Section I

Fixed Income Assets and Liabilities

I. Introduction to Fixed Income

A. **Background Information**

The simplest asset (and/or liability) is called "fixed income." Fixed income is a method of borrowing (lending) money where the return to the lender is fixed. The return to the lender is made up of two components: principal and interest. The principal is the total amount of the original loan and the interest is what the lender receives as compensation for making the loan.

Note that a fixed income security – a security that joins a borrower and a lender – is a liability to the borrower, but an asset to the lender. From the lender's point of view, owning a fixed income asset means that the return is fixed in the sense that the interest payments and principal payments represent the sole sources of return.

The simplest notion of a yield. Consider a simple loan for a *term* of one year, in the amount of $100. If we say that the yield, or interest rate, on this loan is 10 % then, at the end of one year, the following occurs:

1. *Interest* paid of $ 10
2. *Principal* paid of $ 100
3. *Yield* is said to be 10 %

In this simple context, interest, principal and yield all have common, familiar interpretations. The interest payment might even be interpreted as a *coupon* payment, but this interpretation of the interest payment would imply that the loan was actually a security with a principal of $100 and a coupon of 10.00 %.

This loan is an example, not a very interesting one, of a *discount* security, because there are no intermediate interest payments along the way. A *zero coupon* bond, discussed later, is also a discount security because there is only one final payment at maturity.

An Alternative View of the Same Transaction:

Suppose I wish to have $110 at my disposal one year from now and I would like a third party to provide the $110 at that time. What would I have to pay that person now to induce he/she to agree to give me $110 one year from now? Once I know that amount, then I will know the *yield,* or *interest rate,* that is required. Conversely, if I know the interest rate or yield required, I will know the amount that I have to pay now to receive $110 one year from now.

Consider Two Periods:

Suppose now, that I wish to borrow $100, but not pay off the loan until two years has elapsed. Suppose also that the agreed *interest rate* is 10%. Now, there is some ambiguity about what will transpire in this transaction. Here are some possibilities:

1. At the end of the first year, I pay $10 and, at the end of the second year, I pay $110.

2. At the end of the second year, I pay $120 and make no payments until then.

3. At the end of the second year, I make one payment including principal and interest, but make no payments until that time.

Possibility 1: If this were a security, the interpretation would be that the principal was $100, and that the coupon was 10%.

Possibility 2 : If this were a security, it would be a *discount,* or *zero coupon,* security. Neither its interest rate nor its yield would be 10%. If its yield were 10 percent, then at the end of one year, the lender should receive $110. Invested again for another year, $110 would bring more than an additional $10 in interest at a 10% yield, i.e.

$100 multiplied by 1.1 = $110 value of loan at the end of one year

$110 multiplied by 1.1 = $121 value of loan at the end of the second year

To solve for the exact yield, if one payment of $120 is made at the end of the second year, note the equation below:

$100 multiplied times 1+y = Value of loan at the end of one year

$100 times (1+y) again by (1+y) = Value of loan at the end of second year

Hence, the y that solves: 100 times (1+y) times (1+y) = 120 is the correct *yield,* or approximately 9.5%

Possibility 3: In this case, a yield of 10% would imply, from the example in the preceding section, that the amount paid at the end of the second year would be $121.

COMMENT: It is important to note that once the simple one year example is complicated to allow for additional time periods, there is an ambiguity regarding interest rates, yields, etc. This ambiguity shows up if the time period is less than one year and is further complicated if interest payments are permitted on a basis other than annually. We will make note of these complications as we proceed to develop the relevant yield computations for well known securities. It should be emphasized that in all financial markets yields and rates are all *annual* yields and *annual* rates.

1. The concepts of present value and future value

If I have \$ 100 today and I lend it out for one year at 10%, then presumably I will receive \$ 110 in one year. Another way of saying this is that the **future value**, one year from today, of \$ 100 is \$ 110. The following formula describes this:

\$ 100 times (1 + r) = Future Value of \$ 100

If the interest rate is 10 % then the equation becomes:

\$ 100 times (1 + 0.10) = \$ 110 the future value of \$ 100 when interest rates are 10 percent

Now suppose we turn this equation completely around and ask: what is the **present value** of \$ 110 received one year from now, if interest rates are 10 percent? The answer would be the solution to the following equation:

Present Value (1 + 0.10) = \$ 110

We can rewrite this equation in a more familiar form:

$$\textit{\textbf{Present Value of \$ 110}} = \frac{\$110}{(1.10)^1}$$

2. Present Value When There is More Than One Period

Suppose, you receive a single payment of \$ 121 exactly two years from now. What would be the present value of this payment? The following equation answers this question:

$$\textit{\textbf{Present Value of \$ 121 (two years from today)}} = \frac{\$\,121}{(1.10)^2}$$

This notion can be generalized so that if C_1, C_2,…C_N are N payments where C_1 is received at the end of year one, C_2 is received at the end of year 2 and C_N is received at the end of year N, the present value of all of these payments together, assuming a constant interest rate of 10 percent is:

$$\text{Present Value of } C_1, C_2, \ldots C_N = \frac{C_1}{(1.10)^1} + \frac{C_2}{(1.10)^2} \ldots\ldots\ldots\ldots\ldots + \frac{C_N}{(1.10)^N} = \sum_{N}^{i=1} \left(\frac{C_i}{(1.10)^i} \right)$$

For arbitrary interest rates, r (r percent), the expression in the parenthesis in the denominator in the above equation changes from (1.10) to (1 + r).

3. Compounding

Thus far, we have consistently assumed that interest compounds annually. Imagine that interest compounds semi-annually at 10 percent. Then, if you borrow $ 100 today, planning to repay the entire amount plus interest in one year, what would you pay if interest compounded semi-annually? The following is the answer:

Future Value of $100 (Semi-Annual Compounding = ($ 100 times (1 + .10/2)) times (1 + .10/2)

Which equals:

$ 105 times 1.05 = $ 110.25

In this example, compounding more frequently than annually leads to a higher future value. If we compounded monthly (as mortgages do, for example), it leads to an even higher future value.

This can be turned upside down as well. The present value of a series of specific cash payments is always less if you have more frequent compounding.

If compounding is continuous (at every instant), then the future value (of $ 100, one year from today, assuming 10 percent interest) is:

$$\textbf{\textit{Future Value (with continuous compounding)}} = \$\,100 \bullet e^{.10}$$

Finally, if we ask for the present value of $ 1, in X years, with continuous compounding at a constant interest rate, r, we get the following equation:

$$\textbf{\textit{Present Value of \$ 1 in X year (with continuous compounding)}} = \frac{1}{e^{rX}} = e^{-rX}$$

We will return below to the subject of ***present value***, because of its importance to finance.

B. Default Free Securities – The Example of US Treasury Securities

Default free securities are securities whose specific dollar payments are not subject to the risk of default. These securities, by definition, keep their promises. The vast bulk of interesting securities are ***not*** default free. It is important not to confuse the notion of *default free* with the concept of *riskless*. A security can deliver on all of its promises, but still have risk. Similarly, a security may not necessarily be default free, but still have very little risk.

If a loan is *default free*, the lender is 100 percent assured of receiving interest and principal as agreed in the original loan understanding or document. The real world example of a default free security is debt issued by the government. In the United States, we assume that obligations (borrowings) of the United States Treasury are default free securities. The bulk of US Treasury securities consist of:

i. U.S. Treasury Bills
ii. U.S. Treasury Notes
iii. U.S. Treasury Bonds

U. S. Treasury Securities will be assumed to be *default free*. We will simply assume this, although the governmental obligations of any country could be chosen as the default free security for our purposes. The bulk of U.S. Treasury Securities are of five types:

i. U. S. Treasury Bills
ii. U. S. Treasury Notes
iii. U. S. Treasury Bonds
iv. Inflation-Indexed Notes
v. Inflation-Indexed Bonds

Treasury bills are *discount* securities. A **discount security has only one payment to its owner** – the final payment of principal. The owner of a discount security receives no other payments except the final payment at maturity. Treasury Notes and Bonds are *coupon* securities. **Coupon securities make periodic payments** (treasury coupon securities make two payments each year) and then a final coupon payment and principal at maturity. Inflation-Indexed Notes and Bonds are also *coupon* securities.

The total US Treasury debt outstanding as of August 16, 2010 was slightly less than $ 13.4 trillion. Of the debt held by the public approximately two-thirds of this debt consists of treasury notes and bonds (not inflation-indexed). Treasury bills represent approximately one-fifth of the debt held by the public. Together, bills, notes and bonds (not inflation-indexed) represent more than 90 percent of all outstanding treasury securites held by the public. There have been no treasury bonds auctioned since August of 2001, but the Treasury announced in the summer of 2005 that it would begin auctioning the 30 year Treasury bond in January of 2006. (There are, of course, many outstanding treasury bonds, that were auctioned in earlier years and have not, to this date, reached maturity).

Approximately 34 percent of the outstanding debt, totaling $ 4.5 trillion, represents an IOU to the Social Security System and is not held by the public. Interest on the debt is simply accrued and added to the total indebtedness of the US Treasury. In reality the Social Security System's holding of US Treasuries is nothing more than an accounting entry. In order to generate cash, the Social Security System would have to sell the treasury securities that they, in theory, hold. This would simply be a new (very large) offering of US Treasury securities onto the market place.

Summary of Treasury Securities Outstanding
July 31, 2010
(Millions of Dollars)

	Held by Public	***Intergovernmental***	***Totals***
Marketable:			
Bills	1,785,129	5,374	1,790,503
Notes	4,978,425	2,965	4,981,390
Bonds	815,696	4,113	819,809
Infl-Ind Notes *& Bonds*	576,701	210	576,911
Federal Financing Bk	0	10,239	10,239
Total Marketable	**8,155,951**	**22,901**	**8,178,852**
Nonmarketable			
Domestic Series	29,995	0	29,995
Foreign Series	3,386	0	3,386
R.E.A. Series	1	0	1
St & Loc Govt Series	195,589	0	195,589
US Savings Securities	189,420	0	189,420
Govt Acct Series	126,761	4,511,875	4,638,636
Other	1,355	0	1,355
Total Nonmarketable	**546,507**	**4,511,875**	**5,058,382**
Total Public Debt	**8,702,458**	**4,534,776**	**13,237,234**

Source: The Bureau of Public Debt, The US Treasury Dept.
http://www.publicdebt.treas.gov/opd/opds112004.htm

Ownership of Treasury Debt --- March 2010

[In billions of dollars. Source: Office of Debt Management, Office of the Under Secretary for Domestic Finance]

End of month	Total public debt [1] (1)	Federal Reserve and Intragovern-mental Holdings [2] (2)	Total privately held (3)	Depository institutions [3, 4] (4)	U.S. savings bonds [5] (5)	Pension funds [3]: Private [6] (6)	Pension funds [3]: State and local governments (7)	Insurance compa-nies [3] (8)	Mutual funds [3, 7] (9)	State and local govern-ments [3] (10)	Foreign and inter-national [8] (11)	Other investors [9] (12)
2000 - Mar	5,773.4	2,590.6	3,182.8	237.7	185.3	150.2	196.9	120.0	222.3	306.3	1,085.0	679.1
June	5,685.9	2,698.6	2,987.3	222.2	184.6	149.0	194.9	116.5	205.4	309.3	1,060.7	544.8
Sept	5,674.2	2,737.9	2,936.3	220.5	184.3	147.9	185.5	113.7	207.8	307.9	1,038.8	529.9
Dec	5,662.2	2,781.8	2,880.4	201.5	184.8	145.0	179.1	110.2	225.7	310.0	1,015.2	509.0
2001 - Mar	5,773.7	2,880.9	2,892.8	188.0	184.8	153.4	177.3	109.1	225.3	316.9	1,012.5	525.5
June	5,726.8	3,004.2	2,722.6	188.1	185.5	148.5	183.1	108.1	221.0	324.8	983.3	380.3
Sept	5,807.5	3,027.8	2,779.7	189.1	186.4	149.9	166.8	106.8	234.1	321.2	992.2	433.1
Dec	5,943.4	3,123.9	2,819.5	181.5	190.3	145.8	155.1	105.7	261.9	328.4	1,040.1	410.7
2002 - Mar	6,006.0	3,156.8	2,849.2	187.6	191.9	152.7	163.3	114.0	266.1	327.6	1,057.2	388.8
June	6,126.5	3,276.7	2,849.8	204.7	192.7	152.1	153.9	122.0	253.8	333.6	1,123.1	313.8
Sept	6,228.2	3,303.5	2,924.8	209.3	193.3	154.5	156.3	130.4	256.8	338.6	1,188.6	297.0
Dec	6,405.7	3,387.2	3,018.5	222.6	194.9	153.8	158.9	139.7	281.0	354.7	1,235.6	277.4
2003 - Mar	6,460.8	3,390.8	3,069.9	153.4	196.9	165.8	162.1	139.5	296.6	350.0	1,275.2	330.4
June	6,670.1	3,505.4	3,164.7	145.1	199.1	170.2	161.3	138.7	302.3	347.9	1,371.9	328.2
Sept	6,783.2	3,515.3	3,268.0	146.8	201.5	167.7	155.5	137.4	287.1	357.7	1,443.3	371.1
Dec	6,998.0	3,620.1	3,377.9	153.1	203.8	172.1	148.6	136.5	280.8	364.2	1,523.1	395.6
2004 - Mar	7,131.1	3,628.3	3,502.8	162.8	204.4	169.8	143.6	141.0	280.8	374.1	1,670.0	356.3
June	7,274.3	3,742.8	3,531.5	158.6	204.6	173.3	134.9	144.1	258.7	381.2	1,735.4	340.6
Sept	7,379.1	3,772.0	3,607.0	138.5	204.1	174.0	140.8	147.4	255.0	381.7	1,794.5	371.0
Dec	7,596.1	3,905.6	3,690.6	125.0	204.4	173.7	151.0	149.7	254.1	389.1	1,849.3	394.3
2005 - Mar	7,776.9	3,921.6	3,855.4	141.8	204.2	177.3	158.0	152.4	261.1	412.0	1,952.2	396.4
June	7,836.5	4,033.5	3,803.0	126.9	204.2	181.0	171.3	155.0	248.7	444.0	1,877.5	394.5
Sept	7,932.7	4,067.8	3,864.9	125.3	203.6	184.2	164.8	159.0	244.7	467.6	1,929.6	386.0
Dec	8,170.4	4,199.8	3,970.6	117.1	205.1	184.9	153.8	160.4	251.3	481.4	2,033.9	382.6
2006 - Mar	8,371.2	4,257.2	4,114.0	115.3	205.9	186.7	153.0	161.3	248.7	486.1	2,082.1	475.0
June	8,420.0	4,389.2	4,030.8	117.1	205.2	192.1	150.9	161.2	244.2	499.4	1,977.8	482.8
Sept	8,507.0	4,432.8	4,074.2	113.5	203.6	201.9	155.6	160.6	235.7	502.1	2,025.3	475.8
Dec	8,680.2	4,558.1	4,122.1	114.8	202.4	207.5	157.1	159.0	250.7	516.9	2,103.1	410.6
2007 - Mar	8,849.7	4,576.6	4,273.1	119.7	200.3	221.7	159.2	150.8	264.5	535.0	2,194.8	427.1
June	8,867.7	4,715.1	4,152.6	110.4	198.6	232.5	160.2	142.1	267.7	580.3	2,192.0	268.7
Sept	9,007.7	4,738.0	4,269.7	119.6	197.1	246.7	165.6	133.4	306.3	541.4	2,235.3	324.1
Dec	9,229.2	4,833.5	4,395.7	129.8	196.4	257.6	168.8	123.3	362.9	531.5	2,353.2	272.1
2008 - Mar	9,437.6	4,694.7	4,742.9	125.3	195.3	270.5	169.4	129.4	484.4	521.6	2,505.8	341.1
June	9,492.0	4,685.8	4,806.2	112.7	194.9	276.7	169.1	135.5	477.2	513.4	2,587.2	339.4
Sept	10,024.7	4,692.7	5,332.0	130.0	194.2	292.5	171.6	140.6	656.1	500.5	2,799.5	447.0
Dec	10,699.8	4,806.4	5,893.4	105.0	194.0	297.2	174.6	160.5	768.8	491.9	3,075.9	625.6
2009 - Mar	11,126.9	4,785.2	6,341.7	129.1	193.9	305.9	173.2	191.0	716.0	504.1	3,264.6	864.0
June	11,545.3	5,026.8	6,518.5	140.7	193.5	311.2	172.7	209.7	695.0	517.8	3,460.3	817.5
Sept	11,909.8	5,127.1	6,782.7	199.3	192.4	328.3	172.0	233.0	644.9	520.0	3,575.3	917.6
Dec	12,311.4	5,276.9	7,034.5	206.6	191.3	338.4	174.7	235.7	663.9	531.3	3,691.5	1,001.1
2010 - Mar	12,773.1	5,259.8	7,513.3	n.a.	190.2	n.a.	n.a.	n.a.	n.a.	n.a.	3,884.0	n.a.

4. Treasury Bills

There are four main types of treasury bills:

- Four week bills (new in 2001)
- Three month bills (also known as 90 day bills or 13 week bills)
- Six month bills (also known as 180 day bills or 26 week bills)
- The year bill (also known as 360 day bills or 52 week bills, none auctioned since February 27th, 2001). (Hence, none of these are any longer in existence).

Besides these three basic types of treasury bills, there is the Cash Management Bill (**CMB**). A CMB is typically just a few days in maturity and the CMB may vary in size, maturity and frequency depending upon the short term cash needs of the US Treasury Department. (CMB's are always less than one month in maturity).

Treasury securities, all of which have an ***original maturity*** of less than one year, assume that the year contains 360 days when quoting rates. This strange arrangement is a consequence of the fact that the earliest treasury bills quoted rates on a 360 day year basis. This complicates yield analysis, but only slightly. More serious complications come from the fact that **treasury bills are quoted on a discount basis**. Let's work through a simple example using the (no longer in existence) Treasury *year bill*:

Suppose the year bill is quoted at 10 percent with a principal amount of $1,000,000. What does this mean?

a. Treasury bill quotes are discounts, not yields

If a year bill has 360 days *currently remaining in maturity*, then a 10 percent quote means that the current price of that bill is 10% less than its principal value (Principal value is the amount that the bill holder receives at maturity of the bill):

EXAMPLE 1-A:

Principle = $ 1,000,000; Quote = 10 Percent; Remaining Maturity = 360 days
Amount of discount is $ 100,000, which is 10 % of principal
Price = $ 900,000, which is principal ($1,000,000) less discount ($100,000)

How would you calculate the *yield,* in this example? After all, one pays $900,000 now and earns $100,000 within less than a year. The yield, therefore, must exceed 10 percent. Here is how we would calculate a meaningful yield for comparative purposes to other securities:

First, calculate the yield for 360 days:
$ 100,000 divided by $ 900,000 = 11.11% over 360 days

Second, take account of the fact that a year actually has 365 days:
Multiply 11.11% by (365/360) to annualize the yield to 11.27%

Now, let's complicate our example somewhat. Suppose the year bill, that we are considering, was issued some time ago and is currently quoted at 12 percent, but has only 200 days remaining until its maturity. How do we calculate *annualized yield* now?

As before, first calculate the amount of the discount.
Take account of the fact that only 200 days remain to maturity:

(200/360) = .56
.56 times 12 percent = 6.67 percent -- the adjusted discount
The actual amount of the discount will be 6.67% of $1,000,000, or, $66,666.67

Now, to compute the yield, note that the price paid for the treasury bill will be $1,000,000 less the discount of $66,666.67, or $ 933,333.33

One earns $66,666.67 on an investment of $933,333.33, so that the 200 day yield will be:

66,666.67 divided by 933,333.33 = 7.14% over 200 days

Finally, we must ***annualize*** this yield:

7.14% times (365/200) = 13.04%, which is the annualized yield

At this point we can draw some conclusions about the relationship between the quotes that we observe in the marketplace and the actual annualized yields:

1. The actual yield always exceeds the quote in the Treasury bill market

Why? There are two reasons. First, the quote in the Treasury bill market is a discount. Second, the quote assumes a 360 day year, when, in fact, the year contains 365 days (366 days in a leap year).

2. Computation of the annualized yield of a treasury bill involves two key steps:

First, compute the dollar amount of the discount.
Second, adjust for annualization.

b. Using Formulae to Evaluate Treasury Bill Quotes and Yields

Begin, by defining symbols to make our formulae easier to visualize:

D = dollar amount of the discount
F = principal amount of the treasury bill (sometimes called FACE mount)
P = price paid for the treasury bill
d = quote (sometimes called the rate of discount)
Tsm = days from settlement to maturity (settlement is the day you pay)
y = actual annualized yield

In the first part of Example 1-A above, we are supplied the following initial information:

d = 10 percent, or, .10; Tsm = 360; F = 1,000,000

Formula for calculating the dollar amount of the discount:

D = d * F * (Tsm/360)

Apply the formula to the first part of Example 1-A:

D = .10 times 1,000,000 divided by (360/360) = 100,000

Formula for calculating the annualized yield when the dollar discount, the principal amount, and the time remaining to maturity (D, F, and Tsm) are known:

y = (D/(F-D)) times (365/Tsm)

Applying this formula to the first part of Example 1-A gives:

y = (100,000/(1,000,000 - 100,000)) times (365/360) = 11.27%

One could apply the same formulae to the second part of Example 1-A to calculate the actual annualized yield. We will leave that to the reader as an exercise.

COMMENT ON FORMULAE: One of the best sources for formulae that relate to U. S. Treasury securities, as well as other money market instruments, is a book by Marcia Stigum, published in 1981, entitled MONEY MARKET CALCULATIONS: YIELDS, BREAK-EVENS, AND ARBITRAGE. Our formulae are taken directly from Chapter 4 of that book.

5. Treasury Notes and Bonds (those without “inflation adjustment”)

Notes and Bonds are *coupon* securities. *Coupon* securities make interest payments on dates that are pre-specified when the security is created. The opposite of a *coupon* security is a *discount security* that makes no interest payments, but instead pays one lump sum of principal at maturity. The name of a note and bond normally conveys all relevant interest payment, or *coupon,* information.

<u>EXAMPLE 1-B:</u> the 4 3/4's of Feb/37 (or the 4/34's of 2/37)

The 4 3/4's of Feb/37 is a U. S. Treasury bond that was originally issued in February of 2007. This security matures on February 15th, 2037. The "4 3/4" part of the name of the security is normally referred to as the 'coupon' of the security. (It will turn out that in practice the term *coupon* is loosely used in a variety of different contexts to refer to different, though related, things.)

Assume for the purposes of this example that the *principal amount* of the bond in question is $100,000. This principal payment will take place on the maturity date, February 15th, 2037.

How do the *coupon* payments, or interest payments, work? When are these payments actually made – what dates?

The *4 3/4's* designation means that the security will pay 4 3/4th percent on its principal each year. The payments are made twice yearly until maturity.

Total payments per year amount to 4 ¾'s percent of $100,000, or $4,750 per year. This amount is paid in two installments of $ 2,375 each.

What are the dates of the coupon payments?

The maturity date, 'Feb/37', in the name of the security tells us what we need to know about the principal payment date and *all the coupon payment dates*. *It is important to note that everything occurs on the 15th of the relevant month.* (The '15th' is not necessarily the relevant date for securities issued in the very distant past, but it is true of most U.S. Treasury notes and bonds issued over the past several years.) Thus, we know from the "Feb/37" moniker that the maturity date is, in fact, 2/15/2037. We also know, by convention, that interest payments occur, approximately every six months, on precisely 2/15 (February 15th) and 8/15 (August 15th) on each time such dates occur after February 15th, 2007 and including February 15th, 2037.

Summing up our example:

The 4 3/4's of Feb/37 is a treasury bond, which we assume has a $100,000 principal and will provides the following future income to its holder:

8/15/07 -- a payment of $ 2375
2/15/08 -- a payment of $ 2375
8/15/08 -- a payment of $ 2375
.......and so forth until............
2/15/2037 -- a payment of $ 102,375 (which includes the principal payment)

All of this, except the principal amount, we can tell from the name:

"4 3/4's of Feb/37"

a. Treasury Notes and Bonds -- What is the Difference?

First of all, let's highlight the similarities between notes and bonds. All notes and bonds are coupon issues that have more than one year of *original maturity*. Original maturity simply means the remaining length of maturity on the date that the security was *originally issued*.

All US Treasury notes and bonds are coupon issues, not discount issues. *The only distinction between notes and bonds is that notes have original maturities of more than one year and no more than ten years, while bonds all have original maturities exceeding 10 years.*

Some US Treasury Notes are *inflation protected*. These are called **TIPS** meaning Treasury Inflation Protected Securities. We deal with TIPS in a later section. For now, we will restrict our attention to notes and bonds that are ***not*** inflation protected.

In the remainder of what follows, we will use notes and bonds interchangeably because they are essentially the same thing, except for the nuisance original maturity distinction. In every other way, they are identical securites.

b. Prices of notes and bonds

Treasury notes and bonds, after they are issued by the U. S. Treasury, trade freely in the open market. At the time they are issued, which we will return to below, they are originally priced very close to their principal amount, but, after they are actively traded, the price is determined freely in the market place. For the moment assume that the original price at date of issue is 100 (this is not exactly correct, but will suffice for the moment).

The table below indicates what various prices mean in terms of the cost of purchasing a treasury bond with a principal value of $ 100,000:

PRICE	COST
101	$ 101,000
100	$ 100,000
99	$ 99,000

Treasury notes and bonds trade in increments of 32nds, so that our table can include the following quotes as well:

PRICE	**COST**
101 3/32	$ 101,093.75
101 1/16	$ 101,062.50
99 3/4	$ 99,750.00
98 ½	$ 98,500.00

c. Accrued Interest on Notes and Bonds

Return to our Example 1-B:

4 3/4's of Feb 37 with a principal value of $ 100,000

Suppose that today is May the 15th, 2011. Suppose further, slightly incorrectly, that we are precisely half way between coupon payments -- the last payment of $ 2375 was made on February 15th, 2011 and the next coupon payment of $ 2375 is scheduled for August 15th, 2011. If an owner of the 4 3/4's of 2/37 were to sell the security today (May 15th) he would be giving up the certain income of a coupon payment in three months. In a sense, the seller would be deprived of his rightful 3 month share of that coming coupon payment. As a result of these considerations, Treasury notes and bonds trade *with accrued.* This means that a buyer pays not only the current price of the security, but also pays the seller any accrued interest that may be calculated between coupon payments.

In our current example, half of the coupon is *accrued*. Thus, suppose a seller of the 4 3/4's sells to a buyer at a price of 105. Then, total dollar amount that changes hands would be:

Price 105	$ 105,000.00	
Accrued Interest	$ 1,187.50	(half of the coupon)
Total Market V	$ 106,187.50	(price plus accrued)

U. S. Treasury coupon issues (notes and bonds) always trade with accrued. Buyers always pay the price plus the pro-rated amount of the coupon as in the above calculation.

d. Yields of Notes and Bonds

When a coupon security is first issued, its original purchase price is close to 100, which means close to $100,000 for an issue with $100,000 principal value. If the current price is 100, then a coupon of 4 ¾ implies a *yield* of exactly 4 ¾ percent, at least at initial issuance. But, what happens later?

The market price of the security fluctuates as it is bought and sold daily in the market place. Suppose, for whatever reason, the market price of the security drops precipitously to 50 within a short period after the security is originally issued (this is highly unrealistic, of course). What does this security with a 4 3/4 coupon now yield?

The security still will generate the same stream of interest, or coupon, payments of $ 2,375 twice annually and generate a principal payment of $ 100,000 at maturity. If the purchase price is now only $50,000, what does the security now yield? The answer must be about twice what it used to yield -- something close to 9 ½ %. *What a security yields, if this example has meaning, varies with its price. As the price rises, the yield will drop. As the price falls, the yield will rise.*

e. The Concept of Present Value, Again

The payments that will be received by a note or bond holder are all in the future. The question that naturally arises is what these payments worth right now. This leads us directly to the concept of *present value*.

Present value is a way of calculating the current dollar *value* of a future dollar receipt. For example, the loan of $100 at 10% for one year generates $110 one year from now. An equivalent way of describing this transaction is to say that the *present value* of $110, to be received one year from now, is $100. This calculation is often referred to as *discounting* the $110 back to the present with a 10% *discount* rate.

<u>EXAMPLE I-C:</u> A simple loan of $100 at a 10 % interest rate viewed in reverse

In this example, the future receipt is $110, which is $100 multiplied times (1 + r), where r is equal to ten percent (.10). The method of calculating present value in this example is simply to reverse the process, i.e.:

$110 to be received one year from today

divided by (1 + r) where r = .10

gives a present value of $100

This leads to a very simple formula for this special case:

$$PV = \frac{Dollars \quad received \quad one \quad year \quad from \quad today}{1+r}$$

where PV = present value
r = discount rate (or interest rate)

We can quickly complicate our example by assuming that the $ 110 is received two years from now with no other payments between now and then. In this case, the formula becomes:

$$PV = \frac{Dollars \quad received \quad two \quad years \quad from \quad now}{(1+r)^2}$$

which, in this case, gives a present value of $90.91

A further complication arises, if the payment is for a fraction of a year. Lets suppose that we receive $110 six months from now. What is the present value of that payment in a regime of 10 percent annual interest rates? Now, the formula becomes:

$$PV = \frac{\textit{Dollars received six months from now}}{(1+r)^{\frac{1}{2}}}$$

THE GENERAL FORMULA FOR PRESENT VALUE:

Let R be a dollar amount to be received in x.xx years from now.
Suppose that interest rates are always an annualized 10%. Then:

$$PV = \frac{R}{(1+r)^{x.xx}}$$

Fractions of years are simply carried in the exponent of the discounting factor.

f. The Yield to Maturity of a Note or Bond

Return to the earlier example of the 4 3/4's of Feb/37. Suppose that today's date is February 16th, 2007. If we knew what the various discount rates ought to be, we could calculate the present value of all the coupon payments and the final principal payment. We know that treasury coupon issues pay equal coupons every six months equal to one-half the coupon rate times the principal. The 4 3/4's of Feb/37 will pay make payments of $ 2375 every February 15th and August 15th up to and including the maturity date. Then:

$$PV = \frac{\$2375}{(1+r)} + \frac{\$2375}{(1+r)^2} + \frac{\$2375}{(1+r)^3} + \ldots\ldots\ldots \frac{\$\,102{,}375}{(1+r)^{60}}$$

Note that the r in the above equation is the yield for only half the year since the periods are implicitly half year periods. We don't know what the r's are (they might not all be the same). If we did know the r's, then, at least in principle, we would know the present value of this security.

If we think about this problem for a moment, it should seem sensible to realize that a good proxy for present value would simply be what it would take to buy this security -- the current market value. Therefore it should be true that:

Current Market Value = Present Value

If so, then:

$$Market\ Value \quad = \quad \frac{\$2375}{(1+r)} \quad + \quad \frac{\$2375}{(1+r)^2} \quad + \quad \frac{\$2375}{(1+r)^3} \quad + \quad .... \quad \frac{\$\,102{,}375}{(1+r)^{60}}$$

We know the current market value, as determined by the price, and we also know everything else in the above equation except the r's. Why not turn this problem on its head? Why not solve the above equation for r?

In fact, the r that solves equation (1) is the standard method used to calculate yields for bonds and notes and is called the *yield to maturity*. Once solved it is important to note that the yield is only for half the year. ***By convention, it is necessary to double the r to get the yield to maturity, because each period is a six month period between coupons***.

<u>DEFINITION:</u> The **yield to maturity** is defined as the discount rate that makes the present value of all coupons and the principal payment equal to the current market value (price plus accrued interest) of a note or bond. *The calculation uses half year periods, so that the annual yield to maturity is arrived at by doubling the rate used for half year periods.*

It should be noted that public references to yields on notes and bonds always use yield to maturity as defined here. This includes newspaper quotations and other references. This definition is not quite consistent with a normal internal rate of return calculation which would use an annual r with a formulation such as:

$$Market\ Value \quad = \quad \frac{\$2375}{(1+r)^{\frac{1}{2}}} \quad + \quad \frac{\$2375}{(1+r)^{1}} \quad + \quad .... \quad \frac{\$\,102{,}375}{(1+r)^{30}}$$

This latter calculation uses an r that is an annual yield and discounts the periods by using fractional exponents. That is the more normal way of assessing the internal rate of return for half year payments. This way of doing things would give you a higher rate than the method adopted by the Treasury, given earlier, that relies on half year yields using half year periods. ***The Treasury method, however, is the accepted method to use and corresponds to the yields that are cited in the newspaper and in electronic quotation services***.

6. How U.S. Treasury Securities Are Issued

In what follows, we describe the way that the vast bulk of U. S. Treasury securities are issued. It is true that not all U. S. Treasury securities are issued as described below. Certain specialized and and smaller issues are issued in other ways. But, these exceptions are minor and we shall ignore them.

The vast bulk of U. S. Treasury securities are issued through auctions that occur, more or less, regularly, throughout the year. The auctions are conducted by the Federal Reserve System (FRS) on behalf of the U.S. Treasury. The Fed handles these auctions for the convenience of the U. S. Treasury, mainly because of something called the Fed Wire System.

In 2001, there were important changes in the Treasury auction schedule. In September, 2001, the Treasury announced that it would not be issuing any more 30 year bonds in the foreseeable future. The outstanding 30 year bonds rose by more than five points on the day that news was announced and then settled back over the next few trading days. (The Treasury resumed the auction of 30 year Treasury bonds in January of 2006). The Treasury began the issuance of four week bills in 2001 and appeared to eliminate the auction of the year bill after one such auction in 2001.

The Auction Schedule and Representative Sizes in 2006

Name of Security	***When Auctioned***	***2010 Representative Auction Size***
4 week bill	Every Tuesday*	$ 34 Billion
3 month bill	Every Monday*	$ 30 Billion
6 month bill	Every Monday*	$ 30 Billion
Year bill	Last auction 2/27/01	
2-Year Note	Last Wed – Monthly	$ 38 Billion
3-Year Note	Feb, May, Aug, Nov	$ 34 Billion
5-Year Note	2^{nd} Wed - Monthly	$ 37 Billion
5-Year TIPS	April	$ 11 Billion
10-Year Note	8 Months of Year	$ 24 Billion
10-Year TIPS	January	$ 12 Billion
20-Year TIPS	January	
20-Year Bond	Last auctioned 1/8/86	
30-Year Bond	February, August	$ 16 Billion

* Unless Monday (Tuesday) is a holiday. If Monday (Tuesday) is a holiday, then the next non-holiday following Monday (Tuesday) will be the auction date

The Fed Wire System is essentially a cash and securities transfer and *settlement system*. *Settlement* of securities transactions means the actual delivery of the security and the payment for the security in a transaction. Most large cash transfers occur through the Fed Wire System. Access to the Fed Wire System is available to members of the FRS and other institutions upon application. The Fed Wire System is essentially a giant computer network that keeps records of who owns what. When someone uses the phrase "...wire money to...," they are referring to the use of the Fed Wire System.

g. Treasury Bill Auctions

There are three different treasury bills auctioned each week.

Every non-holiday Monday of the year, the three month and six month treasury bills are auctioned:

(i.) 3 Month Treasury Bills -- 90 Day T Bills -- 13 Week T Bills
(ii.) 6 Month Treasury Bills -- 180 Day T Bills -- 26 Week T Bills

These Monday auctions provide for settlement on Thursday. In other words, Thursday is the day that buyers pay for the securities and take possession of them. If Monday is a holiday, the bill auction takes place on the next available non-holiday.

Every non-holiday Tuesday of the year, the four week Treasury bill is auctioned:

(iii) 4 Week Treasury Bills

If the Tuesday is a holiday, the four week bill aunction takes place on the next available non-holiday. Settlement of the four week bill is on Thursday.

The main participants in the auctions are the FRS primary dealers. FRS primary dealers consist of large banks and large securities broker-dealers. Until recently FRS primary dealers were the only participants permitted to bid on behalf of third parties at auctions. That has now changed but, for practical purposes, the primary dealers are the main players at auctions.

<u>EXAMPLE I-D:</u> A 3-Month Treasury Bill Auction

The auction is announced by the FRS the week prior to the actual auction date. For this example, let us assume that the announced size of the 3-Month Bill auction is $ 14 billion. A large bank might submit the following bid:

Auction Bids By a Single Major Bank

Quote	**Amount**
5.00	$ 200 Million
5.01	$ 150 Million
5.04	$ 100 Million
Non-Com	$ 50 Million

The quotes are 360 day, discount quotes as is usual in the Treasury bill market. What the quotes mean is that the bank wishes to buy $ 200 Million at 5.00 %, $ 150 Million at 5.01 %, and $ 100 Million at 5.04 %. "**Non-Com**" means the bank wishes to buy $ 50 Million in bills at the average quote accepted by the FRS established by the auction, whatever that turns out to be. (Non-Com is short hand for non-competitive).

How does the FRS decide who gets what and at what price in the auction? Here are the steps that the FRS takes:

1. The FRS totals all the non-com bids. Suppose that the total non-coms submitted are equal to $3 Billion -- $ 50 Million of the total coming from the bids exhibited above.

2. The FRS subtracts the total non-coms from the total amount of the bill auction. In our example, we subtract $3 Billion in non-coms from the $14 Billion amount of the auction. This leaves $11 Billion to be allocated to the highest bidders.

3. The highest bidders (tenders) are those submitted bids with the lowest quotes. For example, our bank's bid shows the lowest quoted bid of 5.00%. Since this is a discount quote, this represents the bank's highest bid price. The FRS goes through all the bids selecting the lowest quotes until $11 Billion in bids have been accepted.

4. The FRS then reports the results of the auction and gives all the details of the auction including total non-coms, median accepted quote, highest quote accepted, lowest quote accepted.

5. Assigns the final purchase price to all accepted bids that corresponds to the lowest accepted price (highest accepted quote)

The *coverage* of the auction: coverage means the total bids submitted divided by the total amount of the auction. In this example, suppose that total bids, including non-coms, were $21 Billion. Then coverage would be 1.5 (21 divided by 14).

Notice that the method of determining the purchase price is unusual. It is the method of the **Dutch Auction**. A Dutch Auction, also referred to as a *single price auction*, mandates that ***all accepted bids pay the price that corresponds to the lowest accepted bid*** (price), highest accepted bid (yield) established at the auction. The point is that, no matter what bid you submit, if you are among the "winners," you will end up paying exactly the same price as all other "winners." This means that generally you will pay a lower price (higher bid) than what you submitted in the auction. This feature is designed to avoid the problem of the "winner's curse." The "winner's curse" is the notion that auction winners (where winners pay whatever their winning bid is) are always the folks that are too optimistic (and thus are *cursed* by paying too much).

In our example auction, all winning bidders (all non-coms and all bids submitted with quotes no higher than 5.07 %) will pay the same price – the price that exactly corresponds to a quote of 5.07%, regardless of what their actual bid happened to have been.

h. Treasury Note and Bond Auctions

A note or bond auction is organized in precisely the same manner as the bill auction described in Example I-C above. Bids are submitted in yields -- specifically, in *yields-to-maturity* as calculated in the preceding sections. The highest accepted yield (remember, this is a Dutch Auction) is calculated and then the coupon is selected (usually, not always) to the nearest 1/8th, e.g.:

Highest Accepted Yield of Au	Assigned Coupon
4.98	5
5.22	5 1/4
5.13	5 1/8
5.35	5 3/8

Selecting the coupon in this manner makes the purchase price of the note or bond very close to the principal value. If the coupon is above the highest accepted yield, then the purchase price will be above the principal value; if the coupon is below the average yield, then the purchase price will be below the principal value.

Coverage, tails, and non-competitive bids are all utilized in note and bond auctions, similarly to their application in bill auctions.

The timing and cycles for the auctions is subject to change at any time. The announcement of the auctions occurs in the week immediately prior to the auction and the wi's begin trading immediately following the announcement. A *wi* is a "when-issued" instrument that trades in advance of the auction of a new issue.

7. Duration – A Digression

Prices of bonds and their yields are inversely related. Owners of bond portfolios are well aware that if yields go up the value of their holdings will decline – but, by how much? Suppose our portfolio consists of one and only one bond. To simplify this discussion further, let's suppose that the current date is such that accrued interest is zero for the bond that we own. If we are interested in knowing much the price of our bond will change if the bond's yield increases slightly, then, we are interested in:

$$\frac{dP}{dy}$$

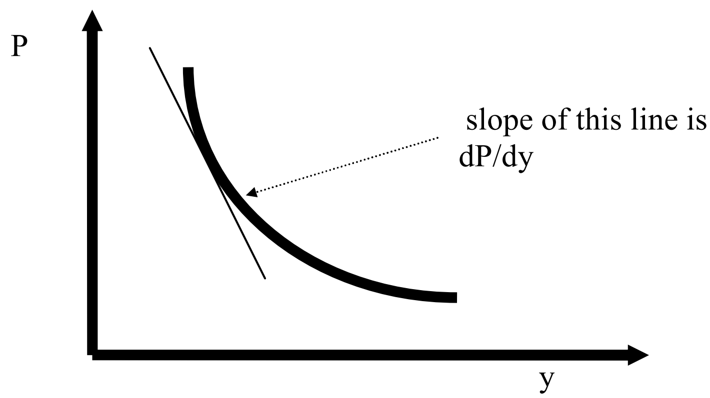
where P is the price of the bond and y is the yield. More meaningful would be the percentage change in price, which is:

$$\frac{dP}{P}$$

Therefore, we are interested in the percentage change in price that results from a change in yield:

$$\frac{dP/P}{dy} = \frac{dP/dy}{P}$$

The above expression is the percentage change in price that results from a change in yield, which is simply the derivative of the price function divided by P. Picture this graphically, below:



The slope of the curve at a particular point is $\frac{dP}{dy}$. Divide by P and you get the percentage change in price for a change in yield. This concept is called ***duration***. The formal definition of duration is that ***duration is the precentage change in value for a (small) percentage change in yield***. Our use of dP/dy focuses our attention upon change in price, but, more broadly, we are interested in change in value (which would include accrued interest for a particular note or bond or might include other bonds and represent portfolio value change).

It just so happens that for most treasury issues, duration has a very simple interpretation. Again, assume for simplicity now that dates are chosen so that accrued interest is zero. Then we can write price as equal to the present value of the remaining coupon stream:

$$P = \frac{coup}{(1+y)} + \frac{coup}{(1+y)^2} + ... + \frac{coup + principal}{(1+y)^n}$$

Differentiating the above expression with respect to y gives:

$$\frac{dP}{dy} = \frac{-1coup}{(1+y)^2} + \frac{-2coup}{(1+y)^3} + ... + \frac{-n(coup + princpal)}{(1+y)^{n+1}}$$

Rearranging the above equations gives:

$$\frac{dP}{dy} = \frac{-1}{(1+y)}\left[\frac{1coup}{(1+y)} + \frac{2coup}{(1+y)^2} + \dots\dots\dots + \frac{n[coup + principal]}{(1+y)^n}\right]$$

Inside the brackets is an expression that, if divided by P, the price of the security, is known as **Macauley duration**. It is simply the weighted average term to maturity of the cash flows with weights given by the present value of the particular cash flow. If duration is:

$$\frac{dP/P}{dy} = \frac{dP/dy}{P}$$

Then, relationship between duration and Macauley duration can be derived as follows:

Note that duration is defined as:

$$\mathrm{D} = \frac{dP/P}{dy} = \frac{dP/dy}{P}$$

Note further that:

$$\frac{dP}{dy} = -\frac{1}{1+y} MD * P$$

So that:

$$D = -\frac{1}{1+y} MD$$

where D is duration and MD is Macauley Duration. Macauley duration is especially simple in the case of zero coupon bonds, since only principal is involved (all the coupons are zero). ***For zero coupon bonds, duration is simply equal to the remaining maturity*** of the zero coupon bond. This means, for example, that the duration of the three month
bill is ¼, the duration of the six month bill is ½, and the duration of the year bill is 1.

How do you use duration (as a practical matter)? Notice ***that for most relevant values of y, duration and Macauley duration aren't much different (duration is slightly smaller).*** The duration of the 30 year bond (with 30 years of maturity left) is approximately 10 (for yields close to 8 percent). What does it mean if the duration is 10? It means if yields go up from 8 % to 9% on the 30 year bond, the value of the bond will fall by 10 percent. If duration were 5, then the value would drop by 5 percent. This accounts for a well known rule of thumb in the bond market. If yields increase by 10 basis points, from say 8.00% to 8.10%, how much will the price of a par bond fall? The answer – 1 point or 1 percent. Why? If a full percent causes a 10 point fall, then 1/10 of a percent should cause a 1 point fall in the price of the bond.

In general, duration means exactly the application cited in the prior paragraph. It gives the effect on the value of the asset caused by a 100 basis point (or 1 percent) increase in interest rates (yields). Thus, duration can be applied to assets other than bonds – common stock, real estate, anything that has an asset value sensitive to changes in market interest rates.

8. Stripping Securities – the Creation of a Zero Coupon Bond

This subject is best seen by an example. I imagine a two year treasury note with a coupon of 5 %. Suppose today is November 15, 2008 and the note is issued today with a maturity of November 15, 2010. The name of the note would be the 5's of Nov '10, which would describe the following sequence of events:

- ***On May 15, 2009, the note would pay a coupon of $ 2,500***
- ***On November 15, 2009, the note would pay a coupon of $ 2,500***
- ***On May 15, 2010, the note would pay a coupon of $ 2,500***
- ***On November 15, 2010, the note would pay a coupon of $ 2,500 and the original principal of $ 100,000***

The above five events, taking place on four separate dates, completely define the two year treasury note known as the 5's of Nov '10. The default free character, assumed for treasury notes, means that each of these payments is absolutely certain to take place – there is no risk of a default of either interest payments (coupon payments) or the principal payment on the maturity date.

Now, consider the following two ideas:

1) Since treasury bills have maturities less than one year, the US treasury does not offer any security similar to a treasury bill (a discount security with no payments until maturity). What if an investor would like to own something like a treasury bill, that pays everything at maturity but nothing at an earlier date, but that has a maturity longer than one year? There are no such treasury securities.

2) The five events described above, four coupon payments and one principal payment, are all separate and distinct events. No one event is contingent upon the other. Also, each event is default free by assumption

The above two ideas occurred to Wall Street traders in the late 1970s, and especially at the firm of Salomon Brothers (which is today part of Salomon Smith Barney, recently renamed simply Smith Barney). These ideas converged to the concept of stripping this two year note and created five separate securities.

Imagine the following process:

1.) First buy $ 10 billion worth of the 5's of Nov '10 at the auction, paying par (a price of 100, or $ 100,000 for each note with a principal value of $ 100,000.

2.) Then approach a custodian bank (which operates, more or less, like a large safety deposit box, except that the contents of the box is itemized at all times and known to the bank. Give the bank the $ 10 Billion worth of the 5's of Nov '10. The bank now has title to five different items: four coupons totaling $ 250,000,000 each payable on May 15 and Nov 15 of 2009 and 2010 and one payment totaling $ 10 billion on Nov 15, 2010.

3.) Then you sell to the public each of the five payments. For simplicitly assume that each payment is sold to a different individual (though, in reality, each payment is divided into small chunks, like $ 25,000 each, and sold). Give the custodian bank the names of the buyers of each of the coupons and of the principal payments and instruct the bank the pay the coupons and the principal payment on the same day the bank receives the coupon payments and the principal payment from the US Treasury

What this process does is it creates five new securities:

1.) $ 25,000,000 worth of principal payment treasury bills that mature on May 15, 2009
2.) $ 25,000,000 worth of principal payment treasury bills that mature on Nov 15, 2009
3.) $ 25,000,000 worth of principal payment treasury bills that mature on May 15, 2010
4.) $ 25,000,000 worth of principal payment treasury bills that mature on Nov 15, 2010
5.) $ 10 Billion worth of principal payment treasury bills that mature on Nov 15, 2010

As you can readily see, items 4) and 5) above are actually identical except in quantity and can be combined into a single item: $ 10,025,000,000 in treasury bills that mature 0n Nov 15, 2010. I have labeled these as "treasury bills," but that is not really what they are. Instead they look and act like treasury bills, but they are actually the "strips" taken from a two year note, the 5's of Nov '10, and are known as ***zero coupon bonds***. This process is known as stripping. This activity began in the late 1970s and became and still is a common practice. Treasury bonds and notes are purchased and stripped in this manner by Wall Street firms and the individual strips (payments – both coupon and principal payments) are sold to the investing public, using a custodial bank as the intermediary to hold the notes or bonds until payment is made.

9. The Yield Curve – A Digression

The yield curve is a useful notion for describing the maturity range of fixed income securities and the yields that correspond to the different maturities. A simple version of a yield curve might be constructed from the following data:

	Maturity (At Time of Issue)
3 MONTH T BILL	90 days
SIX MONTH BILL	180 days
2 YEAR T NOTE	2 Years
5 YEAR T NOTE	5 Years
30 YEAR T BOND	30 Years

Table I-2

The data in Table I-2 can be plotted as a yield curve (with four observations):

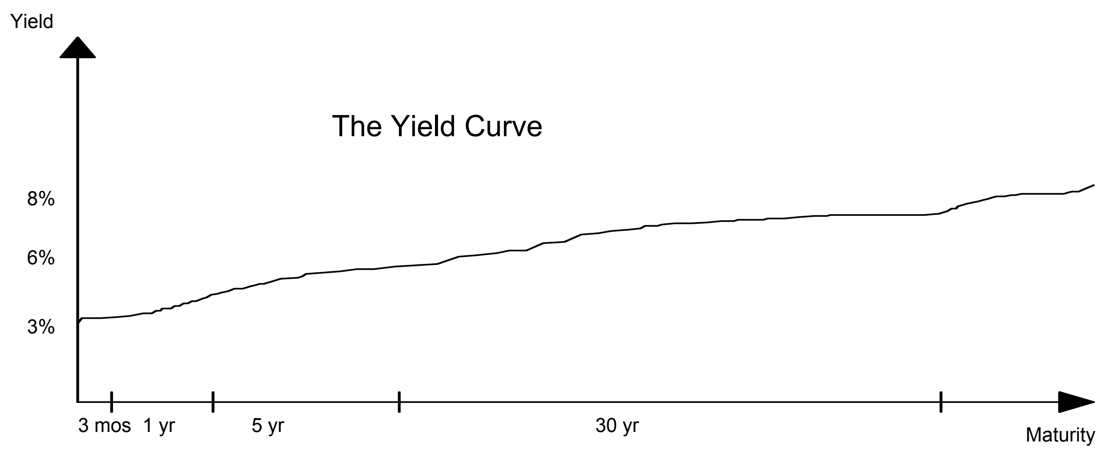


Figure I-2

At a glance, the yield curve permits us to see the entire spectrum of interest rates. We could easily fill in yields for other maturities and our yield curve should give us an increasingly accurate picture of yields on default securities for any maturity. Lets suppose for a moment that we have such a yield curve that identifies, for any maturity, the yield (to maturity) of a treasury security:

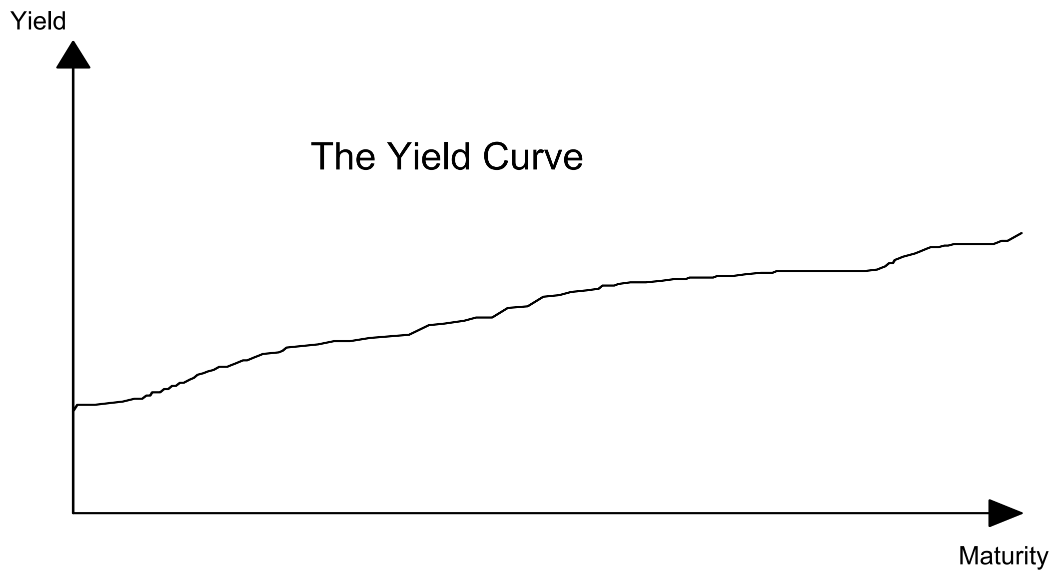


Figure I-3

Our purpose in drawing a yield curve for treasury securities was to identify a default free yield curve. We have identified US Treasury securities as the only default free securities. There are many other securities issued by agencies of the US Government that are guaranteed by the agency itself. These securities are called Agencies as opposed to Treasuries. There is not much difference here in risk. As is so often the case in Economics, we will simply draw an arbitrary line and say that US Treasury securities are default free and that all other securities carry some (even if very slight) risk of default. How should a security that has the potential for default be priced? If we know the yield curve for default free securities, then we should expect securities that carry the risk of default to require higher yields than securities that have no such risk.

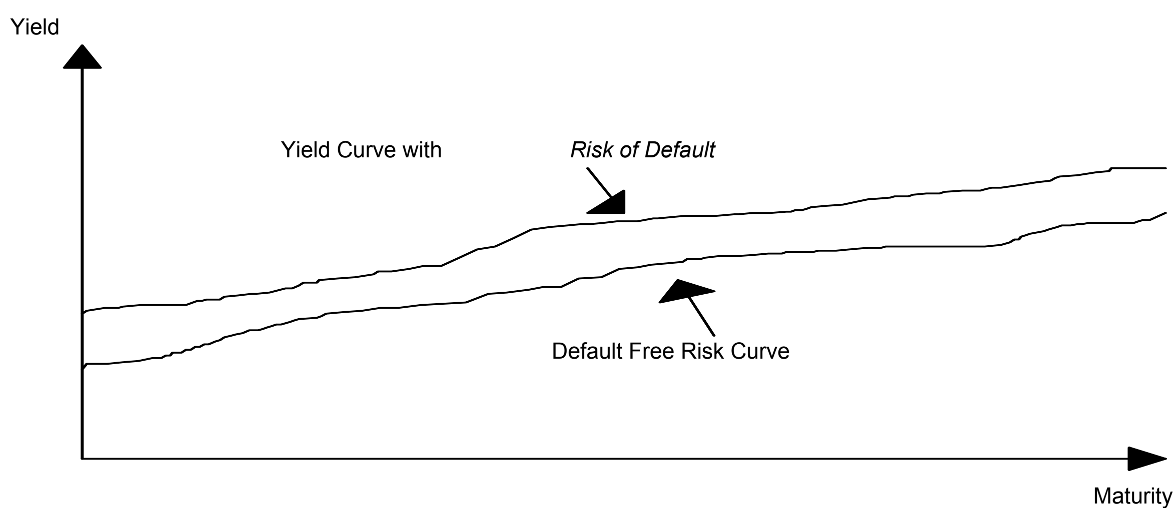


Figure I-4

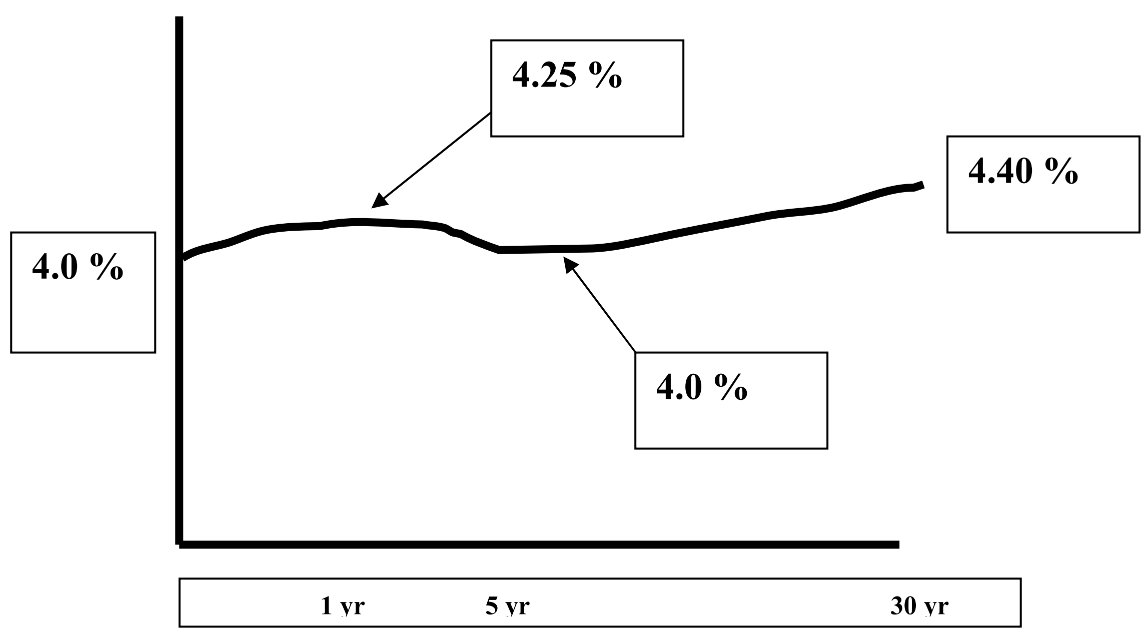
The curves depicted in Figure I-4 show only one level of risk of default. There is obviously a continuum of various risks of default in the actual market place. This means that there are a continuum of curves (all above the default free risk curve) that describe the yield curves that would correspond to all the different degrees of default risk. The higher the risk of default the higher the curve.

If you ask the question how risky is a specific firm's balance sheet, sometimes the best answer is to consult the rates for that firm's debt obligations. In other words, find the firm's yield curve and and see how far about the default free yield curve it is. A company's debt market yields are often the best estimate of the riskiness of a particular company.

10. Can the Yield Curve Slope "The Wrong Way"

What if short rates are higher than long rates? Can this happen? The ***shape*** of the yield curve is often called the ***term structure of interest rates***. There is a natural presumption that shorter rates must be lower than longer rates. The reasoning for the upward sloping yield curve, that most observers think is normal, is that lenders must be compensated with higher rates and yields if they agree to a longer maturity for their lending activity. Borrowers, wishing to lock in a longer fixed rate of interest, are willing to pay higher rates for longer maturities.

But, in the real world, ***it sometimes, infrequently, happens that short term rates are higher than long term rates***. The current period, early 2006, is, at least partially, one of those times:



What does it mean when short rates are higher than long rates? It is frequently mentioned in the business press that whenever the ***yield curve is inverted*** - meaning that short rates are higher than long rates- the yield curve is predicting an economic downturn. In the early 1980s the yield curve became steeply inverted and a major recession was in progress (in this case, the inverted yield curve did not really precede the recession, but instead seemed to accompany the recession). The truth is that no one really can explain the shape of the yield curve or the term structure of interest rates. The popular view that inverted yield curves are precursors of recessions is nothing more than a popular view with no real logical or empirical foundation. Like many things in Economics, the inverted yield curve is one of those occasional perplexities that are not yet fully understood.

C. Fixed Income Securities That Are Subject to Possible Default

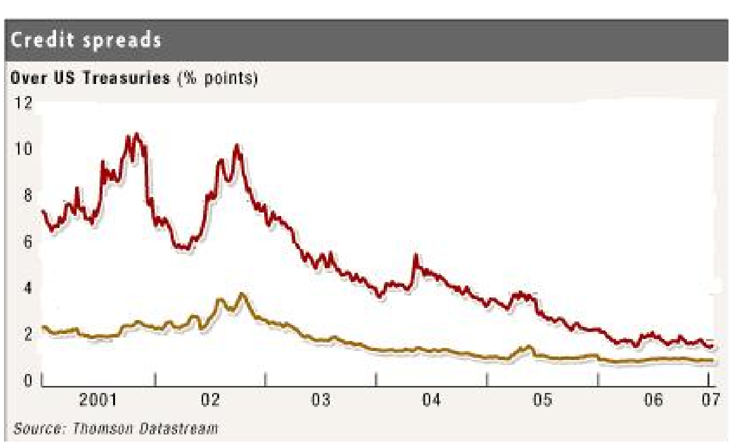
The vast bulk of borrowing and lending in the US and elsewhere have the possibility of defaulting and do default from time to time. Thus, the risk to lenders has the "duration" risk identified in Section B as well as an additional risk that we call "credit risk." Credit risk is the possibility that the lender, for whatever reason, does not honor the promises to repay interest and principal as agreed. ***As a broad generalization, then, there are two main risks to the lender:***

I. Duration risk
II. Credit risk

As we go forward, we will stop referring to the lender as "the lender" and begin to think of the lender as "owning" a fixed income asset. We will think of the "borrower" as having a fixed income "liability." We will primarily interesting in analyzing a fixed income security from the point of view of the "owner" of the asset.

1. A Brief History and Background of the US non-treasury fixed income markets

Other borrowers, besides the government, are constantly in need of funds. Businesses in the 19th century in America borrowed primarily from wealthy individuals and families or from commercial banks. In the 20th century, commercial banks began to dominate business lending, though, after the mid 1970s, commercial bank lending begin to lose ground to a variety of other lenders, but mostly to the growing process of lending "securitization."



By the mid-1970s, there were two main lenders to the business community: (i) commercial banks through direct lending and (ii) investors in corporate bonds and commercial paper. Corporate bonds are structured much like treasury notes and bonds. They typically have principal payments only at maturity and interest payments, usually called coupons, are paid twice annually. Commercial paper is analogous to treasury bills and represents short term borrowing by business from the investing public. Commercial banks and other financial institutions, of course, can own corporate bonds and commercial paper, so, from this point of view, the "investing public" includes banks and other financial institutions as well as pension funds, endowments, and foundations. The key point is that corporate bonds and commercial papers are securities and direct bank lending is not a security.

Commercial bonds were issued (sold) by large established and financially secure companies (what we will later refer to as "public companies.") Up until the late 1970s, very few companies had access to the corporate bond market and the companies that did issue corporate bonds were well known, household name, companies. At the time of issue, corporate bonds were considered safe and secure. They were priced to yield more than comparable maturity treasury notes and bonds, with the difference in yield representing additional income to investors to compensate the investors for the fact that, at least in principle, these commercial bonds were subject to possible default: the more likely the default, the higher the yield relative to treasuries.

The difference between the yield on corporate bonds and an equivalently structured treasury bond is known as ***the credit spread***. The credit spread is considered a measure of the confidence held by the public in the credit worthiness of the economy. Higher credit spreads mean less confidence; lower spreads mean more confidence.

Households borrowed from banks and other savings institutions throughout the first three quarters of the 20^{th} century. Home mortgages flourished, especially after the middle half of the century, and were originated and owned by commercial banks and thrifts (other bank-like savings institutions).

We can summarize the lending available to businesses and households up until the late 1970s as primarily coming from the commercial banks and thrifts. The main exception to this pattern was the relatively small corporate bond market and commercial paper market that was available to the largest and most successful public companies.

One historical footnote, that we shall come back to later, is that a corporate bond sometimes got into trouble. That is, there would be occasions from time to time when the issuer of a corporate bond would begin to get into financial trouble. In which case the bond would fall in price, its yield would rise (since the coupon rate on the bond was fixed), and the bond would fall from "investment grade." Many institutions, such as pension funds and endowments, could only own "investment grade" securities. This meant that bonds that begin to deteriorate in credit quality (the underlying issuer began to weaken financially) would have to be sold by owners who could not legally own non-investment grade securities. These bonds were called "junk bonds." Junk bonds were a relatively small part of the corporate bond market until the 1980s, but after the 1980s, in a somewhat different context, junk bonds became a significant, and, at first, controversial, major funding source for a wide variety of businesses. But, we shall have more to say on that topic later.

2. Commercial Banks, Thrifts and the Mortgage Market

Commercial banks and thrifts are lending institutions that also take deposits. Many of these deposits carry some form of government guarantee. Commercial banks loan money to businesses and households. Thrifts, traditionally, loan money mainly to households, although this focus shifted somewhat in the 1980s after permissive legislation expanded the lending activities of thrifts. For our purposes, we can think of loans to households as primarily home mortgage loans. ***Home Mortgage loans*** are loans that enable individuals and families to buy homes or to refinance an existing home. Generally, a mortgage loan is anything secured by a building – either a personal home or a commercial building of some type. If the mortgage is used financed a commercial building, then we refer to that type of mortgage as a commercial mortgage.

Until 1978, mortgage lending was done in a very simple manner. If you wished to buy a home, you contacted your local banker (or thrift or savings bank banker) and, before buying a home arranged for the bank to lend you enough money to make the purchase. It is presupposed that you have some money of your own and that when combined with the mortgage loan will be enough to acquire the home.

A key feature of a traditional mortgage loan is the amount of the loan, what we call the "principal" of the loan is not paid all at once as is the case with a Treasury note or bond. Instead the principal of a mortgage loan is paid off over time.

From the point of view of the borrower, ***each mortgage payment consists of two parts: (i) mortgage interest; and (ii) principal repayment***. Mortgages are usually constructed so that monthly (which is standard) payments are always the same. What changes, over time, is that interest payments make up most of a mortgage payment in the early years of a mortgage but, over time, gradually give way to principal repayment becoming the bulk of each monthly mortgage payment.

The way mortgage payments work can be confusing at first. Let do an example that illustrates the pattern of declining mortgage interest payments and increasing principal repayments over time that one fines in a fixed rate, fixed payment mortgage.

Assume the following:

1) A 30 year mortgage loan
2) Principal amount = $ 200,000
3) Stated interest rate = 6 %
4) Payments to made monthly for 30 years in such a manner that:
    a. All monthly payments are identical
    b. The full mortgage is totally repaid by the final mortgage payment at the end of thirty years

$ 1,199.10 will be the monthly mortgage payment. This amount will be unchanging. In total there will be 360 payments (30 years times 12 monthly payments per year). For the very first payment of $ 1,199.10, the interest payment will be $ 1,000 (6 % times $ 200,000 divided by 12). The remainder of the payment, $ 199.10 is used to reduce the principal. Thus, after the first monthly payment, the borrower will have paid $ 1,000 in interest and the remaining principal to be paid off will be: $ 200,000 less $ 199.10, which equals $ 199,899.90.

As time passes, while the monthly payment stays constant at $ 1,199.10, that total becomes more and more principal and less and less interest.

After 29 years and 348 payments (29 times 12), the 349th payment will only be $ 69.66 in interest but will have repayment of principal equal to $ 1,129.44. The final payment of $ 1,199.10 will be $ 1,193.14 in principal repayment and $ 5.96 of interest.

Monthly Payment	Payment / Month	Amt. to Interest	Amt. to Principal	Remaining Principal at Month's en
1	1,199.10	1,000.00	199.10	199,800.9
12 (end of 1st Year)	1,199.10	988.77	210.33	197,543.9
24 (2nd Year)	1,199.10	975.80	223.30	194,936.5
36 (3rd Year)	1,199.10	962.03	237.07	192,168.1
48 (4th Year)	1,199.10	947.40	251.70	189,229.1
60 (5th Year)	1,199.10	931.88	267.22	186,108.7
72 (6th Year)	1,199.10	915.40	283.70	182,796.0
84 (7th Year)	1,199.10	897.90	301.20	179,278.8
96 (8th Y)	1,199.10	879.32	319.78	175,544.8
108 (9th Y)	1,199.10	859.60	339.50	171,580.4
120 (10th Y)	1,199.10	838.66	360.44	167,371.6
132 (11th Y)	1,199.10	816.43	382.67	162,903.1
144 (12th Y)	1,199.10	792.83	406.27	158,159.1
156 (13th Y)	1,199.10	767.77	431.33	153,122.4
168 (14th Y)	1,199.10	741.17	457.93	147,775.1

180 (15th Y)	1,199.10	712.92	486.18	142,097.9
192 (16th Y)	1,199.10	682.93	516.17	136,070.7
204 (17th Y)	1,199.10	651.10	548.00	129,671.6
216 (18th Y)	1,199.10	617.30	581.80	122,877.9
228 (19th Y)	1,199.10	581.41	617.69	115,665.2
240 (20th Y)	1,199.10	543.32	655.78	108,007.6
252 (21st Y)	1,199.10	502.87	696.23	99,877.7
264 (22nd Y)	1,199.10	459.93	739.17	91,246.4
276 (23rd Y)	1,199.10	414.34	784.76	82,082.7
288 (24th Y)	1,199.10	365.94	833.16	72,353.8
300 (25th Y)	1,199.10	314.55	884.55	62,024.9
312 (26th Y)	1,199.10	259.99	939.11	51,058.8
324 (27th Y)	1,199.10	202.07	997.03	39,416.5
336 (28th Y)	1,199.10	140.57	1,058.53	27,056.0
348 (29th Y)	1,199.10	75.29	1,123.81	13,933.2
360 (30th Y; end of loan	1,199.10	5.97	1,193.13	1.

> [Notice how different this pattern of income (to the lender) is that what takes place with treasury coupon issues. Treasury issues pay constant interest coupons until the security's maturity date. On the maturity date, there is a final interest coupon payment and the repayment of the entire amount of the principal. The maturity date is the only date that treasury securities pay any of their principal back. But, on the maturity date, all treasuries repay the entire principal all at once.]

What would happen if you repaid the mortgage loan early (earlier than the maturity date)?

A borrower may want to pay off the mortgage before maturity. This might happen because the borrower wishes to move and will need to sell the house and pay off the mortgage. Since the principal is known for each mortgage payment date, then why not pay off that amount and be done with it. For example, imagine in the example above, we took out a thirty year mortgage, but decided after the first month that we no longer liked our house, sold it and planned to repay the mortgage. The remaining principal on the mortgage would be $ 199,899.90 (as we noted in the last section). Can you simply pay that amount and that would take care of it?

Look at this from the point of view of the lender. The lender is planning to earn 6 percent on a mortgage with a $ 200,000 principal with 360 monthly payments of $ 1,199.10 every month for thirty years. Suppose after a few payments, the borrower simply repays the remaining principal. Is that good for the lender? The answer depends upon what has happened to mortgage rates. If mortgage rates have gone down, say to 4 %, the lender is worse off if the borrower repays the mortgage early. The reason is that the lender was earning 6 %. Now the best the lender can do is to earn 4 % on a new mortgage. If mortgage rates have gone up, say to 8 %, then the lender will be better off if there is an early repayment of principal, because he can now lend the same money on a new mortgage at 8 % instead of the earlier lower rate of 6 %.

If the borrower is free to pay off the principal and liquidate the loan whenever they choose, then the lender is at risk whenever mortgage rates decline. The risk is that mortgage rates drop and the lender cannot reinvest his money in a mortgage with a 6 % interest rate. Notice that the lender is also at risk if mortgage rates increase because the lender is locked into existing lower mortgages rates when higher rates are now available (the same risk as the duration risk embodied in a treasury coupon issue). The lender, of course, hopes that the borrower will prepay when rates go up. That is precisely the least likely time for the borrower to prepay. The borrower is most likely to prepay when rates have fallen, which is the worst time for prepayment from the lender's point of view.

Commercial properties, such as office buildings, have mortgages that operate in much the same ways as a home mortgage. Commercial mortgages cannot be repaid by simply paying off the remaining principal. If you buy a building and take out a mortgage to finance your purchase of the building, then, in order to repay the principal and liquidate the mortgage on the building, when interest rates have fallen, you would be required to pay a "penalty" for "early" repayment of the mortgage. The repayment penalty is normally equal to the full present value of the difference between the payments at the original rate (in our case, 6 %) and the now prevailing lower mortgage rate, say 4 %. If mortgage rates had gone up instead of down, there would be no early repayment penalty. The repayment penalty is only triggered if mortgage rates have declined to a level below the rate upon the original commercial mortgage.

It makes sense that the borrower must pay a penalty to repay the principal since the lender suffers if rates have fallen. After all, absent a penalty, borrowers will always payoff mortgages early and take out new mortgages at lower rates, whenever mortgage rates drop sufficiently. What's to prevent early repayments to take advantage of lower mortgage rates, if there are no early repayment penalties? Absent prepayment (the street term for early repayment) penalties, lenders are at risk if rates rise (duration risk) and if they fall (prepayment risk).

3. Prepayment penalties and establishment of GNMA

Prepayment penalties are normal for commercial mortgages but rare for home mortgages. In 1968, the US Congress voted to guarantee mortgage payments to lenders for certain mortgages. The specific legislation created the Government National Mortgage Association (GNMA pronounced 'Ginnie Mae"). Any mortgage that conformed to GNMA standards become GNMA eligible. One of the conforming requirements was that GNMA mortgages must have no prepayment penalties. Borrowers with a GNMA eligible mortgage always have the right to early repayment of principal without penalty.

What is the purpose of GNMA? GNMA permits mortgages to be bundled together and sold as securities to the public. The public then becomes the lender by purchasing GNMA securities. A bank might create the mortgage between itself and the borrower and then sell the mortgage to a Wall Street securities firm who might create a "pool" of such mortgages, creating a security with this "pool" of mortgages, and selling the security to the public.

The way the government "guarantee" works is that the mortgage security issuer charges an insurance premium for each pool of mortgage securities. This insurance premium is paid to the GNMA as payment for "insuring" that each mortgage payment will be paid. These premiums are used to provide the funding to pay off any losses the government might sustain on unpaid mortgage payments that are insured by the government.

This "guarantee" provided by GNMA was the key to public acceptance of mortgage securities. The original GNMA securities were referred to as "pass-through" securities, which described the fact that mortgage payments "passed through' to the owners of the securities. In this manner, GNMA securities enabled the public to become the ultimate lenders to home owners, since the public purchased homeowner mortgages by purchasing GNMA securities.

GNMA pass-throughs have no prepayment penalties for the mortgages that are pooled to create the security. This means the individual homeowners retain the right, with no penalty, to repay their mortgages early. This means if you own a GNMA pass through security, then each month you receive payments that are made up of: 1) normal repayment of principal; 2) mortgage interest; and 3) potentially some early repayment of the underlying mortgages. In such a situation, you really have no way of knowing the maturity of your GNMA security. Some or none or conceivably all of the underlying mortgages could be repaid at anytime without penalty. Your GNMA security could disappear before your very eyes.

The above paragraphs implies that mortgage securities (GNMA and any other that have no prepayment penalties) have risk if rates increase (normal duration risk) and risk if rates go down (prepayment risk).

In addition to the above risks, prepayment risks could be accelerated by more rapid home turnover. If you own a pool of mortgage that was originated in a geographical area where job losses are widespread, then people will be selling their homes and moving. This will create additional prepayment risk. (If rates go up, the mortgage might not get paid off even if the homeowner sells his home and moves. This means that the mortgage security owner is at risk if rates have dropped, but may not benefit from premature home sales, if rates have risen).

So, the reason that homeowner mortgages have no penalty for prepayment is that GNMA (and similar securitizers) require that mortgages eligible for securitization must have no prepayment penalties. No similar provision affects commercial mortgages, even those that are securitized, so that commercial mortgages do not carry risk of lower mortgage rates and early repayment of principal.

4. Mortgage Securitization

The creation of GNMA securitization of mortgages was the beginning of a huge pattern of securitizing home mortgages. Since the early 1980s, there has been a consistent trend toward home mortgages being more and more owned by the investing public and less and less owned on the balance sheets of commercial banks and thrifts. There are several interesting conclusions that can be drawn from these developments:

1) The mortgage market is today much more efficient because of securitization and, as a consequence, mortgage rates are significantly lower (sometimes estimated as at least two percentage points) than would be the case had securitization not taken hold. It's worth noting that investors benefit as well by having a security with characteristics different than what had previously been available in the market place.

2) Because of securitization, home owners have a right generally to prepay mortgages without penalty. This has the economic effect of increasing mortgage rates slightly on mortgages with such prepayment rights. Why? Because such prepayment rights have value and that value accrues to the

borrower and is absorbed as a loss to the lender. Higher mortgage rates are required to offset the cost to the lender (increased risk to future lower mortgage rates) occasioned by zero-cost prepayment rights for borrowers.

3) The ideas behind mortgage securitizations spread to other markets – the market for car loans, for credit card debt and other forms of debt. This lead, in each case, to more efficient markets for these forms of debt obligations and generally lower rates for borrowers.

5. Asset Backed Securities

The enormous success of the securitization of the US mortgage market, lead Wall Street to think about other possible types of "financial engineering" that might be applied to fixed income obligations. Borrowing a page from the treasury strip market, Wall Street began to think about how to "strip" other fixed income obligations. Stripping non-treasury debt is the principle idea behind "asset backed securities." The name, here, is a bit misleading.

A fictional example of an "asset backed security" – the simplest context

Imagine a two year corporate bond with a coupon of 10% and a principal amount of $ 100,000. Suppose it is sold on September 2nd, 2008 and will mature on September 1st, 2010. It plans to make four payments of $ 5,000 on March 1, 2009, September 1, 2009, March 1, 2010 and September 1, 2010 and plans to pay the principal of $ 100,000 on September 1, 2010. We use the word "plans" to suggest that, unlike treasuries, our imaginary corporate is subject to potential default risk. Here is the schedule:

- ***September 2, 2008 Two Year Corporate is created and sold***
- ***March 1, 2009 – pays its first coupon of $ 5,000***
- ***September 1, 2009 – pays its second coupon of $ 5,000***
- ***March 1, 2010 – pays it third coupon of $ 5,000***
- ***September 1, 2010 – pay its fourth coupon of $ 5,000 and its principal of $ 100,000***

There are potentially four separate securities combined into this two year corporate bond with four separate maturities: March 1, 2009, September 1, 2009, March 1, 2010, and September 1, 2010.

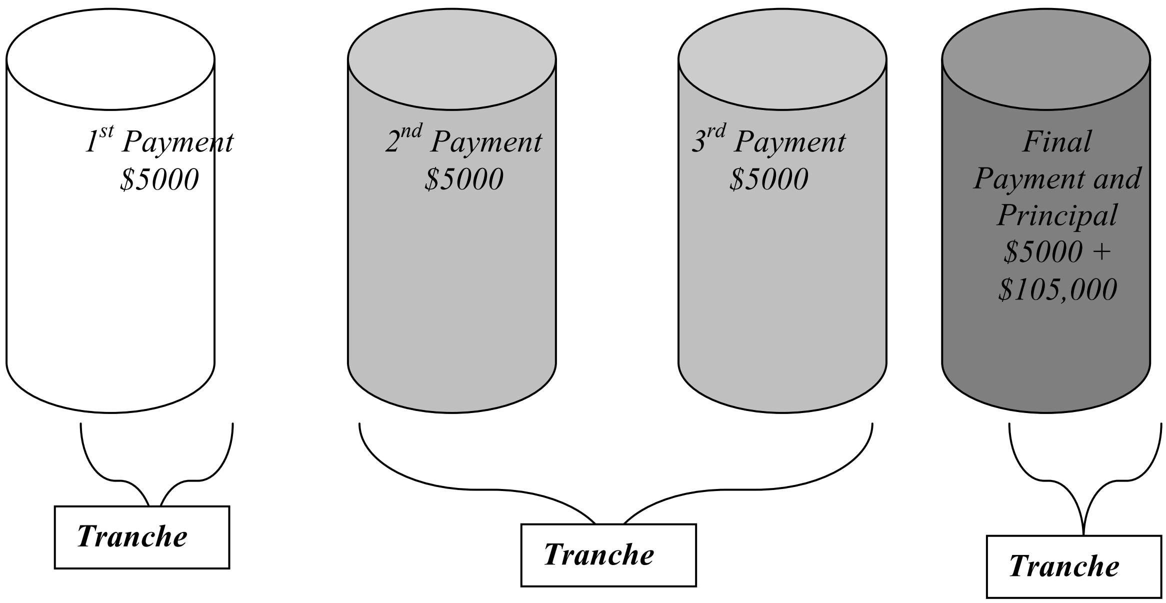
Now, if this two year note was a treasury security, then the different maturities would simply represent different "durations." But, since it is not a treasury security, but instead is a corporate security, each maturity represents not only a different "duration," but a different default risk. The further out the payment, the higher the risk of default. The earlier payments have both lower duration and lower credit risk. From this point of view, the September 1, 2010 payment is much riskier than the March 1, 2009 payment. So, while this concept of separating out the payments is similar to "stripping" a treasury bill, it adds the additional dimension of default risk to the process.

In the language of asset-backed securities, we will divide this two year corporate into three separate tranches:

<u>Tranche 1:</u> The first payment due on March 1, 2009 of $ 5,000

<u>Tranche 2:</u> The next two payments due on September 1, 2009 and March 1, 2010, each of $ 5,000

<u>Tranche 3:</u> The final payments of interest and principal of $ 105,000 total due on September 1, 2010



The plan, then, is to sell each tranche separately as an entirely separate security. Let us look at each tranche separately:

<u>Tranche 1:</u> Tranche 1 has only six months to maturity and is very similar in character to commercial paper. This is the least risky tranche since it has a duration of ½ and has lower credit risk simply because it agrees to pay at an earlier date (after all, if it defaults, so will the other tranches, but not necessarily the other way around).

<u>Tranche 2</u>: Tranche 2 is an "intermediate" debt instrument with one payment due in 12 months and another in 18 months. Thus it's duration is approximately equal to one and it's credit quality is inferior to Tranche 1. Tranche 1 may get paid, but not Tranche 2 in some circumstances, but if Tranche 1 doesn't pay, Tranche 2 is destined to fail as well.

<u>Tranche 3:</u> Tranche is the riskiest tranche of all. The duration of tranche 3 is two and it's credit risk is the highest of all three tranches for reasoning similar to that given earlier.

There are a lot of possibilities here depending upon who is the underlying issuer. (Underlying issuer means the borrower who is expected to make these various payments that underlie each tranche).

For some issuers, Tranche 3 may be very, very risky, while Tranche 1 is not risky at all. This would be the case if there is something that is supposed to happen between month 6 and month 24, but is not currently known for certain. For other issuers, all tranches may have relatively low total risk, but in every case Tranche 3 will be the riskiest tranche and tranche 1 will be the least risky tranche.

What makes asset-backed securities attractive to the issuer is the potential savings in interest costs. They might, for example have to be a 6 coupon, were they to issue a two year corporate bond, but may get a lower total "blended" rate by issuing three separate securities in the forms of Tranche 1, 2, and 3. If they could not get a lower "blended" rate than what would be available in the corporate bond market, then there would be no reason to tranche up the two year corporate. In this latter case, the issuer would simply issue two year corporate bonds. So, the principal motivation to the issuer to consider an asset-backed securitization is the prospect of a lower interest costs over the life of the indebtedness (sometimes called "lower funding costs," "lower financing costs," etc.)

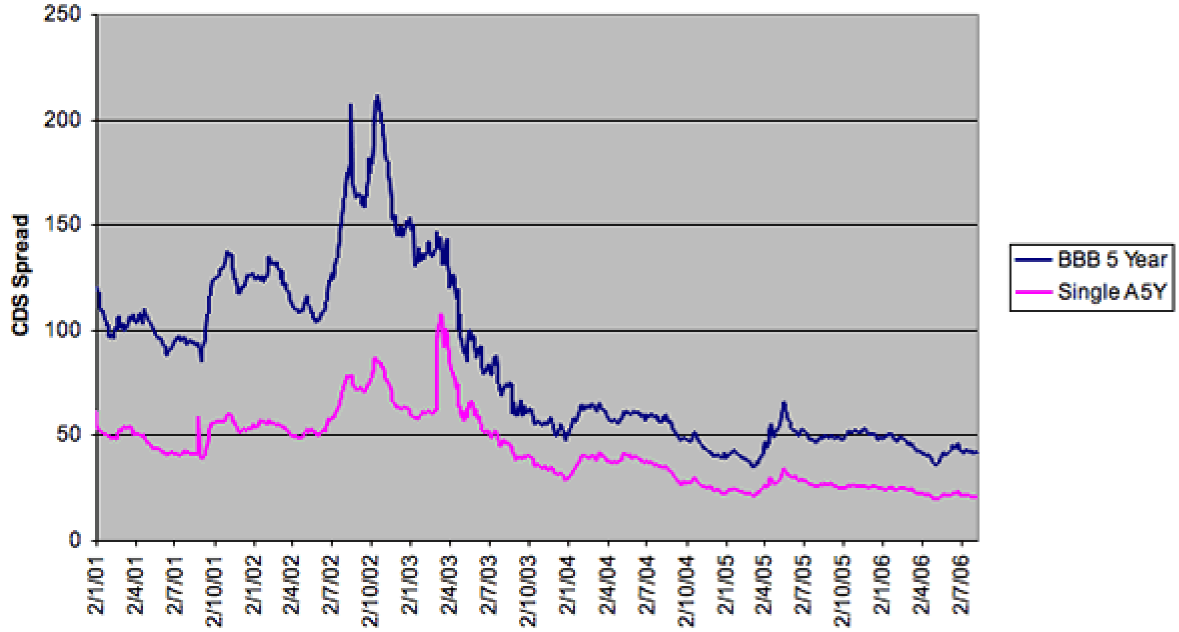
Why would lower "blended" rates be available? Because, at any one time one of these tranches might be in relatively great demand and thus have a lower interest rate than normal. The market will determine whether tranching makes sense or doesn't make sense. But, the possibility is always there because you are appealing to three entirely different markets instead of just one. It is always possible, and often is possible in the real world, that selling into three markets is more attractive, rate-wise, than selling into a single market.

We need a definition of an asset backed security:

Asset backed security: a security that is comprised of parts of given set of cash flows. As a practical matter, a given cash flow can be used to create many different (tranches) sets of cash flows that are known as ***asset backed securities***.

6. Spicing things up – using credit derivatives

Imagine that the issuer is a very risky issuer. Then the issuer might approach an insurance company and ask that they "insure" the first tranche, for example. The issuer would purchase the insurance and then sell the first tranche at a lower interest rate, since it now has lower credit risk. The use of credit guarantees by third parties is an example of a *credit derivative*. It is a common practice to find third party guarantees for some tranches in an asset-backed security construction. The insurance companies are natural candidates for these types of guarantees, since insurance is their basis business. In addition to insurance companies, other entities now participate as providers of guarantees including Wall Street firms, hedge funds and other market participants. While credit default swaps (which basically insure corporate bonds) are the largest part of the credit derivatives market, the types of guarantees mentioned here are fairly common.



7. Financial engineering one step beyond – the waterfall

Imagine there are twenty of these two year corporate bonds, each from a different issuer. Suppose they each have the same maturity and are issued on the same date (and for simplicitly, imagine, that they would pay the same 6 percent coupon, although that isn't really necessary to the example).

Now, the payment schedule would be the same as before, but the size would be greater. In fact, each interest payment would be $ 100,000 (twenty times $ 5,000) and the principal repayment at maturity would be $ 2,000,000 (twenty times $ 100,000).

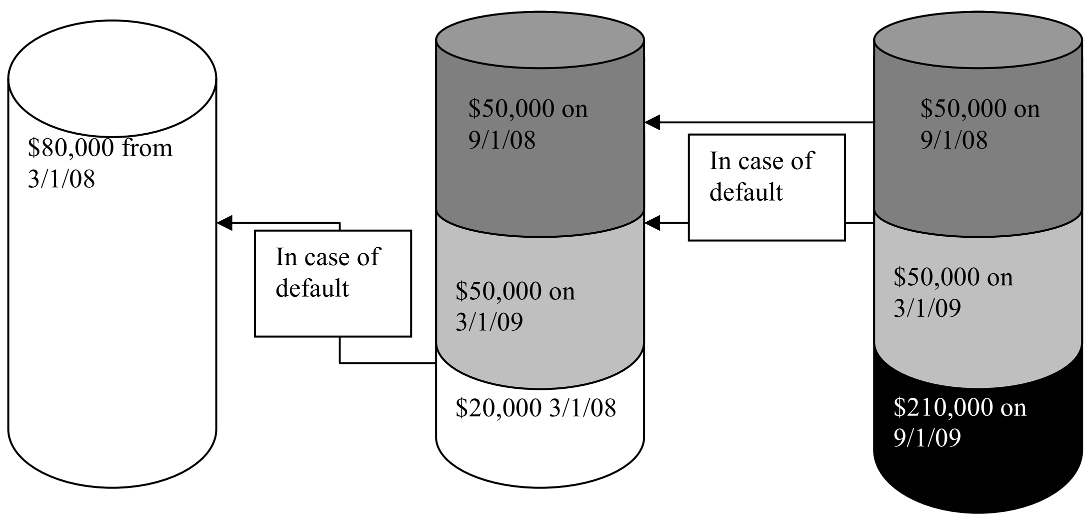
Notice that now there are 20 different issuers, so that a single default only involves one of the issuers. So, now it is possible that no issuer defaults, that all issuers default, or that somewhere between one and twenty of the issuers default on a coupon payment or a principal payment.

Now let's create three different tranches out of these income streams of $ 100,000, $ 100,000, $ 100,000 and $ 2,000,000:

<u>Tranche 1:</u> Receives $ 80,000 of the payments scheduled for March 1, 2008. In the event of a default, tranche 1 always gets paid unless more than $ 20,000 of the first coupon is defaulted.

<u>Tranche 2:</u> Receives $ 20,000 from the first payments of March 1, 2008. But, if there are any defaults, tranche 2 absorbs the defaults. This means if there are more than $ 20,000 in defaults from the March 1, 2008 payments, tranche 2 will receive nothing. Also, Tranche 2 receives all of the $ 50,000 in payments scheduled for September 1, 2008 and $ 50,000 in payments scheduled for March 1, 2009

<u>Tranche 3:</u> Receives all of the $ 2,100,000 in payments schedule for September 1, 2009 and is entitled to $ 50,000 of the September 1, 2008 payments and $ 50,000 of the March 1, 2009. However, the $50,000 received from September 1, 2008 is escrowed until March 1, 2009. In the event of defaults of the September 1, 2008 payments, tranche 3 will absorb the first $ 50,000 in losses. Any net proceeds due to tranche 3 from the September 1, 2008 after defaults will be used as an escrow guarantee available to tranche 2 in case tranche 2 is unable, due to defaults, to receive their full $ 50,000. Also, until tranche 2 has received a total of $ 100,000 in payments, tranche 3 will receive nothing and will only received payments above and beyond the $ 100,000 due to tranche 2. Complicated isn't it. A picture should help:



The idea here is that tranche 2 is used to "credit enhance" tranche 1 by being the first loser in case of default. In a slightly different way, tranche 3 is used to "credit enhance" tranche 2. The result of all of this "financial engineering" is to make tranche 1 very, very low risk. Since tranche 2 is providing credit enhancement to tranche 1, tranche 3 is used to bolster tranche 2 by escrowing part of their "waterfall" of payments that they are due on September 1, 2008 and providing additional enhancement of the March 1, 2009 payments to tranche 2 by taking the position of "first loss." This example is well worth studying. Providing credit enhancements in the manner cited above is common in asset-backed security structures and often enables the issuer to generate substantial savings in interest expense by creating securities that aggregate to a much lower "blended" rate than would be available from a straightforward issuance of a two year corporate bond.