

Learning Module 12: Yield Based Bond Convexity and Portfolio Properties

Q.83 A corporate bond has the following characteristics:

Price: USD 106.50

Coupon rate: 5%

Duration: 7.5 years

Convexity: 101

If the credit spreads narrow by 175 basis points, then the price of the bond will be *closest to*:

A. USD 114.68.

B. USD 122.13.

C. USD 123.78.

The correct answer is **B**.

$$\begin{aligned}\% \Delta PV^{\text{full}} &\approx (-\text{AnnModDur} \times \Delta \text{Yield}) + \left(\frac{1}{2} \times \text{AnnConvexity} \times (\Delta \text{Yield}^2)\right) \\ &= (-7.5 \times (-0.0175)) + (1/2 \times 101 \times (-0.0175)^2) \\ &= 0.1313 + 0.0155 = 0.1468 = 14.68\% \\ \text{Price} &= 106.5 \times (1 + 0.1468) = 122.13\end{aligned}$$

The negative sign at the beginning recognizes the fact that bond prices and yields-to-maturity move inversely (as bond prices increase, bond yields fall).

Also, note that the change in yield is negative because the question tells us that credit spreads narrow by 175 basis points; that's a decrease (-)

CFA Level I, Fixed Income, Learning Module 12: Yield-Based Bond Convexity and Portfolio Properties. LOS 12a: calculate and interpret convexity and describe the convexity adjustment.

Q.969 Which of the following is *most likely* known as a positive amount on a traditional (option-free) fixed-rate bond for either an increase or a decrease in the yield?

- A. Modified Duration.
- B. Annualized convexity.
- C. Convexity Adjustment.

The correct answer is **C**.

Convexity adjustment refers to the positive amount on a traditional fixed-rate bond for either an increase or decrease in yield.

$$\begin{aligned}\% \Delta \text{Full price of a bond} = & (-\text{Annual Modified Duration} \times \Delta \text{Yield}) \\ & + \left(\frac{1}{2} \times \text{Annual Convexity} \times (\Delta \text{Yield})^2\right)\end{aligned}$$

As seen above, the convexity effect, the function after the addition sign, remains positive regardless of whether the change in yield is positive because the Δyield part of the convexity adjustment is squared. The square gets rid of the negative in the case of a decreased yield.

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Q.972 Calculate the expected percentage price gain (loss) from the following data:

- Reduction in yield-to-maturity: 20bps
- Annual modified duration: 23.657
- Annual convexity: 678.98

A. -4.60%.

B. 4.86%.

C. 4.59%.

The correct answer is **B**.

$$\begin{aligned}\% \Delta \text{Full price of a bond} &= (-\text{Annual Modified Duration} \times \Delta \text{Yield}) \\ &+ \left(\frac{1}{2} \times \text{Annual Convexity} \times (\Delta \text{Yield})^2\right)\end{aligned}$$

$$\text{Percentage change in full price} = [-23.657 \times (-0.002)] + \frac{1}{2} \times [678.98 \times (-0.002)^2] = 4.86\%$$

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Q.2148 For a given change in yields, the difference between the actual change in a bond's price and the predicted change in price using the duration measure will be greater for:

- A. A short-term bond.
- B. A bond with less convexity.
- C. A bond with greater convexity.

The correct answer is **C**.

Duration is a linear measure of the relationship between a bond's price and the yield. The true relationship is not linear as measured by convexity. When convexity is higher, duration will be less accurate in predicting a bond's price for a given change in interest rates.

Note: Short-term bonds generally have low convexity.

CFA Level I, Fixed Income, Learning Module 12: Yield-Based Bond Convexity and Portfolio Properties. LOS 12b: Calculate the percentage price change of a bond for a specified change in yield, given the bond's duration and convexity

Q.2155 A bond has a duration of 10.62 and a convexity of 91.46. For a 200 bps increase in yield, the bond's approximate percentage price change is *closest to*:

- A. -24.90%.
- B. -19.41%.
- C. -1.62%.

The correct answer is **B**.

$$\begin{aligned}\text{The estimated price change} &= -(\text{Duration}) \times (\text{Change in yield}) + \left(\frac{1}{2}\right) \times (\text{Convexity}) \times (\text{Change in } y) \\ &= -10.62 \times 0.02 + 0.5 \times 91.46 \times 0.02^2 = -19.41\%\end{aligned}$$

CFA Level I, Fixed Income, Learning Module 12: Yield-Based Bond Convexity and Portfolio Properties. LOS 12b: Calculate the percentage price change of a bond for a specified change in yield, given the bond's duration and convexity

Q.2157 The duration-only based estimate of the decrease in price resulting from an increase in yield is:

- A. Larger than the actual decrease, so it's also improved by a positive adjustment for convexity.
- B. Smaller than the actual decrease, so it's also improved by a positive adjustment for convexity.
- C. Larger than the actual decrease, so it's also improved by a negative adjustment for convexity.

The correct answer is **A**.

The convexity adjustment to the price change is the same for both an increase and a decrease in yield. The duration-only based estimate of the increase in price resulting from a decrease in yield is too low for a bond with positive convexity and is improved by a positive adjustment for convexity. The duration-only based estimate of the decrease in price resulting from an increase in yield is larger than the actual decrease, so it's also improved by a positive adjustment for convexity.

CFA Level I, Fixed Income, Learning Module 12: Yield-Based Bond Convexity and Portfolio Properties. LOS 12c: Calculate portfolio duration and convexity and explain the limitations of these measures

Q.2158 A 9% bond has a full price of \$905 and a YTM of 10%. What is the percentage change in the full price of the bond for a 30 basis point increase in YTM assuming the bond's modified duration is 9.42 and its convexity is 68.33?

- A. -2.83%.
- B. -2.80%.
- C. -2.65%.

The correct answer is **B**.

$$\text{Expected change in bond's price} = \frac{\delta P}{P} = -D_{\text{mod}} \times \Delta y + 0.5 \times C \times \Delta y^2$$

Where

D_{mod} = Modified Duration,

Δy = Change in Yield, and

C = Convexity Effect

$$\begin{aligned}\text{Duration effect} &= -D_{\text{mod}} \times \Delta y = -9.42 \times 0.003 = -0.02826 \\ \text{Convexity effect} &= 0.5 \times C \times \Delta y^2 = 0.5 \times 68.33 \times 0.003^2 = 0.000307\end{aligned}$$

Therefore,

$$\text{Expected change in bond's price} = (-0.02826 + 0.000307) = -2.79530\% \approx -2.80\%$$

CFA Level I, Fixed Income, Learning Module 12: Yield-Based Bond Convexity and Portfolio Properties. LOS 12b: Calculate the percentage price change of a bond for a specified change in yield, given the bond's duration and convexity

Q.2166 A bond valued at \$200,000 has a duration of 8 and a convexity of 20. Assuming that the bond's spread relative to the benchmark curve increases by 25 basis points due to a credit downgrade, then the approximate change in the bond's market value is *closest to*:

- A. -\$4,012.50.
- B. -\$3,988.32.
- C. -\$3,960.20.

The correct answer is **B**.

$$\text{Price Change} = ((-\text{Duration} \times \text{Yield change}) + (0.5 \times \text{Convexity} \times \text{Yield change}^2))$$

$$\text{Price change} = (-8 \times 0.0025) + (0.5 \times 20 \times 0.0025^2) = -1.99\%$$

The bond's value will fall by approximately $-1.99\% \times 200,000 = -\$3,988$.

CFA Level I, Fixed Income, Learning Module 12: Yield-Based Bond Convexity and Portfolio Properties. LOS 12c: Calculate portfolio duration and convexity and explain the limitations of these measures

Q.2167 Which of the following is *most likely not* a limitation of the portfolio duration measure?

- A. It assumes that the yield for all maturities changes by the same amount.
- B. It is subject to huge swings in value since book values may change over time.
- C. It is subject to huge swings in value since the market value may change over time.

The correct answer is **B**.

Bond duration is calculated using market values. Changes in book values are irrelevant.

There are two ways to calculate the duration of a bond portfolio: The weighted average of the time to receipt of aggregate cash flows and the weighted average of the durations of individual bonds that compose the portfolio. The major limitations include: The weighted average of the time to receipt of aggregate cash flows method can not be used for bonds with embedded options or floating rate notes due to uncertain future cash flows. The weighted average of the durations of individual bonds that compose the portfolio method assumes a parallel shift in the curve.

CFA Level I, Fixed Income, Learning Module 12: Yield-Based Bond Convexity and Portfolio Properties. LOS 12c: Calculate portfolio duration and convexity and explain the limitations of these measures

Q.3880 All else being equal, an investor will prefer a bond that is:

- A. Less convex.
- B. More convex.
- C. Less or more convex depending on the investor's overall portfolio.

The correct answer is **B**.

Convexity is a measure of the curvature, or the degree of the curve, in the relationship between bond prices and bond yields. If a bond's duration increases as yields increase, the bond is said to have negative convexity and if a bond's duration rises and yields fall, the bond is said to have positive convexity. All else being equal, investors seek convexity in bonds. In practice, convexity will make bonds trade at a premium when compared to less convex bonds.

CFA Level I, Fixed Income, Learning Module 12: Yield-Based Bond Convexity and Portfolio Properties. LOS 12a: calculate and interpret convexity and describe the convexity adjustment.

Q.3890 An expected change in a bond's price of -1.65% due to a change in yield to maturity (YTM) of 20 basis points creates a 0.02% change in the price of bond from the convexity effect. What is the *most likely* percentage contribution to the change in the bond's price owed to the duration effect?

- A. -0.0167.
- B. -0.0163.
- C. 0.0167.

The correct answer is **A**.

$$\begin{aligned}\text{Change in bond price} &= \text{Duration effect} + \text{Convexity effect} \\ \text{Duration effect} &= \text{Change in bond price} - \text{Convexity effect} \\ &= -1.65 - 0.02 = -1.67\%\end{aligned}$$

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