Breckinridge CAPITAL ADVISORS

Duration 101

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Key Takeaways

- *Interest rate risk, the impact on bond prices from fluctuations in interest rates, is one of the primary risks associated with bonds. It accompanies such other risks as credit, event and liquidity risks, and can have a meaningful impact on the total return of a fixed income security.*
- *Interest rate risk is particularly top of mind now. In July 2023, the Federal Reserve (Fed) pushed the target federal funds rate to a range of 5.25 percent to 5.50 percent, the highest level in 22 years. Given interest rate increases over the past year and the inversion across the Treasury yield curve, investors are carefully assessing the duration of their bonds.*
- *While increasing interest rates have both good and bad elements for fixed income market participants, measuring the impact of rate changes on bond prices remains an important part of investment analysis for bondholders. In this piece, we clarify duration and its role in bond investing.*

Why Duration Matters

A bond is essentially a loan between two counterparties. The traditional bond structure includes a series of cash flows, such as coupon payments that occur before the bond matures, culminating with a maturity where the principal is fully repaid.

The time to maturity is certainly useful in assessing interest rate risk, as the farther into the future a bond matures, the more likely its value could be impacted by changing interest rates. However, maturity should not be viewed in isolation because it does not take into account either the timing of intermittent cash flows before the maturity date, or the potential changes to the ultimate principal repayment date. Timing must be incorporated into interest rate risk due to the time value of money: payments made over a bond's life can be reinvested, and reinvestment risk (the risk that the payments are reinvested at a less attractive rate) increases with time.

A bond's duration, which is used to measure a bond's sensitivity to interest rates, considers the timing of cash flows, providing a much better starting point to assess interest rate risk, relative to maturity. That said, while duration is an important concept for bond investors, we note that it is not a "one-and-done" solution for precisely capturing interest rate risk.

Types of Duration

Macaulay Duration

In 1938, Canadian economist Frederick R. Macaulay, in his book "The Movement of Interest Rates, Bond Yields and Stock Prices in the United States Since 1856," introduced one of the first attempts to codify interest rate risk. Macaulay Duration, as it became known, is the average number of years it will take to receive payments on a bond; importantly, this average is weighted by the capital recovered in each payment. As such, the purpose of Macaulay Duration is to calculate the average time horizon for an investment, rather than to measure price volatility resulting from interest rate fluctuations.

Modified Duration

Modified Duration adjusted the formula for Macaulay Duration to create a new, important calculation. It estimates the percent change in a bond's price for a 1 percent change in the bond's yield to maturity, which is the interest rate available in the market. For example, a bond portfolio with a Modified Duration of 4 years would be expected to gain or lose 4 percent of its market value (bond price) if the yield to maturity, or interest rate available in the market, were to move down or up by 1 percent (See Figure 1).

FIGURE 1:
DURATION EXAMPLE

Modified Duration	Change in Interest Rates	Change in Bond Price
4 years	Down 1%	Up 4%
4 years	Up 1%	Down 4%

Note: For illustrative purposes only. Actual results may fluctuate with market conditions and may vary. The changes in bond price calculated in Figure 1 are estimates and include an underlying assumption that the movement in interest rates occurs instantaneously and the changes in rates occur in a parallel shift across the yield curve. Including a convexity adjustment improves the accuracy of the estimate. The convexity adjustment is a mathematical adjustment to correct for the curvature of the price-yield relationship when estimating the percentage price change per change in yield.

Effective Duration

The drawback of Modified Duration is that it does not consider that interest rate movements can change a bond's cash flows. For example, the cash flows of bonds with optionality can change with the rise or fall of interest rates.

One example of bonds with optionality is callable bonds. The issuer of a callable bond can "call" the bond prior to maturity, thereby returning principal to the bondholder earlier than expected. This typically occurs when interest rates are falling and issuers are able to call bonds with higher coupons and reissue debt at the new, lower prevailing market interest rates.

To capture the sensitivity of bonds to changes in interest rates, while also factoring in a bond's call structure, market participants thus developed Effective Duration, or option-adjusted duration. The difference between the Modified and Effective Duration for option-free (i.e., non-callable) bonds is very small. However, for some bonds with optionality, the difference can be substantial.

Effective Duration has become an essential tool for assessing the interest rate risks of bonds with optionality, such as callable municipal bonds and mortgage-backed securities (MBS), where the timing of principal repayment is highly dependent on the level of interest rates.

While Effective Duration is a more complete measure of a bond's sensitivity to interest rate movements versus the Macauley or Modified Duration measures, it still falls short because it is a linear approximation for small changes in yield; that is, it assumes that duration stays the same along the yield curve. This isn't typically the case. For most bonds, as yields change, bond prices will become more, or less sensitive to yield changes. Therefore, Effective Duration becomes a less accurate estimation of price sensitivity to interest rates for larger changes in rates.

Duration as a Tool

When evaluating fixed income investments, understanding the type of duration used in portfolio reporting and the associated risks of duration is critical. As investors weigh options to manage rate volatility, we look forward to open dialogue with our clients about duration strategies and the relevance of duration to clients' goals and risk tolerance.

#BCAI-08242023-ihugslyj (8/30/2023)

FOOTNOTES:

1. Macauley Duration is calculated by summing up all the multiples of the present values of cash flows and corresponding time periods and then dividing the sum by the market bond price.
2. Modified Duration is calculated by dividing the Macaulay Duration by one plus the yield to maturity.
3. A bond's yield to maturity is the discount rate that equates a bond's price with the present value of the bond's future payments.
4. Optionality: bond features that can change the timing of principal repayment.
5. Effective Duration is calculated by summing up all the multiples of the present values of cash flows and corresponding time periods and then dividing the sum by the market bond price.