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Modeling Assumptions

by Catherine E. Ehrlich

This article focuses on one fundamental modeling assumption — the choice of a benchmark rate or risk-free rate.

This assumption did not require much analysis when I first began learning about the bond market. The yield curve derived from the Treasury market had all the characteristics that one would want.

The market was large — no one investor's buy or sell decisions influenced prices.

The market was liquid — traders could easily establish and liquidate positions, and there were no difficulties in determining market prices for various issues.

Finally, the securities are generally considered not to be at risk of default due to the reputation and financial health of the U.S. government.

Treasuries have been an accurate barometer of the bond market for almost a century. However, fundamental changes in the economy are currently making Treasuries a less than perfect reference rate.

This article re-examines this one assumption, not because it is the most exciting thing to happen to the bond market or because it is a new kind of risk, but rather to use it as a case study of how one needs to monitor fundamental market changes for their impact on assumptions.

Treasuries have been used for a lot of different things in their role as benchmarks. Most discussions of interest rate dynamics rely on a risk-free rate based off a class of securities whose market is large enough not to be impacted by any one trader, liquid and default-free.

While the "default-free" nature of Treasuries is still unquestioned, the size and liquidity of the Treasury market has been declining.

Treasury Curve Dynamics

The yield curve went from being a nice normal positively shaped curve at the end of 1999 to a humped curve by the end of January. The long end of the curve continued to fall, and by the end of August, there had been over a 100 basis point decrease in slope.

Interest rate theory has hypothesized three fundamental influences on yield curvature.

These are:

- **Pure Expectations Theory**
  All government bonds theoretically have the same near term expected return. A positively sloped yield curve is consistent with market expectations for an increase in rates, since the higher yields earned by long-term investors will be offset by capital losses. If investors expect that their long-term bonds will lose value from an increase in rates, they will demand higher initial yields as compensation. Using this theory you can derive a forward curve, which is the market's expectation of future rates.

- **Risk Premium**
  A bond's risk premium is the difference between that long or intermediate term bond's expected one period return and the short-term risk-free return. The different forms of this theory vary by whether that premium is sometimes or always positive and why. The liquidity premium theory is based on the assumption that most investors dislike price volatility and, therefore, long-term investors must be compensated for the extra price volatility that long-term bonds have relative to short term bonds. The preferred habitat theory argues that there are different markets for short term and long-term bonds.

- **Convexity Bias**
  Bonds with positive convexity will perform better when interest rates change than similar bonds with zero or negative convexity. Therefore, if investors expect interest rate volatility, they will give up yield to get convexity.

Generally, all three influences are at work in any given economic situation. All reflect investors' expectations, risk aversion, and market forces for the bond market in general. The influences that were causing contortions in the shape of the Treasury curve this year did not appear to be present for other segments of the fixed income market. While some of the curve inversion may, in fact, be due to investors' expectations of rate decreases, given the economic environment and other indicators, it more likely reflects supply concerns. The continuing decrease in the amount of outstanding Treasuries combined with an announced plan of buybacks caused bond traders to grow concerned about the future supply of long-term Treasuries. This decoupling of the Treasury market from the other fixed income markets has had unforeseen impacts on pricing and modeling.

Treasury supply decreased from mid-1996 to mid-2000. In mid-1996, there were outstanding Treasuries maturing in each of the next thirty years. By mid-2000, there are fewer outstanding bonds at each point, and no maturities between 10 and 15 years. This is primarily the result of bond calls and also of buy backs. Obviously, it is incredibly hard to construct a curve when you have no data points.

During this period, as supply at the long end was decreasing, there became an increasing discrepancy between on-the-run and off-the-run Treasuries.

On- the-runs have lower yields than off-the-runs, due to their liquidity. Prior to September 1998, i.e., the market disruption caused by Long-Term Capital

Management, this liquidity spread was stable at about 4-5 basis points. Afterwards, it has been as much as 25 basis points. While it has retreated somewhat from the highs immediately following the crisis, it has never settled down to its earlier level. Typically the on-the-run curve has been more volatile — buffeted by auctions. This has made the off-the-run curve a better pricing benchmark. However, the paucity of supply for maturities longer than 10 years out coupled with the need to remove on-the-run issues makes this a difficult curve to plot.

The Treasury is committed to maintaining the liquidity of the Treasury market to minimize borrowing costs. By issuing laddered maturities, its borrowing costs are more predictable. This also increases the popularity of Treasuries to investors.

The Treasury also announced a series of buybacks of longer maturity off-the-run issues. This caused the long end of the curve to become expensive for investors, as noted earlier.

Impact on Modeling Assumptions

Why does this matter beyond Treasury arbitrage opportunities? There are an overwhelming number of issues in the U.S. taxable fixed income market — over 70,000 issues excluding pools. Most of these bonds don't trade every day. Therefore, bond market practitioners are forced to manufacture prices. Most pricing systems depend on matrix pricing of varying degrees of sophistication. The underlying premise of this methodology is that a single OAS curve can be determined for certain bonds that share common characteristics. For instance, all bonds with observed or broker prices in the same sector and with the same quality may be grouped together to calculate the average OAS. This will generally vary by duration. Then, any bond in this sector and quality group can be priced using this OAS for its own duration. In practice, it is not always possible to obtain prices on a large enough universe of bonds in any one group to generate an entire OAS curve. Various smoothing and extrapolation techniques must be employed. When the Treasury curve changes shape differently from the rest of the bond market, these techniques become flawed, and the result can be bad pricing.

Simulations generally assume constant spreads to manufacture prices throughout time. Increasing spread volatility calls this assumption into question.

Benchmark Alternatives

What can we use for a benchmark curve? There are four alternatives:

- **On-the-Run Curve**
  As we know, the OTR curve has many missing points and has had volatility associated with auctions that the rest of the market doesn't experience.

- **All Treasury Curve**
  A smoothed all Treasury curve does have new (since 1998) volatility, and is also subject to supply problems.

- **Agency benchmarks**
  In 1998, FNMA began a benchmark notes program, and other agencies have followed. These programs make the issue and maturity structure of Agencies more predictable. These securities do trade with some credit risk, and the issues are much smaller than Treasuries. Under some projections, the size of this market could surpass Treasuries in the next 10 years. Issue-specific differences could become important. The major drawbacks to using agencies are the illiquidity of many issues, and the callable features contained in many issues. This market is also subject to supply problems that currently plague the Treasury market.

- **Swap Curve**
  The swap market is not risk-free, but is a reasonable indicator of systematic risk conditions. This is a very active market with narrow bid-ask spreads. Turnover is considerable higher than coupon agencies, but is less than Treasuries. Liquidity has been somewhat hindered by counterparty credit risk. The absence of an underlying fundamental asset is an advantage — no supply limit. Since corporations can use a combination of bank lending and the swap market as an alternative to debt issue, this market is highly correlated with other spread products. Therefore, this market has potential to be a better hedge than Treasuries. In fact, its major drawback has been a lack of familiarity. Bond markets in other countries have followed the swap curve when their sovereigns experienced similar supply problems.

Market and Modeling Implications

LIBOR OAS has exhibited more stability than Treasury curve OAS. Market pricing is increasingly being quoted off of LIBOR. Also, it is easier to manage basis risk by hedging with LIBOR swaps than Treasury-based instruments.

While these are all attractive advantages for market participants, existing systems and assumptions will need to be modified and/or monitored, if a different benchmark is used. Historical spread data is relative to Treasuries and will need to be adjusted. The volatility parameters of the new term structure will need to be calculated and analyzed. Research will need to be done on the appropriate reference rates for other cash flow models, such as mortgage prepayments.

The impact of changing economic conditions on modeling assumptions will always need to be monitored. Generally, new assumptions or methodologies need to be implemented quickly in response to market changes. However, since so much in fixed income analytics is built upon this one assumption, care should be taken in order to avoid unforeseen discrepancies.

Catherine E. Ehrlich, FSA, MAAA, is a consulting actuary at Milliman & Robertson in New York, NY. She can be reached at cathy.ehrlich@milliman.com.