Section 1

BASIC CONCEPTS

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Basic Concepts

Basis is a term common to all futures contracts. For example, the difference between the price of wheat today (its spot price) and its futures price is the wheat basis. Because the wheat futures market is competitive, the wheat basis tends to equilibrate the cost of financing and storing wheat until the future delivery date. To make it worth anyone's while to set aside wheat for future delivery, the futures price of wheat must be higher than the spot price of wheat. As a result, the wheat basis typically is negative.

Bonds can be set aside for future delivery as well. The chief differences between bonds and wheat are in the physical costs of storage and in what is often called convenience yield. U.S. Treasury bonds are nearly all held in electronic book entry form with the Federal Reserve; thus, the physical costs of storage for bonds are zero. Additionally, bonds offer a yield in the form of actual or accrued coupon income that works to offset the cost of financing the bond until future delivery.

Moreover, if the yield curve is positively sloped so that long-term interest rates are higher than short-term interest rates, holding a bond position for future delivery actually produces a net income rather than a net outgo. For this and other reasons explored in this book, the futures price of a Treasury bond tends to be lower than the spot price; therefore, the bond basis tends to be positive.

There is one more striking similarity between wheat and bonds. Not all wheat is the same. There are slight differences in quality, and wheat from Kansas is not the same (because of transportation costs, if nothing else) as wheat from Nebraska. Nevertheless, wheat futures contracts allow for the delivery of different grades of wheat in different locations. Also, it is the person who is short the futures contract who decides what to deliver and where. As a result, the wheat basis is geared to the grade of wheat and location that combine to make the cost of delivering wheat into the futures contract as low as it can be; that is, the wheat futures price is driven by the "cheapest to deliver."

So it is with bonds. The physical location of bonds is irrelevant, but the Treasury bond futures contract allows the delivery of any U.S. Treasury bond that has at least 15 years remaining to first call, or to maturity if the bond is not callable. Currently, there are about two dozen such bonds, each with its own coupon, maturity and, in some cases, call date. These coupon and maturity differences make up the different grades of bonds. Much of the challenge in understanding the bond basis is in understanding what makes a bond cheap to deliver. The rest of the challenge is in understanding when it is best to make delivery.

This chapter lays out the basic tools needed for an understanding of the bond basis. In particular, it addresses the following topics:

- futures contract specifications
- definition of the bond basis
- conversion factors
- futures invoice price
- carry: the profit or loss of holding bonds
- implied repo rate
- buying and selling the basis
- sources of profit in a basis trade
- RP versus reverse RP rates
- an idealized strategy for trading the bond basis

Treasury Bond and Note Futures Contract Specifications

The Chicago Board of Trade (CBOT) lists futures contracts on Treasury bonds, 10-year Treasury notes, 5-year Treasury notes, and 2-year Treasury notes. The basic specifications for each of these contracts are shown in Exhibit 1.1.

Each contract has a "size," which defines the par amount of the bond or note that is deliverable into the contract. With the exception of the 2-year note contract, this is $100,000 par value. Because of the inherently lower volatility of the price of 2-year notes, the CBOT increased the size of that contract to $200,000.

Each contract has its own "contract grade," which in the case of Treasury bond and note contracts defines the range of maturities of the bonds or notes that are eligible for delivery.

A firm grasp on the concept of contract grade is perhaps the most important key to understanding how note and bond futures work. A widely held misconception about bond futures is that the bond futures contract is based on a 20-year, 8 percent coupon Treasury bond. The source of this financial fiction likely was *The Wall Street Journal*, which

EXHIBIT 1.1 Bond and Note Futures Contract Highlights

Term	Bond	10-Year Note	5-Year Note	2-Year Note
Size	$100,000 par value	$100,000 par value	$100,000 par value	$200,000 par value
Contract Grade	U.S. Treasury bonds with at least 15 years remaining to first call, if callable, or to maturity if not callable	Original issue U.S. Treasury notes with at least 6-1/2 years remaining to maturity	Original issue U.S. Treasury notes with an original maturity of not more than 5 years, 3 months, and a remaining maturity of not less than 4 years, 3 months	Original issue U.S. Treasury notes with an original maturity of not more than 5 years, 3 months, and a remaining maturity of not less than 1 year, 9 months, from the first day of the delivery month but not more than 2 years from the last day of the delivery month
Price Quotes	Points and 32nds of a point	Points and 32nds of a point *	Points and 32nds of a point *	Points and 32nds of a point **
Tick Size and Value	1/32 of a point ($31.25)	1/2 of 1/32 of a point ($15.625)	1/2 of 1/32 of a point ($15.625)	1/4 of 1/32 of a point ($15.625)
Daily Price Limit	3 points	3 points	3 points	1 point
Trading Hours (Chicago Time)	7:20 am - 2:00 pm 5:20 pm - 8:05 pm (CST) 6:20 pm - 9:05 pm (CDST)	7:20 am - 2:00 pm 5:20 pm - 8:05 pm (CST) 6:20 pm - 9:05 pm (CDST)	7:20 am - 2:00 pm 5:20 pm - 8:05 pm (CST) 6:20 pm - 9:05 pm (CDST)	7:20 am - 2:00 pm 5:20 pm - 8:05 pm (CST) 6:20 pm - 9:05 pm (CDST)
Delivery Months	March, June, September, December	March, June, September, December	March, June, September, December	March, June, September, December
Last Trading Day	12:00 noon on the 8th to the last business day of contract month	12:00 noon on the 8th to the last business day of contract month	12:00 noon on the 8th to the last business day of contract month	12:00 noon on the 8th to the last business day of contract month
Last Delivery Day	Last business day of contract month	Last business day of contract month	Last business day of contract month	Last business day of contract month

* The minimum price fluctuation is 1/2 of 1/32 (e.g., 93.165, or 93.16+ indicates 93 points and 16 and 1/2 32nds).
** The minimum price fluctuation is 1/4 of 1/32 (e.g., 91.1625 indicates 91 points and 16 and 1/4 32nds).

is said to have asked the CBOT in the 1970s to provide yields to accompany its Treasury bond futures prices. The CBOT apparently acceded to the *Journal*'s request and provides a hypothetical yield for an 8 percent, 20-year, noncallable Treasury bond with a price equal to the futures price. These are the yields that you will find next to the futures settlement prices in *The Wall Street Journal*.

In fact, bond and note futures are based on deliverable baskets of Treasury issues with widely different price and yield characteristics. For example, any U.S. Treasury bond with at least 15 years remaining to first call or maturity on the first delivery day of the contract month is eligible for delivery. Any original Treasury note with at least 6-1/2 years remaining to maturity is eligible for delivery into the 10-year note contract. The result is that the futures price not only does not behave like any one bond or note, but behaves instead like a complex hybrid of the bonds or notes in the deliverable set, depending on their respective likelihoods of being delivered. We explain these relationships in detail in Chapters 2 and 3.

Futures exchanges regulate the minimum amount by which the futures price is allowed to change. This minimum price change is called a tick. The tick size for the bond and 10-year note contracts is 1/32nd of a point. Given a nominal face value of $100,000 for one contract, the value of this tick is $31.25, which is 1/32nd of $1,000. The allowable tick size for the 5-year note contract is 1/2 of 1/32nd of a point, which is worth $15.625. The 2-year contract's tick size is 1/4 of 1/32nd of a point, but because the nominal face value of the contract is $200,000, the value of the tick is also $15.625, the same as for the 5-year contract.

In most other important respects, the contracts are the same. They share the same trading hours, delivery months, delivery days and procedures, and expiration days.

Because the contracts are so much alike, we will focus mainly on the long-term Treasury bond contract when laying out the key conceptual underpinnings of these contracts. In later chapters, however, we will provide you with a comparison of the key differences between the contracts.

Definition of the Bond Basis

A bond's basis is the difference between its cash price and the product of the futures price and the bond's conversion factor:

$$B = P - (F \times C)$$

where

- B is the basis for the bond/futures combination
- P is the spot or cash bond price per $100 face value of the bond
- F is the futures price per $100 face value of the futures contract
- C is the conversion factor for the bond

Units

Bond and bond futures prices typically are quoted for $100 face value, and the prices themselves are stated in full points and 32nds of full points. In practice, the 32nds are broken down further into 64ths for bonds that are traded actively and in size, but the conventional quote is still in 32nds, with the 64ths represented by a "+".

The 32nds are represented differently in different places. In *The Wall Street Journal,* for example, the 32nds are set off from the whole points by a dash in a futures price quote; that is, a futures price of 91 and 14/32nds would appear as 91-14. Occasionally, you will find the 32nds stated explicitly as 91-14/32nds. Also, because of programming and formatting problems, the dash may be replaced by a period, so that 91-14 appears as 91.14. In this book, the 32nds are stated for the sake of clarity.

Conversion factors are expressed in decimal form.

> ***Important Point.*** In practice, all prices are converted to decimal form when calculating the basis. The resulting basis, which is then in decimal form, is converted to 32nds simply by multiplying the decimal basis by 32.

Basis Comparison. Exhibit 1.2 shows the bases in 32nds of the bonds and notes that were eligible for delivery into the Chicago Board of Trade September 1992 bond and notes futures contracts on August 6, 1992.

Conversion Factors

With the wide range of bonds available for delivery, the Chicago Board of Trade uses conversion factors in the invoicing process to put these bonds on roughly equal footing. Exhibit 1.3 shows the conversion factors of all bonds that were eligible for delivery as of August 6, 1992, for contract months through September 1993.

The conversion factor is the approximate price, in decimals, at which the bond would yield 8 percent to maturity (rounded to whole quarters), or to first call if callable. It can be viewed as the approximate decimal price at which the bond would trade if it yielded 8 percent to first call. (See Appendix A for an exact formula for calculating conversion factors.)

Consider the 8-7/8s of 8/15/17. For the September 1992 contract, the conversion factor for this bond is 1.0935. On the first day of the delivery month, which was September 1, 1992, this bond had 24 years, 11 months, and 14 days left to maturity. The CBOT rounds this number down to the number of whole quarters remaining from the first day of the delivery month until expiration, truncating the odd days, leaving 24 years and 9 months. Thus, 109.35 is the decimal price of an 8-7/8

EXHIBIT 1.2 Deliverable Notes and Bonds (Delivery Month: September 1992)

2-Year Note Futures = 106-05/32nds
5-Year Note Futures = 108-31/32nds
10-Year Note Futures = 108-08/32nds
Bond Futures = 105-04/32nds
RP = 3.35%

Price Date = 8/6/92
Trade Date = 8/7/92
Settlement Date = 8/10/92
First Delivery Date = 9/1/92 (Days remaining = 22)
Futures Expiration Date = 9/21/92 (Days remaining = 42)
Last Delivery Date = 9/30/92 (Days remaining = 51)

Note/ Bond*	Coupon	Maturity	2:00 p.m. Cash Price (32nds)	Conversion Factor	Basis (32nds)	Yield	Yield Value of a 32nd	Dollar Value of a Basis Point	Modified Duration	Option-Adjusted Hedge Ratio	Cash Price + Accrued Interest (decimal)	Carry in Dollars Per Day	Carry in 32nds Per Day	Total Carry in 32nds to Last Delivery Day	Implied RP Rate To First Delivery Day	Implied RP Rate to Last Delivery Day
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
T	5.000	06/30/94	101.1250	0.9518	11.24	4.224	0.01722	18.14	1.78	1.049	101.9477	41.00	0.1312	6.691	-0.84	2.37
T	8.500	06/30/94	107.2300	1.0078	23.50	4.202	0.01654	18.89	1.74	1.092	108.6658	129.86	0.4158	21.193	-3.41	2.88
T02**	4.250	07/31/94	99.3050	0.9371	15.17	4.274	0.01669	18.73	1.87	1.082	100.0686	22.37	0.0715	3.651	-3.60	0.81
T	6.875	08/15/94	104.3000	0.9803	27.92	4.289	0.01586	19.70	1.82	1.139	108.2806	90.40	0.2892	14.753	-7.13	0.55
T	8.625	08/15/94	108.0800	1.0108	30.31	4.304	0.01555	20.10	1.79	1.162	112.4440	135.19	0.4326	22.062	-6.45	1.62
T	8.500	09/30/94	108.1250	1.0091	40.59	4.346	0.01466	21.31	1.91	1.232	111.4562	129.16	0.4133	21.079	-11.12	-0.53
F	6.125	12/31/96	102.1125	0.9334	20.48	5.513	0.00800	39.07	3.79	0.934	103.0340	70.56	0.2257	11.516	-4.35	1.43
F	6.250	01/31/97	102.2100	0.9368	18.38	5.570	0.00786	39.74	3.86	0.950	102.8261	74.15	0.2378	12.102	-3.19	2.00
F	6.750	02/28/97	104.1825	0.9542	18.95	5.599	0.00765	40.82	3.80	0.976	107.5622	86.48	0.2767	14.113	-2.90	2.34
F	6.875	03/31/97	104.3175	0.9582	18.51	5.635	0.00752	41.55	3.87	0.993	107.4717	88.35	0.2827	14.418	-2.51	2.49
F	6.875	04/30/97	104.3000	0.9574	19.55	5.666	0.00741	42.16	3.95	1.008	106.8431	87.40	0.2797	14.263	-3.06	2.26
F	6.750	05/31/97	104.1250	0.9520	20.88	5.690	0.00733	42.65	4.03	1.019	105.7001	86.07	0.2754	14.046	-3.82	1.92
F	6.375	06/30/97	102.2875	0.9367	26.48	5.686	0.00728	42.91	4.14	1.025	103.6087	76.82	0.2458	12.537	-7.05	0.38
F05**	5.500	07/31/97	99.0875	0.9013	33.92	5.669	0.00733	42.63	4.29	1.019	99.4229	56.94	0.1822	9.292	-12.03	-2.11
N07**	7.000	04/15/99	104.1075	0.9501	47.60	6.195	0.00563	55.47	5.20	0.790	106.5736	92.08	0.2946	15.028	-16.38	-3.39
N	9.125	05/15/99	115.2075	1.0562	42.07	6.249	0.00524	59.67	5.07	0.849	117.8057	138.34	0.4436	22.577	-10.69	-0.30
N	6.375	07/15/99	101.0450	0.9163	62.44	6.169	0.00557	56.10	5.52	0.798	101.5910	78.70	0.2518	12.843	-25.29	-7.42
N	8.000	08/15/99	109.2175	0.9998	46.44	6.273	0.00527	59.34	5.23	0.845	113.5698	116.76	0.3736	19.055	-14.40	-2.19
N	7.875	11/15/99	108.2925	0.9934	44.11	6.323	0.00515	60.68	5.48	0.864	110.7758	110.91	0.3549	18.101	-13.41	-1.83
N	8.500	02/15/00	112.1525	1.0269	42.07	6.383	0.00493	63.45	5.44	0.903	116.6098	127.83	0.4090	20.862	-11.63	-0.85
N	8.875	05/15/00	114.2225	1.0486	37.90	6.437	0.00475	65.82	5.64	0.937	116.7935	132.49	0.4239	21.622	-9.16	0.28
N	8.750	08/15/00	114.0025	1.0425	37.03	6.481	0.00466	67.07	5.67	0.955	118.2626	133.25	0.4264	21.746	-9.01	0.35

Note/ Bond*	Coupon	Maturity	2:00 p.m. Cash Price (32nds)	Conversion Factor	Basis (32nds)	Yield	Yield Value of a 32nd	Dollar Value of a Basis Point	Modified Duration	Option-Adjusted Hedge Ratio	Cash Price + Accrued Interest (decimal)	Carry in Dollars Per Day	Carry in 32nds Per Day	Total Carry in 32nds to Last Delivery Day	Implied RP Rate To First Delivery Day	Implied RP Rate to Last Delivery Day
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
N	8.500	11/15/00	112.1575	1.0291	34.95	6.518	0.00459	68.01	5.94	0.968	114.5017	124.43	0.3981	20.307	-8.35	0.53
N	7.750	02/15/01	107.2375	0.9849	36.06	6.549	0.00462	67.57	6.06	0.962	111.5107	111.72	0.3575	18.233	-9.99	-0.34
N	8.000	05/15/01	109.1000	1.0000	34.00	6.582	0.00449	69.63	6.26	0.991	111.2038	113.91	0.3645	18.590	-8.60	0.29
N	7.875	08/15/01	108.1225	0.9920	31.96	6.625	0.00443	70.57	6.29	1.004	112.2121	114.55	0.3666	18.694	-7.90	0.61
N	7.500	11/15/01	105.2250	0.9684	27.96	6.663	0.00442	70.77	6.58	1.007	107.4762	103.79	0.3320	16.939	-6.48	1.09
N10**	7.500	05/15/02	106.0250	0.9672	44.12	6.642	0.00424	73.75	6.84	1.050	107.8512	103.44	0.3310	16.882	-14.12	-2.22
B	10.375	11/15/12-07	128.1625	1.2053	57.62	7.253	0.00286	109.40	8.35	0.997	130.9606	160.06	0.5121	26.122	-14.75	-1.96
B	12.000	08/15/13-08	144.0775	1.3544	59.55	7.277	0.00255	122.55	8.17	1.117	150.0774	194.01	0.6208	31.662	-12.85	-0.96
B	13.250	05/15/14-09	157.0650	1.4763	64.23	7.283	0.00232	134.59	8.39	1.226	160.3356	210.85	0.6747	34.411	-12.40	-0.75
B	12.500	08/15/14-09	150.0900	1.4110	62.40	7.294	0.00239	130.89	8.37	1.193	156.3595	202.07	0.6466	32.977	-12.97	-1.01
B	11.750	11/15/14-09	143.0625	1.3452	57.00	7.305	0.00246	127.06	8.70	1.158	145.9732	183.46	0.5870	29.940	-12.09	-0.74
B	11.250	02/15/15	141.1600	1.3350	37.06	7.427	0.00219	142.82	9.72	1.301	146.9705	176.05	0.5633	28.731	-5.55	2.00
B	10.625	08/15/15	134.2525	1.2728	31.55	7.443	0.00226	138.46	9.89	1.262	139.9556	165.20	0.5286	26.960	-4.21	2.55
B	9.875	11/15/15	126.1925	1.1958	28.58	7.449	0.00236	132.20	10.25	1.205	128.9361	148.36	0.4747	24.212	-3.84	2.60
B	9.250	02/15/16	119.2300	1.1308	26.99	7.459	0.00246	126.82	10.21	1.156	124.2167	141.61	0.4531	23.111	-3.92	2.59
B	7.250	05/15/16	97.1850	0.9211	23.92	7.468	0.00288	108.43	10.92	0.988	99.2921	104.61	0.3347	17.073	-5.18	1.83
B	7.500	11/15/16	100.0925	0.9470	23.54	7.472	0.00280	111.54	10.93	1.016	102.0622	108.83	0.3482	17.761	-4.61	2.10
B	8.750	05/15/17	114.1100	1.0800	25.88	7.469	0.00251	124.70	10.71	1.136	116.4124	129.44	0.4142	21.125	-4.02	2.45
B	8.875	08/15/17	115.2500	1.0935	26.47	7.472	0.00247	126.37	10.52	1.151	120.0968	135.02	0.4320	22.035	-4.14	2.46
B	9.125	05/15/18	118.2600	1.1216	28.94	7.468	0.00239	130.57	10.79	1.190	120.9698	135.39	0.4332	22.096	-4.85	2.10
B	9.000	11/15/18	117.1375	1.1087	28.08	7.474	0.00240	130.17	10.89	1.186	119.5574	133.31	0.4265	21.756	-4.65	2.18
B	8.875	02/15/19	116.0025	1.0952	28.00	7.478	0.00242	129.23	10.74	1.177	120.3234	134.81	0.4313	22.000	-4.80	2.16
B	8.125	08/15/19	107.1350	1.0135	28.09	7.481	0.00256	122.13	10.97	1.113	111.3728	122.28	0.3912	19.956	-5.91	1.64
B	8.500	02/15/20	111.2575	1.0549	29.07	7.482	0.00246	126.94	10.95	1.157	115.9379	128.46	0.4110	20.965	-5.79	1.71
B	8.750	05/15/20	114.2550	1.0829	30.62	7.476	0.00240	130.23	11.14	1.187	116.8655	129.02	0.4128	21.056	-6.08	1.54
B	8.750	08/15/20	114.2700	1.0829	32.12	7.477	0.00239	130.61	10.97	1.190	119.0986	132.47	0.4239	21.619	-6.78	1.29
B	7.875	02/15/21	104.2300	0.9859	34.43	7.473	0.00257	121.79	11.22	1.110	108.5481	117.96	0.3774	19.251	-9.37	0.11
B	8.125	05/15/21	107.2350	1.0140	36.40	7.466	0.00250	125.11	11.41	1.140	109.6552	118.75	0.380	19.380	-9.73	-0.07
B	8.125	08/15/21	107.2600	1.0138	39.58	7.463	0.00249	125.52	11.23	1.144	111.7634	121.92	0.3901	19.897	-11.30	-0.72
B30**	8.000	11/15/21	106.1450	1.0000	42.50	7.453	0.00251	124.68	11.51	1.136	108.3444	116.57	0.3730	19.024	-12.84	-1.43

* T denotes eligible two-year notes, F five-year notes, N ten-year notes, and B bonds.

** denotes on-the-run issue

EXHIBIT 1.3 Conversion Factors for Deliverable Bonds for Selected Contracts

Bond		Contract Month				
Coupon	Maturity	Sep 92	Dec 92	Mar 93	Jun 93	Sep 93
10-3/8	11/15/12-07	1.2053				
12	8/15/13-08	1.3544	1.3518	1.3485	1.3458	
13-1/4	5/15/14-09	1.4764	1.4725	1.4692	1.4652	1.4617
12-1/2	8/15/14-09	1.4110	1.4083	1.4050	1.4022	1.3987
11-3/4	11/15/14-09	1.3452	1.3425	1.3403	1.3374	1.3351
11-1/4	2/15/15	1.3350	1.3339	1.3322	1.3310	1.3293
10-5/8	8/15/15	1.2728	1.2720	1.2706	1.2697	1.2683
9-7/8	11/15/15	1.1958	1.1948	1.1943	1.1932	1.1926
9-1/4	2/15/16	1.1308	1.1305	1.1298	1.1295	1.1287
7-1/4	5/15/16	0.9211	0.9212	0.9217	0.9218	0.9223
7-1/2	11/15/16	0.9470	0.9470	0.9474	0.9474	0.9478
8-3/4	5/15/17	1.0800	1.0795	1.0795	1.0790	1.0789
8-7/8	8/15/17	1.0935	1.0934	1.0928	1.0927	1.0922
9-1/8	5/15/18	1.1216	1.1210	1.1208	1.1202	1.1200
9	11/15/18	1.1087	1.1082	1.1081	1.1075	1.1074
8-7/8	2/15/19	1.0952	1.0951	1.0946	1.0946	1.0941
8-1/8	8/15/19	1.0135	1.0137	1.0134	1.0136	1.0134
8-1/2	2/15/20	1.0549	1.0550	1.0546	1.0547	1.0543
8-3/4	5/15/20	1.0829	1.0825	1.0825	1.0820	1.0820
8-3/4	8/15/20	1.0829	1.0829	1.0825	1.0825	1.0820
7-7/8	2/15/21	0.9859	0.9861	0.9860	0.9862	0.9860
8-1/8	5/15/21	1.0140	1.0137	1.0139	1.0137	1.0138
8-1/8	8/15/21	1.0138	1.0140	1.0137	1.0139	1.0137
8	11/15/21	1.0000	0.9988	1.0000	0.9998	1.0000

percent bond with 24 years and 9 months to maturity that yields 8 percent.

Characteristics of Conversion Factors

- Conversion factors are unique to each bond *and* to each delivery month. Note in Exhibit 1.3 that conversion factors for bonds with coupons higher than 8 percent become smaller for each successive contract month to reflect the drift of their prices toward par as they approach maturity. Similarly, the conversion factors for bonds with coupons less than 8 percent drift upward for successive contract months.
- Conversion factors are constant throughout the delivery cycle.
- Conversion factors are used to calculate the invoice price of bonds delivered into the CBOT T-bond futures contracts.

- If the coupon is greater than 8 percent, the conversion factor is greater than 1.
- If the coupon is less than 8 percent, the conversion factor is less than 1.
- Inexperienced hedgers sometimes use the conversion factor as a hedge ratio. As we show in Chapter 5, however, this can lead to serious hedging errors.

Example: Basis Calculation. Consider the 9-1/4s of 2/15/16. The conversion factor for this bond for the September 1992 delivery cycle is 1.1308. On August 6, 1992, at 2 p.m. Chicago time, it was trading in the cash market at 119-23/32nds, while the futures price at that time was 105-04/32nds. Recall that the basis is defined as

$$\textit{Basis} = \textit{Cash Price} - (\textit{Futures Price} \times \textit{Conversion Factor})$$

To calculate the basis, first convert the cash and futures prices to decimal form. Then calculate the basis as

$$\textit{Basis} = 119.71875 - (105.125 \times 1.1308) = 0.8434$$

which is the basis in decimal form. Convert the result back to 32nds to get 26.99, which you can find in column 6 of Exhibit 1.2.

Futures Invoice Price

When a bond is delivered into the CBOT Treasury bond contract, the receiver of the bond pays the short an invoice price equal to the futures price times the conversion factor of the bond chosen by the short plus any accrued interest on the bond.

$$\textit{Invoice Price} = (\textit{Futures Price} \times \textit{Conversion Factor}) + \textit{Accrued Interest}$$

Accrued interest is also expressed per $100 face value of the bond.

Suppose that the 8-7/8s of 8/15/17 are delivered on 9/30/92 at a futures price of 105-07/32nds. This bond's conversion factor is 1.0935, and accrued interest would be $1.10938. Accrued interest is calculated from the last coupon payment date, which was 8/15/92, to 9/30/92. Thus, the invoice price would be

$$\begin{aligned}\textit{Invoice Price} &= (105.21875 \times 1.0935) + 1.10938 \\ &= 116.16608\end{aligned}$$

The futures contract calls for delivery of $100,000 face value of bonds. For each futures contract, then, the total dollar amount of the invoice would be

$$\textit{Invoice Amount} = \$1{,}000 \times 116.16608 = \$116{,}166.08$$

Carry: Profit or Loss of Holding Bonds

The price at which you would be willing to hold a bond for future delivery depends critically on what you will make or lose in net interest income while holding the bond.

Carry is the difference between the coupon income you make by holding the bond and what you pay to finance the bond. If carry is positive, as it will be if the yield curve is positively sloped, you can earn interest income holding a bond for future delivery. If carry is negative, as it will be if the yield curve is negatively sloped, you will lose interest income. For various purposes, we find it useful to distinguish between

- daily carry in dollars
- daily carry in 32nds
- total carry in 32nds

Exhibit 1.2 shows these three values in columns 13, 14, and 15 for each deliverable bond and for a financing (RP, or repo) rate of 3.35 percent.

Daily Carry

The following formula gives carry in dollars per day for each $100 par value of the bonds.

$$\text{Daily Carry} = \text{Daily Coupon Income} - \text{Daily Financing Cost}$$

where

$$\text{Daily Coupon Income} = \left(\frac{I}{2}\right) \times \left(\frac{1}{Days}\right)$$

where the dollar value of the coupon (I) is based on the coupon rate and the face value of the bond, and

$$\text{Daily Financing Cost} = (P + AI) \times \left(\frac{RP}{100}\right) \times \left(\frac{1}{360}\right)$$

is based on the total market value of the bond. The symbols used are these:

I	is the dollar value of the annual coupon for $100 face value of the bonds. As such, it can be thought of as the coupon stated in full percentage points. I is divided by 2 to put it on a semi-annual basis.
$Days$	is the number of days between coupon payments and ranges between 181 and 186, so that coupon income works on a 365-day year.
P	is the market price per $100 face value of the bond.
AI	is accrued interest per $100 face value of the bond.

RP is the repo or financing rate for the bond, which is stated in full percentage points and is divided by 100 to restate in percent. (The RP rate can be overnight or term, and can be different for different bonds.)

360 is the assumed number of days in a year for RP calculations.

Example: Carry Calculation. Consider the 7-1/2s of 11/15/16 on August 6, 1992. This bond's price plus accrued interest was 102.0622, which can be found in column 12 of Exhibit 1.2. The RP rate was 3.35 percent, and the number of days between coupons, which for this bond are paid on May 15 and November 15, was 184. Given these particulars, and for each $100 par value of the bond, we have

$$\text{Daily Coupon Income} = \left(\frac{\$7.5}{2}\right) \times \left(\frac{1}{184}\right)$$

$$= \$0.020380435$$

$$\text{Daily Financing Cost} = \$102.0622 \times \left(\frac{3.35}{100}\right) \times \left(\frac{1}{360}\right)$$

$$= \$0.009497455$$

so that daily carry is

$$\text{Daily Carry} = \$0.020380435 - \$0.009497455$$

$$= \$0.01088298$$

which is a little over one cent a day for each $100 face value of bonds. For $1 million face value of the 7-1/2s, daily carry in dollars would be

$$\text{Daily Carry} = \$0.01088298 \times 10{,}000$$

$$= \$108.83$$

which you can find in column 13 of Exhibit 1.2.

Daily Carry in 32nds. Standard bond-trading practice is to state carry in 32nds. The value of a 32nd for $1,000,000 par value of a bond is $312.50. Thus, daily carry in 32nds is found simply by dividing daily carry in dollars by $312.50. For the carry calculation example, where daily carry was $108.83, daily carry in 32nds would be

$$\text{Daily Carry in 32nds} = \frac{\$108.83}{\$312.50}$$

$$= 0.348 / 32nds$$

which you can find in column 14 of Exhibit 1.2.

Total Carry in 32nds. For the sake of convenience, carry is calculated for various holding periods. Total carry can be calculated to the first delivery day, futures expiration day, or last delivery day. Of the three, however, we show only total carry to the last delivery day, which happens to be the optimal delivery date given positive carry and which is shown in column 15 of Exhibit 1.2. We have more to say on the problem of optimal delivery in Chapter 2.

For these calculations, total carry is daily carry multiplied by the number of days the bond is held. However, this number is only an approximation. If there is a coupon date between the time of calculation and the delivery date, the number of days between coupon periods changes slightly, thus changing the actual daily carry. An exact solution can be found by calculating the daily carry for each period and multiplying by the number of days carried in the respective periods (see Appendix B).

Theoretical Bond Basis with One Deliverable Bond

If there were only one bond available for delivery, or if there were never any question about what the deliverable bond would be or when the bond would be delivered, the bond basis would be very easy to figure. To simplify matters still more, suppose the bond in question bears an 8 percent coupon, and that its conversion factor is 1.000. In such a simple setting, the futures price would be approximately

$$\textit{Futures Price} = \textit{Bond Price} - \textit{Total Carry to Delivery}$$

Because the bond's conversion factor is 1.000, the bond's basis in this case is just the difference between the bond's price and the futures price. If we take this difference, we find that

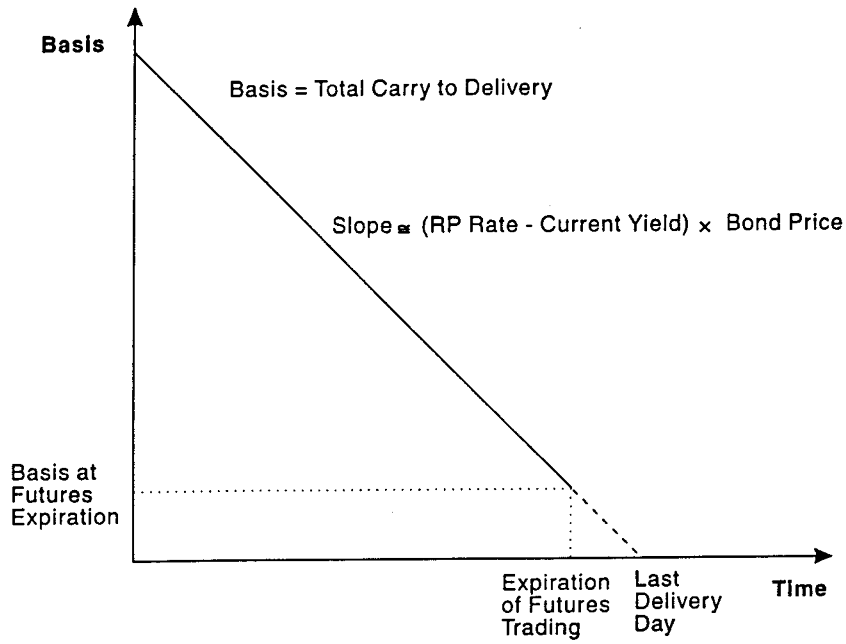
$$\begin{aligned} \textit{Basis} &= \textit{Bond Price} - \textit{Futures Price} \\ &= \textit{Bond Price} - (\textit{Bond Price} - \textit{Total Carry}) \\ &= \textit{Total Carry} \end{aligned}$$

Total carry, of course, has two parts. The first is daily carry in 32nds, which depends both on the difference between the RP rate and the current yield (coupon ÷ price) on the bond and on the price of the bond. The second is the total number of days to delivery. Taking the two together produces a relationship between a bond's basis and the time to delivery like that shown in Exhibit 1.4. Three key points illustrated in the exhibit are:

- The height of the curve is total carry to delivery.
- The slope of the curve is equal to negative daily carry.
- The basis converges to zero as time approaches delivery.

In Exhibit 1.4, the basis relationship is drawn for a setting in which carry is positive. Also note that the basis is represented by a solid line only until the last trading day is reached. After trading in the futures contract has expired, the futures price is fixed while the bond's price is

EXHIBIT 1.4 Basis of Cheapest to Deliver with One Deliverable Bond



free to change. Both of these are important features of the bond basis market and we discuss them further in Chapters 2 and 3.

Implied Repo Rate

The implied repo rate is the theoretical return you would obtain if you bought the cash bond, sold futures short against it, and then delivered the cash bond into the futures. If there is no coupon payment before delivery day, the formula for the implied repo rate is

$$IRR = \left(\frac{Invoice\ Price - Purchase\ Price}{Purchase\ Price}\right) \times \left(\frac{360}{n}\right)$$

which simplifies to

$$IRR = \left(\frac{Invoice\ Price}{Purchase\ Price} - 1\right) \times \left(\frac{360}{n}\right)$$

where n is the number of days to delivery, and both the invoice and purchase price include accrued interest.

If a coupon payment is made before the delivery date, the implied rate of return can be calculated by assuming that the coupon is invested at the implied repo rate from the time it is received to delivery on the futures contract. That is, the implied repo rate is the money market rate that produces

$$Purchase\ Price \times \left(1 + IRR\left(\frac{n}{360}\right)\right) = Invoice\ Price + \left(\frac{Coupon}{2}\right) \times \left(1 + IRR\left(\frac{n_2}{360}\right)\right)$$

where n_2 is the number of days between the coupon payment and the delivery of the bond. When we rearrange this expression to find the implied repo rate, the result is

$$IRR = \frac{\left(Invoice\ Price + \frac{Coupon}{2} - Purchase\ Price\right) \times 360}{\left(Purchase\ Price \times n\right) - \left(\frac{Coupon}{2} \times n_2\right)}$$

Consider the calculation of the implied repo rate on August 6, 1992, for the 7-1/2s of 11/15/16, assuming delivery on the last possible date for delivery into the September 1992 contract (September 30). On August 6, the futures price settled at 105-04/32nds. The number of days from the settlement date of August 10 to the last delivery date of September 30 was 51.[1] The cash price of the 7-1/2s was quoted at 100-9.25/32nds, and accrued interest for each $100 face value of the bonds from the last coupon payment date on May 15 to the settlement date on August 10 was $1.7731. At delivery, accrued interest would be $2.8125.

To calculate the implied repo rate for $100,000 par value of the bond, you first need the purchase price or full price, which was

$$\begin{aligned} Purchase\ Price &= Quoted\ Price + Accrued\ Interest \\ &= \$100.2891 + \$1.7731 \\ &= \$102.0622 \end{aligned}$$

which you can find in column 12 of Exhibit 1.2. Next you need the invoice price. Given delivery on September 30 and a futures price of 105-04/32nds, the invoice price would be

$$\begin{aligned} Invoice\ Price &= (Futures\ Price \times Conversion\ Factor) + Accrued\ Interest \\ &= (\$105.125 \times 0.9470) + \$2.8125 \\ &= \$99.5534 + \$2.8125 \\ &= \$102.3659 \end{aligned}$$

1 Exhibit 1.2 is a report that is produced following the close of business each day. Thus, because the prices shown in Exhibit 1.2 are the closing prices, the next opportunity to trade is the next business day. In this case, because August 6 was a Thursday, the assumed trade date would be Friday, August 7. Cash trades would settle on the next business day, which would be Monday, August 10.

With these numbers, the implied repo rate is

$$IRR = \left(\frac{\$102.3659}{\$102.0622} - 1\right) \times \left(\frac{360}{51}\right)$$
$$= 2.10\%$$

which you can find in column 17 of Exhibit 1.2.

Important Note. The implied repo rate is a theoretical return. The calculation assumes that you are short a number of futures equal to the bond's conversion factor, C, for each $100,000 bonds held long and that any coupon payments can be invested at the implied repo rate. Even then, you can only approximate the return because of variation margin payments on the futures contract. As prices rise, you lose money on your short futures position, and this must be paid through to whoever is long the futures. As prices fall, of course, you collect variation margin payments. Notice, however, that you are paying out variation margin when yields are low and receiving variation margin when yields are high. The overall effect may not be very large, but it is enough to drive a thin wedge between the theoretical and actual return.

Buying and Selling the Basis

Basis trading is the simultaneous or nearly simultaneous trading of cash bonds and bond futures to take advantage of expected changes in the basis. To "buy the basis" or to "go long the basis" is to buy cash bonds and to sell a number of futures contracts equal to the conversion factor for every $100,000 par value cash bond. To "sell the basis" or to "go short the basis" is just the opposite: selling or shorting the cash bond and buying the futures contracts.

Because a bond's basis is defined as the difference between the bond's price and its converted futures price (i.e., basis = price - factor x futures), a useful way of keeping basis trades straight is to remember that whatever position you take in the bond is the position you take in the basis. If you buy the bond and sell the futures, you are long the basis, and you will profit from an increase in the price of the bond relative to its converted futures price. If you sell the bond and buy the futures, you are short the basis. With a short basis position, you will profit if the bond price falls relative to its converted futures price.

In practice, traders can buy or sell the basis in either of two ways. The first is to execute the cash and futures trades separately, which is known as "legging into the trade." For example, to buy the basis, you would buy the bonds in the cash market at the lowest price available and sell the appropriate number of futures contracts at the highest available price in the bond futures market. The second approach to trading the basis is to execute the trade as a spread in the EFP (exchange of futures for physicals) market. Such a transaction simultaneously establishes a position in cash bonds and bond futures at the agreed-upon spread. The main advantage of the EFP market is that it limits the execution risk of establishing a spread position, because traders directly bid and offer on the basis itself.

Consider, for example, the September 1992 basis of the 7-7/8s of 2/15/21 just before the close of futures trading on August 6, 1992. The September 1992 conversion factor for this bond was 0.9859. Futures were trading at 105-04/32nds, and, in the EFP market, the 7-7/8s basis was bid at 34/32nds and offered at 35/32nds. This means that someone was willing to pay at least 34/32nds for the basis of the 7-7/8s and that someone was willing to sell the basis of the 7-7/8s at a price as low as 35/32nds.

In this example, if a trader "lifted the offer" and paid 35/32nds for $10 million of the 7-7/8s basis, the trader would have simultaneously established a *long* position in $10 million par amount of the 7-7/8s and a *short* position in 99 bond futures contracts. The price paid for the bond would be 35/32nds higher than the product of the bond's conversion factor and the price at which the futures were sold. On the other hand, if a trader "hit the bid" and received 34/32nds for $10 million of the 7-7/8s basis, the trader would have simultaneously established a *short* position in $10 million par value of the bonds and a *long* position in 99 bond futures contracts. The price received for the bond would be 34/32nds higher than the product of the bond's conversion factor and the price paid for the futures contracts.

Once an EFP trade has been made, prices have to be set for both the cash bond and the bond futures. In practice, the futures price is set first by the EFP broker at a level that is close to the current market. Then the cash price of the bond is calculated as a residual to achieve the agreed-upon value of the spread. For example, if the trader bought the basis in the EFP market for 35/32nds (step 1), and the 99 futures were sold in the futures market at a price of 105-04/32nds (step 2), the cash price of the bond *net* of accrued interest would be calculated (step 3) as

$$\begin{aligned} \textit{Bond Price} &= (\textit{Basis} + \textit{Conversion Factor} \times \textit{Futures Price}) \\ &= (35/32\text{nds} + 0.9859 \times 105\text{-}04/32\text{nds}) \\ &= (1.09375 + 0.9859 \times 105.125) \\ &= 104.736488 \end{aligned}$$

which produces a basis of almost exactly 35/32nds.

Page 510 of Telerate shows EFP basis quotes provided by Cantor Fitzgerald. An example of this page is shown in Exhibit 1.5. The page shows some of the more actively traded issues eligible for delivery

EXHIBIT 1.5 EFP Basis Quotes

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TELERATE MATRIX                                                          PAGE 510
01/26/93 11:54 EST

                     TELERATE TREASURY 500        (C) 93 MKT DATA CORP/CANTOR   FITZ P510
[30Y BASIS MAT      PRICE      SIZE ]         [CPN    MAT   PRICE          SIZE  YIELD
H 9.250    2/16     35 / 37     5 X 5         7.500   N16                    X
H 7.250    5/16                               8.750   517                    X
H 7.500   11/16        / 37       X 5         8.875   817                    X
H 8.875    5/17                               8.875   219                    X
H 8.500    2/20     40 / 41    10 X 5         8.500   220                    X
H 7.875    8/17                               8.750   520                    X
H 8.125    5/21                               8.750   820                    X
H 8.125    8/21     48+/ 49+    5 X 5         7.875   221                    X
H 8.000   11/21     50 /        5 X           8.125   521                    X
H 7.250    8/22     58          5 X           8.125   821                    X
H 7.625   11/22     72+/ 73+   15 X 10        8.000   N21   108.24+-28      1X1  7.268-25
                           X                  7.250   822   100.00  -02+    5X1  7.250-24
  BLOCK N22                X                  7.625   N22   104.30-00+      5X1  7.218-21
!  2 YR   4.25 -24        12X10     4.250-240 ! 5 YR      5.68 -67+    9X7       5.680-675
!  3 YR  TAK 101.036       X5      TAK  4.692 !10 YR     99.18+-19     1X17      6.434-432
```

into the bond contract and lists the best bid and offer available for each issue, along with the size of the bid and offer. For example, at 11:54 a.m. (New York time) on January 26, 1993, the March basis of the 8-1/2s of 2/20 was bid at 40/32nds and offered at 41/32nds. The "size" column indicates that the bid was good for $10 million and the offer for $5 million.

The main difference between legging into a basis trade and executing a basis trade in the EFP market, apart from execution risk, is the prices at which the two legs of the spread trade are executed. The difference can have a small effect on the realized value of the spread.

If the trader legs into the position, the cash and futures trades are done at their respective *market* prices, and the resulting value of the basis is calculated as a residual. In contrast, if the trader undertakes the trade in the EFP market, the value of the basis and the futures prices are established first, and the invoice price for the cash bonds is calculated as a residual.

For example, if the trader could buy $10 million of the 7-7/8s at a market price of 104-23/32nds and sell 99 bond futures at a market price of 105-04/32nds, the resulting value of the basis would be

$$\begin{aligned} \textit{Basis} &= (\textit{Bond Price} - \textit{Conversion Factor} \times \textit{Futures Price}) \\ &= (104.71875 - 0.9859 \times 105.12500) \\ &= 1.0760 \\ &= 34.43/32\text{nds} \end{aligned}$$

which is the value of the basis as reported in column 6 of Exhibit 1.2, and which is slightly lower than the 35/32nds basis achieved in the EFP example. If the cash price of the bond were 104-23+, or 104-23.5/32nds, the resulting basis would be 34.93/32nds.

Why Use the Bond's Conversion Factor? Perhaps the best reason is that a bond's conversion factor defines its basis. If futures and bonds are combined in a ratio equal to the bond's conversion factor, a change in the bond's basis of any given amount will yield the same profit regardless of whether the change in the basis comes from a change in the price of the bond or a change in the futures price, and regardless of whether bond and futures prices generally rise or generally fall.

As we will see in Chapters 2 and 3, however, a basis position typically has a bullish or bearish tilt. This is because a bond's conversion factor only *approximates* the number of futures required for each $100,000 par value of the cash bonds to remove the directional bias. A trader can, of course, overcome this drawback by using a better hedge ratio to construct spread positions. The profit or loss on this position will generally differ from the profit or loss on a basis position.

Sources of Profit in a Basis Trade

A basis trade has two sources of profit. These are:

- change in the basis, and
- carry

A long basis position profits from an increase in the basis. Further, if net carry on the bond is positive, a long basis position earns the carry as well. On the other hand, a short position profits from a decrease in the basis but loses the carry if carry is positive.

The profit and loss characteristics of long and short basis trades are best illustrated with an example of each.

Buying the Basis. Suppose that on August 7, 1992, September 1992 bond futures are trading at 105-04/32nds. At the same time, the 7-1/4s of 5/16 are trading at 97-18.5/32nds for a basis of 23.9/32nds. You think that 23.9/32nds is a narrow basis at this time in the delivery cycle, and that a long basis position is likely to be profitable. Exhibit 1.2 shows that the 7-1/4s had a conversion factor of 0.9211 Your opening trade would be

On 8/7/92 (settle 8/10/92)
Buy $10 million 7-1/4s of 5/16 at 97-18.5/32nds
Sell 92 September 1992 futures at 105-04/32nds
Basis = 23.9/32nds

By August 21, your views have been borne out, and you want to unwind the position. Your closing trade would be

On 8/21/92 (settle 8/24/92)
Sell $10 million 7-1/4s of 5/16 at 98-17/32nds
Buy 92 September 1992 futures at 106-08/32nds
Basis = 21.26/32nds

Profit/Loss
Bonds
Buy $10 million 7-1/4s of 5/16 at 97-18.5/32nds
Sell $10 million 7-1/4s of 5/16 at 98-17/32nds
Gain = 30.5/32nds x $3,125 = $95,312.50

Futures
Sell 92 September futures at 105-04/32nds
Buy 92 September futures at 106-08/32nds
Loss = 36/32nds x 92 x $31.25 = ($103,500)

Coupon interest earned (14 days)
$10,000,000 x (0.0725/2) x (14/184) = $27,581.52

RP interest paid (14 days)[2]
$9,929,210 x 0.0335 x (14/360) = ($12,935.55)

Summary P/L

7-1/4s of 5/16	$95,312.50
September 1992 futures	(103,500.00)
Coupon income	27,581.52
RP interest	(12,935.55)
Total	$6,458.47

Alternative Summary P/L

You can see from the example that even though you lost more on the futures than you made on the cash bond, you still made money on the trade. Put differently, you lost money on a change in the bond's basis but more than made up for it in positive carry. We find it useful to restate the P/L for a basis trade in terms of these two components: the change in the basis and carry. For this particular trade, these would be

Change in the basis	($8,187.50)
Carry	14,645.97
Total	$6,458.47

where the change in the basis is the combined value of what you made on the 7-1/4s and lost on the September 1992 futures, while carry is the combined value of coupon income received and RP interest paid.

As a rough check on your trade construction, you can compare what you realized on the change in the price relationship between cash bonds and bond futures with what you should have made. The basis narrowed from 23.9/32nds to 21.26/32nds, for a change of -2.64/32nds. For a basis position of $10 million, each 32nd is worth $3,125. Thus, your profit from the change in the basis should have been -$8,250 [= -2.64/32nds x $3,125]. The difference between the theoretical value and what you realized is due simply to rounding in the number of futures contracts. You can deal only in whole contracts, and so you had to sell 92 futures rather than 92.11, which is the exact number needed to replicate the bond's basis.

Selling the Basis. In contrast to the basis of the 7-1/4s, you believe that the basis of the 11-3/4s of 11/14-09 on August 7 is too wide and will narrow more than enough over the next few days to offset any negative carry in a short basis position. From Exhibit 1.2, we know

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2 Calculated on the basis of the full price, or cash price plus accrued interest.

that the conversion factor of the 11-3/4s was 1.3452. Your opening trade is

On 8/7/92 (settle 8/10/92)
Sell $10 million 11-3/4s of 11/14-09 at 143-06.25/32nds
Buy 135 September 1992 futures at 105-04/32nds
Basis = 57/32nds

By August 21, the basis has narrowed enough to close out the position. Your closing trade is

On 8/21/92 (settle 8/24/92)
Buy $10 million 11-3/4s of 11/14-09 at 144-11/32nds
Sell 135 September 1992 futures at 106-08/32nds
Basis = 45.3/32nds

Profit/Loss

Bonds
Sell $10 million 11-3/4s at 143-06.25/32nds
Buy $10 million 11-3/4s at 144-11/32nds
Loss = 36.75/32nds x $3,125 = ($114,843.75)

Futures
Buy 135 September 1992 futures at 105-04/32nds
Sell 135 September 1992 futures at 106-08/32nds
Gain = 36/32nds x 135 x $31.25 = $151,875

Coupon interest paid (14 days)
$10,000,000 x (0.1175/2) x (14/184) = ($44,701.09)

Reverse RP interest earned (14 days)
$14,597,320 x 0.0335 x (14/360) = $19,017.06

Summary P/L

11-3/4s of 11/14-09	($114,843.75)
September 1992 futures	151,875.00
Coupon interest	(44,701.09)
Reverse RP interest	19,017.06
Total	$11,347.22

Alternative Summary P/L

Change in the basis	$37,031.25
Carry	(25,684.03)
Total	$11,347.22

RP Versus Reverse RP Rates

RP stands for repurchase, or "repo." Standard industry practice in the U.S. Treasury bond market is to finance long securities positions through the use of repurchase agreements. Formally, at least, a repurchase agreement is an arrangement in which a bond is sold today at one price and bought back at a later date, often the next day, at a predetermined price that is usually higher. The effect of this transaction is to finance the position, and the difference in the two prices is the cost of financing the position. When the cost is expressed in annual percentage terms, the resulting figure is the RP, or repo, rate. Note that because the repurchase price is set in advance, the RP rate is a comparatively risk-free short-term rate of return.

In a reverse repo, a bond is "reversed in" at one price and sold back later at a predetermined price that is usually higher. The effect of this transaction is to lend money at a comparatively risk-free short-term rate.

Repo transactions can be either overnight or for a set term. If the repurchase is set for the next day, the repo is overnight. If the repurchase is set for any longer period of time, the repo is term.

Under normal circumstances, the reverse repo rate tends to trade between 10 and 25 basis points below the repo rate. In other words, the rate at which you can finance long positions in Treasuries is about 10 to 25 basis points higher than the rate at which you can invest money short-term.

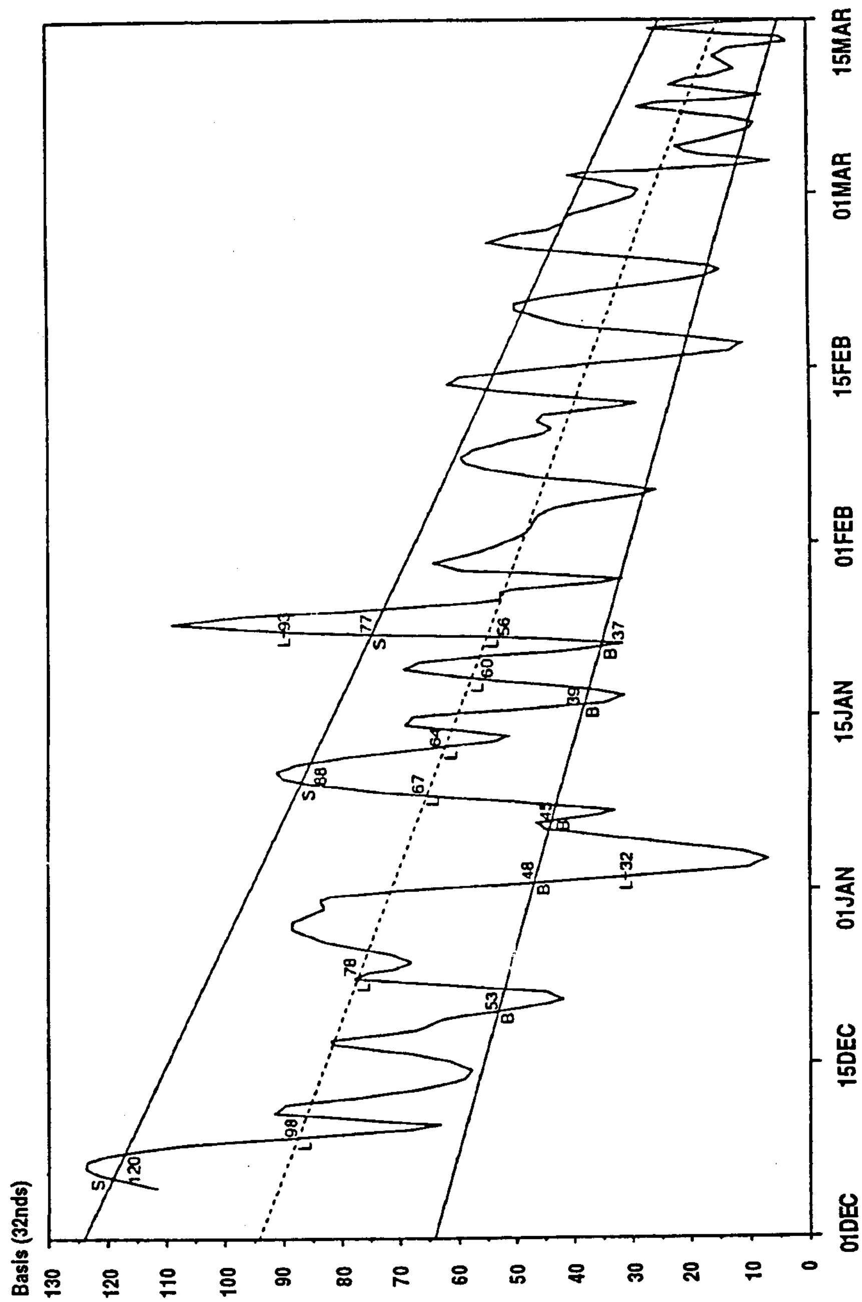
The difference can have a substantial effect on the profitability of basis trades. Suppose, for example, that the reverse repo rate in the example of selling the basis had been 3.10 percent, or 25 basis points lower than the repo rate. At this rate, our income from reverse RP interest would have been only $17,597.88 [= $14,597,320 x 0.0310 x (14/360)] instead of $19,017.06. As a result, the trader's profit from selling the basis would have been $1,419.18 less than was shown in the example. Had the bond been "on special," which we will discuss in Chapter 6, and the reverse repo rate had been as low as, say, 1 percent, the trade would have produced a loss of $1,993.10 instead of a gain.

An Idealized Strategy for Trading the Bond Basis

The smooth convergence of the bond basis shown in Exhibit 1.4 is a radical simplification of how the bond basis behaves. For a variety of reasons, one of which is uncertainty about short-term financing costs, a bond basis follows a rockier road.

The basis illustrated in Exhibit 1.6 follows a rocky road, indeed—rockier, for that matter, than it really has been recently. Over the past couple of years, the costs of trading the basis have become quite low for large traders who are close to the market. As a result, the road has become smoother and the strategy now is profitable only for a highly

EXHIBIT 1.6 A Strategy for Trading the Bond Basis



efficient set of traders—most notably, the primary government securities dealers.

The purpose of Exhibit 1.6, however, is to illustrate an idealized strategy for trading the bond basis. Consider the following rules for trading. You recognize that the basis can bounce around from day to day, but you also believe strongly that the basis should not trade at implied repo rates higher than 4 percent or lower than 1 percent. In Exhibit 1.6, solid diagonal lines represent these upper and lower bounds. You decide to sell the basis whenever it trades above the upper bound and liquidate the position whenever it trades at or below the mid-point of the range. Similarly, you buy the basis whenever it trades below the lower bound and liquidate the position whenever it trades at or above the mid-point of the range.

As it stands, such a strategy sounds like a sure winner, but any realistic trading strategy must allow for the possibility that the entire financing structure may change. A sharp increase in short-term financing costs would shift the trading bounds up. A sharp steepening of the yield curve would shift the trading bounds down. In either case, you should have a rule for bailing out. For this example, assume that you liquidate the trade if it moves 16/32nds against you.

Armed with such a rule, the resulting set of trades would be

1 Sell at 120/32nds, liquidate at 98/32nds, net 22/32nds
2 Buy at 53/32nds, liquidate at 78/32nds, net 25/32nds
3 Buy at 48/32nds, liquidate at 32/32nds, net -16/32nds
4 Buy at 45/32nds, liquidate at 67/32nds, net 22/32nds
5 Sell at 88/32nds, liquidate at 64/32nds, net 24/32nds
6 Buy at 39/32nds, liquidate at 60/32nds, net 21/32nds
7 Buy at 37/32nds, liquidate at 56/32nds, net 19/32nds
8 Sell at 77/32nds, liquidate at 93/32nds, net -16/32nds

The net income from these trades amounts to 101/32nds not counting carry, which would have been more or less a wash. Note that the third and eighth trades were both half-point losers.

Why stop at the eighth trade? One of the key ingredients of any trading strategy is an expected profit objective. Notice that the range of possible outcomes narrows as the expiration of trading in the futures contract approaches. As the range narrows, the expected profit from each trade gets smaller relative to the costs of doing the trade, which are roughly the same no matter when the trade is done. Thus, in this idealized example, we stop trading when the futures contract has about two months remaining to expiration. At this point, the expected profit from a trade is too small to warrant the trading costs and risks.

In the real world of basis trading, as in the real world of almost anything, things are just more complicated. The purpose of this book is to explain those complications and to make trading the bond basis both understandable and accessible.

Section 2

EXERCISES

Pre-course Exercises

Issue

Coupon	=	6 1/4%
Maturity	=	August 15, 2023
Coupon Dates	=	February 15/August 15
Par Amount	=	$1,000,000
Price	=	100 16/32
Factor	=	0.8023

Background

Settlement Date	=	August 25
Repo Rate	=	3.05%
Days from 8/15-2/15	=	184 days
Futures Price	=	117 16/32

1. What is the amount of the coupon payment made on February 15?

2. What is the accrued interest on the 6 1/4s on August 25?

3. What is the full price on August 25?

4. Assume that the full price on the bond on August 25 is the amount financed during the whole period. How much will the repo interest be on the 6 1/4s from August 25 to September 30?

5. How much coupon income will be earned from August 25 to September 30?

6. What is the basis of the 6 1/4s?

7. What is the carry to September 30?

8. What is the value of the strategic delivery options on the 6 1/4s basis?

9. What is the implied repo rate for the 6 1/4s?

Guide to Pre-course Exercises

Issue

Coupon	=	6 1/4%
Maturity	=	August 15, 2023
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Par Amount	=	$1,000,000
Price	=	100 16/32
Factor	=	0.8023

Background

Settlement Date	=	August 25
Repo Rate	=	3.05%
Days from 8/15-2/15	=	184 days
Futures Price	=	117 16/32

1. What is the amount of the coupon payment made on February 15?

coupon amount = (par x coupon rate)/2
= (1,000,000 x .0625)/2
= $31,250

2. What is the accrued interest on the 6 1/4s on August 25?

$$\textbf{accrued interest} = \frac{\textbf{(days since last coupon)}}{\textbf{(days in coupon period)}} \textbf{ x coupon amount}$$

= 10/184 x $31,250
= $1,698.37

3. What is the full price on August 25?

full price = market price + accrued interest (in terms of price)
= 100.5 + 0.169837
= 100.669837

4. Assume that the full price on the bond on August 25 is the amount financed during the whole period. How much will the repo interest be on the 6 1/4s from August 25 to September 30?
   repo interest = (par amount x price) x repo rate x days/360
   = 1,000,000 x 1.00669837 x .0305 x 36/360
   = $3,070.43

5. How much coupon income will be earned from August 25 to September 30?
   accrued interest = (days since last coupon) / (days in coupon period) x coupon amount

   = 36/184 x $31,250
   = $6,114.13

6. What is the basis of the 6 1/4s?
   basis = spot price - (factor x futures price)
   = 100.5 - (0.8023 x 117.5)
   = 6.23 points
   = 199/32nds

7. What is the carry to September 30?
   carry = coupon - repo interest
   = 6,114.13 - 3,070.43
   = 3,043.70
   = 9.74/32nds

8. What is the value of the strategic delivery options on the 6 1/4s basis?
   value of s.d.o.(bnoc) = basis - carry
   = 199/32nds - 9.74/32nds
   = 189.26/32nds

9. What is the implied repo rate for the 6 1/4s?
   invoice price = (factor x futures price) + accrued interest (in terms of price)
   = (0.8023 x 117.5) + (36/184 x 31,250)/10,000
   = 94.8817

   implied repo = [(invoice price/purchase price) - 1] x [360/days]
   = [(94.8817/100.669837) - 1] x [360/36]
   = -.5749
   = -57.49%