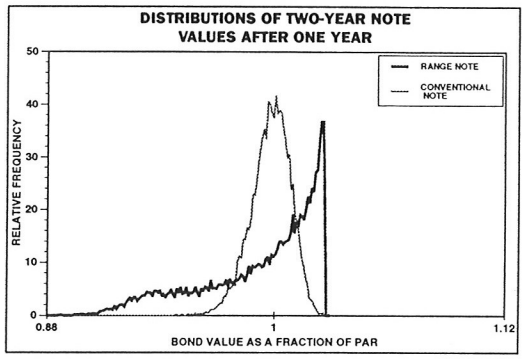
LEARNING CURVE

MARKET RISK OF RANGE NOTES

Range notes provide investors with an above-market coupon, but they must agree to forego coupon payments altogether in the event that LIBOR falls outside prescribed bounds—the range or corridor (DW, 6/12/93). Also known as corridor notes, the complexity of the pricing of these notes creates the potential for the investor to underestimate the "corridor risk."

Typical range notes may have a maturity of two years and currently pay an 8.8% coupon semi-annually. In this *Learning Curve*, we shall consider the issuer to be highly rated so that its cost of funding is equivalent to the LIBOR/swap yield curve, as the swap curve implies rates at which a double-A rated corporate pays fixed. The specific numerical values we employ are appropriate for the U.S. dollar interest rate environment of mid-September 1994, with six-month LIBOR at 5.44%. The market coupon for a conventional note, at 6.5%, is more than 200 basis points lower than that of the range note coupon. In the range note, the investor receives the high coupon only when six-month LIBOR remains within the range 4.5-7.5%. The true coupon is computed on a daily accrual basis.



An investor may create a synthetic range note by pairing a conventional floating-rate note (FRN), which pays LIBOR for each coupon, with an offer-side accrual range floater. In this accrual swap, the investor pays LIBOR and receives 8.8% when LIBOR is inside the corridor and zero when LIBOR is outside the corridor.

On the offer-side swap component of the range note, the investor pays LIBOR and receives a fixed rate accrued at 8.8% when LIBOR trades within the corridor and a fixed rate accrued at zero when LIBOR is outside. We can rewrite this description of what the investor receives in the note. The investor receives 8.8% for all LIBOR settings. He then pays 8.8% when LIBOR exceeds 7.5%. He also pays 8.8% if LIBOR falls below 4.5%. The reader may easily verify that the net result of these three statements is what we have already described: that the investor receives 8.8% if, and only if, LIBOR is in the 4.5-7.5% corridor.

The above descriptions—in which the investor pays 8.8% when LIBOR exceeds 7.5% and pays 8.8% when LIBOR falls below 4.5%—also describe the payoffs of a digital cap and digital floor. This description is helpful in assessing the price implications of the range note in which the investor is short those digital options.

Our pricing model in this *Learning Curve* does not literally specify that the range note contains a cap and floor for every day. Rather, we space 10 to 20 cap/floor combinations within each period. A Monte-Carlo algorithm varies the yield curve stochastically at each time step.

This is the point at which investors can underestimate the "corridor risk." It is quite possible that the forward curve of risk-neutral expected LIBOR values lies entirely within the corridor over the swap tenor. Thus, the total intrinsic value of the digital options the investor has sold is zero. The investor, therefore, may believe that he is likely to receive the full coupon for the life of the swap. In fact, the time value of the digital options is quite high. And it is precisely this component of the option value that is most difficult to estimate.

We now compare two notes: a plain vanilla conventional note paying a 6.5% coupon and the range note that pays 8.8% accrued only when LIBOR is within the corridor range. The probability density functions for the note values immediately after the 12-month coupon payments appear in the accompanying graph.

The nearly symmetric curve has its peak near 100% of par and corresponds to the conventional note. The second curve, with a peak position to the right of the standard note's curve, describes the range note's value. The density function for the conventional note coincides with one's intuition. But the range note is a different story entirely. The peak at approximately 2% above par—immediately after the 12 months of coupon payments—represents the investor's position if LIBOR remains well within its corridor over the course of the first year. This upside, however, is cut off abruptly above 2%.

Both positive and negative deviations of the yield curve tend to decrease the range note's value and, hence, produce the extended downside tail on the distribution. Sub-par values arise from LIBOR's movement outside the corridor as well as from an increase in the price of the options which the investor has sold, as LIBOR simply approaches the corridor boundaries.

These probability density functions make the point clearly. The investor has a greater upside potential in the range note relative to a conventional note, but also has a greater exposure to loss. In a $100 million structured note investment, there is a significant probability—about 14%—that the investor will experience a loss after one year of more than $6 million. The probability of a loss of this magnitude in the associated standard note, on the other hand, is essentially zero—less than 0.01%.

We chose to scrutinize two-year notes, as opposed to those with a longer tenor, for two reasons. Many range notes have been limited to a two-year maturity. And instruments with longer tenors would have correspondingly greater pricing uncertainties.

This week's Learning Curve was written by ***Joseph Pimbley****, senior analyst-structured finance at* ***Moody's Investors Service****.*