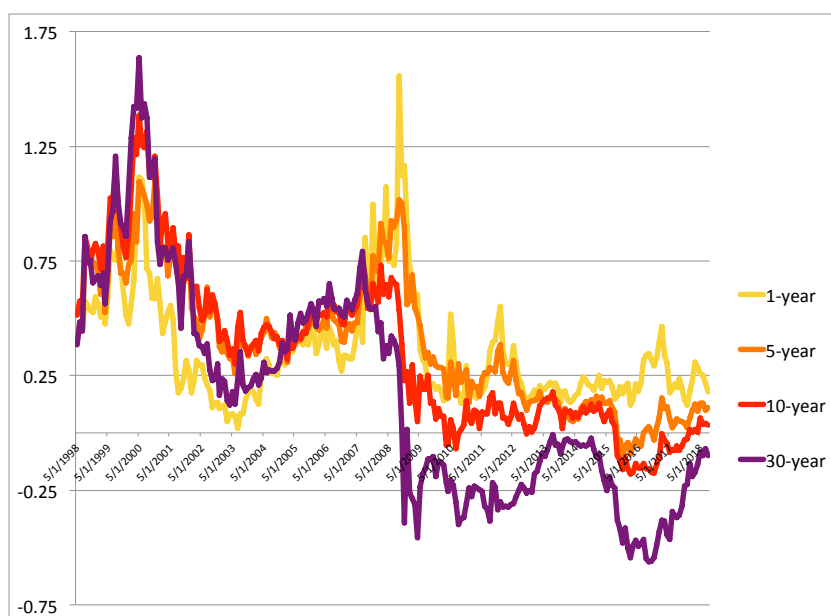
Swap and Treasury Curves September 27, 2018



LIBOR Swap Spread Puzzle

- If c_T is the Treasury par rate to swap for T years of floating repo (${}_0r_{0.5}, \dots, {}_{T-0.5}r_T$)
- And k_T is the fixed LIBOR swap rate to swap for T years of floating Libor (${}_0L_{0.5}, \dots, {}_{T-0.5}L_T$)
- And $L_t = r_t + \text{floating spread}_t$ where floating spread $_t > 0$ because uncollateralized rate $>$ collateralized rate
- Then the swap rate $k_T = c_T + \text{“swap spread}_T”$, where the swap spread for maturity T is the fair *fixed spread* to exchange for the *floating Libor spread* s_t .
- How can this ever be negative?

Swap Spreads 1998-2018



Negative Swap Spreads at Long Maturities —An Arbitrage Opportunity?

- After the financial crisis, the 30-year swap spread plunged negative and has mostly remained since.
 - The 10-year swap spread also went negative.
 - Is this an arbitrage opportunity?
 - The *apparent* arbitrage trade would be to
 1. buy the long Treasury => $+c_T$
 2. finance it with short-term repo => $-r_t$
 3. enter into a swap paying fixed and receiving floating LIBOR => $-k_T + L_t$
- ⇒ Net flow = $c_T - k_T + L_t - r_t$, always > 0 ???

Limits to Arbitrage

- This “arbitrage trade” would have to be held until maturity, consuming “balance sheet” and relying on continually smooth functioning of the repo markets, which seized up during the crisis.
- So the spread this trade generates may be fair compensation for refinancing risk.
- Accounting standards and bank capital requirements treat the swap and financed Treasury positions differently, so swaps and levered bond positions are effectively different and partially segmented markets.
- Long-term investors such as pension funds prefer hedging with swaps, in which leverage is already built in, rather than managing a levered bond position that could violate fund leverage constraints.

Evidence from Klingler and Sundaresan (2016) An Explanation of Negative Swap Spreads: Demand for Duration from Underfunded Pension Plans

Figure 1:
Term structure
of interest rate
swap spreads

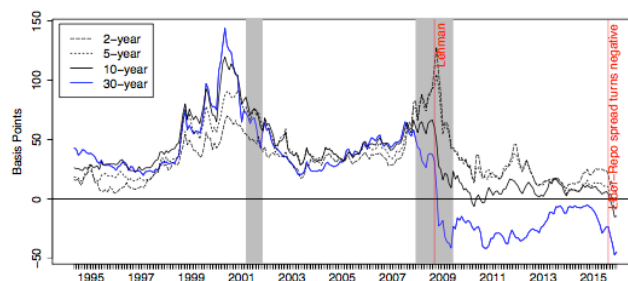
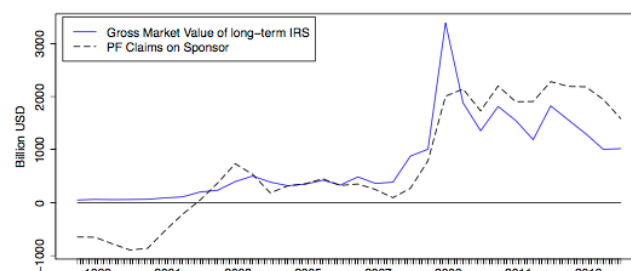


Figure 2:
Size of
pension
liabilities and
long-term
interest rate
swaps



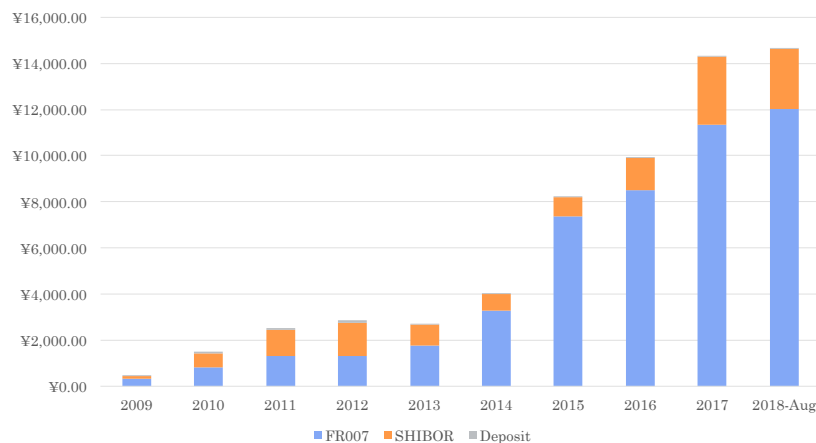
Transition from LIBOR to SOFR

- USD LIBOR benchmarking is becoming increasingly problematic.
- Unsecured cash borrowing by banks is down post-crisis-regulation, replaced by secured funding, leaving fewer transactions on which to base LIBOR quotes, making them more subject to manipulation.
- Banks are increasingly reluctant to contribute quotes that can subject them to legal risk.
- In 2014, the Fed convened the Alternative Reference Rates Committee. It has recommended the Secured Overnight Financing Rate (SOFR) as an alternative benchmark rate, which is based on a blend of Treasury repo rates, with \$750 billion in daily transactions.
- In May 2018 the Chicago Mercantile Exchange launched futures linked to SOFR and began clearing SOFR swaps.
- SOFR would be good for derivative users focused on hedging default-free interest rate risk, but not for those who aim to hedge bank credit risk or “funding risk.”
- The big open question is how existing LIBOR-based contracts would be settled or converted to SOFR. \$200 trillion swaps in question.
- Authorities have promised to support LIBOR only until 2021.

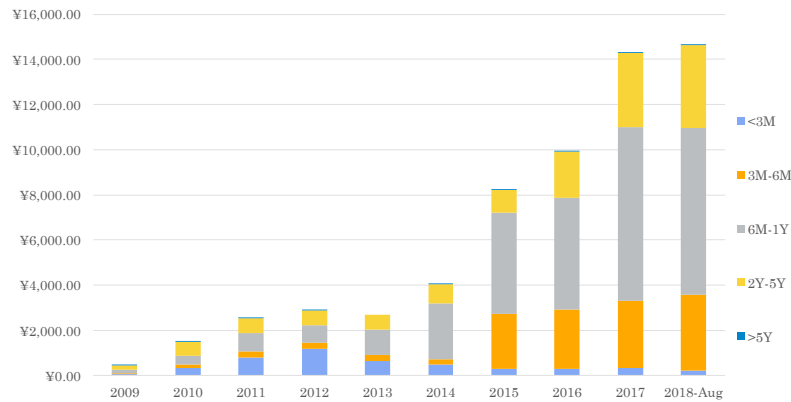
China's Developing IR Swaps Market

- Introduced by the PBoC in 2006, for access only by domestic banks, it has opened up to bank clients and other financial institutions with access to China's interbank bond market.
- Notional outstanding has grown to over \$2.1 trillion.
- FR007 Repo and SHIBOR are the main benchmarks.
- Short IRS maturities, typically less than 1-year, driven by bank demand for hedging money market products.
- Liquidity is improving, with bid-ask spreads falling.
- Likely to become more important with increased interest rate liberalization and bond market development.

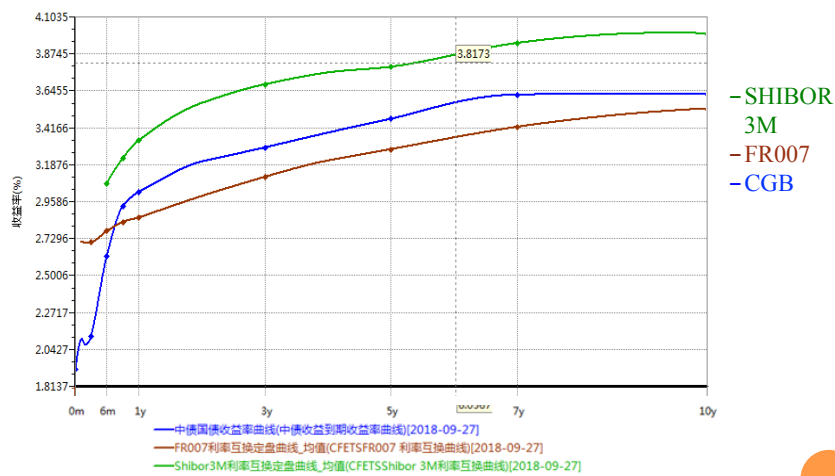
Notional Principal Amount Traded by Benchmark (CNY Billions)



Notional Principal Amount Traded by Maturity (CNY Billions)



Term Structure of China's Swap Rates September 27, 2018



数据来源: Wind

