Applying Modern Risk Management to Equity and Credit Analysis

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Traditional conventions of accounting and actuarial science distort the valuation of capital risk in corporations with pension plans because under these conventions, pension assets and liabilities are not included in balance sheet calculations. The modern risk management tools of derivatives technologies can improve both corporate decision making and external analysis of corporations.

Much has been written about the implications that modern enterprise risk management tools have for internal corporate decision making. This article, however, concentrates on the implications of these tools for external analysis. Particularly, I look at the ways that credit and equity analysts can use such tools to evaluate the intrinsic values and risk profiles of the companies they are analyzing. Inadequate analytical tools and overdependence on traditional accounting and actuarial conventions have resulted in systematic distortions in the estimates of company value and economic risk. My purpose, therefore, is to show how modern enterprise risk management tools can be used by external analysts to develop more accurate estimates of value and risk.

I begin by discussing some past distortions in the valuation of pension liabilities, referring particularly to the measurement of pension fund surpluses and deficits before Financial Accounting Standard (FAS) No. 87 (*Employers' Accounting for Pensions,* 1985), as well as in employee options before option expensing. I then review the current neglect of value and risk in corporate pension plans and wrap up my discussion with a look into a future where derivatives technologies will facilitate a greatly expanded implementation of strategic risk management.

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Past Distortions in Valuation and Risk Analysis

Before 1987, the actuarial discount rate used to determine the present value of pension liabilities was a matter of judgment. This type of analysis tended to describe where rates had been rather than where they were going, and it responded slowly to changes in economic trends. Therefore, during the 1970–80 period, for example, when inflation steadily rose and interest rates were high, this methodology resulted in discount rates that were lower than market rates, thus causing the present value of liabilities to be overstated. Then, as interest rates declined between 1981 and 1986, this approach yielded discount rates that were higher than market rates and the present value of liabilities was understated. The result was a significant and systematic distortion of the funding surplus of corporate pensions.

In the 1970s, analysts, using a stale rate that overstated liabilities, indicated that pension liabilities were exceeding pension assets and that pensions had a deficit problem. Many wrenching discussions revolved around the terrible deficits in corporate pension plans. Then, rates began coming down dramatically, and actuaries and other observers began making the opposite mistake of understating liabilities and overstating the surplus. Leibowitz (1992) warned of this problem and, in a sense, foresaw the difficulties of 2000–2002, when pension assets fell as the stock market declined and pension liabilities rose as a result of falling interest rates.

Another example of such distortions in analysis can be seen in employee stock option programs. Prior to FAS No. 123 (*Accounting for Stock-Based Compensation*, 2004), compensation costs from employee options were not reflected in corporate earnings or labor costs, thereby resulting in companies overstating measures of operating profitability and cost efficiency. This, in turn, had a third effect of stifling innovation in incentive and retention compensation programs because of the preferential accounting treatment for at- or out-of-the-money options. I am hopeful that because such conditions no longer exist, we will see steady improvement and effectiveness in incentive compensation.

Present Failures in Recognizing Value and Risk

By not recognizing the actual value and risks of corporate pension plans, current methods of analysis offer a distorted estimate of systematic risk and the cost of capital. Before addressing that topic, however, I would like to offer a few comments about the role that accounting has played in the demise of the defined-benefit plan.

The number of plan sponsors that have capped their plans or shifted entirely out of defined-benefit plans has grown rapidly. The turning point occurred when IBM, an employee-centric and financially sound corporation, chose to freeze its defined-benefit plan at the beginning of 2006. Such developments have many explanations. One is that defined-benefit plans are simply too expensive. But another, I would suggest, has to do with the accounting method that has traditionally been used to calculate the benefit. In pension accounting, companies are permitted to project forward the expected earnings on their pension assets as if they had been earned, at least for a time, even though they have not. Therefore, if a pension fund holds a mix of equities and debt at a risk-free rate of 5 percent and a blended expected return of 9 percent, the fund can project the 9 percent into earnings and smooth it over a substantial period of time. Such accounting thus allows a company to project, in effect, a risk-free rate that is 400–500 bps higher than the actual risk-free rate. The sense in which this practice causes an effective understatement of liabilities and thus needed funding can be seen by using this projected rate as a risk-free discount rate of future pension benefits. If I were to assume a 10-year duration for pension liabilities, which may be a little conservative, and used a 9 percent rate instead of a 5 percent rate to discount pension liabilities, I would get 67 percent of the value. Thus, if a company takes that valuation legitimately, then it would appear to be giving away $1.00 in benefits when it is really giving away $1.50 in benefits. I believe that this effective understatement of the present value was the main driver of the demise of defined-benefit plans. Accounting conventions simply allowed companies to underestimate the cost of benefits.

Formulas for Estimating Operating Assets. Defined-benefit pension plans currently account for about $3 trillion in assets—a lot to manage and evaluate when analyzing the companies that have them. And make no mistake, from an economic point of view, the pension assets of a corporation belong to the shareholders. Pension assets are the corporation's encumbered assets, and pension liabilities are the corporation's liabilities. The residuals accrue to the shareholders. Therefore, an analyst should consider a corporation's pension assets and liabilities to be an integral part of its total assets and liabilities.

To estimate the beta or the cost of capital for the operating assets of a company, an analyst traditionally assumes that the company is leveraged and, therefore, unlevers the equity betas using the following formula:

$$\beta_{OA}^{T} = \frac{E\beta_E + D\beta_D}{D+E}.$$

Unfortunately, the traditional formula neglects the pension asset and liability. To account for those assets and liabilities, the following formula must be used:

$$\beta_{OA}^{C} = \frac{E\left(\beta_E + \beta_D\right) + \left(D-E\right)\beta_D - PA\left(\beta_{PA} - \beta_{PL}\right) - \left(PA-PL\right)\beta_{PL}}{OA}.$$

This formula provides the correct estimate of the beta of operating assets. The difference between the traditional estimate and the correct estimate can be found by using a third formula:

$$\beta_{OA}^{T} - \beta_{OA}^{C} = \frac{\left[PA\left(\beta_{PA} - \beta_{PL}\right) - \left(PA-PL\right)\left(\beta_{OA} - \beta_{PL}\right)\right]}{\left(OA+PA-PL\right)}.$$

Problems Caused by Traditional Methods of Valuation. Distortion in the cost of capital for operating assets is directly related to the error in systematic risk. For plans that are not in large surplus, either fully funded or underfunded, the error will tend to be positive, which means that the traditional estimate will tend to overestimate the beta of the operating assets. If the beta estimate is too large, the cost of capital estimate will be too large. From the company's point of view, one effect of overstating the cost of capital is that, by using a discount rate that is too high, the company is likely to leave money on the table in the form of not undertaking

projects with positive net present value. From the analyst's point of view, the effect can be a misvaluation of the dividend discount model or any of the earnings models and an underestimate of a company's growth opportunities.

To illustrate the problems caused by traditional methods of valuation, I developed two simple balance sheets, shown in **Table 1**. They demonstrate the effect of pension asset risk mismatch on equity and the cost of capital. The first part is based on traditional estimates; the second adjusts for the effect of pension assets and liabilities. Panel A of Table 1 shows the market value of operating assets to be $40 billion, its debt, $19 billion, and its equity, $21 billion. The beta of the equity is estimated at 2.00, and I assume the beta of the debt to be 0.00. After deleveraging, the estimated beta for the operating assets is 1.05. If the risk-free rate is 5 percent and the equity premium is 7 percent, the weighted average cost of capital (WACC) for operating assets is 12.35 percent. This value can be seen either as a discount rate to be applied in valuing similar operating projects or, from an analyst's perspective, the rate to be used in a dividend discount model or for assessing growth opportunities.

In Panel B, the company's pension assets and liabilities are added to the balance sheet. Notably, the assets and liabilities are equal, indicating that the company's retirement plan is fully funded. From an accounting point of view, therefore, the values net out. The risks, however, do not cancel out, and that is my point. About 60 percent of the pension fund's assets are in equities. If the assets have a beta of about 1.00, the total pension assets have a beta of 0.60 (assuming that the pension fund's fixed-income investments and pension liabilities have a beta of 0.00). When I apply the formulas mentioned earlier, the implied beta for the operating assets is 0.36 (rather than 1.05 for Panel A). With a 5 percent risk-free rate, applying that beta to a 7 percent risk premium leads to a WACC of 7.52 percent. Thus, when one adjusts for the impact of the pension fund on the volatility of the company's operating assets, the WACC changes by almost 500 bps! In companies with large defined-benefit plans, the very magnitude of the assets in the pension plan, even in comparison with operating assets, can lead to a substantial error in analysis.

The effect of the allocation of pension fund assets on the company's asset and equity risk can be seen in **Table 2**; it demonstrates the impact of pension assets on a company's risk valuation. The plan is fully funded, so no value differential exists. The case with 60 percent of pension assets in equities represents the status quo. Following from that, the pension asset beta is 0.60, the total asset beta, 0.49, and the company's equity beta, 2.00. Change the percentage of pension assets in equities, however, and the company's equity beta changes dramatically. With no pension assets in equities, the company's equity beta falls to 0.70; with 100 percent of pension assets in equities, the company's equity beta rises to 2.88.

If I assume instead that the betas of equities as we see them in the marketplace are distorted because of the lack of information, then this same analysis can determine the impact, which is that companies with large equity pension fund investments will appear to have alphas because their actual asset and equity betas are larger than the market believes. The understated beta will cause an overestimate of alpha, those companies will appear to be superior performers, and analysts will value them too highly.

My colleagues and I (Jin, Merton, and Bodie 2006) conducted an empirical study in which we built a model and tested whether market prices were

Table 1. Traditional Standard vs. Full Economic Balance Sheet Estimates

Assets	Value (billions)	Risk (beta)	Liabilities and Equity	Value (billions)	Risk (beta)
A. Traditional[a]					
Operating	$40	1.05	Debt	$19	0.00
			Equity	21	2.00
Total	$40	1.05	Total	$40	1.05
B. Full economic[b]					
Operating	$40	0.36	Debt	$19	0.00
Pension	46	0.60	Pension liabilities	46	0.00
			Equity	21	2.00
Total	$86	0.49	Total	$86	0.49

[a]Traditional estimated WACC operating assets = 12.35 percent.
[b]Correctly estimated WACC operating assets = 7.52 percent.

Table 2. Effect of Pension Fund Asset Allocation on Asset and Equity Risk

Portion of Pension Assets in Equities	Pension Asset Beta	Total Asset Beta	Company Equity Beta
0%	0.00	0.17	0.70
25	0.25	0.30	1.23
60	0.60	0.49	2.00
75	0.75	0.57	2.34
100	1.00	0.70	2.88

picking up the mismatch of risk in pension funds. Previous studies tested whether the market prices of securities reflected the impact of pension surplus and deficit, which they seem to do. But our study examined the risk differential, and the data are entirely consistent with the market accounting for the risk differential. That does not mean that the market is, in fact, doing so—only that the data point is consistent with that view. And regarding the alternative hypothesis—that the market does not take account of the risk differential—the data do not show evidence to support the alternative hypothesis.

Table 3 illustrates an experiment undertaken to determine the relationship between a company's asset allocation in its pension fund and its capital structure. Let us assume that our hypothetical company wants to keep its equity risk fixed at a beta of 2.00. As it adjusts its allocation of pension assets between equities and debt, how must it adjust its debt-to-equity ratio to hold its equity risk constant at 2.00? In the original case, an allocation to equities of 60 percent would require equity capital of $21 billion and a debt-to-equity ratio of 0.90. If, in contrast, the company reduces the allocation to equity in its pension fund to 25 percent, then it will reduce the risk on the left side of the balance sheet, which means that it can reduce the amount of equity capital on the right side of the balance sheet and still keep the same beta. In this case, the company can reduce equity capital to $12.9 billion, but if it increases the allocation to equities in its pension fund to 75 percent, then it will have to increase its equity capital to $24.5 billion. This analysis demonstrates how a pension fund's asset allocation has substantial implications for a company's capital structure.

Examples from Real Companies. Now consider data from Jin, Merton, and Bodie (2006) on several real companies as of 2001, shown in **Table 4**. The beta of equity is estimated with a capital asset pricing model that uses data on three-year rolling monthly stock returns obtained from CRSP and the value-weighted return on all stocks on the NYSE, Amex, and NASDAQ as the proxy for the market. In this instance, the beta of corporate debt is assumed to be 0.175. My colleagues and I considered four well-known companies—Boeing, DuPont, Eastman Kodak Company, and Textron—whose pension plans could be described as middle of the road. We identified the equity betas of the companies and then calculated their operating asset betas first by using the traditional method, which ignores the pension plan, and then by using what I call the "correct method," which incorporates the value and risks of pension assets and liabilities. Based on our analysis, the traditional method caused a percentage error in the estimation of beta that ranged from 139 percent for Boeing to 32 percent for DuPont, with Eastman Kodak coming in at 63 percent and Textron at 46 percent.

Table 3. Trade-Off between Pension Asset Allocation and Capital Structure

Portion of Pension Assets in Equities	Total Asset Beta	Hold Fixed Company Equity Beta	Needed Equity Capital (billions)	Debt-to-Equity Ratio
0%	0.17	2.00	$ 7.3	4.48
25	0.30	2.00	12.9	2.10
60	0.49	2.00	21.0	0.90
75	0.57	2.00	24.5	0.63
100	0.70	2.00	30.1	0.33

Table 4. Errors in Estimating Equity and Operating Asset Betas

Company	Equity Beta	Operating Asset Beta (correct)	Operating Asset Beta (traditional)	Overestimation Error for Traditional
Boeing	0.689	0.228	0.543	139%
DuPont	0.707	0.482	0.634	32
Eastman Kodak	0.867	0.416	0.679	63
Textron	0.732	0.292	0.426	46

Table 5 offers further insights into the flaws of traditional accounting conventions. When adjusted for pension risks, the WACC for each of the four companies drops significantly. Note that in three of the four cases, the companies have pension surpluses and that the one plan that does not has a deficit that is small relative to the size of the company, so these are not companies that have troubled pension plans. The pension risks in these plans are certainly not extreme. Nevertheless, the differences between the traditionally calculated WACC and the WACC adjusted for pension risks cannot be ignored. In the case of Boeing, the standard procedure shows a WACC of 8.80 percent and the adjusted procedure, a WACC of 6.09 percent—a difference of 271 bps. DuPont shows a difference of 129 bps, Eastman Kodak, 228 bps, and Textron, 117 bps. These are not minor differences, and they can have a significant impact both on managers and analysts. I have no idea what methods these companies use for valuation and risk measurement. I am simply using their data to show how traditional conventions may lead analysts to poor evaluations of companies and may lead those same companies to poor decisions in their capital budgeting. Even managements that are not using a full economic approach can benefit from its methods because they can help impart a better understanding of risks and their composition. For example, in another context, I examined the defense industry and found that when using the traditional methods, the betas of pure defense companies are rather high, but when I adjust correctly for the risks of the pension funds, the operating asset betas of defense companies are near zero. From a market point of view, defense projects are estimated to have little systematic risk and, therefore, a low cost of capital, close to the risk-free rate.

Future Distortions: Derivatives in Strategic Risk Management

Companies have been using derivative securities to manage risk for quite some time, and the number of companies doing so will continue to grow. The use of derivatives allows companies to remove massive amounts of risk with little or no immediate impact on the earnings statement or the balance sheet. By eliminating their passive risk, companies can reduce the amount of equity capital needed to support the risk of their assets without removing any of the value creation of risk (see Merton 2005). But because this transfer of risk does not manifest itself in the accounting statements, it creates a real challenge for the analyst to assess the true risk profile of the company.

The Balance Sheet and the Effect of Equity. Consider the effect of holding stocks on the left side of the balance sheet. If a company is holding the S&P 500 Index, which is clearly a passive asset, that investment produces an expected return, but it does not create value. It does, however, have variance. It thus contributes to the volatility on the left side of the balance sheet. This means that the company needs more equity capital on the right side of the balance sheet to support the existing credit rating and cushion the debt against asset volatility, which is fine except that equity capital is expensive. It has material frictional costs. For example, the more equity capital a company has instead of debt capital—all else being equal—the less tax benefit it obtains.

Similarly, a company must deal with the agency costs of equity capital. Consider a hedge fund that proposes charging 2 and 20 and offers a choice of lockup terms for investors' money of 90 days, 1 year, or 10 years. Are investors going to be indifferent among these terms for having their money locked up? Of course they will not. They would rather have the money locked up for the shorter period; they would expect to be compensated for accepting a longer lockup time. Although large institutions do not need liquidity to pay bills, they want liquidity so they can influence management behavior. That is, they want the ability to take their money out if management stops doing what they want done. The longer the lockup period, the larger the agency costs of equity capital. Unlike a hedge fund, the lockup period for shares issued by a corporation is indefinitely long. Shareholders do not have the right to

Table 5. Errors in Estimates of WACC

Company	Pension Assets (billions)	Pension Liabilities (billions)	Pension Surplus/Deficit (billions)	Market Cap (billions)	Book Value of Debt (billions)	Standard WACC[a]	WACC Adjusted for Pension Risks[a]
Boeing	$33.8	$32.7	$ 1.1	$30.9	$12.3	8.80%	6.09%
DuPont	17.9	18.8	(0.9)	42.6	6.8	9.44	8.15
Eastman Kodak	7.9	7.4	0.5	8.6	3.2	9.75	7.47
Textron	4.5	3.9	0.6	5.9	7.1	7.98	6.81

[a]WACC numbers are based on a risk-free rate of 5 percent and a market risk premium of 7 percent.

redeem their shares. Thus, the agency costs of equity capital are greatest for a standard corporation. Because of such costs, equity is expensive, so companies can use derivatives to reduce passive risks as a means of economizing on equity capital without losing any of its value.

If no material frictional costs of equity capital existed, corporations would issue huge amounts of equity capital and use the proceeds to buy passive assets to hold until needed. They would then be rated AAA all the time, and employees, customers, and suppliers would be thrilled. And if an opportunity to invest were to reveal itself, the company could make the investment immediately without going back to the market to raise the needed capital. That, however, is not what corporations are doing and not what money managers are advising, which indicates that corporations see substantial frictional costs in having equity. As companies perceive opportunities to strip out passive risks that are not creating value, they should seize these opportunities and use the risk capacity created either to fund new business assets or reduce equity capital.

Using Derivatives to Manage Risk. The derivatives that companies use to manage risk include interest rate swaps, equity swaps, and credit default swaps. Interest rate swaps allow banks, in particular, to respond to the mismatch between the interest rate durations of loans and deposits, a mismatch that has traditionally created massive risks for the bank's equityholders. Interest rate swaps cost nothing, yet they can substantially transform the risk of a corporation without showing any impact on the balance sheet.

Equity swaps can be especially beneficial for pension funds because they allow fund managers to remove passive market risk and thus add value. If fund managers are creating superior returns through alpha, they can remove the component that is not adding value, which is the benchmark. Brokerage firms, whose profitability is driven by trading volume (which is, in turn, determined by market direction), use equity swaps to hedge the passive business risk of a market decline.

The biggest growth area in the use of derivatives is the credit default swap market, in which companies can trade credit, both sovereign and corporate. For example, banks can use credit default swaps to continue to extend credit to prized customers even when they reach their internal credit limits because banks can lay off the excess amount of risk through the swaps. But financial firms are not the only businesses that can use credit default swaps. For example, a large aircraft manufacturer, such as Boeing, can use credit default swaps to hedge the credit risk from its financing of the airplanes that it sells to airlines. In a concentrated way, Boeing is putting itself into the credit business. Such use of swaps allows manufacturers to extend credit further than in the past by offsetting the risk of that credit and thereby providing manufacturers with another avenue for keeping customers.

The credit default swap market is also encouraging a convergence of credit and equity analysis, the original separation of which can be traced back to the Glass–Steagall Act of 1933. Credit investors are not typically mark-to-market investors, whereas equity investors are. But the fortunes of creditors and of equityholders are linked to the same events that affect the left side of the balance sheet, so the sharing of information between credit and equity analysts offers clear benefits. The credit default swap market has materially improved the transparency of credit-counterparty risk by publicizing the prices of credit even when it is not otherwise traded. The credit default swap market's volume is more than $40 billion a day, and credit research firms are using equity market models to give assessments of credit risk and evaluation.

Finally, consider the case of large equity investors who are comfortable with normal equity risk but want to avoid a steep downturn. The first thought that comes to mind for achieving this result is to buy deep out-of-the-money put options. But such options are not available in sufficient size (and at a reasonable price) for a large investor. An alternative is to buy at-the-money credit protection on the companies in which they own the equities, which is a very deep and liquid market. The logic is that for an adverse credit event to occur, the equity values would have to fall substantially.

Conclusion

Modern risk management techniques create challenges and wonderful opportunities for analysts to develop new tools that can provide more accurate information for investors, analysts, and regulators. Given their analytical benefit, corporations and analysts should not be afraid to use them.[1]

[1]For more on this topic, see Merton (2006a, 2006b).

This article qualifies for 0.5 CE credits.

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Question and Answer Session

Robert C. Merton

Question: What would be the likely impact of new accounting rules for pensions and options on the systematic valuations of the markets?

Merton: I do not know how much misevaluation has gone on, so it is difficult to say. One concern raised is that if pension funds were suddenly to get out of equities, at least out of the passive parts of equities, that change might have a dysfunctional impact on the markets. If pension funds did that, however, they would be reducing their companies' risk, which means the companies would not need as much equity capital. In fact, the companies could buy back their equity. Disruptions can occur in the short run, as happened in the United Kingdom, but generally, the right amount of equity would be demanded by companies repurchasing their own shares as a result of the risk reduction in their assets if pension funds were to make this change. The impact, therefore, would be less systematic in nature. Hopefully, in the long run, better decisions would lead to better valuations.

Question: How have public state funds fared with respect to the treatment of their pension liabilities?

Merton: In terms of giving proper valuations to their liabilities, state pension fund accounting is even more archaic than private pension fund accounting, but surely, the same principles apply. State funds should use market prices and be wary of actuarial smoothing, which leads to the systematic distortion I have identified in the corporate area.

Question: As workers live longer in retirement, what is the impact on pension liabilities, and how are companies going to respond?

Merton: Worker longevity is an important risk and is one reason that companies are shifting to defined-contribution plans. They are trying to shift that risk to their employees. Whatever the accounting rules happen to be, analysts should apply the revised longevity valuations. As with interest rates, the best protection against longevity risk is to use the most up-to-date numbers for longevity. Only then can analysts and managers gauge the impact on value and get a sense of the risk. Then, management can decide whether to get rid of the risk or continue to hold it and inform its shareholders of the decision.

Question: Can you comment on the amount of leverage in the market and how that might impact the decision to use derivatives?

Merton: The concern is whether the credit derivatives markets are at risk to have defaults in them, but that is a concern for mature markets as well as for new and growing markets. Given the degree of risk involved in credit markets, the potential exists for a lot of money to be lost from credit declines. The fact that a lot of money can be lost, however, does not necessarily mean that the market will break and that there will be defaults on the contracts themselves in a crisis period. A number of good things exist to mitigate that risk. The importance of two-way market collateralization should not be underestimated. And, having multiple channels, many hedge funds, and a broader base of assetholders helps as well.

Ultimately, derivatives are important because they provide a critical new factor in financial analysis. Mistakes will be made, and some people will lose money, but I do not foresee disaster.

Question: How do you deal with liquidity risk in a distressed market environment?

Merton: You are basically describing what I think of as liquidity event risk. When the market experiences a shock, it becomes like a deer in the headlights; the market just freezes. A shock occurs, and people do not understand what is going on, so they get out of the market until they do understand. Hedge funds exist in part to take advantage of such situations. I have seen data ranging from 1994 to 2004 showing that every hedge fund investment class has a systematic exposure to this kind of liquidity risk, which is not necessarily bad because hedge funds may be precisely the type of institution that should be bearing that risk. Another type of institution that can bear this risk is a pension fund because pension funds do not need liquidity.

Question: What are the lessons learned from Long-Term Capital Management (LTCM)?

Merton: That was about eight years ago, and I have not spoken about it publicly. If there were some new theory of finance that was discovered because of the LTCM event, however, I would surely have relayed it to everyone a long time ago.

LTCM held very big positions. It was financed that way, and the people running it knew that. Everything was term financed, which is the right thing to do with big illiquid positions. It was also a mark-to-market firm. It had two-way, mark-to-market collateral on its positions. When the events started to go bad and risk managers began telling their desks to reduce their risk exposure to these markets, and to LTCM, the desks could not because they were contractually obliged to provide financing. So, what will the people on the desks do if they cannot get out? They will try to get as much cushion as they can by marking the collateral positions in their favor. It is a natural reaction. What we did not anticipate, however, was the feedback to net asset value (NAV), which caused NAV to go down on a mark-to-market basis, and you can see what that led to. We had good people in place with many years of market experience, so we felt prepared for crisis management, but we never anticipated a position-by-position correlated set of events that had a feedback to NAV.