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Risky Business: Covering Your Assets

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Summary: Today's competitive environment requires companies to take risks in various forms and degrees on both sides of the balance sheet. But are companies taking too much risk? Or not enough risk? Risk measurement and management is an ever-evolving science.

Ms. Cindy L. Forbes: How do you know whether or not you're taking enough risk or too much risk? To answer that question for yourself, you need to have a comprehensive framework for identifying, monitoring, managing, and quantifying the risks on your balance sheet and income statement. The panelists will each present their approach to an integrated risk management framework that lets you know how much risk you have and where it is on your balance sheet. That's the first step in assessing for yourself whether or not you have too much or not enough risk on your balance sheet.

Our first presenter is Mark Abbott. Mark is director of consulting services at BARRA. He joined BARRA through their acquisition of Global Advanced Technology (GAT) last year, so he's one of the assets they acquired.

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†Mr. Abbot, not a member of the sponsoring organizations, is Senior Analyst of Global Advanced Technology for BARRA in New York, NY.

Note: The charts for this session are not available online. Please contact Linda Blatchford at lblatchford@soa.org or call 847/706-3564 for a hard copy.

Mr. Mark Abbott: I basically want to give just a brief survey because we all want to get to your questions. Essentially, I want to give you a little bit of a taste for the complexity and the issues that we feel are important in dealing with risk management and evaluating very complex assets. By all means, I think the market's going to continue to develop these complex assets because of the needs in the marketplace to hedge the liabilities in some cases or provide very specific investment services.

There are four areas that I'd like to cover. One is the framework by which you're going to value the assets because that helps you to identify the sensitivity to some of the underlying risk factors that you're going to be exposed to in acquiring those assets. The second is specifically looking a little bit more at how one of them can be used, (in particular key rate duration), and how it helps measure noninterest-rate sensitivity. If the underlying market changes in a way that the yield curve twists or kinks, it doesn't just move up in a parallel fashion as is currently measured with just the effect of duration statistics. That's something that will help enhance the understanding of the embedded risk of your portfolio, extending that over to the lymph framework as well as looking at the liabilities using the same measures. Third, which is a technique that we've used very successfully over the last two years, is actually establishing a static hedge and improving upon that by using some of the technology. Basically, it will outline the embedded options in a different sort of way—actually what caps and floors are contained in a corporate bond or collateralized mortgage obligation (CMO) through a replicating portfolio. In terms of application we're seeing the most success with the fourth and last theory, value-at-risk (VAR), especially if you start to extend it from just looking at the trading desk, as it was initially applied, to looking at the entire balance sheet and the whole line of business.

Let me start with the consistent framework. In valuing assets in the market, we basically need to derive some underlying curve. Typically, we like to use the market prices that are there for government bonds as a starting point and derive a term structure free of any credit risk. But, if you have no markets for that, you might use the swap curve to derive the underlying pricing vehicle with the embedded credit spreads built-in and make sure that you can price option-free bonds if you have that sort of entity in the marketplace. Next, if you have embedded options such as corporate bonds or if you're dealing with derivatives, you need to have an option pricing model. You can basically do the pricing of those embedded options through these lattice techniques, particularly if you're dealing with American options. You need to have a roll back methodology and it is usually required at every node of lattice that you can use if you're doing simulations. That lattice should still price option-free bonds and most importantly, it should give you the correct valuation for the American and European options. In fact, you need to

calibrate the volatilities you might see in the marketplace to get those prices for the embedded options to come together. Everything needs to have a check and balance.

What do you do with liabilities such as life insurance or annuities that also need to be valued? On the asset side, we have CMBSs and mortgage-backed securities (MBSs), things where path dependency occurs, and, of course, there are a lot of derivatives that also have that built into them these days. You can't do backward substitution all of the time. There are some cases in which you can improve and get fairly quick results using multiple slices of lattices, but the typical methodology is Monte Carlo simulation. We've actually taken the simulation framework and improved it with a structured sample methodology where you start to look at other methodologies such as low discrepancy methodologies to improve that even further. The beauty is once you have a path-dependent framework, you can look at a single asset or all of the assets. This could also include even some of your portfolio of assets and your portfolio of liabilities under each of those interest-rate scenarios, so there's a lot of information available to you once you have that framework established.

With interest-rate risk, essentially about eight years ago, a lot of people were not using effective duration. You saw people using the McCauley duration. I think it's fairly clear that effective duration and convexity are used at the starting point. Looking at the sensitivity to some parameter, in this case interest rate, the yield curve moves up in a parallel fashion. We've actually applied it and I'll get into a little bit later where we adjusted some other risk parameter in a parallel shock and came up with, for example, a prepayment duration. Basically, you're measuring the price sensitivity of your asset to some parallel movement. Unless there are no options embedded, it's not really a representation of an average maturity. So you can get positive durations longer than the maturity of the asset, especially if you have a derivative of much shorter, negative durations. It's basically measuring the movement of the price. If rates go up and the price goes down, you have a positive duration. If rates move up and the price goes up, then you have a negative duration. That's basically the simple rule of thumb here. Convexity adds a little bit of nonlinearity measurement, and I think it's an important thing that some assets and some liabilities have significant convexity. Obviously, MBSs and a lot of liabilities have opposing convexity characteristics. One of the things that we started to do back in the early 1990s, and have been very successful in getting the industry to implement, is using key rate duration as a measure of the sensitivity to various nodes along the yield curve. I'll refer to an example later.

The last area is what I call pathwise measures, where you actually look at and extract information from the underlying interest-rate simulation framework. Sometimes just a simple statistic is not sufficient to explain all of the embedded risk.

Chart 1 is an illustration of key rate duration. Here is the starting yield curve, which would be the yield curve that would be used in an effective duration calculation. We do three price calculations: one up shift, one down shift, and the underlying unshifted. For a key rate duration, this would be at 15 years. We would shop the market just in that region from 10 to 15 and then down again to 20 years. In a positive way, we calculated market value. We do the same thing for a negative price calculation, and calculate the sensitivity of the price to that movement. It's a fairly simple construction, but the value is a mint in terms of the picture of what is being explained.

Chart 2 shows an example of a zero-coupon bond. There are no coupons being paid. It has a 20-year maturity and no interest-rate risk or sensitivity along any of these other key rate duration buckets. Any shock in these regions produces no change in market value because any shock up is reversed in the shock down on that side. In this case where he had the shock up, there is a significant sensitivity in this bucket of 20 years.

This is one way to start to diagnose the embedded risk to interest-rate movements along the whole spectrum of cash flows that you might have in the interest-rate instrument. If you're dealing with a very complex option-embedded instrument like a callable bond, key rate durations actually can start to tell you what's going on with those as well. Chart 2 has an illustration of a callable bond where there's a higher coupon. You can see it's going to be called sooner; in fact, it actually has less duration and less sensitivity than the bond that is going to have cash flows that go out in this case. We do have cases where there's negative duration, and I'll show you one later. First I want to go through another example that moves into the pathwise.

With interest-rate scenarios, we can build a lot of information so that if you're using an option-adjusted pricing model and you have the same option-adjusted spread (OAS) for your underlying instrument, you can now distinguish the characteristics of two bonds or two portfolios by the embedded options in them. For pathwise values, you can think along every scenario you're going to get different cash flows that are generated. We're going to capture the performance along each of these scenarios in terms of surplus. In this case, we used probabilities from an arbitrage-free framework. The next thing you want to do is to map the instruments that will be calculated along this framework that you may explain to be some simple building blocks such as your coupon bonds, caps and floors, or other simple

instruments that can explain the characteristics. In terms of the interest-rate scenarios, Chart 3 shows a fairly symmetric distribution of what we use. Linear path space is a structured sample that we map on to an arbitrage-free lattice, so you see that this is a normal model because basically the movement down is roughly the same as the movement up through this lattice. We typically use about 300 paths when we do an OAS calculation to derive our statistic such as duration or key rate duration.

Chart 4 is an illustration of cash flows along three different paths. The first is a rising rate scenario, the second is a falling rate scenario, and the third is one that sort of drifts along the implied forward rate curve. Here there's not terrible mismatch, but there is some because there actually was a duration mismatch in these two instruments. In the rising rate scenario, you can see that there's a lot more lapse in the Single Premium Deferred Annuity (SPDA); in the falling rate scenario you can see that there are significant prepayments that occurred in the MBS.

We assigned probability weights in a methodology that looked at the end of the line by normal distribution and our mapping of our structured sample on top of that. Chart 5 shows the points, as present values, graphed with the annuities on the y-axis and the MBSs on the x-axis. The MBS in the rising rate scenarios has actually less market value than the SPDA because the SPDAs are paying out fairly quickly so the present value is going to be greater than the MBS because of the duration mismatch. This is a simple way of looking at your asset/liability (A/L) management using just straight economic present value, but it's a good starting point.

Chart 6 looks at a CMO, a fairly complex instrument. Matching a CMO with a set of cash flows is actually a technique that Tom Poe created several years ago called, "Arbitrage-Free Bond Canonical Decomposition." This is a static hedge methodology that we used to replicate either an instrument or a liability or a portfolio with a hedge of various sorts. In this case, I've used zero-coupon bonds to create a replicating portfolio to drift along the implied forward rates so that our market values will be equivalent. I have a Treasury portfolio with no options at all in it. Then I have my CMO. Again, along all of those different paths, I'm going to calculate the market value, and what we see is there is some risk. The Treasury value has gone up, so this means that rates have fallen. In the case of a CMO or an MBS, this is probably prepayment in the underlying collateral that's occurring. That would be a prepayment risk, which is fairly significant in this case. We have an extension risk where rates have risen.

With Chart 6 you can do what I'll call a risk fingerprint—you can see vividly the characteristics of the underlying risk though you don't know exactly what you need

to hedge it. Still, this is a good starting point. Fortunately, we capture all of the per path market values for this asset, and we can create a replicating portfolio that's going to essentially match all of those market values under every one of those scenarios and create a hedge by doing straightforward regression on all of those. You need to capture all those different points of our underlying scenario set for cap lifts or floor lifts that we can use of different strikes to hedge our instrument. Try to minimize the price along every path of a hedge portfolio with our underlying portfolio we're trying to hedge.

This produces the secondary decomposition. Actually, I was doing an SPDA with what I'll call an accrual hedge. My primary decomposition was actually a bond that was going to be a floating rate instrument. It was going to accrue interest and pay out matching that interest based on some sort of amortization schedule. That was fixed up front, but it does have path dependency. With this, plus caps and floors, I basically replicated that portfolio or created a static hedge. Obviously, if you have an infinite number of interest-rate scenarios and a very fine universe of hedge instruments, you can get a perfect match. This was actually a very good example.

In summary on these concepts, I think there's a lot of information that is important in looking at the various scenarios. By just looking at cash-flow mismatch, pathwise profile, assets versus liabilities, or even the risk fingerprint, you can get some sort of a sense of how healthy your management is. If you have problems, you can develop a static hedge to see if you can afford the cost of the hedge overlay on your portfolio. That very well may stabilize you. Certainly you can apply this to different lines of business as well, looking at everything in aggregate or just aggregated to see what the risks are. Or you can hedge them out separately—maybe even creating swaps inside of the company to off lay or lay the risk, particularly lines of business. Then, when you roll it all up, you will know where you stand. Using key rate durations, which actually is a dynamic hedge tool, is not going to give you a permanent hedge. Unlike a static hedge, you have to rebalance your key rate durations as the yield curve changes and even with the static hedge there's going to be some minor maintenance. If you have some errors in your underlying models, for example, your prepayment model may not be that good, but key rate durations allow you to monitor that on an ongoing basis and rebalance and adjust your hedges as well. The beauty is that if you do this right, you're going to constrain this volatility of surplus, which I think is good for the business in general, regardless if you have twists or kinks in the interest-rate movement.

But that isn't sufficient typically; we need to go further. GT & BARRA certainly have done a lot with interest-rate management on the fixed-income side. BARRA has been known for a lot of the equity hedging that they've done in the factor models to look at risk. Essentially, you just need to map all of the different terms. Typically,

Delta will be equivalent or be a rough equivalent to duration or key rate duration. For the gamma, the equity would be similar to convexity, and so on. Ultimately, under various equity movements or interest-rate movements, you get scenario testing that you need.

We have been looking primarily at yield curve risk with key rate durations and the static hedge methodology that I was showing. There are many other risks that need to be brought under control, such as cross currency risk, basis risk, credit risk, and volatility risk. One way is to take a simple duration or Delta measure first, looking at it through the linear risk you might have and adding those factors to your model. We prefer to deploy this in a VAR framework where we're really looking at a maximum expected loss or a holding period for a specific confidence level. Essentially, we're going to look at the losses that one could incur due to any one of these particular movements, and then aggregate them in some way so that we can explain the risks in dollars that you might have in your whole balance sheet at this point. Obviously, the assumptions and methods are very important. In insurance, there's sparse data on the liability side, so it's quite difficult to get at an understanding or even to know if your models are replicating the risks appropriately for the liabilities. It takes a lot of expertise of the practitioners to validate the models to make sure that you're going to get some results that are meaningful for the holding period that you're using this for.

VAR was really originally intended to be used for trading desks at banks where there was a very short risk exposure (maybe one day or several hours in fact). They could find out if the market moved a certain percentage against them. The key is to try the same methodology, at least in the Delta sensitivity, by looking at the linear risks as a first approximation. Taking the concept of duration, we can look at all those other risk sources and do some sort of calculation to get the sensitivities of our A/Ls solved as risk factors and build up what I call a quality assurance table, which allows us to both drill down and look at various sources of risk that might be on the balance sheet offsetting A/Ls along one line of business that aren't properly aligned. You can also roll up and verify to the corporate level that you have the appropriate diversification. Essentially, you value your risk sources. You have your various holdings that have been defined in your model. You may have a distribution that is not normal. Basically, you're looking to find out what is the loss at some level of confidence for some level of holding period. Some of these are very important if you're using a parametric method, which is the method I've described here, where you're looking at the sensitivities to build up a correlation matrix.

Once you start getting into tying this together with other risk sources on the liability side or extending it to global, this can get to be quite a huge and difficult problem, so you want to try to limit the risk factors as appropriate in terms of their

contribution to get some overall picture. This can be done on a block-by-block line of business level, or it can be done in aggregate. By looking at the sources of risks for all the liabilities, all of the assets to key rate duration exposure basis, prepayment, stock movements, credit risk, and prepayment could also include lapse risk. Mortality obviously should be there. So then we can then look at the VAR, or the exposure first unconstrained. How much do we stand to lose if it's by itself? Obviously, the A/Ls should be fairly offsetting in terms of the risk exposure. Your total risk, hopefully, will be significantly smaller than your individual risks that you would have on any block of business or any asset portfolio matching that. Once you meet the two together, you hopefully can reduce that risk. This is just a way of sort of mapping it all out.

Now you can look at the actual return that you would see based on the risk adjusted and see what you're doing with the risk capital. That's actually the beauty of the quality assurance methodology. You can use this as a feedback loop to look at how lines of business are profitable. Are they or are they not properly hedged over time?

We talked briefly about a lot of areas of risk, specifically the securities that this could be used for. The liabilities are part of everybody's business, and there are many applications of it. I think we're sort of at the beginning of really understanding how to manage risk. People have already started to grasp measuring risk, but how do companies more efficiently structure their A/L management and their own internal communications to better reduce this risk and communicate to the regulators and the rating agencies that they are monitoring this with appropriate tools? I think we're working in that direction now with a lot of companies, and hopefully we're going to see a lot of brighter horizons down the road.

Ms. Forbes: I'd now like to introduce our next speaker, Tony Dardis. Tony is a consultant with Tillinghast, and he specializes in A/L management. He's also chairperson of the SOA's Committee on Professional Development and Education for the Finance Practice Area.

Mr. Anthony Dardis: I think we've already seen in Mark's presentation some of the complicated ideas that are being developed in the area of risk management, which we, as actuaries, are actually quite comfortable with. I think some of the things we're not so comfortable with are actually more on the general management side of risk management, and I'm going to touch on some of those aspects.

My background in the area of risk management is probably the same as everybody else here. I think, as actuaries, we are paid to do risk management, but these days the whole topic of risk management has become a specialty all to its own. Generally, I think that's because of the complications that are arising on both the

assets and liability sides of the balance sheet. Things are getting increasingly complicated and increasingly interrelated.

As Cindy said, I work for Tillinghast, the life and property and casualty side of Charles Perrin. Charles Perrin actually has a risk management consulting practice that does more of the general management side of risk management consulting. It has done a lot of work for some large multinational firms that are not insurance companies. Recently I've been working with some of the people in our risk management practice area to develop some of their ideas in an insurance context. As I've already mentioned, as actuaries, we get paid to understand, measure, monitor, and manage risk. Historically, insurance companies have been very good at that, so I think I'm going to give a few hints as to what has made insurance companies look again at the whole question of risk management. I'll then talk about how to establish a framework for establishing what risks one is exposed to and how to control them. I'll focus on an integrated approach to risk management that also looks at capital management. I'll finish off by looking at what insurers might be able to learn from other industries by looking at a case study.

I think essentially insurers are once again looking at the way they deal with risk because risk management is now seen as a potential source of gaining competitive edge. So, insurers are moving away from the idea of controlling risks to avoid volatile results, and they are looking more at the proactive idea of looking at risk as a possible source of competitive advantage. This will sound pretty obvious, but it's an important point: successful risk management requires a rigorous assessment of risk, which means specifically identifying what your sources of risk are and then assigning the impact of each source on future finances. Again, I think actuaries have been very good at working out what the impact of sources of risk are in the past by looking at probability distribution to each item of risk. I'll say a bit more about that later. Some of the components of risk aren't always well-modeled, and we probably have some way to go there, but actuaries have always been very good at the bottom up approach on the general management consulting side, by actually assigning probability distributions to individual components of risk. That's also consistent with the holistic approach to risk management, which basically means just looking at your risks collectively, understanding their interrelationship, and ensuring that nothing falls through the cracks. Holistic risk management is a word that's being bandied around the market quite a bit at the moment.

Let's talk quickly about an integrated framework. It's fast being recognized that successful risk management actually means successful integration of the whole process of risk management, capital management, and performance measurement. I'm not going to talk about capital management and performance measurement; I'm going to concentrate on the first four steps associated with risk management. Step

one, identify and prioritize risk; step two, classify your risks; step three, develop a way to measure risk. Mark has already talked about the Delta Gamma approach and the tail end of distribution approach scenario analysis. That includes dynamic financial analysis and evaluating risk analysis.

First, identify and prioritize your risks. It's not appropriate to start with a ready-made checklist of risks. You need to be specific and consider not just what's concerning the industry, but also what's specific to your company. As another obvious but important point, what's currently an important exposure to your company may not be important tomorrow. Classification of risk has been used quite a lot on the general management side. Mark talked about one approach to classifying risks. Here's another one that is a little bit more general. What the general management consultants have done is come up with four different buckets for putting your risks into. In Table 1, on the left-hand side we determined whether we are or are not well equipped to deal with a risk. On the bottom, you'll see we have looked at whether we have a good understanding of that risk or a poor understanding. Depending on which bucket each of our risks might fall into, we can categorize it according to whether it's manageable, strategic, business as usual, or adaptation. You're probably wondering why this is useful. This permits us meaningful interpretation of risk factors, and it clearly implies necessary actions. What we have here are just some ideas as to how you may interpret risk factors, and what your actions might be depending upon which bucket your risks fall into. Obviously, this would be much more detailed in practice.

TABLE 1
CLASSIFICATION OF RISK

<i>Not well equipped</i>	-Previously lucky? -Learn from the past -Add capabilities	-Learn from others -New capital and/or strategy -Import capabilities
	<i>Well equipped</i>	-Experience is valid -Management Response
	<i>Good Understanding</i>	<i>Poor Understanding</i>

Another way of classifying your risks, and this is more akin to what Mark was talking about, is just splitting up risks by liability or replication risk, asset or investment risk, and then business risk. They will have their parallel with the NAIC risk-based capital (RBC) approaches, and this could fit into the framework that I was previously talking about on the general management side. The whole thing can be done consistently with that.

Step three, develop a way to measure risks. Again, Mark has already talked about this in a fair amount of detail. We parametrically model those risks or stochastically model those risks, and I think this is a real interesting area. It may be that by parametrically modeling some of these items, we're actually excluding some volatility. I think there's a big debate going on in the profession at the moment as to whether some of these parametric assumptions should actually be looked at stochastically. I think some components of risk are often not modeled at all, and maybe that's not appropriate. Again, I've just laid out some examples of some elements of risk that may need to be considered a bit more carefully in the future.

Finally, we need to decide on appropriate risk management techniques. Again, I think everybody here is familiar with some of the techniques that I have laid down here. Some risks can be controlled through the investment markets or more effective underwriting, claims management, and reinsurance. Product line managers and corporate financial administration offices can also exercise more control.

I'd like to finish off with a case study, which is actually concerned with the construction of an interisland tunnel system in the U.S.

Actually, they did a lot of statistical analysis. They established a framework for risk, and they identified, prioritized, quantified, and effectively mitigated all sources of risk. They used some quantitative analysis that was actually quite similar to the sort of analysis that insurance companies do. The project started with very specific objectives. They wanted to get it completed on time and on budget, and they wanted to make sure they didn't injure any of the workers, the environment, or the general public. Their next step was to work out the risks that could jeopardize the achievement of that overriding set of project goals, such as cost and schedule risks, safety-related risks, and third-party risks. I think the point to learn here is that risks need to be identified after first considering what the overriding project goals and objectives are. Once we've done that, we can then do the analysis that's required. At this stage, the work that was done on this project was very similar to work that we already do within the insurance industry—looking at scenario analysis and focusing the testing on those elements of risks that had the greatest potential for variability of construction duration. Having performed the risk measurement work by way of modeling, risk management processes were then put in place.

To conclude my remarks, I think when noninsurance companies or noninsurance industry capital projects tend to be very good is when they look at each task involved in a project and then establish what the potential sources of risk may be. I think that's a good framework for risk management, and it may be that insurers can learn something from that. Table 2 features a matrix that was actually taken from

some pioneering work that was done by some actuaries in the U.K. The Institute of Actuaries in the U.K. set up a working party to look at capital projects. Thackery came up with some ideas for project management and this matrix is such an idea. On the left-hand side of the matrix, we have the various stages of a project, and along the top of the matrix we have the different sources of risk. It requires an expert to go through and identify which boxes are applicable and what actions can be taken once we've identified which of those boxes are applicable to us.

TABLE 2
FRAMEWORK FOR RISK MANAGEMENT

Stage of Project	Source of Risk					
	Political	Business	Economic	Project	Natural	Financial
Concept						
Design						
Contract						
Approval						
Capital						
Construction						
Operation						
Revenues						
Decommissioning						

A similar work is being put together here in the U.S. under the finance practice area, which is under Cindy's chairpersonship. We're setting up a capital projects working group to look at whether or not some actuarial principles can be used in a capital project's context, as well as the flip side of that. If anybody's interested in helping us out, we'd love to hear from you. Either get in touch with myself or Cindy.

Ms. Forbes: Our last speaker is Frank Sabatini. Frank is a partner with Ernst & Young, and he is the national director of AL management services for life insurance companies.

Mr. Francis P. Sabatini: My theme is management information because I think that's the key to any type of risk management program, and I don't want to lose sight of that. There are four levels of competency, at least this is my definition. You can be consciously competent; you can be unconsciously competent, which is a euphemism for lucky; you can be consciously incompetent, which is probably as bad as you can get; or you can be unconsciously incompetent. I think, in general, the managements of the companies worldwide in the insurance industry strive to be consciously competent. You can't do that without management information.

Let's take a look at risk management in the insurance context. Of course, these are my opinions and they're not the opinions of Ernst & Young or anybody else. We've

come a long way baby, but we have a long way to go. What is our risk universe? As we look around the industry, it has primarily been interest-rate risk with maybe a secondary focus on credit risk. If you stop and think about it even from a regulatory point of view, those are the two primary things that we tend to focus on, which excludes all those other risks. We really don't do a very good job at this point at looking at all of them or quantifying the different components. We tend not to be holistic. The industry in general hasn't gotten to the point of looking at risk in a holistic way. I mean all risks across all operating lines, and we're not there yet. Even in an isolated sense if you look at interest-rate risk, we have trouble being holistic across the company. Out of that comes limited management information and utility; that is, even if we do an excellent job of looking at risk for a particular line of business or a particular company or its interest-rate risk only, it's out of context and awfully difficult for management to find that useful or take action. That leads to the fragmented nature by risk element and by line of business. In our horizon, it has historically been long-term. I'm not suggesting that's good or bad; a little later I'll suggest that maybe it should be long, short, or intermediate. By comparison, let's look at the banking industry. I'm not sure how they got to where they are. I haven't read the history, but they generally tend to have a broader view of risk. The VAR concepts that are emerging out of the banking industry incorporate all capital market risks, interest-rate foreign exchange, and commodity equities. They're trying to bring in credit right now, but it's not particularly robust. They tend to be holistic, so it's the total bank—all the assets and all the liabilities. It's management-focused. I have run into a few insurance company chief financial officers who have come over from the banking industry which continually expresses its frustration at not finding a risk management reporting process in place in most companies. The interesting thing is the banking focus is less than one year, and it's being driven primarily by some of the accounting that takes place on that in that business.

So where do we want to go? We'd like to look at the entire risk universe. We want it to be holistic—total company. We want it to be disciplined—management focus and utility. That's the greatest benefit. You can do all the wonderful work in the world, but if it has no value to management, it probably has no value and multiples arise. I know if I were a CEO of a company and somebody used a 30-year horizon, I'd say, "How many years do I have to retirement?" That's not useful. My view is that you need to break your analysis of risk into short, intermediate, and longer term horizons.

What's the impetus? We're going to have a convergence to the financial services industry. The Traveler's-Citicorp merger probably isn't the first. We're going to continue to consolidate. We're going to continue to confront expanding competition and shareholder demands, and expectations are going to increase, not

decrease. Since we're heading on the track where we're all going to be stock companies anyway; that factors into it even more. I'll pick up on a point that Tony made, years ago. If you were good at risk management, that was a competitive disadvantage. I don't think it's a disadvantage at all, and I think we're now having to look at risk management as something that if we don't have it, it's going to be a disadvantage, and it's going to impact shareholder value.

What is comprehensive risk and value management? Very simply, it's a risk and value measurement framework that incorporates all measurable risks. The key word is "all." Another key word is "measurable." There are some risks that probably can never be measured. What's the process? They have to go through a risk assessment, which is basically a mapping process that identifies all the risks that you might want to worry about when building that inventory or universe. You need to map them into those that have relative importance, those that are measurable, those from which you can get the information you need to incorporate them into any kind of risk management process. Once you've done that, then you can go through the quantification process, which leads to performance, measurement and attribution, assessing stakeholder's risk appetites and how much risk you are willing to take, linking risk with returns and strategy formulation and capital attribution, getting into a risk monitoring and management process, and institutionalizing it in the organization.

So what is the risk universe? I've quantified them into four categories: financial, business, operational, and event risk. I'm planning on doing some personal development too. In the category of financial risk, some examples are capital markets, which would include interest-rate risk; equity in market risk; bond market risk; all the types of capital markets risk you might think of—credit risk, foreign exchange, surrender and lapse, premium suspension, and production (meaning new business); business risks—mortality, morbidity, surrender and lapse again, ratings downgrades, litigation, changes in competition, and pricing risks; operations—systems, people, and accounting processes; and event risk—tax law changes and other event-related risks.

What are metrics? Earnings at risk, embedded value at risk, and shareholder value. There are others that are quite possible that share some common characteristics. They're all profit-based and by using profit-based measures, it allows you to do a number of things. First of all, almost every risk element has an impact on profit; therefore, if you can identify, define, and quantify a risk measure, you can probably ascertain its impact on your bottom line in one form or another. By introducing all these different risk elements, you need to move to a platform that allows you to quantify all of them. Second, each of these measures allow you to quantify the impact of risk not only in terms of your current balance sheet, but in terms of future

environments that might reflect new business. Any kind of future flows, taxes, and new production can all be factored into a metric of this type.

What are the benefits? What's the goal? The goal is management information, and the idea of the comprehensive risk and value measurement system is to bring all the risks together into a single measurement framework across the entire company. That's the goal. If you can do that, then you can provide management information so they don't need to feel like they're lacking information that causes them to make the business decisions. It's not going to make the decisions for them, but it's going to give them information that they probably need and want. Probably most importantly, it creates a perspective on the relative exposure to various risks, and whether or not they're comfortable with that relative exposure. I've frequently heard this throughout the industry: Do we have too much interest-rate risk or too much credit risk? What's the right balance? If you build a framework of this type, you should be able to answer that question. That provides a foundation for risk and strategic decision making with a forward view.

So what's the methodology? The first assumption is every risk is dynamic. We're familiar with our traditional methodologies that have been built on cash-flow testing and focused on interest-rate risk, so we tend to treat things like mortality and morbidity as fairly static or nondynamic elements. We then vary the interest-rate elements. There are others that we don't even consider such as the equity markets if we have equity positions in our portfolio and currency exposures if we have them in our portfolio and so forth. In this context every risk is a dynamic risk, at least every measurable risk, which can be defined in some statistical way— some with a fair amount of precision and others with not as much precision. The idea is that it will capture random fluctuations, trends, correlations with each other, economic events, etc. It allows you to define the risk profile reflecting all the elements collectively, and it incorporates their relative correlations both positive and negative. The beauty of it all is to determine the contribution each risk element makes to the overall risk position in a similar fashion to some of Mark's comments.

Let's talk about credit as credit risk. We know that we don't get ten basis points, or a default cost, coming through our income statements every year, so we shouldn't treat it that way in terms of measuring risk. There's a distribution of default outcomes and a history that you can build on. It's certainly not a normal distribution; it's a skewed distribution. It's one where we either have no defaults or we have a fair amount of defaults. You look at credit in more of a dynamic way with pathwise variation, and you define it in terms of its relative correlation to other things that are moving in your modeling environment, whether it's interest rates or to the extent that you can link it to economic conditions.

I'm going to define earnings at risk as the mean value less the 10% value. This is the kind of information that you can get. Chart 7 looks at the distribution of earnings across all the economic events that you've examined in terms of your modeling process. It includes a combination of interest rate, credit lapse, and all the risk dynamics that you built in. Risk then is defined as your earnings at risk between the mean value and the 10% value. There's more you can do with this, but in its basic form this is an earnings-at-risk exposure from all sources of risk. The next step is to break that risk exposure into the contribution that each risk element makes, and I've included baseline expectations for surrender and lapse, credit foreign exchange, equity (equity meaning to the extent that you own equities as an asset class), mortality, and morbidity. The idea here is to hold all the variables constant and vary the other, and determine the contribution or, in an even more dramatic sense, exclude the other variables and evaluate the one. In reality, I don't think you can get an independent result with the technology that we have, but you can at least get the significant component or contribution for each risk element. In this example, what we've done is shown that capital markets risk is more than twice what we would be getting from credit risk. Things like mortality and morbidity have relatively less risk exposure, and they create an environment where you can sit and look at something like this and say, "Well, maybe we should be taking more mortality risk and taking less capital markets risk; or maybe we'd like a better balance between capital markets and credit risk. I didn't think that risk exposures to new business production were as significant as they really are." The beauty of it is that it provides a lot of good information, and there's a lot of detail that can support that in terms of presenting information to management.

Now I've talked mostly about risk management, but I want to just spend a brief moment on value management. There aren't too many organizations that I've spent any time with that didn't think maximizing earnings was important. The goal here would be to maximize earnings for a given level of risk and capital, and it provides a framework for determining adjusted risk capital and effectively allocating capital. To the extent that you can define the shareholder value utility function, you can even get to understanding how your management actions can actually enhance shareholder value.

Now I realize that I've talked about a risk management and a value management framework that takes the complexity in a modeling context of what we do even beyond what we do today. I recognize that the more complex it gets, the more assumptions that we bring to the whole process. When I started out my talk, it seems that the goal is to provide management with information. I recognize that the results can get pretty sensitive to the assumptions you make, but I think if it's presented to management in the proper context, it gives them information and it allows them to make decisions. It doesn't tell them what the decision is, but if

presented in the right format, it gives them more information and perspective than they had before, which allows them to be consciously competent.

Mr. Bruce R. Darling: The agenda mentioned that RBC and target surplus would be addressed. I didn't hear too much about that, and I was wondering if, in your work, since you all are very heavily involved in risk evaluation and that kind of thing, you consider either the RBC formula or the asset valuation reserve formula to provide any relevant management information. Or do you just take them as compliance givens?

Mr. Dardis: I'll say a quick word on that. One of the approaches to classification that I've put up actually had the parallel, C-1, C-2, etc., risk, and I don't think any of us really wanted to get into a big discussion on the appropriateness of the RBC approach to risk classification. I personally think it's pretty good, but certainly that's one approach. What I'm seeing is there are a lot of companies using that approach as a means of doing capital allocation and the corresponding calculations that feed off that.

Mr. Sabatini: There's a concept called RBC arbitrage. The basic idea behind it is that if you build a risk measurement framework of the type that I've just described, you can then really get a handle on how much risk exposure and how much risk capital you really need for your particular businesses. If you know that and you find out that you need more in a particular line of business than the regulators and your shareholders require you to have, you should write a lot of that business. That's kind of a left-handed way of answering your question. I think the RBC concept is great, but I think it actually has to evolve to the point where it better reflects the underlying risks of the different elements.

Mr. Abbott: I think the idea of confirmation is probably the most important aspect here. The RBC has stated their set of what they believe to be sufficient measures, but the question is really to validate them. Through methods like earnings at risk and VAR, we can start to get a handle on whether they're truly accurate enough for all of the assets that are included. Some of them might be penalized far too much. To appropriately have some valid argument to offer some other way of allocating that capital, I think there's still a lot of work that needs to go in producing a confirmation. Certainly, horizon analysis is very important looking at different events that have occurred historically and how those periods would have affected the risk capital. Maybe a scenario or set of scenarios to those historical events in looking at the capital to be required would be a better way to get an understanding of that.

From the Floor: I have a question for Mark on the contribution to VAR. How do you derive the dollar beta? And how do you interpret the results where the assets are negative contributors and the liabilities are positive?

Mr. Abbott: Yes, basically when you look at VAR, everything is additive. But once you start putting in the correlations, then you're really looking at diversification. If you have A/Ls, obviously those will be added and subtracted, but the correlations are really what will offset the contributions across the line. It's the covariance matrix that takes you from the straight VAR contributions to the truly diversified contributions. That's one of the reasons why you need to look at what goes into that development of the covariance matrix. Over what period were you measuring the historical information, or even maybe just subjectively setting up some crisis periods where the correlations were very high? Typically, the dollar beta is going to be much lower once you include all the diversification effects in your VAR. If you just look at the individual buckets, essentially you're going to see those risks are fairly large compared to the total.

We compute VAR and get to the diversification contribution by looking at all the risk sources and the volatilities of those particular areas, the levels of rates for example, and by creating the shocks that one would see in those particular areas to get the sensitivities. Once you have all of those shocks and you know what the contribution to risk is from the risk sources, then you can assign to each of the individual assets the amount of risk that the covariance matrix is going to calculate. It's basically just a mathematical formula you apply based on the shocks—these dollar durations, if you will, that you get from different buckets—whether it's prepayment risk or interest-rate risk. We're using this delta normal or even extending this delta gamma methodology. The dollar beta actually reflects the true diversification of all of that risk and the assignment to the contribution to the total risk in an additive way.

From the Floor: I was wondering if the panelists could comment on their perceived changes in both management and stock analysts' perception of this type of activity. Four or five years ago, any type of attempt to really get down to the risk was perceived as a negative that took away from more productive activities. Do you find that currently there's a lot more reception in that area?

Mr. Sabatini: I really can't comment on shareholders other than to say that shareholder perception of risk probably has impacted some stock prices, and I can think of a couple of examples. From a management perspective, I think there are more management requests for information than there ever were five years ago. I didn't think they even knew to ask the question quite honestly, and I've literally seen it in a few instances where it wasn't someone in the organization trying to

push up the idea. I think it's management for whatever reason deciding that this is important, and it actually works in an organization when it happens that way. When you have senior management support, it usually is successful. I think the other thing that's happening is you're finding that there are banking people who are moving into the insurance industry. I don't know if that's good or bad. Time will tell. These individuals, especially on the financial side, are used to having risk management processes and seeing risk management information, so they're asking for it.

Mr. Abbott: I think if you look in the annual reports right now, you'll probably see only several insurance companies that reported VAR in their statements. I think it's going to be a very different story in five years.

Mr. Dardis: I'll just make a quick comment on that as well. I think as far as management is concerned, one of the most difficult things is actually coming to grips with some of the conceptual ideas. Our job in explaining some of those conceptual ideas is a pretty tough one. The stock analyst question is an interesting one as well. I think stock analysts have been trying to come to grips with the risks that a company is exposed to, and maybe their analysis has tended to be somewhat subjective so far, but I think it's definitely an area that they're going to look at in the future.

Mr. Abbott: I think there certainly is going to be more of an effort to communicate to the shareholders the corporate value and their concern in risk. I know that there's another session on risk management where that issue is going to be addressed a little bit more fully.

Mr. Sabatini: It was kind of a loaded question. I think that basically management seems frustrated with both the regulatory agencies and possibly some of the stock analysts. This might be a means for them to educate the public about the real nature of the risks. It's particularly true when a company is, say, in an expansive mode as many companies are today.

From the Floor: I've seen a couple of companies put their risk management there—they are analyst dog-and-pony shows. I can't say whether or not it helped them or not.

Mr. David K. Sandberg: I think Frank underlined a segment of being able to look at all measurable risk, and I wasn't sure if this came through in the presentations or not. It seems like one of the risks that you have is modeling risk; your assumptions about the interrelationships are wrong. Is that also factored in when you're looking at the VAR? It was nice to get a probability distribution and come up with a mean

and a variance, but that's all said on a set of assumptions about how the behavior interrelates, and certainly for a company that may have a large in-force, if they were trying to get into a new line of business, it seems as if there's a larger variance there. I'm just wondering how you approached that.

Mr. Sabatini: After companies go through this process and look at the information that they have, there has to be some attribution to answer that question. At this point, to do attribution on both sides of the balance sheet is almost impossible. Essentially, you have to look at what your models are predicting. Your business behavior will validate the models that you're using. It's not a simple thing that we can just do right away.

Mr. Abbott: The answer to the question is yes, and one way to get around it is to test the items that you are least comfortable with. To test the sensitivity of the results.

Mr. Dardis: One of the things I was looking at was some of those items where we use a parametric assumption. Maybe we should be looking at some volatility in some of those assumptions. I think that's a modeling risk.