

# Quantitative Portfolio Strategy

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## INDEX DURATION CHANGES IN A VOLATILE INTEREST RATE ENVIRONMENT

Falling interest rates tend to increase the duration of fixed income assets. The mechanism by which bond durations react to yield changes is easily explained for coupon bonds with no embedded options. Duration can be viewed as the average time to cashflow, weighted by the present value of each flow. Higher yields mean greater discounting, making the principal payment less valuable compared to the nearer coupon flows. Lower yields, by contrast, make the principal payment worth more, and thus increase duration. The magnitude of the duration change due to a parallel shift in the curve can be estimated by a bond's convexity. The higher the convexity, the greater will be the change in duration for a given parallel shift in the Treasury curve.

Yet, despite the precipitous decline in short term rates since the beginning of September, the modified adjusted duration of the Lehman Brothers U.S. Aggregate Index (returns universe) declined during September from 4.57 to 4.42. Although the Index would have shortened to 4.52 due to the passage of time alone, market movements still produced a 0.1 decline in the duration of the Aggregate Index.

A partial explanation for this paradox lies in the fact that the primary yield curve movement seen in September was not a parallel shift downward, but a steepening of the curve. While a surge in demand for liquidity drove 2-year Treasury yields down 78 bp, a concern about new Treasury supply pushed 30-year Treasury yields up by 6 bp. The on-the-run 10-year Treasury yield declined by 25 bp. The pivot point for the curve twist was approximately the 23-year Treasury (the 7½s of November 2024) whose yield was unchanged. In addition, the steepening of the swap rate curve was less pronounced than for the Treasury curve: 2-year swap rates declined 74 bp, 10-year swap rates fell 42 bp and the 30-year swap rate fell 14 bp. Given that 77% of the Aggregate Index is spread product, the different behavior of the swap rate curve versus the U.S. Treasury curve could have different implications for changes in the index's duration.

Another explanation for the duration shortening is that different types of bond structures react differently to changes in yield. For zero coupon bonds, the duration is always equal to time to maturity and does not react to yield changes. For bonds with embedded call options (e.g., mortgage passthroughs), the situation is more complex. Falling yields can trigger faster repayment of principal, as issuers and homeowners take advantage of lower interest rates. This effect leads to a shortening of duration, opposite to the duration extension effect described above. As both of these influences occur simultaneously, duration can move in either direction for these types of securities.

The duration of an index is computed by averaging over all component securities. In a non-parallel yield curve movement, the duration changes can be very different for different parts of the index. For example, during September the duration of the Treasury Index decreased from 6.11 to 6.06 even though the average yield on the index

decreased 43 bp from 4.54% to 4.11%. However, the duration of the Treasury Index would have shortened to 6.04 due solely to the passage of time. Consequently, curve movements caused the index duration to increase, as expected. The Intermediate Treasury Index, comprised of maturities 10 years and under, experienced a yield change of –65 bp, from 4.07% to 3.42%. Its duration declined from 3.27 to 3.23. However, its duration would have declined to 3.20 due solely to the passage of time. Even though the convexity of the Intermediate Treasury Index is relatively low (0.17), the large decline in yields caused the index's duration to extend by 0.03. At the other end of the maturity spectrum, the average yield of the Long Treasury Index declined only 5 bp, from 5.37 to 5.32, and its duration was unchanged at 11.08. Given that its duration would have declined to 11.0 due solely to time, curve movements also caused its duration to extend by 0.08. Because longer duration bonds, with their higher convexities (1.84), react more to a given yield change, the relatively small yield decline at the long end produced considerable duration extension.

The effects of changes in the shape of the curve on duration can be seen in the Credit Index whose yield declined from 6.14% to 6.10% and whose duration declined from 5.56 to 5.47. Due to the passage of time the duration would have declined to 5.51 implying that market movement caused duration to decline by 0.04. This average duration change was due to opposing changes at the two ends of the curve. At the long end, the yield increased from 7.20% to 7.50% and duration (net of the effect of time) decreased 0.06. At the short end the opposite occurred as the yield decreased from 5.78% to 5.64% producing a duration extension of 0.01 (net of time). However, the impact of the yield increase at the long end was bigger than the decrease at the short end, producing a net decrease in index duration of 0.04, ignoring the effect of time. In agencies, callability kicks in. So in the short end, even though yields decreased, duration decreased as well. Overall, net of time, the duration of the Credit Index declined by 0.02.

The duration of the Mortgage Index declined by 0.31. Due to the passage of time, the Mortgage Index would have shortened by 0.08. The net shortening due to market movement (0.23) is not surprising considering that 5-year and 10-year Treasury yields declined by 59 bp and 25 bp, respectively. Generally, mortgage durations shorten as Treasury yields fall because prepayments become more likely. However, mortgage prepayments are sensitive to mortgage, not Treasury, yields. Mortgage spreads widened in September, offsetting some of the fall in Treasury yields. For example, a 5-year – 10-year Treasury blend with the same duration as a TBA 30-year GNMA 6% fell in yield by 45 bp whereas the GNMA yield fell only by 18 bp. Secondly, the yield curve steepened significantly as the 2-year – 10-year Treasury yield spread increased from 121 bp to 174 bp. The steeper curve implies higher forward rates that tend to dampen prepayment forecasts and limit the decrease in duration due to lower yields. Overall, the steeper curve offset somewhat the decline in mortgage yields, producing a duration shortening due to market movement of 0.23.

These details highlight that monitoring the overall duration of a portfolio with respect to its benchmark is not enough. Because changes in the curve (both Treasuries and swaps) affect sectors differently, investors who overweight and underweight various sectors, but keep their overall duration neutral with respect to their benchmark, must also monitor their relative curve sensitivities. This is why key rate durations are very important. While the overall duration of the Aggregate Index declined by 0.15, due primarily to the shortening of its large mortgage component, Figure 1 shows that there were significant increases in some of the index's key rate durations.

When the yield curve changes dramatically it is important for portfolio managers to identify any duration drift of their portfolio versus the index. In particular, managers must closely monitor any drift in key rate durations versus their benchmarks to avoid any unintended partial duration exposures. Given the possibility of continued yield curve volatility in the current environment, monitoring key rate duration drift is important. Lehman's PC Product and POINT systems allow investors to monitor duration exposures relative to their benchmark on a continuous basis.

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Figure 1. **Key Rate Durations U.S. Aggregate Index, September 2001**  
Returns Universe

<b>Maturity</b> (Year)	<b>KRD</b> (8/31)	<b>KRD</b> (9/28)
0.5	0.174	0.110
2	0.696	0.851
5	1.148	1.261
10	1.135	0.866
20	0.917	0.825
30	0.526	0.504