

MEASURING HEDGE EFFECTIVENESS FOR FAS 133 COMPLIANCE

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Financial Accounting Standard (FAS) No. 133 requires that all derivatives be marked to market and that changes in their market value be recognized in earnings in the current period. Derivatives may qualify for special hedge accounting treatment, however, provided they are used to hedge specific risks and an effective hedging relationship can be documented. Companies that meet these requirements are permitted to recognize offsetting gains or losses on the hedged item in the same period as any loss or gain on the hedging instrument, potentially dampening the overall impact on earnings.¹

For businesses that use derivatives for risk management, failure to qualify for hedge accounting can have considerable tax consequences. What's more, the mismatch in the timing of income recognition may induce income volatility that does not accurately reflect underlying economic performance. This income volatility can have a substantial impact on other managerial decisions and contractual obligations faced by the company, which may influence the choice of hedging instrument or even whether to hedge at all.²

An assessment of hedge effectiveness is required by FAS 133 at least every three months and whenever financial statements or earnings are reported by the firm. However, the Financial Accounting Standards Board (FASB) leaves the

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1. While FAS 133 addresses "fair value," "cash flow," and foreign currency hedges, we confine our discussion to fair value hedges (hedges related to recognized assets and liabilities or firm commitments), without loss of generality.

2. Franklin Savings and Loan is an extreme example of the consequences of income volatility resulting from failure to qualify for hedge accounting. In 1990, Franklin experienced losses on a hedging instrument they claimed would be offset by subsequent expected gains in their business. They documented their anticipation of hedge effectiveness using a novel method to measure the strength of the hedging relationship. In addition, they volunteered that without hedge accounting treatment, the resulting income statement volatility could trigger debt covenants that might further reduce the firm's equity below minimum capitalization requirements. This hedge accounting issue led regulators to close the savings and loan, ultimately resulting in its demise; see Timothy Koch, *Bank Management*, 3rd edition (Orlando, FL: Dryden, 1995, p. 308) for further discussion of this case. For economic reasons to hedge in general, see David Haushalter, "Why Hedge? Some Evidence from Oil and Gas Producers," *Journal of Applied Corporate Finance*, Vol. 14, No. 4 (Winter 2001), pp. 87-92.

choice of the supporting methodology to the discretion of the company. FAS 133 refers to the possible use of regression or correlation analysis to document hedge effectiveness, but does not provide specific guidelines for applying these methods or identify the minimal standards that must be met to qualify for hedge accounting treatment.

In the absence of specific guidelines, the accounting industry has come to embrace the “80–125 dollar offset ratio standard” as a widely used reference for effectiveness testing. The dollar offset ratio is defined as the change in the value of the hedging instrument divided by the change in the value of the hedged item over the assessment period.³ Under this standard, a hedge is considered effective if there is a high degree of confidence that the dollar offset ratio will remain within a range of 0.80 to 1.25 over the hedge horizon (that is, the change in value of the hedging instrument will be between 80% and 125% of the change in value of the hedged item). But as we discuss in more detail later, the dollar offset ratio can give false signals about hedge effectiveness—it can frequently fall outside the 80–125 band even when the prices of the hedged item and the hedging instrument are highly correlated.⁴

To meet regulators’ expectations for compliance with FAS 133—and more important, to choose an optimal hedging policy—risk managers need clear guidance in measuring hedge effectiveness, the proper use of statistical methods to generate these effectiveness measures, and interpreting the results of their analyses. In this article, we outline a basic framework for assessing anticipated hedge effectiveness. Our framework is based on a two-part operational definition that distinguishes between the *potential* effectiveness of a hedging relationship and the *attained* effectiveness of a selected hedge position.

The *potential* effectiveness of a hedging relationship refers to the strength of the historical relationship between a hedging instrument and the asset or liability to be hedged.⁵ It will also reflect the amount of risk reduction *possible* by applying the

optimal (that is, minimum risk) hedge ratio to a given hedging instrument. By hedge ratio, we mean the position ultimately taken in the hedging instrument relative to the hedged item. The strength of the hedging relationship depends on the correlation between price changes in the hedged item and the hedging instrument under consideration. The amount of risk reduction possible is measured by the square of this correlation. Correlation or regression analysis should reveal the strength of the hedging relationship for alternative hedging instruments, and should thereby aid in choosing among them. This analysis also reveals the extent of risk reduction possible, given the choice of the preferred hedging instrument and the optimal hedge ratio.

The *attained* effectiveness of a selected hedged position, on the other hand, refers to the extent of risk reduction actually achieved by the company’s choice of both the hedging instrument and the hedge ratio. This attained effectiveness can be measured by assessing the volatility of the combined hedged position, given the hedging instrument and hedge ratio actually chosen, relative to the volatility of the unhedged position (that is, the hedged item alone). This assessment is made using historical data on the prices of the hedged item and the hedging instrument over some recent time period deemed representative of the period over which the hedge is to be in place.

Our two-part definition provides a framework for making a clear distinction between hedging and speculation for purposes of assessing or documenting compliance with FAS 133. With our framework as background, we discuss drawbacks of the 80–125 dollar offset rule and review other previously suggested statistical methods for measuring hedge effectiveness. Our framework also leads us to propose alternative measures that gauge the extent of risk reduction achieved by the company, and that account for both the choice of hedging instrument and the amount of this hedging instrument actually held.

3. See the PricewaterhouseCoopers *Accounting and Reporting Manual* (1999) at www.pwccomperio.com.

4. See Eduardo Canabarro, “A Note on the Assessment of Hedge Effectiveness Using the Dollar Offset Ratio under FAS 133,” Goldman Sachs research paper, June 1999. Ira Kawaller and Paul Koch clarify the proper use of regression methodology to measure the effectiveness of a hedging relationship, and they propose alternative measures that focus on the variance of the combined hedged position relative to the variance of the hedged item alone; see their paper entitled “Meeting the ‘Highly Effective Expectation’ Criterion for Hedge Accounting,” *Journal of Derivatives*, Vol. 7 (Summer 2000), pp. 79–87. Andrew Kalotay and Leslie Abreo propose a similar measure of hedge effectiveness and further suggest that users

combine a backward-looking measure using historical data with an analogous forward-looking measure generated from simulation; see their paper entitled “Testing Hedge Effectiveness for FAS 133: The Volatility Reduction Measure,” *Journal of Applied Corporate Finance*, Vol. 14, No. 4 (Winter 2001), pp. 93–99.

5. As required by FAS133, documentation of the user’s anticipation of hedge effectiveness will necessarily involve analysis of historical data to assess the strength of the past relationship between the hedged item and the hedging instrument over some historical period. With this approach, one infers anticipated future hedge effectiveness from the documented strength of the historical hedging relationship.

HEDGING VERSUS SPECULATION

One of the difficulties with measuring hedge effectiveness is that “the word ‘hedge’ is so ill defined and flexible that virtually any transaction can be characterized as a hedge.”⁶ A hedging strategy involves choosing a hedging instrument and an appropriate hedge ratio to accomplish the risk management objectives of the user. In our framework, we define hedging as taking a position in a hedging instrument such that the volatility of the combined hedged position is less than the volatility of the unhedged item alone.

To see how we get to this definition, let S (spot) denote the unit spot price of the hedged item and F (forward) denote the unit price of the hedging instrument (say, a futures contract on the hedged item). The hedge ratio, b , is defined as the amount of the hedging instrument to be sold (bought) for every unit of the hedged item to be held long (short). The unit value of the company’s combined hedged position is then $C = S - bF$. Accordingly, the change in the unit value of the combined hedged position from one period to another is $\Delta C = \Delta S - b\Delta F$, where ΔS and ΔF represent the period change in the price of the hedged item and the hedging instrument, respectively.

The risk associated with the hedging strategy stems from future changes in the value of the combined hedged position, as measured by the variance of that position:

$$Var_C = Var_S + b^2 Var_F - 2\rho b \sqrt{Var_S Var_F} \quad (1)$$

where Var_S is the variance of ΔS , Var_F is the variance of ΔF , and ρ is the correlation between ΔS and ΔF . For a given hedged item, the choice of hedging instrument then determines the values of Var_F and ρ in expression (1).⁷

Assuming the existence of a hedging relationship (that is, ρ is not zero), the choice of an appropriate hedge ratio b enables the hedger to create a combined position with a smaller variance than that associated with the underlying unhedged item alone (Var_C is less than Var_S). A speculator, on

the other hand, will choose a value of b such that the variance of the combined position is *greater* than the variance of the unhedged position (Var_C exceeds Var_S).

The statistical parameters that must be estimated to apply our methodology for documenting anticipated hedge effectiveness include the standard deviation of changes in the spot price of the hedged item and the hedging instrument, respectively, and the correlation between ΔS and ΔF . Estimates of these parameters are provided in Table 1 for ten different assets (hedged items) and their futures contracts (hedging instruments), respectively, assuming a daily hedge horizon. The ten assets presented in Table 1 include five commodities, three foreign currencies, and two stock indexes. Given these parameter estimates, the user can generate the risk profile as a function of the hedge ratio chosen, and can compute all measures of hedge effectiveness proposed in this paper.

To illustrate how the variance of the combined position behaves as a function of the hedge ratio, Figure 1 shows Var_C versus b assuming that ρ is 0.75 and Var_F and Var_S both equal 1.0. The value of 0.75 for ρ in Figure 1 falls within the range of estimated values for the correlations provided in Table 1, which are calculated from historical data on ten selected commodities. Note that the relationship between Var_C and b graphed in Figure 1 has a minimum variance at the optimal hedge ratio, b^* , where

$$b^* = \rho \sqrt{Var_S / Var_F} \quad (2)$$

At b^* , the variance of the combined hedged position is minimized, and we have⁸

$$Var_C^* = (1 - \rho^2) Var_S \quad (3)$$

It is the risk manager’s job to determine the desired extent of risk exposure, Var_C . Figure 1 shows that a financial derivative can be employed as a hedging instrument to attain any level of risk below Var_S , down to Var_C^* (the minimum variance), by varying b between zero and $2b^*$. Of course, the

6. See Thomas Linsmeier and Neil Pearson, “Value at Risk,” *Financial Analysts Journal*, March/April 2000, pp. 47-67.

7. See L. Ederington, “The Hedging Performance of the New Futures Markets,” *Journal of Finance*, Vol. 34 (March 1979), pp. 157-170; see also J. Hull, *Fundamentals of Futures and Options Markets*, 4th edition (Upper Saddle River, NJ: Prentice-Hall, 2002, p. 84). The hedging instrument should have the strongest

possible hedging relationship with the hedged item, given other considerations germane to the hedger’s problem such as liquidity and transactions costs.

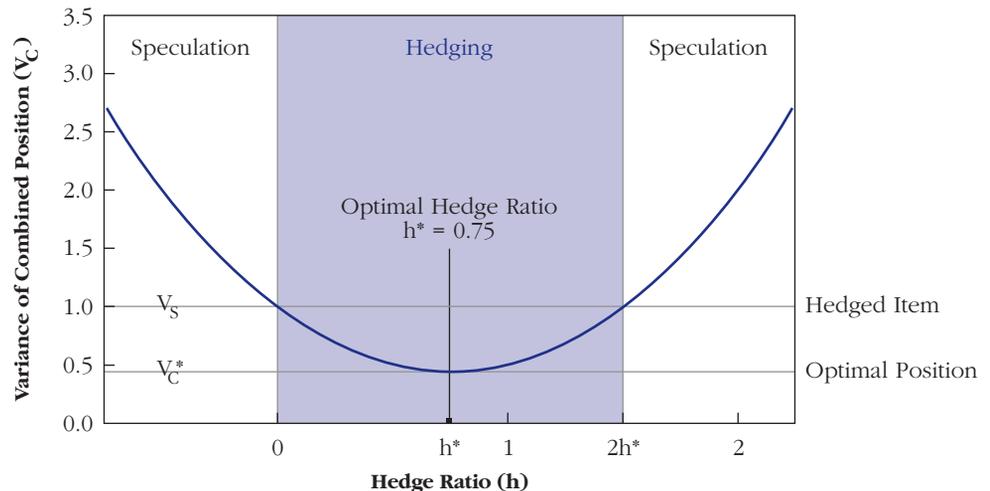
8. Expressions (2) and (3) are obtained by taking the first derivative of expression (1) with respect to b , solving for b to get b^* , and substituting b^* into expression (1). Details are available from the authors.

TABLE 1
DESCRIPTIVE STATISTICS
OF DAILY FUTURES AND
SPOT PRICE RETURNS *

Hedged Item	Sample size	$\sigma(\Delta S)$, (%)	$\sigma(\Delta F)$, (%)	$\rho(\Delta S, \Delta F)$
Soybean Oil	2,659	1.388	1.322	.951
Corn	2,658	1.478	1.291	.891
Cotton	2,638	1.417	1.268	.820
Crude Oil	2,631	2.488	2.252	.874
Wheat	2,658	1.289	1.246	.565
Yen (¥)	2,640	.701	.710	.970
Pound (£)	2,640	.666	.685	.976
Deutschemark	2,640	.691	.698	.973
S&P 500	2,644	.826	.903	.966
NYSE 100	2,645	.747	.883	.957

*Reproduced with permission from Riza Demirer, "Two Essays On Derivatives," University of Kansas dissertation for the degree, Ph.D. in Finance, 2003, p. 40. The sample used to compute these estimates includes daily spot and nearby (i.e., next to expire) futures prices obtained from the Commodity System, Inc. The sample period extends from January 1988 to June 1998. Nearby futures prices are constructed assuming contract rollover about one week before the maturity of each nearby futures contract. The daily trading volume is used as a criterion in deciding the actual rollover date. Daily returns at the rollover dates have been calculated over the same contract; σ and ρ signify standard deviation and correlation, respectively.

FIGURE 1
PLOT OF V_C VERSUS b FOR
 $\rho = 0.75$ WHEN $V_F = V_S =$
1.0 IN EXPRESSION (1)*



In this case, $b^ = 0.75$, and the entity is considered to be hedging if it chooses any hedge ratio, b , such that $0 < b < 1.5$. The choice of any other value of b constitutes speculation on the part of the entity.

derivative can be used to take on additional risk above Var_S by varying b outside the bounds zero to $2b^*$.

The company must document anticipated hedge effectiveness to qualify for hedge accounting treatment under FAS 133. Regulators must correspondingly determine whether the company is employing derivatives to increase or decrease risk. This determination calls for clear guidelines on acceptable methods for measuring and documenting whether a given position in a derivative represents hedging or speculation.

Expressions (1) and (3), along with Figure 1, provide a simple framework for documenting the strength of the hedging relationship ρ and the minimum risk attainable for a given hedging instrument (Var_C^* at b^*), as well as the level of risk actually attained with the chosen hedge ratio (the actual variance, Var_C , attained at the selected b).

Definitions

Note again that for any choice of hedge ratio b between zero and $2b^*$, the variance of the combined

hedged position (Var_C) is less than the variance of the unhedged asset. Thus, any hedge position that includes a relative amount of the hedging instrument within these bounds satisfies our definition of hedging and should be considered a bona fide hedge that qualifies for hedge accounting treatment under FAS 133.

It is clear from the expression for Var_C^* in expression (3) that the *potential effectiveness* of a hedging strategy in reducing the risk of the unhedged position (Var_S) depends only on the correlation ρ between the unhedged item and the hedging instrument. However, expression (1) shows that the *attained effectiveness* of a selected hedging strategy depends on three factors: (i) the relative variances of the unhedged item and the hedging instrument (Var_S and Var_F) during the historical estimation period; (ii) the correlation between the unhedged item and the hedging instrument (ρ); and (iii) the hedge ratio selected by the user (b).

The reliability (or statistical precision) of the estimate of ρ depends on the standard error of this estimate, which is simply the square root of the reciprocal of the sample size. Thus, the user may test the null hypothesis that the true correlation is 0.75 by adding and subtracting twice the standard deviation of this estimate to 0.75, and checking whether the estimate is within this 95% confidence interval. It is noteworthy that, regardless of the statistical precision of the estimate for ρ , the square of this estimate is still the appropriate measure of historical (and thus anticipated) hedge effectiveness. Since the square of this estimate of ρ is the R-square measure obtained from a simple regression of ΔS on ΔF , it literally measures the extent of the variation of ΔS (that is, the total risk of the unhedged item) that can be explained (and thus eliminated or hedged) by using the optimal hedge ratio applied to the hedging instrument.

An analysis of Var_S , Var_F , and ρ for alternative hedging instruments establishes the potential effectiveness of various hedging relationships, and allows the hedger to choose the hedging instrument that provides the maximum possible risk reduction (that is, the lowest Var_C attainable). Given the choice of hedging instrument, the hedge ratio selected (b) will determine the extent to which the user actually reduces risk toward the minimum risk attainable. A meaningful assessment of hedge effectiveness should

account for both the potential effectiveness of the hedging relationship and the attained effectiveness of the selected hedge position.

Non-Optimal Hedging

FAS 133 stipulates that a futures hedge ratio of 1.0 (meaning that equal amounts of the hedged item and the hedging instrument are held) generally qualifies as a bona fide hedge, and provides directions for hedge accounting given this choice of hedge ratio.⁹ A hedge ratio of one may constitute an appropriate hedge if the maturity of the hedging instrument matches the hedge horizon, and if the user intends to hold the derivative position until this maturity. As a practical matter, however, there is often no such perfect matching of maturities, and the user should be free to adjust the risk exposure (b and Var_C) at any time. The resulting basis risk for the combined hedged position depends on the correlation between the hedged item and the hedging instrument, as well as the mismatch in their maturities. In this case, the minimum-variance hedge ratio, b^* , will likely deviate from one, according to expression (2).

Suppose b^* is less than one, as in Figure 1. In varying the hedge ratio from zero toward b^* , the user is clearly reducing risk. Any position in the hedging instrument between a hedge ratio of zero and b^* effectively hedges a portion of the total risk exposure embodied in the unhedged position, so that this use of derivatives should qualify for hedge accounting treatment under FAS 133.

Figure 1 demonstrates that by continuing to increase the hedge ratio beyond b^* toward 1.0, the user is now increasing risk above the minimum risk attainable at Var_C^* . However, it would be inappropriate to disqualify this choice of hedge ratio for hedge accounting treatment, given the stipulation in FAS 133 pertaining to a hedge ratio of one, since it still results in a reduced level of risk (Var_C is less than Var_S). We further argue that, if the user continues to increase the hedge ratio above 1.0 toward $2b^*$, this use of derivatives should *also* qualify for hedge accounting treatment by virtue of the fact that the variance of the combined position is *still* less than the variance of the unhedged position.

In summary, for a derivative position to qualify for hedge accounting treatment, we do not distin-

9. See Kawaller and Koch (2000), cited earlier.

TABLE 2
PROBABILITIES OF THE
DOLLAR OFFSET RATIO
FALLING OUTSIDE THE
INTERVALS [0.80, 1.25] AND
[0.90, 1.10]*

ρ	$P(D_t < 0.80 \text{ or } D_t > 1.25)$	$P(D_t < 0.90 \text{ or } D_t > 1.10)$
1.00	.000	.000
0.99	.362	.608
0.98	.486	.706
0.95	.614	.807
0.90	.713	.863
0.50	.879	.945
0.00	.930	.968

*When the price of the hedging instrument, F , and the price of the hedged item, S , follow correlated Gaussian random walks with $Var_F = Var_S$, and the correlation between ΔF and ΔS is ρ . (Computation of probabilities available from the authors.)

guish between the hedge effectiveness of a smaller hedge ratio closer to zero, and the effectiveness of a larger hedge ratio closer to $2b^*$. As shown in Figure 1, both cases may reduce Var_C only slightly below Var_S . We believe that the FASB should allow hedge accounting treatment when the entity has documented that the chosen hedging instrument and the selected hedge ratio will result in a combined hedged position that has a smaller variance than the unhedged position (that is, Var_C is less than Var_S). This means that any position in the hedging instrument should qualify as hedging rather than speculation whenever it unambiguously reduces risk by some positive amount, no matter how small the reduction.

Later in the article we propose alternative measures of hedge effectiveness that employ this framework to document both aspects of hedge effectiveness, but first we discuss problems with the dollar offset ratio and prior work on measuring hedge effectiveness.

DOLLAR OFFSET RATIO

As noted earlier, the dollar offset ratio is intended to measure the ability of the hedging instrument to generate offsetting changes in the fair value of the unhedged item. However, the dollar offset ratio does not explicitly consider either component of our two-part definition of hedge effectiveness, namely, the strength of the hedging relationship (ρ) or the hedge ratio (b) chosen by the user. Thus, the dollar offset ratio does not fully measure the degree to which the hedger has effectively reduced risk.

Some FASB members believe that to meet the definition of high effectiveness under FAS 133, the dollar offset ratio for the chosen hedging instrument should fall within a range of 0.80 to 1.25 for a large percentage of historical periods; other FASB members believe the range should be 0.90 to 1.10.¹⁰ However, there is a technical difficulty in using the dollar offset ratio with either set of guidelines to measure hedge effectiveness.

The so-called 80–125 test uses the dollar offset ratio to gauge hedge effectiveness by keeping track of the relative frequency with which the dollar offset ratio falls outside the interval [0.80, 1.25] over time. By the 80–125 test, a hedge will be deemed ineffective if the dollar offset ratio falls outside the [0.80, 1.25] range more frequently than some unspecified upper bound, such as 1%, 5%, or 10% of the time. But depending on the statistical processes that determine the price changes of the unhedged item and the hedging instrument (and the correlation between those price changes), the dollar offset ratio is likely to *regularly* fall outside the target range. Table 2 lists the probabilities that the dollar offset ratio will fall outside the intervals [0.80, 1.25] and [0.90, 1.10] for various correlations, ρ . The dollar offset ratio fails the 80–125 test quite often, even when the hedging relationship is strong (that is, when price changes in the unhedged item and the hedging instrument move closely together). For example, the second row of Table 2 indicates that, if the correlation is .99, the dollar offset ratio is expected to fall outside the 80–125 (90–110) target range 36.2% (60.8%) of the time.¹¹

10. PriceWaterhouseCoopers *Accounting and Reporting Manual* (1999).

11. Note that Gaussian random walk models for S_t and F_t are used in this illustration only to allow for analytic computation of the probabilities in Table 1.

Use of non-Gaussian probability distributions would result in different non-zero probabilities of failures for these tests, but these probabilities would likely be more difficult to compute.

A fundamental problem with the dollar offset ratio is that small changes in the price of the hedged item can result in large values of the dollar offset ratio. The dollar offset ratio test is thus more problematic when there is a higher likelihood that price changes in the hedged item will be near zero in any period. (In fact, the dollar offset ratio is undefined if there is no change in the price of the hedged item because the denominator in the ratio is zero). Further, the dollar offset ratio does not take into consideration the relative amount, b , of the hedging instrument that is actually included in the combined hedge position. At best, this measure offers only a slight indication of how well the hedging instrument tends to track the hedged item.¹²

A meaningful measure of hedge effectiveness should incorporate both the correlation of the hedged item with the hedging instrument (ρ), and the amount of the hedging instrument (b) included in the combined position. In the next section we describe several measures of effectiveness and discuss the relative merits of each. This discussion is followed by our proposed alternative measures that account for both ρ and b .

EXISTING MEASURES OF EFFECTIVENESS

Possibly the first proposed measure of hedge effectiveness was the ratio of the minimum variance attainable with the optimal combined hedge position to the variance of the unhedged position, subtracted from one.¹³ We think of this as a measure of the hedging instrument effectiveness, *HIE*:

$$HIE = 1 - (V_c^* / V_s) = (V_s - V_c^*) / V_s \quad (4)$$

This measure represents the relative reduction in variance gained by taking the optimal combined position (b^*) for a given hedging instrument. By substituting $Var_C^* = V_s(1-\rho^2)$ into (4), it can be shown that *HIE* is equal to ρ^2 for the optimal combined position. *HIE* can be estimated easily for a chosen hedge instrument by finding the R^2 of a simple (unconstrained) regression of price changes of the hedged item (ΔS) on price changes of the hedging

instrument (ΔF). Note that this measure focuses on the greatest degree of risk reduction attainable if the optimal hedge ratio b^* is selected, and reflects the strength of the hedging relationship as measured by the correlation ρ . However, it ignores the extent to which the user actually reduces risk toward the minimum attainable, because it does not account for the hedge ratio ultimately selected.

Another measure of hedge effectiveness that *does* account for the hedged position selected by the hedger is the ratio of the variance of the actual combined position to the variance of the unhedged position.¹⁴ We view this as a measure of the overall hedge effectiveness, *OHE*:

$$OHE = V_c / V_s \quad (5)$$

V_c represents variation in the combined hedged position that remains after the user selects b . Similarly, V_s represents the total variation in the unhedged item. Therefore, *OHE* can be interpreted as the proportion of total risk (V_s) that remains after hedging, with a smaller value indicating a more effective hedge. As for the threshold of acceptability for *OHE* to qualify for hedge accounting treatment, our framework would suggest that any hedged position for which *OHE* is less than one (Var_c is less than Var_s) would be considered hedging rather than speculation, and should qualify for hedge accounting treatment. Similarly, our definition of speculation corresponds to values of *OHE* that are greater than one (Var_c exceeds Var_s).

In an article in this journal two years ago, Andrew Kalotay and Leslie Abreo presented a measure they called the volatility reduction measure (*VRM*), which is related to *OHE* and thus also accounts for the hedged position selected by the entity.¹⁵ This measure is

$$VRM = 1 - \sigma_c / \sigma_s = 1 - \sqrt{OHE} \quad (6)$$

where σ_c and σ_s are simply the standard deviations of the combined position and the unhedged item, respectively (that is, $\sigma_c = \sqrt{Var_c}$ and $\sigma_s = \sqrt{Var_s}$). Kalotay and Abreo give three reasons for using

12. In statistical terms, this problem arises because the dollar offset ratio ($\Delta F / \Delta S$) follows a Cauchy distribution, under certain other conditions applying to ΔS and ΔF . This distribution has no finite mean or variance, because it entails division by zero if ΔS might take a value of zero. This represents a profound problem for users who wish to document the dollar offset ratio complies with the 80-125 standard.

13. See Ederington (1979), cited earlier. This measure is also discussed by Hull (2002, p. 85), cited earlier.

14. See Kawaller and Koch (2000), cited earlier.

15. See Kalotay and Abreo (2001), cited earlier.

standard deviations in the computation of VRM: (i) they suggest that standard deviations are more meaningful to managers than are variances, (ii) they argue that this measure has a “common analytic framework with Value at Risk (VaR)” because both VRM and VaR use the standard deviation in their respective calculations; and (iii) they believe this measure can accord with the 80–125 rule, presumably as applied to their VRM.

We agree that the standard deviation may be a more meaningful statistic to some managers than the variance because the standard deviation is measured in the same units (dollars or cents) as the price changes in the unhedged item and the hedging instrument. Further, many managers interpret standard deviations in terms of probabilities associated with returns, for example, as applied in Value at Risk. However, since the standard deviation is simply the square root of the variance, the two statistics are equivalent, so there is no substantive reason to prefer the standard deviation to the variance (or *vice versa*) as a measure of risk.

Consider our definition of hedging versus speculation as applied to the VRM. Our definition of hedging is any hedged position in which Var_C is less than Var_S , which corresponds to any position such that VRM is between zero and one (our definition of speculation corresponds to VRM less than zero). Note that the attempt by Kalotay and Abreo to reconcile their VRM with the 80–125 rule is not in line with our definition of hedging versus speculation. They provide an example in which a VRM of 55% has “clearly failed” the spirit of the 80–125 rule, because VRM is less than 80%. However, we would argue that a firm employing a hedging strategy with a VRM of 55% has reduced its volatility to a level 45% below the unhedged position, and clearly *should* qualify for hedge accounting treatment under FAS 133. Furthermore, we note that applying the 80–125 standard to the VRM of Kalotay and Abreo does not consider the two aspects of hedge effectiveness that we deem most important: the *actual* reduction in risk attained by the hedge ratio chosen and the *potential* risk reduction attainable with the optimal hedge ratio.

OTHER WAYS OF MEASURING HEDGE EFFECTIVENESS

In this section we propose two measures of hedging effectiveness that compare the selected hedge position (with the selected hedge ratio, b) to

the optimal combined position (with the optimal hedge ratio, b^*) that obtains the minimum variance for the chosen hedging instrument. Our first measure reflects what we call the hedge ratio effectiveness, HRE , which considers the extent of risk reduction attained with the selected hedge ratio b relative to the maximum reduction in risk possible with b^* :

$$HRE = \frac{V_S - V_C}{V_S - V_{C^*}} = \frac{V_S - V_C}{\rho^2 V_S} \quad (7)$$

In Figure 1, HRE represents the reduction in risk (that is, the distance below V_C) attained with the hedge ratio chosen (b) as a proportion of the reduction in risk (that is, the distance below V_C) attainable with the minimum variance hedge ratio. The maximum attainable value of HRE is 1.0, which occurs when $b = b^*$ and $V_C = V_{C^*}$. Any combined position for which HRE is between zero and one corresponds to hedging according to our standards, while a negative value of HRE will indicate speculation. As b varies from zero to b^* to $2b^*$, HRE ranges from zero to one and back to zero. Thus, larger values of HRE up to one indicate more effective hedging.

Perhaps the most comprehensive measure is what we call the relative-to-optimal hedge ratio effectiveness, $RHRE$:

$$RHRE = \frac{b}{b^*} = \frac{b}{\rho(\sigma_S/\sigma_F)} = \frac{b\sigma_F}{\rho\sigma_S} \quad (8)$$

In Figure 1, $RHRE$ represents the ratio of the hedged position taken on the horizontal axis (b) relative to the minimum variance hedge ratio (b^*). Any combined position for which $RHRE$ is between zero and two will indicate hedging by our definition, while any other non-zero values of $RHRE$ will indicate speculation. Combined positions for which $RHRE$ equals one are optimal in that they achieve minimum variance for a given hedging instrument. $RHRE$ incorporates both the actual hedge ratio and the strength of the hedging relationship (the correlation) and has the advantage of using standard deviations, which as Kalotay and Abreo observed may be more intuitive for risk managers.

The extent of deviation of $RHRE$ from 1.0 can be used as a measure of hedge effectiveness. In that sense, it lends itself readily to the application of a standard such as the 80–125 (or 90–110) rule if one chooses to define effective hedging as taking a combined position that is within a specified percentage of the optimal position.

The procedure for applying any of these hedging effectiveness measures—*HIE*, *HRE*, *OHE*, or *RHRE*—to establish the anticipation of hedge effectiveness for FAS 133 purposes is simply to document how the user obtains statistical estimates of V_S , V_F , and ρ , and how these estimates are used to compute the measures. The first step is to obtain the time series of price changes in the unhedged item and the hedging instrument. A longer historical sample period is typically desirable, since it provides more observations and thus more precise estimates of ρ . However, there may be limitations on the length of the sample period available or usable. For example, a futures contract under consideration for a hedging instrument may not have been traded very long. Alternatively, the user may be concerned that there has been a structural shift in the nature or strength of the relationship between the hedged item and the hedging instrument, which might render historical estimates over a longer sample period inappropriate for making inferences about the future hedge horizon. In general, the number of past values should be at least as large as the number of time periods for which the hedge will be in place.¹⁶

The next step involves finding the mean price changes of the unhedged item and the hedging instrument, the variance of those price changes, and the correlation between the price changes. Standard statistical techniques can be applied to compute these variables. Once the hedge ratio has been selected, the variance of the combined hedged position can be estimated, and calculation of *HIE*, *HRE*, *OHE*, and *RHRE* is straightforward. Note that in the absence of a hedging relationship (that is, ρ equals zero), there will be technical difficulties in calculating *OHE* and *RHRE* because of the problem of dividing by zero. On the other hand, if there is no hedging relationship, the hedging instrument in question should probably be eliminated from consideration.

CONCLUSION

This study sets forth a two-part operational definition of hedge effectiveness. This definition

leads to a simple framework for assessing anticipated hedge effectiveness for compliance with FAS 133. Our framework and definitions are based on the proposition that meaningful assessment of anticipated hedge effectiveness for FAS 133 should consider both the strength of the hedging relationship (as determined by the choice of the hedging instrument) and the amount of the hedging instrument actually held in the combined hedged position. The measures of hedge effectiveness proposed in this study account for both elements. These measures have clear interpretations relative to the optimal position, and they can be used to distinguish between hedging and speculation.

Our framework does not require a minimum value of the correlation coefficient in order for the hedging strategy to qualify for hedge accounting treatment. That is, we do not distinguish between the validity of a hedging strategy in which the preferred hedging instrument demonstrates a high correlation with the unhedged item, and another strategy in which the hedging instrument reveals a low (but non-zero) correlation. This view acknowledges that, for some risk exposures, the only available hedging instruments may display hedging relationships with relatively low correlations. We hesitate to disqualify a hedging strategy just because the “best” hedging instrument fails to meet a pre-established minimum correlation.

While it is important for the hedger to analyze and document the extent of risk reduction possible, there is much room for debate regarding how low this attainable risk must be to qualify for hedge accounting. We suggest that the crucial test for qualifying under FAS 133 should involve documentation regarding both the extent of risk reduction possible with the particular choice of hedging instrument, and whether the hedge ratio ultimately implemented does, in fact, achieve a lower level of risk. The 80–125 rule can certainly be used to establish guidelines for acceptable levels of risk reduction, although we would argue against the application of anything so rigid, given the inherent difficulties in finding appropriate hedging instruments.

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