Fixed Income Investing – Part XVII
Bond Duration

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Investors include bonds in a diversified portfolio to provide a predictable income stream with relatively low price variance. Bonds offer stability against more volatile assets such as equities and commodities; however, bonds are not without risk. Reinvestment, default and inflation risks are all key components to consider when investing in bonds, but interest-rate risk is arguably the most important factor which impacts the day-to-day pricing. This article explains bond duration, the impact it can have on the price of bonds, and simple strategies to take advantage of different situations.

What is bond duration?

As bond prices are inversely correlated to its yield (all else being equal, bond prices go up when the yield falls and vice-versa), this interest-rate risk can potentially cause large swings in the price of the bond. The degree to how much the price of a bond will change given a move in yield is called duration; bonds with higher durations will exhibit greater price sensitivity to interest rate changes than those with lower durations. Not to be confused with a bond's term-to-maturity (the length of time a bond has until it reaches its maturity date), duration is a key metric used by investors for risk management assessment.

Macaulay duration vs. Modified duration

There are two main measures of duration:

1. **Macaulay duration** calculates the weighted-average time, in years, that it would take a bondholder to receive all the cash flows (coupons and principal amount). As most bonds pay a periodic coupon rate, the weighted-average maturity of a bond is less than its term-to-maturity. The exceptions to this rule are zero-coupon bonds and stripped bonds, whose Macaulay duration is equal to its time until maturity.
2. **Modified duration** is an extension of Macaulay duration and is a truer measure of the price sensitivity of a bond, as it accounts for changes in the yield. For this reason, Modified duration is the more useful measure, as it gives a better representation of how the price of bonds will change given different interest rate scenarios.

   Please note: Similar to the term commonly used in finance, further mentions of "duration" in this article will be referring to "Modified duration."

Factors that influence duration

There are a few factors that impact a bond's particular duration. The most influential factors are:

Factor	Description
1. Maturity	The time until the bond matures has perhaps the largest impact on a bond's duration, with longer-dated bonds having a higher duration, and therefore, greater sensitivity to changes in yield. The duration of a bond will decrease when an interest payment has been made and also gradually decrease each day as it moves closer to maturity.
2. Coupon rate	A bond's coupon rate has an inverse relationship with its duration. So, a bond with a higher coupon would have a lower duration compared to a bond with a low coupon, all other terms being the same.
3. Yield to Maturity	The higher a bond's yield to maturity, the shorter its duration. Therefore, through the day as a bond's price changes, so does its yield to maturity and duration. Along with changes in interest rates as a whole, a corporate bond may also see a change in its yield due to a tightening or widening in its credit spread. This will impact its duration, too.

Price impact on bonds

Any bond price, regardless of its duration, will experience larger fluctuations when it's subject to increasing changes in yield. **Figure 1** shows an example of the extent to how much the price of bonds with different terms will fall, given several yield change scenarios. Investors of short-dated bonds will experience minimal impact, but the longer the term of the bond the greater the risk of seeing a pronounced price drop. The 30-year bond, which in this example has a duration of 19.7 years, would see its price fall significantly for even a 1% rise in yield. Changes in a bond's yield and price over the life of a bond is typical. So long as the bond is continually held until its maturity date, and provided it doesn't default, the investor will not experience any realized loss of principal from the par value.

The opposite also holds true for the price of bonds when yields fall. **Figure 2** highlights how much the price of bonds will increase for different levels of contractions in yield.

Figure 1 – Bond price changes given a rise in yield[1]

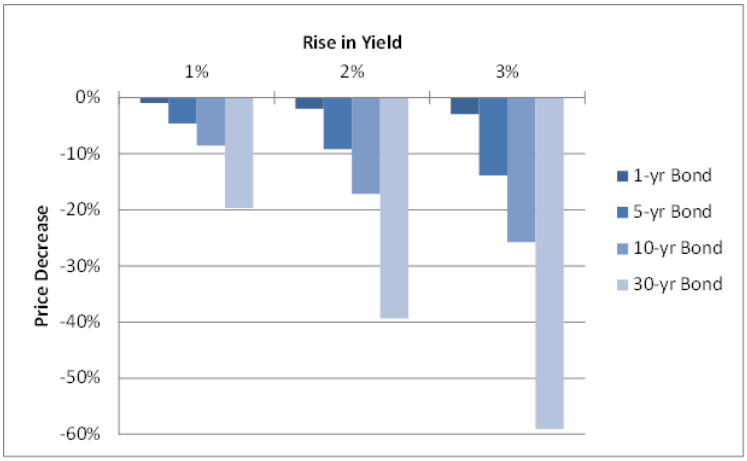
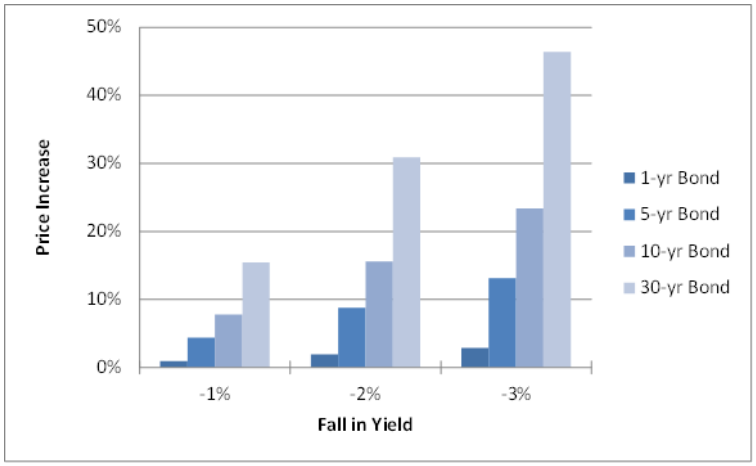


Figure 2 – Bond price changes given a fall in yield[1]



Limitations of duration

Like a lot of financial measurements, duration also has some assumptions and limitations in its application. The relationship between the price of a bond and its yield is non-linear; therefore, the duration of a bond provides only an approximation and is only accurate for small changes in yield.

When calculating the potential price change of bonds, duration assumes an immediate and parallel shift in the yield curve, which is unrealistic. The yield curve is a graphical illustration of bond yields across varying maturities with many independent variable; so factors influencing the yield of short-term bonds are different to

[1]The chart shows a hypothetical example using a bond with a 3% coupon trading at par and ignoring convexity.

those affecting long-term bonds. From the examples in Figure 1, it would be most unlikley that a bond's yield would rise by 1%, or more, instantly. By the time the yield could change by this magnitude, the bond will have accrued interest, which would partly offset the price loss caused by the yield change.

Strategies

Active fixed income investors can position themselves accordingly to take advantage or protect their portfolio due to changes in interest rates. In a world with foresight, when interest rates are expected to increase they would broadly reduce their overall duration to limit the interest-rate risk, while at the same time aim to earn a high coupon that can be re-invested at increasingly higher yields. This doesn't mean investors need to sell all existing positions and move into cash, but rather tweak the portfolio with the objective to increase the income earned per unit of duration.

If interest rates are forecast to fall, investors would look to increase their overall duration to benefit from rising bond prices. Again, wholesale changes are typically not required, more of an adjustment with the aim to have more capital tied up in the principal of the bond and to receive a lower amount of income per unit of duration.

Bond ETFs and duration

Exchange-traded Funds ("ETFs") are an excellent option for short-term, tactical decisions on duration. Many ETF providers conveniently list a fund's duration, along with other metrics, on their website, allowing investors to include this information when conducting research analysis. Either extending or shortening duration doesn't require the need to sell large positions of individual bonds, which can be costly. For example, reducing some longer-term exposure and buying a short-term bond ETF can have a significant impact on the overall portfolio's duration. ETFs that invest in floating rate securities, which closely adjust to the central bank policy rate and have a duration of close to zero, are a good option to make a large impact. Conversely, gaining exposure to longer-term Federal, provincial or corporate bond ETFs can quickly adjust the duration higher to increase sensitivity when rates are expected to decline.

Conclusion

Despite its limitations, assessing an individual bond's or bond portfolio's duration should be a key risk management consideration when investing. Over time, investors should regularly check the duration of their fixed income holdings to ensure it still aligns with their strategy. This is even more important when there has been a meaningful change in interest rates.

Please speak to your BMO financial professional if you have any questions about this article, or would like to discuss your fixed income investments.

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