Duration's Effect on Fixed Income Portfolios

Duration

Duration is a key component in assessing a bond's risk. At its most basic form, duration measures the weighted average term-to-maturity of all income payments (interest as well as principal) from a single bond or a portfolio of bonds. Whereas maturity is a measure of the time for which a bond's principal is repaid, duration also incorporates the present value of interest payments. As a result, the value of a bond's duration will always be less than its average maturity. Zero-coupon bonds are the one exception to this (for zero coupon bonds, duration is equal to maturity) because they have no interest payments.

The term "duration" is often used loosely to describe the weighted average maturity of a bond. In actuality, there are several different and very specific forms of duration, each of which differs in how it accounts for factors such as interest rate changes, embedded options, or redemption features. For investors and their advisors, it is important to understand the subtle and important differences in duration types. The main types are Macaulay, Modified, Effective and Key-Rate Duration.

Macaulay Duration

Frederick Macaulay first introduced the concept of duration in his 1938 book -- based on a historical analysis of bond yields and interest rates. His newly devised numerical measure did not become commonly used until the 1970's. Known today as Macaulay duration, his notion of duration measured the weighted average maturity of a security's cash flows. Each of the weights is determined by the present value of a particular cash flow as a percentage of the bond's price. To clarify this concept, let's use an example of a 5-year bond with a 7% coupon. With semi-annual coupon payments, this bond will have 10 interest payments of $35 each and one final principal payment of $1,000.

Now assume (see Figure 1) that each coupon payment is represented by a container of the same size. And within each container is an amount of water representing the level of that coupon's present value. Because of the time value of money, a $35 coupon received six months from now is worth more than a $35 payment four years hence. Therefore, each successive container will have less water in it. The final container holds both the present value of the last coupon payment and the $1,000 principal. Macaulay's duration is simply the point along the timeline where a fulcrum will balance the cash-flows. Using this analogy, it's easy to understand why a zero-coupon bond's duration is equal to its maturity. With no coupon payments, the only water would be located in the last container.

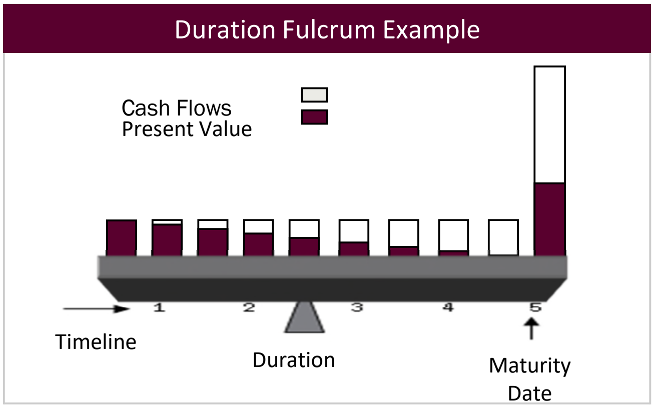

Figure 1
The Concept of Duration

Later on, as the field of finance and financial products became more sophisticated, a measurement was needed that could factor in a bond's sensitivity to changes in interest rates. Fluctuating interest rates will affect a bond's yield and thus its duration. A modification to Macaulay's formula was developed to allow for a close approximation of how much a bond's price changes for each percentage change in yield.

Modified Duration

A modified version of the Macaulay model is able to reflect how much a bond's price changes for each percentage change in yield. It allows us, with a single number, to quickly approximate a summary of a portfolio's sensitivity to changes in interest rates. For example, if a portfolio has a duration of 3.0 years, its value will decline about 3% for each 1% (100 basis points) rise in interest rates and it will rise about 3% for every 1% decline in interest rates. A portfolio with a duration of 3.0 is less risky than a portfolio having a duration of 5.0, which will decline approximately 5% in value for every 1% increase in interest rates.

Duration gives investors a method to compare bonds with different maturities and varying coupons. A bond paying a high coupon rate and having a high yield will tend to have a lower duration than a bond paying a lower coupon rate and lower yield. Using the water container example again, this simply means that the smaller containers will have more water in them, forcing the fulcrum to move to the left. The fulcrum visual is also useful in understanding why a portfolio composed entirely of 5-year notes is more volatile (higher duration) than a portfolio that is 50% invested in 10-year notes and 50% in cash.

Modified duration strictly measures duration for option-free bonds, where a bond's price and yield always move in opposite directions. Because modified duration is basically calculated by dividing Macaulay duration by one plus half the yield, the modified duration will always be numerically less than Macaulay duration.

Effective Duration

Cash flows from securities having redemption features or embedded options (such as callable bonds, capped floating rate instruments, mortgage-backed securities, etc.) will change when interest rates change. Effective duration is a more refined measure used to calculate duration for these types of bonds. Properly calculating the effective duration requires the use of binomial trees (too detailed to cover here) in order to compute a bond's option-adjusted spread (OAS).

Key Rate Duration

Traditional duration measures are calculated assuming there is a parallel shift in the yield curve and does not address the sensitivity of price to non-parallel shifts in the curve. In actuality, parts of the curve may flatten or invert while the remaining portions of the curve remain unaffected or even move in the opposite direction. To help determine a more accurate duration calculation for when this occurs, the key-rate duration was developed.

Key-rate duration reflects the sensitivity of a bond's (or portfolio's) price to changes of each single interest rate along the yield curve. It allows the duration of a portfolio to be calculated for a one basis point change in rates. This method is most often used for bond ladder portfolios (differing maturities) and for building effective portfolio hedging strategies.

Key-rate duration calculates the spot durations of each of the eleven "key" maturities (3-month, 1-, 2-, 3-, 5-, 7-, 10-, 15-, 20-, 25-, and 30-year) along the spot rate curve. While holding the yield for all other maturities constant, it allows duration to be calculated for a particular one basis point interest rate change. If all of these key-rate durations along the curve were totaled, the sum would equal the effective duration.

Duration is Not Perfect

We've acknowledged that the concept of duration helps to explain much of the price movement of a bond. However, as a tool for volatility measurement, it does have certain imperfections:

- Duration estimates are good only for small yield changes. Two bonds with the same duration may perform very differently for large changes in yield.
- Price changes which are caused by a change in credit quality spreads or fluctuating sector spreads are not part of the duration computation.
- Two portfolios which have equal durations may behave very differently in price because of changes in the shape of the yield curve.

Typically, a bond's duration is a positive number. However, some fixed income instruments, such as IO (interest-only) mortgage-backed securities, have negative durations. Negative duration can also be achieved by paying fixed for floating on an interest rate swap or by shorting fixed income instruments. (This is one of the reasons why RNC Genter chooses not to participate in the MBS or swaps markets.)

The Bottom Line

In summary, duration is an extremely helpful tool which allows financial professionals to quickly gauge the amount of potential risk a bond has with respect to its potential volatility. Actively managing a portfolio's duration is essential in reducing interest rate risk on a client's portfolio.