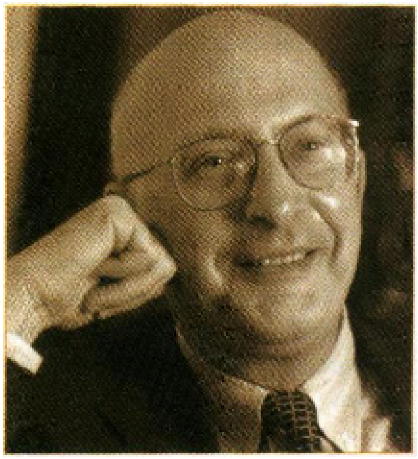
THE VOLATILITY REDUCTION MEASURE



Andrew Kalotay, president of Andrew Kalotay Associates, explains a new method of calculating hedge effectiveness.

According to FAS 133, effectiveness testing should take into account both the historical performance (a retrospective test) and the anticipated future performance (a prospective test) of the hedge. The Financial Accounting Standards Board has suggested two approaches to the historical test. One, the so-called "80/125 Rule," deems a hedge effective if the ratio of the change in value of the derivative to that of the hedged item falls between 80 percent and 125 percent. An unintended and unfortunate property of this rule is that during periods of market stability it is likely to fail virtually any hedge, even if the price movements are insignificant. (See "The 80/as5 Problem," Page 36.)

The second approach suggested by FASB is based on the correlation between the changes in value of the hedged item and those of the derivative. Roughly speaking, a hedge is deemed effective if the R-squared of the regression line explaining the data is sufficiently high. Without reference to the slope of the regression or its intercept, this statistic does little to measure effectiveness. It is also unclear whether the required R-squared threshold should be 80 percent, 90 percent or 95 percent.

Both approaches, then, have their problems. Although the 80/125 rule is intuitively appealing and is easy to implement, it is virtually certain to fail a hedge when markets are stable. The weaknesses of regression-based testing range from logical fallacy to complexity of implementation. However, most corporations apparently consider it to be the lesser of two evils.

The proliferation of software packages claiming "FAS 133 compliance" is of limited help. While these packages may include regression as part of their standard menu, they clearly fail to address hedge effectiveness testing in any satisfactory manner.

Prospective and retrospective results for a given hedge can be combined into a single measure. The entire behavior of the hedge is encapsulated in a single result.

Given this uncertain state of affairs, I propose an alternative test called the Volatility Reduction Measure. In this article, I will demonstrate the use of VRM for both prospective and retrospective testing, and discuss how these measures should be combined into a single hedge effectiveness score.

The following example of a retrospective test conveys the essence of the VRM approach. A $100 million, 8-percent, 10-year corporate bond is being hedged with a 8.25 percent Libor-based swap of the same notional amount. Under amended FAS 133 rules, the hedger is allowed to claim a hedge against changes in value of the bond attributable to changes in benchmark rates (in this case, Libor).

The changes in value of each have been recorded for the five quarters that the hedge has been in existence. For each quarter, the changes in the bond and the swap are added to arrive at a change in the value of the package (bond + swap). As shown in Table 1, the standard deviation (volatility) of the changes in value of the bond alone is $5.764 million; that of the package, $995,000. The addition of the swap has reduced the volatility to 17.26 percent (0.995MM/5.764MM) of what it originally was. In other words, a volatility reduction of 82.74 percent has been achieved.

The same idea is applied to a prospective test in Figure 1. The frequency distribution of 2,000 simulated quarterly changes in the value of the bond is overlaid with analogous information for the combination of the bond and the swap. The graph shows a volatility reduction from $5.602 million to $0.625 million.

More formally, the volatility reduction measure is defined as:

VRM = 1 – [stdev (hedge package) / stdev (item being hedged)]

According to the example in Figure 1, the prospective volatility of the hedged item is expected to be reduced by 88.84 percent (1 – 0.625MM / 5.602MM).

Prospective and retrospective results for a given hedge can be combined into a single measure by properly weighting the inputs into the VRM formula. In this way, the entire behavior of the hedge is encapsulated in a single result. For the above example, the combined VRM result is 87.86 percent.

Combining historical performance with expected future performance has important practical ramifications. Consider a corporation that enters into a long-term—say, 10-year—hedge. It is conceivable that six months into the hedge, a retrospective test will fail, due to some idiosyncrasy of the market. At the same time, prospective testing for the remaining nine-and-a-half years may establish that the hedge is effective. By properly combining the results, one is likely to conclude that the hedge is effective, despite its poor historical performance.

Continuing with the example, the same hedge may fail a prospective test with two years to go, even though it has performed well over the previous eight years. By including credit for previous good behavior, the effectiveness of the hedge may be justified.

TABLE 1:

VOLATILITY REDUCTION MEASURE (RETROSPECTIVE TEST)

Changes in value shown in $ millions

Quarter	Change in Value		
	Swap	Bond	Package (Bond + Swap)
1	(3.0)	3.3	0.3
2	(2.4)	3.0	0.6
3	(4.8)	6.0	1.2
4	7.5	(8.4)	(0.9)
5	7.8	(6.3)	1.5
Standard Deviation		5.764	0.995
Ratio of Standard Deviations 17.26%			
Volatility Reduction Measure 82.74%			

TABLE 2:

CHANGES IN VALUE OF $100 MILLION SWAP AND $100 MILLION BOND

(in $ millions)

Δ_d *(Swap)*	Δ_i *(Bond)*
5.0	(6.0)
2.0	(2.2)
(8.0)	7.0
9.0	(8.0)
11.0	(15.0)
(6.0)	8.0
σ_d *(Swap)*: 7.782	σ_i *(Bond)*: 8.934
ρ_{id} = -97.886%	

VRM IS CONSISTENT WITH THE 80/125 RULE

The VRM approach is similar to the idea of variance reduction introduced by Louis Ederington in 1979 for assessing hedging performance. As implied by its name, the Ederington Method measures volatility reduction from a ratio of variances. VRM's use of standard deviations is motivated (apart from the fact that they tend to be more meaningful to management) by the desire to be in accord with the 80/125 rule. A VRM result of 80 percent is equivalent to variance reduction of a 96 percent, which can be misleading if one is focused on an 80 percent threshold. Or, to put it differently, a variance reduction of 80 percent is equivalent to a VRM of 55 percent. Clearly, in the spirit of the 80/125 rule, this last case has failed.

A clearer way of confirming that the dimensionality of VRM is in line with the intent of the 80/125 rule is to observe what happens when VRM is applied to a single set of changes in value. If the changes in the value of the bond and swap are Δ_i, and Δ_d, respectively, then VRM (assuming standard deviation is measured using the idealized mean of zero) is calculated as follows: VRM = $1 - ((\Delta_i + \Delta_d) / \Delta_i) = 1 - (1 + (\Delta_d / \Delta_i)) = -(\Delta_d / \Delta_i)$ = 80/125 Result.

ACHIEVING MAXIMUM HEDGE EFFECTIVENESS

Consider a hedged item and a derivative with known standard deviations and correlation. To maximize VRM, find the weight of the derivative that minimizes the standard deviation of the hedge package (σ_p), given the standard deviations of the hedged item and the derivative and the correlation between them (σ_i, σ_d, and ρ_{id} respectively). Solve by differentiating $\sigma_p = (\sigma_i^2 + 2\rho_{id} + \sigma_d^2)^{1/2}$ with respect to σ_d and setting the result equal to 0.

The standard deviation of the hedge package (item + derivative) is therefore minimized, and VRM is maximized when the derivative position is scaled so that:

$\sigma_d = -\rho_{id} \cdot \sigma_i$ (Equation 1)

Substituting $\sigma_d = -\rho_{id} \cdot \sigma_i$ in the VRM formula $(1 - (\sigma_i^2 + 2\rho_{id} + \sigma_d^2)^{1/2} / \sigma_i)$ establishes that the maximum volatility reduction is given by: Max VRM = $1 - (1 - \rho_{id}^2)^{1/2}$ (Equation 2)

As an illustration, say a $100 million bond issue is hedged with a $100 million swap. Based on six data points (for simplicity), we see in Table 2 that

Figure 1: Volatility Reduction Measure (Prospective Test)
$100MM 10-Year 8% Bond Hedged with LIBOR Swap Receiving 8.25%
Distribution of 2000 Simulated Quarterly Changes in Value

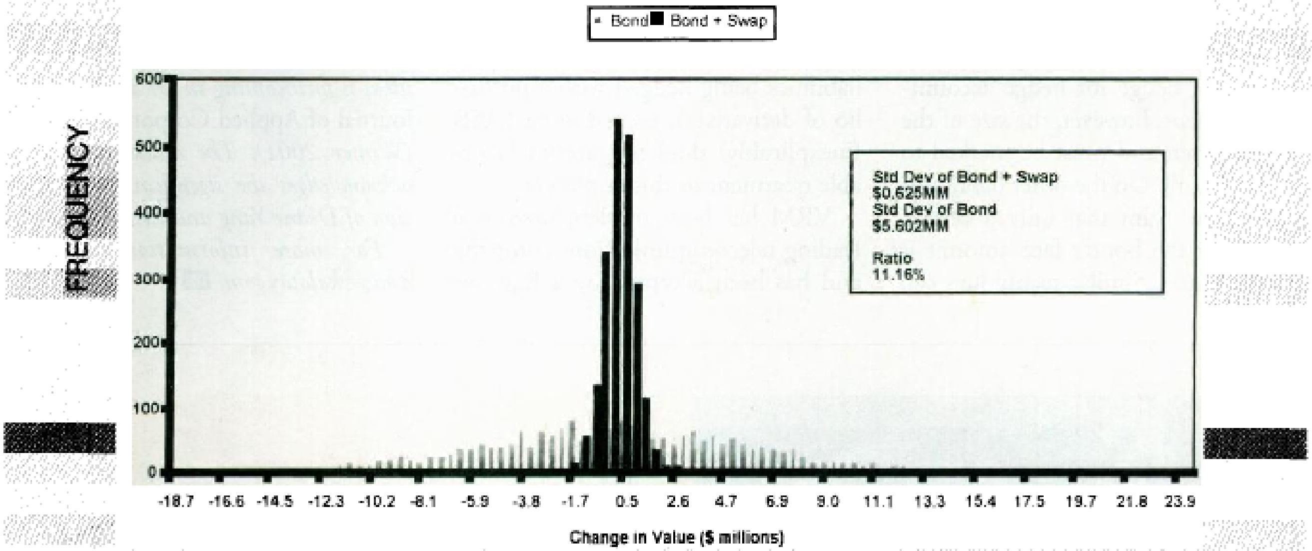
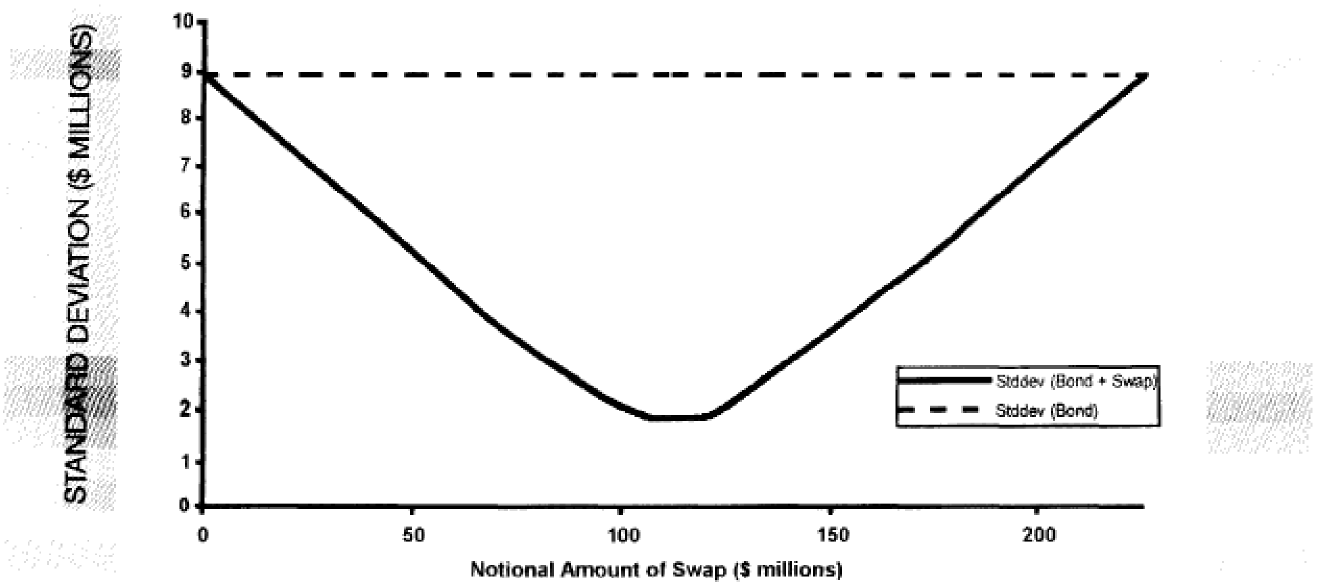


Figure 2: Volatility Reduction of $100MM Bond Issue
Volatility Minimized and VRM Maximized When Swap Size is $112.4MM



the standard deviation of the changes in value of the swap is $7.782 million; that of the bond, $8.934 million; and the correlation between them, -97.886 percent. Changing the size of the swap affects the performance of the hedge. As shown in Figure 2, the maximum volatility reduction is achieved when the notional amount of the swap is $112.4 million ($-\rho_{id} \cdot \sigma_i / \sigma_d$ = 0.97886 x 8.934 / 7.782 = 1.124 from Equation 1 above). This maximum is 79.545 percent (consistent with Equation 2 above).

This method of optimizing the hedge ratio is useful when originating a hedge. When attempting to qualify an existing hedge for hedge accounting treatment, however, the size of the swap is given and must be marked to market in full. On the other hand, it is possible to claim that only a certain percent of the bond's face amount is being hedged. Similar techniques can be employed to determine the size of the bond position that maximizes VRM. This could make the difference between the hedge passing and failing.

BRINGING ACCOUNTING AND RISK MANAGEMENT TOGETHER

While the foregoing discussion and examples are in the realm of fixed income, the VRM test can be applied to hedges in general, whether they are related to currencies or commodities. The VRM test can also be directly applied to portfolio-based hedging (that is, a portfolio of assets or liabilities being hedged with a portfolio of derivatives), even though FASB (inexplicably) does not accord favorable treatment to this at present.

VRM has been implemented at a leading telecommunications company and has been accepted by a Big-Five accounting firm. The VRM approach is superior in its simplicity as well as in its rigor and defensibility. Standard deviation is the accepted measure of volatility. When expressed in dollar terms, standard deviation reflects actual business risk, and unlike arcane statistics, such as R-squared, is familiar to higher management. Last but not least, by expressing volatility in the units of the widely used value-at-risk measure, VRM establishes a natural link between accounting and risk management.

Andrew Kalotay Associates is a New York-based debt management advisory firm. *An extended treatment of these ideas is forthcoming in an article in the* Journal of Applied Corporate Finance *(Winter 2001).* *The author gratefully acknowledges the significant contribution of Deane Yang and Leslie Abreo.*

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