Eurodollar Futures 2.0
Practical Applications
Agenda

1 Measuring risk

2 Hedging Short-term (S-T) rate exposure

3 Creating synthetic investments

4 Pricing and hedging IRS

5 ‘Alpha’ opportunities with EDs & FFs
Measuring Risk

Money market BPVs
Calculated as:
BPV = Face Value x (Days/360) x 0.01%

$10 million 180-day loan
$500 = $10MM x (180/360) x 0.01%

$100 million 60-day loan
$1,666.67 = $100MM x (60/360) x 0.01%

$1 million 90-day Eurodollar futures
$25 = $1MM x (90/360) x 0.01%

<table>
<thead>
<tr>
<th>Days</th>
<th>Face Value $500,000</th>
<th>$1 MM</th>
<th>$10 MM</th>
<th>$100 MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$0.14</td>
<td>$0.28</td>
<td>$2.78</td>
<td>$27.78</td>
</tr>
<tr>
<td>7</td>
<td>$0.97</td>
<td>$1.94</td>
<td>$19.44</td>
<td>$194.44</td>
</tr>
<tr>
<td>30</td>
<td>$4.17</td>
<td>$8.33</td>
<td>$83.33</td>
<td>$833.33</td>
</tr>
<tr>
<td>60</td>
<td>$8.33</td>
<td>$16.67</td>
<td>$166.67</td>
<td>$1,666.67</td>
</tr>
<tr>
<td>90</td>
<td>$12.50</td>
<td>$25.00</td>
<td>$250.00</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>180</td>
<td>$25.00</td>
<td>$50.00</td>
<td>$500.00</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>270</td>
<td>$37.50</td>
<td>$75.00</td>
<td>$750.00</td>
<td>$7,500.00</td>
</tr>
<tr>
<td>360</td>
<td>$50.00</td>
<td>$100.00</td>
<td>$1,000.00</td>
<td>$10,000.00</td>
</tr>
</tbody>
</table>
Hedging Rate Exposure

\[ \Delta \text{Value}_{\text{risk}} \approx \Delta \text{Value}_{\text{futures}} \]

\[ \text{HR} = \frac{\Delta \text{Value}_{\text{risk}}}{\Delta \text{Value}_{\text{futures}}} \]

\[ \approx \frac{\text{BPV}_{\text{risk}}}{\text{BPV}_{\text{futures}}} \]

\[ \approx \frac{\text{BPV}_{\text{risk}}}{25} \]

Sell Eurodollar futures ➜ Hedge risk of rising rates
Buy Eurodollar futures ➜ Hedge risk of declining rates
Hedging Rate Exposure

Anticipated borrowing ...

Example: a corporation anticipates borrowing $100 million for 90 days at 3-month LIBOR + fixed premium

- BPV of loan = $2,500

\[
BPV = \$100,000,000 \times \frac{90}{360} \times 0.01\% = \$2,500
\]

- Sell 100 Eurodollars to “lock-in” prevailing forward rates reflected in futures

\[
HR = \frac{\$2,500}{\$25} = 100 \text{ contracts}
\]
Hedging Rate Exposure

Floating rate loan …

Example: it is March and corporation anticipates borrowing $100 million for 2 years at 3-month LIBOR + fixed premium reset quarterly

Loan “decomposed” into 8 quarterly strips … rate with 1st 90-days locked in … risk that rates rise by 7 quarterly loan reset dates

- BPV of loan = $17,500

\[
BPV = $100,000,000 \times \left(\frac{630}{360}\right) \times 0.01\% = $17,500
\]

- Sell 700 Eurodollars to hedge risk of rising rates

\[
HR = \frac{$17,500}{25} = 700 \text{ contracts}
\]
Hedging Rate Exposure

Floating rate loan ...
HR recommends sale of 700 futures ... but in which contract month?

If hedge “stacked” in nearby “white” Jun contract
- Implies that hedger anticipates a yield curve flattening or inverts, i.e., short-term yields rise relative to long-term yields

If hedge “stacked” in deferred “red” Dec contract
- Implies that hedger hopes yield curve steepens, i.e., short-term yields decline relative to long-term yields

If yield curve expected to flatten or invert ➔ “Stack” short hedge in nearby futures

If yield curve expected to steepen ➔ “Stack” short hedge in deferred futures
Hedging Rate Exposure

Floating rate loan ...
Think of floating rate loan as 7 successive 90-day loans
BPV of each 90-day loan = $2,500

$2,500 = $100,000,000 x (90/360) x 0.01%

HR for each loan period = 100
HR = $2,500 ÷ $25 = 100 contracts

Hedge each loan period separately, that is, sell “strip” of Eurodollar futures

<table>
<thead>
<tr>
<th>Reset Date</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>White June</td>
<td>Sell 100 White Jun futures</td>
</tr>
<tr>
<td>White September</td>
<td>Sell 100 White Sep futures</td>
</tr>
<tr>
<td>White December</td>
<td>Sell 100 White Dec futures</td>
</tr>
<tr>
<td>White March</td>
<td>Sell 100 White Mar futures</td>
</tr>
<tr>
<td>Red June</td>
<td>Sell 100 Red Jun futures</td>
</tr>
<tr>
<td>Red September</td>
<td>Sell 100 Red Sep futures</td>
</tr>
<tr>
<td>Red December</td>
<td>Sell 100 Red Dec futures</td>
</tr>
</tbody>
</table>
Creating Synthetic Investments

Strips …

Buy (sell) strip by buying (selling) series of successively deferred quarterly futures

• Example: buy 3-month investment, and also buy March, June & September futures (a strip), to create a synthetic investment

Yield on strip calculated as follows

\[
\text{Strip} = \prod \left[ 1 + R_i \left( \frac{\text{days}_i}{360} \right) \right]^{-1} \div \left( \frac{\text{term}}{360} \right)
\]
Creating Synthetic Investments

Buy strip: buying series of successively deferred quarterly futures contracts, anchored by ST cash rate (“stub rate”)

<table>
<thead>
<tr>
<th>Contract</th>
<th>Term Days</th>
<th>Term</th>
<th>Futures Price</th>
<th>Implied Rate</th>
<th>Compound Factor</th>
<th>Strip Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>stub</td>
<td>91</td>
<td>91</td>
<td>LIBOR</td>
<td>1.613%</td>
<td>1.0041</td>
<td>1.613%</td>
</tr>
<tr>
<td>Mar-18</td>
<td>91</td>
<td>182</td>
<td>98.2200</td>
<td>1.780%</td>
<td>1.0086</td>
<td>1.700%</td>
</tr>
<tr>
<td>Jun-18</td>
<td>91</td>
<td>273</td>
<td>98.0700</td>
<td>1.930%</td>
<td>1.0135</td>
<td>1.782%</td>
</tr>
<tr>
<td>Sep-18</td>
<td>91</td>
<td>364</td>
<td>97.9750</td>
<td>2.025%</td>
<td>1.0187</td>
<td>1.850%</td>
</tr>
<tr>
<td>Dec-18</td>
<td>91</td>
<td>455</td>
<td>97.8900</td>
<td>2.110%</td>
<td>1.0241</td>
<td>1.910%</td>
</tr>
<tr>
<td>Mar-19</td>
<td>91</td>
<td>546</td>
<td>97.8300</td>
<td>2.170%</td>
<td>1.0298</td>
<td>1.962%</td>
</tr>
<tr>
<td>Jun-19</td>
<td>91</td>
<td>637</td>
<td>97.7800</td>
<td>2.220%</td>
<td>1.0355</td>
<td>2.008%</td>
</tr>
<tr>
<td>Sep-19</td>
<td>91</td>
<td>728</td>
<td>97.7500</td>
<td>2.250%</td>
<td>1.0414</td>
<td><strong>2.047%</strong></td>
</tr>
</tbody>
</table>

December 18, 2017 data

2-yr Strip = **2.047%** minus 2-yr UST = 1.840% equals 2-yr TED = 20.8 bps
2-yr IRS = 2.040%

Strip = (Π [1 + R_i (days_i/360)] -1 ) ÷ (term/360)

Plug in Eurodollar futures curve levels with front “stub” rate to calculate CF
- CF1 = 1+ (.0163*91/360) = 1.0041
- CF2 = 1.0041* (1+.0178* 91/360) = 1.0086...
- Strip Rate = (1.0414 – 1) ÷ (728/360) = 2.047%

Data Source: Bloomberg
Interest Rate Swaps (IRS)

Interest rate swap (IRS) structure:
Exchange a series of periodic fixed rate for floating rate payments based on specified principle.

Multiple valuation points, single valuation point, distinguishing IRS from FRA or futures.

Think of IRS as a bundle of FRAs at quarterly or semi-annual intervals.
Fixed rate payer (or floating rate receiver) is known as “payer” … fixed rate receiver (or floating rate payer) is known as “receiver” … typically intermediated through a dealer
Pricing and Hedging IRS

In an Interest Rate Swap (IRS), counterparties agree to exchange periodic interest payments.

The amount of the payments is based on the notional principal amount.

At the inception of a swap the terms are such that the present value (PV) of the floating payments is equal to the PV of the fixed-rate payments.

Step 1: Establish the terms and notional amount

Step 2: Calculate the floating payments based on a forward curve

Step 3: Calculate the PV of floating payment based on a discount factor

Step 4: Calculate the swap rate by calculating payments that net PVs

Step 5: Calculate projected cash flows and hedge ratios based on BPV
Pricing and Hedging IRS

Value a 2-Year, $100 million IRS for settlement December 20, 2017

<table>
<thead>
<tr>
<th>$100 million notional</th>
<th>Settles</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Year IRS</td>
<td>12/20/2017</td>
<td>12/20/2019</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contract</th>
<th>Term Days</th>
<th>Cumulative Term</th>
<th>Futures Price</th>
<th>Implied Yield</th>
<th>Compound Factor</th>
<th>Discount Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>stub</td>
<td>91</td>
<td>91</td>
<td>LIBOR</td>
<td>1.613%</td>
<td>1.0041</td>
<td>0.9959</td>
</tr>
<tr>
<td>Mar-18</td>
<td>91</td>
<td>182</td>
<td>98.22</td>
<td>1.780%</td>
<td>1.0086</td>
<td>0.9915</td>
</tr>
<tr>
<td>Jun-18</td>
<td>91</td>
<td>273</td>
<td>98.070</td>
<td>1.930%</td>
<td>1.0135</td>
<td>0.9867</td>
</tr>
<tr>
<td>Sep-18</td>
<td>91</td>
<td>364</td>
<td>97.975</td>
<td>2.025%</td>
<td>1.0187</td>
<td>0.9816</td>
</tr>
<tr>
<td>Dec-18</td>
<td>91</td>
<td>455</td>
<td>97.890</td>
<td>2.110%</td>
<td>1.0241</td>
<td>0.9764</td>
</tr>
<tr>
<td>Mar-19</td>
<td>91</td>
<td>546</td>
<td>97.830</td>
<td>2.170%</td>
<td>1.0298</td>
<td>0.9711</td>
</tr>
<tr>
<td>Jun-19</td>
<td>91</td>
<td>637</td>
<td>97.780</td>
<td>2.220%</td>
<td>1.0355</td>
<td>0.9657</td>
</tr>
<tr>
<td>Sep-19</td>
<td>91</td>
<td>728</td>
<td>97.750</td>
<td>2.250%</td>
<td>1.0414</td>
<td>0.9602</td>
</tr>
</tbody>
</table>

The discount factor (DF) is equal to $1 \div \text{compound factor}$

Example: Stub period DF = $1 / 1.0041 = 0.9959$

Data: Bloomberg, CME Group
Pricing and Hedging IRS

Calculate the PV\textsubscript{float} by using the actual days/360 and the DF.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|}
\hline
Contract & Term Days & Rate & Float pymt & Disc factor & PV float \\
\hline
stub & 91 & 0.016133 & 407,806 & 0.9959 & 406,150 \\
Mar-18 & 91 & 0.017800 & 449,944 & 0.9915 & 446,110 \\
Jun-18 & 91 & 0.019300 & 487,861 & 0.9867 & 481,355 \\
Sep-18 & 91 & 0.020250 & 511,875 & 0.9816 & 502,477 \\
Dec-18 & 91 & 0.021100 & 533,361 & 0.9764 & 520,790 \\
Mar-19 & 91 & 0.021700 & 548,528 & 0.9711 & 532,678 \\
Jun-19 & 91 & 0.022200 & 561,167 & 0.9657 & 541,910 \\
Sep-19 & 91 & 0.022500 & 568,750 & 0.9602 & 546,127 \\
\hline
\end{tabular}
\end{table}

Floating payment = days/360 x rate x notional amount

PV\textsubscript{float} = Payment\textsubscript{float} x DF
Pricing and Hedging IRS

Calculation of the fixed swap rate (SR):

\[ PV_{\text{float}} \text{ payments} = PV_{\text{fixed}} \text{ payments} \text{ requires a fixed rate that will produce the same net present value as the floating rate payments.} \]

\[
\text{SR} = \frac{\text{PV of floating-rate payments}}{N \sum_{t=1}^{N} \text{notional amount} \times \text{days/360} \times \text{DF}}
\]
Pricing and Hedging IRS

Calculation of the fixed swap rate (SR):

<table>
<thead>
<tr>
<th>Period</th>
<th>Days</th>
<th>Rate</th>
<th>Float pymt</th>
<th>Disc factor</th>
<th>PV float</th>
<th>fixed notional</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91</td>
<td>0.016133</td>
<td>407,806</td>
<td>0.9959</td>
<td>406,150</td>
<td>25,175,112</td>
</tr>
<tr>
<td>2</td>
<td>91</td>
<td>0.017800</td>
<td>449,944</td>
<td>0.9915</td>
<td>446,110</td>
<td>25,062,345</td>
</tr>
<tr>
<td>3</td>
<td>91</td>
<td>0.019300</td>
<td>487,861</td>
<td>0.9867</td>
<td>481,355</td>
<td>24,940,670</td>
</tr>
<tr>
<td>4</td>
<td>91</td>
<td>0.020250</td>
<td>511,875</td>
<td>0.9816</td>
<td>502,477</td>
<td>24,813,655</td>
</tr>
<tr>
<td>5</td>
<td>91</td>
<td>0.021100</td>
<td>533,361</td>
<td>0.9764</td>
<td>520,790</td>
<td>24,682,010</td>
</tr>
<tr>
<td>6</td>
<td>91</td>
<td>0.021700</td>
<td>548,528</td>
<td>0.9711</td>
<td>532,678</td>
<td>24,547,361</td>
</tr>
<tr>
<td>7</td>
<td>91</td>
<td>0.022200</td>
<td>561,167</td>
<td>0.9657</td>
<td>541,910</td>
<td>24,410,378</td>
</tr>
<tr>
<td>8</td>
<td>91</td>
<td>0.022500</td>
<td>568,750</td>
<td>0.9602</td>
<td>546,127</td>
<td>24,272,330</td>
</tr>
</tbody>
</table>

Fixed notional\_{period} = \text{days}/360 \times \text{DF} \times \text{notional value}

Example period 1 = (91/360) \times 0.9959 \times 100,000,000 = 25,175,112…

SR = \frac{3,977,597}{197,903,862} = 0.02009, or 2.010%
# Pricing and Hedging IRS

Calculate the $PV_{\text{fixed}}$ and fixed payments

\[
SR = \frac{3,977,597}{197,903,862} = 0.02009, \text{ or } 2.010\%
\]

\[
PV_{\text{float}} = PV_{\text{fixed}} \text{ at a rate of } 2.010\%
\]

<table>
<thead>
<tr>
<th>Period</th>
<th>Days</th>
<th>Rate</th>
<th>Float pymt</th>
<th>Disc factor</th>
<th>PV float</th>
<th>Fixed</th>
<th>PV fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91</td>
<td>0.01613</td>
<td>407,806</td>
<td>0.9959</td>
<td>406,150</td>
<td>508,049</td>
<td>505,985</td>
</tr>
<tr>
<td>2</td>
<td>91</td>
<td>0.01780</td>
<td>449,944</td>
<td>0.9915</td>
<td>446,110</td>
<td>508,049</td>
<td>503,719</td>
</tr>
<tr>
<td>3</td>
<td>91</td>
<td>0.01930</td>
<td>487,861</td>
<td>0.9867</td>
<td>481,355</td>
<td>508,049</td>
<td>501,273</td>
</tr>
<tr>
<td>4</td>
<td>91</td>
<td>0.02025</td>
<td>511,875</td>
<td>0.9816</td>
<td>502,477</td>
<td>508,049</td>
<td>498,721</td>
</tr>
<tr>
<td>5</td>
<td>91</td>
<td>0.02110</td>
<td>533,361</td>
<td>0.9764</td>
<td>520,790</td>
<td>508,049</td>
<td>496,075</td>
</tr>
<tr>
<td>6</td>
<td>91</td>
<td>0.02170</td>
<td>548,528</td>
<td>0.9711</td>
<td>532,678</td>
<td>508,049</td>
<td>493,368</td>
</tr>
<tr>
<td>7</td>
<td>91</td>
<td>0.02220</td>
<td>561,167</td>
<td>0.9657</td>
<td>541,910</td>
<td>508,049</td>
<td>490,615</td>
</tr>
<tr>
<td>8</td>
<td>91</td>
<td>0.02250</td>
<td>568,750</td>
<td>0.9602</td>
<td>546,127</td>
<td>508,049</td>
<td>487,841</td>
</tr>
</tbody>
</table>

\[
\text{SR} = 3,977,597 \div \text{197,903,862} = 0.02009, \text{ or } 2.010\%
\]
## Pricing and Hedging IRS

Calculate the BPV of this 2-Year, $100mm IRS.

<table>
<thead>
<tr>
<th>Contract</th>
<th>PV float</th>
<th>PV fixed</th>
<th>Float-Fixed(1)</th>
<th>PV float +01%</th>
<th>PV fixed</th>
<th>Float-Fixed(2)</th>
<th>(1)-(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>stub</td>
<td>406,150</td>
<td>505,985</td>
<td>-99,835</td>
<td>406,150</td>
<td>505,985</td>
<td>-99,835</td>
<td></td>
</tr>
<tr>
<td>Mar-18</td>
<td>446,110</td>
<td>503,719</td>
<td>-57,609</td>
<td>448,616</td>
<td>503,719</td>
<td>-55,103</td>
<td></td>
</tr>
<tr>
<td>Jun-18</td>
<td>481,355</td>
<td>501,273</td>
<td>-19,918</td>
<td>483,849</td>
<td>501,273</td>
<td>-17,424</td>
<td></td>
</tr>
<tr>
<td>Sep-18</td>
<td>502,477</td>
<td>498,721</td>
<td>3,756</td>
<td>504,958</td>
<td>498,721</td>
<td>6,237</td>
<td></td>
</tr>
<tr>
<td>Dec-18</td>
<td>520,790</td>
<td>496,075</td>
<td>24,716</td>
<td>523,259</td>
<td>496,075</td>
<td>27,184</td>
<td></td>
</tr>
<tr>
<td>Mar-19</td>
<td>532,678</td>
<td>493,368</td>
<td>39,309</td>
<td>535,132</td>
<td>493,368</td>
<td>41,764</td>
<td></td>
</tr>
<tr>
<td>Jun-19</td>
<td>541,910</td>
<td>490,615</td>
<td>51,295</td>
<td>544,351</td>
<td>490,615</td>
<td>53,736</td>
<td></td>
</tr>
<tr>
<td>Sep-19</td>
<td>546,127</td>
<td>487,841</td>
<td>58,287</td>
<td>548,555</td>
<td>487,841</td>
<td>60,714</td>
<td>?</td>
</tr>
</tbody>
</table>

- Original value: 3,977,597
- +01 BPV adjustment: 3,994,870
- Net change: 17,273

Compare the original value, NPV = 0, to value with floating rates +01 bps.
### Pricing and Hedging IRS

Calculate the BPV of this 2-Year, $100mm IRS.

<table>
<thead>
<tr>
<th>Contract</th>
<th>PV float</th>
<th>PV fixed</th>
<th>Float-Fixed(1)</th>
<th>PV float +0.01%</th>
<th>PV fixed</th>
<th>Float-Fixed(2)</th>
<th>(1)-(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>stub</td>
<td>406,150</td>
<td>505,985</td>
<td>-99,835</td>
<td>406,150</td>
<td>505,985</td>
<td>-99,835</td>
<td>0</td>
</tr>
<tr>
<td>Mar-18</td>
<td>446,110</td>
<td>503,719</td>
<td>-57,609</td>
<td>448,616</td>
<td>503,719</td>
<td>-55,103</td>
<td>-2,506</td>
</tr>
<tr>
<td>Sep-18</td>
<td>502,477</td>
<td>498,721</td>
<td>3,756</td>
<td>504,958</td>
<td>498,721</td>
<td>6,237</td>
<td>-2,481</td>
</tr>
<tr>
<td>Dec-18</td>
<td>520,790</td>
<td>496,075</td>
<td>24,716</td>
<td>523,259</td>
<td>496,075</td>
<td>27,184</td>
<td>-2,468</td>
</tr>
<tr>
<td>Mar-19</td>
<td>532,678</td>
<td>493,368</td>
<td>39,309</td>
<td>535,132</td>
<td>493,368</td>
<td>41,764</td>
<td>-2,455</td>
</tr>
<tr>
<td>Jun-19</td>
<td>541,910</td>
<td>490,615</td>
<td>51,295</td>
<td>544,351</td>
<td>490,615</td>
<td>53,736</td>
<td>-2,441</td>
</tr>
<tr>
<td>Sep-19</td>
<td>546,127</td>
<td>487,841</td>
<td>58,287</td>
<td>548,555</td>
<td>487,841</td>
<td>60,714</td>
<td>-2,427</td>
</tr>
<tr>
<td></td>
<td>3,977,597</td>
<td>3,977,597</td>
<td>0</td>
<td>3,994,870</td>
<td>3,977,597</td>
<td>17,273</td>
<td></td>
</tr>
</tbody>
</table>

**Original value** | **+01 BPV adjustment** | **Net change**

Compare the original value, NPV = 0, to value with floating rates +01 bps.
Pricing and Hedging IRS

Hedging cash flows of a swap

<table>
<thead>
<tr>
<th>Position</th>
<th>Risk</th>
<th>Hedge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Rate Payer</td>
<td>Rates fall and prices rise</td>
<td>Buy Eurodollar futures</td>
</tr>
<tr>
<td>Fixed Rate Receiver</td>
<td>Rates rise and prices fall</td>
<td>Sell Eurodollar futures</td>
</tr>
</tbody>
</table>
Pricing and Hedging IRS

Hedge ratio = \( \frac{\text{Value}_{\text{risk}}}{\$25} = 17,273 / 25 = 691 \) contracts

<table>
<thead>
<tr>
<th>Contract</th>
<th>PV float</th>
<th>PV fixed</th>
<th>Float-Fixed(1)</th>
<th>PV float +.01%</th>
<th>PV fixed</th>
<th>Float-Fixed(2)</th>
<th>(1)-(2)</th>
<th>Hedge</th>
</tr>
</thead>
<tbody>
<tr>
<td>stub</td>
<td>406,150</td>
<td>505,985</td>
<td>-99,835</td>
<td>406,150</td>
<td>505,985</td>
<td>-99,835</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mar-18</td>
<td>446,110</td>
<td>503,719</td>
<td>-57,609</td>
<td>448,616</td>
<td>503,719</td>
<td>-55,103</td>
<td>-2,506</td>
<td>-100</td>
</tr>
<tr>
<td>Jun-18</td>
<td>481,355</td>
<td>501,273</td>
<td>-19,918</td>
<td>483,849</td>
<td>501,273</td>
<td>-17,424</td>
<td>-2,494</td>
<td>-100</td>
</tr>
<tr>
<td>Dec-18</td>
<td>520,790</td>
<td>496,075</td>
<td>24,716</td>
<td>523,259</td>
<td>496,075</td>
<td>27,184</td>
<td>-2,468</td>
<td>-99</td>
</tr>
<tr>
<td>Mar-19</td>
<td>532,678</td>
<td>493,368</td>
<td>39,309</td>
<td>535,132</td>
<td>493,368</td>
<td>41,764</td>
<td>-2,455</td>
<td>-98</td>
</tr>
<tr>
<td>Jun-19</td>
<td>541,910</td>
<td>490,615</td>
<td>51,295</td>
<td>544,351</td>
<td>490,615</td>
<td>53,736</td>
<td>-2,441</td>
<td>-98</td>
</tr>
</tbody>
</table>

Original value: 3,977,597

+01 BPV adjustment: 3,994,870

Net change: -17,273

Fixed rate receiver (long) floating rate payer will sell Eurodollars to hedge.
Pricing and Hedging IRS

Dodd-Frank legislation requires that cleared OTC IRS be subject to 5-day margin ... futures subject to 1-day margin

THUS ... one may create weighted Eurodollar futures strip that mimics OTC IRS instrument with reduced margin requirements

Basle III risk capital charges similarly favor futures over OTC IRS instruments

---

Estimated Margin Requirements
(as of 3/27/2017)

<table>
<thead>
<tr>
<th></th>
<th>Eurodollar Futures Strip</th>
<th>Cleared-Only IRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Margin</td>
<td>$32,945</td>
<td>Fixed Payer Margin</td>
</tr>
<tr>
<td>Maintenance Margin</td>
<td>$29,950</td>
<td>Fixed Receiver Margin</td>
</tr>
</tbody>
</table>

Notes
For a $10 million notional, 2-year Eurodollar futures strip vs. comparable $10 million notional, spot starting 2-year cleared-only interest rate swap (IRS) instrument.
Spread trading constitutes a large portion of the total volume traded in Eurodollar futures.

Spread trades involving just Eurodollar futures are known as “intra-market” spreads.

Examples of intra-market spreads include:
• Calendar (or time) spreads
• Butterfly spreads
• Condor spreads
Eurodollar Futures
Intra-Market Calendar spreads

An opening trade involving the simultaneous purchase and sale of the same futures contract but at different expiry dates.

The spread is identified by the action taken on the shortest maturity contract.

For example: Buying the EDH7 / EDH8 spread involves buying EDH7 contracts and selling the same amount of EDH8 contracts.

Executing calendar spreads in STIR products generally constitutes expressing an opinion on or hedging yield curve risk.
Eurodollar Futures
Intra-Market Calendar spreads

December 2017 Eurodollar futures (EDZ7)
Eurodollar Futures
Intra-Market Calendar spreads

EDZ7-EDZ8 spread versus EDZ7 prices
Eurodollar Futures
Intra-Market Calendar spreads

Example: Post September FOMC meeting selling the EDZ7 / EDZ8 calendar spread on 09/20/2017 anticipating a curve flattening into year-end.

1st Step: Determine hedge, or spread, ratio.

Spread Ratio (SR) = \( \frac{BPV_1}{BPV_2} \)

All Eurodollar futures contracts have the same BPV = $25.00, therefore…

\( SR = \frac{25}{25} = 1.0 \) or buy/sell equal amount of futures

2nd Step: Execute the trade via broker as a spread to reduce execution risk.

For this example on September 20, 2017 trader decides to sell 1000 EDZ7 / EDZ8 spreads at 33.50 bps.
Eurodollar Futures
Intra-Market Calendar spreads

LIBOR rates trend higher into year-end, EDZ7 trades to lower prices.

What about the yield curve?

On September 20 trader sold 1000 EDZ7/EDZ8 spreads at 33.50 bps:
  Selling 1000 EDZ7 = 98.505
  Buying 1000 EDZ8 = 98.170
  98.505 – 98.170 = .335, or 33.5 bps

This spread implies the trader has a yield curve flattening bias.

Exiting the trade on December 15, 2017.
Eurodollar Futures
Intra-Market Calendar spreads

LIBOR rates trend higher into year-end, EDZ7 trades to lower prices.

But what happens to the yield curve?

This trade implies the trader has a yield curve flattening bias.
Eurodollar Futures
Intra-Market Calendar spreads

On December 15, 2017 trader covers the position, buying 1000 EDZ7/EDZ8 spreads:

Buying 1000 EDZ7 = 98.375
Selling 1000 EDZ8 = 97.900
98.375 – 97.900 = 0.475, or 47.5 bps

From September 20 to December 15, 2017 the yield curve from EDZ7 to EDZ8 widened, or steepened from 33.5 bps to 47.5 bps.

47.5 – 33.5 = 14.0 bps of steepening.
Eurodollar Futures
Intra-Market Calendar spreads

EDZ7-EDZ8 spread versus EDZ7 prices
Eurodollar Futures
Intra-Market Calendar spreads

How did our trader do?

9/20/2017 Sold 1000 EDZ7 = 98.505
12/15/2017 Bought 98.170
98.505 – 98.170 = 0.335, or 33.5 bps gain
33.5 bps x $25 per bps x 1000 contracts = $837,500 gain

9/20/2017 Bought 1000 EDZ8 = 98.375
12/15/2017 Sold 97.900
98.375 – 97.900 = 0.475, or 47.5 bps loss
47.5 bps x $25 per bps x 1000 contracts = $1,187,500 loss

1,187,500 – 837,500 = $350,000 net loss. Why?

Curve steepened by 14.0 bps.
14.0 bps x $25 x 1000 = $350,000
Eurodollar Futures
Intra-Market Calendar spreads

Eurodollar futures EDZ7-EDZ8 spread

Curve steepeners: Buy near contract, Sell far contract
Curve flatteners: Sell near contract, Buy far contract
Eurodollar Futures
Intra-Market Calendar spreads

Spread positions generally reflect lower market risk and therefore require lower margin requirements.

Bought 1000 EDZ7 and sold 1000 EDZ8. What is the margin required?

<table>
<thead>
<tr>
<th>Margin</th>
<th>Delta</th>
<th>Side</th>
<th>Percent</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDH7</td>
<td>1</td>
<td>A</td>
<td></td>
<td>$315</td>
</tr>
<tr>
<td>EDH8</td>
<td>1</td>
<td>B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EDH7 = 250 x 1000 = 250,000
EDH8 = 390 x 1000 = 390,000

315 x 1000 spreads = $315,000 margin required as spread

Versus outright legs = $640,000
European Futures

Butterfly spreads

Similar to a calendar spread a “Butterfly” spread constitutes the difference between two sequential calendar spreads in the same futures contract.

If a calendar spread is \( P_1 - P_2 \), a butterfly is \( ( P_1 - P_2 ) - (P_2 - P_3) \)

Or \( P_1 + P_3 - ( 2 \times P_2 ) \)

Butterfly spreads are designed to take advantage of “humpedness”, or price (yield) anomalies in a yield curve.

The action to the spread is designated by what is done to the front “wing” or contract of a three contract spread.
Eurodollar Futures
Butterfly spreads

December 2017 Eurodollar futures (EDZ7)
Eurodollar Futures
Butterfly spreads

Example: Buying the EDZ7 / EDZ8 / EDZ9 butterfly.
Buy 1x front contract, Sell 2x middle contract, Buy 1x third contract

1st Step: Determine hedge, or spread, ratio.
All Eurodollar futures contracts have the same BPV = $25.00, therefore...
Buy 1000 EDZ7, Sell 2000 EDZ8, and Buy 1000 EDZ9

2nd Step: Execute the trade
Eurodollar Futures
Butterfly spreads

H7-H8-H9 Eurodollar Butterfly

ED27 price

Spread (bps)

Axis Title

ED27
Z7-Z8-Z9 Fly

6/1/2017 7/1/2017 8/1/2017 9/1/2017 10/1/2017 11/1/2017 12/1/2017
**Eurodollar Futures**

**Butterfly spreads**

*Example: Buying the EDZ7 / EDZ8 / EDZ9 butterfly.*

*September 20, 2017: trader buys this fly at 15.5 bps.*

*Bought 1000 EDZ7 = 98.505*

*Sold 2000 EDZ8 = 98.170*

*Bought 1000 EDZ9 = 97.990*

\[(99.505 + 97.990) - (98.170 \times 2) = 0.155, \text{ or } 15.5 \text{ bps.}\]

*Assume trader exits the trade on December 15.*
Eurodollar Futures
Butterfly spreads

Example: Buying the EDH7 / EDH8 / EDH9 butterfly.

December 15, 2017: trader offsets position, selling the Fly.
Sold 1000 EDZ7 = 98.375, 13.0 lower in price
Bought 2000 EDZ8 = 97.900, 27.0 lower in price
Sold 1000 EDZ9 = 97.730, 26.0 lower in price

(98.375 + 97.730) - (97.900 x 2) = 0.305 or 30.5 bps.

The fly widened from 15.5 bps to 30.5 bps Sept 20 to Dec 15, 2017.
Eurodollar Futures

Butterfly spreads

H7-H8-H9 Eurodollar Butterfly

<table>
<thead>
<tr>
<th>Date</th>
<th>EDZ7 Price</th>
<th>Spread (bps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/1/2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/1/2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/1/2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/1/2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/1/2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/1/2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/1/2017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Eurodollar Futures

Butterfly spreads

9/20/2017 Bought 1000 EDZ7 = 98.505
12/15/2017 Sold = 98.375
98.505 - 98.375 = 0.130, or 13.0 tick loss
13.0 ticks x $25 per tick x 1000 contracts = $325,000

9/29/2017 Sold 2000 EDZ8 = 98.170
12/15/2017 Bought = 97.900
98.170 – 97.900 = 0.270, or 27.0 tick gain
27.0 ticks x $25 per tick x 2000 contracts = $1,350,000 gain

9/20/2017 Bought 1000 EDZ9 = 97.990
12/15/2017 Sold = 97.730
97.990 - 97.730 = 0.260, or 26.0 tick loss
26.0 ticks x $25 per tick x 1000 contracts = $650,000 loss

1,350,000 – (325,000 + 650,000) = $375,000 gain. Why?
30.5 – 15.5 bps = 15.0 bps. 15.0 x $25 x 1000 = $375,000
‘Alpha’ Opportunities with Eurodollar Futures

Butterfly spreads

All three futures contracts traded in similar price patterns as yields rose.

Over the course of this trade the yield curve steepened.
Eurodollar Futures

Butterfly spreads

While the yield curve steepened, the EDZ7-EDZ9 it did not steepen uniformly.

**EDZ7**  From 1.495 bps to 1.625 bps = 13.0 bps higher in yield

\[33.5 \text{ bps} \quad \text{to} \quad 47.5 \text{ bps} = 14.0 \text{ bps steeper}\]

**EDZ8**  From 1.830 bps to 2.100 bps = 27.0 bps higher in yield

\[18.0 \text{ bps} \quad \text{to} \quad 1.0 \text{ bps} = 1.0 \text{ flatter}\]

**EDZ9**  From 2.010 bps to 2.270 bps = 26.0 bps higher in yield

The degree of steepening was greater Z7-Z8 than from Z8-Z9.
Eurodollar Futures
Butterfly spreads

Bought 1000 EDZ7
Sold 2000 EDZ8
Bought 1000 EDZ9, think of as two calendar spreads.

1. Margin delta side percent MM
   EDZ7 1 A $315
   EDZ8 1 B

2. EDZ8 1 A $265
   EDZ9 1 B

EDZ7-EDZ8 = 315 x 1000 = 315,000
EDZ8-EDZ9 = 265 x 1000 = 265,000

(315 + 265) x 1000 spreads = $580,000 margin required as fly

Versus outright legs = $1,515,000
Other spread opportunities
Fed Fund futures versus Eurodollar futures:

Since the resolution of the global financial crisis the OIS (overnight index swap) curve has become a reasonable indicator of interbank credit market floating rate risk.

Fed Funds are highly correlated to the OIS overnight rate.

Comparing Fed Funds futures to LIBOR based Eurodollar futures is a reasonable way to capture the spread between the OIS and LIBOR curves relationship.

Expecting the spread to widen = Buy FFs, Sell EDs

Expecting the spreads to narrow = Sell FFs, Buy EDs
Other spread opportunities
Fed Fund futures versus Eurodollar futures:

Many consider the spread a “measure that tracks stress in U.S. money markets.”

Eurodollar futures, based on 3-month LIBOR, reflect the rate at which banks lend to each other.

Fed Fund futures are closely correlated to U.S. central bank rates.

A higher (widening) level in the spread signals increasing stress, while lower (narrower) levels indicate easy funding conditions.

Many financial market and economic factor may influence the trading and pricing of this spread.

Other spread opportunities
Fed Fund futures versus Eurodollar futures:

Example: Buying Fed Fund futures, selling Eurodollar futures

How to construct this trade?

Assume a short EDZ7 position of 1000 contracts

Hedge Ratio (HR) = \( \frac{BPV_{\text{risk}}}{BPV_{\text{contract}}} \)

\( EDZ7_{\text{risk}} = 25 \text{ per bps x 1000 contracts} = 25,000 \text{ bps at risk} \)

\( HR = \frac{25,000}{41.67} (BPV \text{ of FF futures}) = \text{sell 600 Fed Funds futures} \)

But which ones?
Other spread opportunities
Fed Fund futures versus Eurodollar futures:

Quick review:

Eurodollar futures are based on a 3-month LIBOR rate starting on final settlement day (third Wednesday of quarterly contract month). In other words Eurodollar futures are *forward looking*.

Fed Fund futures are based on the average daily effective Fed Funds rate and calculated the last business day of the each contract month. In other words Fed Fund futures are *backward looking*.
Other spread opportunities
Fed Fund futures versus Eurodollar futures:

Example: Buying Fed Fund futures, selling Eurodollar futures

How to construct this trade?
HR = 25,000 ÷ $41.67 = 600 Fed Funds futures. But which ones?

The only Fed Funds contracts that fall completely within the 91 days of the December 2017 Eurodollar futures forward rate are January (FFF8) 2017 and February (FFG8) 2017.

While not completely covering the same time period as the Eurodollar contract period the correlation is extremely high.

Using only two fed Fund contracts makes easier execution and trade tracking.
Other spread opportunities
Fed Fund futures versus Eurodollar futures:

Example: Buying Eurodollar futures, Selling Fed Funds futures

23 October 2017
Bought FFs, sold EDZ7
EDZ7 = 98.495 = 1.505%
Bought FFF8 = 98.635
Bought FFG8 = 98.625
Ave FFs = 98.630 = 1.370%
Spread = 1.505 – 1.370
Spread = 0.1350 or 13.5 bps

15 December 2017
Bought EDM7, sold FFs
EDZ7 = 98.375 = 1.625%
Sold FFF8 = 98.600
Sold FFG8 = 98.595
Ave FFs = 98.5975 = 1.4025%
Spread = 1.625 – 1.4025
Spread = 0.2225 or 22.25 bps

Spread = 22.25 – 13.50 = 8.75 bps wider
Other spread opportunities
Fed Fund futures versus Eurodollar futures:

How did the trade perform?

Sold 1000 EDZ7 = 98.495
Bought = 98.375
12.0 bps x $25.00 per bps x 1000 contracts = $300,000 gain

Bought 300 FFF8 = 98.635
Sold = 98.600
3.5 bps x $41.67 per bps x 300 contracts = $43,753.50 loss

Bought 300 FFG8 = 98.625
Sold = 98.595
3.0 bps x $41.67 per bps x 300 contracts = $37,503 loss

$300,000 – ($43,753.50 + $37,503) = $218,743.50 net gain ÷ 8.75 bps = $24,999 BPV
Other spread opportunities
Fed Fund futures versus Eurodollar futures:

Spread positions generally reflect lower market risk and therefore require lower margin requirements.

**Bought 500 EDZ7 and sold 300 FFF8, Bought 500 EDZ7 and sold 300 FFG8**

What is the margin required?

<table>
<thead>
<tr>
<th>Margin</th>
<th>delta</th>
<th>side</th>
<th>percent</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFF8</td>
<td>3</td>
<td>A</td>
<td>80%</td>
<td>$240</td>
</tr>
<tr>
<td>EDZ7</td>
<td>5</td>
<td>B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{FFN7} = 240 \times 300 = 72,000 \\
\text{EDM7} = 250 \times 500 = 125,000 \\
0.80 \times 72,000 = 57,600 \\ 125,000 - 57,600 = 67,400 \times 2 = 134,800
\]

$134,800 margin required as spread

Versus outright legs = $394,000
For seasoned traders or those who are just getting started, CME Group is your source to learn about the derivatives and risk management industry.

Explore CME Institute where you will find courses on products and trading strategies, seminars, research and commentary.

Institute.cmegroup.com
Contact us:

David Gibbs, Director
Market Development
+1 312 207 2591
David.Gibbs@cmegroup.com

cmeigroup.com

Thank you