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Treasury Futures Basis

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Treasury Cash-Futures Basis

For any Treasury futures contract
and any deliverable-grade Treasury security for that contract…

Basis =
today's Treasury security price
minus
invoice price for forward settlement at Futures delivery reflected in today's Futures price

Basis = Cash Spot Price minus (Futures Price x Invoice Conversion Factor)

Basis Positions and Ratios

Long vs Short
“Long the Basis” ➲ Long Treasury security + short Futures.
“Short the Basis” ➲ Short Treasury security + long Futures.

Size of futures position = Conversion factor

<u>Example: Dec09 10-Year Treasury Note Futures Basis for 4-7/8 of Aug 2016</u>
Assume cash position size = $10m face value
Futures contract notional size = $100k
Conversion factor for invoicing delivery of 4-7/8 of Aug 2016 into ZNZ9 = 0.9402

Long Basis position =

Theoretically: Long ($10m 4-7/8 Aug16) + Short (**0.9402 * ($10 m / $100 k)** ZNZ9)

In practice: Long ($10m 4-7/8 Aug16) + Short (**94** ZNZ9)

Basis = Carry + Embedded Delivery Options

Basis splits into 2 parts

- **Carry –** Reasonably predictable
- **Basis Net of Carry (BNOC)** -- Market price of Futures embedded delivery options

<u>Carry to Delivery</u>

Net income earned by long Basis holder, or paid by short Basis holder, on cash Treasury position

Carry = Accrued Coupon from Spot Settlement Date to Futures Delivery Date
minus Financing Cost from Spot Settlement Date to Futures Delivery Date

<u>BNOC = Treasury Futures Delivery Options</u>

Quality Option – What to deliver

Timing Option – When to deliver

Long basis ➲ Short Futures ➲ Long delivery options

Short basis ➲ Long Futures ➲ Short delivery options

Basis Trading Styles: Strategic vs Tactical

At the heart of the Basis trade is convergence of Cash price to Futures price
Delivery into Futures is what keeps Basis spread "honest". Good basis traders know how to gauge the pace at which cash Treasury spot price gravitates toward forward settlement value reflected in Treasury Futures delivery invoice price.

For Carry to delivery, convergence is obvious.

For BNOC component, convergence is analogous to any option.

Strike Price: Futures invoice price
Expiry Date: Futures delivery date

Time: BNOC value decays as time passes, ie, as Futures delivery date approaches.

Volatility: BNOC Value rises as yield volatility causes more than one Treasury issue to become attractive for making delivery into Futures, ie, as number of "Cheapest to Deliver" candidates rises. Sources of volatility --

(1) general yield levels
(2) slope of yield curve across Treasury maturities deliverable into Futures

Basis Trading Styles: Strategic vs Tactical

Classic basis trading is strategic: Time horizon is often several weeks.

In all but the most volatile environments, passage of time is important.
Relatively large shifts are required in yield levels or in slope of yield curve to change BNOC's value.

Tactical basis trading: Time horizon is short – a few days, even intraday.

Challenges versus strategic trading

Wide bid-offer spread: There must be enough volatility at high frequencies to make trade entry and exit worthwhile.

Cash market illiquidity: Many off-the-run Treasury issues may not be active enough to allow easy position entry/exit.

Advantages versus strategic trading

Less vulnerability to vagaries of repo financing.

Position Entry/Exit: Bid-Offer Spreads

Bid-offer spread for Basis is wide

Entering or exiting a Basis spread means crossing 2 bid-offer spreads – one for Treasury cash, one for Futures.

For Basis trader who is purely a price-taker:

Basis Offer = Treasury cash offer minus (Futures bid * Conversion factor)

Basis Bid = Treasury cash bid minus (Futures offer * Conversion factor)

Example: Dec09 10-Year T-Note Futures Basis for 4-7/8 of Aug 2016 on Friday, 11 Sep 2009

Conversion factor for invoicing delivery of 4-7/8 of Aug 2016 into ZNZ9 = 0.9402

	4-7/8 Aug16	ZNZ9	Basis
Offer	112-15/32	118-00	49.25 ticks ≈ 112-15 – (117-31.5 * 0.9402)
Bid	112-14	117-31+	47.75 ticks ≈ 112-14 – (118 * 0.9402)
Bid-Offer Spread	1 tick	½ tick	1-1/2 ticks

Position Entry/Exit: Legging

Two schools of thought –

<u>Standard: Cash first, then Futures</u>

Put down stakes in the less liquid Cash market.
To complete the position, take advantage of relative maneuverability in the more liquid market.

<u>Alternative: Futures first, then Cash</u>

Often favored by traders who are highly active in Futures.

Put down stakes in the more liquid Futures market.
If price levels in less liquid Cash market become opportune, then complete position.
If not, then just liquidate Futures position: The trader is already involved in the market anyway.

Bid-Offer Spread Implications: Alternative approach may lower the trader's effective Basis bid-offer spread, to the extent that the trader is a price-maker in Futures, ie, he is able to buy Futures at his bid or sell Futures at his offer.

Directional Bias: Alternative approach works best if trader --
buys Basis when Futures price is falling.
sells Basis when Futures price is rising.

Position Entry/Exit: Knowns and Unknowns

Carry = equals Accrued Coupon from Spot Settlement Date to Futures Delivery Date minus Financing Cost from Spot Settlement Date to Futures Delivery Date

Basis = (Accrued Coupon minus Financing Cost) + BNOC

<u>A little notation…</u>

P	Clean spot price (excluding accrued interest) of deliverable Treasury security
F	Futures price
t0	Spot settlement date
t1	Expected forward settlement date for delivery into Futures contract
AI(0)	Accrued coupon up to spot settlement date
AI(0,1)	Accrued coupon from spot settlement date (t0) to expected Futures delivery date (t1)
r	Repo rate

Basis = (AI(0,1) minus ((P+AI(0)) * r * (t1-t0)/360) + BNOC

Position Entry/Exit: Knowns and Unknowns

Things you know

P	Spot price of Treasury security
AI(0)	Accrued coupon from last coupon date to spot settlement date

Things you may be uncertain about

r — Repo rate. Term repo? Open overnight repo? Repo specials?

t1 — Date of delivery into futures.

First delivery day, if Carry is negative.
Last delivery day, if Carry is positive.
Anytime during delivery month, if Carry ≈ zero.

Impacts: (1) Value of AI(0,1)
(2) Value of r, if you use term repo.
(3) Horizon for forecasting daily o/n repo rates, if you use open overnight repo.

Things you don't know

BNOC — True value of embedded delivery options

Position Entry/Exit: Implied RP Rates

For any Treasury futures contract
and any deliverable-grade Treasury security for that contract…

Implied RP Rate is money-market rate of return generated by purchasing Treasury security and then delivering it into Futures.

If Treasury security pays coupon on Day tm between spot settlement day (t0) and Futures delivery date (t1) --

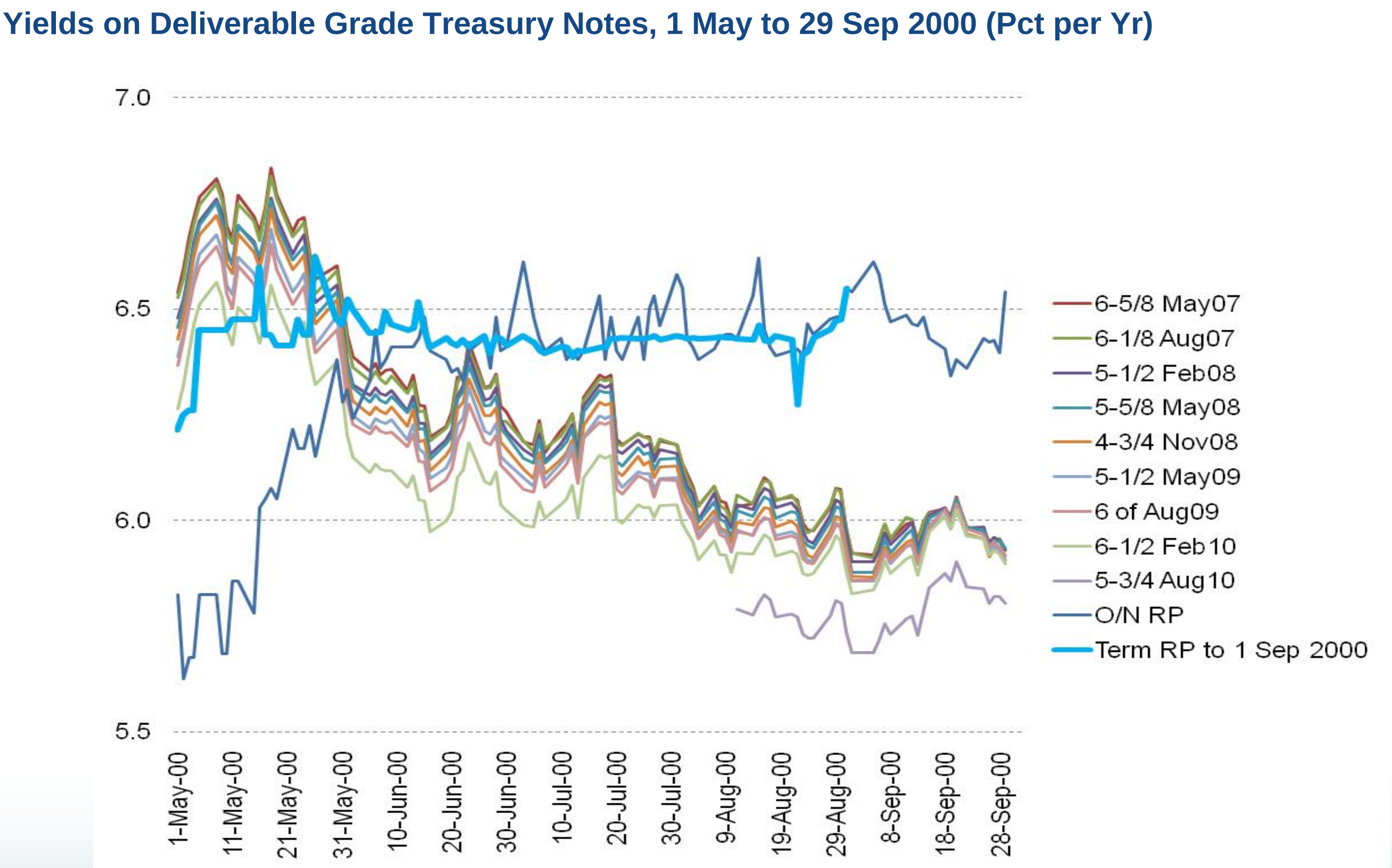
Implied RP = 360/(t1-t0) *
(Futures Invoice Price + (Coup/2) - Spot Purchase Price) /
(Spot Purchase Price – (Coup/2)*(t1-tm)/(t1-t0))

If no coupon payment between spot settlement day (t0) and Futures delivery date (t1) –

Implied RP = 360/(t1-t0) * (Futures Invoice Price/Spot Purchase Price - 1)

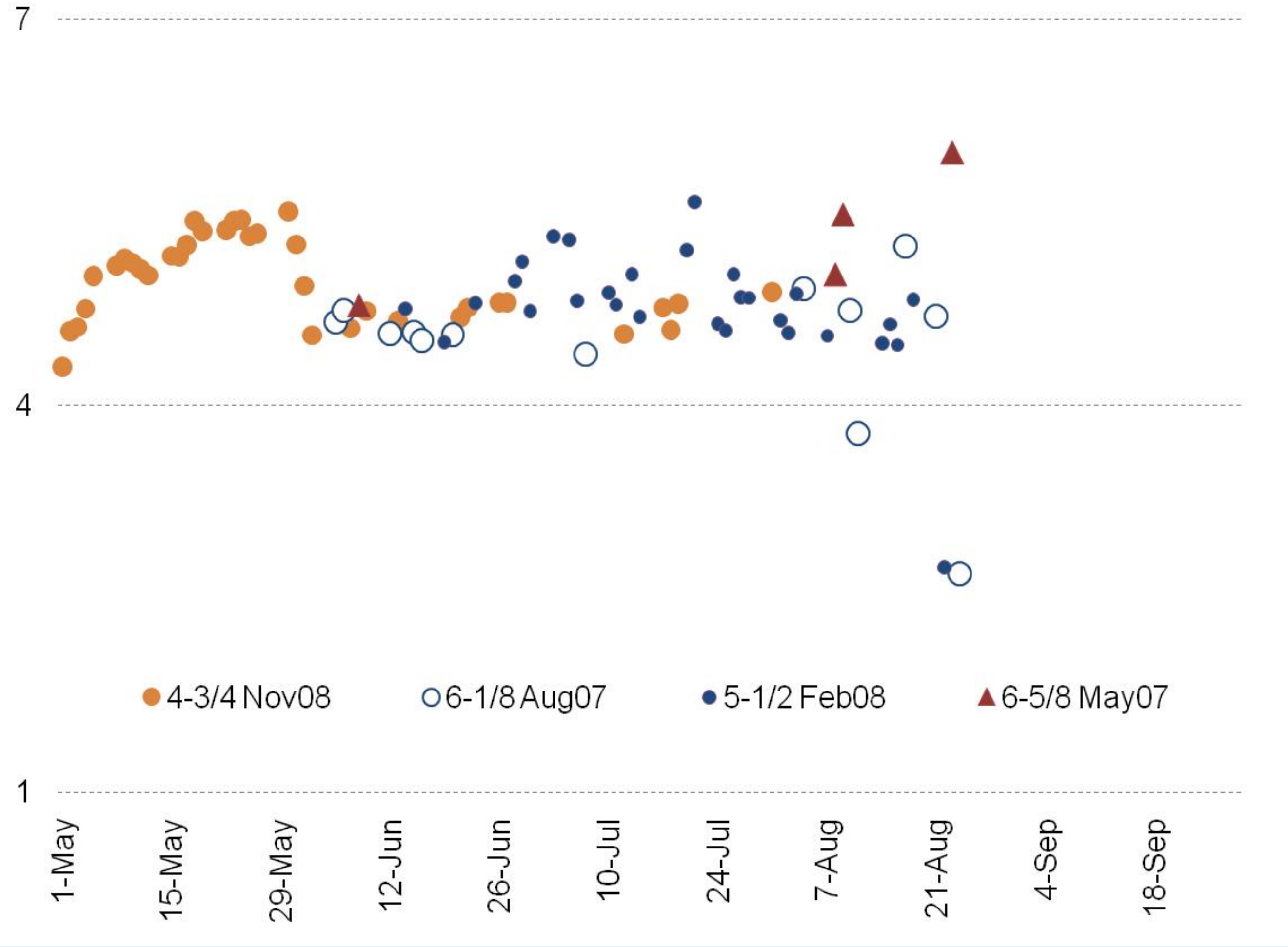
<u>Indicator of Basis trade opportunities:</u>
If Implied RP is high, then Basis is cheap.
If Implied RP is low, then Basis is rich.

Example: Sep 2000 10-Year T-Note Futures (TYU0)



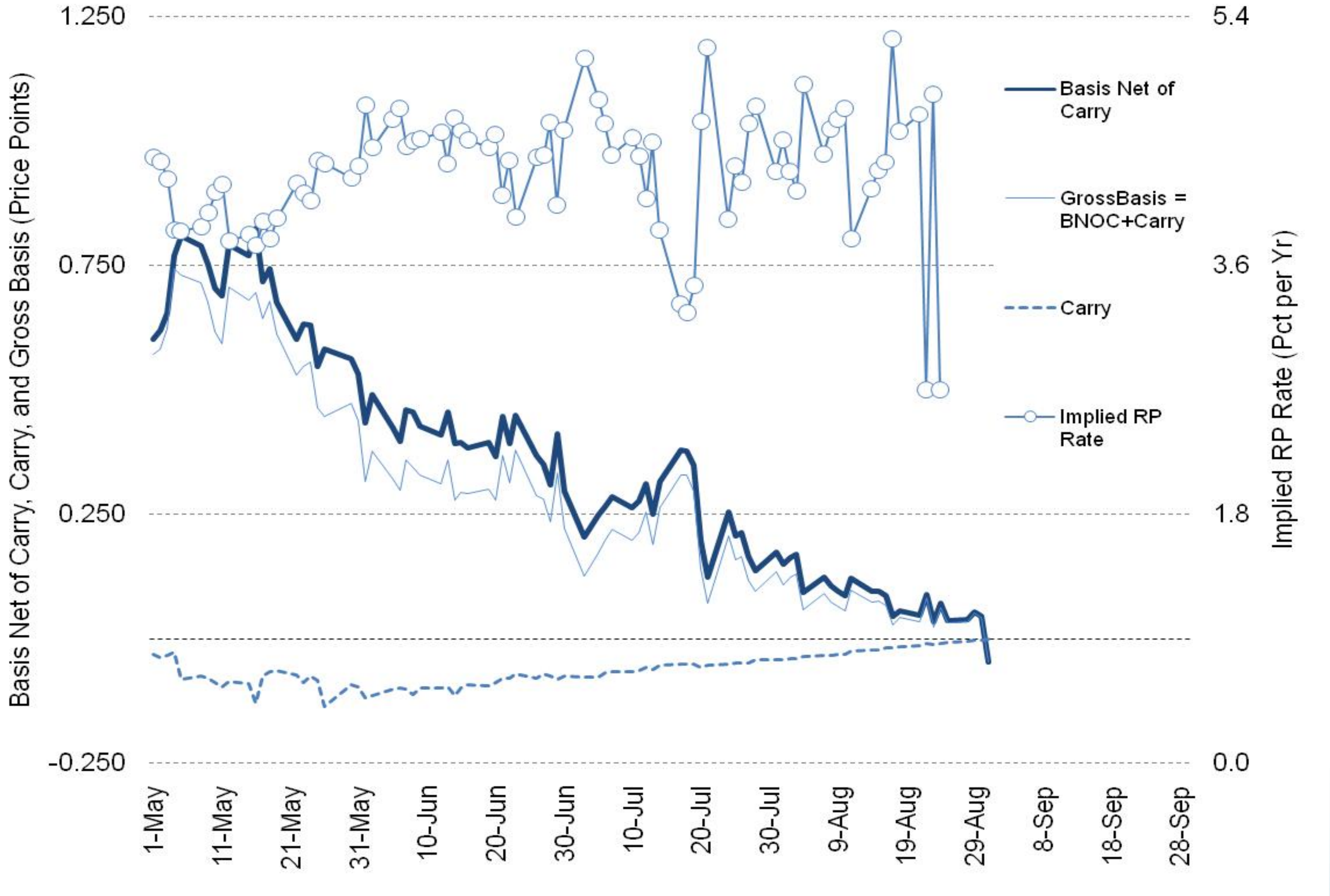
Example: TYU0 CTDs

Cheapest-to-Deliver Issues and Their Implied RP Rates, 1 May to 28 Aug 2000 (Pct per Yr)
(Assumed Futures delivery date is 1 Sep 2000.)



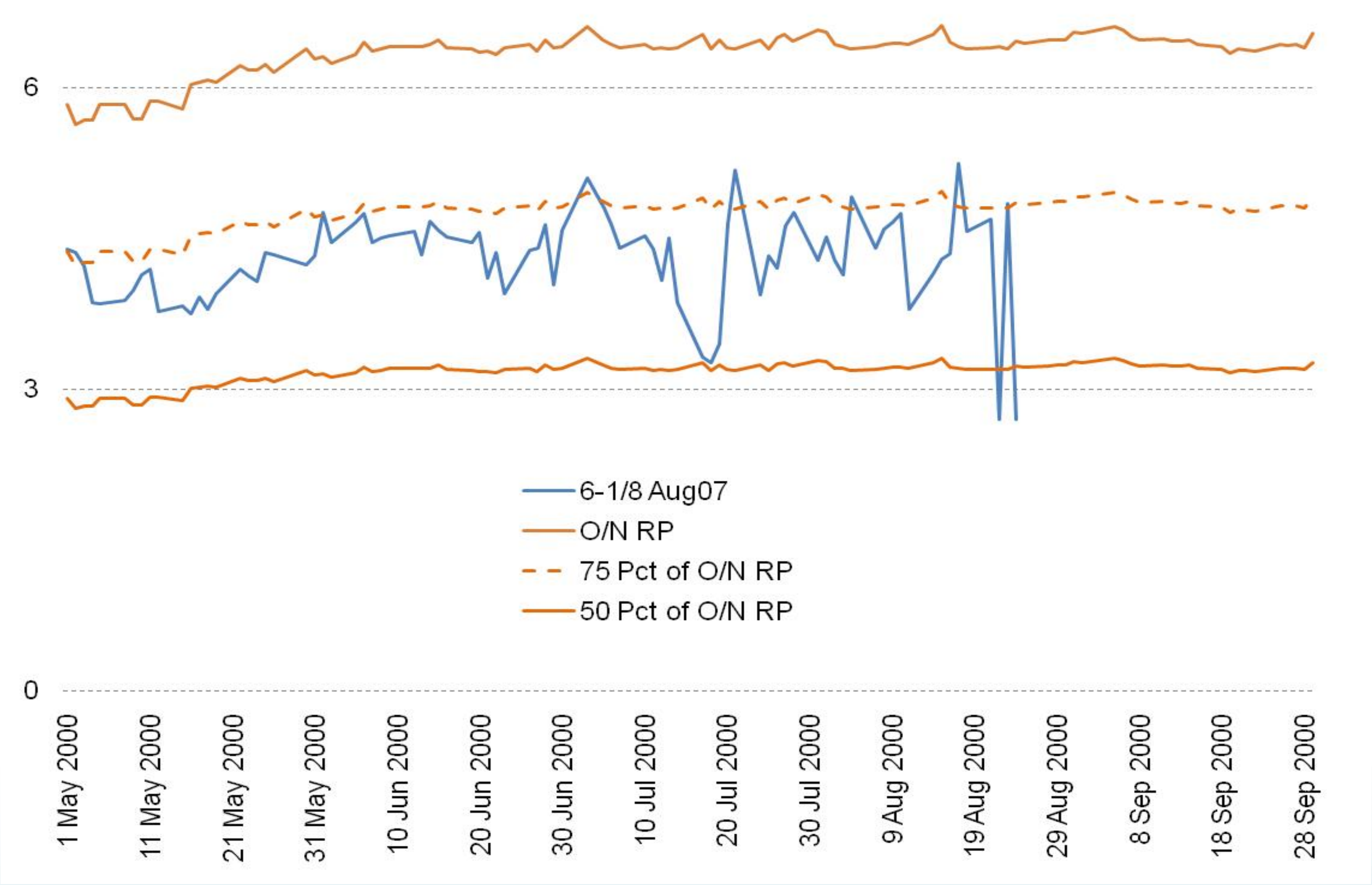
Example: 6-1/8 Aug07 Basis vs TYU0

Gross Basis, Net Basis, Carry, and Implied RP Rates, 1 May to 28 Aug 2000
(Assumed Futures delivery date is 1 Sep 2000.)



6-1/8 Aug07 Basis vs TYU0: Implied RP Rate Channel

Implied RP Rates for 6-1/8 of Aug07, 1 May to 28 Aug 2000 (Pct per Yr)
(Assumed Futures delivery date is 1 Sep 2000.)



6-1/8 Aug07 Basis vs TYU0: Position Entry

3 July 2000: Implied RP Channel suggests Basis is Cheap.

Cash (6-1/8 Aug07) = 99-202 = 99 and 20.25/32nds
Futures (TYU0) = 98-27
Conversion Factor = 1.0067

Gross Basis = 99-202 minus 1.0067 * 98-27 = **4.058 ticks**
Carry to Delivery = **-2.486 ticks** (Coupon = 6.125 pct, Term RP = 6.436 pct)
BNOC = **6.544 ticks**

Before entering Basis position – buying the Basis, in this case – check path of Break-Even Basis and/or Break-Even Implied RP over position holding period.

Position Management Tools: The Carry Bias

Rules of Thumb

If Carry is Positive –
Works in favor of Long Basis
Works against Short Basis
Example: Today

If Carry is Negative –
Works against Long Basis
Works in favor of Short Basis
Example: May-September 2000

When Carry works against the Basis position
…check that expected change in value of BNOC will be big enough to compensate for losses on Carry.

Position Management Tools: Break-Even Basis

Break-Even Basis path aids the basis trader in framing expectations. Separates future paths of Gross Basis into those that are profitable and those that are not.

Example

If you enter Basis position "today", then Break-Even Basis for "tomorrow"

= Value of Gross Basis today
minus projected value of Carry to Delivery as of tomorrow

In general

If you enter Basis position on Day t0, then Break-Even Basis for Day t0+n

= Value of Gross Basis on Day t0
minus projected value of Carry to Delivery as of Day t0+n

Long Basis position is worth considering if…

Future values of Break-Even Basis < Expected future values of Gross Basis

Short Basis position is worth considering if…

Expected future values of Gross Basis < Future values of Break-Even Basis

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Position Management Tools: Break-Even Implied RP

Break-Even Implied RP translates Break-Even Basis into forward-starting Implied RP Rates

Example

If you enter Basis position "today", then Break-Even Implied RP for "tomorrow" =

(360/(days from tomorrow to delivery) *
(AI at delivery - AI tomorrow - Break-Even Basis) /
(Cash Clean Price today + AI tomorrow)

In general

If you enter Basis position on Day t0, then Break-Even Implied RP for Day t0+n =

(360/days from t0+n to delivery) *
(AI at delivery - AI on t0+n - Break-Even Basis on t0+n) /
(Cash Clean Price today + AI on t0+n)

Long Basis position is worth considering if…

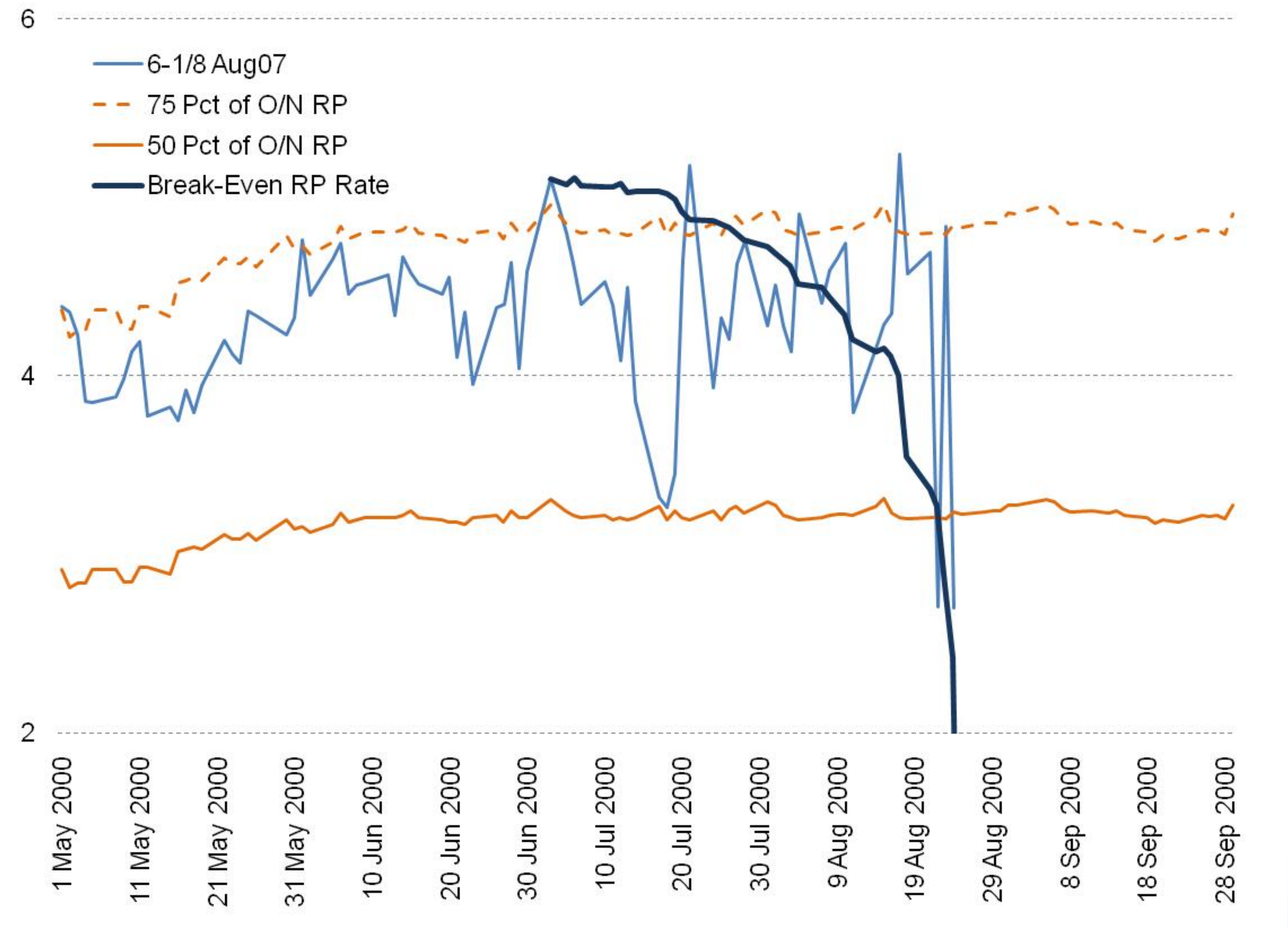
Expected future values of position Implied RP <
Corresponding future values of Break-Even Implied RP

Short Basis position is worth considering if…

Future values of Break-Even Implied RP <
Corresponding expected future values of position Implied RP

Example, Contd: Break-Even Implied RP Path for 6-1/8 Aug07 Basis

Break-Even Implied RP Path for Long Basis Position entered on 3 July 2000 (Pct per Yr)



Example, Contd: Position Exit

Position Safety Check

Basis position's Implied RP Rate is comfortably on "safe" side of Break-Even Implied RP through 21 Jul 2000

18 July 2000: Implied RP Channel suggests Basis is Rich

Cash (6-1/8 Aug07) =   98-27
Futures (TYU0)   =   97-27+

Gross Basis   =   98-27 minus 1.0067 * 97-27+   =   10.519 ticks
Carry to Delivery   =   -1.583 ticks
BNOC   =   12.102 ticks

Example, Contd: Results

True P&L = $20,365.71		
Long Cash (6-1/8 Aug07)	Lost 25.25 ticks on $10 mln face value	**($78,906.25)**
Short Futures (TYU0)	Made 31.5 ticks on 101 contracts	**$99, 422.38**
Carry Income, 5-19 July 2000	Coupon income earned on 6-1/8 Aug07	$23,557.69
	Repo interest paid @ 6.436 pct	($23,708.11)
		($150.42)
Total P&L		**$20,365.71**
Theoretical P&L = $20,031.21		
Change in Carry to Delivery	0.903 ticks on $10 mln face value	$2,812.88
Change in Basis Net of Carry	5.558 ticks on $10 mln face value	$17,368.75
Carry Income, 5-19 July 2000		($150.42)
Total		**$20,031.21**

Rounding Errors: Why is True P&L greater than Theoretical P&L by $334.50?
Futures position was 101 lots instead of 100.67 lots.

Rounding errors are commonplace in Basis Trading. Two useful tips:
(1) Rounding errors should always be within a tick. (Here, it's worth 1/10th tick on 101 lots.)
(2) The bigger the Basis position, the less rounding error matters.

Repo: Term vs Open Overnight

Term Repo has fixed termination date.

<u>Pros</u>

Removes an important source of uncertainty in valuation of Gross Basis and Carry.

Protects Basis position from repo rate shifts, eg, surprise changes in monetary policy.

Insulates Basis position from shifts in “specials” status of Treasury issue.

<u>Cons</u>

Reduces flexibility of position management. Exiting term repo involves either breakage fee or loading down balance sheet with offsetting term repo transaction.

In recent years, term repo market is very small, underserved, and illiquid. Correspondingly wide bid-offer spreads work against the Basis trader.

Repo: Term vs Open Overnight

Open Overnight is essentially rolling o/n repo. May be terminated by either party.

Pros

Allows flexibility of position exit: **Ideal for tactical Basis trader**.

As a practical matter, open overnight repo is what's available. In recent years, much "term repo" is in fact open overnight.

Insofar as repo market liquidity is concentrated in o/n, repo bid-offer spreads should be correspondingly narrow.

Cons

Valuation of Gross Basis and Carry is tougher: Forecast of o/n repo rate is required.

Leaves position vulnerable to monetary policy shifts, and to changes in market expectations of future policy shifts.

Leaves position vulnerable to changes in "specials" status of Treasury issues.

Information Sources

Three thorough, clear, and enjoyably readable analyses of cash-futures basis relationships for Treasury futures and similar contracts built on physical delivery of sovereign debt (listed in pedagogical order) --

Burghardt, Galen, with Belton, Lane, and Papa **The Treasury Bond Basis, 3rd Edition** McGraw Hill, 2005
Plona, Christopher **The European Bond Basis** McGraw Hill-Irwin, 1997 (Out of print, but very good.)
Boberski, David **Valuing Fixed Income Futures** McGraw Hill, 2007 (Advanced, but well worth the effort.)

CME **The US Treasury Futures Delivery Process** January 2008
Everything you wanted to know about how and when shorts get matched to longs for making delivery.
http://www.cmegroup.com/trading/interest-rates/files/CL-100_TFDPBrochureFINAL.pdf

CME **Marks-to-Market in US Treasury Futures and Options:**
Conventions for Computing Variation Margin Amounts March 2008
What gets rounded, in what way, when, and by whom in determining daily margin pays and collects.
http://www.cmegroup.com/trading/interest-rates/files/TreasuryFuturesPriceRoundingConventions_Mar_24_Final.pdf

Information Sources

CME Historical Registrar Reports **CUSIPs Delivered for Financial Contracts**
What got delivered into what Treasury contract and when, from the dawn of time to the present.
http://www.cmegroup.com/market-data/reports/registrar-reports.html

CME **Treasury Futures Conversion Factors**
http://www.cmegroup.com/trading/interest-rates/treasury-conversion-factors.html

Bloomberg
Furnishes many handy analytical tools for those interested in Treasury cash-futures relationships. For example, <BBG Treasury futures code> DLV <GO>

Information Sources

US Treasury Department, Treasury Direct
http://www.treasurydirect.gov/RT/RTGateway?page=institHome

US Treasury Department, Office of Debt Management
http://www.treasury.gov/offices/domestic-finance/debt-management/

Federal Reserve Bank of New York
http://www.newyorkfed.org/markets/primarydealers.html

	Maturity	*Auction Schedule*	*Auction Sizes … Lately ($ blns)*
Bonds	30-Year	New Issues: Feb, May, Aug, and Nov Reopenings: All other months Issue Dates: 15th of auction month	New Issues: 14 Reopenings: 11 (2 / new issue)
Notes	10-Year	New Issues: Feb, May, Aug, and Nov Reopenings: All other months Issue Dates: 15th of auction month	New Issues: 22 Reopenings: 19 (2 / new issue)
	7-Year and 5-Year	New Issues: Monthly Issue Dates: Last day of auction month	7-Year: 27 5-Year: 37
	3-Year	New Issues: Monthly Issue Dates: 15th of auction month	35
	2-Year	New Issues: Monthly Issue Dates: Last day of auction month	40

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Data sources: CME Group, IHS Global Insight, US Treasury Department

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Treasury Note and Bond Futures

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