understanding basis risk in hedging transactions

by **Ira** Kawaller

When companies recognize the presence of a risk relating to interest rates, currencies, or commodity prices, the idea of hedging that risk reasonably follows. And while not all risks are necessarily hedgeable, if a derivative instrument that can reliably deliver something close to the desired offset can be identified, hedging is something to consider.

A derivative is a contractual agreement between two parties that generates a payoff dictated by some reference price, rate, or index that is external to the contract itself. To be considered as a reliable hedge, however, the derivative's underling price should be closely correlated to the price pertaining to the risk exposure. If so, it's likely that a derivative transaction can be structured to mitigate some portion, if not all, of the preexisting risk.

In some cases, the choice of the derivative is obvious. For example, for a variable-rate borrower with debt tied to one-month LIBOR, exposed to the risk of rising interest rates, an obvious derivative choice is one that pays off when one-month LIBOR increases. In this example, the price underlying the risk exposure and the underlying price of the derivative are identical, so choosing this derivative is self-evident. When an identical match isn't available, however, finding an appropriate derivative might be a bit harder. To take an example from the commodities industry, the price exposure of a corn farmer who sells a grade of corn other than No. 2 yellow corn priced at par. In this situation it's unlikely that the farmer would be able to find a derivative that delivers a perfect offset. That is, any corn derivatives that are available are likely to generate close offsets, but not perfect offsets.

Regardless of the commodity in question, for purchasers, the risk is that the commodity price could rise; for sellers, the risk is that the commodity price could fall. In the general case, commodity derivatives tend to price with reference to some industry standard benchmark, but actual invoice prices tend to vary from this benchmark due to differences in quality and/or location or assorted mark-ups or surcharges. Still, as previously stated, if the exposure's invoice price is highly correlated to the price underlying the derivative, the hedge can reasonably be expected to work. To the extent that these two prices do not move in lock-step, however, the performance of the hedge will be somewhat uncertain.

examples of basis risk in hedging transactions

The difference between the price that functions as the source of the exposure and the price that underlies the intended derivative is generally identified as the basis. Thus, when hedging a risk where the basis amount is uncertain, the hedging entity would be transforming the risk pertaining to the full price of the commodity to a much smaller exposure relating to the variability of the basis. In most situations, employing a hedge of this type would substantially lower the risk to the company.

The following exhibits show six possible hedging scenarios. Each one depicts the same objective of locking in the price of a forthcoming purchase of "widgets" using a widget forward contract. The starting conditions for all the scenarios are the same, with the spot price of widgets (i.e., market price for an imminent delivery of widgets) equal to $750, and the widget forward contract priced at $753.

Exhibit 1 shows the first two scenarios. In the first, while starting at $750, widget prices rise to $900; in the second, they fall to $600. In both cases, though, we observe convergence of the spot and forward prices. Such convergence would be expected at the expiration of the forward contracts only if the price paid for the physical widgets when acquired at the end of the hedge is exactly equal to the price of the forward contract at its expiration or liquidation. In both cases, despite large price changes in opposing directions, the hedge realizes an effective (post-hedge) price of $753 – identical to the price of the forward at the inception of the hedge. This effective ex-post price follows from paying the then-prevailing spot market price for buying the widgets and either subtracting any hedge gains from that price (Scenario 1) or adding hedge losses (Scenario 2).

Exhibit 1: Long Forward Hedge; Perfect Convergence

Scenario 1			
	at Start of Hedge	at End of Hedge	Gain (Loss)
Spot Widget Price	750	900	-150
Widget Forward Price	753	900	147
Basis*	3	0	-3
		Physical purchase price	*900*
		Less gain on hedge	*-147*
		Effective ex post price	*753*
Scenario 2			
	at Start of Hedge	at End of Hedge	Gain (Loss)
Spot Widget Price	750	600	150
Widget Forward Price	753	600	-153
Basis	3	0	-3
		Physical purchase price	*600*
		Plus loss on hedge	*153*
		Effective ex post price	*753*

* Basis is defined as Futures Price minus Spot Price.

In the real world, the invoice price of the widgets would likely pertain to a commodity having quality or location differences from the benchmark commodity that underlies the derivative contract, in which case perfect convergence would not be anticipated.

Two additional scenarios showing imperfect convergence are presented in Exhibit 2. These two scenarios have been designed such that when the hedge terminates, the forward prices end up being at a premium of $1 to their corresponding spot prices. Under these assumed conditions, rather than locking in a post hedge price of $753, the example ends up realizing an effective price of $752 – i.e., the starting forward price adjusted by the ending basis conditions.

Exhibit 2: Long Forward Hedge; Imperfect Convergence

Scenario 3			
	at Start of Hedge	at End of Hedge	Gain (Loss)
Spot Widget Price	750	900	-150
Widget Forward Price	753	901	148
Basis	3	1	-2
		Physical purchase price	*900*
		Less gain on hedge	*-148*
		Effective ex post price	*752*
Scenario 4			
	at Start of Hedge	at End of Hedge	Gain (Loss)
Spot Widget Price	750	600	150
Widget Forward Price	753	601	-152
Basis	3	1	-2
		Physical purchase price	*600*
		Plus loss on hedge	*152*
		Effective ex post price	*752*
* Basis is defined as Futures Price minus Spot Price.			

To complete this set of examples, Exhibit 3 shows another pair of imperfectly converging scenarios; but in this exhibit, the ending basis has the forward price being $5 less than the ending spot price. And in these cases, the effective ex-post widget price is $758 (= $753 – (-5)).

Exhibit 3: Long Forward Hedge; Imperfect Convergence

Scenario 5			
	at Start of Hedge	at End of Hedge	Gain (Loss)
Spot Widget Price	750	900	-150
Widget Forward Price	753	895	142
Basis	3	-5	-8
		Physical purchase price	*900*
		Less gain on hedge	*-142*
		Effective ex post price	*758*
Scenario 6			
	at Start of Hedge	at End of Hedge	Gain (Loss)
Spot Widget Price	750	600	150
Widget Forward Price	753	595	-158
Basis	3	-5	-8
		Physical purchase price	*600*
		Plus loss on hedge	*158*
		Effective ex post price	*758*
* Basis is defined as Futures Price minus Spot Price.			

If, at the start of the hedge, the hedging entity correctly anticipates the ending basis amounts, the company will be able to correctly forecast the hedge's outcome. More likely than not, though, the best the hedger could expect to do is anticipate some prospective range for this ending basis; and an estimated hedge outcome could be made based on that presumed range. For example, if at the inception of the hedge the hedging entity thought that the possible ending basis might be as high as $10 (i.e., the forward price ending up $10 above the spot price) or as low as -$7 (i.e., the forward price $7 lower than the spot price), the day-one expectation would be for the hedge to deliver an effective price of widgets falling somewhere between $743 (= $753 – $10) and $760 (= $753 – (-$7)). Should the hedging entity mis-estimate the ending basis conditions, however, the expected hedge outcome will be equally off.

With this orientation, it is clear that the ex-post outcome of a hedge is wholly dependent on the size and direction of the ending basis – something that the hedging entity should appreciate from the start as being outside the scope of the hedge objective. Put another way, after the fact, the resulting effective price realized is fully understandable and attributable to (a) the initial derivative price and (b) the ending basis value. There are no price factors other than these two parameters.

accounting treatment of derivative hedges

All of the scenarios above assume a one-to-one hedge construction, where the volume or size of the underlying exposure is equal to the notional amount of the derivative contract. This sizing reflects an implicit assumption that the hedging entity is willing to accept the risk associated with basis variability. Put another way, the objective of the hedge would be to address only the portion of the risk that relates to the variability of the price of the benchmark commodity. Critically, in order to hedge this component exposure perfectly, the invoice price of the commodity must explicitly reference the underlying price of the derivative at the time the derivative is liquidated.

The Financial Accounting Standards Board (FASB) recognized the legitimacy of this kind of component hedging – albeit belatedly. That is, in FASB's initial release of its standard for accounting for derivatives and hedging transactions (originally issued as FAS 133 in 1998), the Board restricted hedge accounting for commodity hedges to those situations where the derivative served to offset changes in the entire invoice price of the commodity, which tended to preclude the application of hedge accounting when basis effects represented "too large" a portion of the commodity's overall price variability. FASB amended this guidance in November of 2017 with the release of ASU2017-12, which reversed course and allowed hedge accounting for a component of commodity prices, with an important proviso -- that the component being hedged was contractually specified in the purchase or sales agreement.

Although hedge accounting is not automatic and a variety of prerequisite conditions must be satisfied to qualify for this treatment, hedge accounting is widely understood (correctly) to be the preferred accounting treatment for derivatives used in hedging transactions. This preference derives from the fact that, with hedge accounting, the payoff of the derivative is recognized in earnings in the same accounting period as is the earnings realized from the hedged exposure. This coincident earnings recognition serves to reflect the intended hedging objective. Otherwise, without hedge accounting, these two earnings amounts would likely be reported in different accounting periods, giving rise to income statement volatility that many financial statement users regard as misleading or artificial.

Under this more liberalized guidance, reporting entities seeking to apply hedge accounting are still required to assess hedge effectiveness and qualify for hedge accounting by demonstrating that the hedge will be "highly effective" in offsetting changes in cash flows attributable to the price change of the contractually specified component. But whenever the contractually specified component in the purchase or sales contract is identical to the underlying price of the derivative, this assessment of high effectiveness can be made "qualitatively" by simply asserting the equivalence of the hedged item's price with the derivative's underlying price. This is all well and good when this condition is satisfied, but if the contractually specified reference price differs in the slightest from the derivative's underlying price, a quantitative effectiveness test is required.

conclusion

Although basis risk is often considered to be largely uncontrollable, a more appropriate perspective should appreciate the fact that the consequent earnings variability that follows from basis risk is easy to quantify. All that's required is having some historical perspective as to the range of basis conditions that have occurred – that, and an appreciation that those historical boundaries may still yet be tested.

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Prior to founding Derivatives Litigation Services, Kawaller has had decades of experience as a practitioner, advisor, educator, and expert witness, concentrating on issues pertaining to derivative instruments and financial risk management. His longest tenures were as the President of Kawaller & Company, a consulting firm specializing in assisting commercial entities with their use of derivatives, and as the director of the New York office for the Chicago Mercantile Exchange.

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He received a Ph.D. in economics from Purdue University and has held adjunct professorships at Columbia University and Polytechnic University. He writes and lectures prodigiously, largely focusing on derivative contract market activity.