Total Return Analysis

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Introduction

Last year, both the Federal Financial Institutions Examination Council (FFIEC) and the Office of Thrift Supervision (OTS) issued policy guidance that recommends institutions conduct a total return analysis in assessing the effects of interest rate changes on the returns associated with investment securities and financial derivatives prior to taking a position in these financial instruments. The 1998 FFIEC policy statement states: "The agencies [i.e., the FRB, FDIC, OCC, OTS, and NCUA] agree that the concept of total return can be a useful way to analyze the risk and return tradeoffs for an investment. This is because the analysis does not focus exclusively on the stated yield to maturity. Total return analysis, which includes income and price changes over a specified investment horizon, is similar to stress testing securities under various interest rate scenarios. The agencies' supervisory emphasis on stress testing has, in fact, implicitly considered total return. Therefore, the agencies endorse the use of total return analysis as a useful supplement to price sensitivity analysis for evaluating the returns for an individual security, the investment portfolio, or the entire institution." In Thrift Bulletin 13a, issued last year, OTS states: "Management should exercise diligence in assessing the risks and returns (including expected total return) associated with investment securities and financial derivatives."

This *Risk Management Release* discusses total return analysis and shows how it can be used to measure the expected return of fixed-income securities. In evaluating the expected return of an individual fixed-income security, or portfolio of fixed-income securities, investors typically use internal rates of return, such as yield to maturity or yield to call, as selection criteria. These two yield measures, however, are unlikely to reflect the correct expected investment return. Instead, total return provides a better measure of prospective investment return.

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Conventional Measures of Investment Return

The price of a bond is equal to the present value of the bond's expected cash flows. By definition, the yield, or internal rate of return, is that interest rate that equates the present value of a bond's cash flows to its current market price. Yield to maturity (YTM) and yield to call (YTC) are two frequently used measures of return (or yield) on fixed-income securities. YTM is used to price and trade non-callable bonds, while

YTC is used to price and trade callable bonds.

YTM is the internal rate of return on a non-callable bond that is held until maturity. In using this yield measure, one assumes that the security is held until maturity and that all cash flows can be reinvested at the same constant YTM. YTC is the internal rate of return on a callable bond that is held until either the first call or first par call date. In using this yield measure, one assumes that the security is held until being called by the issuer and that all cash flows can be reinvested at the same constant YTC.

Both of these return measures have several important drawbacks. First, investors typically do not hold fixed-income investments until these investments mature or are called. Second, interim cash flows cannot be reinvested at the assumed constant yields. Finally, it is not possible to compare the likely returns on investments with different maturities or more complex return/risk profiles.

Total Return Analysis in Theory

Total return analysis avoids the shortcomings associated with using the two conventional yield measures, YTM and YTC, and provides an investor with a better measure of the expected return on fixed-income investments. The total return (also known as the horizon or total holding-period return) accounts for the three sources of potential dollar return on a bond:

- Coupon interest payments,
- Capital gain or loss when a bond matures, is sold, or called, and
- Income from reinvestment of coupon interest payments (interest-on-interest income).

Therefore, to calculate the total return for a non-callable bond, an investor chooses an investment horizon or holding period, a reinvestment rate, and a selling price for the bond at the end of the investment horizon (i.e., end-of-period required return). Based on the values chosen for these parameters, the total return calculation is straightforward. First, total coupon payments plus interest-on-interest income are calculated for the assumed reinvestment rate over the given investment horizon using the following expression:

where

Coupon plus interest-on-interest =

$$\text{Coupon}\left[\frac{(1+r)^h - 1}{r}\right]$$

h = length of investment horizon, and
r = assumed reinvestment rate.

Second, the predicted sales price of the bond at the end of the investment horizon is calculated. Third, total future dollars derived from the bond over the holding period are calculated by summing total coupon payments, reinvestment income, and the predicted sales price. Finally, this value is substituted into the following expression to obtain the total return:

$$y_h = \left[\frac{\text{Total future dollars}}{\text{Purchase price of bond}}\right]^{1/h} -1$$

where r and h are defined as above, and

Total future dollars =

  Coupon payments
+ Interest-on-interest income
+ Sales price.[1]

Total Return Analysis in Practice

There are several different approaches that could be used to calculate total return. First, an investor, or portfolio manager, could calculate total return on the basis of subjective forecasts of the reinvestment rate and required yield at the end of the investment horizon. Second, implied forward rates from the yield curve (e.g., U. S. Treasury or LIBOR yield curves) could be used to determine the reinvestment rates and the yield on a bond at the end of the investment horizon. This approach to total return analysis produces what is called an arbitrage-free total return because the calculation is based on the market's expectations of the reinvestment rate and end-of-period required yield. Finally, scenario analysis could be used to calculate total return. Scenario analysis involves specifying different possible values for the reinvestment rate and the required yield at the end of a given investment horizon, and then calculating the total return associated with each scenario.

Of the three approaches, total return analysis based on scenario analysis is the best approach because it allows an investor, or portfolio manager, to measure how sensitive a bond's expected performance is to

[1] This discussion draws on material from Frank J. Fabozzi, editor, *The Handbook of Fixed Income Securities*, 5th Edition, 1997, Chapter 4. See this chapter for further discussion of the total return concept.

differing reinvestment rates and end-of-period required yields. Total return analysis can also be used to compare the expected returns of a bond for investment horizons of varying lengths. In the two examples that follow, scenario analysis is used to compare: (1) the total returns for a bond using two different investment horizons, and (2) the total returns for two bonds of different maturities.

To assess the effect on a bond's total return of varying the length of the investment horizon using scenario analysis, assume a bond, say Bond A, is a 9 percent coupon, 20-year non-callable bond with a current market price of $109.90 and a yield to maturity of 8 percent. Tables 1 and 1A show various scenarios for the reinvestment rate and end-of-period required yields for Bond A for a three-year and ten-year investment horizon, respectively.

As shown in the tables, there are three different reinvestment rates, 4, 5, and 6 percent, and three different end-of-period required yields, 6, 8, and 10 percent. In both tables, for each combination of reinvestment rate and end-of-period yield, there is a total return estimate for Bond A.

As shown in the two tables, the total return estimates vary substantially across the two investment horizons. The differences in the total return estimates illustrate the effect that the choice of investment horizon has on a bond's expected return since the relative importance of the reinvestment rate and end-of-period required yield is related to investment horizon. For short investment horizons, for example, reinvestment income is small, but it increases in size as the investment horizon lengthens.

Table 1. Scenario Analysis for Bond A's Total Return

	Required Yield at End of 3-Year Investment Horizon (%)		
Reinvestment Rate (%)	6.0	8.0	10.0
4.0	13.36	7.78	3.06
5.0	13.44	7.87	3.16
6.0	13.53	7.97	3.26

Table 1A. Sensitivity of Bond A's Total Return to Investment Horizon

	Required Yield at End of 10-Year Investment Horizon (%)		
Reinvestment Rate (%)	6.0	8.0	10.0
4.0	7.59	6.88	6.24
5.0	7.85	7.16	6.53
6.0	8.11	7.43	6.82

The second example compares the total returns for two bonds of different maturities. The first bond, Bond A, is the same bond used in the previous example. The second bond, Bond B, is a 7.25 percent coupon, 14-year non-callable bond with a current market price of $94.55 and a yield to maturity of 7.9 percent. (This example is adapted from Fabozzi, *The Handbook of Fixed Income Securities*, 5th Edition, pages 72-75.) In comparing the total returns for the two bonds below, the investment horizon is set to three years. On the basis of yield to maturity, Bond A appears to be a better investment than Bond B because of Bond A's higher yield to maturity. However, as the example shows convincingly, yield to maturity is not a reliable measure of expected investment return.

Table 1 *(left)* and Table 2 *(page 4)* show various scenarios for the reinvestment rate and end-of-period required yields for Bond A and Bond B, respectively. There are three different reinvestment rates, 4, 5, and 6 percent, and three different end of period required yields, 6, 8, and 10 percent. These are the same values used in the previous example.

The total return estimates for both bonds vary substantially across the different rate scenarios. For Bond A, these estimates range from a maximum value of 13.53 percent to a minimum value of 3.06 percent. For Bond B, these estimates range from a maximum value of 12.16 percent to a minimum value of 3.48 percent. This example shows the high degree of sensitivity of a bond's expected return to different values for reinvestment rates and end-of-period required yields.

If a portfolio manager currently owned Bond B, the higher yield to maturity on Bond A might induce the manager to swap Bond A for Bond B in a pure yield pickup swap transaction. However, Tables 1 and 2 show that the likely returns on both bonds are sensitive to what happens to interest rates, despite the higher promised yield to maturity for Bond A. To see this more clearly, Table 3 shows the total return for Bond A minus the total return for Bond B in basis points.

Table 2. Scenario Analysis for Bond B's Total Return

	Required Yield at End of 3-Year Investment Horizon (%)		
Reinvestment Rate (%)	6.0	8.0	10.0
4.0	12.00	7.50	3.48
5.0	12.08	7.58	3.57
6.0	12.16	7.67	3.67

Table 3. Bond A's Total Return Minus Bond B's Total Return (in Basis Points)

	Required Yield at End of 3-Year Investment Horizon (%)		
Reinvestment Rate (%)	6.0	8.0	10.0
4.0	136	28	- 42
5.0	137	29	- 41
6.0	137	30	- 41

Table 3 shows that for required yields of 6 and 8 percent, Bond A's total return exceeds that of Bond B's for all three reinvestment rates. However, for a required yield of 10 percent, the situation reverses dramatically, with Bond B's total return exceeding that of Bond A. These results suggest that investment decisions based only on stated yield to maturity will not produce the best total returns as interest rates change. The results of this simple example demonstrate the importance of conducting a stress test over various interest rate scenarios when evaluating the expected return on investment securities prior to taking positions in these financial instruments.

Conclusion

This *Risk Management Release* has shown how total return calculations based on scenario analysis can be used to measure the expected return of fixed-income securities. In evaluating the likely return of an individual fixed-income security, or portfolio of fixed-income securities, some investors use promised yield to maturity or yield to call as selection criteria. These yield measures, however, are unlikely to reflect the correct expected investment return as interest rates change and investments are sold prior to maturity. Instead, total return provides a better measure of expected investment return.

In summary, investment decisions made on the basis of YTM or YTC can lead to investments with lower total returns depending on changes in reinvestment rates, end-of-period required yields, and length of the investment horizon. However, there is an important caveat. In computing total returns based on scenario analysis, investors should be aware that total return estimates will only reflect expected investment returns if expectations regarding reinvestment rates and end-of-period yields turn out to be correct.