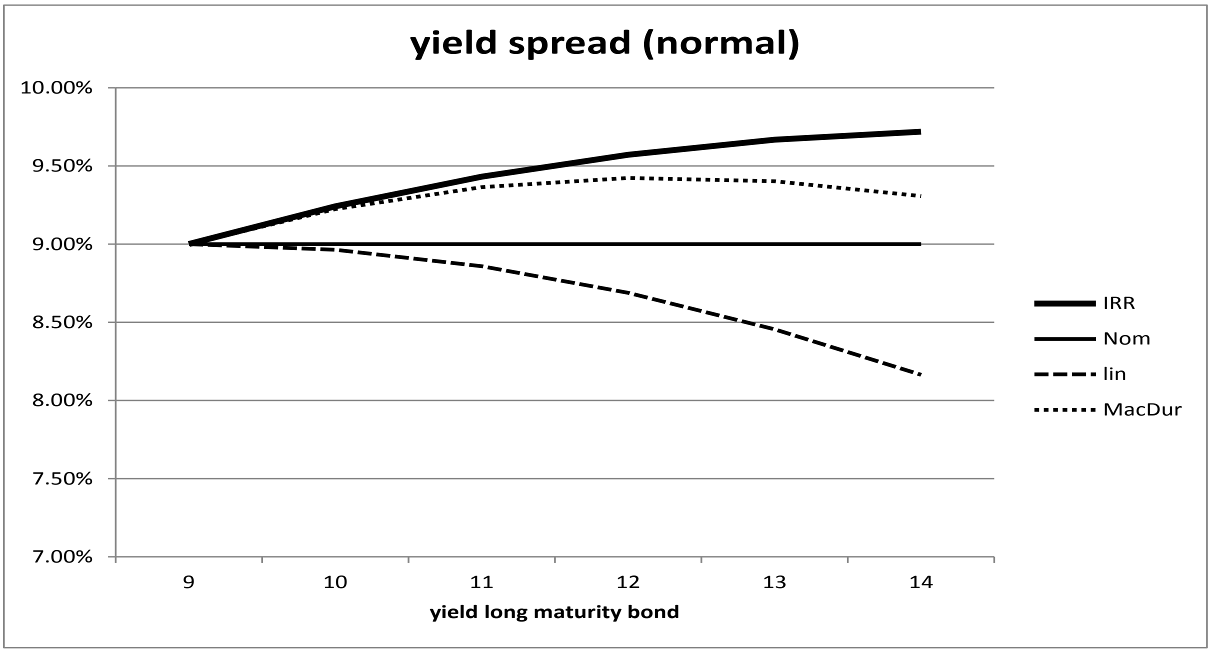
Yields of bonds and bond portfolios

Reference or benchmark portfolios play an important role in asset management since they are often the starting point for measuring the yield of an invested portfolio. A working group of the Swiss Bond Commission (SBC) determined that various figures are used to illustrate the yields of a benchmark portfolio, even though yield measurement spans the same time period. The yield of an individual bond is often the subject of much discussion, yet nothing is said when an individual bond is transitioned to a portfolio. To better understand this transition, we will start by discussing the definition of "yield".

The **yield to maturity** is a well-established measurement for indicating a bond's future (ex ante) yield. It is derived from the coupon, the nominal value and the term to maturity of the bond. A bond's fair value and the cash flow calculated using discount factors are compared with one another. What we are looking for here is the interest rate where both sides have the same value. Thus, we are considering a condition that must apply at any given time. This equation has multiple solutions; the yield to maturity is just one of them. The various implementations usually find the right solution. Generally speaking, the equation for yield to maturity cannot be calculated using simple algebraic operations, but rather the solution has to be approximated numerically. Applied mathematics has several options for this, however. In the meantime, yields to maturity have plummeted and are now close to zero or even slightly negative. This situation raises many questions in investment practice, but it does not fundamentally undermine the concept of yield to maturity.

When calculating the yield to maturity, it is assumed that future coupons will be paid out and no default will occur, i.e. the debtor will remain solvent until expiry. The **direct yield** does not make this assumption, however. It is defined as the coupon divided by the price of the bond. The SBC working group mentioned above is currently in the process of investigating how key portfolio data such as duration or convexity for negative interest rates behave, in the aim of demonstrating the relationship between the direct yield and the yield to maturity.

Portfolio analysis frequently refers to the "yield". The question is, which yield? In the following, we will not focus on a single bond. Rather, we will examine the ex-ante yield of an entire bond portfolio, i.e. exclusively future cash flows are factored into the calculation. The equation for yield to maturity will be generalized to derive an equation for the bond portfolio **(internal rate of return).** This equation is not solved exactly by the programs offered by most software providers; instead, it is considered in combination with the yields to maturity of the individual bonds. We will examine three approximations for the internal rate of return. The weightings are based on the nominal (nom), the price (lin) or the Macaulay duration (MacDur) of the individual bonds. In the figure, the internal rate of return is compared with these approximations using a model portfolio.



The approximation of the internal rate of return

The portfolio is comprised of three bonds with varying terms (short, medium and long). In order to illustrate the effects more clearly, we will assume very positive yields to maturity (not entirely in line with the market). All approximations are the same for the same yields to maturity; the approximations reveal a yield spread of 4%–14% between short and long maturity bonds in the portfolio (normal yield structure). We can deduce from this that the more the yield curve moves away from a flat yield curve, the worse the approximations become. Our analysis also shows that the approximation using the Macaulay duration is superior to the other approximations. This is why this approximation method is also recommended by the European Bond Commission (EBC).
We encounter a similar problem when calculating the Macaulay duration as we do when calculating yields. Most software programs determine the Macaulay duration as a weighted total of the Macaulay duration of the individual bonds. The question is, which yield is used for the calculation? In most cases, the yields of the individual bonds are used; however, it would also be appropriate here to use the internal rate of return. Again, we observe that the results are the same if the yield curve is flat. The steeper the yield curve, the more disperse the results. A publication entitled "The approximation of the internal rate of the return (IRR) of a portfolio" is being prepared by the SBC working group; results have repeatedly been presented at EBC meetings.

References:

Bond Analytics. Presentation at EBC meeting,
London, Wolfgang Marty, 2015
Portfolio Analytics, Springer, 2nd Edition, Wolfgang Marty, 2015
Constructing & Calculating Bond Indices, 2nd Edition Patrick J. Brown, 2002

Author:

Dr Wolfgang Marty works at AgaNola as an Investment Strategist. He is a member of the Bond Index Commission of SIX Swiss Exchange and is Chair of the SFAA Bond Commission. He specializes in portfolio optimization and performance measurement.