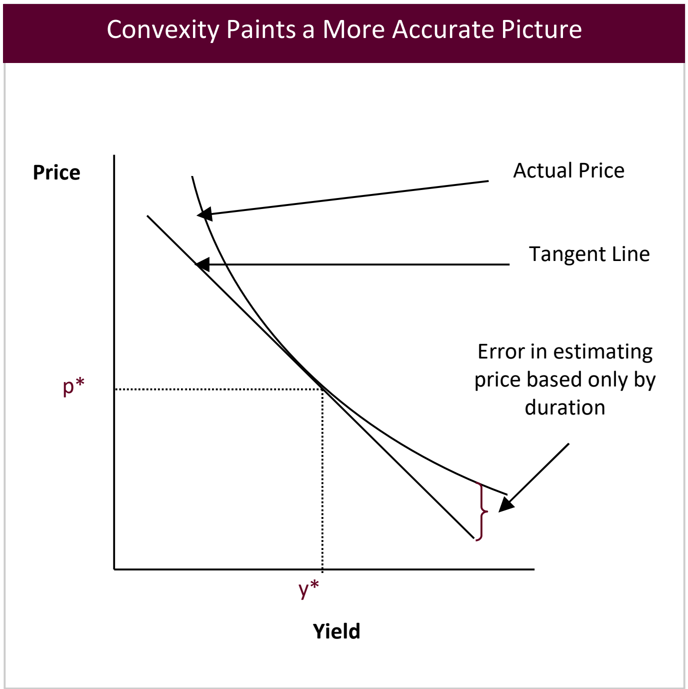
Convexity – Explained

Convexity

While duration is a close approximation of the price-yield relationship of a bond, convexity captures that relationship much more precisely. Convexity measures the rate of change of duration as yields change. Thus, convexity can help give a more precise estimate as to how a bond (or portfolio) will react to changes in interest rates.

Figure 1

The Price Yield Relationship of a Bond



In the illustration above (Figure 1), the straight line (tangent line) is a measure of duration. However, the curved line is a more accurate representation of the price-yield relationship. This deviation from the tangent line, or more simply, the change not explained by duration that is represented by the curved line, is known as convexity. As this line bends upward, its convexity (i.e., convex in shape) is positive. If the curve were bending downward, the convexity would be negative. Because of this curvature, a bond with a higher convexity will normally tend to have a higher price than a bond with lower convexity.

Regardless of whether interest rates rise or fall, the higher convex bond will perform better as the bond will enjoy more price appreciating in a falling interest rate environment and less price depreciation in a rising rate environment. Thus, it is advantageous to have the most positive convexity in a bond as possible.

Negative Convexity

Bonds that lack embedded options (i.e., no call or put provisions) will have positive convexity. For a positively convex bond, duration will always *overestimate* a bond's price drop *for a rise in interest rates* and it will *underestimate* a bond's price rise *for a drop in interest rates*. This is why duration is only accurate for small changes in yield.

However, some Treasury bonds, many corporate bonds, and most municipal bonds are callable. Callable bonds have negative convexity at certain price-yield combinations because of the embedded option. What you are giving up when you buy a callable bond is convexity. For example, as rates fall, the price of a bond that is immediately callable would not rise substantially above the call price since the likelihood of that bond being called will increase. An identical non-callable bond's price would have continued to rise. The effect of negative convexity on a bonds price is illustrated in Figure 2 below.

The point at which the price of the bond with the embedded option begins to diverge from an identical bond without the embedded option is when the bond begins to exhibit negative convexity. When a bond exhibits negative convexity, duration will always *overestimate* a price rise *for a drop in interest rates* and *underestimate* a bond's price drop *for a rise in interest rates*.

In Conclusion

Convexity is a more definitive measure of duration and understanding even the most basic characteristics of convexity will allow the bond investor to better comprehend the risk characteristics of a single bond or a portfolio of bonds. Duration and convexity are two of the most fundamental measures of volatility and risk associated with investing in fixed income securities.

Figure 2

Non-Callable and Callable Price Yield Relationship