Bond Basics: Key Factors Affecting Bond Prices.
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The bond market has an illustrious history which can be traced back to “promises to pay” written on clay tablets in Babylon. In the early Christian Church charging interest on any type of loan was considered usury, which was a sin. In William Shakespeare’s ‘The Merchant of Venice’, the main character, Shylock, a Jewish money lender (under Judaism at this time lending money to somebody who wasn’t a relation was not considered a sin), was sentenced to death when he demands “a pound of flesh” to clear the debts from money leant to a Christian who defaults on the loan.

Starting in the 14th Century, the definition of what was classified as usury by Christian Church officials began to change. At first, the method employed to disguise money lending was through currency exchange, and it was currency exchange which gave rise to banking in Italy. During the late middle ages, Italy was positioned in the middle of important trade routes between Asia and Europe. The wide variety of currencies in the Italian states of Venice, Genoa and Florence made monetary exchange necessary. The creation of the Medici bank in Florence in 1397, a bank set up to primarily deal in currency exchange, would set the Medici family on the path to becoming the richest in Europe. However, what made the Medici bank different was they were in fact a lending institution. While openly charging usury was still prohibited, the Medici bank would hide interest charges from loans under the complexities associated with currency exchanges.

During the 15th and 16th centuries, the Italian states were constantly at war, both with each other and with other European powers. Governments generally would use taxes on trade and revenues on monopolies to cover expenses during normal times. However, in order to finance, the now numerous wars and hire soldiers, the states began issuing war bonds, which were essential loans made from wealthy families. This would mark the beginning of the modern bond market as we know it today.

Bonds would continue to be used to finance wars over the next couple of centuries. The British government issued Consols beginning in 1751, some of which are still outstanding today. Consols were different than any form of ‘bonds’ issued before this time because they were liquid. The British also had an easier time getting foreign
investors to purchase these bonds because they could be exchanged for sought-after British manufactures and colonial goods.

The British government would issue Consols to fund the Napoleonic war while both the North and the South issued bonds to fund the American Civil War. However, increasingly bonds also began to be used to finance other types of projects such as trade and business expansion. The growing British bond market lead to an inflow of foreign investment which in turn was able to be used to finance British imperialism.

Today, bonds are issued by governments, municipalities and corporations to finance a wide scale of projects. As of the end of Q214, the US bond market, with over $38.1 trillion of debt outstanding, is nearly two times the size of the US stock market (1). Unlike stocks, there is not a centralized exchange for bonds. Instead bonds trade in a negotiated market and are referred to as over-the-counter (OTC) securities.

Despite the size of the bond market and the fact that bonds can make up a sizeable portion of an investors overall asset allocation, the factors which affect bond prices and the returns on bonds are not well understood by many investors. This paper lays out some of the most influential risk factors to a portfolio of corporate bonds.

**The Risks:**

**Interest Rate Risk:**
The most basic relationship in bond prices is the inverse relationship between interest rates and bond prices. Monetary policy rates, such as the Federal Funds rate set by the Federal Open Market Committee (FOMC), directly influence the level of US Treasury rates. US Treasury rates are used as a benchmark for the pricing of nearly every fixed income asset since they are considered to be largely free from the chance of default. As Treasury rates increase or decrease, this movement has a direct effect on the price of outstanding bonds. The relationship between the change in interest rates and the prices of bonds are inversely related. In other words, as interest rates increase, the price of outstanding bonds decrease and as interest rates decline, the price of outstanding bonds increases.

To illustrate why this inverse relationship exists, imagine an investor purchases a 30 year bond with a hypothetical coupon of 5% at par ($1000). Now, suppose immediately after purchasing the 5% bond, market interest rates increase to 6%, newly issued bonds would have a coupon rate of 6%. The investor holding the 5% coupon bond would now no longer be able to receive $1000 if they wanted to sell their bond. This is due to the fact that another investor looking to purchase a 30 year bond could purchase a new bond with a 6% yield. Since the coupon of the bond is fixed the only thing which can adjust to make the 5% bond appealing to a potential purchaser of the 5% bond is price. The price will have to be adjusted downward to give the 5% bond a 6% yield (in this example the price of the 5% coupon bond will need to be reduced to a market price of $862).
On the other hand, if immediately after the investor purchases the 5%, market interest rates decline to 4%, then the investor will be able to sell the 5% bond for more than par ($1000) in the market (market price would be $1174).

The relationship between the price of the bond and changes in interest rates can be summarized by the following:

1. When the coupon rate of the bond equals the yield required by the market then the bond will be equal to its par value ($1000).
2. If the coupon rate of the investor’s bond is lower than the yield required by the market, then the market price of the investor’s bond will be less than $1000.
3. If the coupon rate of the investor’s bond is higher than the yield required by the market, then the market price of the investor’s bond will be greater than $1000.

At this point, it is important to point out that the price of the bond at maturity will be par ($1000), assuming that the issuer of the bond doesn’t default, regardless of the level of interest rates at maturity. The market price of the bond will only vary during its time before maturity.

Duration:
Duration is a measure of the approximate sensitivity of the price of a bond to a change in interest rates. From a simplistic standpoint, duration can be viewed as the weighted average time of the present value of the coupon and principal payments of a bond. The higher the duration, the greater the increase in price of the bond will be for a given decline in yield and the greater the decline in price will be for a given rise in yield.

The following formula can be used to calculate the approximate change in a bond’s price using its duration:  

\[ \text{Approximate change in bond price} = \text{Duration} \times \text{Percentage change in yield} \]

If a bond’s duration is 5 years, then its price would increase around 5% if interest rates decreased 1% (100 bps). Conversely, if interest rates increased 1%, then the value of the bond would decrease by approximately 5%.

Duration incorporates the bond’s yield, coupon, and final maturity into one number, which is expressed in years, to indicate this price sensitive. These factors affect the timing and size of the cash flows from the bond. Specifically, they will affect duration in the following ways:

1) The duration of a bond will be higher - the longer its maturity, the lower its coupon and the lower its yield, and
2) The duration of a bond will be lower - the shorter its maturity, the higher is coupon and the higher its yield.\(^{(2)}\)
The reasons for the above relationships are as follows:

- When the coupon rate is low, the return of principal at maturity represents a large portion of the total payments. Therefore, the payments are skewed toward the future, making the duration longer. The extreme example of this is a zero coupon bond, which since it makes only one payment at maturity and no coupon payments along the way, will have a duration which is equal to its time to maturity.

- Given the relationship between zero coupons and duration stated above, it is clear that coupon paying bonds will have durations shorter than their time to maturity.

- The longer the maturity of a security, the longer it will take an investor to receive all the bond’s cash flows and therefore, the longer the weighted-average maturity of all the cash flows and the longer the duration. In other words, the further into the future the payments come, the more sensitive the market price of the bond will be to the present value of those future payments.

When the above factors are reversed they will shorten the duration of a bond.

The chart below illustrates how duration changes with maturity and yield:

<table>
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<th>Maturity (in Years)</th>
<th>2%</th>
<th>4%</th>
<th>6%</th>
<th>8%</th>
<th>10%</th>
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</table>

Therefore, duration is a very useful measure for building bond portfolios. If an investor expects that interest rates will decline they would favor bonds with longer durations, which would be bonds with longer maturities and lower coupons. The investor may also want to avoid callable bonds as the likelihood of the call being exercised by the issuer would increase as interest rates decline. On the other hand, if investors believed interest rates were going to increase they would likely prefer bonds which possess a shorter duration.

**The Yield Curve:**
The yield curve is a line graph that plots the relationship between yields to maturity and time to maturity for bonds of the same asset class (i.e. government bonds, corporate bonds, etc) and credit quality with yield on the vertical axis and time on the horizontal axis. The plotted line begins with the *spot interest rate*, which is the rate for the shortest maturity, and extends out in time, typically to 30 years.
Traditionally, the yield curve is upward sloping with longer maturity bonds yielding more than shorter maturity bonds. A yield curve can be flat with bonds yielding the same amount for shorter term and longer term bonds and it can also be downward sloping with shorter term bonds yield more than longer term bonds.

The current shape of the yield curve and changes to that shape are controlled by a variety of factors. The Federal Reserve through its monetary policy control short term rates. However, the medium and longer term portions of the yield curve are controlled by other factors such as the market’s expectation for future growth, a term premium and inflation expectations. Investors use the yield curve as a reference point for forecasting interest rates, pricing bonds and creating strategies for boosting total returns. The slope of the yield curve also provides an important clue to the direction of future short-term interest rates; an upward sloping curve generally indicates that the financial markets expect higher future interest rates and as a sign that the economy is expanding. An inverted (downward) sloping curve indicates expectations of lower rates in the future and would be associated with a recessionary environment. Before the onset of the last six recessions the yield curve has become inverted.

**Yield Curve Risk:**
As discussed above, duration is the approximate percentage price change for a parallel shift in the yield curve. The major short coming of duration is it measures a bond portfolio’s sensitivity to parallel shifts in the yield curve. This very rarely happens as changes in interest rates generally do not affect all bonds equally, in other words, long term rates will usually increase or decrease by a different amount than short term rates.
Therefore, two bond portfolios with similar durations may potentially perform very differently due to the yield curve not changing in a parallel fashion.

Yield curve risk can be measured by using a key rate duration approach. This approach measures the price sensitivity for a change in one ‘key’ interest rate (models generally use 1month, 3month, 6month, 1year, 2year, 3year, 5year, 7year, 10year, 15year, 20year, 25year, 30year maturities as the key rates) while holding the interest rates at the different maturities constant. This process is repeated for every bond in the portfolio and for each of the different ‘key rates’. A portfolio’s key rate duration is the weighted average of the key rate durations of the bonds in the portfolio.

**Credit Risk:**
The yield and the eventual return received by a bond investor will also be influenced by the credit quality of the issuer. Issuers which are viewed as more credit worthy will pay a lower yield on their bonds than issuers investors view as less credit worthy.

The two major types of credit risks faced by investors are the risk of default and the risk of downgrade in credit quality by one of the ratings agencies. Default risk is the risk that the issuer of the bond will fail to satisfy the terms of the obligation with respect to the timely payment of interest and/or repayment of principal. Since US Treasuries are backed by the ‘full faith and credit’ of the US government they are considered free from default risk and are therefore generally used as the benchmark for the bond market against which other bonds trade and are priced.

The three main rating agencies (Moody’s, S&P, and Fitch) provide analysis of corporate bond issuers, grading each issuer according the issuer’s financial condition and management, economic and debt characteristics, and the specific revenue sources backing the bond. The corporate bond market ratings fall into two broad classifications – investment grade and non-investment grade. Investment grade bonds carry ratings of at least Baa3/BBB-/BBB- from Moody’s, S&P, and Fitch respectively. While non-investment bonds (also known as High Yield) are rated Ba1/BB+/BB+ and lower. The credit rating on a bond reflects the rating agency’s assessment of the probability that the bond will default and the estimated recovery value in the event of default. Lower ratings are indicative of a bond that has a greater risk of default than a bond with a higher rating. The credit rating agencies continue to monitor issuers over time and issuer credit ratings can either improve or deteriorate.

Since corporate bonds have more credit risk than US Treasuries, they require that investors receive more compensation, in the form of a higher yield, for a bond with a similar maturity. This divergence creates a “credit spread” between corporate and Treasuries, so the corporate bond investor earns an extra yield (called a ‘spread’) by taking on this credit risk. The credit spread affects the price of the bond and can be graphically plotted and measured as the difference between the yield of a corporate and Treasury bond at each point of maturity along the yield curve. This additional yield spread will vary over time and among issuers depending upon the market’s perception of business conditions and as the fundamentals for a company improve or worsen. Lower
rated bonds will tend to outperform higher rated bonds when the economy is performing well. However, lower rated bond will tend to drop more in value than higher rated bonds when the economy is entering or is in a recession.

**Conclusion:**
An investor can use interest rate risk and credit risk to build a bond portfolio which is consistent with their economic outlook. As with other types of investments an investor pursuing a higher return will need to be willing to take on more risk. All other factors being equal, bonds with greater interest rate risk and higher credit risk tend to have higher yields as well as more price volatility.

**Notes:**
1. Bond market includes the entire amount of debt outstanding including asset-backed, government debt, municipals, money market and corporate debt. The Wilshire 5000, which is viewed as a good measure of the entire US Stock market, had a market capitalization of approximately $20.8 trillion as of the end of Q214.
2. Modified duration only calculates duration based on changes in yield. While effective duration will calculate it based on changes in yield and, if applicable (i.e. in the case of a callable bond) bond cash flows to calculate duration.
3. The coupon of a bond and the yield of a bond will generally be the same at issuance when the bond is worth par ($1000). However, as the bond price changes as it trades in the secondary market then the coupon and yield may not be the same. If a bond is a fixed rate bond then the coupon will stay the same throughout the life of the bond. Therefore, if a bond is trading below the $1000 par in the secondary market, then the yield of the bond will be greater than its coupon. Conversely, if the bond is trading above $1000 in the secondary market then the coupon will be greater than the yield.