Effectiveness of Corporate Hedging

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Version: September 2014

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Abstract

Many studies have documented that hedging by nonfinancial firms has a significant impact on cash flows, firm value and stock returns. However, other studies have raised questions relating to the effectiveness of corporate hedging programs by nonfinancial firms. This paper proposes an explanation to reconcile these contradictory findings. A simple model is used to illustrate the point that different hedging objectives may not always be consistent with one another, and that metrics appropriate for one objective may not be appropriate for another. Consequently, assessing a particular hedging program using the wrong metrics can be seriously misleading. In order to evaluate hedging effectiveness with respect to specific operational objectives (such as reducing the volatility of cash flows), it is important to take into account the different motivations and conflicting objectives that underlie corporate hedging programs.

Keywords: Corporate Hedging, Hedging Effectiveness

The question whether corporate hedging is worth doing remains controversial. On the one hand, several studies have documented the sensitivity of stock returns and/or operating income to changes in exchange rates. Examples of studies supportive of corporate hedging include Jorion (1990), Allayannis and Ofek (2001), Muller and Verschoor (2005), Clark and Mefteh (2010) and Yip and Nguyen (2011). On the other hand, other studies such as Copeland and Joshi (1996), Hentschel and Kothari (2001) and Bali, Hume and Martell (2007) raise questions about the effectiveness of corporate hedging programs, especially those of nonfinancial firms. For example, Copeland and Joshi (1996) in their classic, much cited study claim that "even the most superbly designed and executed programs seem not to reduce cash flow volatility significantly for most firms."

This paper suggests a partial explanation for these apparently contradictory findings. In a nutshell, corporate hedging may have a number of (not always mutually consistent) objectives. Most empirical studies that investigate hedging effectiveness with respect to specific operational goals (such as reducing the volatility of cash flows) appear to ignore this point and use a one-size-fits-all approach to measuring effectiveness.[1] For example, it would be inappropriate to assess the hedging program of a firm that is attempting to reduce the uncertainty relating to near term cash flows by testing whether derivatives use has any impact on the volatility of the time series of cash flows. The paper uses a simple hedging model to illustrate this point.

[1] Of course, studies that test whether or not hedging affects firm value or stock returns are not subject to this criticism.

The rest of the paper is organized as follows. The next section contains a brief review of the literature. The following two sections outline a hedging model and a discussion of the issues respectively. The last section concludes with a summary and suggestions for further research.

Literature Review

Classic studies that laid down the theoretical rationale for hedging include Stulz (1984), Smith and Stulz (1985) and Froot et al (1993). Since then a number of empirical studies have investigated the effects of corporate hedging using a variety of approaches.

One of the first studies to question the effectiveness of hedging was Copeland and Joshi (1996), henceforth referred to as CJ. The main objective of CJ was to answer the question whether hedging has any appreciable impact on the volatility of a firm's cash flows. For a sample of large firms from the Compustat database, they estimated hedged cash flows based on a hypothetical hedging program and compared these with unhedged cash flows.

Carried out for a period of 10 years, this analysis reveals that this hypothetical hedging program reduces the volatility of income by more than 10% for only 20 of the 198 firms in the sample; and for only one firm does the volatility decrease by over 20%. Further, CJ find that the correlation between "unhedged" cash flows and change in foreign exchange (FX) rates is too low for hedging to have any appreciable reduction in volatility of income. Based on these results and a confidential case study (results of which are not reported in detail), CJ conclude that hedging foreign exchange risk is unnecessary for most firms.

Examples of other studies that provide a similar negative report on the effectiveness of hedging programs of nonfinancial firms are Hentschel and Kothari (2001) and Bali, Hume and Martell (2007).

This result is at odds with a number of studies that document a significant relationship between operating income/stock returns and exchange rate changes. See for example Donnely and Sheehy (1995), Choi and Prasad (1995), Prasad and Rajan (1995), and Chow, Lee and Solt (1997), Allayannis and Ofek (2001), and Clark and Mefteh (2010). All of these studies suggest that firm valuation is affected by exchange rate fluctuations.

Model

Rao (2011) contains a theoretical model that provides the optimal multiperiod hedging strategy in order to minimize the variability of cash flows. The model is briefly outlined here for ease of reference. Let w_t denote period t cash flow and suppose that if follows the stochastic process represented by

$$w_t - w_{t-1} = (1 - \delta)(\mu - w_{t-1}) + u_t \qquad (1a)$$

or equivalently,

$$w_t = (1 - \delta)\mu + \delta w_{t-1} + u_t \qquad (1b)$$

Above, μ is the long run mean, u_t is white noise, and (1-δ) is the speed of adjustment parameter. It is clear from equation (1b) that δ can also be interpreted as the autoregressive coefficient. If δ = 1, then w_t follows a random walk. If δ is strictly between 0 and 1, then reversion to the mean is gradual; in other words, if this period's value is above (below) the long run mean, next period's value can also be expected to be above (below) the long run mean but closer. If δ = 0, then w_t is independently and identically distributed (i.i.d.) each period. Thus, higher the value of δ, lower is the degree of mean reversion.

Suppose that the hedging firm's objective is to minimize the variability (unconditional variance) of the time series of period-by-period cash flows by hedging using forward contracts. To allow for basis risk, the forward contract is assumed to be based on an underlying that is different from the hedged variable. For simplicity, the hedging firm is allowed to take positions only in the forward contract maturing at the same time as the cash flow being hedged. However, forward contracts are available for all maturities ranging from 1 period to *n* periods. Therefore, the firm can hedge a certain period's cash flows by taking a position in the appropriate forward contract as early as *n* periods in advance. Further, the firm can modify this position each subsequent period.

Further it is assumed that the forward price is the expected spot price at maturity. This implies that the expected change in forward prices is zero. Therefore, hedging cannot affect the expected value of cash flows in any period and allows us to focus on the variability of cash flows.

Let y_t denote the process underlying the forward contract. For example, this might be a process for an exchange rate or oil prices. Suppose that this process too is first-order autoregressive:

$$y_t - y_{t-1} = (1-\theta)(\rho - y_{t-1}) + \xi_t \qquad (2a)$$

or equivalently,

$$y_t = (1-\theta)\rho + \theta\ y_{t-1} + \xi_t \qquad (2b)$$

Above, y_t is the value of the process in period t, ρ is the long run mean, ξ_t is white noise, and (1-θ) is the speed of adjustment parameter. Assume that all non-contemporaneous variances between ξ and u are zero.

Each period's cash flows can be hedged by taking positions in forward contracts ranging from one period ahead to n periods ahead. Let p_{T-k} denote the (short) forward position taken at time T-k to hedge period T cash flows. Let f_{t+k}^{t+n} be the forward price in period $t+k$ of the forward contract that matures in period $t+n$. Therefore, post-hedge cash flows in period T are given by

$$C_T = \sum_{k=1}^{n} p_{T-k}(f_{T-k}^{T} - y_T) + w_T \qquad (3)$$

The optimal p_{T-k}'s, can be easily found using dynamic programming. Define the cumulative forward position in period t for the purpose of hedging period T's cash flow as h_t. Thus, for $i = 0, \ldots, n-1$

$$h_{T-n+i} = \sum_{j=0}^{i} p_{T-n+j} \qquad (4)$$

It is easily shown that for $k = 1, \ldots, n$

$$h_{T-k} = \frac{\sigma_{u\xi}}{\sigma_{\xi}^2}\left(\frac{\delta}{\theta}\right)^{k-1} \tag{5}$$

It is apparent that the hedging pattern (i.e., the pattern of cumulative hedge positions) depends crucially on the ratio of δ and θ. The case $\delta = \theta$ indicates a situation wherein both cash flows and the risk process mean-revert with the same speed. In that case, the optimal strategy is to take the single period optimal hedge n periods ahead and then retain this position without any modification whatsoever until it is closed out at maturity. If $\delta < \theta$, then cash flows mean-revert faster than the underlying of the forward contract. In this case, the optimal hedging strategy is to take a partial (underhedged) position n periods ahead and make gradual increases over the hedging tenor.

Lastly, if $\delta > \theta$, then cash flows mean-revert slower than the underlying of the forward contract. Such a situation appears unlikely in real life. In this case, the optimal hedging strategy is to overhedge in the first period of the hedging tenor (i.e. n periods ahead), and then reverse the excess position gradually over the rest of the hedging tenure.

Applying this model to FX hedging, the optimal hedging strategy (including the decision how far ahead of time to hedge or equivalently whether to hedge long term cash flows or short term cash flows) depends on:

- the extent to which current FX shocks affect future exchange rates (the degree of mean reversion in spot rates).

- the extent to which adverse movements in FX rates can be neutralized by price increases or operational changes. (the degree of mean reversion in cash flows).

Thus, the optimal hedging strategy depends on the relative degrees of mean reversion of the hedged series and the forward contract's underlying.

Discussion

Many firm hedge in order reduce the volatility of cash flows (or earnings). The main benefits include a smoother earnings stream, reducing reliance on costly external financing owing to unanticipated shortfalls in internally generated cash flows, and the ability to carry out planned investments.

However, other firms may hedge in order to reduce uncertainty sorrounding near term cash flows. The main rationales may be to facilitate planning and control, and buying temporary protection against adverse price/exchange rate movements. As pointed out by Brealey and Kaplanis (1995), hedging provides the firm with some breathing time to adjust to shocks by making suitable operational adjustments.

In such a case, it would be a mistake to assess hedging effectiveness by looking at how hedging reduces volatility of cash flows over time. Instead, the focus should be on how hedging reduces the conditional variance of near-term cash flows. In this connection, it is worth noting that several studies indicate that FX rates mean-revert very slowly or follow a random walk. In that case, the optimal strategy is either to only hedge near term cash flows or not hedge at all

To better illustrate this point that hedging may well accomplish the latter objective without the former, consider again the model described above. For simplicity, assume that hedging may be carried out only one period in advance.

Then, it is easy to calculate that the unconditional variance of w_t is given by

$$Variance(w_t) = \frac{Variance(u_t)}{(1-\delta^2)}. \tag{7}$$

The conditional variance of w_t is given by

$$Variance_{t-1}(w_t) = Variance(u_t) \tag{8}$$

Whether the objective is to minimize the unconditional or conditional variance of cash flows, the optimal hedge in this simple framework is given by

$$h_{t-1} = \frac{\sigma_{u\xi}}{\sigma_{\xi}^2} \tag{9}$$

Under this strategy, the unconditional variance of cash flows is given by

$$\begin{aligned} Variance(C_t) &= Variance(w_t) - \frac{Covariance(u_t, \xi_t)}{Variance(\xi_t)} \\ &= \frac{Variance(u_t)}{(1-\delta^2)} - \frac{Covariance(u_t, \xi_t)}{Variance(\xi_t)} \end{aligned} \tag{10}$$

and the conditional variance of cash flows is given by

$$\begin{aligned} Variance_{t-1}(C_t) &= Variance_{t-1}(w_t) - \frac{Co\,\mathrm{var}\,iance(u_t, \xi_t)}{Variance(\xi_t)} \\ &= Variance(u_t) - \frac{Co\,\mathrm{var}\,iance(u_t, \xi_t)}{Variance(\xi_t)} \end{aligned} \tag{11}$$

It is clearly possible for the unconditional variance to be relatively large (owing to δ being close to unity) and the conditional variance to be small. In fact, if δ equals unity, then cash flows follow a random walk and the unconditional variance may not even exist, while the conditional variance still may. Thus, it is possible that hedging is worthwhile despite its not significantly decreasing the volatility of cash flows.

Conclusion

The question whether corporate hedging by nonfinancial firms is effective remains controversial. Different hedging objectives may not always be consistent with one another, and that metrics appropriate for one objective may not be appropriate for another. Consequently, assessing a particular hedging program using the wrong metrics can be seriously misleading.

This paper illustrates this point by using a specific example. A simple hedging model is used to show that hedging the time series variability of cash flows and the uncertainty of near term cash flows are not necessarily consistent with one another. As a result, assessing hedging effectiveness of a program that targets the latter objective by using a metric appropriate to the former objective would be inappropriate.

One can, of course, always meaningfully test whether hedging has any impact on firm value or stock returns. However, in order to evaluate hedging effectiveness with respect to specific operational objectives (such as reducing the volatility of cash flows or reducing the probability of financial distress), it is important to take into account the different motivations and conflicting objectives that underlie corporate hedging programs.

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