CASE STUDY: USING STOCHASTIC OPTIMIZATION AND VALUATION MODELS TO EVALUATE THE CREDIT RISK OF CORPORATE RESTRUCTURING

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Companies restructure their product mix to boost sales and profits, increase shareholder value, or to survive when the corporate structure becomes impaired. In successful restructurings, management not only actualizes lucrative new projects, but abandons existing projects when they no longer yield sufficient returns, thereby channeling resources to more value-creating uses.

At one level, restructuring can be viewed as changes in financing structures and management. At another level, restructuring may be operational—in response to production overhauls, market trends, technology, and industry or macroeconomic disturbances. It is often the essence of strategy formulation—that is, management's response to changes in the environment to creatively deploy internal resources—that improves the firm's competitive position. Indeed, changing operating and financial structures in pursuit of a long-run strategy is a key corporate goal—the most direct path to shareholder value.

For banks called on to finance corporate restructurings, things are a bit different. For example, most loans provide a fixed return over fixed periods that are dependent on interest rates and the borrower's ability to pay. A good loan will be repaid on time and in full. It is hoped that the bank's cost of funds will be low, with the deal providing attractive risk-adjusted returns. If the borrower's business excels, *the bank will not participate in upside corporate values* (except for a vicarious pleasure in the firm's success). However, if a borrower ends up financially distressed, lenders share much, perhaps most, of the pain.

Two disparate goals—controlling default (credit) risk, the bank's objective, and value maximization, a traditional corporate aspiration—are often at odds, particularly if borrowers want term money to finance excessively aggressive projects. In the vast majority of cases of traditional credit analysis, where the spotlight focuses on deterministically drawn projections, hidden risks are often exceedingly difficult to uncover. Devoid of viable projections, bankers will time and again fail to bridge gaps between their agendas and client aspirations.

This case study offers ways for bankers to advance both their analytics and communication skills—senior bank officials and clients alike to "get the deal done" and ensure risk/reward agendas are set in equilibrium. Undeniably, the direct way to achieve results is to take a stochastic view of strategic plans rather than relying inappropriately on deterministic base case or conservative scenarios. Let us start with the following fundamentals:

- Stochastically driven optimization models allow bankers to more realistically represent the flow of random variables.
- In negotiating restructuring loans, borrowers (and bankers) can determine under stochastic assumptions optimal amounts to invest in or borrow to finance projects.
- McKinsey & Company, Inc.,[1] suggests that business units should be defined and separated into lines of business. Business units should be broken down into the smallest components and analyzed at the base level first.
- Consolidating financials, rather than consolidated reports, should be used to perform business-unit valuations.
- Knowing the market value and volatility of the borrower's assets is crucial in determining the probability of default.
- A firm's leverage has the effect of magnifying its underlying asset volatility. As a result, industries with low-asset volatility can take on larger amounts of leverage, whereas industries with high-asset volatility tend to take on less.
- After restructuring is optimized at the unit stage, unit level valuations are linked to the borrower's consolidated worksheet to process corporate valuations.

The Business Case

Consider the data in Excel spreadsheets depicted in Figures 14.8, 14.9, and 14.10. The worksheets depict management's original restructuring plan. ABC Bank is asked to approve a $3,410,000 loan facility for the hypothetical firm RI Furniture Manufacturing LTD. Management wants to restructure four of its operating subsidiaries. In support of the facility, the firm supplied the bank with deterministic base case and conservative consolidating and consolidated projections—income statement, balance sheet, and cash flows.

The deterministic or static forecasts tendered the bank limited the variability of outcomes. From a banker's perspective it is often difficult to single out which of a series of *strategic options* the borrower should pursue if the bank fails to understand differences in the range and distribution shape of

	Distribution	Operating Profit Margin Range	Operating Profit Margin Most Likely
All Weather Resin Wicker Sets	Triangular	5.5% – 12.6%	11.0%
Commuter Mobile Office Furniture	Triangular	6.5% – 8.7%	7.5%
Specialty Furniture	Triangular	0.5% – 5.3%	4.7%
Custom Built Furniture	Uniform	3.3% – 6.6%	None

FIGURE 14.8 Distributional assumptions.

possible outcomes and the most likely result associated with each option. Indeed an overly aggressive restructuring program might reduce the firm's credit grade and increase default probabilities. We will not let this happen. Undeniably, this deal deserves stochastic analytics rather than a breadbasket consisting of passé deterministic tools.

From deterministic consolidating projections, bankers developed a stochastic spreadsheet depicted in Figure 14.10. This spreadsheet included maximum/minimum investment ranges supporting restructuring in each of four product lines. Using optimization along with the deterministic McKinsey DCF Valuation 2000 Model, the firm's bankers came up with a stochastic solution. On a unit level, they developed a probability distribution assigned to each uncertain element in the forecast, established an optimal funding array for the various business combinations, and held cash-flow volatility to acceptable levels, preserving the credit grade (again at the unit level). Finally, the last optimization (worksheet) was linked to the consolidating/consolidated DCF valuation worksheet(s). The firm's bankers then determined postrestructuring equity values, specific confidence levels, and probabilities that asset values fall below debt values.

Product Line	Lower Bound	Upper Bound
All Weather Resin Wicker Sets	1,000,000	1,250,000
Commuter Mobile Office Furniture	600,000	1,000,000
Specialty Furniture	570,000	1,100,000
Custom Built Furniture	400,000	900,000

FIGURE 14.9 Investment boundaries.

	B	C	D	E	F
1	**RI Furniture Co. Limited: Strategic Plan**				
2					
3		*Annual*	*Lower*	*Upper*	
4	***Proposed New Product Lines***	***operating return***	***bound***	***bound***	
5	All Weather Resin Wicker Sets	9.7%	$1,000,000	$1,250,000	
6	Commuter Mobile Office Furniture	7.6%	$600,000	$1,000,000	
7	Specialty Furniture	3.5%	$570,000	$1,100,000	
8	Custom Built Furniture	5.0%	$400,000	$900,000	
9					
10					
11		*Amount*		*Constraint*	
12	***Decision variables***	***invested***			
13	All Weather Resin Wicker Sets	$1,125,000			
14	Commuter Mobile Office Furniture	$800,000		*Decision Variables prior to optimization*	
15	Specialty Furniture	$835,000			*Total amount*
16	Custom Built Furniture	$650,000			*invested*
17	*Total expected return*	$231,058		*Objective*	$3,410,000
18	*(Annual operating return X Amount invested)*				

FIGURE 14.10 Borrower's original strategic restructuring plan (reworked by the bank in a stochastic mode, not yet optimized).

Business History

RI Furniture started operations in 1986. The firm manufactures a full line of indoor and outdoor furniture. Operating subsidiaries targeted for restructuring, depicted later, represent approximately 65 percent of consolidated operations.

- *All Weather Resin Wicker Sets.* This furniture comes with a complete aluminum frame with handwoven polypropylene resin produced to resist weather. *Operating profit margin distributions and investment ranges for each subsidiary are shown in Figures 14.8 through 14.10.*
- *Commuter Mobile Office Furniture.* The commuter rolls from its storage location to any work area and sets up in minutes. It integrates computer peripherals (monitor, CPU tower, keyboard, and printer) in a compact, secure mobile unit.
- *Specialty Furniture.* After restructuring, this business segment will include production of hotel reception furniture, cafe furniture, canteen furniture, restaurant seating, and banqueting furniture.
- *Custom-Built Furniture.* Furniture will be custom built in the firm's own workshop or sourced from a host of reputable manufacturers both at home and abroad.

The analysis was run by placing a constraint on $3,410,000 investment—that is, the bank's facility cannot exceed $3,410,000. Later we place an additional constraint: the forecast variable's volatility. From the information in Figures 14.8 and 14.9, the bank developed the spreadsheet depicted in Figure 14.10.

Using optimization, a constraint on investment/loan facility was entered:

All Weather Resin Wicker Sets + *Commuter Mobile Office Furniture* + *Specialty Furniture* + *Custom Built Furniture* <=3410000.

Note that investment falls to within the constraint boundary, while expected return increased.

Simulation statistics reveal that volatility of the expected return (the forecast variable), as measured by the standard deviation, was $20,000. Again, *volatility of operating results affects the volatility of assets*. This point is important. Suppose we determine the market value of a corporation's assets as well as the volatility of that value. Moody's KMV demonstrates that volatility measures the propensity of asset values to change within a given time period. This information determines the probability of default, given the corporation's obligations. For instance, KMV suggests that if the current asset market value is $150 million and a corporation's debt is $75 million and is due in 1 year, then default will occur if the asset value turns out to be less than $75 million in 1 year. Thus, as a prudent next step, bankers discuss the first optimization run (Figure 14.11) with management on three levels: (1) maximum expected return, (2) optimal investments/loan facility, and

	A	B	C	D	E	F
10						
11			Amount		Constraint	
12		Decision Variables	Invested			
13		All Weather Resin Wicker Sets	$1,247,100		Decision Variables	
14		Commuter Mobile Office Furniture	$993,671		prior to optimization	
15		Specialty Furniture	$570,000			Total amount
16		Custom Built Furniture	$598,998			invested
17		Total expected return	$245,757		Objective	$3,409,769
18		(Annual operating return X Amount invested)				
19						

Total Expected Return - Risk Simulator Forecast Distribution

Histogram | Preferences | Statistics | Options

Statistics	Result
Number of Trials	1000
Mean	248378.1019
Median	248845.3630
Standard Deviation	20278.0716
Variance	411200188.4180
Average Deviation	15951.5389
Maximum	314095.8767
Minimum	176695.9212
Range	137399.9555
Skewness	-0.0396
Kurtosis	0.2564
25% Percentile	234474.0950
75% Percentile	261455.6607
Error Precision at 95% confidence	0.5060%

FIGURE 14.11 Run Two optimization results.

(3) volatility of expected return. If volatility is unacceptable, the standard deviation must be reduced to preserve credit grade integrity. We assume the bank requires project standard deviation to be equal to or below $17,800.

The final simulation shown in Figure 14.12 produced an optimization that reconciled both risk/reward agendas discussed earlier. The loan facility effectively reduces to (optimized) $3,331,102, and because the firm requires less money, financial leverage improves. We note that $227,889 is the maximized expected return, lower than the $245,757 produced with no volatility constraint—lower risk reduces rewards.

The story does not end here; our analysis up to now was restricted to the unit level—that is, business segments involved in the restructuring. While the spreadsheet in Figure 14.12 worked its stochastic wonders, it *must now link to consolidating and consolidated discounted cash-flow (DCF) valuation worksheets*. Consolidated DCF valuations provide a *going-concern* value—the value driven by a company's future economic strength. RI Furniture value is determined by the present value of future cash flows for a specific forecast horizon (projection period) plus the present value of cash flow *beyond* the forecast horizon (residual or terminal value). In other words, the firm's value depends on cash-flow potential and the risks (threats) of those future cash flows. These perceived risks or threats help define the discounting factor used to measure cash flows in present value terms. Cash flow

	B	C	D	E	F
10					
11		***Amount***		*Constraint*	
12	***Decision variables***	***invested***			
13	All Weather Resin Wicker Sets	$1,000,000			
14	Commuter Mobile Office Furniture	$993,225		*Decision Variables*	
15	Specialty Furniture	$723,457		*prior to optimization*	*Total amount*
16	Custom Built Furniture	$614,420			*invested*
17	*Total expected return*	$227,889		*Objective*	$3,331,102
18	*(Annual operating return X Amount invested)*				
19		**Expected**	**Total**		
20	**Summary**	**Return**	**Investment**	**Standard Deviation**	
21	**Borrower's Original Projections**	$231,058	$3,410,000	n/a	
22	**Run One: Original Projections Optimized**	$245,757	$3,409,769	$20,373	
23	**Run Two: Project Volatility Constraint**	$227,889	$3,331,102	$17,800	
24	**Run Two: Project Volatility Actual**			$17,701	
25	**Expected Return and Loan Reduction**	$17,868	$78,667		
26	***(Bank Requirement: Reduce Project Risk)***				
27					
28			**Run One**	**Run Two**	
29	**Investment (Loan Amounts)**	**Original Strategy**	**Optimized; No**	**Optimized; Risk**	
30		**Not Optimized**	**Risk Constraint**	**Constraint**	
31	**All Weather Resin Wicker Sets**	$1,125,000	$1,247,100	$1,000,000	
32	**Commuter Mobile Office Furniture**	$800,000	$993,671	$993,225	
33	**Specialty Furniture**	$835,000	$570,000	$723,457	
34	**Custom Built Furniture**	$650,000	$598,998	$614,420	
35	**Total**	$3,410,000	$3,409,769	$3,331,102	

FIGURE 14.12 Final optimization results.

depends on the industry and the economic outlook for RI Furniture's products, current and future competition, sustainable competitive advantage, projected changes in demand, and this borrower's capacity to grow in light of its past financial and operating performance. Risk factors that the firm's bankers will examine carefully include their borrower's financial condition; quality, magnitude, and volatility of cash flows; financial and operating leverage; and management's capacity to sustain operations on a profitable basis. *These primary attributes cannot be ignored when bankers determine distributions associated with assumption variables.*

Simulation and optimization embedded into powerful valuation models provides an intuitive advantage; it is a decidedly efficient and precise way to get deals analyzed, done, and sold.

CASE STUDY: REAL OPTIONS AND KVA IN MILITARY STRATEGY AT THE UNITED STATES NAVY

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Millions of dollars are spent by the United States military for information technology (IT) investments on Quick Reaction Capability Information Warfare (IW) and intelligence collection systems. To evaluate and select projects yielding maximum benefits to the government, valuation tools are critical to properly define, capture, and measure the total value of those investments. This case study applies Knowledge Value-Added (KVA) and Real Options valuation techniques to the Naval Cryptologic Carry-On Program (CCOP) systems used in the intelligence collection process, with particular focus on human capital and IT processes. The objective is to develop a model and methodology to assist in the budgeting process for IW systems. The methodology had to be capable of producing measurable objectives so existing and future CCOP systems could be evaluated.

The Challenge

The Chief of Naval Operations directed its CCOP Office to focus on three goals for fiscal year 2005: efficiencies, metrics, and return on investment.