

[Academic Script] [Bond Management (part-2)]

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Bond Management (part-2)

Friends in this section we will try and learn Bond management. We will explore theories of bond management and various risk that bond valuation faces. Our focus would be to understand the term and risk structure of interest rates. We will also elucidate duration and convexity of bond.

Basic Theorems of Bond Valuation and Term Structure Basic Theorems of Bond Valuation

Bond prices often differ from face value over the period of time, Burton Malkiel's an economic writer has introduce five theorems that describes the relationship between bond prices and yields. These theorems are conceptualisation of the relationship between bond prices, yields, coupons, and maturity.

Theorem 1: Bond prices move inversely with interest rates or it can be explained as bond prices and yields move in opposite directions.

Theorem 2: The longer the maturity of a bond, the more sensitive is its price to a change in interest rates.

Theorem 3: The price sensitivity of any bond increases with its maturity, but the increase occurs at a decreasing rate. A bond's sensitivity to interest rate changes i.e. increases at a diminishing rate as its maturity grows.

Theorem 4: The lower the coupon rate on a bond, the more sensitive is its price to a change in interest rates or in other words, we can say that higher coupon bonds have less interest rate risk.

Theorem 5: For a given bond, the volatility of a bond is not symmetrical, i.e. a decrease in interest rates raises bond prices more

than a corresponding increase in interest rates lower prices. Stated differently, capital gains from an interest rate decline exceed the capital loss from an equivalent interest rate increase.

It is important to know that Price-yield relationship is fundamental to bond price behaviour and is based on the principle that bond prices and yields move in opposite directions. This principle is derived from the fact that the price of a bond is equal to the present value of its future cash-flows. That is a change in yield mathematically must produce an off-setting change in price in the opposite direction. Because present value is an exponential function, the price-yield relationship is convex, meaning that bond prices rise at an increasing rate when yields fall and decline at a decreasing rate when yields rise.

Long maturities have greater price fluctuations; therefore, if large change in interest rates happen, these bonds will be unattractive for speculative purposes. Similarly, lower the coupon, the higher is the price volatility. Again, these would not be preferable if rates are expected to rise.

The implication of Malkiel's bond price theorems to bond investors concern how investors should act with regard to trading in bonds. Specifically, the two major variables of bonds which are important in assessing price changes are:

a. The coupon and

b. The maturity.

To receive the maximum impact from an expected change in interest rates, investors should purchase low coupon, long maturity bonds.

Risk in bonds

As compared to the stocks, it is generally considered that Bonds are safe investment and a great source of generating income. However, every coin has two sides similarly along with its benefits we would also like to throw light on the darker side of holding corporate and government bonds. In this topic we will explain you how your hard earned money can be guarded against the risk that prevails in the market.

Interest Rate Risk

Under this risk the interest rate and bond prices are inversely related; thus, as interest rate decreases the price of bonds trading in the marketplace generally increases. On the contrary, when interest rate rises, the price of bonds tends to fall. It happens because when interest rates are on the decline, investors try to capture or lock in the highest rates as it is opportunity for him to earn as much as he can. This is known as speculation in simple language. The increase in demand results into an increase in bond price. On the other hand a rational investor will always divest from the bond which pay lower interest rates and will invest in the bonds whose interest rate rises. This would force bond prices down.

Let's look at an example:

An investor owns a bond that trades at par value and carries a 4% yield. Suppose the prevailing market interest rate surges to 5%. What will happen? Investors will want to sell the 4% bonds in favor of bonds that return 5%, which in turn forces the 4% bonds' price below par.

Default Risk

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A bond is nothing but a certificate of debt, that ensures the investor that he will get his principle amount plus interest on it on a specific date – maturity date. Elaborating the same it means that this is borrowed money that must be repaid by the company over time with interest. But many investors fails to realize that corporate bonds doesn't have such guarantee, instead they trade on the company's good hence the returns are dependent on the corporation's ability to repay that debt.

As an investor it is one's duty to calculate the probability and possibility of default, based on which the investment decision should be taken. As means of analysis the possibility of default can be determined by company's coverage ratio, which will give a better picture of the risk involved hence it is better to understand it before initiating an investment. As an analyst we will suggest that this analysis of the corporation's income and cash flow statements will determine company's operating income and cash flow. Further, by deriving various ratios or say by weighing the income and cash flow that against its debt service expense we get to know the leverage or say the capacity of company to repay its debt. The logic is, the greater the coverage (or operating income and cash flow) in proportion to the debt service expenses, the safer the investment. Thus, the calculated risk that an investor faces in an investment is known as Default Risk.

Risk Structure of interest rates

The relationship between interest rates on bonds with the same term to maturity is called the risk structure of interest rates. The interest rate of a certain financial instrument may reflect the aggregate economic conditions such as general economic perspectives, inflation expectations, systemic risk etc. Thus, factors specific to the instrument can be classified as:

For,

- 1. Risk structure: liquidity, default risk, taxation
- Term structure: Bonds with longer maturities lead to larger fluctuations in rates of return and in interest rates. Thus, the interest rates tend to increases with maturities.

We generally calculate risk structure by calculating the risk premiums.

Bond duration

The term duration as we know is related to time duration with respect to bonds. Here it measures how long, in years; it takes for the price of a bond to be repaid by its internal cash flows. It is a very important measure for investors as it considers that a higher duration bond carries more risk and is more volatile than bonds with lower durations.

For each of the two basic types of bonds the duration is the following:

1. Zero-Coupon Bond – Duration is equal to its time to maturity.

2. Vanilla Bond - Duration will always be less than its time to maturity.

The properties of Bond Duration: Duration of a Zero-Coupon Bond



As we can see in the figure available here, the four-year time period is taken by a zero-coupon bond to mature. The money bag balancing on the far right represents the future value of the bond, the amount that will be paid to the bondholder at maturity. The fulcrum holding the lever represents duration, here in this case it is at 4 years, hence the red lever is balanced there. The fulcrum balances the red lever at the point on the time line at which the amount paid for the bond and the cash flow received from the bond are equal. The entire cash flow of a zero-coupon bond occurs at maturity, so the fulcrum is located directly below this one payment.

Duration of a Vanilla or Straight Bond

Considering a vanilla bond commonly known as straight bond, pays coupons annually and matures in five years. The cash flows consists of five equal annual coupon payment and the last payment includes the face value of the bond.



The picture shown represents the cash flows during the period and on the maturity date. Unlike the zero-coupon bond, the straight bond pays coupon payments throughout its life and therefore is generally short term in nature or say pays back sooner.

Modified Duration

Modified duration is a formula that expresses the measurable change in the value of a security in response to a change in interest rates. Modified duration follows the concept that interest rates and bond prices move in opposite directions.

Duration measures the average cash-weighted term to maturity of a bond. It is a very important number for portfolio managers, financial advisors and clients to consider when selecting investments because, all other risk factors equal, bonds with higher durations have greater price volatility than bonds with lower durations. There are many types of duration, and all components of a bond, such as its price, coupon, maturity date and interest rates, are used to calculate duration. This formula is used to determine the effect that a 100basis-point (1%) change in interest rates will have on the price of a bond. Calculated as: Modified Duration = $\left[\frac{\text{Macauley Duration}}{\left(1 + \frac{\text{YTM}}{n}\right)}\right]$

Modified Duration Calculation

Modified duration is an extension of something called Macauley duration, which allows investors to measure the sensitivity of a bond to changes in interest rates. In order to calculate modified duration, the Macauley duration must first be calculated. The formula for the Macaulay duration is:

Macauley duration = Sum of (PV)(CF) * T / market price of the bond.Here, (PV)(CF) is the present value of a coupon at period t and T is equal to the time to each cash flow in years. This calculation is performed and summed for the number of periods to maturity. Friends let us note down some principles of duration to keep in mind.

- 1. As maturity increases, duration increases and the bond becomes more volatile.
- 2. As a bond's coupon increases, its duration decreases and the bond becomes less volatile.
- 3. As interest rates increase, duration decreases and the bond's sensitivity to further interest rate increases goes down.

Bond Convexity

For a given bond, a graph of the relationship between price and yield is convex. This means that the graph forms a curve rather than a straight-line, what we call a linear curve. The degree to which the graph is curved shows how much a bond's yield changes in response to a change in price. Thus, this change in the yield is known as bond convexity. In this section we take a look at what affects convexity and how investors can use it to compare bonds.

Convexity and Duration

In the graph a tangent at a particular price of the bond (touching a point on the curved price-yield curve), the linear tangent is the bond's duration, which is shown in red on the graph.



The exact point where the two lines touch represents Macaulay duration. Modified duration, must be used to measure how duration is affected by changes in interest rates. But modified duration does not account for large changes in price. If we were to use duration to estimate the price resulting from a significant change in yield, the estimation would be inaccurate. The portion between the straight line – tangent and actual bond price of the graph show the ranges in which using duration for estimating price would be inappropriate.

Furthermore, as yield moves further from Y*, the space between the actual bond price and the prices estimated by duration (tangent line) increases. The convexity calculation, therefore, accounts for the inaccuracies of the linear duration line. This calculation that plots the curved line uses a Taylor series, a very complicated calculus theory that we won't be describing here. The main thing for you to remember about convexity is that it shows how much a bond's yield changes in response to changes in price.

Immunization and Rebalancing of Bond Portfolios Immunization:

Bond immunization is a kind of investment strategy that intends to take advantage of the duration of bonds. Bond investors planning their investments efficiently will be eager to employ it over the long term. As an ardent and learned investor, one should know about this investment strategy and its application to the portfolio.

Bond immunization is an investment strategy used to against interest rate risk of bond investments. It is used by adjusting the portfolio duration and by matching the investor's investment time horizon. It does this by locking in a fixed rate of return during the amount of time an investor plans to keep the investment without cashing it in. Thus, Immunization is locking the amount of investment in a fixed rate of return for the time period an investor plans to keep the bond without cashing it in.

We have learnt previously that interest rates affect bond prices inversely. That is when interest rates rises bond prices slope down. This is not the case when a bond portfolio is immunized. That is the investor receives a specific rate of return over a given time period regardless of what happens to interest rates during that time. In other words, the bond is "immune" to fluctuating interest rates.

An investor need to note that for immunization of a bond the investor need to know the duration of the bonds and thus adjust the portfolio accordingly so that the duration equals the investment time horizon. For instance, suppose you need Rs 500,000 in five years for your child's education. You might decide to invest in bonds. You can immunize your bond portfolio by selecting bonds that will equal exactly Rs 500,000 in five years regardless of interest rate changes. You can buy one zero-coupon bond that will mature in five years to equal Rs. 500,000 or several coupon bonds each with a five year duration, or several bonds that "average" a five-year duration.

Duration measures a bond's market risk and price volatility in response to a given change in interest rates. Duration is a weighted average of the bond's cash flows over its life. The weights are the present value of each interest payment as a percentage of the bond's full price. The longer the duration of a bond, the greater its price volatility.

Rebalancing

Rebalancing is an essential component of the portfolio management process. An investor, investing in the market and one who engages in the expert advice or a professional help for investments are exposed to desired level of systematic risk exposure and thus their portfolio manager has a responsibility to adjust investment holdings to adhere to the clients' constraints and preferences. Although one need to know that portfolio rebalancing strategies incur transaction costs and tax liabilities.

Friends why is rebalancing adviced? The answer to the question is because

- 1. Portfolio rebalancing safeguards the investor from being overly exposed to undesirable risks. *and*
- 2. Rebalancing ensures that the portfolio exposures remain within the manager's area of expertise.

There are several basic rebalancing options that either retail or institutional investors can utilize to create an optimal investment process. We will just briefly list out the same here for your convenience

There are two broad approaches to rebalancing—calendar and threshold.

In the **Calendar approach**, the investor rebalances according to a set schedule (usually monthly, quarterly or annually), regardless of how much—or how little—a portfolio has drifted from its target allocations. On the plus side, rebalancing on a schedule takes the emotion out of investing decisions. But if allocations have changed only slightly, you may incur trading costs and tax-reporting hassles—and spend some time—without getting a lot of benefit.

In contrast, is **threshold rebalancing** where only when a portfolio's asset allocations change by a set degree one tries to adjust it. The common rule of thumb is a change of five percentage points in the weightings for the major asset classes in portfolio.

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Thus, the Portfolio rebalancing provides protection and discipline for any investment management strategy at the retail and professional levels. The ideal strategy will balance out the overall needs of rebalancing with the explicit costs associated with the strategy chosen.

Summary

Friends in this section our motto was to understand and learn Bond management. To which, we explored theories of bond management and various risk that bond valuation faces. As we promised we understood the term and risk structure of interest rates. We did deeply explain you about duration and convexity of bond. Thank you **Glossarv**

Zero Coupon Bond - Duration is equal to its time to maturity. **Vanilla Bond** - Duration will always be less than its time to maturity.