UNIVERSITY OF RICHMOND
Robins School of Business™

§13. BOND YIELDS AND VALUATION

FIN 366: INVESTMENTS

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PRE-CLASS READING

Recall that a **corporate bond** is a security that requires 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 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.

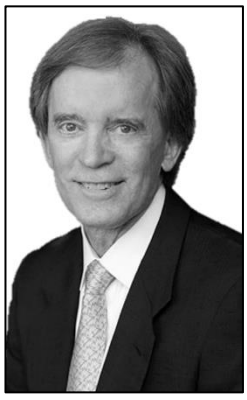
To determine what a bond *yields*, an investor can compute the bond's **yield to maturity** – the average annual rate of return one earns if they pay the bond's price and collect all coupon payments and the par value at maturity. This yield is established by the price investors are willing to pay for the bond. A bond's yield is higher when it has higher risk as investors demand a higher return to compensate for the higher risk. To determine the price of a bond, the investor discounts the **coupon payments** and **par value** to the present using market yields as the discount rate.

The **yield curve** shows the yields that U.S. government debt of varying maturities currently offers. A **normal** yield curve is when short term rates are lower than long term rates. The yield curve often **inverts** when bond investors sell out of short-term debt (causing prices to *fall* and yields to *rise*) and buy into longer-term debt (bidding up prices and causing yields to *fall*). This is because investors want to lock-in longer term "safe haven" debt payments in expectation that the Fed may lower short-term rates in the near future to combat an economic slowdown. As such, **yield curve inversions** have been powerful predictors of recessions.

Bond **duration** is an important way to characterize the overall interest rate sensitivity of a bond. It is important that bond investors understand the duration of their bonds and appropriately match the duration of their assets and liabilities.

INVESTOR PROFILE: BILL GROSS

Bill Gross (1944–) is the cofounder of Pacific Investment Management Company (Pimco). Now under the Allianz brand, Pimco is one of the largest investment management firms in the world, with over $2 trillion in assets under management. He was known as the "Bond King" for his exceptional performance as the manager of Pimco's Total Return fund, growing the fund to over $293 billion at its peak.



Gross read Ed Thorp's *Beat the Dealer* book on gambling and blackjack and found some success implementing his strategies in Vegas. He used the $10,000 he earned from gambling to pay for some of his Business School tuition at UCLA following his service in Vietnam. (Eventually, Gross and Thorp would become friends). He worked in the fixed income department at the insurance company Pacific Mutual after graduating. His role entailed clipping bond coupons to mail to the bond issuer to receive the coupon payments. At the time, there was little market for *trading* bonds, but Gross was inspired to try his hand at it, founding Pimco as an investing arm within Pacific Management. His approach to active bond management was

innovative at the time. His strategies, in part, took advantage of generally falling bond yields (therefore rising bond prices) from the late 1980s through the early 2010s.

He wrote colorful newsletters to his investors discussing interest rates and outlooks for the economy, but also discussed his time as a Naval officer, Michael Jackson songs, his body fat percentage, and his disdain for auto-flushing toilets. In 2014, Gross left Pimco after 43 years in a messy breakup to join Janus Capital Group. *Pensions & Investments* reports that investors withdrew nearly $290 billion from PIMCO in the year following his departure, though earlier declines in part led to his leaving the firm. He was not able to replicate his success at Janus, where his Global Unconstrained Bond Fund only returned 0.3% per year, and ranked below 90% of other similar bond funds. He retired from Janus in 2019. He now resides in coastal California where he ran into legal trouble for blasting the *Gilligan's Island* theme song on repeat to annoy his neighbors after they reported him to the city for violating an ordinance regarding art installations in his backyard.[1]

Visit *Articles and Readings* at josephfarizo.com/fin366.html for additional pre-class required readings.

BOND YIELDS

YIELD TO MATURITY

Recall the basic structure of a corporate bond: a firm borrows by issuing a bond to a lender, or bondholder, and collects a dollar amount at issuance. Over a fixed term, the borrowing firm pays interest payments, or _____, to the bondholder. At the bond's _____, the firm pays the _____ or _____ value, usually with the final coupon payment to the bondholder. Given bonds, like stocks, have an active secondary market, the bondholder at any time does not need to necessarily be the original lender.

EXAMPLE: A bond investor purchases three corporate bonds: (1) Nextpower Inc., (2) Echostar Corp., (3) Hecla Co., paying $19,850, $51,299, and $1,000, respectively, for each. What is the investor's yield on each of these three bonds? What is the current yield on each bond? The characteristics of the bonds are summarized in the table below.

SOLUTION: Recall the yield, or _____ (YTM) is the average compound rate of return over the life of the bond, assuming you purchase the bond at its price, all coupon payments are made, and all coupon payments are reinvested at that same yield. The _____ (CY) is the bond's annual coupon divided by its price.

We are careful to recognize that coupon rates, YTM, and CY are *always* expressed in *annual* terms.

In the calculator, input the price as a negative in order to compute a yield. The PMT should be the per-period payment. Yields are annualized.

Bond	(1) Nextpower	(2) Echostar	(3) Hecla
Bond Characteristics	$20,000 par 6% coupon Semiannual payments Price = $19,850 30-year bond 15 years to maturity	$50,000 par 5% coupon Quarterly payments Price = $51,299 30-year bond 8 years to maturity	$1,000 par 6% coupon Weekly payments Price = $1,000 30-year bond 5 years to maturity
Calculator Key	Input/Output		
	2ND → CLR TVM		
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%**

What if the investor instead paid \$100 more for the Nextpower bond (\$19,950 instead of \$19,850)? Their yield would be _____, which is lower than the original 6.0769% yield.

INTERPRETATION: Unlike stocks, bonds have fixed payment schedules and maturities that allow investors to compute their anticipated returns. Bonds are therefore often discussed in terms of what they are *yielding*.

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 investors buying and selling bonds (supply and demand).

If bond yields fall, investors have *bought* bonds. If bond yields *rise*, investors have *sold* bonds.

Companies issue bonds at prevailing market rates. That is, if a company's previously issued bonds are yielding 7% in markets, it implies investors are willing to pay some price such that their bonds yield them 7%. 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%.

Bonds of similar risk and structure will have prices established by supply and demand in markets such that they yield about the same, regardless of the coupon rate.

Over time, interest rates change due to economic conditions and Fed policy, 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.

A firm's cost of debt in their WACC should be the expected yield of new debt they issue.

Components of Yield

All else equal, investors demand that bonds of greater risk offer higher yields. That is, investors are willing to pay lower prices for higher perceived levels of risk. If a bond's _____, the legal document outlining the bond's contract between issuer and lender, indicates the bond has features favorable to the lender, it reduces risk.

Table 1: Bond Features

Feature	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.	Decreases
Callable	Bonds that can be repaid by the issuer before their maturity date at a specified **call price**.	Increases
Puttable	Bonds that can be sold back to the issuer at a predetermined price before maturity, at the holder's option.	Decreases
Extendable Bonds	Bonds where the holder has the option to extend the maturity date beyond the original schedule.	Decreases
Debenture	Unsecured bonds backed only by the creditworthiness and reputation of the issuer (most corporate debt).	Increases
Secured	Bonds backed by collateral.	Decreases
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.	Decreases
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.	Decreases

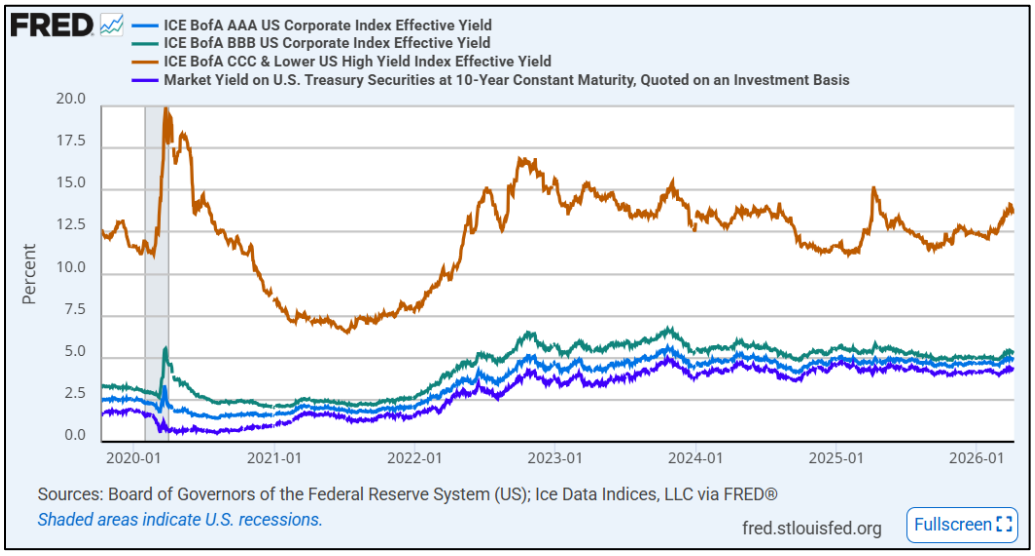
Credit Ratings	Assessments provided by credit rating agencies which evaluate the creditworthiness of the issuer. **Moody's**, **S&P**, and **Fitch** are the three primary credit rating agencies.	Decreases
	Investment Grade: Relatively lower risk of default.	Decreases
	Speculative Grade: Relatively higher risk of default.	Increases

Credit ratings agencies assess creditworthiness by looking at a firm's interest coverage (ability to pay interest expense with its earnings), leverage, cash flow, and firm/industry outlook.

Figure 1: Credit Ratings

Credit Risk	Moody's	Standard & Poor's	Fitch
Investment Grade			
Highest quality	Aaa	AAA	AAA
High quality	Aa	AA	AA
Upper medium grade	A	A	A
Medium grade	Baa	BBB	BBB
Below Investment Grade			
Lower medium grade	Ba	BB	BB
Low grade (speculative)	B	B	B
Poor quality (may default)	Caa	CCC	CCC
Most speculative	Ca	CC	CC
No interest being paid or bankruptcy petition filed	C	C	C
In default	C	D	D

Figure 2: Corporate Bond Yields from FRED (https://fred.stlouisfed.org/)



THE YIELD CURVE

The _____ shows the yields of Treasury securities with varying times to maturity. An upward sloping, or _____, yield curve occurs when the yields on longer-term securities are greater than yields on shorter-term securities. A downward sloping, or _____, 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 (and not every inversion precedes a recession).

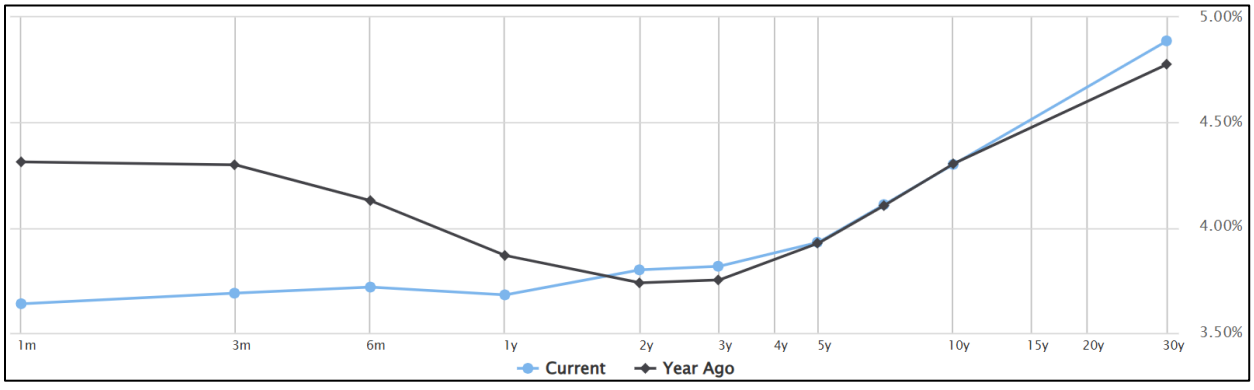
Fed policy generally establishes shorter-term rates. Investor supply and demand establishes longer term rates in response to Fed action. A positive (negative) _____, the difference between what 10-year and 2-year Treasuries are yielding, tells us if the yield curve is normal (inverted).

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: Yield Curve, April 2026
(Source: https://www.wsj.com/market-data/bonds)



YIELD TO CALL AND YIELD TO WORST

Callable debt is attractive for bond issuers: it gives them an option to pay off debt early and reissue bonds at lower rates when interest rates in the economy are falling. Thus, bond investors, all else equal, do not prefer callable bonds. Borrowing firms must therefore offer higher yields on their callable debt relative to non-callable debt to entice lenders to buy these bonds.

The _____ (YTC) is the bond's yield assuming it is called early at the call price. If bonds may have multiple call dates, the _____ (YTW) is the lowest possible return an investor can expect from a bond under its various maturity and call dates.

Most municipal and corporate debt is callable. Treasury bonds, notes, and bills are not callable.

EXAMPLE: What is a bond's YTM, YTC, and YTW assuming it has two call dates as summarized in the table below?

SOLUTION: To determine a bond's YTC, replace the time to maturity and future value with the time until the call date and the call price, respectively. The YTW will be the lowest possible yield of the various yields you compute.

Bond	Maturity	First Call Date	Second Call Date
Bond Characteristics	$50,000 par 5% coupons Semiannual payments Price = $54,000 30-year bond		
Maturity/Call	Maturity: 30 years	Call Date: 5 years at $51,500	Call Date: 10 years at $50,750
Calculator Key	Input/Output		
	2ND → CLR TVM		
N	60	10	20
I/Y	**<CPT> 2.2554**	**<CPT> 1.8899**	**<CPT> 2.0688**
PV	-54000	-54000	-54000
PMT	1250	1250	1250
FV	50000	51500	50750
	YTM	YTC	YTC
Yield	**4.5108%**	**3.7797%**	**4.1376%**

INTERPRETATION: The bond's YTW is the *worst* yield possible among the YTM and possible YTCs, in this case the first call date, at 3.7797%.

BOND PRICES

What *should* an investor pay for a bond? Recall the value of a bond is the present value of coupon payments plus the present value of the par value paid at maturity.

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

The appropriate discount rate to use in a bond price calculation is the prevailing yields (the rate investors demand) on other similar bonds.

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 10% annually. Assume the bond has (1) annual, (2) semiannual, and (3) monthly 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 periods.

SOLUTION: We are sure to adjust our N, I/Y and PMT to reflect the appropriate number of periods:

Calculator Key	Input/Output		
2ND → CLR TVM			
	Annual Payments	Semiannual Payments	Monthly Payments
N	30	60	360
I/Y	10% annual rate ÷ 1 annual period = 10	10% annual rate ÷ 2 semiannual periods = 5	10% annual rate ÷ 12 monthly periods = 0.833
PV	**<CPT> -811.46**	**<CPT> -810.71**	**<CPT> -810.08**
PMT	8% × $1,000 ÷ 1	8% × $1,000 ÷ 2	8% × $1,000 ÷ 12
FV	$1,000	$1,000	$1,000

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

The discount rate we chose must have been the *prevailing yields on bonds at the time*. Revisit the earlier figure showing bond yields of various types of corporate debt. What credit rating do you expect this bond to have?

The intuition is that you should be willing to pay a price for a bond such that the price you pay appropriately reflects the bond's risk.

PREMIUM, DISCOUNT, AND AT PAR BONDS

Usually, a corporate bond coupon is fixed. Investors may demand a higher *yield* if the market rate in the economy is higher than a bond's stated coupon – that is, they may wish to pay a lower price than par such that their *overall return* matches that of the rate in the economy.

_____

price > par and CR > CY > YTM

_____

price < par and CR < CY < YTM

_____

price = par and CR=CY=YTM

To reemphasize, *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.

- Bonds with high coupons may sell at a premium and reduce yields to market rates.
- Bonds with low coupons may sell at a discount and increase yields to market rates.

INTEREST RATE RISK: DURATION AND CONVEXITY

Interest rate risk is the risk that a bond's value falls when market interest rates rise. All else equal, the longer the time to maturity, the more sensitive a bond is to rising interest rates. Bond _____ is the "effective" maturity of a bond. 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. Longer duration implies greater interest rate risk.

EXAMPLE: Assume you identify the four bonds below, each with 20 years to maturity and a price equal to par of $1,000. While they have different coupons, the bonds are otherwise identical.

- Bond A: 0% coupon
- Bond B: 3% coupon
- Bond C: 5% coupon
- Bond D: 8% coupon

The investor receives the principal in 20 years, but they also receive payments every 6 months for bonds B, C, and D. We can think of the bond as having "mini-maturities" every six months. By a formula for duration, these bonds' durations would be:

- Bond A: 20 years
- Bond B: 15.182 years
- Bond C: 12.865 years
- Bond D: 10.292 years

These duration measures tell us that it is *as if* the bond holder has been repaid their investments in approximately 20, 15, 12, and 10 years, respectively.

In this example, Bonds A is most susceptible to interest rate risk because of its longest duration, while Bonds B, C, and D are progressively less susceptible to interest rate risk given their shorter durations.

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 _____ 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.

A famous case of the importance of immunizing bond portfolios is Silicon Valley Bank's failure in 2023. At the time, SVB was the 16th largest bank in the US, and this was the largest bank failure since the 2008 financial crisis.

SVB's depositors tended to be tech startups and venture firms that required short term access to cash. SVB, however, invested their deposits in long-term government bonds – safe from default, but riskier due to their long durations. When the Fed raised rates in 2022 to combat inflation, SVB's long-duration bond portfolio lost significant value (prices fall as rates rise!), such that it needed to sell bonds at a significant loss when depositors attempted to withdraw. Depositors were paid, but SVB shareholders lost everything.

The lesson: the duration of the bank's liabilities (short term deposits) should have been matched with the duration of its assets (shorter term government bonds).

Bond _____ describes the curvature of the price-yield relationship in bonds. 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.

EXAMPLE: You buy a 2-year 10% *annual* coupon bond priced at par = $1,000. Therefore, its yield is 10%.

- If interest rates rise 1% to 11%, the value is: $982.87 (-$17.13 from par)
- If interest rates fall 1% to 9%, the value is: $1,017.59 (+$17.59 from par)

This is desirable for bond investors! It implies you stand to gain more than you stand to lose in the event of an equal change in interest rate magnitude.

IN CONCLUSION

Bond yields, duration, and convexity are essential measures that govern how a bond's value will respond to changes in interest rates. Bond investors should consider each of these in constructing fixed income portfolios, being particularly mindful to interest rate risk and how to protect their portfolio against it.

CRITICAL THINKING & CONCEPTUAL QUESTIONS

1. Explain how supply and demand (and the buying and selling) of bonds establishes their yields.
2. If the interest rates in the economy rise, what happens to the value of existing bonds? What if the interest rates fall? Why?
3. If the interest rates rise, what do we expect will happen to the coupon payments that new bonds pay? What about the coupon payments of already issued bonds?
4. In what interest rate environment is a callable bond more likely to be called?
5. What will the price of a bond be if the coupon rate is exactly the same as the bond's yield to maturity?
6. Explain why a bond's coupon rate may be the same as the yield to maturity at issuance, and why this is known as "issuing at par."
7. Everything else held constant, would you expect a firm's callable bond to be issued with higher or lower coupons than its non-callable bonds?
8. Explain how different bond features, i.e., seniority, credit rating, collateral, etc., affect a bond's yield and why.
9. Explain the differences between YTM, YTC, and YTW.
10. Why do bond prices fall when interest rates rise? Don't investors *want* to receive higher interest rates?
11. What warnings does a negative 10-2 spread imply about the economy? Why?
12. Two firms want to issue bonds in the primary market to raise money. Both firms will issue bonds 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?
13. 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?
14. 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?
15. 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%?
16. 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?
17. 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?
18. 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?"
19. Explain bond duration and bond portfolio immunization. Why is this important in banking and in insurance?
20. 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.

ANALYTICAL QUESTIONS

Royal Caribbean Cruises Ltd. (NYSE: RCL) has a "BBB" credit rating. Among its debt, it has the following active issuances:

- Maturing in 2033 with a 4.75% coupon and a YTW of 5.48%
- Maturing in 2038 with a 5.25% coupon and a YTW of 5.57%

Answer the following questions:

1. Explain why the coupons on these debt issuances are different while the YTW is similar (Hint: think about when the bonds were issued).
2. Revisit the corporate bond yields present in Figure 2 of these lecture notes. Does RCL's YTW on these bonds make sense given the information in the figure?
3. How does this question relate to the statement presented above that "*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*"?
4. If you were to compute RCL's cost of debt for its WACC in a DCF analysis, explain why the bond's YTM or YTW is a better measure than its coupon.
5. If RCL comes to market today to issue new debt *at par*, what coupon rate do you think it would need to offer, and why? If they wanted to pay a coupon of 3%, would they need to offer their debt at par, at a discount, or at a premium?

CFA QUESTIONS

Answers are in the *Notes & References* section below.[2]

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. 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.
3. 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
4. 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
5. A fixed-income analyst is pricing a $100 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
6. A four-year, 2.0% coupon bond that pays coupons semiannually is trading at a price of $102.581 with a par of $100. The bond's annualized yield-to-maturity is closest to:
    a. 0.67%
    b. 1.34%
    c. 2.22%

NOTES & REFERENCES

[1] See https://www.wsj.com/articles/bill-gross-retiring-from-janus-11549287324, https://www.pionline.com/money-management/decade-after-bill-grosss-contentious-departure-pimco-team-he-assembled-continues, https://williamhgross.com/, https://www.wsj.com/articles/bill-gross-retiring-from-janus-11549287324, https://www.reuters.com/article/business/bill-gross-once-wall-streets-bond-king-retires-after-rocky-second-act-idUSKCN1PT19T/, *The Bond King* by Mary Childs.
[2] CFA Question answers: 1)A, 2)B, 3)B, 4)A, 5)A, 6)B