Interest Rate Swaps

Concepts and Buzzwords

- Swaps
- Swap Spreads
- Credit Risk of Swaps
- Swap Spreads vs. Credit Spreads
- Counterparty
- Notional amount
- Plain vanilla swap
- Swap rate
- Synthetic Duration

Readings

- Veronesi, Chapter 5
- Tuckman, Chapter 18
- Krishnamurthy, "How Debt Markets Have Malfunctioned in the Crisis"

Description of a Swap

- An *interest rate swap* is a contract which commits two counterparties to exchange, over an agreed period, two streams of interest payments, each calculated using a different interest rate index, but applied to a common notional principal amount.
- A plain vanilla or generic swap is a fixed-for-floating swap with constant notional principal, constant fixed interest rate, floating 6-month interest rate, and semi-annual payments.
- The *swap rate* is the quoted fixed rate.

Which Side is Which?

- Institutionally, we can just call one counterparty the fixed payer and one counterparty the fixed receiver.
- For valuation, duration, and swaption analysis, it is convenient to identify one side as long the swap and the other short the swap.
- We'll say the fixed receiver is long the swap and the fixed payer is short the swap.
- Some people use the opposite convention.

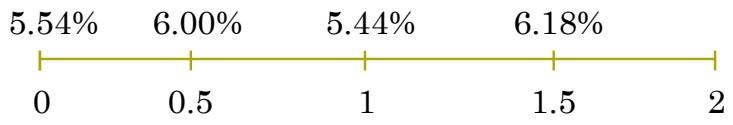
Swap Cash Flows

- 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.
- If the notional amount of the swap is N and the maturity is T, the time t cash flow to this party is

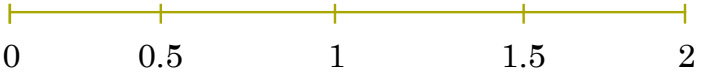
  $N(k - {}_{t-0.5}r_t)/2$ for $t = 0.5, 1, 1.5, \ldots, T$.
- Note that no principal is exchanged.

Class Problem

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



- What are the cash flows to long swap position?



Swap as Bond minus Floater

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

  $N(k - {}_{t-0.5}r_t)/2$ for t=0.5, 1, 1.5, …, 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.

⇒swap(k, T) = fixed rate note(k, T) – floating rate note

Swap Value and Interest Rate Risk

- Swap = Long a fixed rate bond, short a floater
- Swap value = value of bond – value of floater

  = value of bond – 100
- Swap dollar duration = dollar duration of bond – dollar duration of floater
- Swap dollar convexity = dollar convexity of bond – dollar convexity of floater

Example:
$100 Notional of a 2-Year 5.5% Swap

Security	Price	$Dur	Duration
2-Year 5.5% Coupon Bond	100.0019	187	1.87
Floater	100	49	0.49
2-Year 5.5% Swap	0.0019	138	

Swaps and Synthetic Duration

- Swaps are a low-maintenance way to take a levered position in a bond, because the funding/leverage is built in.
- They can be used to hedge bond positions or other long-term fixed income assets or liabilities.
- For example, pension funds with long-term liabilities might hold equities and then hedge interest rate risk by layering on "synthetic duration" at no cost with a swap.

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Class Problem

Use the data below to calculate the value and dollar duration of a 1.5-year 5% swap

Security	Price	$Dur	Duration
$1 Par 0.5-yr zero	0.973047	0.4734	0.49
$1 Par 1-yr zero	0.947649	0.9225	0.97
$1 Par 1.5-yr zero	0.922242	1.3465	1.46

$100 Par 1.5-yr 5% Bond			
$100 Par Floater			
$100 Not'l 1.5-yr 5% Swap			

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: swap(k, T) = fixed rate note(k, T) – floater
- The value of the floater is par.
- To make the swap worth zero, the swap rate must make the fixed rate bond worth par as well.
- The swap rate must be the par rate for maturity T.

⇒New swap(T) = Par bond(T) – Floater

because only then do you get 0 = 100 – 100.

Example

- Recall the 2-year swap with fixed rate 5.5% is worth 0.0019 per $100 notional amount:
  - The 2-yr 5.5% bond is worth 100.0019
  - The floater is worth 100
  - swap value = 100.0019 - 100 = 0.0019
- To make the swap worth exactly zero, the swap rate must be set equal to the par rate for 2 year maturity:
  - 2-year par rate = 2(1-0.897166)/ (0.973047+0.947649+0.922242+0.897166) = 5.499%

Swap-Based Products

- Forward Swap: The swap begins at some specified future date with the terms set in advance (mutually binding)
- Amortizing Swap: Notional amount of swap, and thus, the size of the coupon payments, changes over time according to a schedule.
- Zero Swap: There is no exchange of payments until maturity. Then a fixed amount of accumulated interest is exchanged for interest that has accumulated at the floating interest rate.
- Swaption: An option on a swap, usually with strike price 0, i.e., the right to enter into a swap with specified terms at some future date.
- Putable Swap: The fixed interest receiver has the right to cancel the swap before maturity (the premium for the cancelation option is paid up front)
- Callable Swap: The fixed interest payer has right to cancel the swap before maturity (premium paid up front)

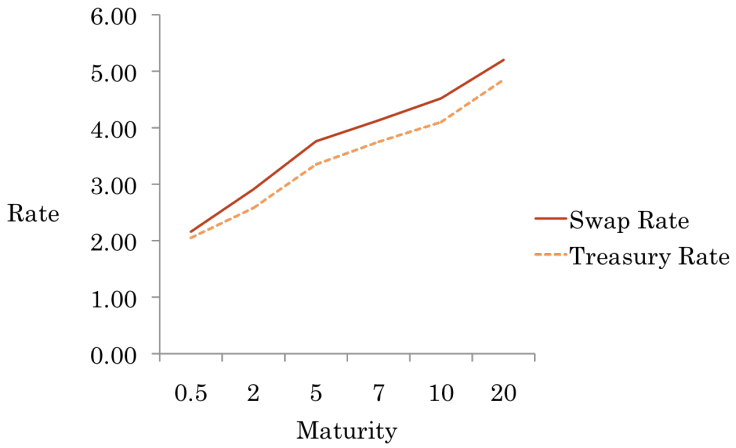
LIBOR and LIBOR Swaps

- So far, we have assumed that the floating rate in the swap is the riskless 6-month rate.
- In practice, the floating rate is typically LIBOR, London Interbank Offered Rate (typically 3-month LIBOR vs. semi-annual fixed payments).
- LIBOR is the average of the middle 8 of the quoted short-term borrowing rates of 16 contributor banks identified by the British Bankers Association:
  - Bank of America, Bank of Tokyo-Mitsubishi UFJ, Barclays, Citibank, Credit Suisse, Deutsch Bank, HBOS, HSBC, JPMChase, Lloyds, Rabobank, Royal Bank of Canada, Norinchukin, Royal Bank of Scotland, UBS AG, WestLB

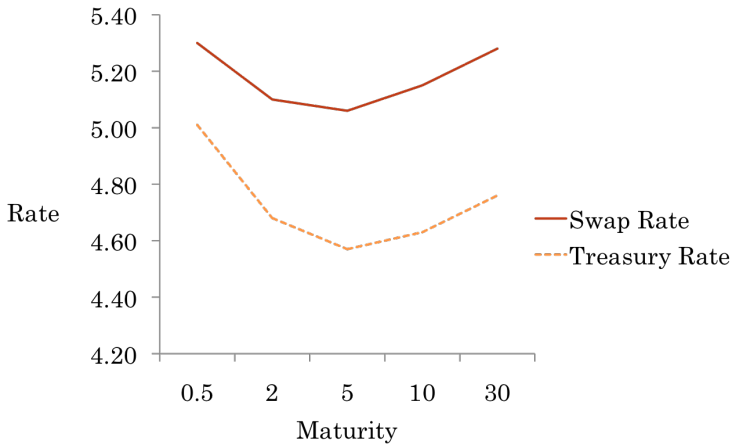
LIBOR Swap Spreads

- The borrowing rates of these banks reflect default and liquidity risk and thus are higher than riskless (Treasury) short-term rates.
- The spread of 3-month LIBOR over 3-month T-Bill rates is called the TED spread.
- Thus, in a LIBOR swap, the floating payments are the 3-month riskless rate plus the TED spread.
- Therefore, even if the counterparties are default-free, the fixed rate in a LIBOR swap must include a fixed spread over the riskless (Treasury) par rate, to compensate for the floating TED spread.
- In other words, the LIBOR swap is a swap of
  - fixed riskless par rate for floating riskless 3-month rate, and
  - fixed swap spread for floating TED spread.

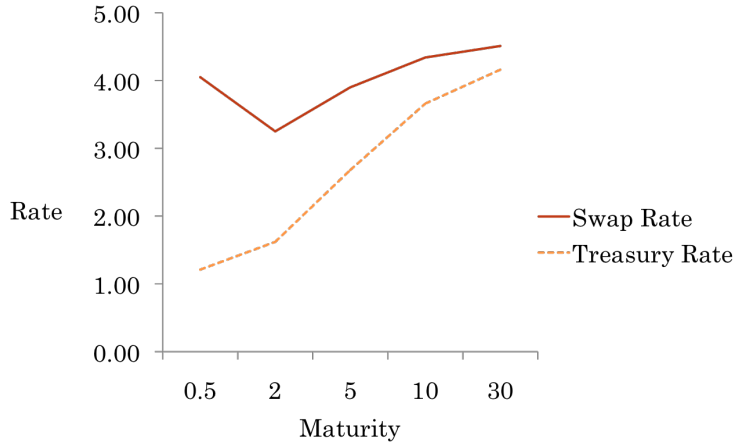
Swap and Treasury Curves October 2004



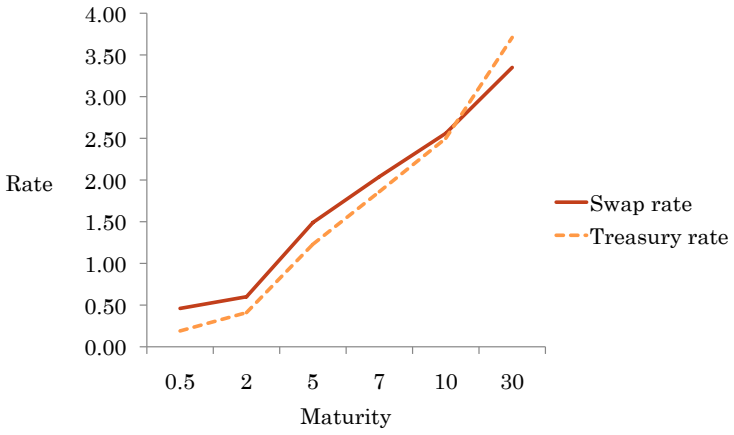
Swap and Treasury Curves September 28, 2006



Swap and Treasury Curves
October 2, 2008



Swap and Treasury Curves
October 5, 2010



Why Does the Swap Spread Vary with the Swap Maturity?

- The counterparties are not only exchanging fixed riskless coupons for floating riskless coupons but also fixed spreads for floating spreads.
- The long side receives a fixed swap spread in exchange for the floating spread in the LIBOR rate over the life of the swap.
- The fair fixed spread to receive depends on the swap maturity for the essentially same reason that the par rate varies with maturity—differing expectations and uncertainties about the path of the floating spread over different time horizons.

Negative Swap Spreads at Long Maturities?

- Since the financial crisis, long maturity swap rates have been lower than Treasury rates—a puzzle?
- The apparent arbitrage trade would be to buy the long Treasury, finance it by borrowing at short-term repo rates, and simultaneously enter into a swap paying fixed and receiving floating LIBOR.
- But this position 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 just be fair compensation for refinancing risk.
- At the same time, long-term investors such as pension funds may prefer hedging with the synthetic duration of swaps, in which leverage is already built in, rather than explicitly managing a levered bond position that could also violate fund leverage constraints.

Swap Spreads and Credit Risk

- The swap spread is not a credit spread in the usual sense.
- The fixed swap spread is compensation for the floating spread in LIBOR over T-Bills, or repo rates.
- It is not because of the risk of default by one of the swap counterparties--it would be there even if the counterparties were default-free. Note that the swap dealer could be on either side of the swap, so he could be receiving the spread just as well as paying it.
- Counterparty credit risk is controlled in other ways:
- Dealers won't transact with really poor credits.
- Credit triggers are provided which force a downgraded counterparty to settle his side of the swap at market rates.
- In any case, the value at risk is much smaller than the swap notional amount since the swap is a combined long-short position.

Long Swap Spreads vs. Long Credit Spreads (The Term Structure of Credit Spreads)

- A conventional wisdom in corporate borrowing is that poorer credits have a comparative advantage issuing shorter term debt and rolling it over because they pay a lower credit spread on short-term debt than on longer term debt.
- Some propose that these firms can manufacture cheaper fixed rate debt by rolling over short-term borrowing and then converting it to fixed by entering into a swap in which they pay fixed and receive floating.
- But this is not riskless. This "term structure of credit spreads" that risky borrowers face reflects default risk over the life of the bond.

Example: Swap Rates vs. Bond Yields of LIBOR Borrowers

- Consider the borrowing rates of LIBOR borrowers. By definition, the spread of their short-term debt over LIBOR is zero.
- But their long-term fixed-rate bond yields are 150-275 basis points over swap rates.
- Why can't these issuers just synthesize long-term fixed at the swap rate by rolling short-term LIBOR loans and swapping it to fixed?

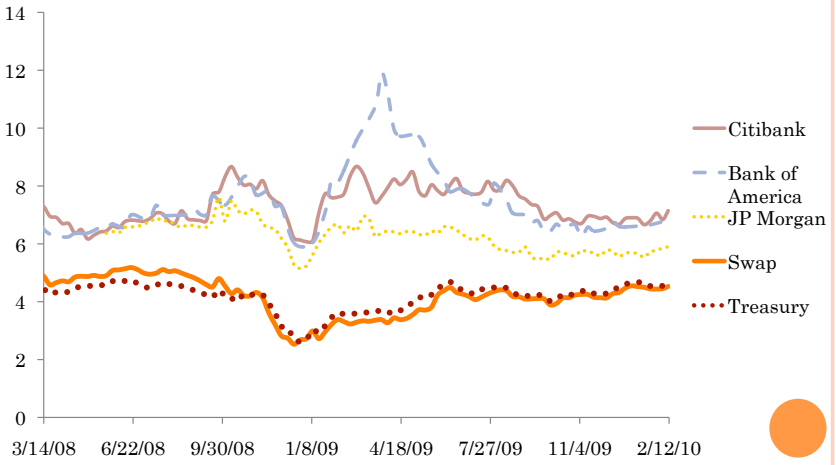
Issuer	10-Year Rate	30-Year Rate
Swap Rate	2.85	3.70
Barclays	4.32	
JPMorgan	4.40	5.32
Credit Suisse	4.73	
B of A	5.12	6.42
Citibank	5.31	6.45

Risks in Converting Floating to "Fixed"

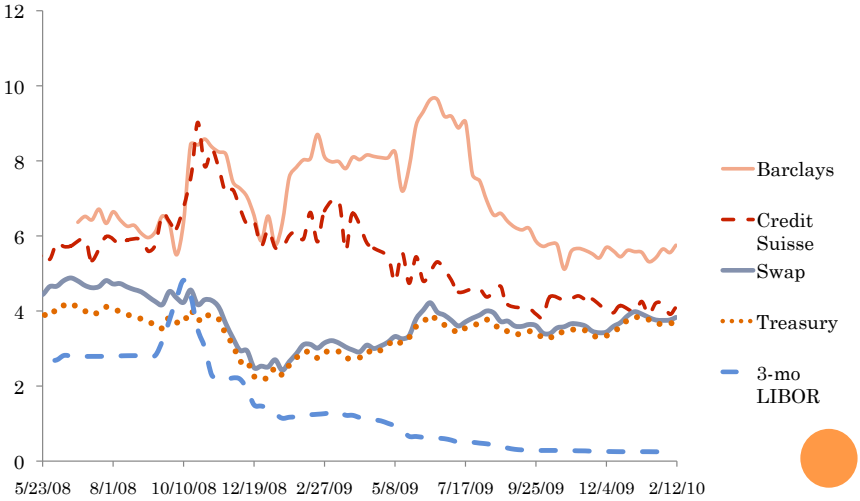
- Consider an institution that currently can borrow short-term at LIBOR.
- It is typically the case that this institution's long-term fixed rate bond yield is higher than the swap rate.
- Example: Citibank's 30-year bond yield was 6.45% in August 2010.
- The 30-year swap rate was 3.70%.
- Suppose this institution follows a strategy of rolling over 3-month loans at LIBOR, and entering into a 30-year swap to pay fixed, receive LIBOR. Has it synthesized 3.70% fixed?
- synthetic "fixed" rate

  = swap rate + 3-mo borrowing rate – LIBOR
- The institution's net borrowing rate will rise if its credit quality worsens and its short borrowing rate rises.

Bond Yields and Swap Rates: 30-Year Maturities



Bond Yields and Swap Rates: 10-Year Maturities



Swap Spreads vs. Credit Spreads

- LIBOR borrowers pay zero over LIBOR for short debt, by definition. But their long-term borrowing rates are much higher than swap rates.
- The long-term bond spread of a LIBOR borrower reflects the possibility that that borrower's credit quality could deteriorate, and that that borrower could cease to be a LIBOR borrower or even default, over the life of the loan.
- Of course the borrower's credit could also improve, but its 3-month borrowing rate couldn't go below T-Bill rates.
- The swap spread is only compensation for the future TED spreads. These are the average spreads over Treasuries of a continually refreshed pool of A/AA credits, with poorer credits dropping out.
- By contrast, a given LIBOR borrower's long bond credit spread over Treasuries is like compensation for that borrower's floating short-term spread that an investor could otherwise earn by buying its short debt every period.