STRUCTURAL SURVEY

WHAT TOOLS SHOULD investors use to assess the risk in different types of structured notes and to assess how efficiently they are priced? Sumitomo Bank Securities' Scott Peng, co-author with Ravi Dattatreya of *The Structured Note Market: The Definitive Guide for Investors, Traders and Issuers*, says investors have long relied on duration to measure risk in the fixed-income market. But while this is an easy measurement to understand, it is, perhaps, too simple to analyse structured notes. After all, it assumes a parallel yield curve shift (to allow comparison of notes across different maturities). Clearly, such an assumption will not measure any impact of yield curve steepening or flattening on the value of any note.

Peng recommends Key Treasury Rate Duration (KTRD) analysis. The concept of Key Rate Duration was first developed by Thomas Ho[1] and measures the change in the value of a note with respect to a one-basis-point change in a particular key rate. Ho used the zero Treasury rates as key rates, so the risk of a note is expressed not as a single number but as a graph showing the durational risk with respect to individual zero rates of different maturities. KTRD extends the concept by using the components of the Treasury curve as the underlying key rates. "This makes the risk analysis of structured notes much more intuitive," explains Peng.

He recommends breaking down the risk of a structured note into two parts: a discounting component and an index component. The former describes the duration of the note with respect to the comparable maturity Treasury rate (eg, the five-year Treasury). It is present in all fixed maturity notes (structured and unstructured) and decreases as the note matures. The index component of risk includes cashflows that are indexed to any rate – such as coupons linked to Constant Maturity Treasury (CMT).

KTRD analysis requires identification of, first, the discounting and index components of risk, and, second, of the key Treasury rates which correspond to them, bearing in mind that each risk component may contain more than one relevant key Treasury rate. Next, the key Treasury rate duration of the note (as defined by a change in present value with respect to a one-basis-point movement of each rate) is calculated. KTRD risk analysis can then be represented visually by plotting the net KTRD of a structured note over a KTRD maturity spectrum.

Consider, for example, a five-year US agency structured note with a quarterly coupon of five-year CMT – 1.90%. Using KTRD analysis, Peng says this note has a net negative duration of –6.1 in the 5.25- to 10-year Treasury sector, and a net positive duration in the zero to five-year Treasury sector. These characteristics result in the note performing well in a yield curve steepening environment and losing value in a flattening one. If such analysis were performed on this and other similar structured notes, Peng says that investors would have a better understanding of the potential impact of changes in the shape of the yield curve on the price of some of these notes, such as CMT floaters.

Duration analysis that takes into account non-parallel shifts in the yield curve is just one form of risk analysis that should be done. Izzy Nelken, president of Super Computer Consulting, stresses that dissecting structured notes into their component building blocks is another way to evaluate the investment merits of any structured note.

The building blocks of any structured note typically include a floating-rate note (FRN) embedded with various derivative contracts such as options (caps, floors or something more exotic) and swaps. A straight corporate floater, for example, has periodic coupons whose values are tied to the level of some index. The holder of this security will receive a payment every three months. The level of the payment is computed by examining the three-month Libor rate at the beginning of that three-month period and adding a market-level spread of, say, 25bp.

In buying a structured note and any floating-rate note, day count conventions determine how accrued interest is calculated. The most widely used are Actual/360, Actual/Actual and 30/360. The most popular, Actual/360, means that interest accrues each month based on the actual number of days in that month. However, it is assumed that there are only 360 days in a year.

Many popular indices can be used to calculate the value of a floater. Libor is the rate at which international banks offer to place deposits with each other. Maturities range from overnight to one year. This index is sensitive to the credit rating of the banking industry. Libor rates go up when bank credits are deteriorating.

CMT is also popular. It represents the yields on various outstanding Treasury bonds, which are collected by the Federal Reserve and published. Data is collected and yields published for one-, two-, three-, five-, seven-, 10-, 20- and 30-year Treasury bonds.

Prime rate, another popular reference index, is the average rate banks charge their most creditworthy customers. The Federal Funds rate, in contrast, is the average rate paid out by the large banks for overnight funds.

Risk pulled a couple of term sheets randomly from the market for analysis by Nelken to see how different structured notes may or may not be fairly priced. For example, a callable fixed floater term sheet (see table 1) has the holder selling an embedded interest rate cap to the issuer and receiving a higher yield in return. This type of security pays an increased floating-rate coupon for the first year. If the issuer does not call it after the first year, it converts into a fixed-rate bond. In a nutshell, the risk/reward profile of this note depends on how fairly the embedded cap is priced by the dealer.

The value of caps (or any options, for that matter) depends on the following five variables: time to expiration, the current level of the reference index, the strike level, the volatility and the risk-free interest rate. As with standard options, being long a cap or a floor implies being long volatility since their value increases as volatility goes up.

How efficiently was this deal priced? To value it properly Nelken notes that an investor must look at a) the value of a one-year floating-rate note (FRN) and b) a one-year cap beginning in one year with a 7.25% strike and compare them with c) investing in a callable fixed floater. Nelken says that the following relationship must hold: c = a – b. In other words, owning a callable fixed floater is equivalent to being long an FRN and short a cap.

It is easy to see this from the issuer's point of view. If, in one year, rates are below 7.25%, the issuer will not use the cap (b). In other words, the issuer will refinance his debt and call the bond (c). On the other hand, if rates are above 7.25%, say 8%, the issuer will use the

1: Structured note price analyses

Callable fixed floater note
Issuer: US agency
Maturity: 2 years
Call date: 1 year
Coupon before call date: 3-month Libor + 0.10%
Index: 3-month Libor
Quoted margin: +0.10%
Day count: Actual/360
Reset frequency: Quarterly
Payment frequency: Quarterly
Coupon after call date: 7.25%
Payment: Annual
Day count: 30/360

Investor's choice FRN
Issuer: US agency
Maturity: 3 years
Reset frequency: Quarterly
Guess frequency: Quarterly
Provisional coupon: 3-month Libor + 3.50%
Index: 3-month Libor
Quoted margin: +3.50%
Day count: Actual/Actual
Reset frequency: Quarterly
Payment frequency: Quarterly
Range width: 100bp

[1] Thomas Ho, *Key Rate Duration – A Measure of Interest Rate Risk Exposure*, Journal of Fixed Income, September 1992

cap (b) for he will want to borrow money at 7.25% rather than 8%. Thus, the bond (c) will not be called and he will be able to borrow at 7.25%.

Nelken analysed this rate using a volatility assumption of 15%, the market volatility level when the note was offered. In that case, the price of the cap was about 65bp (using basic option pricing). A regular FRN issued by a US agency might pay Libor – 0.10%, so the issuer is only paying 0.20% for the cap even though it is worth 0.65%. For this reason, Nelken concluded that this bond was expensive and not a good investment opportunity.

Nelken also analysed an investor's choice FRN, a popular structured note which uses a different pricing method (see table 1). This type of security pays a conditional coupon. Investors are asked to guess the level of Libor in the upcoming period. If successful, they receive a high coupon. If Libor falls outside the range, they receive nothing. Interest guessing is performed quarterly. This security is available at several other range widths and margins. It is also often available with a daily accrual of interest. In other words, interest is earned every day that the index is within the range.

Investor's choice FRNs are sensitive to volatility and to the level of the index. When either the index level or the volatility is high, it is difficult to guess the level of the index within the prescribed band. However, when both the index and its volatility are low, the probability of guessing the index rises and so does the expected payout.

Nelken points out that investors can use the value of futures contracts to centre their guess every three months. But what is the probability that the investor will guess within the 100bp band, given that three-month Libor is 5.6875% and volatility is 15%? To answer this question, the investor needs a statistical model of Libor, argues Nelken. While many such models exist, for illustration purposes, he suggests that one possibility would be to assume that Libor behaves according to geometric Brownian motion. In this model:

$$\Delta L = \mu L \Delta t + \sigma L z \sqrt{\Delta t}$$

The variable ΔL is the change in Libor, L, in a small interval of time, Δt, and z is a drawing from a standardised normal distribution (ie, a normal distribution with a mean of zero and a standard deviation of 1.0). The parameter μ is the drift rate of Libor and the parameter σ is the standard deviation.

From this, Nelken generates the following equation:

$$\sigma L z \sqrt{\Delta t} = 0.5\%$$

Plugging in assumptions about Libor and its volatility, Nelken solves the equation for z, which equals 1.172161. He says that the probability of making a correct guess is given by $N(z) - N(-z) = 2 * N(z) - 1$ where $N(z)$ is the cumulative normal distribution function. In this example, the value is 0.758868. This means that there is about a 75% chance of guessing correctly.

From this information, Nelken says that the expected coupon of this instrument can then be computed – see table 2. The expected coupon is thus 6.972%.

Thus, under current market conditions, Nelken argues that this structured note looks quite attractive. He also says that investors can conduct some scenario analysis assuming different Libor rates and volatilities as shown in table 3. The horizontal axis is the assumed level of Libor and the vertical axis is the volatility. The numbers in the cells are the expected average coupon. They are italicised in red when Nelken says that an investor could expect the investor's choice structured note to outperform the normal FRN.

The moral of Nelken's dissection of these two structured note deals? "The risk/reward characteristics of many of these notes are so different that you must develop a method to price their individual parts," he says. "Only then will you know if any particular note is fairly priced." ■

Izzy Nelken, president of Super Computer Consulting: "The risk/reward characteristics of many of these notes are so different that you must develop a method to price their individual parts"

Photo: Ignacio Alvarez/Custom Images Photography

2. Calculating the expected coupon

No. of correct guesses	Average coupon	Probability
12	9.1875	3.647%
11	8.4219	13.908%
10	7.6562	24.306%

3. Scenario analysis for investor's choice FRN

	3.1875%	3.6875%	4.1875%	4.6875%	5.1875%	5.6875%	6.1875%	6.6875%	7.1875%	7.6875%	8.1875%
12.00%	*6.63%*	*7.02%*	*7.33%*	*7.57%*	*7.75%*	*7.87%*	*7.96%*	*8.02%*	*8.06%*	*8.07%*	8.08%
12.50%	*6.61%*	*6.97%*	*7.26%*	*7.47%*	*7.62%*	*7.72%*	*7.79%*	*7.83%*	*7.85%*	*7.85%*	7.85%
13.00%	*6.58%*	*6.92%*	*7.18%*	*7.36%*	*7.49%*	*7.57%*	*7.62%*	*7.64%*	*7.65%*	7.64%	7.63%
13.50%	*6.55%*	*6.87%*	*7.10%*	*7.25%*	*7.36%*	*7.42%*	*7.45%*	*7.46%*	*7.45%*	7.44%	7.41%
14.00%	*6.52%*	*6.81%*	*7.01%*	*7.14%*	*7.22%*	*7.27%*	*7.28%*	*7.28%*	*7.26%*	7.24%	7.21%
14.50%	*6.48%*	*6.75%*	*6.92%*	*7.03%*	*7.09%*	*7.12%*	*7.12%*	*7.11%*	7.08%	7.05%	7.02%
15.00%	*6.44%*	*6.68%*	*6.83%*	*6.92%*	*6.96%*	*6.97%*	*6.96%*	*6.94%*	6.91%	6.87%	6.83%
17.50%	*6.20%*	*6.32%*	*6.36%*	*6.36%*	*6.34%*	*6.29%*	6.24%	6.19%	6.13%	6.07%	6.02%
20.00%	*5.91%*	*5.93%*	*5.90%*	*5.84%*	*5.78%*	*5.70%*	5.63%	5.56%	5.49%	5.42%	5.36%
22.50%	*5.60%*	*5.55%*	*5.47%*	*5.38%*	*5.29%*	5.20%	5.11%	5.03%	4.96%	4.89%	4.82%
25.00%	*5.29%*	*5.19%*	*5.08%*	*4.97%*	4.86%	4.76%	4.67%	4.59%	4.51%	4.44%	4.38%
27.00%	*4.99%*	*4.86%*	*4.73%*	4.60%	4.49%	4.39%	4.29%	4.21%	4.14%	4.07%	4.01%
30.00%	*4.71%*	*4.56%*	*4.41%*	4.28%	4.17%	4.06%	3.97%	3.89%	3.82%	3.75%	3.69%