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Convexity

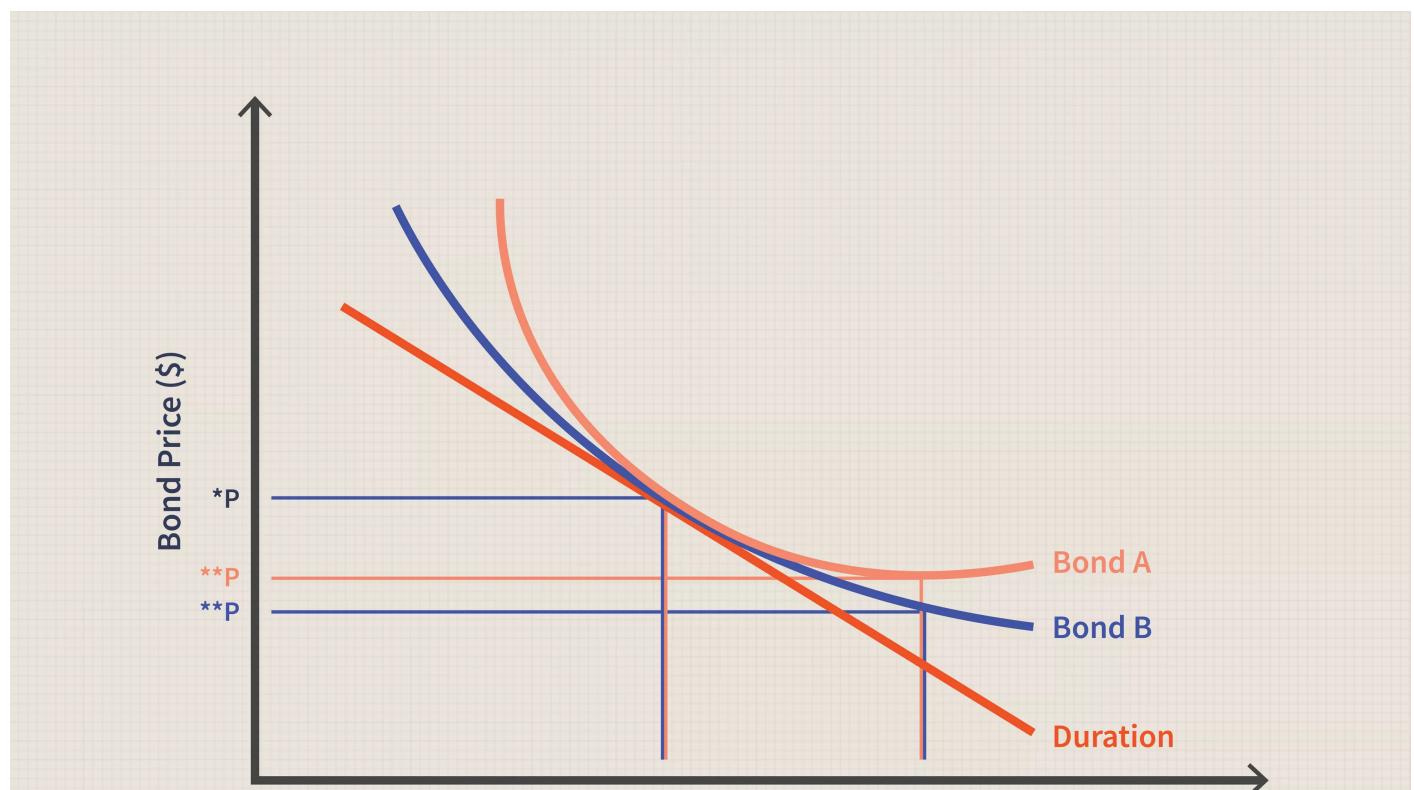
By [JAMES CHEN](#) | Updated Oct 14, 2019

What Is Convexity?

Convexity is a measure of the curvature, or the degree of the curve, in the relationship between bond prices and bond yields. Convexity demonstrates how the duration of a bond changes as the interest rate changes. Portfolio managers will use convexity as a risk-management tool, to measure and manage the portfolio's exposure to [interest rate risk](#).

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KEY TAKEAWAYS

- Convexity is a risk-management tool, used to measure and manage a portfolio's exposure to market risk.
- Convexity is a measure of the curvature in the relationship between bond prices and bond yields.
- Convexity demonstrates how the duration of a bond changes as the interest rate changes.
- If a bond's duration increases as yields increase, the bond is said to have negative convexity.
- If a bond's duration rises and yields fall, the bond is said to have positive convexity.



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Convexity Explained

Before explaining convexity, it's important to know how bond prices and market interest rates relate to one another. As interest rates fall, bond prices rise. Conversely, rising market interest rates lead to falling bond prices. This opposite reaction is because as rates rise, the bond may fall behind in the earnings they may offer a potential investor in comparison to other securities.

In the example figure shown above, Bond A has a higher convexity than Bond B, which indicates that all else being equal, Bond A will always have a higher price than Bond B as interest rates rise or fall.

The [bond yield](#) is the earnings or returns an investor can expect to make by buying and holding that particular security. The price of the bond depends on several characteristics including the [market interest rate](#) and can change regularly.

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How Market Interest Rates and Bond Yields Relate

As the market rates rise, new bonds coming on the market also have rising yields as they are issued at the new, higher rates. Also, as rates increase, investors demand a higher yield from the bonds they buy. Investors don't want a fixed-rate bond at current yields if they expect interest rates to rise in the future. As a result, when interest rates increase, the issuer of these debt vehicles must also raise their yields to remain competitive. However, as the interest rate climbs the price of bonds returning less than that rate will fall.

How Interest Rates and Bond Prices Relate

If an investor owns a fixed-rate bond that pays 2% and interest rates begin to rise above 2%, they may want to sell this lower paying security. The reason for the sell-off is that their existing rate is less attractive than the current market. Investors don't want to hold a bond that pays 2% if they can invest the same principle into one that pays a higher rate in the future. In a rising rate market, bondholders look to sell their existing bonds and opt for newly-issued bonds paying higher yields.

Because there is a glut of bonds at the lower rate on the market, the prices for these debt holdings will drop. Also, as bonds sell off and the price falls, the investor may wait for rates to stop rising before getting back in the bond market by buying the higher-yielding security. As a

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duration of a bond is high, it means the bond's price will move to a greater degree in the opposite direction of interest rates. Conversely, when this figure is low the debt instrument will show less movement.

Typically, if market rates rise by 1%, a one-year maturity bond price should decline by an equal 1%. However, for bonds with long-dated maturities, the reaction increases. In other words, if rates rise by 1%, bond prices fall by 1% for each year of maturity. For example, if rates rise by 1%, the two-year bond price would fall 2%, the three-year bond price by 3%, and the 10-year price by 10%.

Convexity and Risk

Convexity builds on the concept of duration by measuring the sensitivity of the duration of a bond as yields change. Convexity is a better [measure of interest rate risk](#), concerning bond duration. Where duration assumes that interest rates and bond prices have a linear relationship, convexity allows for other factors and produces a slope.

Duration can be a good measure of how bond prices may be affected due to small and sudden fluctuations in interest rates. However, the relationship between bond prices and yields is typically more sloped, or convex. Therefore, convexity is a better measure for assessing the impact on bond prices when there are large fluctuations in interest rates.

As convexity increases, the [systemic risk](#) to which the portfolio is exposed increases. The term systemic risk became common during the financial crisis of 2008 as the failure of one financial institution threatened others. However, this risk can apply to all businesses, industries, and the economy as a whole.

The risk to a fixed-income portfolio means that as interest rates rise, the existing fixed-rate instruments are not as attractive. As convexity decreases, the exposure to market interest rates decreases and the bond portfolio can be considered hedged. Typically, the higher the [coupon rate](#) or yield, the lower the convexity—or market risk—of a bond. This lessening of risk is because market rates would have to increase greatly to surpass the coupon on the bond, meaning there is less risk to the investor.

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fallen. Therefore, if a bond has negative convexity, its duration would increase—the price would fall. As interest rates rise, and the opposite is true.

If a bond's duration rises and yields fall, the bond is said to have positive convexity. In other words, as yields fall, bond prices rise by a greater rate—or duration—than if yields rose. Positive convexity leads to greater increases in bond prices. If a bond has positive convexity, it would typically experience larger price increases as yields fall, compared to price decreases when yields increase.

Under normal market conditions, the higher the coupon rate or yield, the lower a bond's degree of convexity. In other words, there's less risk to the investor when the bond has a high coupon or yield since market rates would have to increase significantly to surpass the bond's yield. So, a portfolio of bonds with high yields would have low convexity and subsequently, less risk of their existing yields becoming less attractive as interest rates rise.

Consequently, zero-coupon bonds have the highest degree of convexity because they do not offer any coupon payments. For investors looking to measure the convexity of a bond portfolio, it's best to speak to a financial advisor due to the complex nature and the number of variables involved in the calculation.

Real World Example of Convexity

Most [mortgage-backed securities \(MBS\)](#) will have negative convexity because their yield is typically higher than traditional bonds. As a result, it would take a significant rise in yields to make an existing holder of an MBS to have a lower yield, or less attractive, than the current market.

For example, the SPDR Barclays Capital Mortgage Backed Bond ETF ([MBG](#)) offers a yield of 3.33% as of March 26, 2019. If we compare the ETF's yield to the current 10-year Treasury yield, which trades at roughly 2.45%, interest rates would have to rise substantially, and well above 3.33% for the MBG ETF to have a risk of losing out on higher yields. In other words, the ETF has negative convexity because any rise in yields would have less impact on existing investors.

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expected future interest rate or yield. [more](#)

Price Value of a Basis Point (PVBP)

Price value of a basis point (PVBP) is a measure used to describe how a basis point change in yield affects the price of a bond. [more](#)

Yield to Maturity (YTM)

Yield to maturity (YTM) is the total return expected on a bond if the bond is held until maturity. [more](#)

Understanding Bonds and Interest Rate Risk

Interest rate risk is the danger that the value of a bond or other fixed-income investment will suffer as the result of a change in interest rates. [more](#)

Operation Twist

Operation twist is the name given to a Federal Reserve monetary policy operation that involves the purchase and sale of bonds. [more](#)

Duration Definition

Duration indicates the years it takes to receive a bond's true cost, weighing in the present value of all future coupon and principal payments. [more](#)

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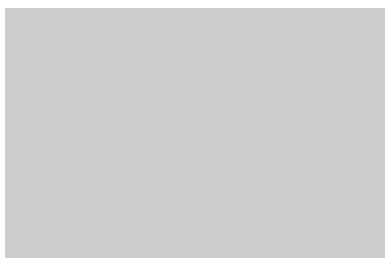
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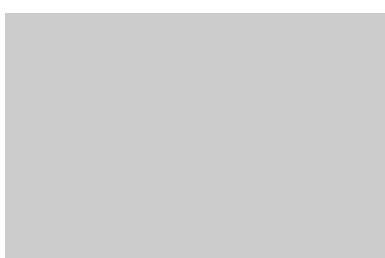
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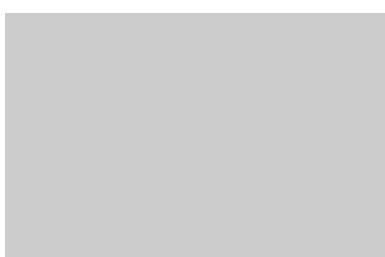
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