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A Closer Look

A Primer on Bond Yields

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In Brief

- **How are bond yields measured? Simple bonds have simple measures; bonds with complex features require a more comprehensive approach.**
- **Numerous yield measures exist, but most are insufficient to varying degrees and can be misleading.**
- **The Effective Yield measure reliably incorporates all of a bond's attributes, no matter how complex.**

The Best Way to Measure a Bond's Yield

In the earliest days of debt, debt service consisted simply of a set of fixed interest payments until the bond's maturity. The traditional Yield-to-Maturity (YTM) yield calculation works well for these simple bonds.

As markets evolved and bonds became more complex, new types of yield measures, some with incomplete calculations, sprang up. Examples of these potentially misleading yield measures include Yield-to-Call, Yield-to-Worst, Current Yield, and others.

This proliferation of yield measures has caused confusion, especially for clients who may notice that different vendors use different yield-reporting conventions in their account statements.

For example, a bond mutual fund may use SEC Yield while a high-yield debt portfolio may quote Yield-to-Worst, and a corporate bond portfolio may use Yield-to-Call. Occasionally, Current Yield (also called Income Yield) is used. All these yield measures are insufficient to varying degrees and under certain circumstances (please see Appendix).

What is truly needed is a single comprehensive yield measure that is accurate for *all* types of bonds. Fortunately, there is one: Effective Yield. Effective Yield is reliable across all types of bonds, even those with complex derivative elements, like calls, puts, step-up coupons, prepayment options, and others.

Simply put, Effective Yield (also called Option-Adjusted Yield) takes into account *all* of a bond's attributes (including premium/discount, coupon/interest payments, options, etc.). It correctly prices each attribute using a time-value-of-money approach, and calculates an accurate yield. This methodology is standardized in a way that makes comprehension straightforward and consistent. **Effective Yield takes the confusion out of calculating a bond's yield, making it a superior measure to other yield calculations.**

Digging Deeper

To learn how Effective Yield works, let's start with a more basic yield measure — Yield-to-Maturity (YTM).

The Foundation: Yield-to-Maturity

The clearest yield measure for a "plain-vanilla" bond is the YTM formula. A plain-vanilla bond consists simply of fixed coupon payments and a final maturity, and has no option features, floating-rate elements, or other complicating attributes.

The YTM formula reconciles two key elements: the bond's cash flows (future coupon and principal payments) and the bond's current price. In essence, if we know the cash flows and the bond's price, we can simply calculate the discount rate that equates the two. That discount rate is the bond's YTM.

The equation uses the concept of "present value." Present value takes into account the idea that $100 cash today is more valuable than a promise of $100 sometime in the future; that is, we **discount** the value of future cash flows. The bond market's setting of yields determines **how much** we discount those future cash flows. The YTM formula solves for the discount rate (yield) that reconciles the bond's cash flows with its price.

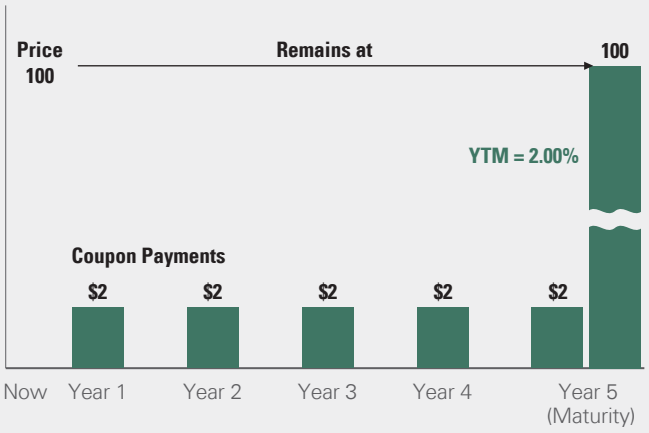
Consider a 5-year bond, priced at 100 (or "par"), with a coupon rate of 2% (see Exhibit 1). If you were to buy this bond at par, and the price stayed at par over the entire life of the bond, you would receive $2 every year (2% * 100). Therefore, the yield would be 2%.

YTM: Price Goes Up, Yield Goes Down

If the bond's price in the example above rises from 100 to 102, what happens to the yield? (See Exhibit 2.) **When a bond's price goes up, its yield goes down, and *vice versa*.** If we plug the new, higher price of 102 into the YTM formula and then solve for the new YTM, the yield is lower at 1.58%. Why?

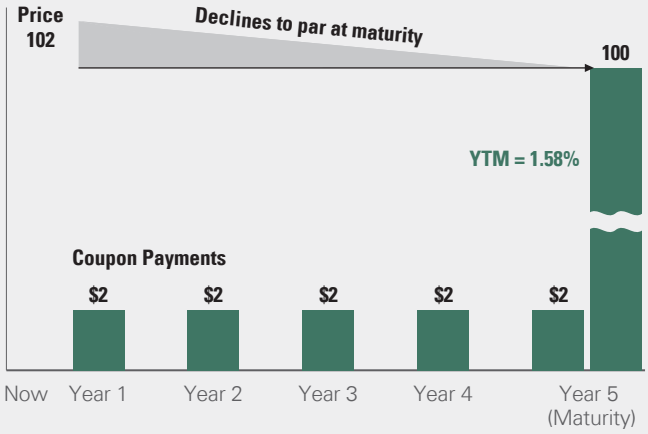
Fundamentally, someone has to be buying bonds, and someone has to be selling. When there are more buyers of bonds than sellers, prices rise and yields decline until the number of bonds available for purchase equals buyers' collective demand.

Exhibit 1: YTM of a Plain-Vanilla Bond, With 2% Coupon, Priced at Par



Source: Bessemer Trust

Exhibit 2: YTM When the Bond's Price Rises to 102



Source: Bessemer Trust

This is what happens in our example when yields decline:

1. The *future value of money* — which you'll remember is discounted from today's value — **becomes more expensive** (or, to be perfectly clear, less discounted).
2. The 2% *coupon* cash flows of our original bond **remain the same**.
3. The *market yield* is now **below** our original 2%.
4. Bond buyers are willing to pay a slightly **higher price** for the bond to receive its higher-than-market coupon/interest cash flow.

Problem: Callable Bonds

The YTM formula is adequate for plain-vanilla bonds, but what if the same bond in the example above is callable in three years? A callable bond can be bought back by the issuer (or "called"), often at a price of par, on dates specific to each bond's legal documentation. That is, the issuer owns a call option on the bond, and that call option can be valued using option-pricing formulas.

A dependable yield calculation for a callable bond should incorporate two things. First, the value of the embedded call option is calculated, and second, the future cash flows derived from the call option are discounted. But YTM is not capable of valuing the embedded call. So what do we do?

We could calculate the YTM based solely on the call price. This is called Yield-to-Call (YTC). But this measure ignores the optionality of the call and always assigns a 100% probability that the bond will be called even though that probability is highly variable. Thus, the most reliable measure lies somewhere between the YTM and YTC, depending on factors that determine the value of the call option.

It is easy to see how call options complicate yield calculations. Call options are just one type of feature found in bonds — there are put options, step-up features, prepayment options, and many, many more.

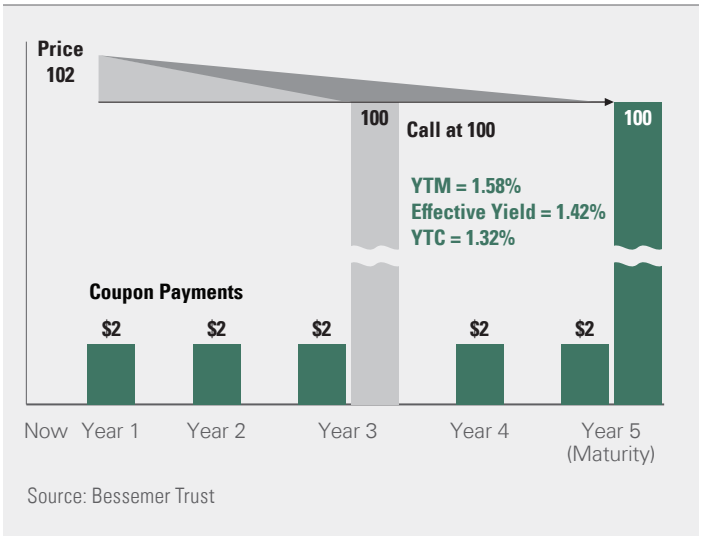
We believe the most comprehensive, consistent, and accurate way to measure the yields of complex bonds is Effective Yield.

Culmination: Effective Yield

Effective Yield is the most reliable way to measure a bond's yield. It both takes into account and correctly values the many different types of option features that may be part of a bond's structure (see Exhibit 3).

These features can include, for example, call options on a corporate or municipal bond; prepayment options on a mortgage-backed security; the option value of an inflation-protection feature; or even the option value of a hurricane-related insurance liability that is embedded in a "catastrophe bond."

Exhibit 3: Yield Mechanics of a Callable Bond



Source: Bessemer Trust

We do not show the formula for Effective Yield. The formula is modular, and, depending on what option features a bond contains, only the appropriate valuation modules are used for each type of option. These formulas are very complex and are different for each type of option. As a result, we have chosen to focus on the concepts supporting the Effective Yield measure, rather than on the underlying math.

Effective Yield is therefore a robust and preferable measure for two important reasons: It is **versatile**, and it is **comprehensive**. This is true across many different types of bonds. Whenever possible, we use Effective Yield in our clients' account statements and reports.

Appendix: Yield Measures We *Don't* Use, and Why

Yield-to-Maturity (YTM) is reliable only for plain-vanilla bonds without any option features. As a result, it is often too limited for our portfolio-reporting purposes.

For plain-vanilla bonds, YTM and Effective Yield will be the same; for anything more complex, YTM is potentially misleading.

Yield-to-Call (YTC) ignores option valuation and calculates a yield based on the call price and date, regardless of whether it's likely the bond will be called. But in reality, the probability that a call option is exercised is variable, depending on a number of factors. Not all bonds will necessarily be called.

Effective Yield correctly measures the option value and accurately utilizes it in calculating a yield.

Yield-to-Worst (YTW) also ignores correct option valuation and assumes the worst outcome between Yield-to-Maturity and Yield-to-Call (both above), incorrectly based on the notion that this approach is conservative.

Effective Yield correctly measures the option value and accurately utilizes it in calculating a yield.

SEC 30-Day Yield is used by the SEC to enable mutual funds to quote their yields consistently on an after-fee basis. It uses the past 30 days' worth of net investment income (investment income minus fees) divided by the maximum offering price of the fund during the previous 30 days. While consistent — and mutual funds are required to display the SEC's formulation — it is not a comprehensive measure of a bond portfolio's yield.

The SEC 30-Day Yield does not include all elements of a reliable yield calculation and can be a misleading measure of a bond portfolio's return on capital.

Current Yield or **Income Yield** does not include either option valuation or the time value of money, giving a potentially misleading picture of a bond's yield. While this yield measure is standard practice — and correct — for equities, it is too simplistic when applied to bonds because it can overstate (or understate) the yield on a bond's underlying capital.

Current Yield can be a misleading measure of a bond's return on capital.

About Bessemer Trust

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