

Treasury Note and Bond Futures

Advantage Futures, 16 July 2009

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Outline

- **Treasury Futures**
 - What's deliverable
 - Contract critical dates
 - Delivery invoicing
- **Treasury Cash-Futures Basis**
 - Carry
 - Basis = Carry + Delivery Options
 - Cheapest to Deliver
 - Implied RP Rates
 - Futures Equivalent Forward Prices
- **Quality Option: Shifts in Cheapest to Deliver**
- **Timing Option: When to Deliver**
- **Some Rules of Thumb and Common Sense**
 - Conversion Factors and Market Yields
 - "Cheapest to Deliver" is no guarantee as to what gets delivered.
 - "Cheapest to Deliver" is no guarantee as to what determines futures contract fair value.
 - Basis positions are analogous to option positions.
- **Information Sources**

Treasury Futures

Futures Contract	Contract Size (Face Val, \$)	Trading Increment	Deliverable Grade	Last Trading Day	Last Delivery Day
<i>(Position relative to contract's named expiry month)</i>					
Bonds (ZB,US)	100,000	Half 32 nd \$15.625 30 Aug: Full 32 nd \$31.25	Treasury bonds. <i>Remaining term to maturity (or term to first call date):</i> 15 yrs ≤ <i>m</i>	7 th b-day before last b-day	Last b-day
10-Year Notes (ZN,TY)	100,000	Half 32 nd \$15.625	Treasury notes. <i>Remaining term to maturity:</i> 6 yrs 6 mos ≤ <i>m</i> ≤ 10 yrs	7 th b-day before last b-day	Last b-day
5-Year Notes (ZF,FV)	100,000	Quarter 32 nd \$7.8125	Treasury notes. <i>Original term to maturity:</i> <i>m</i> ≤ 5 yrs 3 mos <i>Remaining term to maturity:</i> 4 yrs 2 mos ≤ <i>m</i> ≤ 5 yrs 3 mos	Last b-day	3 rd b-day after last b-day
3-Year Notes (Z3N,3YR)	200,000	Quarter 32 nd \$15.625	Treasury notes. <i>Original term to maturity:</i> <i>m</i> ≤ 5 yrs 3 mos <i>Remaining term to maturity:</i> 2 yrs 9 mos ≤ <i>m</i> ≤ 3 yrs	Last b-day	3 rd b-day after last b-day
2-Year Notes (ZT,TU)	200,000	Quarter 32 nd \$15.625	Treasury notes. <i>Original term to maturity:</i> <i>m</i> ≤ 5 yrs 3 mos <i>Remaining term to maturity:</i> 1 yr 9 mos ≤ <i>m</i> ≤ 2 yrs	Last b-day	3 rd b-day after last b-day

Treasury Futures

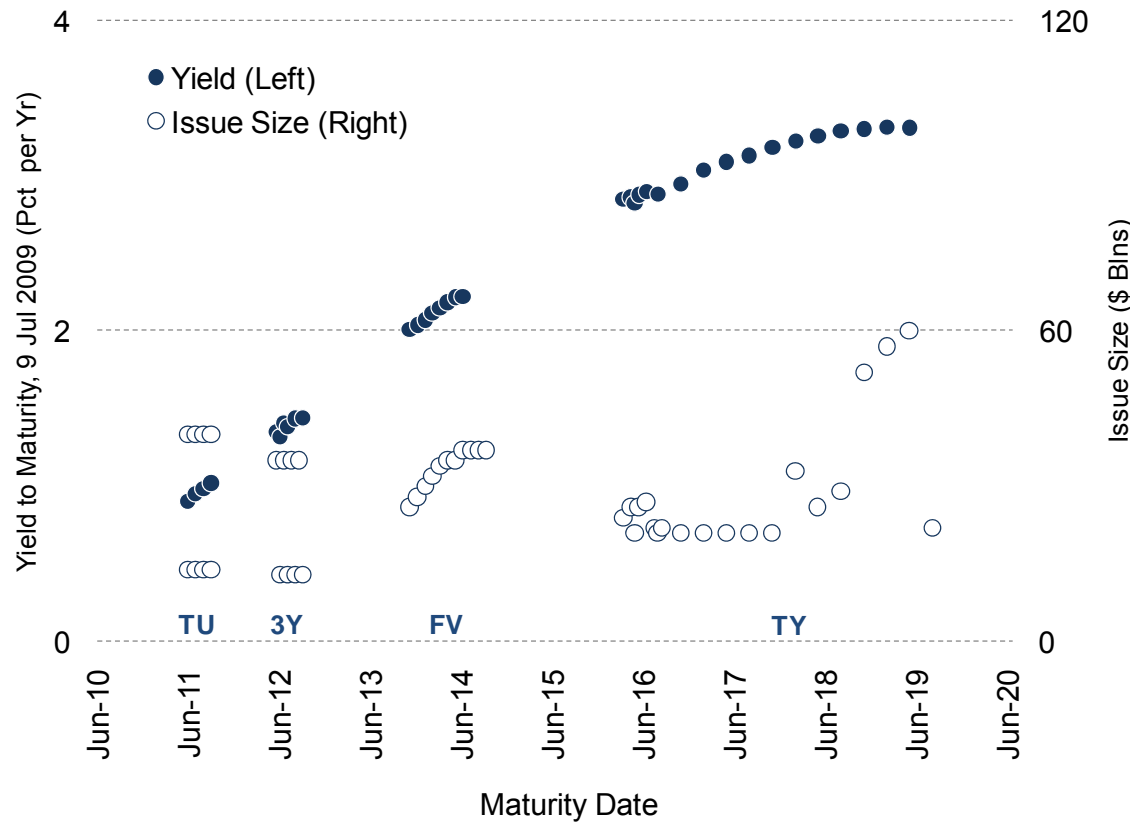
What's deliverable into Sep09 Note futures?

10-Years – 20 issues = Five 7-yr notes (lately \$27 bln) and fifteen 10-yr notes (\$22bln initial, \$60bln with reopenings)

5-Years -- 11 issues, all 5-yr notes (lately \$37bln)

3-Years – 8 issues = Four 3-yr notes (\$35 bln) and four old 5-yr notes (\$13 bln)

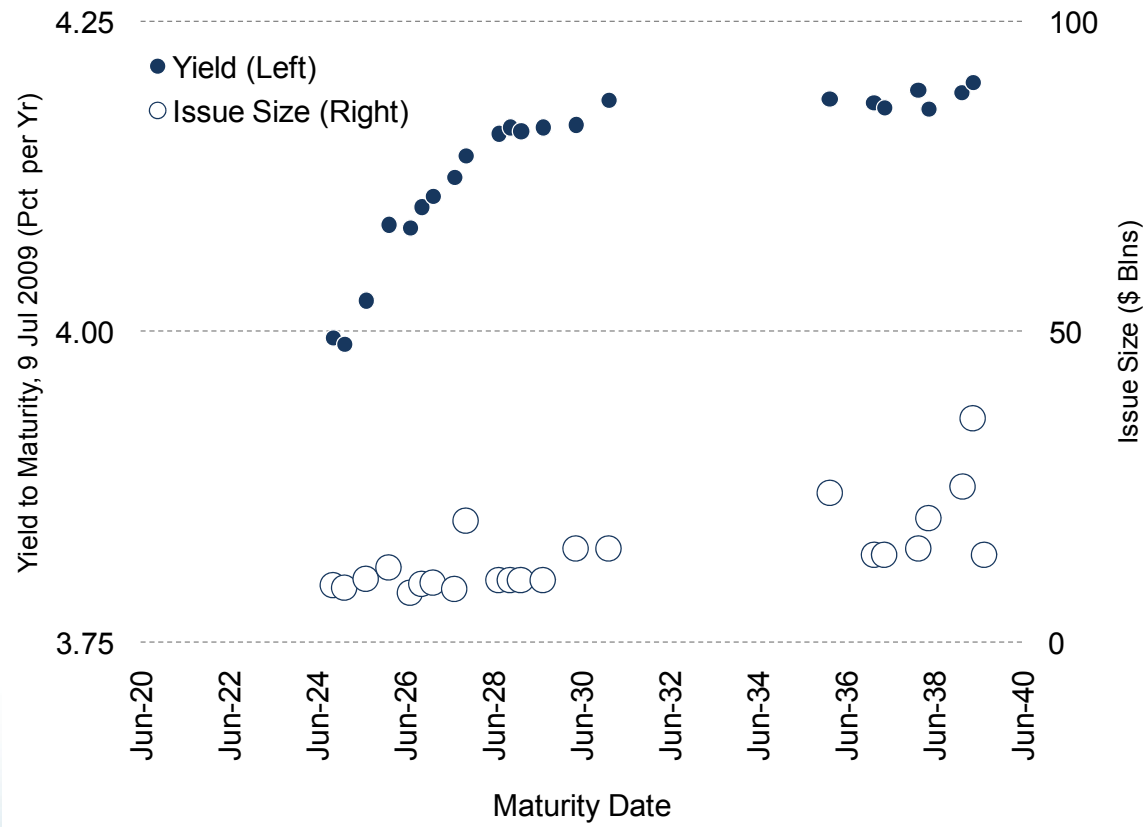
2-Years -- 8 issues = Four 2-yr notes (\$40 bln) and four old 5-yr notes (\$14 bln)



Treasury Futures

What's deliverable into Sep09 Bond futures?

23 issues, all 30-year bonds at issue



Treasury Futures

What's deliverable? How to measure term to maturity.

(1) Get first day of futures contract's named expiry month.

(2) Get maturity date of Treasury security.

(3) Round (2) down –

For Bond futures and 10-Year Note futures, round down to first day of last previous Mar, Jun, Sep, or Dec.

For 5-Year, 3-Year, and 2-Year Note futures, round down to first day of month.

(4) Compute (3) minus (1) --

For Bond futures and 10-Year Note futures, number of years and whole quarters.

For 5-Year, 3-Year, and 2-Year Note futures, number of years and whole months.

Example: Is 3-7/8 of Oct 2012 (an old 5-year note) deliverable into Sep09 3-Year T-Note futures?

(1) First day of futures expiry month: 1 Sep 2009

(2) Treasury note maturity date: 31 Oct 2012

(3) Treasury note maturity date rounded down (to first day of month): 1 Oct 2012

(4) (3) minus (1) = 1 Oct 2012 minus 1 Sep 2009 = 3 years 1 month

Answer: 3-7/8 of Oct 2012 is not deliverable into Sep09 3-Year T-Notes

Treasury Futures

Contract critical dates: When do contracts start delivering? Stop delivering? Stop trading?

Intention Day: Two business days before Delivery Day

Short position holder announces his intent to make delivery. Clearing House matches Short to Long.

Notice Day: One business day before Delivery Day

Short position holder announces what he will deliver. Clearing House transmits invoice to Long.

Delivery Day

For all contracts, First Delivery Day = first b-day of expiry month.

For Bonds and 10-Year Notes, Last Delivery Day = last b-day of expiry month.

For 5-Year, 3-Year, and 2-Year Notes, Last Delivery day = 3rd b-day after last b-day of expiry month.

Example: Contract critical dates for Sep09 futures

	<i>Bond and 10-Year</i>	<i>5-Year, 3-Year, and 2-Year</i>
First Intention/Position	Fri, 28 Aug	Fri, 28 Aug
First Notice	Mon, 31 Aug	Mon, 31 Aug
First Delivery	Tue, 1 Sep	Tue, 1 Sep
Last Trading	Mon, 21 Sep	Wed, 30 Sep
Last Intention	Mon, 28 Sep	Thurs, 1 Oct
Last Notice	Tue, 29 Sep	Fri, 2 Oct
Last Delivery	Wed, 30 Sep	Mon, 5 Oct

Treasury Futures

Delivery Invoicing

Long taking delivery receives Treasury Notes or Bonds, then pays Invoice Amount.

Short making delivery delivers Treasury Notes or Bonds, then receives Invoice Amount.

Invoice Amount

For Bonds, 10-Year Notes, and 5-Year Notes: $(\$1000 \times P \times c) + \text{Accrued Interest}$

For 3-Year and 2-Year Notes: $(\$2000 \times P \times c) + \text{Accrued Interest}$

P = contract daily settlement price on the day that the short Clearing Member gives Clearing House notice of intention to deliver. Points and fractions of points with par = 100 points.

c = conversion factor. Equals price at which Treasury security delivered would yield 6 pct per annum, according to conversion factor tables prepared and published by the Exchange.

Rounding

For each individual contract lot that is delivered:

- (1) the converted futures price $(\$1000 \times P \times c)$ shall be rounded to the nearest cent, with half-cents rounded up to the nearest cent.
- (2) Accrued interest is rounded to the nearest cent first, then added to converted futures price.

Treasury Futures Contracts

Delivery Invoicing Example

Delivery into one Jun09 10-Year Note futures contract (ZNM9)

Assumptions

- (1) You plan to make delivery on Last Delivery Day: Tue, 30 June 2009.
- (2) Futures final settlement price (at termination of trading on Friday, 19 June) = 116-01.
This means the applicable contract daily settlement price (when your clearing member firm announces to Clearing House that you intend to deliver, on Friday, 26 June) is also 116-01.
- (3) You notify Clearing House (on Tuesday, 29 Sep) that you will deliver 3-1/4 of 31 May 2016.

Invoice Amount = (\$1000 x P x c) + Accrued Interest per \$100,000 Face Value

$$\begin{aligned} &= (\$1000 \times 116.03125 \times 0.8491) + (\$3250/2) \times (30\text{Jun} - 31\text{May}) / (30\text{Nov} - 31\text{May}) \\ &= \$98,522.1344 + \$1625 \times (30 \text{ days} / 183 \text{ days}) \\ &= \$98,522.13 + \$266.39 \\ &= \$98,788.52 \end{aligned}$$

Treasury Cash-Futures Basis

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

“Long the Basis” ➔ Long cash + short futures. Size of short futures position = conversion factor.

Example: Jun09 10-Year Note Futures, 14 May 2009

<i>Coupon</i>	<i>Maturity</i>	<i>Conversion Factor</i>	<i>Spot Price (14 May for 15 May Sett)</i>	<i>Converted Futures Price = Futures Price x CF</i>	<i>Basis (Price Pts)</i>	<i>Basis (32nds)</i>
4 1/2	15-Feb-16	0.9202	112.5937500	111.9625	0.6313	20.2
2 5/8	29-Feb-16	0.8205	100.5000000	99.8318	0.6682	21.4
2 3/8	31-Mar-16	0.8012	98.7031250	97.4835	1.2196	39.0
2 5/8	30-Apr-16	0.8149	100.1015625	99.1504	0.9512	30.4
5 1/8	15-May-16	0.9519	116.4687500	115.8195	0.6493	20.8
4 7/8	15-Aug-16	0.9365	114.7656250	113.9457	0.8199	26.2
4 5/8	15-Nov-16	0.9200	113.3437500	111.9381	1.4056	45.0
4 5/8	15-Feb-17	0.9179	113.0078125	111.6826	1.3252	42.4
4 1/2	15-May-17	0.9080	112.0312500	110.4781	1.5532	49.7
4 3/4	15-Aug-17	0.9215	113.6640625	112.1206	1.5434	49.4
4 1/4	15-Nov-17	0.8873	110.1406250	107.9595	2.1812	69.8
3 1/2	15-Feb-18	0.8354	104.0937500	101.6447	2.4491	78.4
3 7/8	15-May-18	0.8569	106.8906250	104.2606	2.6300	84.2
4	15-Aug-18	0.8625	107.5703125	104.9420	2.6283	84.1
3 3/4	15-Nov-18	0.8420	105.3593750	102.4477	2.9117	93.2
2 3/4	15-Feb-19	0.7672	96.9921875	93.3467	3.6455	116.7
3 1/8	15-May-19	0.7900	100.1640625	96.1208	4.0433	129.4

Treasury Cash-Futures Basis

Basis = Carry to Delivery plus Value of Delivery Options

Carry to Delivery

Income earned by long Basis holder on cash Treasury position

equals Accrued Coupon (Spot Settlement Date to Futures Delivery Date)
minus Financing Cost (Spot Settlement Date to Futures Delivery Date)

Delivery Options

Embedded in Treasury futures delivery process

Long basis ⇔ Short Futures ⇔ Long delivery options
Short basis ⇔ Long Futures ⇔ Short delivery options

Quality Option – What to deliver
Timing Option – When to deliver

Carry

Carry to Delivery, Part 1: Accrued Coupon (Spot Settlement Date to Delivery Date)

$(\text{Coupon}/2) \times (\text{Delivery Date} - \text{Last Coupon Date}) / (\text{Next Coupon Date} - \text{Last Coupon Date})$

Day counts: Act/Act

Example: Jun09 10-Year Note Futures, 14 May 2009. Assume delivery on 30 June 2009.

<i>Coupon</i>	<i>Maturity</i>	<i>Last Coupon</i>	<i>Next Coupon</i>	<i>AI, 15 May to 30 Jun (Price Points)</i>
4 1/2	15-Feb-16	15-Feb-09	15-Aug-09	0.572
2 5/8	29-Feb-16	28-Feb-09	31-Aug-09	0.328
2 3/8	31-Mar-16	31-Mar-09	30-Sep-09	0.298
2 5/8	30-Apr-16	30-Apr-09	31-Oct-09	0.328
5 1/8	15-May-16	15-May-09	15-Nov-09	0.641
4 7/8	15-Aug-16	15-Feb-09	15-Aug-09	0.619
4 5/8	15-Nov-16	15-May-09	15-Nov-09	0.578
4 5/8	15-Feb-17	15-Feb-09	15-Aug-09	0.588
4 1/2	15-May-17	15-May-09	15-Nov-09	0.563
4 3/4	15-Aug-17	15-Feb-09	15-Aug-09	0.604
4 1/4	15-Nov-17	15-May-09	15-Nov-09	0.531
3 1/2	15-Feb-18	15-Feb-09	15-Aug-09	0.445
3 7/8	15-May-18	15-May-09	15-Nov-09	0.484
4	15-Aug-18	15-Feb-09	15-Aug-09	0.508
3 3/4	15-Nov-18	15-May-09	15-Nov-09	0.469
2 3/4	15-Feb-19	15-Feb-09	15-Aug-09	0.349
3 1/8	15-May-19	15-May-09	15-Nov-09	0.391

Carry

Carry to Delivery, Part 2: Financing Cost (Spot Settlement Date to Futures Deliv Date)

$(\text{Spot Price} + \text{Accrued Interest to Spot Sttlmt}) \times \text{RP} \times (\text{Delivery Date minus Spot Settlmt Date})/360$

Day counts: Act/Act for Treasury Accrued Coupon, Act/360 for RP Financing Rate

Example: Jun09 10-Year Note Futures, 14 May 2009.

Assume delivery on 30 June 2009. Assume Term RP for 14 May to 30 June = 0.175 pct

<i>Coupon</i>	<i>Maturity</i>	<i>Spot Price 14 May Quote 15 May Sttlmt</i>	<i>AI (Last Coupon to 15 May)</i>	<i>All-In Price = Spot Price + AI</i>	<i>Finance Cost 15 May to 30 Jun</i>
4 1/2	15-Feb-16	112.5937500	1.106	113.700	0.025
2 5/8	29-Feb-16	100.5000000	0.542	101.042	0.023
2 3/8	31-Mar-16	98.7031250	0.292	98.995	0.022
2 5/8	30-Apr-16	100.1015625	0.107	100.209	0.022
5 1/8	15-May-16	116.4687500	0.000	116.469	0.026
4 7/8	15-Aug-16	114.7656250	1.199	115.964	0.026
4 5/8	15-Nov-16	113.3437500	0.000	113.344	0.025
4 5/8	15-Feb-17	113.0078125	1.137	114.145	0.026
4 1/2	15-May-17	112.0312500	0.000	112.031	0.025
4 3/4	15-Aug-17	113.6640625	1.168	114.832	0.026
4 1/4	15-Nov-17	110.1406250	0.000	110.141	0.025
3 1/2	15-Feb-18	104.0937500	0.860	104.954	0.023
3 7/8	15-May-18	106.8906250	0.000	106.891	0.024
4	15-Aug-18	107.5703125	0.983	108.554	0.024
3 3/4	15-Nov-18	105.3593750	0.000	105.359	0.024
2 3/4	15-Feb-19	96.9921875	0.676	97.668	0.022
3 1/8	15-May-19	100.1640625	0.000	100.164	0.022

Basis = Carry + Delivery Options

Carry = Accrued Interest minus Financing Cost

Example: Jun09 10-Year Note Futures, 14 May 2009.

Assume delivery on 30 June 2009. Assume Term RP for 14 May to 30 June = 0.175 pct

<i>Coupon</i>	<i>Maturity</i>	<i>AI 15 May to 30 Jun</i>	<i>Finance Cost 15 May to 30 Jun</i>	Carry = <i>AI minus Finance Cost</i>	Basis = <i>Spot Price minus Futures Price x CF</i>	Delivery Options = <i>Net Basis = Basis minus Carry</i>
4 1/2	15-Feb-16	0.572	0.025	0.546	0.6313	0.0849
2 5/8	29-Feb-16	0.328	0.023	0.306	0.6682	0.3627
2 3/8	31-Mar-16	0.298	0.022	0.276	1.2196	0.9433
2 5/8	30-Apr-16	0.328	0.022	0.306	0.9512	0.6454
5 1/8	15-May-16	0.641	0.026	0.615	0.6493	0.0347
4 7/8	15-Aug-16	0.619	0.026	0.594	0.8199	0.2264
4 5/8	15-Nov-16	0.578	0.025	0.553	1.4056	0.8528
4 5/8	15-Feb-17	0.588	0.026	0.562	1.3252	0.7630
4 1/2	15-May-17	0.563	0.025	0.537	1.5532	1.0157
4 3/4	15-Aug-17	0.604	0.026	0.578	1.5434	0.9655
4 1/4	15-Nov-17	0.531	0.025	0.507	2.1812	1.6745
3 1/2	15-Feb-18	0.445	0.023	0.421	2.4491	2.0278
3 7/8	15-May-18	0.484	0.024	0.460	2.6300	2.1695
4	15-Aug-18	0.508	0.024	0.484	2.6283	2.1443
3 3/4	15-Nov-18	0.469	0.024	0.445	2.9117	2.4665
2 3/4	15-Feb-19	0.349	0.022	0.328	3.6455	3.3179
3 1/8	15-May-19	0.391	0.022	0.368	4.0433	3.6751

Cheapest to Deliver

What makes the “Cheapest to Deliver” issue cheapest to deliver?

The issue that is most profitable for the short to deliver.

Two gauges:

(1) Implied RP Rate

Synthetic market rate that long Basis holder earns by buying Treasury security and delivering it into futures contract at futures invoice price.

Issue with highest Implied RP Rate = “Cheapest to Deliver”

Implied RP Rate = $(F / P - 1) \times (360/\text{days})$

F = Converted futures price (futures price x Conversion Factor)
plus accrued interest from last coupon date to assumed delivery date

P = All-in spot price (clean price plus accrued interest from last coupon date to spot settlement date).

(2) Futures Equivalent Forward Price

Forward price of deliverable security, divided by Conversion Factor

Forward price = Spot clean price minus Carry to assumed delivery date.

Issue with lowest futures equivalent forward price = “Cheapest to Deliver”

Cheapest to Deliver: Implied RP Rates

Implied RP Rates for Jun09 10-Year Note Futures, 14 May 2009

ZNM9 daily settlement price = 121-21+. Assume futures delivery on 30 June 2009

Implied RP Rate = (Futures/Cash) minus 1, annualized as an act/360-day basis

Coupon	Maturity	Conv Factor	Spot Price 15 May Sttlmt	AI (Last Coupon to 15 May)	Cash All-In Price = Spot Price + AI	Converted Futures Price = Futures Price x CF	AI (Last Coupon to 30 Jun)	Futures Invoice Price	Implied RP Rate
4 1/2	15-Feb-16	0.9202	112.5937500	1.1064	113.7001	111.9625	1.6782	113.6406	-0.409
2 5/8	29-Feb-16	0.8205	100.5000000	0.5421	101.0421	99.8318	0.8702	100.7020	-2.634
2 3/8	31-Mar-16	0.8012	98.7031250	0.2920	98.9951	97.4835	0.5905	98.0740	-7.282
2 5/8	30-Apr-16	0.8149	100.1015625	0.1070	100.2086	99.1504	0.4351	99.5855	-4.866
5 1/8	15-May-16	0.9519	116.4687500	0.0000	116.4688	115.8195	0.6406	116.4601	-0.058
4 7/8	15-Aug-16	0.9365	114.7656250	1.1985	115.9642	113.9457	1.8180	115.7637	-1.353
4 5/8	15-Nov-16	0.9200	113.3437500	0.0000	113.3438	111.9381	0.5781	112.5163	-5.714
4 5/8	15-Feb-17	0.9179	113.0078125	1.1371	114.1449	111.6826	1.7248	113.4074	-5.056
4 1/2	15-May-17	0.9080	112.0312500	0.0000	112.0313	110.4781	0.5625	111.0406	-6.921
4 3/4	15-Aug-17	0.9215	113.6640625	1.1678	114.8319	112.1206	1.7714	113.8920	-6.405
4 1/4	15-Nov-17	0.8873	110.1406250	0.0000	110.1406	107.9595	0.5313	108.4907	-11.724
3 1/2	15-Feb-18	0.8354	104.0937500	0.8605	104.9542	101.6447	1.3052	102.9499	-14.946
3 7/8	15-May-18	0.8569	106.8906250	0.0000	106.8906	104.2606	0.4844	104.7450	-15.709
4	15-Aug-18	0.8625	107.5703125	0.9834	108.5537	104.9420	1.4917	106.4337	-15.284
3 3/4	15-Nov-18	0.8420	105.3593750	0.0000	105.3594	102.4477	0.4688	102.9165	-18.146
2 3/4	15-Feb-19	0.7672	96.9921875	0.6761	97.6683	93.3467	1.0256	94.3722	-26.411
3 1/8	15-May-19	0.7900	100.1640625	0.0000	100.1641	96.1208	0.3906	96.5114	-28.539

Cheapest to Deliver: Implied RP Rates

Hypothetical Implied RP Rates for Jun09 10-Year Note Futures, 14 May 2009

Assume hypothetically that ZNM9 settled at 122-22+ on 14 May instead of settling at 121-21+

Assume as before that futures delivery is on 30 June 2009

Implied RP Rate = (Futures/Cash) minus 1, annualized as an act/360-day basis

Coupon	Maturity	Conv Factor	Spot Price 15 May Sttlmt	AI (Last Coupon to 15 May)	Cash All-In Price = Spot Price + AI	Converted Futures Price = Futures Price x CF	AI (Last Coupon to 30 Jun)	Futures Invoice Price	Implied RP Rate
4 1/2	15-Feb-16	0.9202	112.5937500	1.1064	113.7001	111.9912	1.6782	113.6694	-0.211
2 5/8	29-Feb-16	0.8205	100.5000000	0.5421	101.0421	99.8574	0.8702	100.7277	-2.436
2 3/8	31-Mar-16	0.8012	98.7031250	0.2920	98.9951	97.5085	0.5905	98.0990	-7.084
2 5/8	30-Apr-16	0.8149	100.1015625	0.1070	100.2086	99.1759	0.4351	99.6110	-4.667
5 1/8	15-May-16	0.9519	116.4687500	0.0000	116.4688	115.8492	0.6406	116.4898	0.142
4 7/8	15-Aug-16	0.9365	114.7656250	1.1985	115.9642	113.9750	1.8180	115.7930	-1.155
4 5/8	15-Nov-16	0.9200	113.3437500	0.0000	113.3438	111.9669	0.5781	112.5450	-5.515
4 5/8	15-Feb-17	0.9179	113.0078125	1.1371	114.1449	111.7113	1.7248	113.4361	-4.860
4 1/2	15-May-17	0.9080	112.0312500	0.0000	112.0313	110.5064	0.5625	111.0689	-6.722
4 3/4	15-Aug-17	0.9215	113.6640625	1.1678	114.8319	112.1494	1.7714	113.9208	-6.209
4 1/4	15-Nov-17	0.8873	110.1406250	0.0000	110.1406	107.9872	0.5313	108.5184	-11.527
3 1/2	15-Feb-18	0.8354	104.0937500	0.8605	104.9542	101.6708	1.3052	102.9760	-14.751
3 7/8	15-May-18	0.8569	106.8906250	0.0000	106.8906	104.2874	0.4844	104.7718	-15.513
4	15-Aug-18	0.8625	107.5703125	0.9834	108.5537	104.9689	1.4917	106.4607	-15.090
3 3/4	15-Nov-18	0.8420	105.3593750	0.0000	105.3594	102.4740	0.4688	102.9428	-17.950
2 3/4	15-Feb-19	0.7672	96.9921875	0.6761	97.6683	93.3706	1.0256	94.3962	-26.219
3 1/8	15-May-19	0.7900	100.1640625	0.0000	100.1641	96.1455	0.3906	96.5361	-28.346

Cheapest to Deliver: Futures Equivalent Forward Price

Futures Equivalent Forward Prices, Jun09 10-Year Note Futures, 14 May 2009

Assume futures delivery on 30 June 2009

<i>Coupon</i>	<i>Maturity</i>	<i>Conversion Factor</i>	<i>Spot Price 14 May Quote 15 May Sttlmt</i>	<i>Spot Yield 15 May</i>	<i>Carry to Delivery = AI minus Finance Cost</i>	<i>Forward Price for 30 Jun = Spot Price minus Carry</i>	<i>Futures Equivalent Price = Forward Px / Conv Factor</i>	<i>Forward Yield 30 June</i>
4 1/2	15-Feb-16	0.9202	112.5937500	2.464	0.546	112.047	121.764	2.515
2 5/8	29-Feb-16	0.8205	100.5000000	2.544	0.306	100.194	122.114	2.593
2 3/8	31-Mar-16	0.8012	98.7031250	2.582	0.276	98.427	122.849	2.631
2 5/8	30-Apr-16	0.8149	100.1015625	2.609	0.306	99.796	122.464	2.658
5 1/8	15-May-16	0.9519	116.4687500	2.542	0.615	115.854	121.708	2.592
4 7/8	15-Aug-16	0.9365	114.7656250	2.626	0.594	114.172	121.914	2.677
4 5/8	15-Nov-16	0.9200	113.3437500	2.651	0.553	112.791	122.599	2.700
4 5/8	15-Feb-17	0.9179	113.0078125	2.750	0.562	112.446	122.503	2.801
4 1/2	15-May-17	0.9080	112.0312500	2.810	0.537	111.494	122.791	2.859
4 3/4	15-Aug-17	0.9215	113.6640625	2.878	0.578	113.086	122.720	2.928
4 1/4	15-Nov-17	0.8873	110.1406250	2.896	0.507	109.634	123.559	2.943
3 1/2	15-Feb-18	0.8354	104.0937500	2.965	0.421	103.672	124.099	3.013
3 7/8	15-May-18	0.8569	106.8906250	2.996	0.460	106.430	124.204	3.042
4	15-Aug-18	0.8625	107.5703125	3.054	0.484	107.086	124.158	3.102
3 3/4	15-Nov-18	0.8420	105.3593750	3.095	0.445	104.914	124.601	3.140
2 3/4	15-Feb-19	0.7672	96.9921875	3.110	0.328	96.665	125.997	3.154
3 1/8	15-May-19	0.7900	100.1640625	3.106	0.368	99.796	126.324	3.149

Quality Option: Shifts in Cheapest to Deliver

Shifts in Futures Equivalent Forward Prices, Jun09 10-Year Note Futures, 14 May 2009

Assume futures delivery on 30 June 2009. Assume GC term RP is fixed at 0.175 percent

Yield Change (Bps)	OTR 10-Yr Forward Yld (Pct)	4 1/2 Feb-16	2 5/8 Feb-16	2 3/8 Mar-16	2 5/8 Apr-16	5 1/8 May-16	4 7/8 Aug-16	4 5/8 Nov-16	4 5/8 Feb-17	4 1/2 May-17	4 3/4 Aug-17	4 1/4 Nov-17	3 1/2 Feb-18	3 7/8 May-18	4 Aug-18	3 3/4 Nov-18	2 3/4 Feb-19	3 1/8 May-19
200	5.15	108.58	108.23	108.64	108.25	108.32	108.04	108.19	107.73	107.56	107.23	107.39	107.14	107.04	106.70	106.60	106.79	106.94
190	5.05	109.20	108.88	109.31	108.92	108.94	108.69	108.86	108.41	108.27	107.95	108.14	107.92	107.83	107.51	107.42	107.67	107.82
180	4.95	109.82	109.54	109.98	109.59	109.57	109.34	109.53	109.11	108.98	108.67	108.89	108.71	108.63	108.31	108.25	108.55	108.71
170	4.85	110.44	110.19	110.65	110.26	110.21	110.00	110.22	109.80	109.70	109.40	109.65	109.50	109.43	109.13	109.09	109.45	109.61
160	4.75	111.08	110.86	111.33	110.94	110.85	110.66	110.90	110.51	110.42	110.13	110.42	110.30	110.24	109.95	109.94	110.35	110.52
150	4.65	111.71	111.53	112.01	111.62	111.49	111.33	111.59	111.21	111.15	110.87	111.19	111.11	111.06	110.78	110.79	111.26	111.44
140	4.55	112.35	112.20	112.70	112.31	112.14	112.00	112.29	111.93	111.89	111.62	111.97	111.93	111.88	111.62	111.66	112.18	112.37
130	4.45	112.99	112.88	113.39	113.00	112.80	112.68	112.99	112.65	112.63	112.37	112.75	112.75	112.71	112.46	112.53	113.10	113.30
120	4.35	113.64	113.56	114.09	113.70	113.45	113.36	113.70	113.37	113.37	113.13	113.54	113.58	113.55	113.32	113.41	114.04	114.25
110	4.25	114.29	114.24	114.79	114.40	114.12	114.04	114.41	114.10	114.12	113.90	114.34	114.41	114.40	114.18	114.29	114.98	115.20
100	4.15	114.95	114.93	115.50	115.11	114.78	114.73	115.13	114.84	114.88	114.67	115.14	115.26	115.25	115.04	115.19	115.94	116.16
90	4.05	115.61	115.63	116.21	115.82	115.45	115.43	115.85	115.58	115.64	115.44	115.95	116.11	116.11	115.92	116.09	116.90	117.14
80	3.95	116.28	116.33	116.93	116.54	116.13	116.13	116.58	116.32	116.41	116.23	116.77	116.97	116.98	116.80	117.00	117.87	118.12
70	3.85	116.95	117.04	117.65	117.26	116.81	116.83	117.31	117.08	117.19	117.01	117.59	117.83	117.85	117.69	117.92	118.86	119.11
60	3.75	117.62	117.75	118.38	117.99	117.50	117.54	118.05	117.83	117.97	117.81	118.43	118.70	118.74	118.59	118.85	119.85	120.11
50	3.65	118.30	118.46	119.11	118.72	118.19	118.26	118.79	118.60	118.76	118.61	119.26	119.58	119.63	119.50	119.79	120.85	121.12
40	3.55	118.98	119.18	119.85	119.46	118.88	118.98	119.54	119.37	119.55	119.42	120.11	120.47	120.53	120.41	120.73	121.86	122.14
30	3.45	119.67	119.91	120.59	120.20	119.58	119.71	120.30	120.14	120.35	120.24	120.96	121.37	121.44	121.34	121.69	122.88	123.17
20	3.35	120.36	120.64	121.34	120.95	120.28	120.44	121.06	120.92	121.16	121.06	121.82	122.27	122.35	122.27	122.65	123.91	124.21
10	3.25	121.06	121.37	122.09	121.71	120.99	121.17	121.83	121.71	121.97	121.88	122.69	123.18	123.27	123.21	123.62	124.95	125.26
0	3.15	121.76	122.11	122.85	122.46	121.71	121.91	122.60	122.50	122.79	122.72	123.56	124.10	124.20	124.16	124.60	126.00	126.32
-10	3.05	122.47	122.86	123.61	123.23	122.43	122.66	123.38	123.30	123.62	123.56	124.44	125.03	125.14	125.12	125.59	127.06	127.40
-20	2.95	123.18	123.61	124.38	124.00	123.15	123.41	124.16	124.11	124.45	124.41	125.33	125.96	126.09	126.08	126.59	128.13	128.48
-30	2.85	123.90	124.37	125.16	124.77	123.88	124.17	124.95	124.92	125.29	125.26	126.22	126.90	127.05	127.06	127.60	129.21	129.57
-40	2.75	124.62	125.13	125.94	125.55	124.62	124.93	125.74	125.74	126.13	126.13	127.13	127.85	128.01	128.04	128.62	130.30	130.67
-50	2.65	125.35	125.89	126.72	126.34	125.35	125.70	126.55	126.56	126.98	127.00	128.04	128.81	128.98	129.03	129.64	131.40	131.79
-60	2.55	126.08	126.66	127.51	127.13	126.10	126.48	127.35	127.39	127.84	127.87	128.95	129.78	129.96	130.03	130.68	132.51	132.91
-70	2.45	126.81	127.44	128.31	127.93	126.85	127.25	128.17	128.23	128.71	128.75	129.88	130.75	130.95	131.04	131.73	133.63	134.05
-80	2.35	127.56	128.22	129.11	128.73	127.60	128.04	128.99	129.07	129.58	129.64	130.81	131.74	131.95	132.06	132.78	134.76	135.19
-90	2.25	128.30	129.01	129.92	129.54	128.36	128.83	129.81	129.92	130.46	130.54	131.75	132.73	132.96	133.09	133.85	135.91	136.35
-100	2.15	129.05	129.80	130.73	130.35	129.13	129.63	130.64	130.78	131.34	131.45	132.70	133.73	133.98	134.13	134.92	137.06	137.52

Timing Option: When to Deliver

**Embedded Delivery Options are American-style exercise.
Short futures holder may make delivery on any acceptable delivery day.**

First Delivery Day =
First b-day of named expiry month for all contracts.

Last Delivery Day =
Last b-day of named expiry month for Bonds and 10-Year Notes
3rd b-day after last b-day of expiry month for 5-Year, 3-Year, and 2-Year Notes

Example: Delivery Days for Sep09 Futures

	Bond and 10-Year	5-Year, 3-Year, and 2-Year
First Delivery	Tue, 1 Sep	Tue, 1 Sep
Last Delivery	Wed, 30 Sep	Mon, 5 Oct

Timing Option: When to Deliver

Rules of thumb --

Negative Carry ➔ Deliveries tend to occur early (as below).

Approx Zero Carry ➔ Delivery timing depends on cash market technicals

Positive Carry ➔ Deliveries tend to occur late (as in example above).

Hypothetical Example: Jun09 10-Year Note Futures, 14 May 2009, in a parallel universe with negative carry.
Assume delivery on 1 June 2009. Assume Term RP for 14 May to 1 June = 4.5 pct

<i>Coupon</i>	<i>Maturity</i>	<i>Conv Factor</i>	<i>AI 15 May to 1 Jun</i>	<i>Finance Cost 15 May to 1 Jun</i>	<i>Carry = AI minus Finance Cost</i>	<i>Basis = Spot Price minus Futures Price x CF</i>	<i>Delivery Options = Net Basis = Basis minus Carry</i>
4 1/2	15-Feb-16	0.9202	0.211	0.242	-0.030	0.6313	0.6616
2 5/8	29-Feb-16	0.8205	0.121	0.215	-0.093	0.6682	0.7617
2 3/8	31-Mar-16	0.8012	0.110	0.210	-0.100	1.2196	1.3197
2 5/8	30-Apr-16	0.8149	0.121	0.213	-0.092	0.9512	1.0428
5 1/8	15-May-16	0.9519	0.237	0.247	-0.011	0.6493	0.6600
4 7/8	15-Aug-16	0.9365	0.229	0.246	-0.017	0.8199	0.8374
4 5/8	15-Nov-16	0.9200	0.214	0.241	-0.027	1.4056	1.4328
4 5/8	15-Feb-17	0.9179	0.217	0.243	-0.025	1.3252	1.3506
4 1/2	15-May-17	0.9080	0.208	0.238	-0.030	1.5532	1.5834
4 3/4	15-Aug-17	0.9215	0.223	0.244	-0.021	1.5434	1.5644
4 1/4	15-Nov-17	0.8873	0.196	0.234	-0.038	2.1812	2.2189
3 1/2	15-Feb-18	0.8354	0.164	0.223	-0.059	2.4491	2.5077
3 7/8	15-May-18	0.8569	0.179	0.227	-0.048	2.6300	2.6781
4	15-Aug-18	0.8625	0.188	0.231	-0.043	2.6283	2.6712
3 3/4	15-Nov-18	0.8420	0.173	0.224	-0.051	2.9117	2.9623
2 3/4	15-Feb-19	0.7672	0.129	0.208	-0.078	3.6455	3.7239
3 1/8	15-May-19	0.7900	0.144	0.213	-0.068	4.0433	4.1118

Some Rules of Thumb and Common Sense

(1) Conversion Factors and Market Yields

Conversion factors for delivery invoicing are built (arbitrarily) around a 6 percent yield to maturity.

Interaction between conversion factors and market yield levels creates biases in the choice of cheapest to deliver issue

- | | |
|----------------|---|
| Yields > 6 pct | CTD tends to be deliverable issue with longest duration (long term to maturity, low coupon).
Eg, CTD into 10-Year T-Note Futures is likely to be OTR 10-year note or old 10-year note. |
| Yields ≈ 6 pct | Potentially many deliverable issues are candidates for CTD.
Choice is based on cash market technical factors, eg, (i) supply and demand for specific securities, (ii) reinvestment risks, (iii) tax considerations, (iv) shape of yield curve, (v) stripping activity, (vi) repo specials. |
| Yields < 6 pct | CTD tends to be deliverable issue with shortest duration (short term to maturity, high coupon).
Eg, CTD into 10-Year T-Note Futures is likely to be issue with 6 ½ or 7 years to maturity. |

(2) “Cheapest to Deliver” is no guarantee as to what gets delivered

CTD is simply the deliverable grade issue that is theoretically optimal for short futures holder to deliver. Short futures holder making delivery is not required to deliver CTD.

Even when market yields are far from 6 pct, short reserves the right to deliver any deliverable grade issue. Often, issues other than CTD do get delivered, even though they are theoretically suboptimal for the short to deliver.

Some Rules of Thumb and Common Sense

(3) “Cheapest to Deliver” is no guarantee as to what determines futures contract fair value.

In theory, fair valuation of futures contract is determined by its arbitrage relationship to the CTD issue.

In practice, futures fair value may depend upon several deliverable issues, not just one.

When many short contract holders decide to carry their positions to delivery, the volume of open interest being delivered may exceed the available supply of the CTD. When market participants anticipate this, the futures contract may be valued so as to reflect the potential for delivery of a probability-weighted mix of CTD, second CTD, third CTD, and possibly more issues.

Example: Dec06 deliveries into Note futures (ZTZ6, ZFZ6, and ZNZ6)

(4) Basis positions are analogous to option positions

Basis, even for CTD, is typically greater than cost of carry. I.e., basis net of carry is typically positive.

Premium reflects value of embedded delivery options

Basis net of carry behaves like an option: It is affected by length of time to delivery, volatility of market yields, correlation (or lack thereof) among yields on deliverable issues, likelihood of changes in CTD status prior to delivery, proximity of market prices to ‘crossover’ point (where CTD status moves from issue to another).

	Long CTD Basis	Short CTD Basis
Yields > 6 pct	Long Put	Short Put
Yields ≈ 6 pct	Long Straddle	Short Straddle
Yields < 6 pct	Long Call	Short Call

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-](http://www.cmegroup.com/trading/interest-rates/files/TreasuryFuturesPriceRoundingConventions)

[rates/files/TreasuryFuturesPriceRoundingConventions](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>

	<i>Maturity</i>	<i>Auction Schedule</i>	<i>Auction Sizes ... Lately (\$ blns)</i>
Bonds	30-Year	New Issues: Feb, May, Aug, and Nov Reopenings: All other months Issue Dates: 15 th of auction month	New Issues: 14 Reopenings: 11 (twice)
	10-Year	New Issues: Feb, May, Aug, and Nov Reopenings: All other months Issue Dates: 15 th of auction month	New Issues: 22 Reopenings: 19 (twice)
Notes	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: 15 th of auction month	35
	2-Year	New Issues: Monthly Issue Dates: Last day of auction month	40

Disclaimer

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

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Treasury Note and Bond Futures

Advantage Futures, 16 July 2009

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