UNIVERSITY OF RICHMOND
Robins School of Business™

§14. BOND VALUATION AND PORTFOLIOS

FIN 366: INVESTMENTS

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BOND VALUATION

A **corporate bond** is a security that obligates the issuer (the *borrower*) to pay specified coupon payments and principal to the bondholder (the *lender*) over a period. The **par** or **face value** or **principal** is the amount borrowed by the firm, to be repaid at maturity. The **coupon** is the periodic payments (most commonly semiannual – twice yearly) that are paid by the borrowing firm over the life of the bond, expressed as a percentage of par.

Bonds have numerous features that affect their valuation, all disclosed in the bond's **indenture**, the contract between the issuer and the lender.

BOND PRICES

Recall the value of a bond is the present value of coupon payments plus the present value of the par value paid at maturity.

$$Bond\ Value = \sum_{t=1}^{T} \frac{Coupon\ Payments}{(1+r)^t} + \frac{Par\ Value}{(1+r)^T}$$

⚠ Unless otherwise specified, assume a bond makes semiannual coupon payments. The discount rate (or **yield to maturity**) and coupon rate will *always* be quoted at an annual rate, which requires you to adjust accordingly to match the period.

Semiannual Coupons

EXAMPLE: What is the value of an 8% coupon bond that matures in 30 years with a par value of $1,000? Assume we discount our cash flows at a **yield** of 10% annually.

SOLUTION: We assume there are 30 × 2 = 60 semiannual periods, and the interest payment will be (8% × 1000) ÷ 2 = $40 every six months. By the bond pricing formula, we have[1]:

$$Bond\ Value = \sum_{t=1}^{60} \frac{\$40}{(1+.05)^t} + \frac{\$1000}{(1+.05)^{60}} = 810.71$$

The bond has a value of $810.71.

We can obtain the value in a financial calculator:

Calculator Key	Input/Output
2ND → CLR TVM	
N	30 years × 2 semiannual periods = 60
I/Y	10% annual rate ÷ 2 semiannual periods = 5
PV	**< CPT > -$810.71**
PMT	(8% × 1000) ÷ 2 semiannual periods = 40
FV	1000

INTERPRETATION: Notice the calculator displays the bond price as a negative. This implies that the investor would *pay* (a cash outflow) of $810.71 to *receive* the coupon payments and principal (cash inflows).

Visit the Excel File *Bond Price Calculator* at josephfarizo.com/fin366.html to compute the price (and yield to maturity) on a bond with your chosen inputs.

Accrued Interest and Invoice Prices

If a bond is purchased between coupon payments, the buyer of the bond must pay the seller for **accrued interest**, or the prorated share of the upcoming payment. The **invoice price**, sometimes referred to as the **dirty price**, is the price the investor pays, the sum of the bond value and the accrued interest.

$$Accrued\ Interest = \left[Per\ Period\ Coupon \times \frac{Days\ since\ last\ payment}{Days\ between\ payments}\right]$$

$$Invoice\ Price = Bond\ Value + Accrued\ Interest$$

The "bond value" portion is often referred to as the **clean price**. We assume there are 182 days between coupon payments on semiannual coupon bonds. Thus, the second term of the accrued interest formula represents the percentage of time that has passed since the last coupon.

Bonds are quoted in the financial press as the present value of the principal and coupon payments, not at their *invoice price*. The investor must determine the price they pay based on the timing of their purchase and the quoted bond price.

EXAMPLE: What is the invoice price of a 6% coupon bond with a $5,000 par issued 20 years ago with 5 years to maturity, assuming a yield of 4% if the last coupon payment was made 3 weeks ago?

SOLUTION: First, we obtain the bond's value, the clean price:

Calculator Key	Input/Output
2ND → CLR TVM	
N	10
I/Y	2
PV	**< CPT > -$5449.13**
PMT	150
FV	5000

Then, we determine the accrued interest portion:

$$Accrued\ Interest = \left[\frac{300}{2} \times \frac{21}{182}\right] = 17.31$$

The invoice price or the dirty price of the bond is the sum of the two values above, or 5449.13 + 17.31 = $5,466.44.

INTERPRETATION: The investor would need to pay a price of $5,466.44 to the seller of the bond.

Other Coupon Intervals

While a vast majority of corporate bonds pay semiannual coupons, there may be special cases where bonds have different coupon payment intervals specified in the indenture.

EXAMPLE: Below are examples of different bonds and the necessary inputs to obtain their prices:

Calculator Key	Input/Output		
	2ND → CLR TVM		
	\$10,000 par 4% coupon 6% yield Quarterly payments 10 years to maturity	\$5,000 par 8% coupon 5% yield Monthly payments 10 years to maturity	\$100,000 par 5% coupon 5% yield Annual payments 10 years to maturity
N	40	120	10
I/Y	1.5	0.41667	5
PV	**<CPT> -\$8,504.21**	**<CPT> -\$6,178.52**	**<CPT> -\$100,000**
PMT	100	33.3333	5000
FV	10000	5000	100000

INTERPRETATION: These three examples showcase three types of bonds:

1. **Premium Bonds** have a price > par and a coupon rate > yield.
2. **Discount Bonds** have a price < par and a coupon rate < yield.
3. **At Par Bonds** have a price = par and a coupon rate = yield.

BOND YIELDS

Yield to Maturity and Current Yields

Given the price of a bond and its series of coupon payments, we can determine the bond's **yield** or **yield to maturity**, which is the *annual* discount rate that equates the present value of the bond and its price. From the bond pricing formula, it is the discount rate r. It is the average compound rate of return over the life of the bond, assuming you purchase the bond at its price and reinvest all coupon payments at that same yield.

A related measure is the bond's **current yield**, which is simply the annual coupon divided by the bond's clean price.

$$Current\ Yield = \frac{Annual\ Coupon}{Bond\ Value}$$

In the calculator, you must input the price as a negative in order to compute a yield.

EXAMPLE: To compute each bond's yield to maturity, we need to remember to adjust the value the calculator produces by the appropriate number of periods to express the yield to maturity as an annual rate.

Calculator Key	Input/Output		
	2ND → CLR TVM		
	\$20,000 par 6% coupon Semiannual payments Price = \$19,850 15 years to maturity	\$50,000 par 5% coupon Quarterly payments Price = \$51,299 8 years to maturity	\$1,000 par 6% coupon Weekly payments Price = \$1,000 5 years to maturity
N	30	32	260
I/Y	**<CPT> 3.0385**	**<CPT> 1.1525**	**<CPT> 0.1154**
PV	-19850	-51299	-1000
PMT	600	625	1.1538
FV	20000	50000	1000
	Yield to Maturity		
Annualized I/Y	**6.0769%**	**4.6098%**	**6.0000%**
	Current Yield		
Ann.Coup / Pr.	**6.0453%**	**4.8734%**	**6.0000%**

INTERPRETATION: We are always careful to express the YTM and the current yields as annual rates. We can now expand our premium and discount bond definitions:

1. **Premium Bonds**: price > par and CR > CY > YTM.
2. **Discount Bonds**: price < par and CR < CY < YTM.
3. **At Par Bonds**: price = par and CR=CY=YTM.

Remember to always express the CR, CY, and YTM as *annual* rates.

Yield to Call and Yield to Worst

Callable bonds allow the bond issuer (the borrowing firm) to repay the bonds early by paying a bond's **call price** to the holder. **Call provisions** are disclosed in the bond's indenture. Firms often do this to pay off debt early and reissue at lower rates when interest rates are falling. Thus, bondholders, all else equal, do not prefer call features. Borrowing firms must therefore offer higher yields on callable debt to entice lenders to buy these bonds.

The **Yield to Call** (**YTC**) is the bond's yield assuming it is called early at the call price. Bonds may have multiple call dates. The **Yield to Worst** (**YTW**) is the lowest possible YTC that can be received on a bond if the bond is called at the earliest possible call date permitted in the bond's indenture. The YTC and YTW can be the same if there is only one call date remaining. Like the YTM, YTC and YTW are presented as annual rates.

EXAMPLE: Assume we have a $1,000 30-year 9% coupon bond, with 20 years to maturity, but a call date 5 years from today at a call price of $1,050. What is the YTW and YTM if the bond has a clean price of $1,098.66?

Calculator Key	Input/Output	
	2ND → CLR TVM	
	$1,000 par 9% coupon Semiannual payments Price = $1,098.66	$1,000 par 9% coupon Semiannual payments Price = $1,098.66
N	10	40
I/Y	**<CPT> 3.7222**	**<CPT> 4.0014**
PV	-1,098.66	-1,098.66
PMT	45	45
FV	1050	1000
	YTC = YTW	YTM
Annualized I/Y	**7.4444%**	**8.0029%**

INTERPRETATION: Notice the coupon payment is still computed as a percentage of par, but the FV and N inputs change to reflect the different terms of the call feature. The YTC is the same as the YTW in this case.

BOND HOLDING PERIOD RETURNS

Investors may also wish to determine the **holding period return** associated with buying and selling bonds prior to maturity. As before, the HPR will account for the income and capital gains associated with the investment. If yields or prevailing interest rates change, the bond price changes as well.

$$HPR = \frac{Interest\ Income + Bond\ Price_{New} - Bond\ Price_{Old}}{Bond\ Price_{Old}}$$

Note that we make significant simplifying assumptions here (i.e., coupons are the end of the holding period with no reinvestment or taxes).

PRACTICE: An investor purchases an 8% coupon, 30-year, \$1,000 bond making semiannual payments at a yield of 6% with 30 years to maturity. They hold this security for 3 years and sell when yields are 5%.

SOLUTION: To find the HPR, we compute the bond's beginning and ending price as well as the sum of the coupons received:

Calculator Key	Input/Output	
2ND → CLR TVM		
	Purchase	Sale
N	60	54
I/Y	3	2.5
PV	**<CPT> 1276.76**	**<CPT> 1441.85**
PMT	40	40
FV	1000	1000

And to obtain the HPR:

$$HPR = \frac{(\qquad\qquad) + (\qquad\qquad - \qquad\qquad)}{(\qquad\qquad)} = 31.72\%$$

INTERPRETATION: This investor's return was approximately 31.72% given they bought and sold this bond prior to its maturity. Notice this differs from the coupon rate and other yields.

Visit the Excel File *Yields and Returns* at josephfarizo.com/fin366.html to compute the different yields and returns with various coupon periods.

BOND CHARACTERISTICS, MARKETS, AND YIELDS

THE RELATIONSHIP BETWEEN PRICES AND YIELDS

Bond prices and yields are inversely related: as investors pay more for a bond, the yield to holding the bond falls. Yields are established by the market.

Companies issue bonds at prevailing market rates. That is, if interest rates in the economy are such that investors expect a 7% return, then companies will issue their new bonds with a coupon around 7%. Over time, interest rates change, but previously issued bonds' coupons remain the same. Therefore, the prices that investors are willing to pay for the bond in the secondary market will fluctuate such that the overall yield, which takes into account both coupon *and* price, is similar to what the prevailing interest rate is in the economy.

Bonds of similar risk and structure (time to maturity, callability, etc.) will have prices established by supply and demand in markets such that they yield about the same, regardless of the coupon rate.

Similarly, in bond valuation the *yield* or *yield to maturity* used in the bond valuation computation is a *prevailing market rate*. That is, we discount a bond's coupon and par value based on the current rate that other similar and newly issued bonds are currently yielding. In this way, it represents an opportunity cost.

Four key factors that affect yields include:

1. **Interest Rate Risk**: the probability that interest rates in the economy can rise (fall) which reduces (increases) the price of the bond.

2. **Credit or Default Risk**: as the probability of firm default rises, the firm must pay higher yields (through paying higher coupons or issuing at a discount from par, or both) to compensate investors for the risk.

3. **Liquidity Risk**: bond trading generally occurs over the counter rather than on exchanges, and can be subject to high bid-ask spreads.

4. **Inflation Risk**: given corporate bonds pay a fixed coupon rate, the value of these payments falls as inflation rises.

We can obtain current and historical bond yields for corporate and government issuers on the St. Louis FED's FRED website: https://fred.stlouisfed.org/. The existing rates give us estimates of appropriate discount rates to use in our bond valuation computations.

Figure 1: Aaa and Baa Corporate Bond Yields from FRED

Duration, Convexity, and Immunization

Bond **duration**, sometimes referred to as **Macaulay's duration**, is the effective maturity of a bond. That is, it is the weighted average of the times to each coupon or principal payment, with the weights related to the proportion of the total value of the bond accounted for by the payment.

EXAMPLE: Assume you observe three corporate bonds, each with 20 years to maturity and a price equal to par of $1,000:

- Bond A: 3% coupon
- Bond B: 5% coupon
- Bond C: 8% coupon

Although the investor receives the principal in 20 years, they also receive payments every 6 months. Thus, we can think of the bond as having "mini-maturities" every six months. By the formula for duration, these bonds' durations would be:

- Bond A: 15.182 years
- Bond B: 12.865 years
- Bond C: 10.292 years

These duration measures tell us that it is *as if* the bond holder has been repaid their investments in approximately 15, 12, and 10 years, respectively.

A lower coupon or longer time to maturity increases bond duration, all else equal. Zero coupon bonds have a duration that matches their time to maturity.

Duration is important for **immunizing** portfolios from interest rate risk. It entails duration matching the timing of asset inflows with liability outflows to protect from overexposure to interest rate changes. This is common in the insurance industry, where insurers may match the duration of the bonds they invest in with the timing of expected insurance claims.

Bond **convexity** describes the curvature of the price-yield relationship in bonds. It is a desirable trait for bond investors.

Bond **convexity** implies that an increase in a bond's yield results in a smaller price change than a decrease in a bond's yield of the same magnitude.

Interest Rate Sensitivity

We can now characterize **interest rate risk**, or the degree to which bond values change when interest rates in the economy change.

1. *Convexity*: An increase in a bond's yield results in a smaller price change than a decrease in yield of equal magnitude.

2. *Time to Maturity and Duration*: Prices of long-duration and long-term bonds are more sensitive to interest rate changes than prices of short-duration and short-term bonds.

3. *Sensitivity to Maturity*: While interest rate risk increases with time to maturity, it does so at a decreasing rate. For example, a 30-year bond experiences a price change of *less than double* that of a 15-year bond if interest rates change.

4. *Coupons*: Prices of low coupon bonds are more sensitive to interest rate changes than prices of high coupon bonds.

BOND FEATURES AND THEIR EFFECTS ON YIELDS

Recall that bonds have numerous features defined in their indenture that characterize their risk. In general, those provisions that result in greater risk to the bond holder may mean that the bond investor requires that the firm offer those bonds at a greater yield.

Table 1: Bond Features

Term	Definition	Effect on Bond's Yield
Convertible Bonds	Bonds that can be converted into a predetermined number of shares of the issuing company's stock at the bondholder's discretion.	Typically lower yields due to the added value of the conversion option.
Callable	Bonds that can be redeemed by the issuer before their maturity date at a specified call price.	Higher yields to compensate for the call risk.
Debenture and **Secured Bonds**	**Debentures** are unsecured bonds backed only by the creditworthiness and reputation of the issuer while **secured bonds** are backed by collateral.	Debentures offer higher yields compared to secured bonds due to higher risk.
Puttable	Bonds that can be sold back to the issuer at a predetermined price before maturity, at the holder's option.	Lower yields due to the added security and flexibility for the holder.

Extendable Bonds	Bonds where the holder has the option to extend the maturity date beyond the original schedule.	Lower yields due to the added flexibility of extending maturity.
Credit Ratings	Assessments provided by credit rating agencies which evaluate the creditworthiness of the issuer. **Moody's**, **S&P**, and **Fitch** are the three primary credit rating agencies[2]	Higher ratings typically lead to lower yields given the decreased risk, and vice versa.
Investment Grade and **Speculative Grade**	Bonds rated by credit agencies as having a lower risk of default are termed **investment grade**, while higher risk bonds are **speculative grade**.	Investment grade yields are generally lower, speculative grade yields are generally higher.
Collateral	Assets pledged by a borrower to secure a bond or loan which can be seized by the lender if the borrower defaults.	Collateral reduces risk, leading to lower yields.
Protective Covenants	Clauses in a bond contract requiring the issuer to adhere to certain conditions to protect the interests of bondholders. • **Negative covenants** prohibit certain firm actions, such as high dividend payout ratios, issuing of new debt, or pledging collateral to another lender. • **Positive covenants** require certain actions, such as maintaining certain levels of net working capital or preserving collateral.	Enhance bond safety, potentially leading to lower yields.
Seniority	The order of priority in which bondholders are repaid in the event of an issuer bankruptcy. • **Senior** debt holders are paid before **junior** or **subordinate** debt holders.	Higher seniority results in lower yield due to lower risk.
Sinking Funds	An account managed by the **trustee** (financial institution) into which the borrowing firm can make payments to retire portions of the debt early. The trustee can, on behalf of the firm, purchase the bonds from holders that wish to get the par value back early and retire the bonds.	Can lower yields due to reduced risk of non-payment at maturity.

BOND MARKETS

Bond and fixed income markets (including corporate and government debt) are larger than equity markets. In 2022, $1.4 trillion of corporate debt was issued while equity issuance totaled $100 billion, and the global market value of debt outstanding is $129.8 trillion relative to an equity market cap of $101.2 trillion. Yet, the market value of corporate debt outstanding in the US was $10.2 trillion while the market value of equity in the US was $64 trillion.

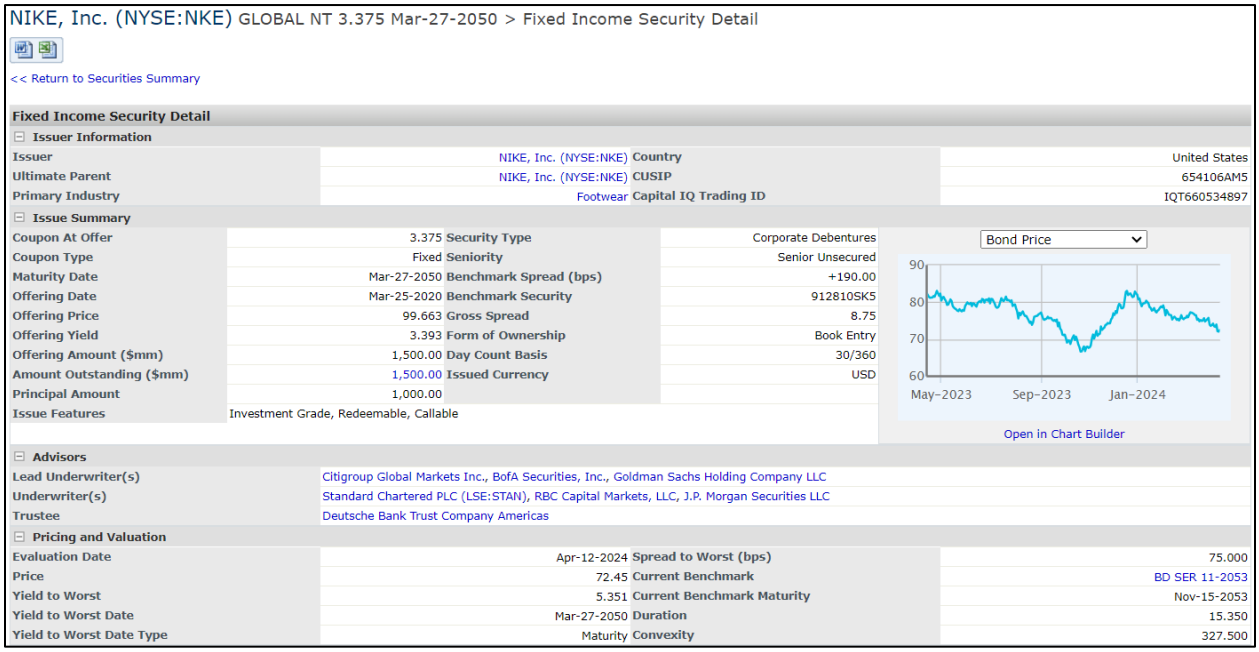
The Securities Industry and Financial Markets Association (SIFMA) Capital Markets Factbook provides these and many more summary statistics on markets.

Most individual or retail investors hold shares of corporate debt through bond or asset allocation mutual funds rather than directly, given the higher denomination of corporate debt and lower liquidity relative to equities. Bonds are often traded **over the counter** directly among dealers, and may have prices that are privately negotiated between the parties.

Bond quotes, detail, and trading information are available at S&P NetAdvantage and at FINRA's Bond Center.

While most firms only offer one share class of equity, firms usually have several bonds with varying maturities and coupon rates established at the time of their issuance.

Figure 2: Bond Quote (S&P NetAdvantage)



NIKE, Inc. (NYSE:NKE) GLOBAL NT 3.375 Mar-27-2050 > Fixed Income Security Detail

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Fixed Income Security Detail

Issuer Information

Issuer	NIKE, Inc. (NYSE:NKE)	Country	United States
Ultimate Parent	NIKE, Inc. (NYSE:NKE)	CUSIP	654106AM5
Primary Industry	Footwear	Capital IQ Trading ID	IQT660534897

Issue Summary

Coupon At Offer	3.375	Security Type	Corporate Debentures
Coupon Type	Fixed	Seniority	Senior Unsecured
Maturity Date	Mar-27-2050	Benchmark Spread (bps)	+190.00
Offering Date	Mar-25-2020	Benchmark Security	912810SK5
Offering Price	99.663	Gross Spread	8.75
Offering Yield	3.393	Form of Ownership	Book Entry
Offering Amount ($mm)	1,500.00	Day Count Basis	30/360
Amount Outstanding ($mm)	1,500.00	Issued Currency	USD
Principal Amount	1,000.00		
Issue Features	Investment Grade, Redeemable, Callable		

Bond Price

Open in Chart Builder

Advisors

Lead Underwriter(s)	Citigroup Global Markets Inc., BofA Securities, Inc., Goldman Sachs Holding Company LLC
Underwriter(s)	Standard Chartered PLC (LSE:STAN), RBC Capital Markets, LLC, J.P. Morgan Securities LLC
Trustee	Deutsche Bank Trust Company Americas

Pricing and Valuation

Evaluation Date	Apr-12-2024	Spread to Worst (bps)	75.000
Price	72.45	Current Benchmark	BD SER 11-2053
Yield to Worst	5.351	Current Benchmark Maturity	Nov-15-2053
Yield to Worst Date	Mar-27-2050	Duration	15.350
Yield to Worst Date Type	Maturity	Convexity	327.500

The Yield Curve

The **Treasury Yield Curve** shows the yields of Treasury securities with varying times to maturity. An upward sloping, or **normal**, yield curve occurs when the yields on longer-term securities are greater than yields on shorter-term securities. A downward sloping, or **inverted**, yield curve occurs when the yields on shorter-term securities are greater than longer-term securities.

The yield curve has inverted before *every recession since the 1950s*, though some of these inversions may have been coincidental.

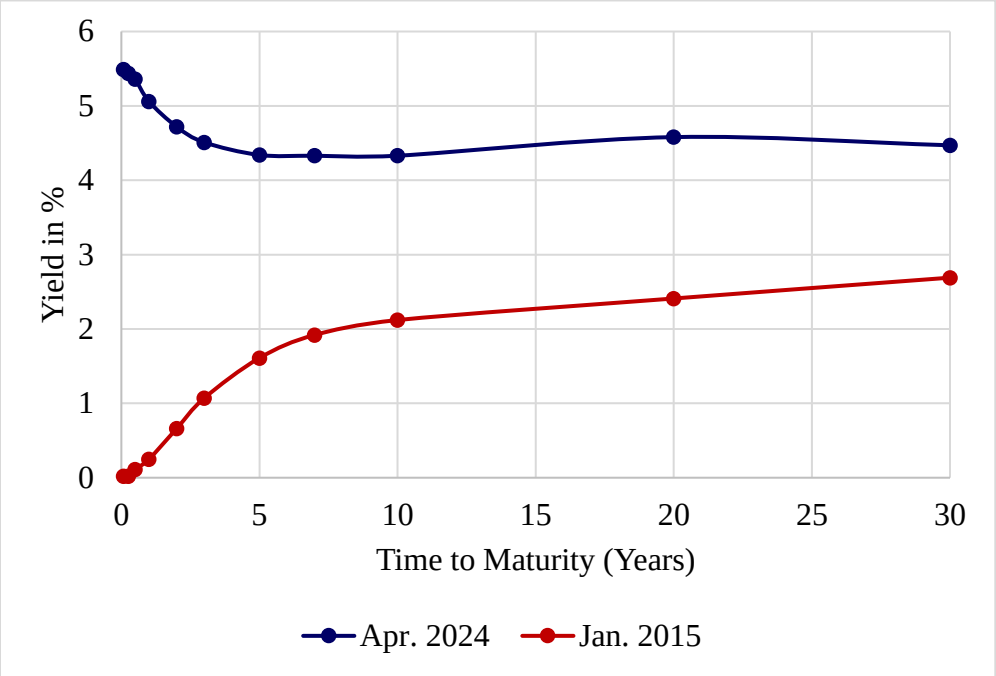
Fed policy generally establishes shorter-term rates. Investor supply and demand establishes longer term rates in response to Fed action. A positive (negative) **10-2 Spread**, the difference between what 10-year and 2-year Treasuries are yielding, tells us if the yield curve is normal (inverted).

Example: Investors bid on various maturities of Treasury bonds based on their expectations for future interest rates, inflation, and economic conditions, which creates the shape of the yield curve.

Normal yield curve: Investors demand higher yields of (and are thus willing to pay less for) longer-term bonds, expecting higher risks with increasing maturity length. They would rather hold shorter term debt and "roll over" the debt when it matures at suspected higher rates in the future.

Inverted yield curve: Investors expect lower future interest rates perhaps in response to an economic slowdown, leading them to bid up the prices (and reduce yields) on longer-term debt to lock in rates for a longer period of time.

Figure 3: Treasury Yield Curve (Source: treasury.gov)



CRITICAL THINKING QUESTIONS

1. What drives changes in bond prices through time?
2. If the FED raises interest rates, what happens to the value of existing bonds. What if the FED lowers interest rates? Why?
3. If the FED raises interest rates, what do we expect will happen to the coupon payments that new bonds pay?
4. For what type of firm (and in what type of market conditions) is it advantageous for an investor to exercise their option to convert a convertible bond?
5. In what interest rate environment is a callable bond more likely to be called?
6. In what interest rate environment is it advantageous for an investor to demand early repayment on a puttable bond? When should they extend an extendable bond?
7. What will the price of a bond be if the coupon rate is the same as the bond's yield to maturity?
8. When would we expect a bond's coupon rate to be the same as the YTM?
9. Everything else held constant (EEHC), would you expect higher or lower coupons offered on a firm's convertible bonds or non-convertible bonds? Why?
10. EEHC, would you expect a firm's callable bond to be issued with higher or lower coupons than its non-callable bonds?
11. EEHC, is a bond's price higher or lower if coupons are higher? What if the discount rate is higher? The par value?
12. Why do bond prices fall when interest rates rise? Don't investors want to receive high interest rates?
13. Two firms want to issue bonds in the primary market to raise money. Both firms will issue senior unsecured callable debentures with 5% coupons, 30 years to maturity, and a $1,000 par value. However, one of these firms is AAA rated while the other is BBB rated. What will the BBB rated company need to do in order for it to attract investors and sell these bonds in the primary market?
14. If a bond sells at $900 and its par is $1000, is this a premium or discount bond? What if it sells for $1100 and its par is $1000? Why would a bond sell below or above par in the first place?
15. Why do we use yields of other similar and newly-issued bonds if we want to determine what the value of another bond is today?
16. If a bond has a coupon rate of 9% and a YTM of 10%, is this a premium or discount bond? What if its coupon rate is 11% and the YTM is 10%?
17. Would it make more sense for you to calculate the yield to call on a callable bond you hold if you expect interest rates will rise or if you expect interest rates to fall?
18. If prevailing interest rates change, what happens to the coupon rate of previously issued bonds? What likely happens to the coupon rates of newly issued bonds?
19. You hold a 4% coupon bond maturing in 10 years. You notice that interest rates are beginning to rise. What does this mean for your coupon payments and bond value?
20. How would you answer a client who asks, "This corporate bond I hold is locked into paying me 7% coupons. I get $70 a year for the next 30 years, as well as $1,000 at maturity. Why should I care what happens to prevailing markets rates? How does this affect me and my bond?"

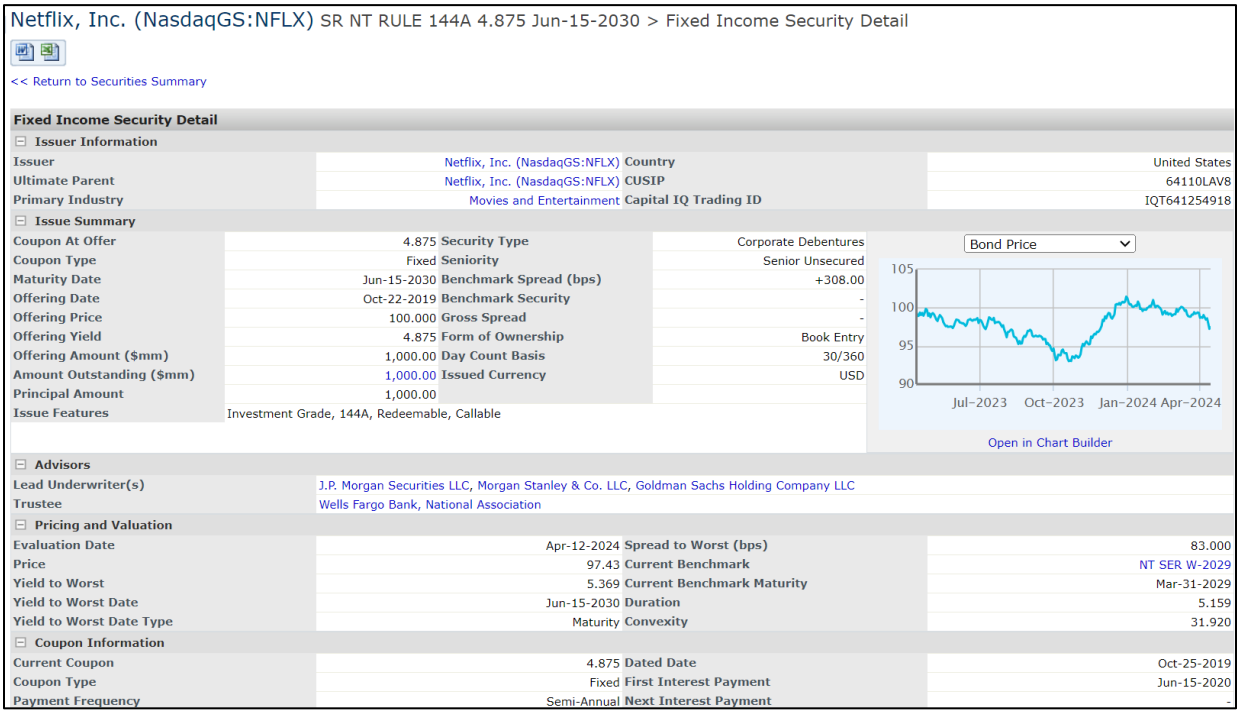
21. Everything else held constant which of the bonds in each of these pairs would you expect to be offered at a lower price, assuming they all pay no coupons? (Hint: if a zero coupon bond is offered at a lower price, is its yield higher or lower relative to a zero coupon offered at a higher price?)
    a. Senior vs. Subordinate
    b. Debenture vs. Collateralized
    c. Speculative vs. Investment Grade
22. For each pair below, choose which one you think is more likely to have the higher credit rating, everything else held constant:
    a. A firm with leverage significantly above the industry average vs. a firm with leverage significantly below the industry average
    b. A subordinate debt issue vs. a senior debt issue
    c. A secured vs. an unsecured bond issue
    d. An investment grade vs. a speculative grade bond
23. Would you rather be an equity holder or a subordinated debt holder of a firm in the event of that firm's liquidation following bankruptcy?
24. You predict interest rates are about to fall significantly. Which type of bond, in terms of its coupon rate and time to maturity, would be best to hold prior to the interest rate change (assuming you want a high capital gain on your bond?)
25. Are there generally cash flows sent to the bondholder at a bond's duration? *Can* there be a cash flows to the bondholder at the time of a bond's duration?
26. What would doubling a bond's time to maturity mean for its sensitivity to interest rates?
27. Why do we care to calculate a bond's "effective maturity" given the indenture tell us when it matures?
28. What is the goal of duration matching? In what instances would it be useful? What types of firms might find it useful?
29. CHALLENGE In March of 2023, Silicon Valley Bank (SVB) collapsed. This was the largest bank failure since the 2008 financial crisis. Interestingly, SVB largely held safe medium- and longer-term government securities. Yet interest rates rose while their clients increasingly withdrew their money from their accounts. Explain how this resulted in a collapse, using what you know about interest rate risk, immunization, and duration.
30. CHALLENGE Explain the intuition behind why a coupon bond that sells above par has a YTM less than its coupon rate. Explain the intuition behind why a coupon bond that sells below par has a YTM greater than its coupon rate.
31. CHALLENGE "**Spread trades" on the yield curve** involve purchasing a treasury with one maturity while shorting a treasury with a different maturity in order to make a profit. Assume the yield curve is currently "normal" and you expect it to flatten. What type of treasuries will you buy and which type of treasuries will you sell? Assume the yield curve is currently "inverted" and you expect it to become "normal". Which type of treasuries will you buy and which type of treasuries will you sell?

ANALYTICAL QUESTIONS

1. You collect data on two corporate bonds and summarize their characteristics in the table below. Given these characteristics, identify which features help to explain why Bond A has a lower coupon rate than Bond B. Which features appear to contradict why Bond A has a lower coupon than Bond B? Explain.

	Bond A	Bond B
Coupon	8%	12%
Collateral	Firm land and property	None
Callable	Not callable	In 10 years
Convertible	Yes: 20 shares per bond	No
Extendable	Extendable for 3 years	May not be extended
Credit Rating	BBB+	AA
Senior/Subordinate	Senior	Subordinate
Sinking Fund	Yes	No

2. Use the figure below to answer the questions that follow. Note that bonds are quoted as a percentage of par, i.e., if the bond's price is 101.3 and the bond's par is $1,000, the bond costs $1,013. Assume there is no accrued interest in this example.



Netflix, Inc. (NasdaqGS:NFLX) SR NT RULE 144A 4.875 Jun-15-2030 > Fixed Income Security Detail

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Fixed Income Security Detail

Issuer Information

Issuer	Netflix, Inc. (NasdaqGS:NFLX)	Country	United States
Ultimate Parent	Netflix, Inc. (NasdaqGS:NFLX)	CUSIP	64110LAV8
Primary Industry	Movies and Entertainment	Capital IQ Trading ID	IQT641254918

Issue Summary

Coupon At Offer	4.875	Security Type	Corporate Debentures
Coupon Type	Fixed	Seniority	Senior Unsecured
Maturity Date	Jun-15-2030	Benchmark Spread (bps)	+308.00
Offering Date	Oct-22-2019	Benchmark Security	-
Offering Price	100.000	Gross Spread	-
Offering Yield	4.875	Form of Ownership	Book Entry
Offering Amount ($mm)	1,000.00	Day Count Basis	30/360
Amount Outstanding ($mm)	1,000.00	Issued Currency	USD
Principal Amount	1,000.00		
Issue Features	Investment Grade, 144A, Redeemable, Callable		

Bond Price

105 100 95 90

Jul-2023 Oct-2023 Jan-2024 Apr-2024

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Advisors

Lead Underwriter(s)	J.P. Morgan Securities LLC, Morgan Stanley & Co. LLC, Goldman Sachs Holding Company LLC
Trustee	Wells Fargo Bank, National Association

Pricing and Valuation

Evaluation Date	Apr-12-2024	Spread to Worst (bps)	83.000
Price	97.43	Current Benchmark	NT SER W-2029
Yield to Worst	5.369	Current Benchmark Maturity	Mar-31-2029
Yield to Worst Date	Jun-15-2030	Duration	5.159
Yield to Worst Date Type	Maturity	Convexity	31.920

Coupon Information

Current Coupon	4.875	Dated Date	Oct-25-2019
Coupon Type	Fixed	First Interest Payment	Jun-15-2020
Payment Frequency	Semi-Annual	Next Interest Payment	-

   a. What is this bond's price and coupon payment? Maturity date?
   b. What is its current yield?
   c. What is its effective maturity?
   d. Is this bond backed by collateral?

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e. Is this subordinate debt?
f. Since January 2024, have yields been generally rising or falling?
g. From October 2023 to January 2024, have yields generally been rising or falling?
h. What is the average annual rate of return on this bond if you buy it at its current price and hold it until it is called at the earliest possible date? Explain why this is the same as the YTM in this example.

CFA QUESTIONS

Answers are in the *Notes & References* section below.[3]

1. An investor can do which of the following to increase the expected return of their fixed-income portfolio?
    a. Hold bonds with lower credit ratings
    b. Hold shorter term bonds when the yield curve is normal
    c. Hold bonds without call provisions
2. If interest rates rise 2%, a previously issued fixed-coupon bond's price
    a. Will fall by a smaller magnitude than its price would rise if interest rates fell by 2%
    b. Will fall by a greater magnitude than its price would rise if interest rates fell by 2%
    c. Would not change because the bond pays fixed coupons
3. Assume that the Japanese government issues two non-callable fixed-coupon bonds on the same date with the same coupon rate. The bonds are identical except that one matures in 10 years and the other matures in 30 years. If the relevant market discount rates for both bonds rise by 0.65%, which of the following will be true?
    a. The 10-year bond will have a larger percentage price change than the 30-year bond.
    b. The 10-year bond will have a smaller percentage price change than the 30-year bond.
    c. The 10-year bond and the 30-year bond will have equal percentage price changes.
4. A non-callable fixed-coupon bond with a maturity in 10 years and a face value of 100 is issued with an annual coupon rate of 2.8% when the applicable market discount rate is also 2.8%. The price of this bond at issuance is:
    a. Less than 100
    b. Exactly 100
    c. More than 100
5. A non-callable fixed-coupon bond with a maturity in 10 years and a face value of 100 has an annual coupon rate of 2.8%, while the market discount rate is 4.0%. The price of this bond at issuance is:
    a. Less than 100
    b. Exactly 100
    c. More than 100
6. A non-callable, fixed-coupon bond has a price of 106.0625 and a YTM of 2.8%. If the YTM were to increase instantaneously by 0.80%, the price of the bond would decrease by 11%. If the YTM were to decrease instantaneously by 0.80%, the price of the bond would increase by:
    a. Less than 11%
    b. Exactly 11%
    c. More than 11%
7. A fixed-income analyst is pricing a bond using the following equation:

$$PV = \frac{3}{(1+0.0275)^1} + \frac{3}{(1+0.0275)^2} + \ldots + \frac{103}{(1+0.0275)^{40}}$$

The bond's price relative to par is most likely

a. Greater than 100
b. Exactly 100
c. Less than 100

8. A four-year, 2.0% semiannual coupon bond that pays coupons semiannually is trading at a price of 102.581. The bond's annualized yield-to-maturity is closest to:
    a. 0.67%
    b. 1.34%
    c. 2.22%

NOTES & REFERENCES

[1] By the present value of an annuity formula, we know that

$$\sum_{t=1}^{60} \frac{\$40}{(1+.05)^t} = PMT \times \frac{1-\left(\frac{1}{(1+r)^t}\right)}{r} = 40 \times \frac{1-\left(\frac{1}{(1+0.05)^{60}}\right)}{0.05} = 757.17$$

We add the present value of the coupon payments to the present value of the par value received at the end:

$$Bond\ Value = 757.17 + \frac{\$1000}{(1+.05)^{60}} = 757.17 + 53.54 = \$810.71$$

[2] Credit rating agencies have slightly different scoring systems. They arrive at scores by estimating the ability of the borrowing firm to repay principal and interest using ratio analysis (in particular, leverage and interest coverage), and by assessing economic and market risk.

Investment grade	Moody's	Standard & Poor's	Fitch
	Aaa	AAA	AAA
	Aa1	AA+	AA+
	Aa2	AA	AA
	Aa3	AA-	AA-
	A1	A+	A+
	A2	A	A
	A3	A-	A-
	Baa1	BBB+	BBB+
	Baa2	BBB	BBB
	Baa3	BBB-	BBB-
Non-investment-grade (speculative grade or "junk")			
	Ba1	BB+	BB+
	Ba2	BB	BB
	Ba3	BB-	BB-
	B1	B+	B+
	B2	B	B
	B3	B-	B-
	Caa1	CCC+	CCC+
	Caa2	CCC	CCC
	Caa3	CCC-	CCC-
	Ca	CC	CC
At or near default			
	C	C	C
		D	D

[3] CFA Question answers: 1)A, 2)A, 3)B, 4)B, 5)A, 6)C, 7)A, 8)B