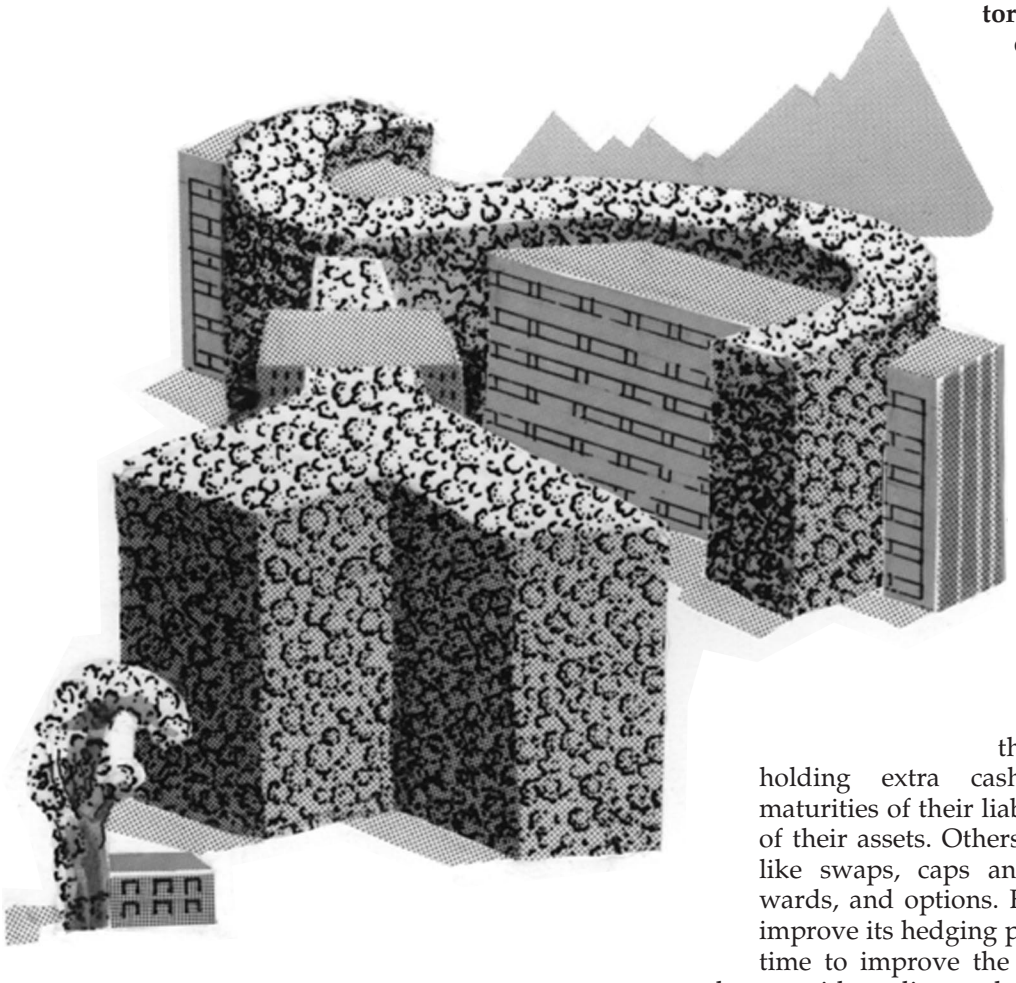
Pergamon

European Management Journal Vol. 16, No. 1, pp. 63–69, 1998

Printed in Great Britain
PII: S0263-2373(97)00074-1
0263-2373/98 $19.00 + 0.00

Link Your Company's Hedging to Raising Your Stock Price

ASHOK RAO, *Babson College, Massachusetts, USA*
JOHN EDMUNDS, *Babson College, Massachusetts, USA*



All companies hedge currency, interest rate, or commodity price exposure, using natural or contractual hedges. But traditional defensive hedging is restrictive and yet, greater flexibility appears to bring problems of control. Ashok Rao and John Edmunds solve this dilemma in a simple model which can be run on Microsoft Excel software. The model monitors a company's hedging on a daily basis, to measure how much each hedge is contributing to shareholder value, and to assess how much the set of hedges that are in place add to shareholder value. Various extensions of the model are possible.

All companies hedge. Some do it the traditional way, by holding extra cash, or matching the maturities of their liabilities to the maturities of their assets. Others use hedging products like swaps, caps and floors, futures, forwards, and options. Every company tries to improve its hedging policies, and at the same time to improve the control it has over its employees with trading authority. Improvement is a priority because hedging has the power to raise shareholder value, or to destroy the company if it is misused. Every time the company enters into a hedging commitment, the transaction has to be monitored to make sure it conforms to corporate goals, adds a measurable dollar amount to shareholder value, and does not expose the company to risk of serious loss.

Traditional Approaches to Controlling Hedging Activity

Hedging used to be an arcane specialization, and it was done by one or a few experts working in treasury at the corporate headquarters level. Top management viewed hedging as defensive. The aim was to protect the company from losses, which stemmed from currency devaluation or commodity price fluctuations.

Top management controlled the experts who did the hedging by imposing trading limits on them. There were several kinds of trading limits in common use. One was for the total long positions to equal short positions at the close of business each day. Another kind of limit was more sophisticated and restrictive. It required total duration-adjusted long positions to equal duration-adjusted short positions.

Another kind of control system was driven by the need to explain all hedging to regulators and auditors. The approach was to link every hedge with an asset or liability item that is exposed to fluctuation. Every hedging product was like a shield to protect a specific balance sheet or income statement item from a specific threat. Every foreign exchange forward contract, for example, would be linked to a specific exchange rate exposure. Every interest-rate swap would be associated with a specific asset or liability item on the balance sheet; for example, an issue of fixed-rate bonds would be swapped into floating-rate debt. The swap would have the same face amount and maturity as the bonds.

These control systems are defensive. They make it easy to explain the company's hedging to the auditors, and they smooth the financial reporting process. But defensive control systems have several difficulties. First, the company's treasury staff may want to over-hedge an exposed position. For example, the company expects to receive 8 million German marks in 11 months. The cost of hedging that exact amount of marks for that exact amount of time may be higher than the cost of hedging 10 million marks for one year. The treasury staff may argue that the risk associated with over-hedging is small, in comparison to the cost of a tailor-made hedge for exactly 8 million marks for exactly 11 months. Should the treasury staff be allowed to over-hedge in this case?

Second, a hedge may become unnecessary before it expires. Suppose the payment of 8 million German marks comes in after 10 months instead of 11 months. In the meanwhile, the mark may have gone down slightly. Suppose the 10 million German mark forward commitment was used to hedge this cash flow, and now has a paper profit. The treasury staff might want to sell the 8 million marks immediately, and keep the forward contract open for the remaining two months, in hope of making a bigger profit. Should the treasury staff be allowed to keep the forward contract open in this case?

Third, a hedge may serve to cover two exposures. The company may have German marks coming in for the next 5 years, and may also need to expand its factory in Canada. In that case, the company might borrow German marks for 5 years, and convert the proceeds of the loan into Canadian dollars. This takes advantage of the lower interest rate in Germany, and the German mark cash flows hedge part of the repayment of the loan. The company could do a 5-year, dollar-for-mark currency swap to hedge the part of the German mark loan that was unhedged. The funds for the Canadian expansion would then have been obtained cheaply, and the German mark inflows would have been hedged. The remaining exposure would be the Canadian dollar inflows coming from the new factory. Those could be hedged with a Canadian dollar-for-US dollar currency swap, which would begin after the new factory began producing. This hedge would cover the exposures and would raise money cheaply. But should it be permitted? It violates the principle of matching each hedge to a single exposure.

Fourth, a hedge may be overtaken by events. The Canadian subsidiary may be sold before the German mark loan has been repaid. The buyer pays cash, and now the situation is completely different. Whatever loans and hedges the company arranged at the beginning have now lost their counterparty asset and liability items, so they are loose ends. They will have to be closed out or assigned to new counterparty asset and liability items.

So the neat approach of linking each hedge to a mate, and keeping the two married until they both expire, does not work perfectly, and controlling the traders, so that their net positions remain within narrow limits, does not maximize the value of the company's stock at all times. There may be times when hedging products are good investments. Market conditions may create a glut of swaps, or swaptions, or caps and floors. If a glut develops, traders will want to buy the underpriced assets, but the defensive control system will keep them from doing it. Their hands would be tied.

Yet the alternative, namely allowing treasury staff some flexibility in matching hedges to specific asset and liability items, leads too close to the abyss. It is just a small step from strict matching to speculation, from defensive hedging to pro-active anticipatory hedging, to speculation with only flimsy links to real underlying transactions involving raw materials and finished goods.

Most companies do not have a satisfactory solution to this dilemma. Most have a working solution, but are still not able to say that they have their hedging activity set up so that it consistently adds to share-

holder value, always remains in control, and also provides the treasury staff with opportunities to exercise their analytic and trading skills to the fullest. We present here a simple method for monitoring a company's hedging on a daily basis, which measures how much each individual hedge is contributing to shareholder value, and which can assess how much the set of hedges that are in place add to shareholder value. The monitoring software runs in Microsoft Excel. The inputs it requires and the outputs it gives are straightforward. The monitoring software can be used to assess hedges that are already in place, and it can also be used to choose among a list of new hedges that are proposed.

The Approach

Every asset and liability item on a company's balance sheet has a variance: that is, a characteristic amount that its value fluctuates over time. The assets have expected returns and the liabilities have expected costs. Any of the assets might yield a return higher than what was expected, or lower than what was expected. That range is the variance for that asset. Similarly, every liability item has an expected cost, and the range of fluctuation is its variance. During most periods the returns the assets earn are higher than the costs of the liabilities; otherwise the company is not profitable. If the returns or the costs are volatile, however, the company's profits will be erratic. The Capital Asset Pricing Model combined with a valuation model shows the tradeoff between (undiversifiable) volatility and the value of the firm.

Hedging products are capable of reducing the volatility of a company's earnings over time. They cost money, but they can be worth the price if they are used properly. Each hedging product has its own variance. Its fluctuations are supposed to offset the variance of an asset or liability item. Some hedging products have a large variance compared to their cost. They can be used to offset the risk associated with a large asset or liability item. Like a pinch of powerful spice in a bowl of soup, they can make a big change.

Financial reporting rules require firms to show hedging products in the footnotes, as contingent liabilities. In the approach shown here they are treated the same as the asset and liability items. The firm owns assets, and owes liabilities; it also owns or owes calls, puts, swaps, caps, floors, swaptions, etc. Hedging products are treated as if they were conventional asset and liability items. A variance is calculated for each one, and those variances are included in the analysis along with the ones calculated for asset and liability items.

After all the existing asset, liability, and hedging product items have been taken into account, and their variances have been estimated, the next step is to simulate the variance of the firm's earnings over the time horizon of the upcoming 10 years. This gives a scenario of earnings, and a scenario for the volatility of earnings (Tables 1 and 2).

That earnings scenario, together with a current quote for the Treasury bill interest rate, and the return on the market portfolio, can be used to compute the value of the company (Table 3).

After developing a benchmark estimate for the value of the company, new hedging products can be bought or sold on a pro forma basis, and added to the existing portfolio of assets, liabilities, and hedging products. This pro forma addition will change the company's risk/return profile, and management will be able to compute how much net contribution the new hedging product adds to the value of the firm. If there are several new hedging products that are being considered, quadratic programming allows considering them all at the same time, and arrives at the combination which maximizes the value of the firm.

Mathematical Programming

Mathematical programming maximizes or minimizes an objective function. The objective function in this case is the company's stock price multiplied by the number of shares outstanding. The stock price comes from discounting projected future earnings by the cost of capital. The cost of capital depends on the cost of shareholders' equity, the cost of debt, and the firm's capital structure. The cost of shareholders' equity, in this approach, depends on the variance of aftertax earnings.

As an example, the firm borrows $200 million for five years, paying LIBOR. There are five alternative hedges to protect against a rise in LIBOR. These are (1) to borrow at a fixed rate; (2) to do a five-year fixed-for-floating swap; (3) to buy a cap; (4) to sell a floor; (5) to buy a 2×5 swaption (Table 4).

Mathematical programming allows computing the least-cost combination of these hedging products which will bring the variance of the firm"s cost of borrowing $200 million down to the target level set by top management, or the level which stock market investors signal is appropriate.[1]

Quadratic programming is used instead of the more familiar linear programming because the objective function and the constraints include squared terms. To compute an asset's variance requires squaring the differences between individual observations of the asset's value and asset's average value, adding up the squared differences, and dividing through by the number of observations. Happily, Excel can solve

Table 1 Balance Sheet Including Existing Hedges with Variances ($mil.)

Asset items	*Dollar amount*	*Expected return (%)*	*Variance of the return*
Cash and equivalents	15	5	0.0025
Accounts receivable	35	11	0.01
Inventory	65	17	0.0625
Fixed assets	175	23	0.1225
Total conventional	290		
Hedging products receivable	44.7		
Product and face amount	*Market value*		
Interest rate cap 50 million	1.5	3	0.0225
Call on German marks 75 million	2.25	3	0.0144

Liability items	*Dollar amount*	*Expected cost (%)*	*Variance of the cost*
Accounts payable	30	8	0.0144
Floating rate debt	50	16.25	0.0196
Fixed rate debt (marks)	75	7	0
Stockholders equity	135	18.42	
Total conventional	290		

Hedging products payable

Product and face amount	*Market value*		
Interest rate floor 50 million	0.7	1	0.0256
Crude oil swap 100 million	3	2	0.0196

Expected profit of the company	($mil.)
Is equal to the expected return on assets, minus the expected cost of the liabilities plus the annual dollar revenues of hedging products sold, less the annual dollar cost of hedging products purchased	
Dollar value of the expected return on assets	55.9
Dollar value of the expected cost of liabilities	15.775
Less annual cost of hedging products purchased	3.75
Plus annual revenue from hedging products sold	3.7
Gives net pretax income to stockholders equity	40.075
Less cost of stockholders equity at 18 per cent	24.3
Gives expected annual shareholder value created	15.775

Note:
Maximizing the stock price boils down to maximizing expected annual shareholder value created, subject to controlling variance of the expected annual shareholder value created. Lowering the variance costs money, because it is done either by choosing safer assets, or by using less debt, or by buying hedging products. The tradeoff is favorable as long as every reduction in the variance lowers the discount rate that investors use to discount the company's earnings by enough so that the present value if the stream of income to shareholders rises

moderately large quadratic programming problems, so special programming skills are not required.

In the example calculation shown, top management has set a high tolerance for volatility, so the answer is to sell a floor with face value equal to 40 per cent of $200 million, or $80 million. The cash from selling the floor would be available to offset higher financing cost in the event that LIBOR rises. If top management is less tolerant of risk, the recommended amount of hedging increases (Table 5).

Inputs to the Complete Model

For each asset and liability item, a time series of dollar values has to be generated. This series should be realistic, and should be faithful to the fluctuations the asset makes in real life. The series can be generated by simulation. Then, when a series has been generated, its variance can be calculated.

The asset's covariance vis-à-vis an index, for example the S + P 500 Index, also needs to be calculated. This is easy if there is a time series showing the asset's

Table 2 Income Statement. 10 Year Projection: Including Effects of Hedges; One Scenario of Shareholder Value Created ($mil)

Year	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
No hedge											
Dollar value of the expected return on assets	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9
Dollar value of the expected cost of liabilities	15.775	15.12	12.4	12.745	12.25	11.65	10.805	11.35	12.37	11.805	11.43
Gives net pretax income to stockholders equity	40.125	40.78	43.5	43.155	43.66	44.25	45.095	44.55	43.53	44.095	44.47
Less cost of stockholders equity at 18 per cent	24.870	24.870	24.870	24.870	24.870	24.870	24.870	24.870	24.870	24.870	24.870
Gives expected annual shareholder value created	15.255	15.910	18.630	18.285	18.785	19.380	20.225	19.680	18.660	19.225	19.600
Hedge											
Dollar value of the expected return on assets	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9	55.9
LIBOR	16.25%	14.94%	9.50%	10.19%	9.19%	8.00%	6.31%	7.40%	9.44%	8.31%	7.56%
Cost of floating debt	9.00%	9.00%	9.00%	9.00%	9.00%	8.00%	6.31%	7.40%	9.00%	8.31%	7.56%
Dollar value of the expected cost of liabilities	12.15	12.15	12.15	12.15	12.15	11.65	10.805	11.35	12.15	11.805	11.43
Less annual cost of hedging products purchased	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
Plus annual revenue from hedging products sold	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Gives net pretax income to stockholders equity	43.7	43.7	43.7	43.7	43.7	44.2	45.045	44.5	43.7	44.045	44.42
Less cost of stockholders equity at 18 per cent	24.870	24.870	24.870	24.870	24.870	24.870	24.870	24.870	24.870	24.870	24.870
Gives expected annual shareholder value created	18.830	18.830	18.830	18.830	18.830	19.330	20.175	19.630	18.830	19.175	19.550

value during a time period in the past. If there is no such time series, and none can be obtained, one will need to be simulated.

Simulating variances for each hedging product requires slightly more programming. Some hedging products do not pay off unless specified conditions are met. So the simulation will have conditional payoffs built into it. Still, each hedging product will need to have an estimated variance and covariance.

The next input is the firm's cost of capital. This can be estimated easily, because the formulas are well known, and most companies already have computed what their cost of capital is. The amount of reduction which a hedging product can achieve in the firm's cost of capital then has to be computed. This is easy to do, provided that a reduction in the volatility of the firm's cash flows leads directly to a reduction in its cost of stockholders' equity. There are theoretical reasons why this reduction does not go all the way down to zero, and there is a recognition lag. The cost of stockholders' equity will not decline until the investing public recognizes that the company's earnings have become more stable, and bids higher prices for the company's stock.

Table 3 Value of the Firm (Assuming Unlevered Beta is Known, and that the Hedges Reduce the Unlevered Beta)

This sheet assesses the value of the firm's equity. It uses inputs from the balance sheet and income statement.
It begins with the firm's unlevered Beta, assuming that no hedging is done. Then it computes the firm's levered Beta. Using its levered Beta, the return on the market portfolio, and the T-bill rate, it computes the firm's cost of equity. Then it uses the Gordon formula to value the firm's equity.
This sheet is used before and after proposed the hedges have been taken into account.

Annual income to common equity	44.7
Firm's unlevered Beta	1.2
Firm's debt/equity ratio	0.534483
Firm's tax rate	0.34
Firm's levered Beta	1.552759
T-bill rate	0.06
Return on the S&P 500	0.14
Firm's cost of equity pre-hedging	0.184221
Firm's growth rate of dividends	0.03
Value of the firm from Gordon formula	289.8444

Table 4 Proposed Hedges

Proposed Hedges

Liability to be hedged: $200 million 5-year loan priced at LIBOR

Hedge alternative 1: borrow fixed-rate instead	Cost	0.38125
Hedge alternative 2: fixed-for-floating swap, 5 years	Cost	0.27757
Hedge alternative 3: buy a 5-year cap	Cost	0.36175
Hedge alternative 4: sell a 5-year floor	Income	0.26742
Hedge alternative 5: buy a 2 × 5 swaption	Cost	0.3714

Table 5 Quadratic Programming Output, Showing only 40 per cent of One Hedging Product is Used

Fixed	Swap	Cap	Floor	2 × 5 Swaption		
0	0	0	0.4	0		
0.38125	0.27757	0.36175	0.26742	0.3714		0.106968
1	1	1	1	1	0.4	0.4
0	0.15	0.036	0.017	0.022	0.00272	0.0032
0	0	0	0.16	0		

Note:
Excel Solver chooses the least-cost hedge among five alternatives, to bring the variance in the firm's cost of floating-rate debt down to the level set by top management. For the given level of variance, selling a floor covering only 40% of the face amount of the liability is enough hedging.

Using This Approach to Monitor a Hedging Program

Now suppose the company has an in-the-money option and wants to sell it to recognize the paper profit. To replace the coverage the option gives, the company wants to buy two different hedging products. The model can fine-tune the decision. On a pro forma basis, the company sells the in-the-money option, then simulates the payoffs from the two proposed hedging instruments. If they provide the needed coverage, and cost less than the amount being offered for the in-the-money option, the firm buys an optimal mix of the two instruments being offered.

Conclusion

Hedging can be an integral part of the shareholder value creation process. It does not have to be considered separately, nor does it have to be strictly defensive. With the modelling and control process described here, each proposed hedge can be assessed and compared to other hedges that are available, and hedging can be monitored on an ongoing basis, so that management can be sure it is being harnessed to create value in a stable, quantifiable way. Every proposed hedge should be subjected to the kind of analysis described here. The method is easy to use, so it is a disservice to shareholders to engage in hedging

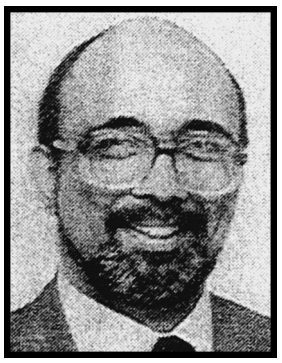
without it, and it also harms shareholders if a firm refuses to use hedging instruments on the mistaken grounds that they are too risky.

Note

1. The Capital Asset Pricing Model indicates that the required rate of return for a common stock only goes down if its undiversifiable risk goes down. According to that view, managers of companies should only hedge those risks that investors are unable to hedge for themselves. The approach here assumes that companies should consider hedging all risks, because volatile earnings are not valued as highly as stable earnings. Smithson and Smith have a clear discussion of this point in their book *Managing Financial Risk* (Smithson and Smith, 1995). They report empirical studies showing that companies can lower the unlevered Beta of their stock by engaging in risk management. The approach here is to make a direct link between variance of earnings and unlevered Beta.

Reference

Smithson, and Smith, (1995) *Managing Financial Risk*. Irwin, pp. 101–113, 505–509.



ASHOK RAO, *F. W. Olin Graduate School of Management, Babson College, Babson Park, MA 01257-0310, USA.*

Ashok Rao is Professor of Decision Systems Support at Babson College, and has held positions in major corporations including Northern Telecom. His consulting and research include TQM, materials management, computer-integrated enterprises and management training. Dr Rao is President of RAM Systems Inc., a software consulting company.

JOHN EDMUNDS, *F. W. Olin Graduate School of Management, Babson College, Babson Park, MA 02157-0310, USA.*

John Edmunds is Associate Professor of Finance at Babson College with areas of specialization in international corporate finance, capital markets and derivative securities. He also teaches at the Arthur D. Little School of Management, and was voted 'Professor of the Year' there in 1994. Author of over 65 articles and cases, his most recent publication is 'Securities: the new world wealth machine' in the Fall 1996 issue of Foreign Policy.