Class 15: Interest Rate Swaps
Financial Markets, Spring 2020, SAIF

Jun Pan

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

April 10, 2020
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.
Derivatives Usage by Global Fortune 500 Firms

<table>
<thead>
<tr>
<th>Usage by industry</th>
<th>Usage by product</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Global Fortune 500</strong></td>
<td><strong>Total usage across all industries: 94%</strong></td>
</tr>
<tr>
<td>Financial</td>
<td>98%</td>
</tr>
<tr>
<td>Basic materials</td>
<td>97%</td>
</tr>
<tr>
<td>Tech.</td>
<td>95%</td>
</tr>
<tr>
<td>Industrial goods</td>
<td>92%</td>
</tr>
<tr>
<td>Health care</td>
<td>92%</td>
</tr>
<tr>
<td>Utilities</td>
<td>92%</td>
</tr>
<tr>
<td>Consumer goods</td>
<td>91%</td>
</tr>
<tr>
<td>Services</td>
<td>88%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>FX</td>
<td>88%</td>
</tr>
<tr>
<td>Interest rate</td>
<td>83%</td>
</tr>
<tr>
<td>Commodity</td>
<td>49%</td>
</tr>
<tr>
<td>Equity</td>
<td>29%</td>
</tr>
<tr>
<td>Credit</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: ISDA 2009 Survey
Interest Rate Swaps

**Description**

A vanilla interest rate swap is an agreement between two counterparties to exchange cashflows (fixed vs floating) in the same currency. This agreement is often used by counterparties to change their fixed cashflows to floating or vice versa.

**Properties**

- **United States Dollar**: USD
- **Effective**: T+2, 04/18/11
- **Term**: 5 YR, 04/19/16
- **Quoted In**: Percent

**Fixed**

- **Day Count**: 30/360
- **Pay Freq**: Semi-annual
- **Coupon**: 2.4170%

**Float**

- **Day Count**: ACT/360
- **Pay Freq**: Quarterly
- **Index**: 30Y US0003M
- **Reset Freq**: Quarterly

**Analytics**

- 0) SwPM: Valuation in SwPM
- 1) SwDF: USD Swap Curves
- 2) BBTI: Electronic Trading
- 3) IRDD: Interest Rate Derivatives
- 4) N1: Swap News
- 5) FWCM: USD Forward Curve Matrix
- 6) WCV: Currency Ticker Search
- 7) USSW: Treasury/Money Markets

**Ticker**: DES

**Benchmarked against**

- USD 3m Libor
  - Quarterly
  - ACT / 360

**5Y Swap Rate**: 2.417% (p.a.)
- Semi-Annual
- 30/360
TED Spread: 3M LIBOR - 3M Treasury Bills

LIBOR and TBill Rates (%)

TED Spread (bps)

Financial Markets, Spring 2020, SAIF
Class 15: Interest Rate Swaps
Jun Pan
TED Spreads in 2008 and 2020

2008

2020

Class 15: Interest Rate Swaps

Jun Pan 9 / 23
LIBOR/IRS and UST Curves

US Treasury Rates (%)

LIBOR/Interest-Rate Swap Rates (%)

Financial Markets, Spring 2020, SAIF

Class 15: Interest Rate Swaps

Jun Pan 10 / 23
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

Figure 1. Evolution of Swap Spreads and Major Events, 1994 to 2004

- Treasury buyback announcement
- Monetary expansion begins
- 1998 Russian default and LTCM collapse
- MBS convexity hedging
- 1997 Asia crisis
- Y2K liquidity
Swap Spreads

Swap Spreads (bps)

Swap Spreads in 1998 (bps)

Swap Spreads in 2008 (bps)

Swap Spreads in 2020 (bps)
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

BarCap Mortgage-Backed Security

BarCap 5-Year Treasury Bellwethers

Yield (%), Duration (yr)


Yield and Duration, MBS vs UST

BarCap Mortgage-Backed Security

BarCap 5-Year Treasury Bellwethers

Yield (%), Duration (yr)

### Interest Rate Swaps

<table>
<thead>
<tr>
<th></th>
<th>Pay-Fixed</th>
<th>Receive-Fixed</th>
<th>Basis</th>
<th>Foreign Currency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notional balance as of December 31, 2008</td>
<td>$546,916</td>
<td>$451,081</td>
<td>$24,560</td>
<td>$1,652</td>
</tr>
<tr>
<td>Additions</td>
<td>297,379</td>
<td>279,854</td>
<td>2,765</td>
<td>577</td>
</tr>
<tr>
<td>Terminations</td>
<td>(461,695)</td>
<td>(455,518)</td>
<td>(24,100)</td>
<td>(692)</td>
</tr>
<tr>
<td>Notional balance as of December 31, 2009</td>
<td>$382,600</td>
<td>$275,417</td>
<td>$3,225</td>
<td>$1,537</td>
</tr>
<tr>
<td>Additions</td>
<td>212,214</td>
<td>250,417</td>
<td>55</td>
<td>636</td>
</tr>
<tr>
<td>Terminations</td>
<td>(317,587)</td>
<td>(301,657)</td>
<td>(2,795)</td>
<td>(613)</td>
</tr>
<tr>
<td>Notional balance as of December 31, 2010</td>
<td>$277,227</td>
<td>$224,177</td>
<td>$485</td>
<td>$1,560</td>
</tr>
</tbody>
</table>

### Interest Rate Swaptions

<table>
<thead>
<tr>
<th></th>
<th>Pay-Fixed</th>
<th>Receive-Fixed</th>
<th>Interest Rate Caps</th>
<th>Futures</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notional balance as of December 31, 2008</td>
<td>$79,500</td>
<td>$93,560</td>
<td>$500</td>
<td>$—</td>
<td>$827</td>
<td>$1,198,596</td>
</tr>
<tr>
<td>Additions</td>
<td>32,825</td>
<td>19,175</td>
<td>6,500</td>
<td>—</td>
<td>13</td>
<td>639,088</td>
</tr>
<tr>
<td>Terminations</td>
<td>(13,025)</td>
<td>(37,355)</td>
<td>—</td>
<td>—</td>
<td>(92)</td>
<td>(992,477)</td>
</tr>
<tr>
<td>Notional balance as of December 31, 2009</td>
<td>$99,300</td>
<td>$75,380</td>
<td>$7,000</td>
<td>$—</td>
<td>$748</td>
<td>$845,207</td>
</tr>
<tr>
<td>Additions</td>
<td>51,700</td>
<td>51,025</td>
<td>—</td>
<td>598</td>
<td>—</td>
<td>566,645</td>
</tr>
<tr>
<td>Terminations</td>
<td>(53,850)</td>
<td>(47,790)</td>
<td>—</td>
<td>(353)</td>
<td>(59)</td>
<td>(724,704)</td>
</tr>
<tr>
<td>Notional balance as of December 31, 2010</td>
<td>$97,150</td>
<td>$78,615</td>
<td>$7,000</td>
<td>$245</td>
<td>$689</td>
<td>$687,148</td>
</tr>
</tbody>
</table>

### Future maturities of notional amounts

<table>
<thead>
<tr>
<th></th>
<th>Pay-Fixed</th>
<th>Receive-Fixed</th>
<th>Basis</th>
<th>Foreign Currency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 year</td>
<td>$70,656</td>
<td>$14,200</td>
<td>50</td>
<td>$386</td>
</tr>
<tr>
<td>1 to less than 5 years</td>
<td>90,788</td>
<td>168,000</td>
<td>35</td>
<td>—</td>
</tr>
<tr>
<td>5 to less than 10 years</td>
<td>96,400</td>
<td>29,632</td>
<td>100</td>
<td>511</td>
</tr>
<tr>
<td>10 years and over</td>
<td>19,383</td>
<td>12,345</td>
<td>300</td>
<td>663</td>
</tr>
<tr>
<td>Total</td>
<td>$277,227</td>
<td>$224,177</td>
<td>$485</td>
<td>$1,560</td>
</tr>
</tbody>
</table>

(Dollars in millions)
Interest Rate Sensitivity of Net Portfolio, Fannie Mae 2014

### As of December 31, 2014

<table>
<thead>
<tr>
<th>Rate level shock:</th>
<th>2014</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100 basis points</td>
<td>$0.4</td>
<td>$0.1</td>
</tr>
<tr>
<td>-50 basis points</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>+50 basis points</td>
<td>(0.1)</td>
<td>(0.1)</td>
</tr>
<tr>
<td>+100 basis points</td>
<td>(0.1)</td>
<td>(0.5)</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Duration Gap (In months)</th>
<th>Rate Level Shock 50 bps</th>
<th>Rate Level Shock 50 bps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Minimum</td>
<td>(0.3)</td>
<td>0.0</td>
</tr>
<tr>
<td>Maximum</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>
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.
Mortgage Lenders in 2020

- Deluged with refinancing demand as rates are sharply lower:
  - Rate on 30-year fixed-rate mortgage hitting 3.29%, lowest ever recorded.
  - Refinancing applications rose 224% compared to the year prior.
  - Refinancing accounts for 75.9% of total mortgage applications.

- Facing massive margin calls amid Fed’s QE:
  - Mortgage banks are losing money on their interest-rate hedges.
  - Duration hedging: poor performance during volatile markets.
  - Also exposed:
    - Customers failed to close on loans because of quarantines.
    - Mortgage lenders stuck with the hedge without the off-setting loans.
Fed’s QE and MBS in 2020

- MBS: $10.33T as of end 2019.
- Fed announced MBS QE on 3/15.
- Week One: 3/19-25
  - increase in holdings: $1.2B.
  - decrease in yields: 100+ bps.
- Week Two: 3/26-4/1
  - increase in holdings: $55.9B.
  - decrease in yields: 4 bps.
  - 3/31: one-day spike of 41 bps!
Duration Hedging in this Environment = ?

Bloomberg BarCap MBS Yield (%)

QE Announced on 3/15

One Two

MBS UST 10Y

Bloomberg BarCap MBS Duration

MBS UST 10Y
Main Takeaways