Tailing the Spread

Figure 3.4 **Profit Function for a General Intra-commodity Futures Spread Position**

DATE	***Nearby Position***	***Deferred Position***
$t=0$	Short Q_N units at $F(0,N)$	Long Q_T units at $F(0,T)$
$t=1$	Close out position with Long Q_N units at $F(1,N)$	Close out position with Short Q_T units at $F(1,T)$

In this case, the profit function can be specified:

$$\pi(1,T) = \{F(0,N) - F(1,N)\}\ Q_N + \{F(1,T) - F(0,T)\}\ Q_T \tag{3.4}$$

To motivate the profit function for a tailed spread, consider the trading profile for an intra-commodity spread with potentially unequal position sizes. Letting the contract amounts be Q_N and Q_T, the short-the-nearby, long-the-deferred trade is depicted in Figure 3.4. The tail for an intra-commodity spread can be set by holding either spread leg constant and varying the other leg. To see this, set $Q_T = 1$. It can now be verified that $Q_N = F(0,T)/F(0,N)$ will give a trade profit function that depends only on $\Delta\ ic$. Observing that $F(0,T)/F(0,N) = \{1 + ic(0)\}$ and substituting this result and $Q_T = 1$ into (3.4) gives:

$$\pi(1) = F(1,N)\ \Delta\ ic \tag{3.5}$$

The case where $Q_N = 1$ *and* $Q_T = F(0,N)/F(0,T)$, gives virtually the same result:

$$\pi(1) = \{F(1,N)/(1 + ic(0))\}\ \Delta\ ic$$

Because the two approaches do not give the same exact answer, the trades can involve taking a slightly different number of contracts for the spread legs. However, because the change in *ic* is the only random variable in either profit function, the difference is not of practical importance.

To illustrate the use of a tail, consider the following gold prices that were available in February 1989:

June 1989	\$379	Aug 1989	\$382.90
June 1990	\$404.80	Aug 1990	\$409.20

For the June contracts, the one year spread gives $1 + ic(0) = 1.068$ and for the August contracts $1 + ic(0) = 1.069$. Using the tailing method that sets the number of deferred contract equal to one involves taking 1.068 June 89 nearby contracts for every one June 90 deferred contract. By tailing, the dollar value of the gold underlying the nearby and deferred positions is equalized. In the futures market terminology, this method of spread tailing is a ***dollar equivalency*** technique. Because futures contracts are only traded in whole numbers, it is necessary to gross the number of contracts up until an acceptable ratio is found. In this case, 14(1.068) = 14.952. Hence, a ratio of 15 nearby for every 14 deferred contracts would appear to be acceptable; though as the size of the spread trade positions grows, the more accurate the tail can be.

Because gold is typically at or near full carry, the size of the tail will depend on the prevailing level of interest rates. To see this, consider the following prices for gold futures prices for June 16, 1992:

June 1992	\$343.10	Aug 1992	\$344.90
June 1993	\$355.80	Aug 1993	\$358.40

Observing that for the June contracts $1 + ic(0) = 1.037$ and for the August contracts $1 + ic(0) = 1.039$, using the method that sets the deferred contract equal to one involves taking 1.039 Aug 92 nearby contracts for every one Aug 93 deferred contract. Again observing that futures contracts are only traded in whole numbers, it is necessary to gross the number of contracts up until an acceptable ratio is found. In this case, 24(1.039) = 24.936. Hence, a ratio of 25 nearby for every 24 deferred contracts would appear to be an acceptable hedge ratio; subject to the caveat that as the size of the spread trade position grows, the more accurate the tail can be. The large number of contracts required to tail the spread in 6/92 was unusual, driven by the historically low interest rates of this period.

The need to tail a spread depends on both the shape of the term structure of futures prices and the length of time between N and T. When prices across delivery months are relatively the same level or if there is no distant deferred deliveries available for trading, it is not necessary to tail. This is the case in a number of commodities. For example, in currencies there is often no trade in futures contracts over one year to delivery. Taking, say, a six month (Sept. 92/Mar. 93) spread in Japanese yen, using the price quotes for 8/31/92 gives a tail of (.8016/.8013) = 1.0004. For the Canadian dollar on that date the same maturity for the contracts gives a tail of 1.0067. Neither of these numbers indicates that a tail is required unless the trade sizes go well beyond the allowable position limits. The story is different again for Tbond futures that admit both distant delivery dates and typically sloped futures term structure. Using 7/16/92 quotes gives a Sept 92/Sept 93 tail of 1.046. As will be seen when the specifics of inter-commodity trades such as the turtle are considered, dollar equivalency is not the only possible tailing method. The process of setting the tail can also be done to attain profit functions that are dependent on components of ic, and not just ic itself.

Table 3.1 **Interest Rate Futures Prices**

INTEREST RATE

	Open	High	Low	Settle	Change	Lifetime High	Lifetime Low	Open Interest
TREASURY BONDS (CBT)–$100,000; pts. 32nds of 100%								
Sept	103-00	103-16	102-30	103-09	+ 6	118-26	90— 12	390,284
Dec	102-10	102-24	102-08	102-17	+ 5	118-08	91-19	73,842
Mr95	101-22	101-30	101-22	101-25	+ 5	116-20	98-20	4,218
June	101-05	101-08	101-04	101-04	+ 5	113-15	98-12	1,638
Sept	....	....	....	100-17	+ 5	112-15	97-28	673
Est vol 200,000; vol Fri 509,266; op int 470,763, +7,397.								
TREASURY BONDS (MCE)–$50,000; pts. 32nds of 100%								
Sept	103-02	103-16	103-02	103-09	+ 8	115-20	100-02	14,067
Dec	102-14	102-24	102-14	102-17	+ 7	114-00	99-10	359
Est vol 3,500; vol Fri 5,328; open int 14,430, +51.								
TREASURY NOTES (CBT)–$100,000; pts. 32nds of 100%								
Sept	104-01	104-09	103-31	104-05	+ 2	115-01	101-18	241,497
Dec	103-03	103-10	103-01	103-06	+ 1	114-21	100-25	24,587
Est vol 40,000; vol Fri 152,073; open int 266,143, +9,983.								
5 YR TREAS NOTES (CBT)–$100,000; pts. 32nds of 100%								
Sept	03-295	04-025	03-295	104-00	....	10-195	102-12	180,491
Dec	03-075	103-10	03-055	03-075	....	104-18	101-26	10,898
Est vol 20,000; vol Fri 61,379; open int 191,389, +4,901.								
2 YR TREAS NOTES (CBT)–$200,000, pts. 32nds of 100%								
Sept	02-232	102-25	02-232	02-235	– ¾	104-31	102-04	31,300
Dec	102-05	02-055	02-045	02-045	– ¾	02-187	02-045	610
Est vol 2,000; vol Fri 2,112; open int 31,910, +145.								
30-DAY FEDERAL FUNDS (CBT)-$5 million; pts. of 100%								
Aug	95.56	95.57	95.56	95.57	+ .01	96.58	95.05	4,662
Sept	95.32	95.33	95.31	95.33	+ .02	96.44	94.81	3,083
Oct	95.08	95.10	95.08	95.09	+ .01	95.63	94.63	807
Nov	94.88	94.91	94.88	94.89	+ .01	95.52	94.50	311
Dec	94.62	94.62	94.62	94.62	....	96.00	94.46	102
Est vol 2,222; vol Fri 2,743; open int 9,053, +1,000.								

TREASURY BILLS (CME)–$1 mil.; pts. of 100%

	Open	High	Low	Settle	Chg	Discount Settle	Discount Chg	Open Interest
Sept	95.24	95.26	95.22	95.24	....	4.76	....	18,533
Dec	94.68	94.70	94.65	94.66	– .02	5.34	+ .02	9,198
Mr95	94.38	94.40	94.37	94.39	....	5.61	....	3,245
Est vol 1,559; vol Fri 3,962; open int 30,994, –905.								
LIBOR-1 MO. (CME)–$3,000,000; points of 100%								
Aug	95.27	95.30	95.27	95.29	+ .02	4.71	– .02	22,148
Sept	95.06	95.08	95.06	95.06	+ .01	4.94	– .01	9,640
Oct	94.86	94.87	94.86	94.86	+ .01	5.14	– .01	2,602
Nov	94.70	94.70	94.70	94.69	+ .01	5.31	– .01	2,376
Dec	93.97	93.97	93.97	93.97	....	6.03	....	1,594
Ja95	....	....	....	94.31	– .01	5.69	+ .01	384
Feb	....	....	....	94.19	– .01	5.81	+ .01	112
Mar	....	....	....	94.06	....	5.94	....	109
May	....	....	....	93.81	....	6.19	....	205
Est vol 5,304; vol Fri 12,937; open int 39,263, +2,351.								

Source: *Wall Street Journal*, Monday, August 8, 1994.

Table 3.2 **Eurodollar Futures Prices**

EURODOLLAR (CME)–$1 million; pts of 100%

	Open	High	Low	Settle	Chg	Yield Settle	Yield Chg	Open Interest
Sept	94.82	94.83	94.80	94.81	+ .01	5.19	– .01	427,280
Dec	94.09	94.12	94.08	94.09	....	5.91	....	496,265
Mr95	93.85	93.87	93.84	93.85	....	6.15	....	333,927
June	93.55	93.55	93.52	93.53	....	6.47	....	249,693
Sept	93.26	93.27	93.25	93.26	....	6.74	....	215,033
Dec	93.00	93.00	92.97	92.99	....	7.01	....	150,225
Mr96	92.93	92.93	92.90	92.92	....	7.08	....	130,650
June	92.82	92.82	92.80	92.81	....	7.19	....	106,418
Sept	92.72	92.73	92.71	92.72	+ .01	7.28	– .01	97,391
Dec	92.56	92.58	92.55	92.56	+ .01	7.44	– .01	76,780
Mr97	92.55	92.57	92.54	92.56	+ .02	7.44	– .02	68,643
June	92.47	92.49	92.46	92.48	+ .02	7.52	– .02	57,107
Sept	92.40	92.42	92.39	92.41	+ .02	7.59	– .02	52,734
Dec	92.26	92.28	92.25	92.27	+ .02	7.73	– .02	50,066
Mr98	92.27	92.29	92.26	92.28	+ .02	7.72	– .02	36,539
June	92.19	92.21	92.18	92.20	+ .02	7.80	– .02	31,795
Sept	92.11	92.14	92.11	92.13	+ .02	7.87	– .02	23,814
Dec	92.00	92.02	91.99	92.01	+ .02	7.99	– .02	19,722
Mr99	92.02	92.04	92.02	92.03	+ .02	7.96	– .02	15,964
June	91.95	91.98	91.95	91.96	+ .02	8.04	– .02	8,867
Sept	91.89	91.91	91.89	91.90	+ .02	8.10	– .02	8,182
Dec	91.78	91.79	91.78	91.78	+ .02	8.22	– .02	6,986
Mr00	....	....	....	91.81	+ .01	8.19	– .01	7,109
June	....	....	....	91.76	+ .01	8.24	– .01	5,273
Sept	....	....	....	91.71	+ .01	8.29	– .01	7,028
Dec	....	....	....	91.61	+ .01	8.39	– .01	5,862
Mr01	....	....	....	91.67	+ .01	8.33	– .01	6,923
June	....	....	....	91.64	+ .01	8.36	– .01	4,428
Sept	....	....	....	91.62	+ .01	8.38	– .01	2,373
Dec	....	....	....	91.54	+ .01	8.46	– .01	2,429
Mr02	91.59	91.59	91.59	91.60	+ .01	8.40	– .01	2,009
June	91.60	91.60	91.60	91.61	+ .01	8.39	– .01	2,141
Sept	....	....	....	91.60	+ .01	8.40	– .01	1,785
Dec	....	....	....	91.52	+ .01	8.48	– .01	1,354
Mr03	....	....	....	91.57	+ .01	8.43	– .01	1,516
June	....	....	....	91.55	+ .01	8.45	– .01	1,158
Sept	....	....	....	91.56	+ .01	8.44	– .01	1,071
Dec	....	....	....	91.50	+ .01	8.50	– .01	1,385
Mr04	....	....	....	91.56	+ .01	8.44	– .01	1,124
Est vol 193,687; vol Fri 775,986; open int 2,692,116, +42,309.								

Figure 3.3 **Profit Function for a Tailed Tbond Spread**

DATE	***Nearby (N) Position***	***Deferred Position** (T)*
$t=0$	Short $[F(0,T)/F(0,N)]\ Q$ Tbonds at F(0,N)	Long Q Tbonds at $F(0,T)$
$t=1$	Long $[F(0,T)/F(0,N)]\ Q$ at $F(1,N)$	Short Q at $F(1,T)$

From (3.5), the profit function for the short-the-nearby, long-the-deferred tailed Tbond spread takes the form:

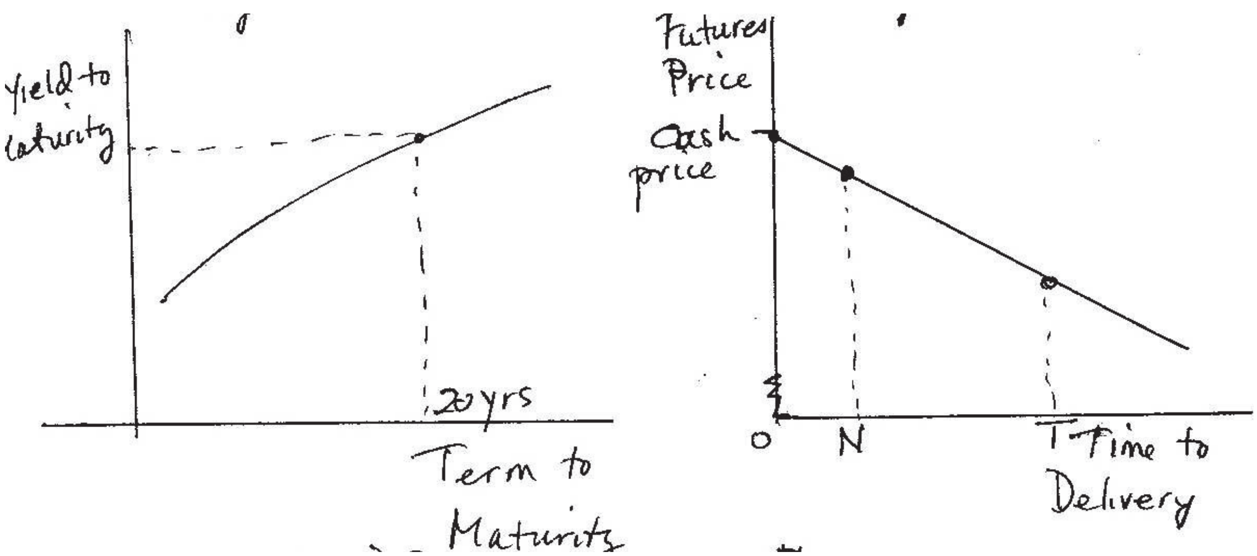
$$\pi(1) = F(1,N)\ \Delta\ ic = F(1,N)\ \{\Delta\ irr(N,T) - \Delta\ R(N,T)\}$$

where *irr* is the implied repo rate *(irr)*, the repurchase agreement financing rate implied in Tbond futures prices, and R is the return earned on the cash Tbond position during the period between the two delivery dates, *N* and *T*. With suitable modification, this type of profit function also applies to all other debt futures contracts.

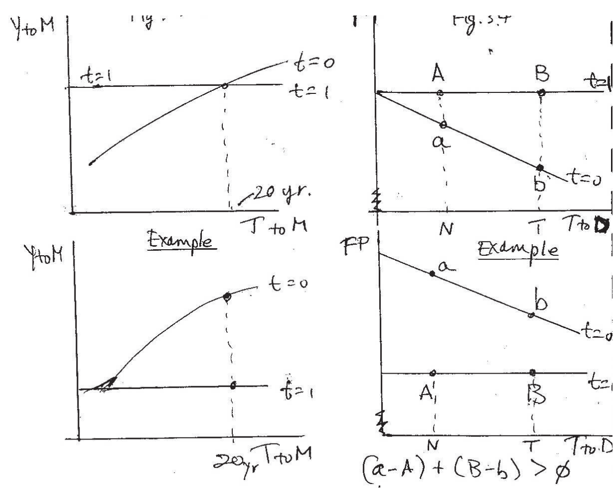
One interesting application of the concept of tailing occurs with the intra-commodity Tbond spread. In this case, the tailed spread can be used for speculating on changes in the shape of the yield curve (see Figure 3.3). From Figure 3.3, the connection between the payoff on a tailed Tbond spread and shifts in the term structure of interest rates should be apparent. While more precise examination of the determination of *irr* can be found in a number of sources, e.g., Siegel and Siegel (1990, Chap. 6), Rentzler (1986), for purposes of analyzing the tailed Tbond spread *irr* can be taken to be a short term interest rate while the cash Tbond rate, being for > 15 year maturities, is a long-term rate.[11] From $F(0,T) = F(0,N)\{1 + irr(0,N,T) - R(0,N,T)\}$, it follows that $F(0,T) < F(0,N)$ and the futures price term structure is downward sloping when the yield curve is upward sloping. By considering a variety of yield curve changes, allowing for changes in the spot Tbond rate, it can be verified that π on the tailed Tbond spread depends only on changes in yield curve shape; the level of the spot interest rate does not affect the profitability of the trade undertaken. This is not surprising, given that the spread is tailed. However, the positions involved in the tailed spread must be reversed when the yield curve is inverted. While a short-the-nearby, long-the-deferred spread is profitable when an upward sloping yield curve flattens, a long-the-nearby, short-the-deferred spread is profitable when an inverted yield curve flattens. Similarly, the positions will be reversed when a flat yield curve either inverts or becomes upward sloping.

Tables 3.1 and 3.2 provide various interest rate futures prices from Aug. 8, 1994. Examining the Tbond futures prices in Table 3.1 reveals a downward sloping futures price term structure. The more deferred the delivery date, the lower the price. Figure 3.3 demonstrates theoretically that this futures price structure is a result of the downward sloping yield curve in the Treasury bond market, a result that is supported empirically by the upward sloping cash Tbond yield curve on Aug. 8, 1994. A similar result applies for the Eurodollar futures prices which also reflects the presence of a downward sloping cash market yield curve. However, it is not possible to use Figure 3.3, which applies to Tbond futures, as a theoretical motivation for the connection between the cash market yield curve and the term structure of futures prices. As demonstrated in Sec.6.3, the term structure of Eurodollar futures prices reflect the implied forward interest rates embedded in the Eurodollar cash market yield curve.

Graphs 3.1 and 3.2 **The Relationship between the Cash Yield Curve and the Futures Term Structure**



Graphs 3.3 and 3.4 (with examples)



Graphs 3.5 and 3.6