Jonathan Carmel
jcarmel@lehman.com
Lev Dynkin
ldynkin@lehman.com

THE PROSPECTS OF NEGATIVE ANNUAL RETURNS FOR SHORT-DURATION TREASURY BENCHMARKS

We analyze the magnitude, likelihood, and timing of the Treasury curve backup from current levels, which may cause negative annual returns for the 1-3 Year Treasury Index and the 2-year on-the-run note.

The 1-3 Year Treasury Index has never experienced a negative 12-month total return in the Lehman data history. The data for this index start in January 1992. The lowest 12-month return recorded for this index is +0.51% and came during the January-December 1994 period. Data for the on-the-run 2-year note stretch back an additional seven years, to January 1985, and also show positive realized total returns for each 12-month interval. Many users of the 1-3 Year Treasury Index prize preservation of capital and have found comfort in this unbroken streak of positive realized annual returns. In particular, this benchmark has been very popular with central banks due to its liquidity, capital protection, and high reward per unit of duration.

However, as of the end of September, the yield on the Lehman 1-3 Year Treasury Index has dropped to 2.79%, the lowest level on record. This low yield level provides relatively thin protection against the prospect of a negative cumulative return over the upcoming 12 months. The small safety margin against negative realized returns is particularly troublesome given the current steepness of the yield curve and its implications for the prospect of future yield increases and negative price returns. Investors in this part of the curve may be concerned that an unexpectedly strong and fast economic recovery could cause the Fed to take back all of the recent easings and that such a scenario could result in the first negative annual return for 1- to 3-year Treasuries. This article assesses the likelihood of negative total returns for the 1-3 Year Treasury Index and the 2-year on-the-run Treasury note over the coming 6-month and 12-month holding periods.

The Timing of Tightening

One might be tempted to use the standard duration-based approximation for returns

$$\text{index return} \approx y\,\Delta t - D\,\Delta y \qquad (1)$$

to assess the yield increase required for the index to experience negative returns. At the end of September, index duration was 1.70 years. With this number and a yield of 2.79%, Equation (1) finds that a 164 basis point increase in index yield would be sufficient to push 12-month returns to zero, and any increase in yields beyond this level would results in negative cumulative returns.

[1]Due to monthly rebalancing, one would expect index duration in six months to remain close to unchanged.

Equation (1) is only accurate for short holding periods in which both yield changes Δy and time changes Δt are small. Moreover, it assumes that time return is unaffected by the yield change. Suppose the increase in yield occurred halfway into the 12-month investment period. Then in six months, the index would suffer a similar negative price return of roughly -(1.7)(1.64) = -2.79% at the moment of the yield increase.[1] However, index yield would rise to 4.43% for the second six months of the investment horizon. The resulting increase in time return would boost the index's 12-month cumulative return by roughly 82 basis points and result in a positive total 12-month return of roughly 0.82%.

Timing is crucial. If the increase in yields occurs immediately, then the index will benefit from the higher time return for the entire 12 months. On the other hand, if the yield change occurs at the end of the investment period, the increase in index yield will cause the index to have an adverse price return with no accompanying increase in time return over the 12-month horizon. Figure 1 reports the yield increases required for the 1-3 Year Treasury Index to experience negative 12-month total returns under three scenarios: 1) all increases in yield occur immediately, 2) yield increases occur at a constant rate over time, and 3) all yield increases occur at the end of the investment period.

The yield increase resulting in negative annual returns varies from 164 basis points to 356 basis points, depending on timing. If we take the constant increase scenario as our base case, a rise of 225 basis points is certainly within the realm of possibility. The standard deviation of 12-month cumulative yield changes for the 1-3 Year Treasury Index is 160 basis points. A 225 basis point move over a 12-month period would be a 1.4 sigma event. In fact, the previous 12 months saw yields on 1- to 3-year Treasuries drop by 329 bp. Given that yields changed by 329 basis points in the past 12 months, the possibility of a 225 basis point rise cannot be dismissed, particularly if the economy were to recover more quickly and vigorously than expected.

Rolldown and Expected Future Yield Curve Shifts

The shape of the yield curve may provide important information about likely yield changes. One important factor influencing future index yield is the change in index yield that comes from rolling down the current yield curve. Rolldown effects were approximated from the shape of the off-the-run spline. The current yield curve is quite steep and

Figure 1. **Yield Increase Required for Negative Total Return,** bp, 10/1/01

Yield Increases Occur	6-Month Holding Period	12-Month Holding Period
Immediately	109	356
At a Constant Rate	94	225
At the End	82	164

offers a 5.2 basis point decrease in yield at each month's rebalancing. Over six months, this translates into a decline of 31 basis points. Over a year, it comes to a 62 basis point drop.

These rolldown yield changes must be combined with the numbers from Figure 1 to obtain the yield curve shift that would result in a negative realized return. Figure 2 shows that the short end of the yield curve would have to shift up by more than 125 bp to result in a negative 6-month total return. A negative 12-month holding period return would require the short end of the curve to shift up by more than 287 bp. Both of the numbers are under the "constant rate increase" scenario.

Yield Curve Steepness

Yield curve steepness tends to be mean reverting. Abnormally steep yield curves eventually revert to normal steepness. Similarly, abnormally flat or inverted yield curves can also be expected to revert to normal steepness. As one moves down the end of September yield curve from the point that matches current index duration to the point 12 months farther out on the spline, yields increase by 59 basis points. Typically, the point 12 months farther out on the Treasury spline from the spot that matches the duration of 1- to 3-year Treasuries has 20 basis points additional yield. It would be reasonable to expect this 38 basis points of abnormal slope to be erased over some future time horizon.

Of course, it isn't clear how much of this 38 basis point move, if any, will occur over the next 12 months. In addition, it isn't clear how much of the movement will result in an increase in 1- to 3-year yields, rather than a decrease in 2- to 4 year yields. However, once the economy hits bottom, one can be confident that interest rate movements will be uniformly in the upward direction.

Regardless of how one allocates the 38 basis points of abnormal steepness in this part of the curve, it clearly cannot be more than a minor factor relative to the 287 bp yield shift required to put 1- to 3-year Treasuries into negative annual return territory. For 6-month returns, the abnormal steepness is 20 basis points, once again falling far short of what would be required to generate negative 6-month holding period returns.

Figure 2. **Rolldown Effects & Curve Shift Required for Negative Returns,** bp, 10/1/01

Increases Occur	6-Month Holding Period			12-Month Holding Period		
	Breakeven Index Yield Increase	Rolldown	Breakeven Curve Increase	Breakeven Index Yield Change	Rolldown	Breakeven Curve Increase
Immediately	109	31	140	356	62	418
At a Constant Rate	94	31	125	225	62	287
At the End	82	31	113	164	62	226

Figure 3 incorporates rolldown and yield curve steepness effects to estimate the unanticipated shift in the Treasury curve required to push total returns negative. If yield increases occur at a constant rate, the Treasury curve must increase by 287 bp (Figure 2) to result in negative total returns. Current yield curve steepness suggests that the market anticipates a 38 bp increase, implying that 249 basis points of unanticipated yield curve increases will lead to breakeven total returns for the year. The analysis estimates that anything more than this will lead to negative total returns over the upcoming 12-month holding period.

2-Year On-the-Run

As noted earlier, the 2-year on-the-run Treasury note has rewarded investors with positive total returns over every 12-month interval in our data history dating back to 1985. At the end of September, the 2-year on-the-run had a yield of 2.82% and a 1.84-year duration. If we were to pursue breakeven analysis by applying these numbers to the standard duration-based approximation (Equation (1)), the prediction obtained is that a 153 basis point increase in yield would be sufficient to cause negative 12-month returns.

However, we have already seen that the standard duration-based approximation for returns can be misleading. This is particularly the case for the 2-year on-the-run. PC Product, for instance, reports that a 365 basis point shift in the Treasury curve is required to send 12-month returns on the 2-year note to zero. For holding periods with nontrivial length, it is important to apply the complete quadratic approximation for realized return:

$$\text{index return} \approx y\,\Delta t - D\Delta y + \tfrac{1}{2}C(\Delta y)^2 + \tfrac{1}{2}y^2(\Delta t)^2 + (1 - yD)(\Delta t)(\Delta y) \qquad (2)$$

where D is duration and C is convexity. For short maturity indices such as the 1-3 Year Treasury Index, convexity will be quite small, allowing us to ignore the third term. Similarly, y^2 is a very small number $(0.0282)^2$, implying the fourth term in Equation (2) can also be safely ignored. However, the last term in Equation (2) will be significant. (1 - yD) is close to one and Δt equals one for an annual investment horizon.[2] Therefore, the last term will be on the order of Δy and is important in determining the breakeven yield change.

Figure 3. **Steepness Effects and Curve Shift Required for Negative Returns**, bp, 10/1/01

	6-Month Holding Period			12-Month Holding Period		
Increases Occur	**At Start**	**Constant Rate**	**At the End**	**At Start**	**Constant Rate**	**At the End**
Breakeven Index Yield Increase	109	94	82	356	225	164
Rolldown	31	31	31	62	62	62
Abnormal Steepness	20	20	20	38	38	38
Breakeven Unanticipated Curve Increase	120	105	93	380	249	188

Applying the end of September index numbers to Equation (2) estimates the breakeven yield change required for a negative 12-month total return on the 2-Year On-the-Run to be 316 basis points. Adding rolldown effects brings the estimated yield curve increase required for negative 12-month returns to be 378 bp, reasonably close to the more accurate PC Product number which is based on complete repricing.

The Hold to Maturity Effect

The 1-3 Year Treasury Index and the 2-year on-the-run offer comparable yields (2.79% for the 1-3 Year Index, 2.82% for the 2-year note) and the 2-year note has a slightly longer duration: 1.84 years versus 1.70 years for the index. Yet the 2-year note provides more protection against a negative 12-month return. The key factor behind this is that the index rebalances each month to maintain an approximately constant duration of 1.7 years, while the duration of the 2-year note gradually declines from 1.84 years to 0.90 years. The time-averaged duration of the 1-3 Year Index is roughly 1.63 years, compared with 1.37 for the 2-year note. While the current duration of the 2-year note is longer than the current duration of the 1-3 Year Index, the time-averaged duration of the 1-3 Year Index is much longer than the time-averaged duration of the 2-year note over the upcoming 12-month period (1.63 versus 1.37).

Alternatively, this can be thought of as a "hold until maturity" effect. The 2-year note will certainly return its 2.82% yield if held for two years, regardless of any interim yield changes. A 12-month holding period for a 2-year note is a sufficiently close to the security's total life that a partial "hold until maturity" effect, represented by the last term in Equation (2), greatly increases the yield change required for negative cumulative returns.

Yield Curve Volatility

While the current abnormally steep yield curve may not have much impact on expected interest rate movements, one may be concerned that they are an indicator of an abnormally volatile interest rate environment. Swaption volatilities can be used to assess current volatility. Swaption volatilities are typically quoted in terms of "yield volatilities," which are at an all-time high for short-tenor, short-maturity swaptions. For instance, a 1-month option on a 2-year swap has a record implied yield volatility of 35.1%, more than twice its historical average of 17.25%.

However, the volatilities relevant for our analysis are basis point volatilities. Basis point volatility is yield volatility multiplied by yield level. Currently, the combination of extremely low yield levels and extremely high yield volatilities has caused basis point volatilities to be near their average levels. Basis point volatility on the 1-month, 2-year swaption mentioned above is 121 basis points, slightly above its typical level (101). On the basis of this implied swaption volatility, an unanticipated 249 basis point increase in rates

---

[2] The last term in Equation (2) can be safely ignored for investment strategies such as the 1-3 Year Treasury Index that rebalance monthly. The proper way to apply Equation (2) to assess annual returns with monthly rebalancing is to set Δt to (1/12) and then compound the results. Setting Δt to (1/12) reduces the importance of the last term in Equation (2) by a factor of 12 relative to the importance of the standard-duration term.

would be slightly more than a 2-sigma event for a 1-year horizon and clearly cannot be dismissed as impossible.

What to Do?

Investors who cannot tolerate negative annual returns may wish to shorten portfolio duration. 12-month bills always provide 100% safety against negative annual returns. Of course, it is not necessary to go that far. Our analysis of a buy-and-hold position on a 2-year note showed that a position with a time-averaged duration of 1.37 requires the yield curve to increase by more than 365 basis points for negative 12-month returns to be realized. The current duration of the 1-3 Year Treasury Index is 1.70. Moving portfolio duration from this range down to the vicinity of 1.3 years should provide very solid protection. Currently the 1-year part of the Treasury curve is rich, offering yields below both the 6-month and 2-year regions. Thus, moving to 1-year maturity assets will adversely affect yield. An alternative would be to invest in 3-month and 6-month bills, but this approach is likely to cause investors to reinvest at lower rates should the Fed continue to ease.

In addition to shortening duration, investors may wish to consider shifting to high grade spread product. At the end of September, the yield of the 1-3 Year Agency Index was 3.13%, offering investors a somewhat larger cushion against the prospect of negative annual returns. 1- to 3-year agencies also had a slightly shorter duration (1.67 versus 1.70). Figure 4 reports the yield increase required for negative 12-month returns for 1- to 3-year U.S. Treasuries, 1- to 3-year U.S. agencies, and investment in the 2-year swap (rebalanced monthly). All numbers assume a gradual rise in yields. 1- to 3-year agencies required an additional 33 basis point increase in rates before suffering negative 12-month returns.

Figure 4. **Yield Increase Required for Negative Total Return, Constant Increase Scenario**

	6-Month Holding Period	12-Month Holding Period
1-3 Year UST	94	225
1-3 Year USA	105	258
2-Year Swap (rebalanced monthly)	97	230

Publications—L. Pindyck, A. DiTizio, B. Davenport, W. Lee, D. Kramer, J. Threadgill, R. Madison, A. Acevedo, K. Kim, C. Rial, J. Batstone