RECORD, Volume 23, No. 2*

Montreal Spring Meeting
June 19–20, 1997

Session 74OF
Management of Insurance Company Risk

Track: Financial Reporting/Investment
Key words: Corporate Strategy, Financial Management, Management Information, Risk Classification

Moderator: GERALD A. LOCKWOOD
Panelists: DAVID W. CARLSON
ALASTAIR G. LONGLEY-COOK
KENNETH S. ROBERTS
H. MICHAEL SHUMRAK
Recorder: DAVID W. MORRIS

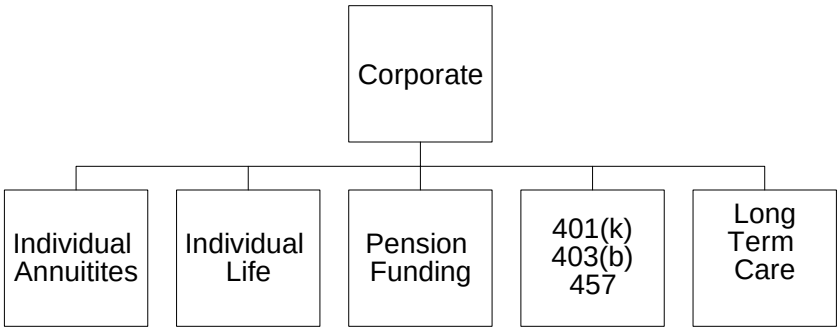
Summary: The potential actuarial role in strategic risk management is significant. Identifying, understanding and managing risk is critical to insurance companies and all corporate entities. The focus of the panel is on the overall structure of management of corporate risk, including asset/liability management. The concept of transfer pricing is also included as a component of risk management.

Mr. Gerald A. Lockwood: Risk management has become a hot topic in the business world. Boards of directors and the senior management of companies are talking about it. Many companies are focusing on the function as being a critical area of development, and insurance companies are no different. Many of us have always seen the job of the actuary as fundamentally risk management, but the role is not always viewed as actuarial in many companies. But I believe the potential role of actuaries in strategic risk management is a very significant one. The topic of risk management can be very broad. Our four speakers will be discussing three different aspects of risk management and risk management in an insurance company context. Our first speaker will be Michael Shumrak. Michael is managing director of Chalke Consulting Group, where he is responsible for Chalke's risk management, marketing, and product strategy practice. Michael will be explaining how transfer pricing can be utilized in managing an insurance company's asset/liability risks.

Mr. H. Michael Shumrak: My topic is transfer pricing. A good way to start is to do a simple conceptual version of this, maybe one that you're familiar with. When I hear the words "transfer pricing," I think about situations in which companies have gone to a strategic business unit format where people manage product lines or markets. Then the question becomes "How do you allocate expenses?" Or, if you're using a central resource like data processing or legal resources, "How do you allocate that?" In some cases, companies go to the extreme of charging out those entities almost like internal consultants, and with others the costs are just allocated. We're going to talk about applying that same sort of concept, but rather than to the area of expenses, we're going to apply it to risk. Here, conceptually, we are talking about a risk manager profit center and a situation that, we hope, helps eliminate what otherwise seems to be the eternal conflict involving the marketing function. The focus is going to be on interest-sensitive products. A conflict exists between the marketing strategies, vis-à-vis interest rate strategies, and asset/liability management (ALM) strategies, the other side of the house that's trying to maintain reasonable matching and risk management.

Many companies have a matrix organizational structure, and this attribution goes on (Chart 1). In a typical organizational structure divided by product lines, you'd have a corporate area, and there might be lawyers and data processing, or maybe even some investment expertise in corporate.

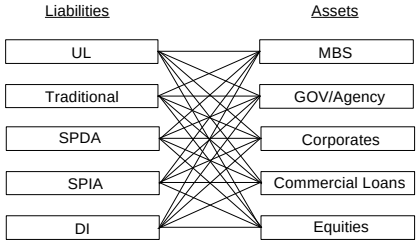
CHART 1
ORGANIZATIONAL STRUCTURE



Now, let's get into the asset management function. We're not going to get into expense transfer pricing; we're going to talk about financial and risk transfer pricing. Concerning asset management, most companies don't have a complete complement of investment asset managers and ALM people for every division; it's just not economical. So, again, some sort of allocation approach exists. In some cases you have portfolio segmentation so the overall assets of a company get divided up in one form or another to the various lines of business. In this case, we have universal

life (UL), and they are getting a piece of some assets, or in some cases of segmentation, actual assets matched up with their liabilities (Chart 2). But, when you really stop to look at it for all the products taken together, you end up with a situation which is very difficult and often confusing and impractical. Then you end up with solutions where maybe you notionally give people shares in the assets, rather than giving them the entire asset. The problem with that, though, is that it really doesn't allow the product manager or the profit center management in UL to say, "I think I want a different investment strategy," because he or she has a piece of many different investments, and you just can't practically say, "I don't want this, I want more of that."

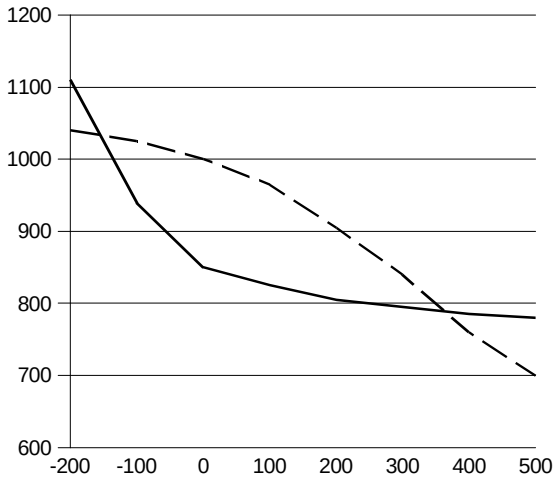
CHART 2
PORTFOLIO SEGMENTATION



A different way to look at the business, jumping into financial risk transfer, is to look at the business in terms of the functions of manufacturing, distribution, and marketing, managing the in-force policies, investment performance, and the interest rate mismatch. If you're managing a market or UL product line, you probably have the greatest influence over the liability management—probably about 80% degree of control—and in a typical setup you have limited management responsibility or impact on what you can do with investment income—around 10%. Your degree of control with expenses is something in between, say, 25%. Yet, with the concept of these profit centers you are held responsible for everything, like you're running a little business. So, the idea is to try to reconstruct the organizational framework so that you're really working with what you can control and have the flexibility to manage the business the way you think it can best grow profitably. Then you won't be stuck in the middle of this back and forth between marketing strategy and investment strategy and risk.

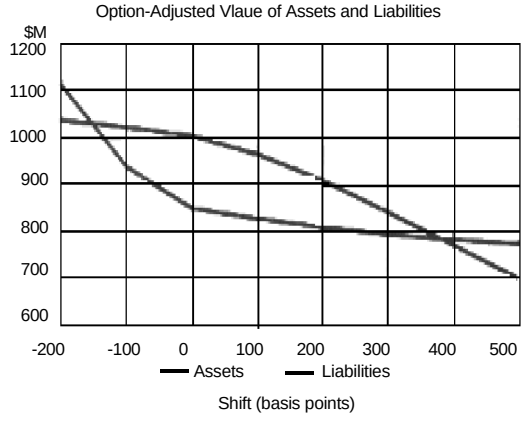
One tool we have used is option-adjusted analysis. Here we have a price behavior curve, and it shows the characteristics of the assets and liabilities based on instantaneous parallel shifts in the yield curve (Chart 3).

CHART 3
OPTION-ADJUSTED VALUE OF ASSETS AND LIABILITIES



This is our building block. This is just one more elaborate example of the price behavior curves for assets and liabilities, and then, of course, the difference is the surplus, and it shows the pattern and then some statistics on option-adjusted values, duration and convexity (Chart 4).

CHART 4
FPM LIFE INSURANCE COMPANY: 4TH QUARTER 1996



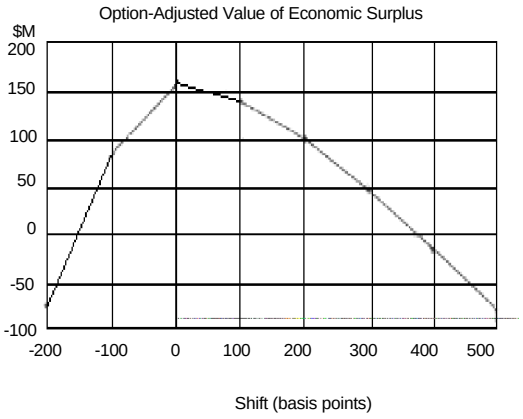
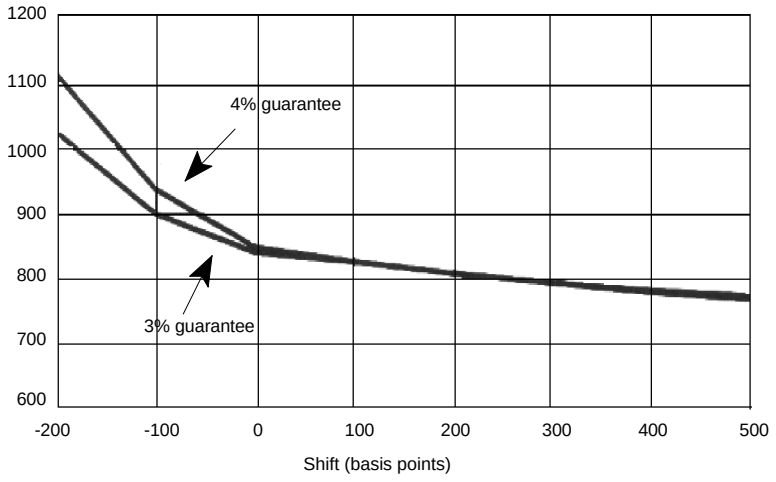


TABLE 1
FPM LIFE INSURANCE COMPANY: 4TH QUARTER

Shift	Assets			Liabilities			Economic Surplus		
(b.p.)	OAV	Duration	Convexity	OAV	Duration	Convexity	OAV	Duration	Convexity
-200	1038	1.47	N/A	1113	18.66	N/A	-75	-188.24	N/A
-100	1023	1.89	-39.10	938	10.61	906.18	85	-45.51	-10470.59
+0	1004	4.04	-199.20	848	2.66	801.89	156	12.23	-5641.03
+100	965	6.16	-176.17	826	2.23	48.43	139	37.62	-1510.79
+200	909	7.96	-121.01	808	1.76	49.50	101	110.42	-1458.33
+300	842	9.21	-47.51	794	1.40	37.78	48	-500.00	-1458.33
+400	771	10.14	0.00	783	1.06	35.12	-12	-83.95	2291.67
+500	700	N/A	N/A	775	N/A	N/A	-75	N/A	N/A

Again, these are our building blocks to try to affect this approach. Therefore, you can characterize liabilities just like we often characterize convexity and duration of assets. Given that you can do that, you can study interesting issues such as changing the guaranteed rate on an interest-sensitive product (Chart 5).

CHART 5
LIABILITIES



In this case, at a point in time before interest rates shift, it doesn't appear to have much impact, but it would increase sales. We know in terms of the financial economics that it really does increase the risk, and so, again, we examine the shape of the differences and different marketing and product positions we want to take. We can do the same thing with the assets (Chart 6). Then you can look at asset mixes with more or less optionality in conjunction with the liabilities (Chart 7).

CHART 6
ASSETS

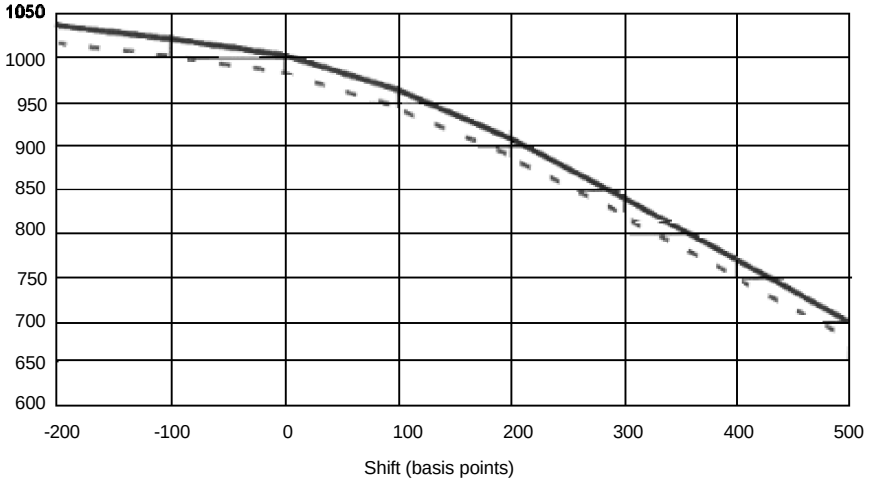
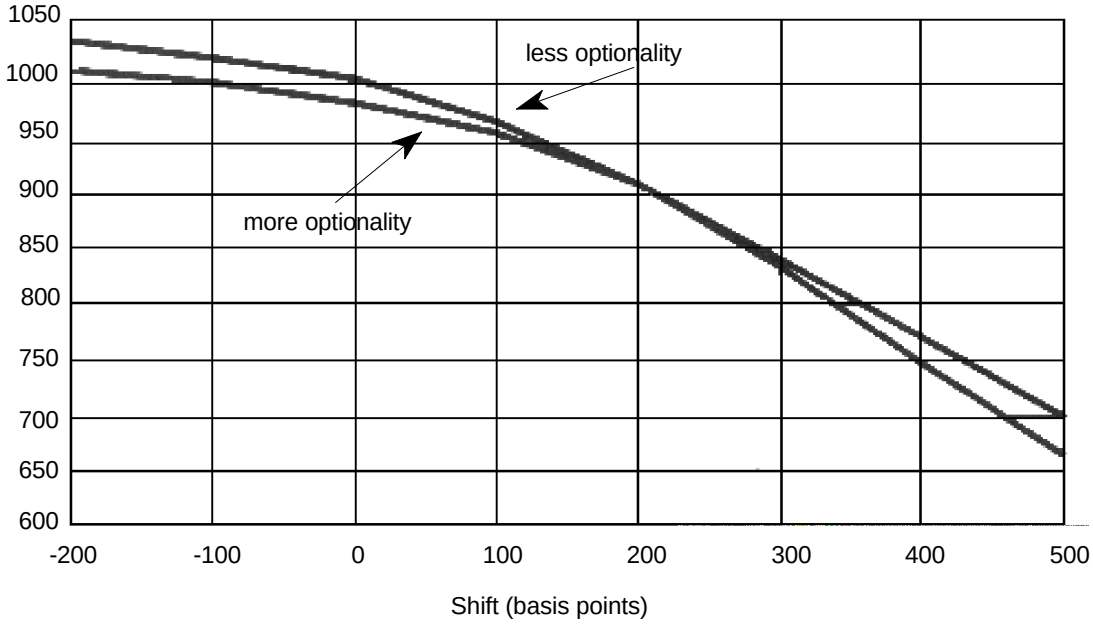


CHART 7
ASSETS



In the traditional profit & loss statement (P&L), you have your assets and your liabilities. The way we want to look at it is, let's isolate the product manager who mainly controls the product but doesn't have much influence over the investments, and set them up with another P&L that has their actual liabilities, but with some notional assets. These notional assets would be defined based on a benchmark set at the corporate level, set by corporate and a new profit center that's going to be called the risk management profit center. They'll establish some benchmark for

assets in terms of quality, duration, and so forth. The liability manager is going to have his financial results marked back in terms of if he goes way out there on the risk curve for the liabilities. He's not going to have, in this framework, an investment reaction where they'll say he can't do that. So he has the freedom to reasonably do what he thinks to build a business. But if he does something that creates many sales, but proportionately more risk, then his net earnings and his P&L will be less. So, he or she will make out only if he or she is adding value. The situation is similar with asset management. They would manage the assets how they deem fit, not in reaction to some politics between competitiveness and risk management or investment performance, but versus a bogie that's in terms of notional liabilities. And the notional liabilities would be set by the risk manager, per corporate guidelines as to liability characteristics that they're willing to deal with. If the asset manager wants to perfectly and conservatively match that, fine. If they want to go out there and really go for performance, they can do that. But, then, just like the product manager, the investment manager would take a hit unless they create more value for the risk.

So the question is, What is the risk P&L? These notional assets and notional liabilities would be the risk management P&L. These would be initially purchased and paper traded just like real assets/liabilities. You would have to have indices of the assets/liabilities, but you trade them right along with the actual assets; they would be purchased and sold and managed by this risk management function. And this is where all the risk management activity takes place, as opposed to a product manager feeling constrained by conservative investments or an investment department contained or pressured by aggressive liability marketers. Of course, the sum total ends up to be the same, because you still have the assets/liabilities that you'd normally have in your P&L. It's just that you're looking at the product manager vertically, and the asset manager vertically, and the risk manager horizontally. Add it all up, and you come back to your regular P&L: Liability Product P&L + Asset Management P&L + Risk Management P&L = Traditional P&L. But, more important, you get a track record for (1) the people managing the products, where they can mostly control the liabilities but not the assets, (2) the asset manager, where they have a practical benchmark for their performance, not clouded by liability strategies, and (3) a risk manager who instead of wondering what risk management is and where it takes place, is very explicitly performing at a certain level.

Now, the advantage is that it separates the investment performance from the risk bearing and from the product management on a fairly objective, quantifiable basis. It centralizes risk management so you don't have diseconomies between how risk management is directly, or implicitly, handled in one line versus another. And then, of course, to the extent that you really look at the price behavior curves and

work with your dividends or other strategies to mold and match your assets/liabilities, it directly recognizes the risks and rewards of those strategies. Finally, it eliminates all the contortions of how you parcel out pieces of assets. The requirement for implementing this is tracking these custom indices, because, again, the only way this will work is if you can really formulate, develop, and trade these notional assets/liabilities. You also have to feed that to your general ledger because the whole thing must come back to the real assets/liabilities you have.

Mr. Lockwood: Our next speaker is Dave Carlson. Dave is vice president and actuary in the corporate financial area at Mass Mutual. His responsibilities include corporate actuarial oversight in the analysis of financial and corporate structure transactions. Dave will be discussing how Mass Mutual incorporates a broad risk management perspective into the process of testing the adequacy of reserves and assets. It is slightly different look at how risk management can enter into our practice.

Mr. David W. Carlson: As Jerry noted, Mass Mutual actually takes a quite broad perspective on risk management in the process between our actuarial opinion and the underlying cash-flow testing. When Jerry and I had talked several weeks ago about what Mass Mutual might offer this panel, we thought that might bring a different perspective, relative to what you'll hear from the others.

I'll try to quickly profile Mass Mutual, just to get some dimension to the company as you look at how we approach risk management. Most of my remarks will deal with the actuarial opinion and asset adequacy process. Then I will finish up with a couple brief comments on some work we're doing now, trying to bring a total enterprise capital allocation process to a more rigorous level. And that will tie in, I think, a little more directly with some of the discussion from the other speakers that obviously goes well beyond the cash-flow testing process.

Like most companies, Mass Mutual has evolved quite dramatically in the recent past. As many of you may be aware, Mass Mutual merged with Connecticut Mutual just a little over a year ago. Since the Met/New England transaction closed, it's probably no longer the biggest mutual company merger, but it was certainly a substantial transaction. The merger had quite a pervasive effect throughout the organization, in terms of our overall profile and our operations. Another transaction that was somewhat lower profile, but had just as big an impact in terms of how the company looked after it was completed, was the divestiture of one of Mass Mutual's three primary lines of business. Just over a year ago, we sold our group life and health line to Well Point Health Networks, which is a California based HMO. That line of business had been contributing a substantial part of Mass Mutual's profits

and was a big part of the total operation, so our profile looked quite different after that transaction closed last April.

Meanwhile, we have a rapidly growing money management, or asset management, arm to the enterprise at this point. This really got rolling several years ago when we purchased a retail mutual fund complex, now known as Oppenheimer Funds, Inc., not quite a household name, but many of you may have heard of it. Like the rest of the fund industry, Oppenheimer has grown quite dramatically since we bought them. They've had compound annual growth rates, in both earnings and assets under management, in excess of 30% since the acquisition. Their growth has been turbocharged by the fact that they've made some of their own acquisitions, buying two specialty mutual fund companies in 1995. And then, the latest element of the asset management story and the shift in Mass Mutual is that we bought an institutional asset manager, D. L. Babson of Cambridge, Massachusetts, in a transaction that closed two years ago. That added another significant amount of asset management, as opposed to insurance, business to the family.

Here are some numbers of what we look like after all that's rolled together (Table 1). I'm not going to go through liability by liability, but on the left side, if you look just at the insurance company, it doesn't really look much different than we looked several years ago. However, the Connecticut Mutual business changed the profile a little, and the exit of the group life and health business changed it some. But, mostly, we don't look much different now than we did several years ago. We probably looked like many life and annuity companies. If you look at the right side, though, you see a pretty dramatically different picture when you look at assets under management (Table 2). If you go back a few years, the assets under management would have been 100% in the insurance company. You can see now that the insurance company assets are just barely a third of the total, and Oppenheimer is almost half. In fact, if you look at the market today, for better or worse, Oppenheimer has probably become the majority of the company from an assets-under-management basis. The institutional manager is over 10% at this point, and then we have some other, smaller, downstream asset management expertise that make up the rest.

So, with that sort of view of what Mass Mutual looks like, let me turn to our asset adequacy and actuarial opinion process. The key, very high level, driver of this process is a view that we need to actively consider all the risks to our ability to meet our obligations. Our observation has been that if you look around, companies seem to focus on the interest rate risk alone. We certainly won't argue that risk isn't important. Clearly any life and annuity company needs to understand its exposure to interest rate volatility, but our view is that certainly shouldn't be the central focus, and more important, it absolutely shouldn't be the sole focus of the risk evaluation.

Instead, we focus on a thoughtful consideration of all the risks that we're exposed to. Most of the rest of what I'll talk about will get into that overall approach.

TABLE 2
MASSMUTUAL PROFILE
INSURANCE COMPANY

Liabilities ($billion)			Earnings ($million)		
Life Insurance	21.3	43%	Ind Life/Ann/DI	222	78%
Fixed Annuities	2.4	5	Group Pension	63	22
VA	7.2	15	Other	1	0
DI	1.4	3		286	
Group Pension	16.2	33			
Other	0.7	1			
	49.2				

TABLE 3
MASSMUTUAL PROFILE
TOTAL ENTERPRISE

Assets Under Management ($billion)		
Insurance Companies	47.2	36%
Oppenheimer (retail mutual funds)	62.4	48%
D.L. Babson (institutional mgr)	15.6	12%
Other (equity Remgr, etc.)	5.6	4%
	130.8	

Another key to our process that I'll just mention briefly here, because it can be debated quite extensively—we've debated it inside the company—is we actually try to define statutory reserve adequacy. We do this in order to give some framework in terms of how to think about the tail of the risk curve. Our working definition has been that we want to be highly confident that if all we had were assets equal to liabilities, we'd actually be able to insure the obligations. We try to put a number on that. We say that we want to be 90% confident that assets equal to reserves will, in fact, mature the obligations. It's important to recognize (given the fact that it has been debated quite a bit in the literature in the industry) that we don't use 90% to construct a grand stochastic curve and then pick the reserve point at 90%. Rather, we really use it to convey that we truly mean something like 90% when we say highly confident, and we don't mean something like 70%, or, more important, that we don't mean that we want to be 99%.

The last thing I'll mention briefly in terms of our process, and again I'll come back to this a bit as I go along, is that we actually package the results of our analysis in a marketing-type document that we use with the rating agencies and other outside parties that are interested in our results. I'm sure other companies have found that the rating agencies seem to have become interested in asset adequacy analysis in recent years. Also, when we've been through diligent exercises with outside entities in mergers and acquisitions, we found we were able to tell the cash-flow testing story in nice, simple, clear terms. Words and pictures have helped quite a bit to get people comfortable with our strong story.

Just a very quick overview of the process through which we implement all this. On an annual basis, each line of business is charged with identifying the risks that they think their business is exposed to. That includes, obviously, perennial risks like interest rate volatility and credit risk. We also ask them to spend some time identifying the "issues of the moment," and to review the past "issues of the moment" to tell us whether those are still part of what we need to worry about. Once the corporations in each of the lines have agreed on their key risks for the year, then we agree on a testing plan, and the objective of that is probably no surprise. Given that we've all agreed on the risk exposures, and we all have a definition of what we think adequacy means, the idea of the testing plan is to be able to convince ourselves that in light of all the risks those reserves, in fact, meet our definition of adequacy.

I've listed here all of the specific risks that we actually considered in our 1996 opinion (Table 3). I'm not going to go through all of them here. I'll spend just a minute on the disability insurance (DI) risk, not because it's the most important, but because it's an easy illustration of how we go about it. I'll mention just a couple of others, though, from the list.

TABLE 4
RESERVE/ASSET ADEQUACY CONTEXT

Risks Considered in 1996 Analysis	
Bond credit risk	Mortality (formerly AIDS)
Derivatives	Market conduct
Disability Income	Merger
Interest rate volatility	Real estate
Liquidity	

The dividend and spread pressure issue is obviously an important dynamic for any company doing this type of testing. For mutual companies that have substantial blocks of existing traditional life insurance, the dividends have frequently proven to be sort of sticky on the way down and have been much more reactive, sometimes overly reactive, on the way up. This becomes the same sort of issue that people

more conventionally associate with UL and annuity asset analysis exercises. But that truly is a big part of demonstrating the adequacy for us. We spend quite a bit of time each year trying to understand how that dynamic has changed, and to look at different stress scenarios where the dividends react slowly to problems, and react quickly when the distribution system thinks that they need to be more competitive.

Another risk I'll touch on briefly is market conduct. This is arguably the high-profile issue of the moment for any company that sold a significant amount of life insurance on a vanishing premium basis for the last 15 years. We've had extensive internal discussions on how to address this risk, and how to think about it so it's in terms of capital adequacy and reserve adequacy. The details of that debate, obviously, are beyond the scope of this discussion. But the one thing I would point out is that we included a very extensive and candid discussion of this issue in our 1996 document. We make sure that we're monitoring the high-profile public settlements that are in the newspapers on a weekly basis. Frankly, we think some things make our sales process and operations a little different from what some of the high-profile cases have involved. And, again, we try to make that case reasonably clearly in our discussion document in the 1996 opinion.

The last thing I'll touch on very briefly is stock market volatility. Like most insurance companies, we don't have much in the way of direct exposure to this. Going back to what I said before, in terms of the increasing role and the total enterprise of Oppenheimer and the institutional manager, the strong stock market is actually a big part of the current economic value of those companies (even though the assets they manage aren't on their balance sheet). The high economic value that we attribute to those entities now seems driven in large part by the strong market. So understanding what changes in the market will do to that economic value is an important part of our overall consideration of risk, and I'll touch on that briefly at the very end again, when I get to our capital allocation process.

I'll quickly go through a case study on DI. The issue here for us, like most companies in the DI market, has been that after the overheated competition of the 1980s there were many pieces to pick up in terms of the DI business. This has clearly been a high-profile issue. There has been a steady stream of information in the financial press about large losses by DI writers, huge reserve increases, and companies exiting the business on a fairly regular basis. For us, this issue was actually heightened by the merger with Connecticut Mutual because both companies brought significant DI blocks to the merged company, and it was complicated a bit more by the fact that during the calendar year preceding the merger, the Connecticut Mutual block had actually shown a $55 million statutory loss, which made DI one of the central focuses of the merger evaluation from the start. On our balance sheet we addressed the problem by putting up substantial

reserves like much of the DI industry. On the old Mass Mutual block we put up just under $100 million in two pieces, and on the old Connecticut Mutual block, we put up $133 million, also in two stages. The analysis that underlies those strengthens for the most part ties back to this definition of adequacy that I talked about before.

We were looking at the problems of the business, trying to understand what the tail of the probability curve looked like, and set up reserves that would get us to something like the 90% confidence level. One twist to that, in the case of the Connecticut Mutual business, though, is that all the parties involved got a comfortable $100 million in reserve strengthening. Then it turned out one of the regulators who needed to approve the merger liked our 90% confidence idea. He hired his own advisor to evaluate the DI blocks in light of the 90% confidence, and surprise, surprise, his advisor decided that $100 million wasn't enough. After much negotiation we came to $133 million as the total strengthening on the Connecticut Mutual DI block. In the end, that actually helped our story quite a bit. Given that we were comfortable at $100 million we could make a very strong case that the problems of the DI business had been put behind us at $133 million in the Connecticut Mutual block, and over $200 million in total. That, combined with the solid strategic story for the financial structure of our DI business going forward, put us in a position to convince the outside world that DI is actually a very solid business for us right now.

What we try to do, in a simple picture of all the scenarios that we look at for a given line of business, is to take a subset of those scenarios to try and show how strong the results are, and make the case that we meet this 90% definition. For this block of business, we do over 100 deterministic scenarios, looking at not only interest rate risks, but also various combinations of credit risk, mortality risk, lapse risk, and then this dividend stickiness risk that I referred to before. You could argue that no matter what we throw at a worst-case scenario, we still have a fairly substantial margin in the reserves, on the individual life block. The overall idea is simply to explore the edges of the plausibly adverse, educate ourselves in what those edges look like, and then be able to convey to anybody looking at this that the reserves are adequate.

I'm going to close with a few brief comments on our evolving capital management process. For the insurance businesses it's a relatively easy step to extend what we're doing on the reserve side, to a capital adequacy context. Again, you can debate where the end point of the probability curve can be; the conventional wisdom seems to be something like 99%, and that's the basic point of reference for what we're doing on the insurance business. The risk-based-capital (RBC) formula isn't the perfect way to transition this sort of evaluation of the risks into capital adequacy context, but for better or worse right now, we use the RBC formula to make that transition. The real challenge for us, going back to my first couple of

slides, is the growing asset management business in the family. And to a lesser extent, although it didn't show up at the start because it's still quite small, we also have a small international business at this point that's getting larger. The RBC formula just doesn't work at all, from our point of view, for international operations or the money management business. So the real challenge of what we're trying to do now, in terms of extending what we do on the reserve side, to a full-blown rigorous RBC allocation process is how to deal with the asset management business and to a lesser extent the international business. This is really work in progress for us right now. We're working to understand the risk exposures in these businesses and melt them into our approach on the traditional insurance business. Among the options that we're considering is a value-at-risk (VAR) sort of approach that many consultants seem to talk about. I think you'll hear about that in Ken or Alastair's comments, and we're looking at that sort of approach in terms of our asset management business.

In closing, to be clear here, we don't have any grand answers on how to make this extension, but our objective is to bring the broad-based risk management approach that we use elsewhere to the total enterprise, and to extend it to the capital allocation process in the same way that we use it for reserves now.

Mr. Lockwood: Our next speaker is Ken Roberts. Ken is a consultant to insurance companies and banks and helps them plan and implement systems to manage financial risk. Until last year he was in the corporate risk management unit at Prudential. Ken will introduce us to the try to the VAR approach for identifying and measuring financial risk and enterprise risk.

Mr. Kenneth S. Roberts: I'm going to talk about, first, what a risk profile could be, from a value at risk perspective, for a diversified insurance enterprise. Then I'll go step by step into how you would actually generate such a profile, perhaps, for your company.

I was brought in at the beginning of the corporate risk management unit by Helen Galt, company actuary for Prudential Insurance Company of America. Her vision was that the company actuary should not just be doing the actuarial work, but also should be taking the lead role in the oversight of risk management for the entire enterprise. She had me look at the difficult risk issues that came up, and moved me into issues like C–4 and property/casualty risk. We looked at all kinds of risk measures for different issues that came up, for example, looking at the multiple risk for a single product line, or looking at a single risk across multiple product lines. We developed several different measures for the entire enterprise-wide risk. I think, ultimately, it's good to have several measures, because risk is pretty complicated.

People can ask many different questions, so it's good to have many different ways of answering them.

I'm going to talk about only one of them here, and I chose this one for two reasons. First, it's a VAR approach, which has generated extensive use in the banking world and the world of trading and Wall Street. So this is an extension of value at risk to things like mortality risk and other insurance risks. Second, I think it's a good risk measure to get started with. It doesn't require big Monte Carlo modeling, and it builds naturally on the sort of sensitivity testing that most companies do already in connection with their cash-flow testing or their product development. So, let's get into what the actual profile would look like (Table 4). This is a sample company. It's definitely not Prudential; it's not anybody. These are just invented numbers to give you some idea of what it could look like. This is a company with two major lines of business: UL insurance and mutual fund management. Also, I've put a third major organizational unit in with the asset management function for the general account assets. So as you see at the top, you have to have a base value for each major organizational unit before you can really do value at risk. We have that, and it adds up to, fortunately, a positive total for the whole enterprise. We have two sides to the risk picture. First, as a normal volatility picture with the VAR beside it (that's normal volatility), and then we have stress scenarios. So we're looking at risk in two different perspectives. That's one of the things that makes this approach different: typically, the actuarial approaches focus on that long tail, sort of one year, 99 years out of 100 kind of thing. Here we are also going to look at the normal kind of year-to-year, quarter-to-quarter volatility and see what we can say about that.

Now, alongside we have different risk factors, line equity price risk. This company has some direct common stock exposure, and also, as Dave was pointing out, when you have a big fund management business, you have some indirect exposure to common stock risk. Of course, you have credit risks from the public and private bond portfolios, and, of course, there's interest rate risk that covers multiple organizations and how they match each other. Then we have the traditional insurance risks covering mortality, lapse and expense. I threw in one kind of C-4 business risk: this would be the risk that the distribution expenses on their mutual funds, in order to bring in the kind of business that could generate the spreads they want, might be higher than expected. So that's the volatility perspective. You can add these up and actually get to the one number that is the overall standard deviation for the enterprise, based only on a normal volatility perspective. It doesn't include stress scenario details, so it's not a true standard deviation, but it tells you something, and you can compare that to the enterprise total value. Fortunately the value is bigger than the amount at risk. Now, at the bottom, you want to supplement this normal volatility with stress scenarios, so I threw some in—an earthquake, an epidemic—and you can see those hit different organizations. They

sort of round out the picture of what's happening out there on the tail. That's the overall picture.

TABLE 5
RISK PROFILE FOR ENTERPRISE

Enterprise	G.A. Invested Assets	Universal Life Ins.	Mutual Fund Management	Enterprise Total	
Base Value	2600	-2000	300		900
Drivers	Undiversified Risk			Undiv. Total	Diversified
Equity Price	-200		-113	-313	228
Credit Risk	220			220	115
Investment Mgt Expense	3		30	33	10
Interest Rate: Short	22	-12	2	11	4
Interest Rate: Intermed	193	-239	2	-44	-15
Interest Rate: Long	107	-49	6	64	24
UL Mortality		229		229	96
UL Lapse		93		93	41
UL Expense		85		85	30
MF Sales Cost Risk			75	75	11
Total All Drivers (drivers)	374	65	106		545
Stress Scenarios	Gross Loss			Gross	Net of Reins
Los Angeles Earthquake	39	40		79	28
Great Flu Epidemic		300		300	255

This differs from a RBC picture in three ways: First, this is focused on volatility, as opposed to 99 years out of 100, or extreme insolvency exposure. It turns out that many losses, short of insolvency, can have a real impact on the company, leading to things like downgrades, embarrassing discussions with stock market analysts, and rating agencies. So we thought it was worth looking at just the overall volatility. Second, this is a dynamic measure based on the actual models and data that you have in your company. It's not like RBC where, however much of that product you have in this pigeon hole, that's your number. As in C–3, these are actual interest rate risk measures based separately on the liabilities and the assets, and so what you get is going to be the net number, and depending on how well you match, that number is going to be bigger or smaller. It moves dynamically with how you actually run your business, how you actually design and sell your products. Third,

it takes very explicit consideration of the diversification considerations. With RBC, you have a very simplistic square root formula. Here, we distinguish both the stand-alone undiversified risk and diversified risks and how they add up. So, that's the way it goes beyond RBC, and this is the way a VAR-type approach can contribute to the overall enterprise financial picture.

We did some work on some of the benefits. We already talked about the framework that includes both the volatility and the stress scenarios. This is a special version of VAR, called a delta normal approach. The "delta" means that its sensitivity measure focuses on the first derivative of the value. The "normal" means that we make the assumption that all the risks are normally distributed, and because there are many of them, it's a multivariant distribution. Now, what are the benefits of this approach? One is you can deliver it as a first phase. Even if you intend to do some sort of grand Monte Carlo modeling some day, it might be good to have something to show for your efforts earlier. It extends value risks from the usual foreign exchange interest rate and stock market risks to insurance risks like mortality, lapse, and expense. It's explainable, and, as you'll see, it's very simple to calculate. It's just addition and multiplication that you can put in the spreadsheet, as opposed to storing everything to a big black Monte Carlo box (where you get some number out, and it's not easy to explain to people where you got the number from). You can very easily explain all these numbers, both to yourself and to other people, like, where did we get this risk number from on that page? On the other hand, I think it makes a great foundation if you ever do want to do a black box. This raises the right issues that you need to get out of the way before you can do a good job with some first-hand, fancy, Monte Carlo modeling.

By right issues, I mean not just things like, Did we run enough scenarios, should we run another 500 scenarios, or did we use the right interest rate generator? I think the right issues are more like, Did we even look at the right risks? What is our measure of value for the important business, did we look at the right risks, and do we have an overall risk measure at all? I think those are the things you want to focus on as you get started on this, not on the details of Monte Carlo modeling. I think this method helps by being simple. Finally, because it focuses on normal volatility, you can make connections with the financial management cycle, like before annual planning, and then at the end of the year you have these volatility measures, and you can say, Well, what actually happened? How does that correspond to the volatilities we were expecting? So, there's the overall picture. Let's get into the step-by-step.

The basic steps are, first, get the data on what your actual business is. Calculate a baseline value for that. Then you want to measure the sensitivity of that value to each one of those risk drivers, which means you have to identify those risk drivers,

then for each one of those risk drivers you find out what the volatility is. Then you have a simple formula for putting all that together, and you get the stand-alone undiversified risk for each risk driver, and you can do some scaling for whatever confidence level you want on that. Finally, apply some correlations, and you can get the grand picture, the enterprise risk for all the factors, multiple organizations, like that picture I showed you earlier. Let's go through each one of those steps.

The first one is getting the data. Basically, the data you need are pretty similar to the data you need for cash-flow testing. You need to know what you have in force, and you need to know the pricing assumptions; mortality, lapse and interest sensitivity of lapses. The other step is, if you think the value of your future business is of importance, then you probably need some assumptions about that, too. The reason getting these data is an issue at all is typically the people who want to get this enterprise picture of risk are different from the people who actually have the data and the models. So a first prerequisite of doing this as a project, if you're one of these enterprise folks, is How are you going to approach the people who have the data and the models, and how are they going to be involved in all this? There are different approaches to that, but you need to sort that out.

The next step is to calculate your baseline value. This has been discussed and discussed at all kinds of seminars; I'm not going to say much more about it here, except for a couple of things. Our approach differs from cash-flow testing in one way, namely, that in cash-flow testing you take every possible holding that you're interested in, asset or insurance, and you project it out on all the same scenarios. For assets, they may have a market value, or you might have some other way of calculating their value or sensitivity to risk as you're projecting out all the cash flows. For example, for a share of AT&T stock, you know what its current value is without projecting some future cash flows; some techniques exist to know what the risk is without actually putting it in the same cash-flow matrix that you put all your insurance products. So you have a little more flexibility in being able to understand what the sensitivity is than projecting everything out of the same cash-flow thing. Other than that, you want to project out your cash flow and take some sort of discounted value. I'm not going to get into the details. The key reason why this step could be important is that you may not have a well-established measure of value for some important organizational unit. In particular, this can happen for mutual companies, and there are actually some lines of business, of course, that you can work hard to establish a value for, like participating whole life. So you need to get down a solid measure of value that can be derived from risk factors before you can go on to VAR, and that's why I put it here.

Now, once you have a model for measuring value, you need to measure the sensitivity of that to the different risk drivers. First, you have to identify those risk

drivers. Typically, they are the same parameters that you put in your cash-flow testing models or your pricing models. Now you have to value them. So, obviously, for bonds these risk drivers are interest rates and spreads for the different rating classes. For UL it's going to be interest, mortality, lapse, and expenses. Now, for each driver you could just look at the whole driver, but for some of them you may want to break it down and look at it a little more finely. Interest rates are the classic example. If you look at interest rates just in one lump, all you get is parallel shifts. So you want to look at several different positive moves with interest rates.

You could do the same thing with mortality. There are many mortality factors, as you all know. You don't give it just one number for mortality, you give it a whole table. You're not going to vary every single factor individually, but you want to think about the different sorts of mortality risks. Here are some ideas along those lines. First, you have the distinction between year-to-year statistical fluctuation in mortality versus a shift in the whole table. Another thing you could worry about is the whole trend of mortality. What do you think about the volatility of that? Another issue would be, Do you want to segment it into old age versus young age mortality? So, there are many opportunities. You probably don't want to do all of those on your first try, but they are things you need to think about. The old age versus young age one could be important, especially if you're interested in what the offset is between life mortality versus annuity mortality.

Once you have all that, you have to figure out how to map the different risk drivers into the model you're using to generate the cash flows and the value for various products. You have to say, Well, my old-age parameter means 70 and above, the young-age one is all the rest, and so to do the sensitivity run, the people who have the models do one run bumping up the old-age mortality (70 and above). Then make another run bumping up the young-age mortality; so it's pretty straightforward. So that's the idea: for each risk driver you perturb the parameters once and project the cash flows, recalculate the value, and see how far the value moves. Once you know that percent change in value, you divide by the change in the driver. So that way it doesn't matter too much exactly how large a shift that you choose because you're just going to divide it out in the end anyway. You get what I call the sensitivity, which I denoted with delta. Notice that with interest rate risks that's the essentially the same thing as duration. So, it's applying that same interest rate duration concept to all your risk.

So far those sensitivity runs look much like the kinds of things you might do as part of cash-flow testing or product design. The key thing to do to get the VAR measure from that is to add volatility: standard deviation, which I'll denote by sigma. Now, to do that, ideally what you want is some good historical data. If you don't have those, then you have to make do with what is available. You need to look at those

data, apply some statistical tools so you can get the volatility for each one and whatever subdrivers you use (old age mortality, young age mortality, etc.). You need a separate volatility for each. It's best when doing this not to just start throwing tools at it, but actually to think about the stochastic process. We don't have time to get into that, but what I mean is, for example, the way in which things vary with uncertainty over time.

A quick example here is to take *S* for survivorship, with *Q* as the true underlying mortality. What this says is, here's the survivorship at the beginning of the year. The survivorship at the end of the year, of course, is less the amount of deaths, and that's going to be equal to *Q*, the *Q* you think is true, but epsilon is the random factor:

$$S_t = S_{t-1} - (1+\tilde{\varepsilon}_D)\ Q_{t-1}\ S_{t-1} \qquad [\tilde{\varepsilon}_D \text{ is } Normal(0,\sigma_D)]$$

$$Q_t = (1+g+\tilde{\varepsilon}_Q)Q_{t-1} \qquad [\tilde{\varepsilon}_D \text{ is } Normal(0,\sigma_Q)]$$

But, in addition, you might believe about mortality that the *Q* itself can change over time. It might be different from last year. So the second line says that your *Q* for the new year is the *Q* at the beginning of the year, adjusted for a growth rate, which these days is negative for mortality, which is kind of nice, but even if you believe the long-term trends, you might think that it's somewhat random in any particular year. Once you know what that process is, you can then go back and look at the data to sort out all that historical volatility: which one is sort of random fluctuation year to year and which one actually represented some change in the overall shift of mortality rates (or whatever your drivers were). So opportunities for judgment are there in what you make stochastic, what you don't, and what data you use. The further back you go, the more data you have. On the other hand, it may not be relevant to the current situation, and then what do you do with holes in the data? There are many opportunities there.

Now we get to the magic formula, or the first one. You're going to come up with a volatility, and you typically want to apply a scaling factor for that. You don't want just one standard deviation. You can make it two standard deviations, or 2.5 standard deviations, and you also scale it for time, since with a shorter period of time, there's not as much time for things to wander around. Typically, you scale it according to the square root of time, and to get the undiversified risk for each driver to stand alone. It's just straight multiplication. You multiply your confidence factor times the volatility you got from the previous step, times the sensitivity from the step before, times the base value, and you get the undiversified risk number. Here's the calculation for the expense fluctuation for UL: 2.5 deviations for one year, and 10% volatility, 5% sensitivity, $2,000 base value, and we get 25. That's the formula.

In Table 5 you can see the expense fluctuation on the second line from the bottom. I don't show the 2.5 since that's the same for everything, but you can see the sensitivity, the volatility, the $2,000 base value, and the 25. All you're doing for each one of those rows is just making that calculation. That gives you stand-alone risks for each one of those risk factors. It's interesting to look at that. The next step is to realize that not all those bad things are going to happen at once. You want some way of dealing with the correlations, and how to aggregate those into a measure over multiple risks. The straightforward way to do that is with a correlation matrix. It's the least complicated thing between, on the one hand, just adding them up as if everything is going to go wrong at once, and, on the other hand, assuming that everything is totally diversified. Using a correlation matrix, the simple, straight multiplication formula becomes a matrix multiplication formula. It just involves a little pre- and post-multiplication by vectors and one square root and multiply by your scaling factor and value:

$$VAR=\alpha(\delta^T\sigma^T[Corr]\sigma\delta)^{1/2}V.$$

That is very easy to implement in a spreadsheet. So, it's not a black box, it's just a spreadsheet, and the only black box is in this product modeling. It's the black box, that the people who have the products understand and have grown to know and love. But, what you're doing in the center is simple to explain for yourself and other people.

There's more to life than normal volatility, so I think you need stress scenarios. Philosophies abound on choosing stress scenarios; I don't have time for them here, but you need to think about yours. One thing I would stay away from the first time around is trying to assign specific probability to the stress scenarios. It's my experience in doing Monte Carlo studies that the scenarios are always going to be very sensitive to assumptions. I think when you look at this you realize that there are assumptions in there, so maybe it's better just to take some scenarios that might be historical or might be chosen for some other reason, and just see what the results look like. That relates to my point about wanting to know what your confidence is and your confidence symbol. You come up with this 99% limit, but how sensitive is that to the variations in the underlying assumptions? Pretty sensitive, I think, which is one of the benefits of this method. It gives you some sort of result without getting into all the details on what's out there on the tail.

So here's the picture, which is basically the same thing you'd expect, pretty much exactly what you saw before (Chart 4). Undiversified risks, diversified risks, risk factors—this shows how they add up. Note these numbers in the diversified column: the intermediate interest rate risk is actually slightly negative. For some reason, for this company, maybe because of the particular way they run their UL

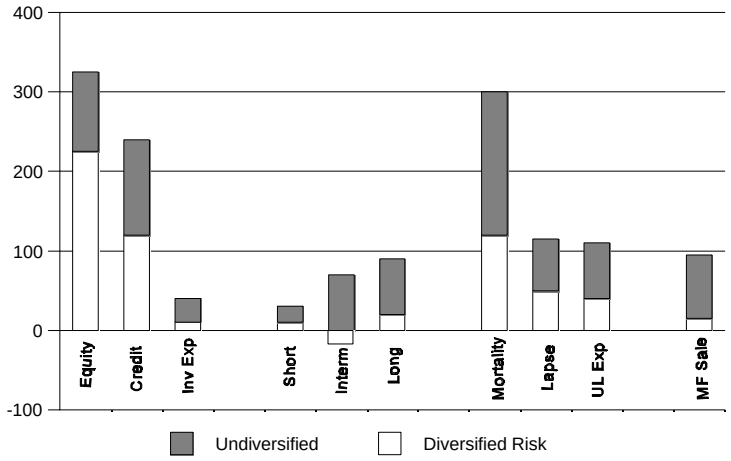
business, it's actually serving as a natural hedge to some of the other risks. It's kind of nice; I wish there were more of these. Don't count on it being true for you, but it's the sort of thing that might fall out of this.

TABLE 6
RISK PROFILE FOR UL PRODUCT

Universal Life **Base Value -2000**			
Drivers	Sensitivity to Driver	Driver Volatility	Undiversified Risk
Interest Rate: Short (.25–3yr)	-0.23%	105 bp	-12
Interest Rate: Intermed (5–10)	-5%63	85	-239
Interest Rate: Long (15–30)	-1%5	65	-49
Mortality fluctuation	0%5	15.00%	4
Mortality long-term shift	100	2.5	125
Mortality long-term trend	20	0.10	100
Lapse fluctuation	0.30	20.00	3
Lapse long-term shift	30.00	5.00	75
Lapse/Interest model param A	15.00	2.00	15
Expense fluctuation	5.00	10.00	25
Expense long-term shift	30.00	4.00	60

Finally, I have a graphical picture that shows both the diversified risks and the undiversified risks (Chart 8). It gives you a picture of the big risks. That is always good to know. Just because it's a big risk doesn't mean you shouldn't be doing it, but then you ask the question, Which ones do we really want to be into? What return are we getting from those? For this company interest rate risks turned out not to be that large, and mortality risk turned out to be a major risk. On the other hand, a little bit of a trap lurks there. The interest rate seems to be small because it was the offset from two fairly large exposures, so I wouldn't take from this, Well, no need to worry about interest rate risks. But, as Dave was pointing out, many other risks are there, and they could actually be substantial for a particular company. One question the company could ask is, We have a good deal of both direct exposure to equity risk and indirect exposure; do we really want both?

CHART 8
RISK PROFILE FOR ENTERPRISE



From a performance perspective you can say, Well, one year's performance didn't actually come out as expected; it never does. You can now ask the question What are the sources? If you had a gain by source, you could then look at those variations and say, Does it seem to be explained in terms of our risk profile, or do we have some variation, say, in interest rate that was way out of line with what the business unit manager and asset manager said that they were doing in regard to controlling interest rate exposure? So there are some ideas for an approach you could take. It is, in some ways, the simplest approach, building off the cash-flow testing. On the other hand, as you can see, there could be significant roadblocks.

Mr. Lockwood: Our next speaker is Alastair Longley-Cook from Aetna. Alastair's been working with Ken in the practical sense of how to put some of this into place, and you will be very interested to see how he built on the theoretical foundation that Ken laid for putting some of this into practice.

Mr. Alastair G. Longley-Cook: I am going to focus on the practical aspects, and because we want to give you plenty of time for discussion, I'm going to move along very quickly. I'm using, as a model here, Aetna's risk management process, which has as its basic structure a corporate risk management entity: not a big department, but an entity. Then, within the lines and among the lines, people are responsible for actually doing the risk management. Keep that model in mind, and I want to talk about some of the issues that we run into with this structure.

First of all, what are our objectives here? Again, think of this as a corporate risk management entity trying to convince the line managers to do this. If all you do is

emphasize the negative, that is, the object of this is to avoid errors, mistakes, potholes, and so on, then usually you don't get very far. They say, "We're doing that anyway. We know more about our business than you do. And leave us alone." It's important to emphasize the other side, which is, by doing good risk management you also identify opportunities that, with proper management, can perhaps even increase a line of business risk profile with buy-in from corporate because it's being well managed. So, the positive, as well as the negative, should be emphasized.

The other issue, which I harp on frequently, is the issue of consistency of tools. Usually you find in a large organization that everybody's doing things their own way, so from a corporate perspective, you can't compare them, you can't add them up, you can't create the kind of synergistic calculations that Ken was talking about. We make the lines follow these steps to create a risk profile. First, risk identification. To help with that I usually encourage the lines to think of financial risks, which are those that are driven by contingent cash flows. Interest rates, default rates, and equities would be market risk, and mortality and morbidity would be ones that actuaries focus on in addition to the assets. The operational risks—competitiveness, legal risk, and strategic decisions—which I usually refer to as those that are not stochastically modelable are the wild cards that Ken listed. It's very important to try to measure those, but usually you can't. I'm a firm believer that if you can't measure a risk, you can't manage it, and so, as I'll get to later, there are other ways you need to deal with those. It's very important to identify those, but when you try to do any modeling around them you very quickly run into trouble. In fact, those tend to be the ones that end up costing the most money.

Step two—and this is where I focus 90% of my energy—is encouraging good quantification. We do use VAR, and I'm not going to go through this because Ken's already done a very good job. The only caveats are that VAR, as defined in Risk Metrics, which is on the Internet (and is used by the banks), tends to focus on short durations and marketable assets. When you're dealing with risks facing insurance companies, you usually do not have those two entities. You're usually talking about long durations and assets/liabilities that cannot be marked to market, and so you run into a whole set of problems around that. But that doesn't mean you can't use VAR, only that you have to take a longer-term perspective.

The third step in the risk profile would be listing the controls and monitoring process. It's very easy to set up a process, have the actuaries do the calculations, and then put it in the file drawer and forget about it. What's crucial is to have this as an ongoing process. You should know how you're going to monitor the process, how you're going to make sure that what you calculated is valid, and how you did against that bogie. Build it into the planning process and decide right off the bat

what you are going to do about those risks. There are basically only three things you can do with risks. You can eliminate them, say, by underwriting them away, transfer them, say, through reinsurance, or actively manage them, because frankly you're not going to get rid of all your risks. You have plenty of risks to manage, and in fact make money from them, but that's the key reason for going through all of this. But I come back to my point about when you can't measure it: if you can't measure it you should eliminate it, because you can't manage it. You want to make sure you have the reports and the guidelines. And this last point is absolutely crucial: hard to do, but essential. You have to tie compensation to it, because otherwise it will be ignored by the people making the very decisions that are going to get the company into the most trouble. If you're not rewarding management decisions with a solid risk element, then basically they have a blank check in terms of what risks they can run. The whole goal here is to provide a more disciplined way of doing this so that we avoid some of the problem areas of the past. The last step is to build it into the planning process, and as I say, make it part of the performance review.

So what do we do with all this? It's all very nice, and we have these nice profiles, but what do we do with it? There are many things we can do. First, measure and compare risk exposures. That's why you need these consistent tools. I maintain that the value of your VAR number isn't really all that important because it can say it's based on so many assumptions. What is important is how it compares to the others, and you use that to prioritize. You say, OK, where do we focus? It turns out usually that you end up focusing on interest rate risks. But, there may be some other exposure. You may have a big exposure to mortgage loans, for instance, or a big equity exposure that you didn't quite realize was that big, so the comparative is really important. Second, compare from one time period to the next. Did we improve the situation by getting out of those collateralized mortgage obligation (CMOs), or have we worsened the situation? Or has the environment worsened the situation because it changes, for example, exogenous changes to the marketplace? Next, you can evaluate performance on a risk-adjusted basis. I'll come back to that. Determine appropriate reserve capital levels; we're all familiar with that. This is being used more and more in discussions with regulators and analysts. I would say, at this point, that you don't get much positive by rating analysts by having a risk management profile system like this, but you get a big negative if you don't. So that's kind of the minimum bid to play the game nowadays, to have something you can talk about. Hopefully, over time, they'll begin understanding it a little better and start getting some positives to it. Finally, of course, it helps make strategic decisions in terms of what lines of business you want to be in and what ones you want to get out of on a risk-adjusted basis.

Very briefly, the roles and expectations are key here. Again, this idea of a sort of corporate overview and the line management interplay. What does corporate risk management bring to the table? Leadership, objectivity, consistency, and the ability to aggregate risks. They have to be the driver and the cheerleader and try to ensure that what's going on out there is objective and consistent. What do the lines do? They do the work, and it's very important to make sure they do the work. If they try to give you the work, then you've made a big mistake, because then they will say, "Now that's your risk. Corporate risk management will protect me." The line managers own the risk, and it's important to make sure they understand they own the risk. They have to manage and measure it. They know their business better than corporate does, so you can't take that monkey off their back. They'd be very glad to get rid of it. So make sure they do the actual modeling and calculations.

Advanced applications can be used to determine risk-adjusted capital. The risk-adjusted return on capital (RAROC) approach has been written up, and we're familiar with that in terms of the RBC number. If your earnings are divided by that, you have the risk-adjusted return. Second, efficient frontier analysis: I'd say this is a little more sophisticated. Basically, if you have many lines of business, or different possible capital expenditures, if you look at them in terms of the profitability and let's say VAR or sigma or sigma squared, then you get a scatter diagram, and as you know, those on the efficient frontier are the better products to invest capital in, if you're looking at capital as an investment, as opposed to a surplus insurer.

Finally, there are different ways to risk adjust other than just using a hurdle rate. A method that I've spoken and written about extensively is to take your present values at a risk-free rate and then use an explicit risk discount, which is based on modern portfolio theory. But it works out to be quite manageable. For normal distributions it works out to be a discount that's dependent upon variance, so it ends up being very similar to Markowitz's mean variance type of analysis:

$$\text{Risk Adjustment}_i = \frac{a}{2V}\,\sigma^2 v_i$$

where σ_{Vi} = value volatility: one standard deviation change in V as a result of change in risk i, and a = the degree of risk aversion (e.g., 5.7 demonstrated by investors in the S&P500 over 1950–1995).

There are other formulas when it's not normal, and that would get you a risk-adjusted number. With Risk Metrics you can download the information.

One final comment, in terms of communication. I believe it's very important that what gets done here gets communicated to the right people. And so, with this sort of corporate line of business setup, I think it's important that you have a corporate

entity that oversees and has a direct line of communication to, say, the chairman or the CFO, whoever the decision maker is there, to make sure that what's being done in the line by the time it comes up is not filtered too much.

Mr. Sam Gutterman: Just a general question about correlation of these risks that you're talking about. I think the suggestion was to develop a correlation matrix. Any ideas that you would like to share about how to do this?

Mr. Roberts: There's no doubt that the correlation matrix is where the most judgment is needed, and even with the public market instruments where they have many measured correlations, the correlations seem to move around. So, you could use several approaches with that. One is to try out several correlation matrices and see what happens. Another is just to choose some basic correlations in, say, five different categories; totally uncorrelated, totally correlated, things in the middle. Remember, we're not trying to put an enormous amount of stake in the accuracy of all this, so the important thing is that the correlation is simply better than assuming that everything is going to happen all at once, or nothing is going to happen at once. So as long as it doesn't look better than that and you don't totally believe in the probabilities that come out of the whole thing, then I don't think you're going to do much better.

Mr. Shumrak: When you get caught up in this, many of the people doing the work have trouble with the softness of some of the assumptions, and what I keep saying is, we're not worried about answers to the third decimal point. We want to find out whether or not our exposure is $10 million, $100 million, or $1 billion. So whether or not the correlation factor is exactly right and whether or not you're getting it to the third decimal place aren't as important.

Mr. Michael J. Cowell: You commented on the volatility of the unreliability of the results when you essentially have created a stochastic process by looking at numbers of the mean and trying to get out to the 99th percentile or beyond. Would you comment on the value of attempting to establish the underlying mathematical structure, which presumably might be more stable in helping you find values at the extreme levels of probability, as a result of your stochastic process?

Mr. Roberts: Well, it's beyond just mathematics, finding those extreme values. It's one thing in a scientific laboratory context to look for long probability distributions because there you can do 10,000 trials under very controlled circumstances. But, here in the financial world, in order to get good data out of the tail, you need a great deal of data. Companies who experience many events out at the 99% level aren't around to do risk analysis. So almost by the nature of it you couldn't possibly have really good data out there on the tail. You either have to have many

assumptions about what's happened, some sort of assumption about what must be happening out there that is hard to justify, or to live with the fact that it's kind of hard to know. I don't think it's a matter of mathematics, I think it's a matter of the reality of the business world.

Mr. Joseph Koltisko: I've heard other consultants describe these VAR approaches as bottom-up, very data intensive, very consulting intensive, cash-flow testing-like projects. What do you make of a view that says forget all of that, get rid of the supercomputer and do it on an Excel spreadsheet from the top down, and look at the volatility of GAAP operating earnings? Could you evaluate that kind of a proposition? What do you think the value is for that kind of approach for looking at capital and risk?

Mr. Roberts: Well, I had sort of a mix of the two. Namely, you do a great deal of data-intensive work at the business unit level, but the way you bring it together is with a simple spreadsheet. The danger of using a spreadsheet for the whole thing is that you're not dealing with just the whole risks that are specific to the actual products that this company is selling, the actual population of in force. I've used approaches that took a spreadsheet approach for the whole thing, and we came up with very approximate ideas as to what the behavior of the different product lines would be. You could almost do that as a first step. It could be worth something as a way to get a handle on where your risks are. But I really think you want to get to an approach that deals with the specifics of your products and the specifics of exactly how you're doing your ALM to make it dynamic enough, to really be meaningful to how you actually run your business.

Mr. Longley-Cook: I think that's right. I'd add that what's key here is to understand enough about the drivers and monitor the drivers so you can see what the effect is when the world changes. For example, mortgage loans: many insurance companies had significant assets in mortgage loans, and that was fine: they never lost any money on them, and everything just kept going up and up. So if all you've done is some kind of VAR based on the volatility of earnings in the pension area or something, then none of that would have shown up, and you would have lost your shirt. On the other hand, and this is Monday morning quarterbacking but I think it's valid, if the companies had this kind of process in place and understood the sensitivity of their liabilities to changes in the mortgage loan environment and changes in the real estate environment in the 1980s, I think the VAR would have gone off the chart as the real estate market and interest rates started to change. Going back and doing some numbers, that's true, they did, and to the extent you have a good system, and that direct line of communication to the CFO or the chairman, where the risk manager can say, “Hey, wait a minute, we're going off the chart here; I think we need to take another look at this,” then this is serving a useful

purpose. But you have to have enough of the underpinnings in your model for that to show up. If all you're doing is continuing historical views, you're not going to pick up those changes.

Mr. Erin Dandridge Cole: You talked about the assets using a short time horizon for the VAR calculation, and that it might be more appropriate for liabilities to use longer. I'm curious, do you eventually come to some point where you use the same time for both so you can look at them commonly?

Mr. Longley-Cook: I didn't mean to use something different for the two sides of the balance sheet. You have to have them both on the same basis. The point I was trying to make is if you look at definition of VAR and Risk Metrics and some of the other articles, it's defined as the amount that you can lose, let's say 90% confidence, during the time period it takes you to unwind your investment. So, you have a portfolio of derivatives. How long is it going to take you to get out of that portfolio? A week? Maybe a day. The period of time measured by delta Δ in that calculation is very, very short. The biggest I've seen is a month. We sit back and say, How do we apply this to an insurance company? We have annuities and insurance policies on the books for 20 or 30 years. We're not going to sell our assets; they don't change in value that quickly, we hope. What's appropriate for us? So I've used Δ as a year. In other words, how much does the present value of distributable earnings (with asset/liability cash flows projected out 20 or 30 years) change over a period of one year due to changes in the underlying drivers? It doesn't matter so much whether you take a year or a quarter. Just be sure that all your calculations are all done on that same basis, and then you can compare.

Mr. Cole: So you've sort of dismissed how long it takes to unwind.

Mr. Longley-Cook: It's just not relevant. If you get into trouble, you're not going to suddenly sell all your CMOs in five minutes; it's too late. Frankly, we're not viewed that way; we don't report that way. We don't report on a mark to market basis every quarter, and so what is the meaning of that loss? It's a paper loss, and by the end of the year it may well recover. You might want to do something else, but you're not necessarily just going to sell all the assets. You can't sell the liabilities, so selling the assets isn't going to do you any good.