Is correlation coefficient the standard for FAS133 hedge effectiveness?

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A recent survey done by Pricewaterhouse-Coopers identifies hedge effectiveness as a top concern for corporate executives regarding compliance with the new U.S. accounting standard known as FAS 133, which was adopted last year by the Financial Accounting Standards Board (FASB). This is not surprising, since ineffective hedges have the potential to impact earnings right away, possibly causing corporate reputational risk. A key gauge of hedge effectiveness has emerged in the form of the correlation coefficient, but what risks does it pose?

Of all the possible FAS 133 compliance tools, why does the correlation coefficient stand out? Many companies have already identified the correlation coefficient as a preferred tool for assessing effectiveness. It is simple to compute with a calculator or business software program. It is easy to interpret and compare across hedges since its value must fall within the [-1, +1] range. It doesn't require hiring a statistician to compute or evaluate correlation coefficient results.

Effectiveness is broadly thought of as the degree by which the change in the dollar value of a derivative instrument offsets the change in the dollar value of the hedged item. A truly effective hedge will result in a net change of zero dollars as market conditions vary. Hedge effectiveness must be assessed at inception, and regularly thereafter, in order to answer two questions. First, does the evidence suggest that the hedge will be effective in the future? Second, was the hedge effective during the past reporting period? The goal of the assessment process is to classify a hedge as effective or not effective.

In contrast, the measurement of effectiveness determines the magnitude and sign of accounting entries. Measurement and assessment procedures are complicated by the choices a company makes, within the spectrum of allowable alternatives under FAS 133. For example, the time value of an option may be left out of the assessment process and identified in the company's FAS 133 procedures manual as a direct measure of ineffectiveness. The Dollar Offset Ratio is used to measure effectiveness and can also be used to assess effectiveness. (*See Table 1* for an example of the Dollar Offset Ratio computation.)

Assessment and measurement are two different concepts and must be evaluated accordingly. Why? It is conceivable that a hedge assessed as effective will nevertheless reflect dollar ineffectiveness that shows up on the hedger's income statement. There are many reasons for this likely outcome. The most straightforward explanation is that no perfect hedge exists. Derivative instrument prices seldom move in exact tandem with the prices of the liability or asset being hedged.

Assessing effectiveness: why Correlation?

The choice of how to provide evidence of hedge effectiveness should be married with the economic realities at hand. For example, demonstrating hedge effectiveness at the inception of a hedge, by using a method that relies on historical data makes little sense, if past prices are not readily available. Finding the correlation coefficient between derivative instrument prices and the prices of the item being hedged is a good approach, because it's an easy number to compute and interpret.

Extending the idea of high correlation first discussed in the Statement of Financial Accounting Standards No. 80, 'Accounting for Futures Contracts,' many companies will classify a hedge as effective under FAS 133 if the correlation coefficient falls between +0.80 and +1.00. Using historical data does pose risk. Importantly, the use of historical data assumes that the future relationship between the exposure and the derivative instrument will be similar. This may not be true, if an event occurs that affects one market, but not the other, such as a regulatory or tax law change.

Historical data choice: input details affect output

Historical data choices must also be considered in interpreting the correlation coefficient accurately. Data choices that impact correlation numbers include the time interval length, the exact calendar period for which sample

Table 1 Dollar offset ratio (DOR)

Variable	End of Period 1	End of Period 2	End of Period 3
Derivative Value ($)	1000	1010	1025
Hedged Item Value ($)	975	987	1000
Periodic DOR	N/A	+ 0.83	+ 1.15
Cumulative DOR	N/A	+ 0.83	+1.00

Table 2 Correlation, calendar dates and time period (daily data used)

Period	Correlation Coefficient	CP Mean (Median) (%)	CP Range (%)	ED Mean (Median) (%)	ED Range (%)
1998	+ 0.85	5.40 (5.49)	0.76	5.45 (5.50)	0.87
1999	+ 0.93	5.10 (5.05)	1.72	5.14 (5.06)	1.75
2000	+0. 98	6.27 (6.47)	1.23	6.33 (6.53)	1.02
1998-2000	+ 0.98	5.59 (5.49)	2.00	5.64 (5.50)	1.96

Figure 1 Invariance of Correlation Coefficient

$$\rho_{(aX+b,\ \alpha Y+\beta)} = \frac{E[[(aX+b)-E(aX+b)] * [(\alpha Y+b)-E(\alpha Y+b)]]}{[E[[(aX+b)-E(aX+b)]^2] * E[[(\alpha Y+b)-E(\alpha Y+\beta)]^2]]^{0.5}}$$

Note: Both 'b' and 'β' cancel in both the numerator and denominator.

$$\rho_{(aX+b,\ aY+\beta)} = \frac{E[[aX-aE(X)] * [\alpha Y-\alpha E(Y)]]}{[E[[aX-aE(X)]2] * E[[\alpha Y-\alpha E(Y)]^2]]^{0.5}}$$

$$\rho_{(aX+b,\ aY+\beta)} = \frac{E[[a(X-E(X)] * a[Y-E(Y)]]}{[E[a^2[X-E(X)]^2] * E[[\alpha^2[Y-E(Y)]^2]]^{0.5}}$$

$$\rho_{(aX+b,\ aY+\beta)} = \frac{a\alpha E[[(X-E(X)] * [Y-E(Y)]]}{[a^2\alpha^2]^{0.5} * [E[[X-E(X)]^2] * E[[Y-E(Y)]^2]]^{0.5}}$$

$$\rho_{(aX+b,\ aY+\beta)} = \frac{E[[(X-E(X)] * [Y-E(Y)]]}{[E[[X-E(X)]^2] * E[[Y-E(Y)]^2]]^{0.5}} = \rho_{(X,Y)}$$

This is the general case and applies to any constant basis relationship.

For example, suppose the hedged item always trades at 5 cents above the derivative instrument price. Let X represent the derivative instrument with 'a' equal to 1 and 'b' equal to 0. Let Y represent the hedged item with 'α' equal to 1 and 'β' equal to $0.05.

Then $\rho_{(aX+b,\ \alpha Y+\beta)}$ can be written as $\rho_{(X,\ Y+0.05)}$ and this has been shown to equal $\rho_{(X,Y)}$

data is collected and the frequency of data used. For example, consider the sample-based correlation values shown in *Tables 2 through 4*. Using publicly available data, estimated correlation between one-month Euro-deposit rates and commercial paper rates clearly depends on data issues. This might be the kind of evaluation done by a company that has entered a fixed-to-LIBOR interest rate swap as a means of hedging against rising commercial paper funding costs.

A key point is that it's hard to establish a functional relationship between the correlation coefficient and data choice without knowing more about the joint probability distribution of the two variables, and, therefore, the related distribution of the correlation coefficient. Intuitively, using data that represents longer periods of time tends to smooth out short-term market anomalies and better typifies the relationship between the prices of the derivative instrument and the hedged item.

The high numbers presented here suggest little cause for worry about a hedge not being classified as effective, but that is not always the case. There are times when the data choices made could make the difference between enjoying favorable hedge accounting treatment or not. This is especially true if the relationship between the derivative instrument and the hedged item tends to vary a lot over time, or when the relationship is weak.

Invariance and basis: are there weaknesses?

Many hedges are imperfect due to basis differences. Consider the case of a commodity derivative instrument with an underlying deliverable that is materially different in quality than that of the hedged exposure. The two price histories will often track differently. However, the correlation coefficient is the same whether basis is considered or not, if it can be shown that the basis is stable over time. This simplifies the practitioner's task of assessing effectiveness. *See Figure 1* for the proof.

Where do we go from here?

Deciding on the proper way to assess and measure hedge effectiveness is a big undertaking. It is essential to determine a procedure that marries well with a company's ultimate risk management goals, recognizing the limitations of permitted tools.

Other issues remain. The hedger must decide whether to evaluate price data or price differential data, what data vendor to use and when to modify procedures. The latter activity requires close monitoring of the price behavior of both the derivative instrument and the hedged item.

Evaluating the probability that the correlation coefficient will fall within the acceptable range is worth pursuing, especially for hedges that are considered *a priori* imperfect. This requires testing whether bivariate normality can be demonstrated. Otherwise, the probability distribution becomes complicated very quickly and empirical simulations are required. The authors are currently working on answers to these questions. ■

Table 3 Correlation, calendar dates and time period (monthly data used)

Period	Correlation Coefficient	CP Mean (Median) (%)	CP Range (%)	ED Mean (Median) (%)	ED Range (%)
1998	+ 0.96	5.40 (5.48)	0.51	5.45 (5.51)	0.43
1999	+ 0.89	5.15 (5.00)	1.18	5.14 (5.00)	1.52
2000	+1.00	6.27 (6.48)	0.89	6.32 (6.53)	0.87
1998-2000	+ 0.98	5.60 (5.49)	1.75	5.64 (5.51)	1.80

Table 4 Correlation and data frequency (simple averages used for entire 1998–2000 period)

Data Frequency	Correlation Coefficient	CP Mean (Median) (%)	CP Range (%)	ED Mean (Median) (%)	ED Range (%)
daily	+ 0.98	5.59 (5.48)	2.00	5.64 (5.51)	1.96
monthly	+ 0.98	5.15 (5.00)	1.18	5.14 (5.00)	1.52
quarterly	+1.00	5.59 (5.49)	1.66	5.64 (5.53)	1.73

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