Introduction to Bond Markets

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December 10, 2014

Bonds

- A bond is a financial security that promises to pay a fixed (known) income stream in the future
- Issued by governments, state agencies (municipal bonds), and corporations
- Bonds are characterized by
  - Maturity date
  - Face, par or principal value (i.e., the notional amount typically 1000)
  - Coupon rate
  - number of coupon payments/ year (typically 2)

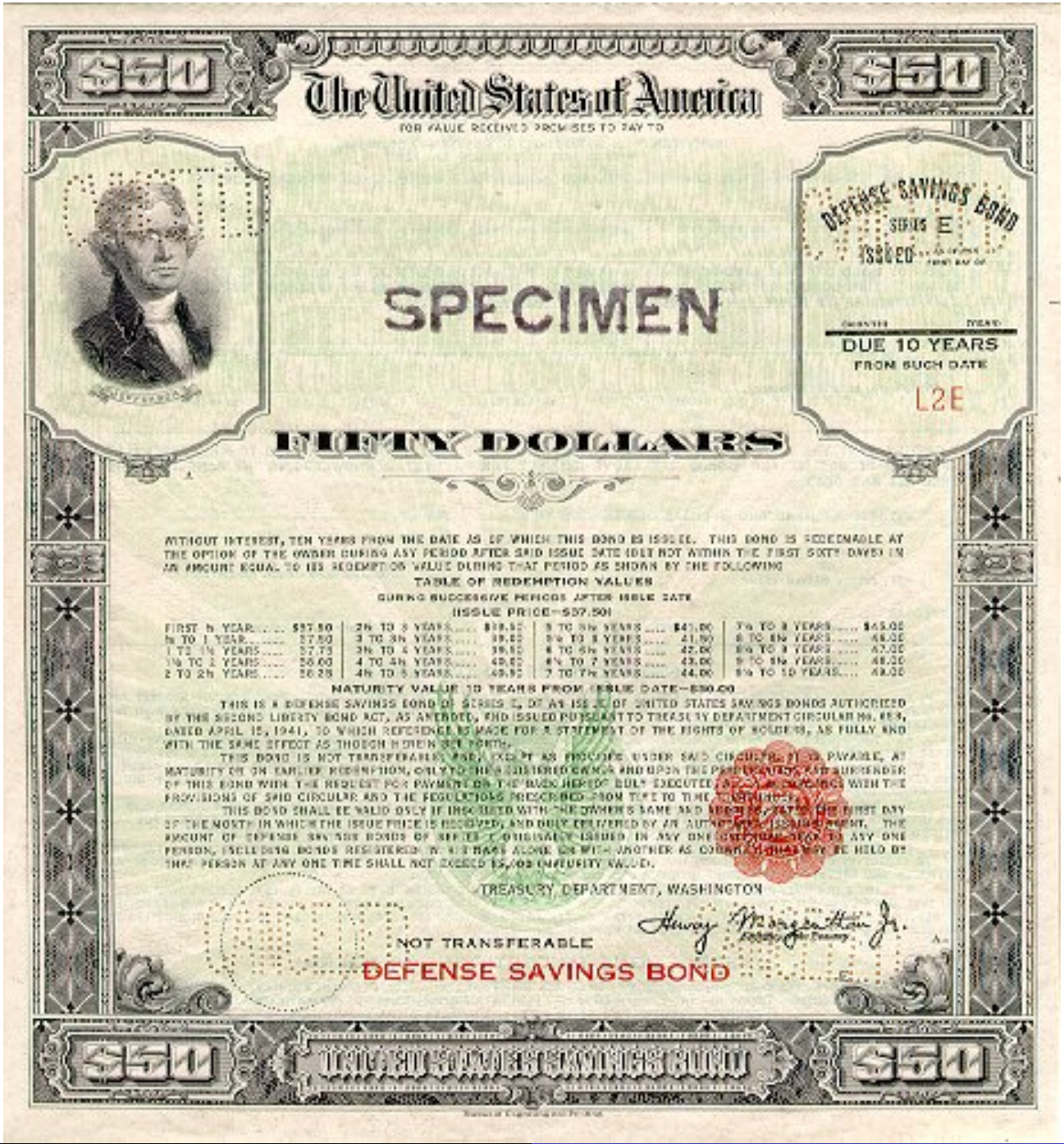
Repayment types

- Pure discount or zero coupon bonds: Bonds that pay no interest (coupon). They sell at a discount (price below par) to provide investor with positive return.
- Coupon bonds. Pays fixed coupon at known times. For example, A November 2021 maturity, 8% government bond will pay its owner $40 = 8\% * 1000/2$ every April 15th and November 15th in addition to 1000 at expiration on November 15th, 2021.
- Floating rate. Pays variable rate coupons linked to some benchmark rate. Example: Inflation indexed bonds' (I-bonds) coupon rate is determined by the level of inflation (as measured by the relative change in the CPI)

Government Bonds

US government bonds are interesting because

- The default risk is thought of as zero (although it may not be)
- They are highly liquid
- They provide a basic benchmark for other fixed income securities including other sovereign bonds, corporates, munis, etc.



$50

The United States of America

FOR VALUE RECEIVED PROMISES TO PAY TO

SPECIMEN

DEFENSE SAVINGS BOND
SERIES E
ISSUED ... (DAY OF MONTH) (YEAR)

DUE 10 YEARS
FROM SUCH DATE

L2E

FIFTY DOLLARS

WITHOUT INTEREST, TEN YEARS FROM THE DATE AS OF WHICH THIS BOND IS ISSUED. THIS BOND IS REDEEMABLE AT THE OPTION OF THE OWNER DURING ANY PERIOD AFTER SAID ISSUE DATE (BUT NOT WITHIN THE FIRST SIXTY DAYS) IN AN AMOUNT EQUAL TO ITS REDEMPTION VALUE DURING THAT PERIOD AS SHOWN BY THE FOLLOWING

TABLE OF REDEMPTION VALUES

DURING SUCCESSIVE PERIODS AFTER ISSUE DATE

ISSUE PRICE—$37.50

FIRST ½ YEAR	$37.50	2½ TO 3 YEARS	$38.62	5 TO 5½ YEARS	$41.00	7½ TO 8 YEARS	$43.00
½ TO 1 YEAR	37.50	3 TO 3½ YEARS	38.62	5½ TO 6 YEARS	41.50	8 TO 8½ YEARS	43.00
1 TO 1½ YEARS	37.75	3½ TO 4 YEARS	39.50	6 TO 6½ YEARS	42.00	8½ TO 9 YEARS	43.00
1½ TO 2 YEARS	38.00	4 TO 4½ YEARS	40.00	6½ TO 7 YEARS	43.00	9 TO 9½ YEARS	43.00
2 TO 2½ YEARS	38.25	4½ TO 5 YEARS	40.50	7 TO 7½ YEARS	44.00	9½ TO 10 YEARS	43.00

MATURITY VALUE 10 YEARS FROM ISSUE DATE—$50.00

THIS IS A DEFENSE SAVINGS BOND OF SERIES E, OF AN ISSUE OF UNITED STATES SAVINGS BONDS AUTHORIZED BY THE SECOND LIBERTY BOND ACT, AS AMENDED, AND ISSUED PURSUANT TO TREASURY DEPARTMENT CIRCULAR NO. 653, DATED APRIL 15, 1941, TO WHICH REFERENCE IS MADE FOR A STATEMENT OF THE RIGHTS OF HOLDERS, AS FULLY AND WITH THE SAME EFFECT AS THOUGH HEREIN SET FORTH.

THIS BOND IS NOT TRANSFERABLE AND, EXCEPT AS PROVIDED UNDER SAID CIRCULAR NO. 653, PAYABLE, AT MATURITY OR ON EARLIER REDEMPTION, ONLY TO THE REGISTERED OWNER AND UPON THE PRESENTATION AND SURRENDER OF THIS BOND WITH THE REQUEST FOR PAYMENT ON THE BACK HEREOF DULY EXECUTED AND IN ACCORDANCE WITH THE PROVISIONS OF SAID CIRCULAR AND THE REGULATIONS PRESCRIBED FROM TIME TO TIME THEREUNDER.

THIS BOND SHALL BE VALID ONLY IF INSCRIBED WITH THE OWNER'S NAME AND BEARS AN ISSUE DATE THE FIRST DAY OF THE MONTH IN WHICH THE ISSUE PRICE IS RECEIVED, AND DULY ENTERED BY AN AUTHORIZED AGENT. THE AMOUNT OF DEFENSE SAVINGS BONDS OF SERIES E ORIGINALLY ISSUED IN ANY ONE CALENDAR YEAR TO ANY ONE PERSON, EXCLUDING BONDS REGISTERED IN HIS NAME ALONE OR WITH ANOTHER AS COOWNER WHICH MAY BE HELD BY THAT PERSON AT ANY ONE TIME SHALL NOT EXCEED $5,000 (MATURITY VALUE).

TREASURY DEPARTMENT, WASHINGTON

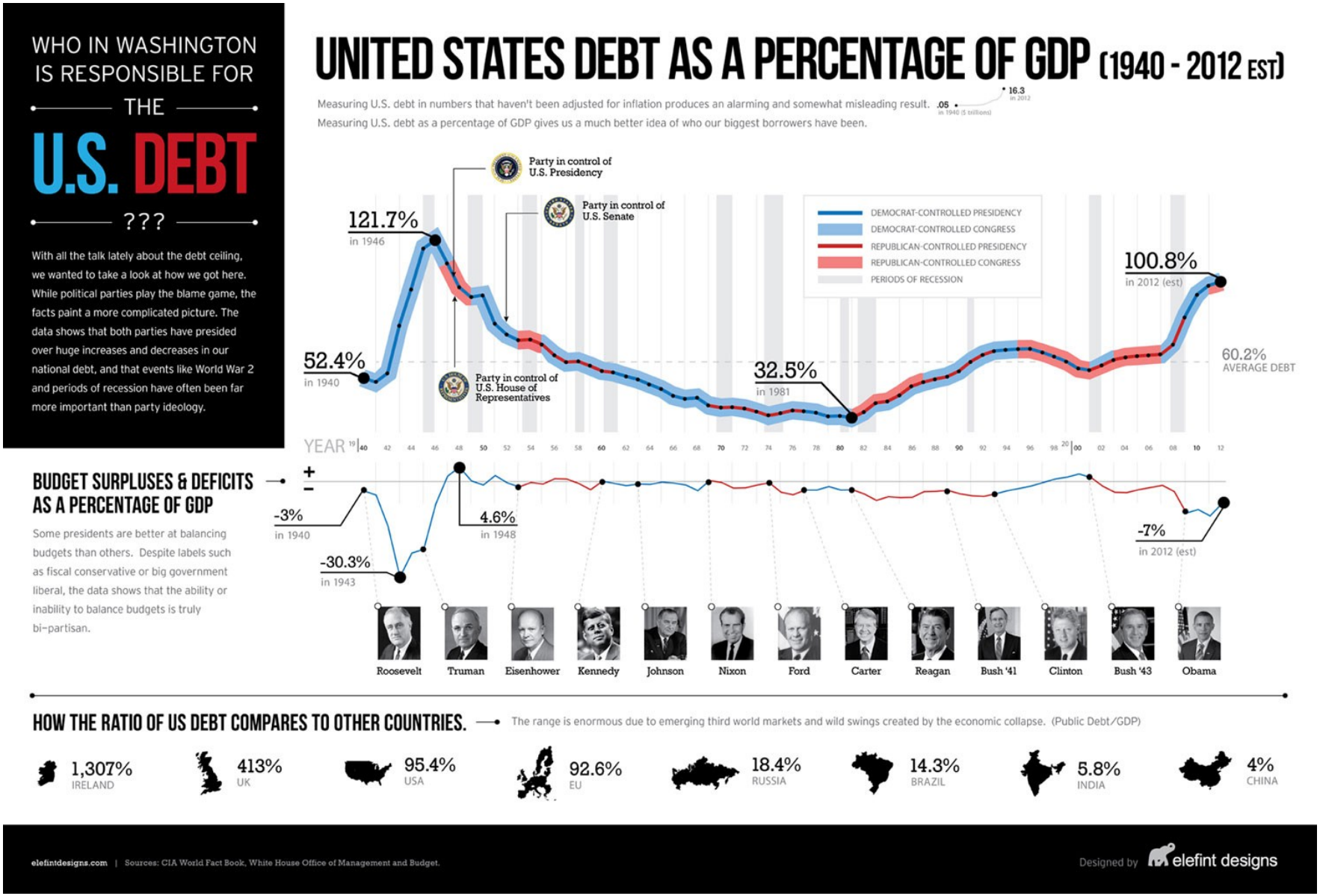
Henry Morgenthau Jr.
Secretary of the Treasury

NOT TRANSFERABLE

DEFENSE SAVINGS BOND

$50

$50


WHO IN WASHINGTON IS RESPONSIBLE FOR THE
U.S. DEBT
???
With all the talk lately about the debt ceiling, we wanted to take a look at how we got here. While political parties play the blame game, the facts paint a more complicated picture. The data shows that both parties have presided over huge increases and decreases in our national debt, and that events like World War 2 and periods of recession have often been far more important than party ideology.
UNITED STATES DEBT AS A PERCENTAGE OF GDP (1940 - 2012 EST)
Measuring U.S. debt in numbers that haven't been adjusted for inflation produces an alarming and somewhat misleading result. .05 in 1940 ($ trillions) 16.3 in 2012
Measuring U.S. debt as a percentage of GDP gives us a much better idea of who our biggest borrowers have been.
Party in control of U.S. Presidency
Party in control of U.S. Senate
Party in control of U.S. House of Representatives
DEMOCRAT-CONTROLLED PRESIDENCY
DEMOCRAT-CONTROLLED CONGRESS
REPUBLICAN-CONTROLLED PRESIDENCY
REPUBLICAN-CONTROLLED CONGRESS
PERIODS OF RECESSION
121.7% in 1946
52.4% in 1940
32.5% in 1981
100.8% in 2012 (est)
60.2% AVERAGE DEBT
YEAR 19 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 20 00 02 04 06 08 10 12
BUDGET SURPLUSES & DEFICITS AS A PERCENTAGE OF GDP
Some presidents are better at balancing budgets than others. Despite labels such as fiscal conservative or big government liberal, the data shows that the ability or inability to balance budgets is truly bi-partisan.
+
−
-3% in 1940
-30.3% in 1943
4.6% in 1948
-7% in 2012 (est)
Roosevelt Truman Eisenhower Kennedy Johnson Nixon Ford Carter Reagan Bush '41 Clinton Bush '43 Obama
HOW THE RATIO OF US DEBT COMPARES TO OTHER COUNTRIES.
The range is enormous due to emerging third world markets and wild swings created by the economic collapse. (Public Debt/GDP)
1,307% IRELAND
413% UK
95.4% USA
92.6% EU
18.4% RUSSIA
14.3% BRAZIL
5.8% INDIA
4% CHINA
elefintdesigns.com | Sources: CIA World Fact Book, White House Office of Management and Budget.
Designed by elefint designs

Government bonds come in three varieties:

- Bills. These are zero coupon bonds with maturities less than one year
- Notes. Semi-annual coupon bonds with maturities less than 10 years
- Bonds. Semi-annuals with more than 10 year maturity

Auctions

- Govt bonds are sold in the primary market through auctions.
- Bids submitted through dealers or directly to the treasury
- Competitive and non-competitive bids:
  - competitive bid: bidder submits amount and price (as in limit order)
  - non-competitive: quantity demanded at clearing price (as in market order)
- Market clearing: Non-competitive bids subtracted from total supply. Market clears by matching supply with demand from competitive bids. Single price auction mechanism means that the marginal bid determines the auction price.

Secondary Markets

- No standardized exchange as with stocks
- Sold over-the-counter through dealers or the treasury themselves (treasurydirect.gov)
- Dealer quotes displayed through Bloomberg. BGcantor live data available from them
- $t + 1$ settle: trades are settled the day after executed.

T-Bills

Treasury Bills are zero coupon bonds issued with less than one year maturity.
T-Bills are quoted at a *discount basis*. Let d denote the discount basis, then the price you pay, P, is

$$P = 100(1 - d\frac{t}{360}) \tag{1}$$

where t is the number of calendar days to expiration.


<HELP> for explanation.
United States
1) Actions
2) Tools
3) Settings
Fixed Income Trading
13:03
4) Actives
5) Bills
6) Notes
7) TIPS
8) Strips
9) Sprds
10) Curves
11) FRN
12) Bfly
13) WI
BidPx /AskPx AskYld YlChg
31) 12/11/14 0.045 / 0.040 0.041 --
32) 12/18/14 0.045 / 0.040 0.041 -0.010
33) 12/26/14 0.075 / 0.070 0.071 -0.005
34) 01/02/15 0.040 / 0.035 0.035 -0.010
35) 01/08/15 0.050 / 0.045 0.046 +0.005
36) WI 1MTH /
37) 1M ROLL /
38) 01/15/15 0.020 / 0.010 0.010 -0.005
39) 01/22/15 0.010 / 0.005 0.005 --
40) 01/29/15 0.010 / 0.005 0.005 --
41) 02/05/15 0.010 / 0.005 0.005 --
42) 02/12/15 0.005 / 0.000 0.000 --
43) 02/19/15 0.005 / 0.000 0.000 -0.005
44) 02/26/15 0.010 / 0.005 0.005 --
45) 03/05/15 0.010 / 0.005 0.005 --
46) 03/12/15 0.035 / 0.025 0.025 --
47) WI 3MTH /
48) 3M ROLL /
49) 03/19/15 0.025 / 0.020 0.020 --
BidPx /AskPx AskYld YlChg
50) 03/26/15 0.025 / 0.020 0.020 --
51) 04/02/15 0.040 / 0.035 0.035 --
52) 04/09/15 0.045 / 0.040 0.041 --
53) 04/16/15 0.045 / 0.040 0.041 --
54) 04/23/15 0.055 / 0.050 0.051 --
55) 04/30/15 0.060 / 0.055 0.056 -0.005
56) 05/07/15 0.070 / 0.065 0.066 --
57) 05/14/15 0.075 / 0.070 0.071 +0.005
58) 05/21/15 0.075 / 0.070 0.071 -0.005
59) 05/28/15 0.080 / 0.075 0.076 --
60) 06/04/15 0.090 / 0.085 0.086 --
61) 06/11/15 0.100 / 0.095 0.096 -0.010
62) WI 6MTH /
63) 6M ROLL /
64) 06/25/15 0.090 / 0.085 0.086 -0.005
65) 07/23/15 0.120 / 0.115 0.117 -0.010
66) 08/20/15 0.130 / 0.125 0.127 -0.005
67) 09/17/15 0.130 / 0.125 0.127 -0.010
68) 10/15/15 0.140 / 0.135 0.137 -0.005
Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000
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SN 842817 EST GMT-5:00 H435-5570-0 10-Dec-2014 13:03:01

Bloomberg T-bill quotes

Previous slide contains columns with maturity, bid/ask (quoted on discount basis), previous close, and change.
Lets compute some prices from the discounts:
The 6/11/15maturity has 182 days till expiration from when the quotes were taken on Dec 10, 2014. Thus, the best bid of 0.10 gives a price

$$P_{\text{bid}} = 100 * (1 - 0.001 * 182/360) \approx 99.949444$$

while the best ask of 9.5 BP gives

$$P_{\text{ask}} = 100 * (1 - 0.00095 * 182/360) \approx 99.9519$$

Note that the ask exceeds the bid on a price basis, but the ask is lower than the bid on a discount basis.

Notice that the price of a T-bill can be found from the discount in MS Excel using the function "TBILLPRICE." You can also use the Excel function DAYS() to compute the number of days between the settlement date and the maturity.
So

=DAYS('6/11/2015',today()+1)

yields 182, and

=TBILLPRICE(today()+1,'6/11/2015', 0.0001)

gives 99.949444 in Excel.

Bond and note quotes

Bonds are quoted on a *flat price* basis in units of 100. Fractions of a dollar are quoted in units of 32nds. So for example, $100 - 07^{1}4$ means $100 + 7.25/32 = 100.226563$.
The *invoice price* is what the investor actually pays is given by

$$\text{Invoice price} = \text{flat price} + \text{accrued interest} \tag{2}$$

The accrued interest is the interest that the bond has earned since the last coupon payment.

The *flat price* is also called the *clean price*.
The *invoice price* is also called the *dirty price* or *full price*.

<HELP> for explanation. Govt **BBT**

U.S. TREASURY 5-10YR NOTES

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1)	2 1/2	313	96-17+ / 96-18	3.287	+2	21)	4 1/2	N15	105-14 / 105-15+	3.644	+1
2)	3 1/8	413	99-06+ / 99-07	3.301	+2	22)	9 7/8	N15	139-11+ / 139-14 1/4	3.709	+4 1/4
3)	3 1/2	513	100-25+ / 100-26	3.319	+2 3/4	23)	4 1/2	216	105-09 / 105-10 3/4	3.690	+1 1/4
4)	3 5/8	513	101-16 3/4 / 101-17 1/4	3.280	+3 1/4	24)	9 1/4	216	136-07 3/4 / 136-13+	3.718	+7 1/2
5)	3 3/8	613	100-07 1/4 / 100-07 3/4	3.322	+3 3/4	25)	5 1/8	516	109-05 1/4 / 109-05 3/4	3.766	--
6)	4 1/4	813	104-13 / 104-13+	3.304	+3 1/2	26)	7 1/4	516	122-31 1/4 / 123-01 3/4	3.829	+3
7)	12	813	101-07 3/4 / 101-09	1.547	-3/4	27)	4 7/8	816	107-09 1/4 / 107-09 3/4	3.820	-1/2
8)	4 1/4	N13	104-15 1/4 / 104-15 3/4	3.329	+3 3/4	28)	4 5/8	N16	105-16 1/4 / 105-16 3/4	3.846	-2
9)	4	214	103-08 / 103-08+	3.357	+3 1/2	29)	7 1/2	N16	125-02 / 125-03+	3.948	+2 1/4
10)	13 1/4	514	110-25 3/4 / 110-28	0.719	+1-20+	30)	4 5/8	217	105-11 / 105-13	3.881	+3/4
11)	4 3/4	514	107-09 1/4 / 107-10 3/4	3.362	+2 1/2	31)	4 1/2	517	104-09 / 104-09 3/4	3.920	+1
12)	12 1/2	814	110-17 3/4 / 112-19 3/4	1.162	+1-17	32)	8 3/4	517	134-28+ / 134-29 1/4	4.029	+3/4
13)	4 1/4	814	104-18+ / 104-19 1/4	3.410	+2 1/4	33)	8 7/8	817	136-10 1/4 / 136-11 3/4	4.064	+1 1/4
14)	4 1/4	N14	104-15 / 104-16+	3.454	-1/2	34)	4 3/4	817	106-01 3/4 / 106-02 1/4	3.951	+1
15)	11 3/4	N14	111-30+ / 112-30	2.129	+21	35)	4 1/4	N17	102-08 / 102-08+	3.958	+1
16)	4	215	102-28 / 102-30 1/4	3.497	+1 1/4	36)	3 1/2	218	96-11 1/4 / 96-11 3/4	3.957	+3/4
17)	11 1/4	215	144-26+ / 144-27+	3.581	+2 1/4	37)	3 7/8	518	99-08+ / 99-09	3.963	+1
18)	4 1/8	515	103-15 1/4 / 103-16	3.546	+1	38)	9 1/8	518	140-16 / 140-18 3/4	4.087	+2 3/4
19)	4 1/4	815	104-02 / 104-02+	3.595	+1 1/4						
20)	10 5/8	815	143-05+ / 143-08	3.669	+2 3/4						

T/ACT | BILLS | T/0-1 | T/1-2 | T/2-5 | T/5-10 | T/10-20 | T/20-30 | TIPS | STRIPS | AG/OTR | AGENCIES | CURVES

The “+” symbol means one half 32d. For example, the bond labelled $3^{1}8$ 413 (a 3.125% coupon bond with maturity April 15th, 2013) has a best bid quoted at 99-06+ which equals $99 + 6.5/32 = 99.203125$.

Example

Take for example a bond denoted $4^{1}4$ 813.
This note has 4+1/4% coupon and matures Aug 2013. It pays coupon Feb 15th and Aug 15th.
On June 30th, 2008, there were 46 days until the next coupon payment for this bond (31 in July + 15 in August). There were therefore 180-46=134 days since the last coupon (Feb 15th).

The accrued interest is therefore $(4 + 1/4) * (1/2) * (134/180) = 1.581944$. The invoice price is therefore

$$104 + 13/32 + 1.581944 = 105.9882$$

if you buy this bond at the market bid. The invoice asking price is

$$100 + 13.5/32 + 1.581944 = 106.0038$$

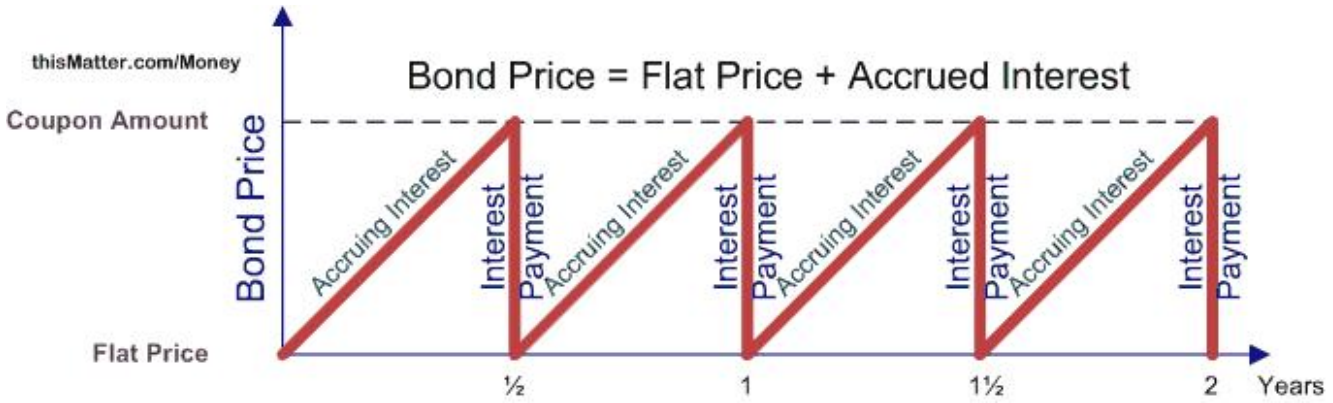

Figure : The relationship between retail price and quoted (flat) price. The flat price is below the retail price.

<HELP> for explanation. Govt **BBT**

U.S. TREASURY 10-20YR NOTES/BONDS Page 1/ 1

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1)	9 N18	140-09 3/4 / 140-11	4.168	+1 1/4
2)	8 7/8 219	139-18 / 139-19 1/4	4.212	+1 1/2
3)	8 1/8 819	133-25+ / 133-26+	4.272	+1
4)	8 1/2 220	138-01 / 138-02 3/4	4.301	+1 1/4
5)	8 3/4 520	140-25 3/4 / 140-27 1/4	4.315	+1 1/2
6)	8 3/4 820	141-03 3/4 / 141-05 3/4	4.344	-1/4
7)	7 7/8 221	133-16 / 133-17+	4.385	+1 1/4
8)	8 1/8 521	136-13 / 136-14	4.389	-1 1/2
9)	8 1/8 821	136-25 1/4 / 136-26 1/4	4.401	-1 3/4
10)	8 N21	135-26+ / 135-27+	4.419	-3/4
11)	7 1/4 822	129-01 1/4 / 129-03	4.452	+1 1/4
12)	7 5/8 N22	133-10+ / 133-12+	4.454	-3/4
13)	7 1/8 223	128-06+ / 128-07+	4.473	-1
14)	6 1/4 823	119-03+ / 119-05 1/4	4.490	-1 1/4
15)	7 1/2 N24	134-23 1/4 / 134-24 1/4	4.481	-2
16)	7 5/8 225	136-11 3/4 / 136-13 1/4	4.492	-2 1/4
17)	6 7/8 825	127-21 1/4 / 127-22 1/4	4.532	-1 1/4

Curve Trades

18)	2YR vs 10YR	134.88 / -135.67	-1.66
19)	5YR vs 10YR	63.81 / -64.34	-2.03
20)	10Y vs 30YR	54.95 / -55.34	+0.15

Other Markets

21)	TII 10YR	106-09+ / 106-11+	0.915	+3
22)	TII 30YR	125-25+ / 125-27+	2.003	-7
23)	US Long(CBT)	16:38 d 115-26	+5	
24)	10Y Fut(CBT)	16:39 d 114-01+	+7	
25)	5Yr Fut(CBT)	16:39 d 110-19 3/4	+5 3/4	
26)	Fed Funds	16:38 2.500	+1.250	
27)	EURO$ (IMM)	16:35 d 97.075	-0.010	
28)	DowJones Ind	16:30 11350.010	+3.500	
29)	S&P 500 Ind	16:49 1280.000	+1.620	
30)	NASDAQ Cmp	16:48 2292.980	-22.650	
31)	Japanese Yen	16:48 106.182	+0.042	
32)	EUR-USD	16:49 1.575	-0.004	
33)	Nymex wti crd	16:19 d 140.550	+0.340	

T/ACT | BILLS | T/0-1 | T/1-2 | T/2-5 | T/5-10 | T/10-20 | T/20-30 | TIPS | STRIPS | AG/OTR | AGENCIES | CURVES

Web Resources

- www.treasurydirect.com. The treasury's own wholesale department.
- ftp.publicdebt.treas.gov/dfi/price/ This site gives daily updates of bids/asks for US treasury Bills, notes and bonds. The file "dfi_price_today.txt" contains prices collected at noon.
- www.federalreserve.gov/pubs/feds/2006/200628/feds200628.xls This is a spreadsheet with historical yield curve data. These are interpolated zero coupon and forward rates. We will use this data later in class.
- www.bgcantor.com. Data products from Cantor.
- Bloomberg terminal in library.

Some useful Excel functions

- tbillprice(settlement,maturity,discount) computes the price of a tbill from the discount. It automatically computes a the number of days to expiration based on a 360 day calendar year.
- coupdaysnc(settlement,maturity,frequency,basis). Computes the number of days between "settlement" and the next coupon date. Frequency is the number of coupons/ year (typically 2) and basis is the number of day per year convention (use 0).
- coupncd(settlement,maturity,frequency,basis). Returns the date (as integer) for the next coupon.
- coupnum(settlement,maturity,frequency,basis). Number of coupon payments before expiration.