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JOEY THOMPSON 2013-06-21

The Current Environment for Bond Investing

U. S. Government bonds are often thought of as safe investments, but like all investments, there is risk involved. When yields and inflation are very low, as they currently are, investors can lose a substantial amount of their investment if inflation or yields increase. This note discusses the reason for this. Under these circumstances, cash and short-term bonds can be reasonable alternatives for the fixed-income portion of a diversified portfolio.

Background A bond represents the debt of an entity, typically a government-related institution or a corporation. The entity borrowing the money, the debtor, issues the bond. The investor lending the money, the creditor, receives the bond. Usually, the bond can be sold in the marketplace, and whoever holds the bond at the time that a payment is due is the rightful recipient of that payment.

There are many types of bonds, but most publicly traded bonds make interest-only payments every six months and a final payment including the principal on the date of maturity. As an example, consider a typical government bond, the ten year Treasury Note with a face value of $1,000 with a 3% coupon or annual interest rate. The bond pays $3\% \times \$1000 = \$30$ every year, but it makes payments of $15 every six months since it is a semi-annual bond. Over the lifetime of the bond, the holder will receive interest payments of $\$30 \times 10$ years $= \$300$. Thus, after purchasing the bond, the bond holder will receive 19 payments of $15 with a final payment of $1015 on the tenth anniversary of the bond.

Glossary for Bond Terms

Maturity The date or the length of time when the debt must be repaid.

Principal The face value of the bond. The amount on which interest payments are made, and along with any final interest payment, the amount that is paid at maturity.

Coupon The annual interest payment. Usually half is paid each six months.

Rating A measure of how likely the bond is to be repaid in full. Riskier bonds have lower ratings.

Duration The price sensitivity to a change in yield. (see detailed description on page 4)

Debt vs. Equity

There are only two ways to finance the assets of a corporation: equity or debt (or some hybrid that is a combination of the two like preferred stock or convertible bonds). Either the corporation can sell equity (shares of stock) in itself

to an investor in exchange for cash (or other assets of value), or the corporation can borrow. The way in which a company finances its assets is known as the company's *capital structure*.

Debt is at the top of the capital structure. In other words, the debt holders must be paid before the company owners (the shareholders) are paid. If a corporation declares bankruptcy, the assets are used to pay the creditors in full before any value is distributed to the shareholders. For this reason, debt is often thought to be a safer investment than equity. Since bonds appear safer, why invest in equity? Because the total amount that is paid to debt holders is capped; whereas, equity holders receive a portion of the profits of the corporation. It is clearly better to have been an early equity holder in Google or Apple than to have been a lender to either.

Yield and Price A bond's *yield to maturity* is the *effective* interest rate that the bond holder will receive from now until maturity, taking into account the current market price of the bond and the timing of all interest payments including the final payment (assuming that all payments are made as expected). This is the same as the Internal Rate of Return (IRR) for the bond. Since bonds are sold in the market, their price can vary from one moment to the next, and since price is a key factor in calculating the yield, we see that the yield varies and is closely related to the current market price of the bond. The yield is NOT the same as the interest rate. The interest rate, i.e., the coupon, is fixed; the yield varies.

Consider a hypothetical example of a one year government bond with a face value of $100 and an annual coupon of 10%. (The U.S. Government doesn't sell such a bond; we use this example for clarity.) At the end of the year, the bond holder would receive the annual coupon of $10 plus the face value of $100 for a total of $110. Assume that the original buyer of the bond purchases the bond from the government for exactly $100. Because there is just one payment exactly one year after purchase, it is easy to calculate the yield to maturity of the bond to be 10%:

$$\frac{(\$110 - \$100)}{\$100} = 10\%.$$

If all other bonds in the market with similar rating and payment schedule had a yield of 6%, investors would be willing to pay considerably more than $100 for our example bond. Why? With all other things being equal, if the investor has a choice to pay $100 and get a 6% return on their investment or pay $100 and get a 10% return, they will choose the 10% return. Assume that on the day of issue, the lucky buyer decided to resell the bond in the open market. Since there would be many buyers willing to pay $100 for the bond, the seller would use an auction to sell the bond. Ignoring transaction costs, the bidders would be willing to buy the bond up to a price of $103.77 at which price the yield would be 6% just like all the other bonds with a similar safety rating:

$$\frac{(\$110 - \$103.77)}{\$110} = 6\%.$$

In our example, the face value and coupon were fixed at $100 and 10%, but the price and yield depended on the market conditions and ended up being $103.77 and 6%, respectively. As a general rule, yields and prices go in opposite directions: when yields fall, prices rise; when yields rise, prices fall. Because yield to maturity and price are so closely related, bond prices are often quoted as a yield rather than a price.

Bonds and Auctions
Even though our examples may suggest otherwise, neither the government or other institutions sell bonds at a price far off the market value. For the government in particular, bonds are auctioned. The face value and coupon rate are fixed prior to the auction, but the actual price that the government receives depends on the market demand for the bonds.

Duration The relationship between yield and price for a bond varies depending on the time to maturity for a bond. To illustrate, consider two government bonds that are identical except for time to maturity. Both pay a coupon of 4% semi-annually with a face value of $100. Bond A matures in one year; bond B matures in ten years. To make things easy, let's also assume that both bonds are purchased in the marketplace today for their face value which means that the market thinks that a yield of 4% is correct for each. (This example is not realistic since under normal circumstances, yields are different for bonds of different maturities. Figure 1 shows the actual yields for government bonds of various maturities as of Jun 16, 2013.)

If yields in the market suddenly decrease from 4% to 3%, the price of both bonds will increase. The price of bond A, the one year bond, will increase from $100 to $100.98. The price of bond B, the ten year bond, will increase from $100 to $109.31. (These price changes aren't obvious. The values were calculated with a financial calculator.)

If yields in the market suddenly increase from 4% to 5%, the price of both bonds will decrease. The price of bond A, the one year bond, will decrease from $100 to $99.04. The price of bond B, the ten year bond, will decrease from $100 to $91.62.

Big Picture: Principal Losses Long-term vs. Short-term Bonds

It's easy to understand why a shift in yield affects the price of a short term bond less than a long term bond if we consider some extreme examples. For starters, a bond that matures tomorrow doesn't depend on current market yield at all. The investor knows exactly how much money the bond will pay tomorrow, the face value plus the final coupon payment. Whether interest rates are 1% or 20% doesn't really matter to the investor who is collecting the money tomorrow.

Now consider the case of a thirty-year semi-annual government bond paying a 2% coupon, and let's assume that there is no doubt that the government will make all the payments. Even though the investor *knows* that they will receive the coupon payment every six months for thirty years, the value of that coupon will plummet if bond yields increase to 20%. Ignoring the math, if the yield on bonds is 20%, that strongly suggests that inflation is very high. That means that after a few years the coupon payments become almost worthless in today's dollars. The market won't pay a lot for that bond.

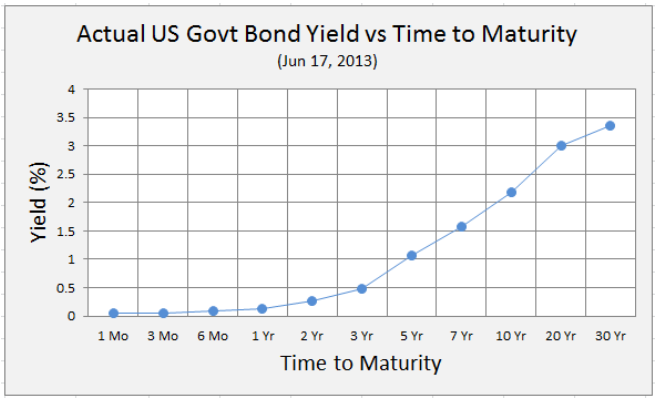

Figure 1: Yields for U.S. Government Bonds on Jan 16, 2013 with maturities from one month to thirty years. The shape of the yield curve is typical since longer term bonds have higher yields. However, the current yield curve is unusual in that it is near historic lows. Data source: www.treasury.gov.

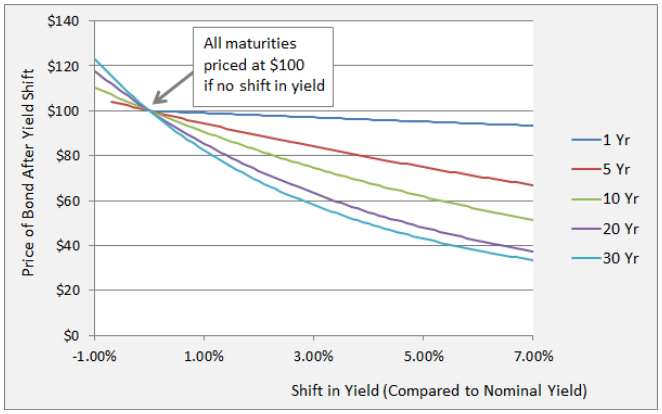

Figure 2: Figure showing how the market value of U.S. Government bonds change if market yields shift. Since yields are near historic lows, it is unrealistic to consider significant downward shifts. Yields are almost certain to increase, driving the market value of bonds lower. The only question is when, how much, and how quickly.

Notice how the prices changed: a 1% shift in yields results in a price change of about 1% for the one-year bond and a nearly 10% change for the ten year bond. This approximate relationship is a convenient way to know how much of an impact a shift in yields will have on bonds of various length to maturity: for each shift of 1% in yield, the price of a bond will change by approximately 1% for each year to maturity of the bond. As an example, if yields shift upward by 0.1%, the value of a four-year bond will decrease by around 0.4%.

Figure 2 shows the relationship between a change in yields and the price for government bonds of various times to maturity. The bonds are assumed to trade at par on Jan 16, 2013 using then-current yields. Since yields are at historic lows, it is unrealistic for actual yields to shift down by 1%; and, in particular, there is no data for a downward shift of 1% for the 1 Year and 5 Year bonds since bonds with those maturities are already selling below 1% coupon yield.

Duration (actually, modified duration) is the name given to the exact relationship between a small shift in yield and the resulting change in price:

$$D = -\frac{\frac{\Delta P}{P}}{\Delta y} = -\frac{\text{Percentage change in Price}}{\text{Change in Yield Percent}},$$

where

$$D = \text{Modified Duration}$$

$$P = \text{Price of the bond in the market}$$

$$\Delta P = \text{Change in price of the bond}$$

and

$$\Delta y = \text{Change in yield (measured in percent)}$$

As we saw from the example, the duration of a bond is similar in number to the time to maturity of the bond in years, but duration is more useful because it can be

applied to a portfolio of bonds with various times to maturity. Intuitively, a bond portfolio with a modified duration of 10 should be comprised of bonds with a value-weighted average time to maturity of something around ten years. Much more importantly, we know that the value of that portfolio would decrease by about 10% if yields in the bond market increased by 1% and vice versa.

When reviewing a portfolio of bonds, it is critical to know the duration. This single number provides insight into how sensitive the portfolio will be to shifts in interest rate.

Commentary The Jacobi method of inverting problems leads us to ask not what are the best bond funds in which to invest. Instead, we ask how safe are these 'conservative' investments in U.S Government bonds. The answer is: not very.

Our discussion is not concerned with whether or not the government will honor its obligation to repay its debt. It isn't that the investor will stop receiving interest payments or that the principal payment will be in jeopardy. If the investor holds the bond to maturity, we assume that the investor will be repaid.

The real concern is that inflation and/or bond yields will begin to increase. We don't know when and how much, but we know with almost absolute certainty that yields will increase since long-term U.S. Government bond yields are lower now than they have been since before the 1870's. When yields do increase, the value of long term bonds will decline.

Investors may say that it doesn't matter because they will eventually get repaid. There are two problems with this view: 1) The investor will have to choose between missing good investment opportunities or selling the bond and realizing a loss, and more importantly, 2) If yields increase, that probably means that inflation has increased. Even though the investor receives all of the payments, the payments are declining in value because of inflation.

How much could the value of long-term bonds decline? Reviewing Figure 2 again, we see that an increase in 30-year bond yields of 3% (from current yields of around 3% up to a new yield of around 6%) would reduce the value of those bonds by 40%! How likely are long-term yields to increase to 6%? Figure 3 shows that yields were 6% in 2000 and at that rate or higher for almost the entire period shown before 2000. Also, note from the plot that when yields increase, they often increase quickly.

In other words, we see that at the present time, long-term bonds have the potential to create large losses for those that hold them. Short-term U. S. Government bonds are a safer alternative since their value is not highly dependent on yield, but they are currently paying very low interest payments: a one year U.S. Government Bond currently offers a yield of only 0.12%.

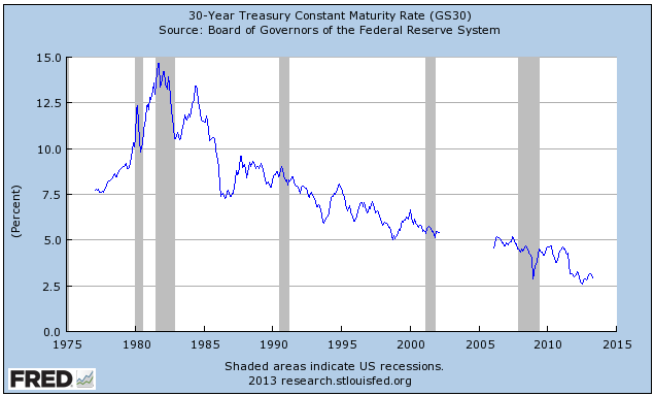

Figure 3: The historical yield of 30-year government bonds showing that current yields are lower than at any time since the 1970's. (The government suspended issuing bonds from 2002 – 2006 leading to the corresponding period without data in the plot.) Source: St. Louis FRED (Federal Reserve Economic Data)

Within this context, the question is how to maximize returns while managing risk. Surprisingly, at the present, cash and cash equivalents (including short-term U.S. Bonds) are reasonable alternatives to longer term bonds for investors seeking safety. The foregone interest payments are not large, and the liquid investment position provides an option to purchase securities quickly when market conditions create opportunities.