

## Yield Curve

September 2004

### Yield Curve Basics

The yield curve, a graph that depicts the relationship between bond yields and maturities, is an important tool in fixed-income investing. Investors use the yield curve as a reference point for forecasting interest rates, pricing bonds and creating strategies for boosting total returns. The yield curve has also become a reliable leading indicator of economic activity.

The following article explains the basics: Starting at the beginning: What is yield? / What is the yield curve? / What determines the shape of the yield curve? / When does the slope of the yield curve change? / What are the different uses of the yield curve?

#### Starting at the beginning: What is yield?

*Yield* refers to the annual return on an investment. The yield on a bond is based on both the purchase price of the bond and the interest, or coupon, payments received.

Although a bond's coupon interest rate is usually fixed, the price of the bond fluctuates continuously in response to changes in interest rates, as well as the supply and demand, time to maturity, and credit quality of that particular bond. After bonds are issued, they generally trade at premiums or discounts to their face values until they mature and return to full face value. Because yield is a function of price, changes in price cause bond yields to move in the opposite direction.

There are two ways of looking at bond yields: current yield and yield to maturity.

- *Current yield* is the annual return earned on the price paid for a bond. It is calculated by dividing the bond's annual coupon interest payments by its purchase price. For example, if an investor bought a bond with a coupon rate of 6% at par, and full face value of \$1,000, the interest payment over a year would be \$60. That would produce a current yield of 6% ( $\$60/\$1,000$ ). When a bond is purchased at full face value, the current yield is the same as the coupon rate. However, if the same bond were purchased at less than face value, or at a discount price, of \$900, the current yield would be higher at 6.6% ( $\$60/\$900$ ).
- *Yield to maturity* reflects the total return an investor receives by holding the bond until it matures. A bond's yield to maturity reflects all of the interest payments from the time of purchase until maturity, including interest on interest. Equally important, it also includes any appreciation or depreciation in the price of the bond. *Yield to call* is calculated the same way as yield to maturity, but assumes that a bond will be called, or repurchased by the issuer before its maturity date, and that the investor will be paid face value on the call date.

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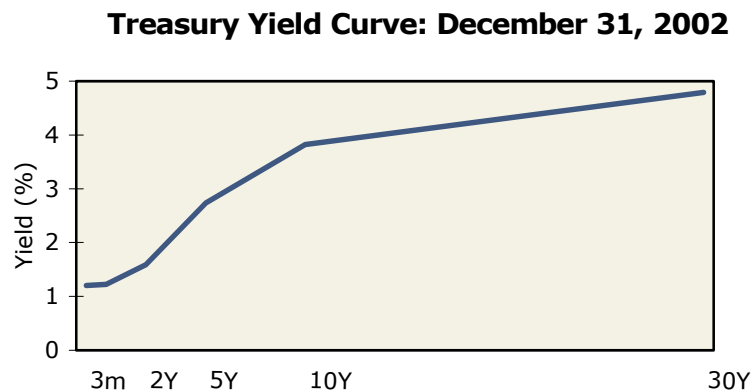
Because yield to maturity (or yield to call) reflects the total return on a bond from purchase to maturity (or the call date), it is generally more meaningful for investors than current yield. By examining yields to maturity, investors can compare bonds with varying characteristics, such as different maturities, coupon rates or credit quality.

### What is 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 and credit quality. 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.

Figure 1 below is the yield curve for U.S. Treasuries on December 31, 2002. It shows that the yield at that time for the two-year Treasury bond was about 1.6%.

Figure 1



Source: Salomon Yieldbook

A yield curve can be created for any specific segment of the bond market, from triple-A rated mortgage-backed securities to single-B rated corporate bonds. The Treasury bond yield curve is the most widely used, however, because Treasury bonds have no perceived credit risk, which would influence yield levels, and because the Treasury bond market includes securities of virtually every maturity, from 3 months to 30 years.

A yield curve depicts yield differences, or *yield spreads*, that are due solely to differences in maturity. It therefore conveys the overall relationship that prevails at a given time in the marketplace between bond interest rates and maturities. This

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relationship between yields and maturities is known as the *term structure of interest rates*.

As illustrated in Figure 1 above, the *normal* shape, or *slope*, of the yield curve is upward (from left to right), which means that bond yields usually rise as maturity extends. Occasionally, the yield curve slopes downward, or inverts, but it generally does not stay inverted for long.

### What determines the shape of the yield curve?

Most economists agree that two major factors affect the slope of the yield curve: investors' expectations for future interest rates and certain "risk premiums" that investors require to hold long-term bonds.

Three widely followed theories have evolved that attempt to explain these factors in detail:

- The *Pure Expectations Theory* holds that the slope of the yield curve reflects only investors' expectations for future short-term interest rates. Much of the time, investors expect interest rates to rise in the future, which accounts for the usual upward slope of the yield curve.
- The *Liquidity Preference Theory*, an offshoot of the Pure Expectations Theory, asserts that long-term interest rates not only reflect investors' assumptions about future interest rates but also include a premium for holding long-term bonds, called the *term premium* or the *liquidity premium*. This premium compensates investors for the added risk of having their money tied up for a longer period, including the greater price uncertainty. Because of the term premium, long-term bond yields tend to be higher than short-term yields, and the yield curve slopes upward.
- Another variation on the Pure Expectations Theory, the *Preferred Habitat Theory* states that in addition to interest rate expectations, investors have distinct investment horizons and require a meaningful premium to buy bonds with maturities outside their "preferred" maturity, or habitat. Proponents of this theory believe that short-term investors are more prevalent in the fixed-income market and therefore, longer-term rates tend to be higher than short-term rates.

Because the yield curve can reflect both investors' expectations for interest rates *and* the impact of risk premiums for longer-term bonds, interpreting the yield curve can be complicated. Economists and fixed-income portfolio managers put great effort into trying to understand exactly what forces are driving yields at any given time and at any given point on the yield curve.

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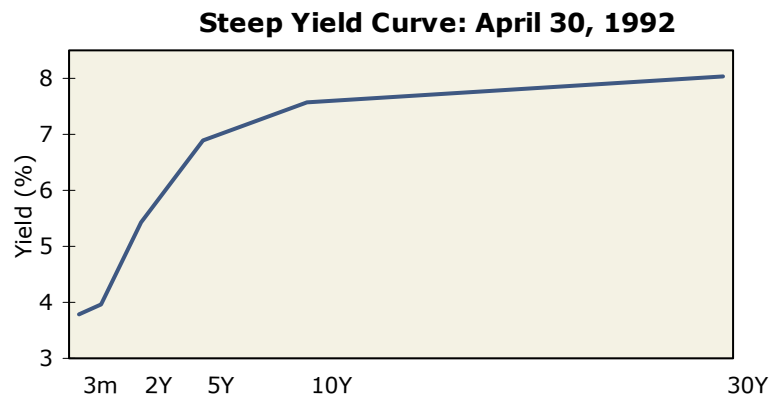
### When does the slope of the yield curve change?

Historically, the slope of the yield curve has been a good leading indicator of economic activity. Because the curve can summarize where investors think interest rates are headed in the future, it can indicate their expectations for the economy.

A sharply upward sloping, or *steep* yield curve, has often preceded an economic upturn. The assumption behind a steep yield curve is interest rates will begin to rise significantly in the future. Investors demand more yield as maturity extends if they expect rapid economic growth because of the associated risks of higher inflation and higher interest rates, which can both hurt bond returns. When inflation is rising, the Federal Reserve will often raise interest rates to fight inflation.

Figure 2 below shows the steep U.S. Treasury yield curve in early 1992 as the U.S. economy began to recover from the recession of 1990-91.

Figure 2



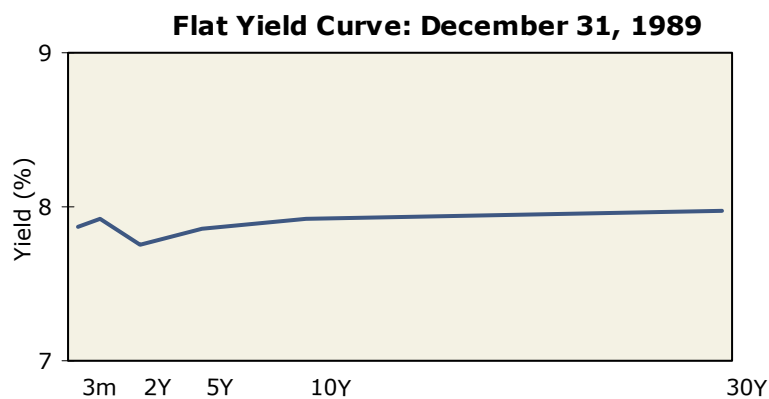
Source: Salomon Yieldbook

A *flat* yield curve frequently signals an economic slowdown. The curve typically flattens when the Federal Reserve raises interest rates to restrain a rapidly growing economy; short-term yields rise to reflect the rate hikes, while long-term rates fall as expectations of inflation moderate. A flat yield curve is unusual and typically indicates a transition to either an upward or downward slope. The flat U.S. Treasury yield curve in Figure 3 below signaled an economic slowdown prior to the recession of 1990-91.

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Figure 3



Source: Salomon Yieldbook

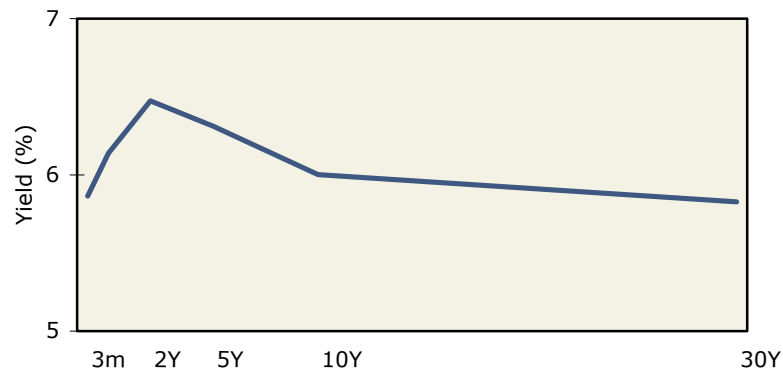
An *inverted* yield curve can be a harbinger of recession. When yields on short-term bonds are higher than those on long-term bonds, it suggests that investors expect interest rates to decline in the future, usually in conjunction with a slowing economy and lower inflation. Historically, the yield curve has become inverted 12 to 18 months before a recession. The graph below depicts an inverted yield curve in early 2000, almost a year before the economy fell into recession in 2001.

Figure 4

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### Inverted Yield Curve: March 31, 2000



Source: Salomon Yieldbook

#### What are the different uses of the yield curve?

The yield curve provides a reference tool for comparing bond yields and maturities that can be used for several purposes.

First, the yield curve has an impressive record as a leading indicator of economic conditions, alerting investors to an imminent recession or signaling an economic upturn, as noted above.

Second, the yield curve can be used as a benchmark for pricing many other fixed-income securities. Because U.S. Treasury bonds have no perceived credit risk, most fixed-income securities, which do entail credit risk, are priced to yield more than Treasury bonds. For example, a three-year, high-quality corporate bond could be priced to yield 0.60%, or 60 basis points, more than the three-year Treasury bond. A three-year, high-yield bond could be valued 4% more than the comparable Treasury bond, or 400 basis points “over the curve.”

Third, by anticipating movements in the yield curve, fixed-income managers can attempt to earn above-average returns on their bond portfolios. Several *yield curve strategies* have been developed in an attempt to boost returns in different interest-rate environments.

Three yield curve strategies focus on spacing the maturity of bonds in a portfolio. In a *bullet* strategy, a portfolio is structured so that the maturities of the securities are highly concentrated at one point on the yield curve. For example, most of the bonds in a portfolio may mature in 10 years. In a *barbell* strategy, the maturities of the securities in a portfolio are concentrated at two extremes, such as five years and 20 years. In a *ladder* strategy, the portfolio has equal amounts of securities

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maturing periodically, usually every year. In general, a bullet strategy outperforms when the yield curve steepens, while a barbell outperforms when the curve flattens. Investors typically use the laddered approach to match a steady liability stream and to reduce the risk of having to reinvest a significant portion of their money in a low interest-rate environment.

Using the yield curve, investors may also attempt to identify bonds that appear cheap or expensive at any given time. The price of a bond is based on the present value of its expected cash flows, or the value of its future interest and principal payments discounted to the present at a specified interest rate or rates. If investors apply different interest-rate forecasts, they will arrive at different values for a given bond. In this way, investors judge whether particular bonds appear cheap or expensive in the marketplace and attempt to buy and sell those bonds to earn extra profits.

Fixed-income managers can also seek extra return with a bond investment strategy known as *riding the yield curve*, or *rolling down the yield curve*. When the yield curve slopes upward, as a bond approaches maturity or “rolls down the yield curve,” it is valued at successively lower yields and higher prices. Using this strategy, a bond is held for a period of time as it appreciates in price and is sold before maturity to realize the gain. As long as the yield curve remains normal, or in an upward slope, this strategy can continuously add to total return on a bond portfolio.

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run Treasury for the 1 and 6 month, and 1, 3, 5 and 10-year periods as of the end of the month. The performance is represented before fees and expenses.

In an environment where interest rates may trend upward, rising rates will negatively impact fixed income securities. Bonds with a longer duration (a measure of the expected life of a security) tend to be more sensitive to changes in interest rates, usually making them more volatile than securities with shorter durations.

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