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THC MARKET BULLETIN

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THC Cointegration: Manage Value with Clarity
Bulletin 34

New Paradigm in Basis Trading

Basis trades consist of two or more legs to exploit any temporal misalignments of relative prices of securities. Pair trades between the cash and the futures markets, calendar trades and butterfly trades are examples of basis trades that may offer opportunities in these fast growing and volatile Treasury markets.

To date, the hedge ratios between the legs of a basis trade are often determined by minimizing the DV01 number. DV01 is the dollar change of a position for a one basis point parallel shift of the yield curve, and the DV01 of a futures contract is often approximated by that of the cheapest-to-delivery (CTD). A principled approach to basis trading is to ensure minimization of DV01 exposure in order to eliminate yield curve risk.

However, this approach is inadequate to manage the value of the trade with clarity in today's markets because traders have to take the following factors into considerations in executing basis trades:

- Futures contract values do not move in tandem with the cheapest-to-deliver (CTD) bonds because the futures contract contains an embedded delivery option.
- Cheap/Rich values of CTD or bonds in the delivery basket are determined relative to the on-the-runs (i.e., the basis between the CTD and the OTR), and therefore, the relative value of the futures vis-à-vis the OTR must factor in the CTD/OTR basis together with the futures/CTD basis.
- Yield curve risk is not confined to parallel shifts (the curve can twist), resulting in continued and significant interest rate risk to pair trades with similar terms and negligible DV01s.
- The market microstructures have to be an integral part of the trading process; for example, the price discovery process at the start of the US trading session, new calendar rolls, session close, market-making in the less active markets (e.g., 30-year Classic) or developing markets (e.g., the Ultra Bond), etc. These factors can seriously affect the efficacy of the traditional hedge ratio approach in managing basis trades. THC Cointegration offers a new trading analytical process to overcome these problems.

This THC approach enables traders to:

- Seek new trading opportunities as the markets continue to grow in size, volatility and complexities;
- Isolate interest rate risk from cheap/rich values and formulate new trading strategies;
- Trade the delivery options;
- Monitor multiple trades with a sharper tool to identify values.

THC Cointegration: Managing Value with Clarity

The THC approach uses financial models, as opposed to empirical models, to determine the structural relationships between the markets, such as the cash markets and the futures markets. Financial modeling does not primarily rely on historical time series to identify value. Instead, the models provide a coherent description of the price relationships, resulting in a method that accurately identifies the mean-reversion process. For example, traders cannot rely on correlations in price movements when pair trading the 5-year futures with the corresponding 5-year OTR prices. Traders need to consider all factors mentioned above to identify the convergence process. The THC financial models give such a description.

VRC Steps

THC Cointegration requires three necessary steps which can be described as "VRC":

(1) Valuation

(2) Risk Management

(3) Cointegration

Trading is a process where the three parts form a cycle; where trades can be continually monitored, revised and executed.

(1) "Valuation" refers to determining opportunities with the structural relationships that a trader specializes in trading. A common class of trades is the futures/cash relationship with minimal interest rate risk exposure on the premise that the cheap/rich of the relationship should follow a mean reversion process. Traders can view the time series of cheap/rich of the trade to identify the value real time.

The figure below shows the changing cheap/rich values of a pair trade between the 7-year bond and the 10-year June contract. When the cheap/rich value reaches maximum (minimum), the analysis would suggest sell (buy) the trade.

Figure 1. *Trend Analysis: Monitor the Trading Opportunities*

(2) "Risk Management" refers to enabling traders to identify interest rate risk exposures, taking delivery options, yield curve parallel and non-parallel shifts into account.

For example, consider the pair trade of buying $10MM for the 5-year OTR (912828MZ0) and selling 65 TYM0 contracts. The resulting DV01 is -$38.60. But the figure below shows that the key rate DV01s of the 5-year and 7-year equal $3,500 in absolute value. That is, whenever the 7-year rate rose (fell) 1 bpts more than the 5-year rate, the position would gain (lose) $3,500. This is called the *leg risk*. The examples in the following section will show how the cointegration approach can mitigate this leg risk.

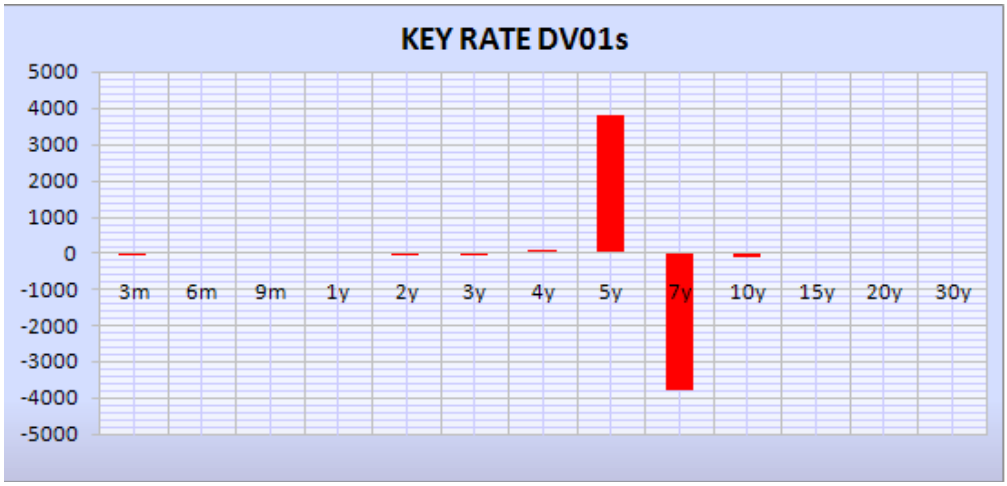

Figure 2. Key Rate DV01: Manage the Interest Rate Risks

(3) "Cointegration" graphically illustrates the stochastic movements of cheap/rich and interest rate returns of the trade over a historical period. Such clarity in a financial modeling environment enables traders to interpret seemingly random movements of price relationships and provides information on the likelihood of convergence over the trading horizon.

Figure 3 below shows the attribution of the P/L of a butterfly trade from 5/5/2010 to 5/7/2010. The yellow color and the green color depict the P/L attributed to the changing cheap/rich values and the changes in the yield curve. The key rate DV01 enables the trader to adjust to positions to optimize the risk and return tradeoffs. (See Bulletins 32 & 33 for further clarification regarding the butterfly trade and DV01).

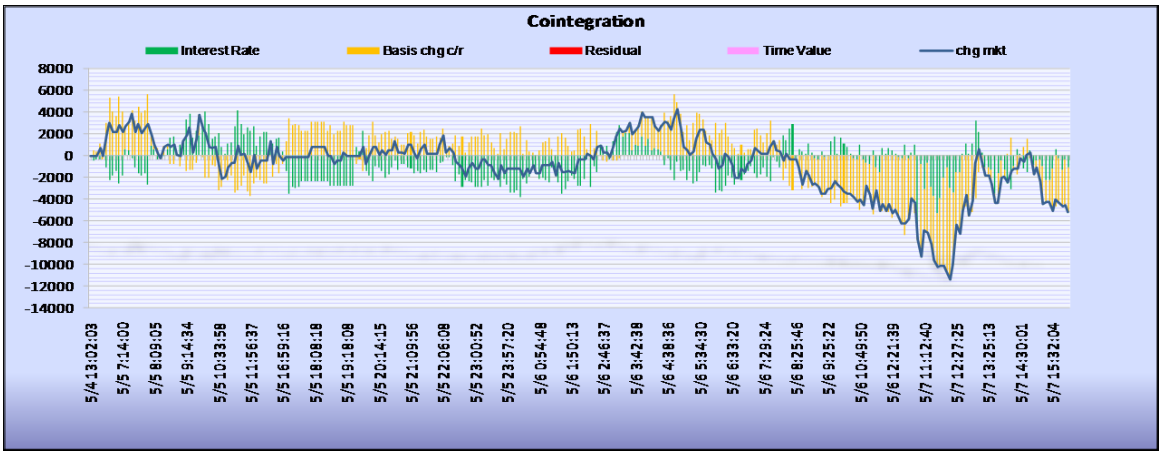

Figure 3. Cointegration: Monitor the Trade

Trade Phases

Given the cointegration trade signals, traders can relate the information to the market microstructures, such as the bid-ask spreads, market liquidity and depth. Traders can then decide on how to execute spread trades. There are three phases in this process.

Step 1. *Valuation Phase*. Use the *Trend Analysis* tab, enter the positions and check the time trends of the cheap/rich.

Step 2. *Risk Management Phase.* Use the *Position/Risk* tab to optimize the interest rate risk exposure of the trade.

Step 3. *Cointegration Phase.* Use the *Cointegration* tab to analyze the behavior of the interest rates risk and the cheap/rich movements and monitor "spread price" movements of the trade. Monitoring these movements would provide inputs to the entry and exit decisions of a trade.

Five Sample Trades

The following trades are used to illustrate the cointegration process, beginning with some standard pair trades and moving to more complex trades.

1. **5 C/F Hedge Ratio 99.** Buy $10 MM 5-year OTR and sell 99 5-year June contracts (FVM0)

   a. Key rate DV01 shows that there is a significant mismatch of the 4-year and 5-year rate exposure. The impact of the interest rate exposure can be verified by the cointegration analysis. DV01 = -$0.96. The leg risk = $ 3,000.

   b. To isolate the cheap/rich from interest rate risk, use the 7-year OTR to formulate a butterfly. The effect can be verified by the cointegration analysis. Short 105 FVM0 contracts, buy $16 MM 5-year (MZ0 4/30/15), and sell $4 MM 7-year (NA4 4/30/17).

   c. Monitor the 5-year basis cheap/rich in *Trend Analysis* tab to decide on the entry-exit points.

   d. The cheap/rich trends should relate to the P/L values in Cointegration, when interest rate risks are negligible.

The time series of the 5-year futures basis cheap/rich can provide the trading signals. For example, the futures contract became rich during the morning of 5/21, viewed in *Trend Analysis* tab and that would result in the fall in the spread price of the trade.

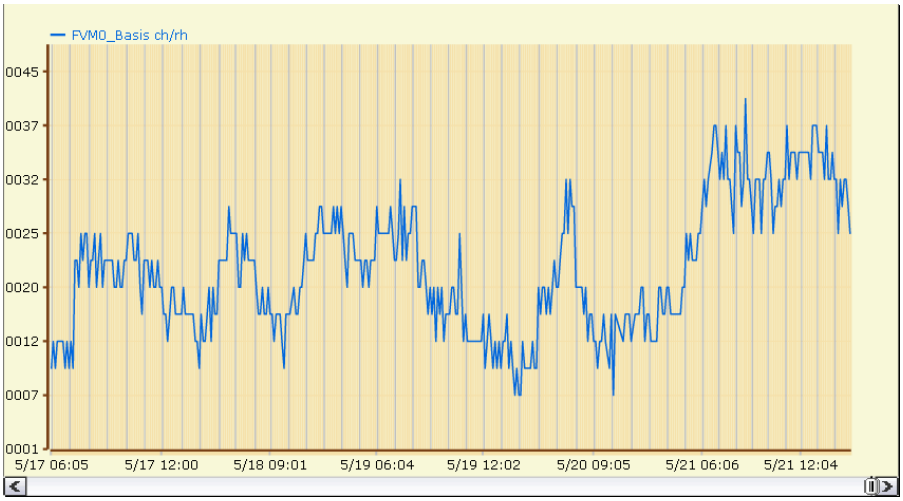

Figure 4. Time series (in the *Trend Analysis* tab) of the 5-year Futures Contract

The left and right panels below are the Key Rate DV01 of the Pair Trade and the Butterfly Trade respectively as described above.

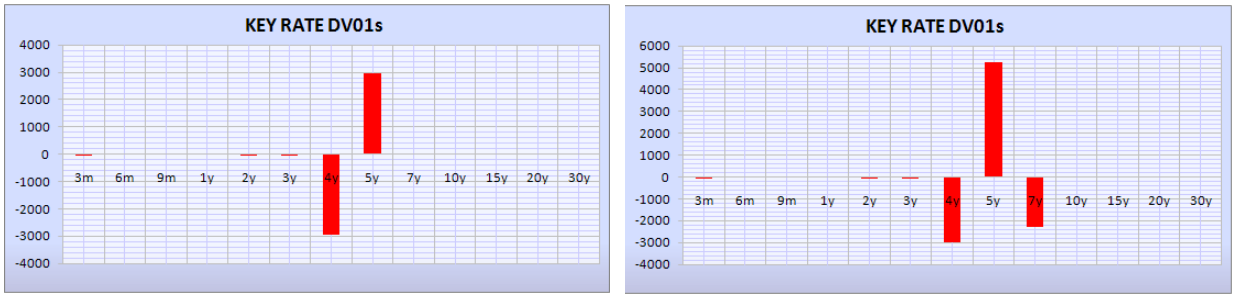

Figure 5. Key Rate DV01 of the Pair Trade and the Butterfly Trade

Using key rate DV01 to revise the position, interest rate exposure is clearly minimized, and traders can then monitor the mean-reverting process of the cheap/rich (the yellow component).

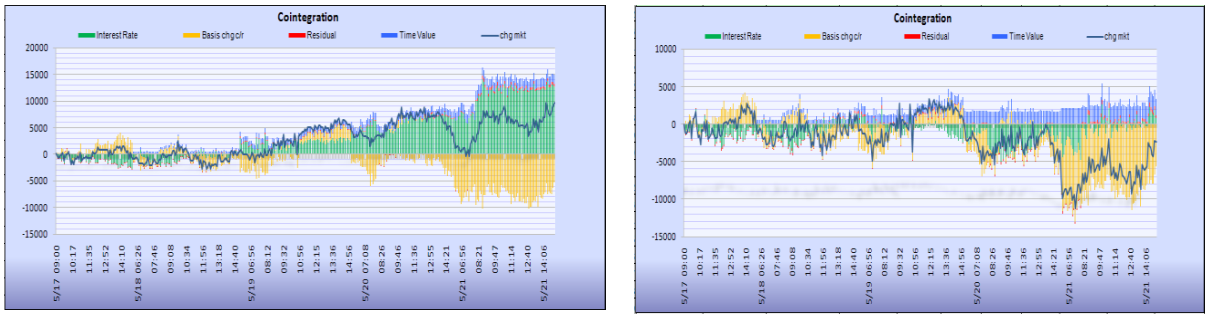

Figure 6. The Cointegrations of the Alternative Basis Trades

2. **10 C/F HR88**. Buy $10 MM 7-year OTR and sell 88 10-year June contracts (TYM0)

   a. Key rate DV01 shows that the trade has significant mismatch of 7-year and 10-year interest rate exposure. DV01 = $3.32. Leg risk $686.

   b. Revise the trade to: short 84 TYM0 contracts, sell $0.6MM 5-year OTR, and buy $10MM 7-year OTR.

   c. This trade accounts for the delivery options in the TYM0.

3. **UL C/F HR85.** Buy $10 MM 30-year OTR and sell 85 UL June contracts (ULM0)

   a. Key rate DV01 shows that the trade has significant mismatch of 30-year and 20-year interest rate risks. DV01 = $-13.14. Leg risk = $3,000

   b. Revise the trade to: short 85 ULM0 contracts, buy $2MM 10-year OTR and $9MM 30-year OTR.

   c. Although this relatively new market lacks extensive historical data to determine empirical hedge ratios, the trade enables participation and the chance to exploit the relatively large fluctuations of the cheap/rich values.

4. **30 F/C HR(-7, 10, -4)**. *Buy $10 MM 30-year futures (USM0), sell $7MM and $4MM in 10-year and 30-year OTRs respectively.*

   a. The CTD of the 30-year futures is exposed to the 15-year interest rate risk and therefore a butterfly trade is used to hedge the interest rate risks.

b. This trade DV01 = -$30.56 and the wing risk = $4,000.

c. In the *Trend Analysis* tab, the basis c/r shows the trend of cheapening of the 10-year CTD while the futures c/r shows that the futures are fairly priced relative to the CTD. This trade therefore shows the importance of incorporating the basis between the CTD and the OTR.

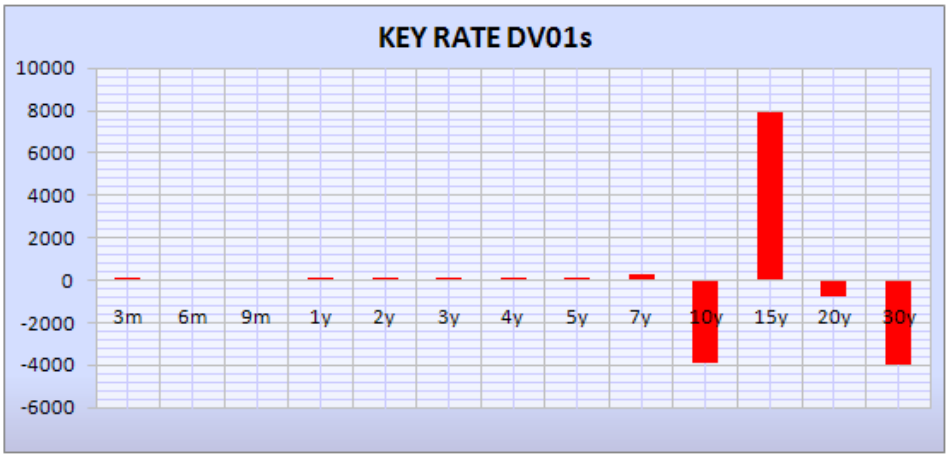

Figure 7. Key Rate DV01 of the USMO Butterfly Trade

5. **10 F/F HR10.6**. Buy $10 MM 10-year September contract and sell $10.6 10-year June contracts

a. The calendar trade has DV01= $10.7. The leg risk = $650 in the 10-year interest rate.

b. Revise the trade to 135 TYM0 contracts, sell 96 TYU0 contracts and sell $5MM 5-year MZ0 4/30/15.

c. This trade shows even the calendar trade has significant interest risk exposure and the risk can be measured, monitored and managed. This trade is particularly important as the market enters the roll cycle.

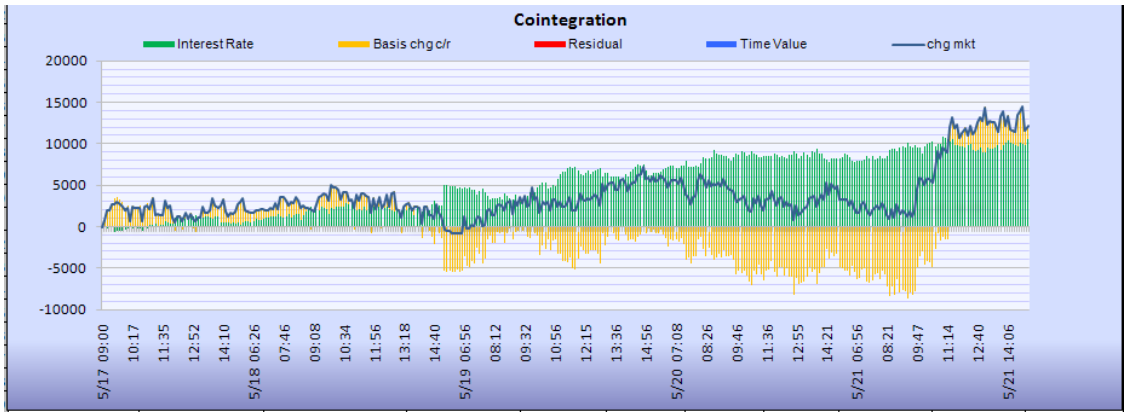

Figure 8. Cointegration of the 10-year Calendar Trade

Below is the time series (in the *Trend Analysis* tab) of basis cheap/rich of TYM0 – TYU0. The results clearly show the drop in the cheap/rich value on 5/21, leading to a lowering of the calendar trade value.

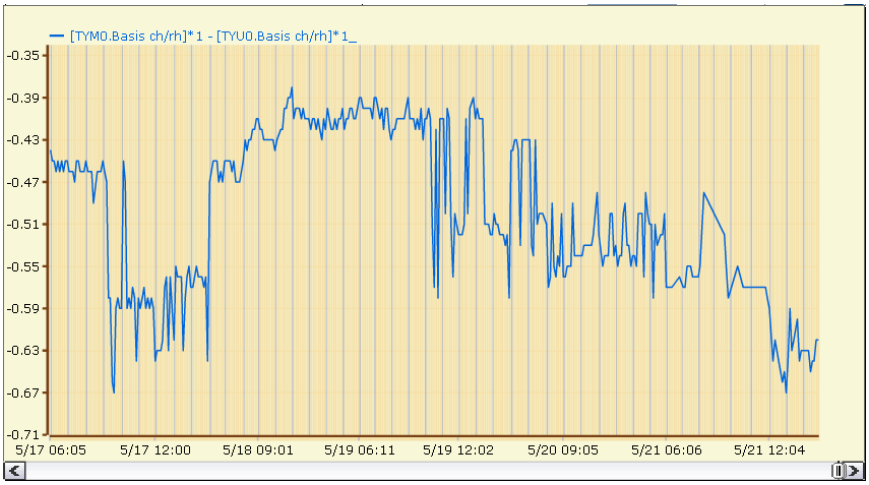

Figure 9. The Calendar Basis Cheap/Rich Time Series

The left panel and the right panel below are the key rate DV01 profile of the Butterfly Trade and the corresponding cointegration, respectively. The results clearly show the significant reduction of the interest rate risks, minimizing the green component of the P/L.

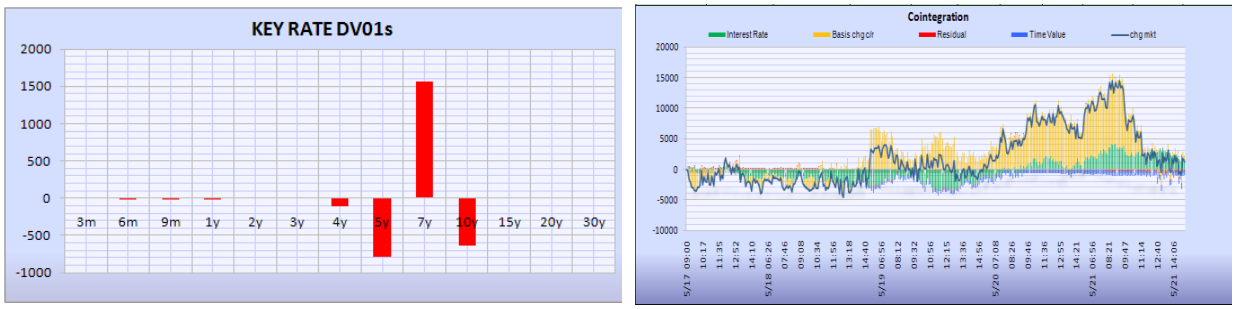

Figure 10. The Key Rate DV01 and the Cointegration of the Calendar Butterfly Trade

Conclusion: Beyond the Illustrated Basis Trades

a. The above examples illustrate the importance of accurate measures of risks and values to isolate the cheap/rich and interest rate risks to exploit trading opportunities. The cointegration approach enables traders to manage the basis trade.

b. The process can be extended to CTD/OTR, CTD/Futures and other basis trades along the curve.

c. The process can be extended to trading the cointegration interest rate movements exploiting any temporal idiosyncratic yield curve movements.

d. The cointegration approach can be extended to the LIBOR curve and the basis trades between the LIBOR/Swap curve and the Treasury curve.

Note that THC Decisions™ Treasury Analytics has many functions beyond trading basis. They including: hedging investment portfolios, cash trading, risk management and more.