One Good Turn

By Galen Burghardt and Susan Kirshner
Dean Witter Institutional Futures

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ONE GOOD TURN
Galen Burghardt and Susan Kirshner explain how taking advantage of anomalies in borrowing costs around the year end can make for a happy new year.

It has been eight years since there was last any serious pressure on year-end dollar financing rates. But 1986 lives on in people's memory because the spike in the fed funds rate that year - and the year before - was so large and so expensive for those who had to borrow. As a result, "the turn", a two-, three- or four-day period from the last business day of one year to the first business day of the next, still has a profound effect on the way people think about year-end financing.

Figures 1 and 2 show both how much and how quickly the market's perceptions of the possible premium in turn financing rates can change. They chart the spread between the December and January one-month Libor futures prices for years ending 1982 and 1993 respectively. The December Libor futures price is 100 less the value of a one-month forward rate that spans the end of the year while the January futures price is 100 less the value of a one-month forward rate that does not. This means that any increase in the turn premium will decrease the value of the spread. Using the rules of thumb developed in this article, the 60-tick drop in the spread in November 1992 was evidence of a 500-basis-point increase in the turn premium.

The 20-tick drop in the spread in October 1993 suggested a 200bp increase in the expected turn premium. The subsequent rise in the spread largely reflects a fading of the market's concern over the turn premium as the year drew to a close.

The purpose of this article is to explain what the turn is and how it affects spot and forward dollar interest rates that span the end of a calendar year. We also draw out the implications for trading Libor and Eurodollar futures and options on futures. In doing so, we derive some useful rules of thumb for translating turn premiums into futures market spreads and show how volatility in the turn premium translates into additional volatility in the December Libor and Eurodollar futures prices. One of the things we find is that options traders regularly seem to pay far too much for the extra volatility.

The turn
"The turn" is the period between the last business day of the current calendar year and the first business day of the new year. As New Year's Day is a holiday, the number of days in the turn is at least two calendar days and can be three or four. The turn lasts two days if December 31 falls on a Monday, Tuesday or Wednesday. In each of these cases, the next calendar day is a holiday so that money borrowed on Monday would be paid back on Wednesday, two days later. Money borrowed on Tuesday is paid back on Thursday, and money borrowed on Wednesday is paid back on Friday.

If December 31 falls on a Friday or Saturday, so that January 1 falls on a weekend, the number of days in the turn depends on whether the Fed wire is open on the following Monday. In 1993, December 31 fell on a Friday and the Fed wire was open on the following Monday (January 3). Since money borrowed on the Friday was paid back three days later on the Monday, 1993/1994 was a three-day turn. This year, December 31 falls on a Saturday and the Fed wire will be closed on the Monday (January 2), making 1994/1995 a four-day turn.

If December 31 falls on a Thursday, the turn will last four days since money borrowed on Thursday will be paid back the following Monday. Figure 3 shows a time line of the turn for the end of 1994. The last business day is Friday, December 30. A bank looking to borrow overnight funds on Friday would normally repay those funds the following Monday, which is the new business day. But this year, as New Year's Day falls on Sunday, the Fed wire is closed on Monday, January 2.

Rate behaviour around the turn
The turn has gained notoriety among bankers because of the pressures that have been brought to bear on year-end financing rates in years past. The source of this pressure is said to be the demand by banks for cash that can be used to club their balance sheets at the end of the calendar year. Although the Fed does what it can to accommodate this year-end increase in demand for liquid balances, and does an excellent job most of the time, it appears to have misjudged the size of the shift at least twice since 1984.

Figure 4 shows that the turn rate and the average rate around the turn appear to have been fairly close to one another in most of the past 10 years. In 1984, for example, normal financing rates during the five days before and after the turn were around 8.37%. For the turn between 1984 and 1985, the turn rate increased to 8.74%, for a turn premium of 0.37%. The "turn ratio", which is simply the ratio of the turn rate to the non-turn rate and which we will use later when we examine the effect of the turn on rate volatility, was only 1.04.

At the end of 1985, however, the turn premium was more than five percentage points, and at the end of 1986, nearly seven. The effect of a seven percentage point turn premium on the cost of funding $1 billion over the year end, even for a turn period as short as two days, is $339,000. This is serious money in anybody's book.

Since 1986, realised rate behaviour around the turn has been unremarkable. Even so, the possibility of a large premium still looms large, and wide swings in the market's expectations about turn financing rates can have dramatic effects on forward deposit rates.

Effects on Eurodollar and Libor futures prices
As the one-month Libor and three-month Eurodollar futures prices for years ending 1990-1993 suggest, the relationship between the turn rate and the deposit rates to which the Libor and Eurodollar futures contracts will settle can be determined by comparing two borrowing transactions. In the first, money is borrowed for the full term at a lending rate. In the second, money is borrowed in three legs – one that runs from December 21 through January 29, one that runs from December 21 through January 29, one that runs from December 30 through January 3, and one that runs from January 4 through the end of the turn. Under the first strategy for borrowing one-month money, one dollar borrowed on December 21 would call for $1 + 33/360.

...
The three-month term deposit rate can be expressed the same way. The only difference is that the non-turn rate for the 90-day period would be different from the non-turn rate for the 33-day period.

To get a sense of how large an effect the turn can have on December Libor and Eurodollar futures prices, suppose first that the turn and non-turn rates are the same, say 6%. In this case, both one-month and three-month deposit rates would be (except for a trivial amount of compounding) 6%. December Libor and Eurodollar futures prices would both be $94.00 (= 100.00 - 6.00). Suppose now that the turn rate increases by 200bp to 8%, while the non-turn rate stays at 6%. At these rates, the fair value of the December Libor contract would be 93.75 (= 100.00 - 6.25), and the fair value of the December Eurodollar contract would be 93.91 (= 100.00 - 6.09). Thus, the effect of a 200bp increase in the spread between turn and non-turn rates is to decrease the fair value of the December Libor contract by 25bp and the fair value of the December Eurodollar contract by 9bp.

Although the effect of any given turn/non-turn rate spread on the fair value of the December Libor and Eurodollar futures contracts depends to some extent on the actual number of days in the forward periods and on the level of rates, we have what we need for excellent working rules of thumb.

With a four-day turn, the effect of each 100bp increase in the spread between the turn and non-turn forward deposit rates is a 12-tick decrease in the fair value of the December Libor contract and slightly more than a 4-tick decrease in the fair value of the December Eurodollar contract.

With a three-day turn, the effect of each 100bp increase in the spread between the turn and non-turn forward deposit rates is a 9-tick decrease in the fair value of the December Libor contract and just over a 3-tick decrease in the fair value of the December Eurodollar contract.

From this 50bp differential, we can determine the spread between turn and non-turn financing rates that is implied by the Libor futures contract. Using the rule of thumb that each 100bp in the spread reduces the fair value of the December Libor contract by about 12bp, the 50bp differential in the December contract implies a spread of about 400bp between the turn and non-turn rates. This implied rate spread can be compared easily with the spreads quoted in the forward deposit market as a way of comparing the pricing of the two markets. If you find, for example, that the implied rate differential is larger than the actual, then you know that the December Libor contract is cheap relative to cash.

Implications for futures spreads
As the turn rate affects both the December Libor and Eurodollar futures contracts, it affects the values of several key futures spreads including the:

- **December LED spread**. In this spread, you are long the Libor contract and short the Eurodollar contract. Given the rule of thumb for a four-day turn, each 100bp increase in the premium translates roughly into an 8-tick decrease in the value of this spread. Thus, the December LED spread is about 32 ticks.
With an implied turn premium of around 400bp, December Eurodollar futures trade 16 ticks or so lower than they would without the turn. Thus, we know that about 16 ticks of the current December TED spread can be attributed to the turn. By the same token, the December/March Eurodollar calendar spread is 16 ticks lower than it would be without the turn.

Effect of the turn on Libor and Eurodollar volatilities

Uncertainty about financing rates over the turn is an additional source of volatility for the one-month and three-month deposit rates to which the December Libor and Eurodollar futures contracts will settle. How can the effect of turn-rate volatility on the volatilities for options on December Libor and Eurodollar futures be determined?

The biggest hurdle to calculating this is how to represent turn-rate volatility. The few observations that we have on the turn, which are shown in Figure 4 (page 47), suggest fairly strongly that turn rates are not lognormally distributed.

With few observations, however, we only have what we think are two reasonable guides to choosing an alternative distribution. The first is that the size of the turn rate premium should be related to the level of interest rates. The second is that the chance of getting a huge turn premium should be related to the level of non-turn rates. And, at any given set of levels of volatility, the contribution is smaller for a two-day turn than for a four-day turn.

The effect of turn-rate volatility is higher if the level of non-turn interest rates is lower. This is shown in Figure 10, where everything is the same as in Figure 9 except that the level of non-turn interest rates is 3% rather than 6%. At this level of rates, we reckon that the effect of 4.5% volatility in the turn/non-turn ratio combined with 25% base rate volatility is an increase of 2.52% in December Libor and 2.23% in December Eurodollar volatility for a four-day turn.

These results may not seem very exciting at first glance because they cannot shed much light on whether December Libor or Eurodollar options are expensive or cheap.

### 9. Add-on turn volatility premium (3% forward rate)

<table>
<thead>
<tr>
<th>Volatility of the turn ratio</th>
<th>Base rate volatility for:</th>
<th>One-Month Libor</th>
<th>Three-Month Eurodollars</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two-day turn</td>
<td>Four-day turn</td>
<td>Two-day turn</td>
</tr>
<tr>
<td>15%</td>
<td>0.40</td>
<td>0.56</td>
<td>0.33</td>
</tr>
<tr>
<td>25%</td>
<td>0.48</td>
<td>0.60</td>
<td>0.35</td>
</tr>
<tr>
<td>35%</td>
<td>0.62</td>
<td>0.68</td>
<td>0.39</td>
</tr>
<tr>
<td>45%</td>
<td></td>
<td></td>
<td>0.90</td>
</tr>
</tbody>
</table>

### 10. Add-on turn volatility premium (6% forward rate)

<table>
<thead>
<tr>
<th>Volatility of the turn ratio</th>
<th>Base rate volatility for:</th>
<th>One-Month Libor</th>
<th>Three-Month Eurodollars</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two-day turn</td>
<td>Four-day turn</td>
<td>Two-day turn</td>
</tr>
<tr>
<td>15%</td>
<td>0.72</td>
<td>1.05</td>
<td>0.66</td>
</tr>
<tr>
<td>25%</td>
<td>0.83</td>
<td>1.11</td>
<td>0.69</td>
</tr>
<tr>
<td>35%</td>
<td>1.03</td>
<td>1.23</td>
<td>0.76</td>
</tr>
<tr>
<td>45%</td>
<td></td>
<td></td>
<td>1.26</td>
</tr>
</tbody>
</table>
But they can be a powerful tool in evaluating spread trades between December Libor and Eurodollar options.

For instance, even in the extreme case – rates at 6%, turn ratio volatility at 0.45, base rate volatility at 25% and a four-day turn – the effect of turn-rate volatility on the difference between Libor and Eurodollar volatilities would only be about 0.3% (the difference between 2.52 and 2.21, as shown in Figure 10). In less extreme cases, and with a three-day turn, the effect would be smaller.

On this basis, we would expect the spread in implied volatilities for the Libor and Eurodollar options to be quite small. But in Figures 11, 12 and 13 we see that in 1992, 1993 and 1994 the options market has paid a hefty premium for the LED volatility spread. In 1993, for example, the implied volatility spread was consistently about 8% greater than the historical volatility spread. At the time of writing, the LED-implied volatility spread for the December 1994 contracts is trading around 6.5% – about 5% greater than the historical volatility spread.

We view this as an opportunity to take advantage of an apparent mispricing. For example, to sell December 1994 Libor volatility and buy December 1994 Eurodollar volatility on October 3, 1994, one could have:

- sold 100 of the December 94.00-93.75 Libor strangles at 35 ticks per strangle and sold 10 December Libor futures to make the position delta neutral (futures at 93.83) and
- bought 100 of the December 94.00 Eurodollar straddles at 30 ticks per straddle and bought 11 December Eurodollar futures to make the position delta neutral (futures at 93.96).

Thus, the spread position could have been established for a net credit of 500 ticks.

A position like this would have some interesting and desirable characteristics. As the spread is long the low-volatility options and short the high-volatility options, the net position provides a rare opportunity to be long gamma and to have time decay work in your favour at the same time.

Figures 11 and 12 show how highly variable the implied LED volatility spread is. Thus, even though the additional premium paid for Libor volatility seems not to be justified by either the theory or the evidence, a position that is short Libor volatility and long Eurodollar volatility can produce large swings in a trader’s profit and loss from day to day. Also, a sharp increase in the turn rate can be costly for anyone who is short Libor volatility. In late November 1990, for example, such a spike in the turn rate increased the 20-day historical volatility spread to around 14%.

Even so, there are two ways the trader can make money on the trade. The first is a collapse in the implied volatility spread so that it accords more closely with what it should be. This is the best outcome because it avoids the need to actually work for a living by managing the position until the December expiration of the options.

If the implied volatility spread does not collapse, the trader can still make money if the realised difference between December Libor and Eurodollar volatilities proves to be less than 6.5%. In this case, if the position is properly managed, the trader can profit from the relatively higher time decay that would be taken in on the Libor options than would be paid out on the Eurodollar options.

Galen Burghardt is a senior vice-president and director of research at Dean Witter’s institutional futures group in Chicago and Susan Kirshner is a vice-president in the same group.