INTEREST RATES

Tracking DSFs with Eurodollar Bundles
New Proxy for Interest Rate Swaps

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John W. Labuszewski
Managing Director
Research & Product Development
312-466-7469
jlab@cme集团.com

James Boudreault
Senior Director
Research & Product Development
312-930-3247
James.boudreault@cme集团.com
Eurodollar futures were originally introduced in 1982 and have experienced great success as a means of pricing and hedging over-the-counter (OTC) interest rate swap (IRS) risk exposures. Eurodollar futures bundles were subsequently introduced as a means of creating a strip of Eurodollar contracts that parallels the risk associated with IRS instruments.

Deliverable Swap Futures (DSFs) were introduced in late 2012. They represent futures contracts that call for the delivery of an IRS instrument that is cleared and carried on the books of the CME Clearing House.

As such, both Eurodollar bundles and DSFs generally speak to the same types of interest rate risk exposure. It follows that both contracts should follow parallel pricing tracks.

The intent of this study is to provide a straightforward and empirical assessment of the degree to which these instruments have been tracking one with the other. To the degree that this tracking is “true,” it follows that one may trade one instrument off against the other as a form of spread or arbitrage if one deviates from the other, thus providing a source of trading opportunity.

**Eurodollar Bundle Primer**

A Eurodollar bundle consists of the simultaneous sale or purchase of one each of a series of consecutive Eurodollar futures contracts. The first contract in any bundle is typically the first quarterly contract in the Eurodollar strip, but bundles may be constructed starting with any quarterly contract. CME lists bundles in 1-, 2-, 3-, 4-, 5-, 6-, 7-, 8-, 9-, and 10-year terms to maturity.

E.g., one may buy a 1-year or white bundle by purchasing the first 4 quarterly expiration Eurodollar futures contracts. E.g., one may sell a 3-year or green bundle by selling the first 12 quarterly expiration Eurodollar futures contracts.

E.g., one may sell a 5-year or gold bundle by selling the first 20 quarterly expiration Eurodollar futures contracts.

<table>
<thead>
<tr>
<th>Term</th>
<th>Color Code</th>
<th>Comprised of</th>
<th>BPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Year</td>
<td>White</td>
<td>1st 4 Quarterlies</td>
<td>$100</td>
</tr>
<tr>
<td>2-Year</td>
<td>Red</td>
<td>1st 8 Quarterlies</td>
<td>$200</td>
</tr>
<tr>
<td>3-Year</td>
<td>Green</td>
<td>1st 12 Quarterlies</td>
<td>$300</td>
</tr>
<tr>
<td>4-Year</td>
<td>Blue</td>
<td>1st 16 Quarterlies</td>
<td>$400</td>
</tr>
<tr>
<td>5-Year</td>
<td>Gold</td>
<td>1st 20 Quarterlies</td>
<td>$500</td>
</tr>
<tr>
<td>6-Year</td>
<td>Purple</td>
<td>1st 24 Quarterlies</td>
<td>$600</td>
</tr>
<tr>
<td>7-Year</td>
<td>Orange</td>
<td>1st 28 Quarterlies</td>
<td>$700</td>
</tr>
<tr>
<td>8-Year</td>
<td>Pink</td>
<td>1st 32 Quarterlies</td>
<td>$800</td>
</tr>
<tr>
<td>9-Year</td>
<td>Silver</td>
<td>1st 36 Quarterlies</td>
<td>$900</td>
</tr>
<tr>
<td>10-Year</td>
<td>Copper</td>
<td>1st 40 Quarterlies</td>
<td>$1,000</td>
</tr>
</tbody>
</table>

Eurodollar futures are generally quoted in terms of the “IMM Index” or 100-Yield, e.g., a yield of 0.86% implies a quote of 99.14 (= 100.00 – 0.86). They are generally quoted in minimum increment of ½ of one basis point or 0.005% (or $12.50 based upon a 90-day, $1 million face value instrument).  

But the price of a bundle is quoted by reference to the average change in the value of all Eurodollar futures contracts included in the pack or bundle since the prior day’s settlement price. They are quoted in increments of one quarter (1/4th) of one (1) basis point (0.01%).

E.g., if the first 4 quarterly Eurodollar contracts have advanced 2 basis points for the day while the next 4 quarterly Eurodollar contracts have advanced 3 basis points for the day, then a 2-year or red bundle may be quoted as “+” or up 2.5 basis points.

\[
\text{Bundle Quote} = \frac{[(+2 \text{ bps} \times 4 \text{ cnts}) + (+3 \text{ bps} \times 4 \text{ cnts})]}{8 \text{ cnts}} = +2.5 \text{ basis points}
\]

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1 Eurodollar futures are sometimes color coded to facilitate reference to individual contract months or to packs and bundles. Futures expiring within one year, including the first 4 quarterly contracts are referred to as “white” months. The 2nd year is “red,” 3rd year is “green,” 4th year is “blue,” 5th year is “gold,” 6th year is “purple,” 7th year is “orange,” 8th year is “pink,” 9th year is “silver,” and the 10th year is “copper.” Thus, a bundle comprised of the first 8 quarterly contracts is referred to as a red bundle; the first 20 quarterlies is a green bundle; all 40 quarterlies is a copper bundle.

2 While most Eurodollar futures contract months are quoted in minimum increments of ½ of one basis point ($12.50), note that nearby contracts are quoted in increments of ¼ of one basis point or 0.0025% ($6.25).
DSF Primer

As a preamble, let us review the salient features of Deliverable Swap Futures. DSFs are futures contracts that call for the delivery of IRS instruments. The deliverable IRS instruments are standardized or plain-vanilla swaps that are cleared and carried through the facilities of the CME Clearing House.

Separate DSFs are available that call for the delivery of a 2-, 5-, 10- or 30-year term IRS instrument with a notional value of $100,000. Contracts are listed for expiration on the Monday preceding the 3rd Wednesday of the contract months of March, June, September and December.

The buyer or long of a DSF becomes the fixed rate receiver (floating rate payer) of the swap upon delivery. Thus, the long DSF position will benefit from falling rates (rising prices).

The seller or short of a DSF becomes the fixed rate payer (floating rate receiver) upon delivery of the swap. Thus, the short DSF position will benefit from rising rates (falling prices).

The floating rate associated with the delivered swap is based on the ICE Benchmark Administration Limited (ICE) 3-month LIBOR fixing, or the same rate that is used to settle CME Eurodollar futures contracts. Each contract calls for the delivery of a swap with a specified fixed rate or coupon that is established by the Exchange generally to approximate market rates at the time of listing, e.g., 0.5%, 1.0%, 1.5%, 2.0%, etc.

These products are quoted as 100% of par plus the non-par value (NPV) of the deliverable swap instrument in percent of par. Two-year DSFs are quoted in minimum increments of ¼% of 1/32nd of 1% of the $100,000 notional face value, or $7.8125. Five- and 10-years DSFs are quoted in increments of ½% of 1/32nd of 1% of $100,000 or $15.625; 30-year DSFs are quoted in increments of 1/32nd of 1% of $100,000 or $31.25.

NPV may be assessed as the present value of the future stream of fixed rate payments less the present value of the floating rate payments. The NPV of a swap may be positive or negative depending upon the relationship of prevailing swap (fixed) rates and the fixed rate or coupon associated with the DSF.

| Reference Convention |
|----------------------|-----------------|
| **DSF Position** | **Delivered Swap Position** |
| Buyer (Long) | Fixed Rate Receiver (or Floating Rate Payer) |
| Seller (Short) | Fixed Rate Payer (or Floating Rate Receiver) |

Thus, DSFs may be quoted above 100% of par, e.g., 101%, 102%, 103%, etc., if prevailing rates are greater than the DSF coupon rate. Or, DSFs may be quoted below par, e.g., 99%, 98%, 97%, etc., if prevailing rates are less than the DSF coupon rate.

Tracking PLs

Eurodollar strips, frequently executed with the use of Eurodollar futures bundles, generally parallel the performance of IRS instruments. As such, they may be used either to replicate or hedge the risks associated with swaps. DSFs call for the delivery of either 2-, 5-, 10- or 30-year swaps. Thus, it is

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3 For a more detailed discussion of the contract terms and conditions of DSFs and a broad review of their applications, see “Understanding Deliverable Swap Futures” (February 1, 2013), found at http://www.cmegroup.com/trading/interest-rates/understanding-dsf.html
4 To participate in a physical delivery, a futures position holder must be an Eligible Contract Participant (ECP) as defined in the Commodity Exchange Act and CME Rule 9005.C., and must be registered with CME by a CME IRS Clearing Member as an IRS Participant per CME Rules 9005.A. and 9005.B.

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logical to assume that a 2-year red, a 5-year gold or a 10-year copper bundle should track or parallel or closely correlate with DSF futures pricing.  

To test that proposition, we compare the value of ten (10) 2-year DSFs expiring in June 2013 with the value of a 2-year or red bundle with a lead month of June 2013, i.e., a series of eight (8) consecutive quarterly Eurodollars from June 2013 through March 2015. Note that we pair one (1) bundle with ten (10) DSFs to the extent that Eurodollar futures carry a nominal face value of $1 million compared to $100,000 associated with a DSF contract. This practical test is conducted based on the assumption that one might assume a long position in either instrument as of January 2, 2013 and liquidate those positions on June 17, 2013 when they expire in unison.

As one might confirm based upon a visual inspection of the daily mark-to-market (MTM) profit and loss (PL), the tracking of the 2-year DSF is extraordinarily close with that of the 2-year Eurodollar bundle. At every twist and turn, the two instruments follow one with the other rather closely.

We may further test this proposition by comparing the daily marked-to-market PL of ten (10) 5-year DSFs expiring in June 2013 with a 5-year or gold bundle with a lead month of June 2013. Again, a simple visual inspection confirms the close correlation between DSFs and Eurodollar bundles of equivalent duration and face value.

In addition to 2- and 5-year DSFs, CME also lists 10- and 30-year DSFs. Clearly, however, it is impossible to construct a 30-year bundle to the extent that Eurodollar futures are only available extending some ten years out into the future.

While one can readily construct a 10-year bundle at any given time, it was not possible to construct a 10-year bundle with a lead month of June 2013 in January 2013. Note that the 39th contract in that copper bundle (December 2022) was not listed until expiration of the March 2013 Eurodollar futures contract. Similarly, the 40th contract in the copper bundle (March 2023) was not listed until expiration of the June 2013 contract.

**A Closer Look**

But let’s take a somewhat closer look at the cumulative PL associated with DSFs and comparable maturity bundles. Upon closer examination, we find that there are some divergences between the PL on the two related instruments.

Note that the difference in the monetary PL associated with the 2-year DSF vs. the 2-year bundle remained within a range of -$209.375 and +$134.375. The difference in the monetary PL of the 5-year DSF vs. 5-year bundle fluctuated within a

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Note that, because Eurodollar futures extend out only 10 years into the future, one is precluded from creating a 30-year bundle or strip.

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range bounded by -$593.75 and +$1,206.25. The larger range associated with the 5-year relative to the 2-year tenure instruments may be attributed to the increased volatility associated with 5-year vs. 2-year instruments.

But this simplicity neglects to consider that the risk exposure implied by a swap may not match quite so neatly with that of a Eurodollar bundle. In order to achieve a more precise hedge, one must calculate a hedge ratio (HR) which represents the ratio between the Basis Point Values (BPV) associated with the two instruments.

\[
\text{Hedge Ratio (HR)} = \text{BPV}_{\text{Bundle}} \div \text{BPV}_{\text{DSF}}
\]

E.g., as of January 2013, the BPV associated with a single June 2013 5-year DSF contract was measured at $47.62. The BPV for a 5-year Eurodollar futures bundle consisting of 20 contracts is equal to $500 (= $25 per contract x 20 contracts). The appropriate hedge ratio may be calculated as 10.5. This suggests that one match 10.5 DSFs vs. a single 5-year bundle.

\[
\text{Hedge Ratio (HR)} = \$500 \div \$47.62 = 10.5
\]

A similar analysis in the context of the 2-year DSF contract suggested a hedge ratio of 10.0 or the same ratio as applied above.

Applying these ratios, the 5-year DSF and Eurodollar bundle positions display reduced divergence. Note

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8 Calculated as the cumulative PL of the DSF less the cumulative PL of the comparable maturity bundle.

9 Basis point value (BPV) measures the expected monetary change in the value of an instrument given a one (1) basis point change in yield (0.01%). It is also referred to as the Dollar Value of an 01 or DV01.

10 To the extent that one cannot deploy a fractional futures contract, this implies that one might match 21 DSF vs. 2 5-year bundles.

11 We assume, as a matter of convenience, that one may deploy a fractional futures position.
that the range of PL differentials declines from a range bounded by -$593.75 and +$1,206.25 to a range bounded by -$634.37 and +$714.06. This range falls within (approximately) +/- one (1) basis point or $500.

We may further wish to "weight" the bundle or Eurodollar strip. In this example, however, we applied a simple equally-weighted strip as the lowest common denominator. 12

Convexity

We further add that a certain amount of the divergence might be attributed to "convexity." Convexity is a reference to the fact that the responsiveness of coupon-bearing fixed income instruments to fluctuating yields tends to be dynamic as yields rise and fall.

DSFs are effectively coupon-bearing instruments in the sense that they are listed with exchange-assigned fixed rates or coupons. These coupons are generally associated to reflect prevailing swap rates at the time of initial listing. E.g., the coupons associated with the June 2013 2- and 5-year DSFs were established, respectively, at 0.50% and 1.00%.

IRS instruments and DSFs exhibit convexity akin to other coupon-bearing fixed income securities. By contrast, Eurodollar futures taken individually represent the future or forward delivery of a specific money market instrument. Non-coupon bearing money market instruments exhibit zero convexity. In particular, a single $1 million face value 90-day Eurodollar futures contract has a BPV that is fixed at $25 per contract.

Thus, as rates advance (prices decline), the swap fixed rate receiver experiences a loss but at a decelerating rate. As rates decline (prices advance), the swap fixed rate payer generates a profit but at an accelerating rate. This "positive convexity" benefits a long DSF position relative to a position in Eurodollar futures or Eurodollar bundles.

Note that convexity is rather subdued in the current low-rate environment and is further muted in shorter maturities. Thus, convexity may be characterized as a subtle but nonetheless interesting phenomenon.

Arbitrage Opportunities

The dove-tailed nature of bundles and DSFs strongly suggest that arbitrage or, if you will, spreading opportunities may become available if DSFs and Eurodollar futures should become misaligned.

To learn more about Eurodollar futures or Deliverable Swap Futures (DSFs), please visit our website at www.cmegroup.com.

12 Please refer to our publication “Constructing and Managing Eurodollar Futures E-qtyvalents” (June 20, 2013) for further discussion on this point. In particular, this article described CME Group’s online E-qtyvalents tool which may be referenced to construct appropriately weighted strips of varying lengths. This piece is found at http://www.cmegroup.com/education/featured-reports/constructing-and-managing-eurodollar-futures-eqtyvalents.html

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