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RESEARCH OF THE COMMITTEE ON VALUATION AND RELATED AREAS

Moderator: ROBERT W. STEIN
Panelists: JOSEPH J. BUFF
PETER B. DEAKINS
MICHAEL E. MATEJA
DANIEL J. MCCARTHY
IRWIN T. VANDERHOOF
Recorder: ROBERT W. STEIN

- Objectives of the committee
- Areas of current research
- Summary of findings
- -- C-1 Risk
  -- C-2 Risk
  -- C-3 Risk
  -- Combination of risks
- Future areas of interest

Note: This session presented the results and findings of this research which has been conducted by the various Task Forces of COVARA. During the last several years, these Task Forces have been studying the quantification of risk and have developed means of measuring and evaluating risk in an insurance enterprise. Their reports contain a thorough analysis of the issues addressed and the methodologies developed, as well as discussions of the key conclusions which have been drawn from this extensive work.

Reports were given by the chairmen of the following Task Forces:

- C-1 Risk - Irwin Vanderhoof
- C-2 Risk - Dan McCarthy
- C-3 Risk - Pete Deakins
- Combination of Risks - Mike Mateja

The reports of these Task Forces are available in printed form from the Society offices for $30.

MR. ROBERT W. STEIN: The panelists represent the task force chairmen of the committee who will be summarizing the findings and thoughts that they have on the work that they've completed during the last several years. The Committee on Valuation and Related Areas was formed several years ago to identify the risks to which the industry was exposed, to develop means of measuring those risks, and ultimately, to suggest potential means of managing those risks. During this process, the committee members and task forces have developed methodologies and procedures to examine the risks they've identified. As you'll hear from their presentations, the committee has gone a long way towards providing the practical tools to evaluate the risks to which an insurance company is exposed.

Some of this material has been presented in various forms in the past. Over the years there has been a continuing flow of information from the committee, represented by various papers, seminars, sessions at other society meetings and so on. This panel, however, represents a culmination of the first phase of our work, which has been the initial identification of risks and the development of risk measurement tools. It represents an opportunity to look back at what has been done and to interpret what that work might allow us to conclude about risk.

We have an outstanding panel. These are the individuals who, over the years, have done all of the work of the task forces. I'll make some brief introductions and we'll move into their conversations. Joe Buff is a consulting actuary at Tillinghast, Nelson and Warren in New York. He'll be addressing C-1 Risk analysis methods. He has been a member of that task force for some time now.

Irwin Vanderhoof is the Chief Actuary and Chief Investment Officer of the individual lines at the Equitable. Irwin is a founding member of the committee and heads the C-1 Task Force. Irwin will talk about the interest rate markets which he has been studying.

Dan McCarthy is a consulting actuary with Milliman and Robertson in New York. He has been the chairman of the C-2 Task Force over the years and he'll be reporting on the findings in that area.

Pete Deakins is a consulting actuary with Milliman and Robertson in their Philadelphia office. He has assisted Stan Tulin in the C-3 area and Pete will be presenting the findings of the C-3 group.

And finally, Mike Mateja is Vice President and Corporate Actuary of the Aetna. He has lead the Combination of Risks Task Force and has provided information on the impact of the combination of risks. His task force has been instrumental in providing many of the thoughts that have emerged from the task forces and the committee in this area and he will present some comments about the combination of risks and the general risk measurement process.

MR. IRWIN T. VANDERHOOF: Basically, what I'm going to do is go through the report of the C-1 Task Force. Most of the report addresses the question of bond defaults. Bond defaults are important because something like 40-50% of the assets in the industry have traditionally been in bonds. Also, bonds have been well studied. There are sources of data, particularly the Hickman Study covering the years from 1900 to 1943. There's a great deal known about bonds. What I've tried to do is take the information from the Hickman Study, which is comprehensive, and, to the extent to which it is possible, contrast that with data subsequent to 1943. This later data is based on the work of various people in the brokerage community and most recently by Ed Altman of NYU, whose publications on junk bonds are well known.

The first thing I included are tables of bonds outstanding and defaults from 1900 through 1985 and the default rates. This actually doesn't sound like much fun, but it's sort of interesting because the average default rate for all bonds outstanding from 1900 through 1944 was 1.65% per year. The average default rate for all bonds outstanding from 1945 to 1985 was .08%. That's quite a bit different. I did some analysis on a statistical basis and you might conclude that there's a 1-in-200 chance that the data comes from the same universe. If you use an F-Test on the standard deviations, you get an answer that the probability that the two standard deviations are from the same universe is 4 x 10 to the minus 36th power. You can have various arguments that the F-Test is not suitable for a Beta distribution, which this must be. But even if it's not suitable, it still should give you some idea that the world, as far as bond defaults, has changed. It's a different world. The old world can come back, but it's not the same world. I did Beta distributions on this material also and Chi-Square

tests. Beta distributions, which are probability distributions that run from 0 to 1, fit the data reasonably well, especially well on the tails. It's sort of mushy on the later data around the middle of distribution.

If the world is different, why is the world different? The high default rates of the earlier period must be attributable to a number of factors. One is that we actually can learn something about economics. We actually know more now than we did then. During the first five years of the 1930s, the money supply decreased by one-third. Consider what happens in this country or Canada now if there are a lot of bond defaults. If there are a lot of defaults, both governments are going to pump the money supply up. You may have higher interest rates eventually, but you are not going to have bond defaults. Also, the economy of the United States has been more stable since 1945. As far as I can tell, the automatic stabilizers work. The economy actually is more stable. So there are reasons default should be much lower.

I then examined the question of incidence of default. Do defaults occur early or late in the history of a publicly available debenture? Also, ratings of bonds outstanding can change. In 1928, you had 4,000 investment grade bonds. In 1944 you had 800. Downgrading goes on during a depression. So I do defaults by risk class. (These are agency ratings generally.) In the Hickman period, low-grade bonds other than investment grade bonds defaulted, in total, over their life span about 40-50%. That's not true anymore. The same kind of thing, however, is true on market ratings. The higher the interest rates you get, the more likely a bond is to default. The worse the agency rating, the more likely a bond is to default.

I also did some work on current junk bonds. Current junk bonds have about the same statistical characteristics as all bonds did prior to 1945. Also, before bonds default, their ratings tend to change. Default is not something that takes place immediately as a sudden event, except in an International Harvester, or a Johns Manville case, perhaps. Usually there's a deterioration in quality which is recognized by the markets and by the agencies.

In addition, I checked the impact of diversification. Diversification will help, but not that much. If you go through a difficult economic period, diversification will not save you from higher defaults in the portfolio.

At default, there tends to be a loss immediately on that day. Actually, from the Altman database, I can find that on the 195 bonds that defaulted since 1971, they were selling, on the average, at a price of about $60 at the beginning of the year of the default and around $32 at the end of the month of default. So you lose about 40% of the total value at the beginning of the year of the default and then about half of what value is left by the end of the year.

And then I give you some Beta distributions for junk bonds, for the losses on junk bonds going into default, and a combination of those two which would show the losses on a portfolio. The profitability of a loss at a certain level on a portfolio of junk bonds is provided. Investment grade bonds aren't very interesting. I mean, if you're going to have defaults on the order of 100 basis points and losses on those defaults of half of that, you get down to a 5-basis point loss on default and it's not very interesting for a study.

I also spent some time on mortgages and real estate. Mortgages, in general, have about the same characteristics in the current world as bonds do -- very, very low default rates on traditionally written mortgages. The key item on mortgages and real estate is that real estate will tend to produce a return that's related to inflation.

That's the end of my report. I'd like to give particular thanks to Donald Cody, who's here, without whose continuing encouragement and support this thing would never have been done. I'd also like to thank Faye Albert, a member of my C-1 Task Force.

MR. JOSEPH J. BUFF: The topic of my discussion is one methodology for looking at C-1 Risk within the context of asset/liability management for a life insurance company. To get started, let's take a look at a definition of C-1 Risk. Basically, C-1 Risk is the risk of asset defaults and the loss of common stock market value and the related reductions of investment income. I'll talk about an approach that's intended for fixed income investments, which basically means bonds, mortgages and mortgage pass through securities. I would mention that in our last committee meeting we discussed research for modeling equities, again within the asset/liability approach, and we expect that within six months or a year perhaps, we will have some research to report for those of you who

are suddenly very interested in the stock market. But this talk is going to be solely about the bond market.

We'll begin by taking a look at the process of bond defaults because, in order to understand this particular methodology, the idea is to take apart what happens when a bond defaults within the world of an insurance company balance sheet. Particular focus will be on the problem of C-1 Risk. What's it about? What influences risk exposure? What are the financial processes that create risk? And what, in fact, are the financial processes that result from risk and losses? And once we've taken a look at the context that defines the problem (or says what the right question might be), we'll look at a proposed modeling solution.

The solution, I would stress, is a methodology and we on the Committee on Valuation and Related Areas (COVARA) have made a distinction between methodologies and assumptions and scenarios. You might say a methodology is a modeling approach. Assumptions are assumptions about the variables under control by the insurance company or the insurance industry that have to be fed into the model and scenarios are assumptions about the external world. In this case, things in the capital markets also have to be fed into the model. You need scenarios that are the right sort of scenarios for your purpose and you need assumptions that are appropriate for your particular management problem. What we're talking about here is a methodology.

Now, let me talk a little about the context in which this approach takes place. We are going to take a look at modeling liability cash flows in order to measure reserve and surplus requirements, risk charges and pricing. It's something that can be customized to an individual company's risk exposure. It's very consistent with valuation actuary cash flow testing. In fact, it can be developed -- the particular programming -- by modifying an existing C-3 risk model. And in particular, it's going to enable companies to address the question of different asset allocation strategies. So this methodology is not necessarily only for valuation, but also is applicable to pricing and investment strategy analysis.

For instance, should we allocate our new investable funds to all investment grade bonds, or to 80% investment grade and 20% junk? How do you, in fact, compare those two strategies? Well, that's an asset allocation question, just as "Should you buy 5 year-bonds or 10-year bonds?" is an asset allocation question.

Existing C-3 cash flow methods are one approach to saying, "Do you buy the 5-year bonds or the 10-year bonds?" But let's take a look at the C-1 Risk and then we'll see how we can do cash flow projections that help us get a handle on the problem. We also need to talk a bit about the whole issue of diversification because this is where one source of complexity enters into the methodology and we must resort to Monte Carlo sampling.

Diversification has an important effect on portfolio's risk exposure. When you're talking about the C-1 Risk, there are at least a couple of ways to diversify. One is by the size of your bonds; in other words, how much money do you put in any one bond or do you spread it around in little bits of a bunch of different bonds? And then there are industry categories. For instance, energy bonds or broadcasting bonds; that sort of diversification. And one needs to come up with specifications for not only the starting assets, but also the reinvestment strategy, because just like for a C-3 Risk projection, there's going to be a reinvestment strategy that must be defined. A good C-1 Risk model should have the ability to reflect the genuine effect of diversification on the risk exposure of the company.

That's one form of diversification. Another that we need to look at is salvage value. When a bond goes into default, as Irwin has just indicated, it's not worthless. It has value. In fact, you can make general statements about the value depending on when you're measuring (given the date of the default). Of course, bonds in default are very seldom completely worthless and one thing you could do to get a model started, a relatively simple rule, is to say that when the bond defaults you'll sell it for the salvage value. You, therefore, need an assumption and I borrowed one from Irwin's work and said, 40% seems to be a rather good long-term average.

What we're coming up with is basically a three-step plan to studying the C-1 Risk. I stress, on behalf of the committee, that it is by no means the only approach possible, but just one that we've been looking at. And that's to begin by using scenarios of nonconstant future default rates that same way we look at scenarios of yield curves. And these scenarios undoubtedly should vary by the asset type, which means bonds versus mortgages, and also by quality; for instance, AAA, which is about as good as you get, or single B, which is like an average of subinvestment grade. Also, as mentioned, they should vary by

industry, like the entertainment industry versus the food industry. So that would be our Step 1.

Step 2 in the process is the need to reflect diversification. And here we resort to Monte Carlo sampling. I made an analogy that a portfolio of bonds exposed to default risk is very much like a portfolio of insured lives subject to mortality risk. The basic problem is "How do you understand the gain and loss tail of the claims in the aggregate on a portfolio of insured lives when their ages and the face amounts vary?" And we actually have that basic problem in a portfolio when we're looking at defaults. Bonds sort of die and they're subject to different levels of risk of this default-type death event. Depending on the makeup of your portfolio, as far as the relative face amount of different bonds and the number of different bonds, you have different risk exposure. So as the formal report indicates, in some detail, the Monte Carlo methodology can be applied within these scenarios to look at how a particular portfolio might respond and get a distribution of results. Basically, the events, (the bond defaults) are simulated by flipping a coin. Then the financial model puts together the big picture of things like accumulated surplus or present value profits.

The third step of the 3-step approach is to follow this rule that when a bond defaults -- sell it for a salvage value and reinvest the proceeds. The salvage value is, in fact, an assumption. You can make it fixed. Just let it run as 40%. Or you could make it variable, because in fact, data may show that among perhaps 2 or 3 dozen defaults the actual salvage value for each of those default events ranged from 15% of par to 85% of par. So the 40% is stable in a very aggregate sense, but from default event to default event it can vary quite a lot. This, too can be reflected in a fancy model.

And then we move to the actual cash flow projections. These are meant to be as similar as possible to what we do. For instance, Regulation 126 looks at C-3, which is to project the asset and liability cash flows from an existing data base using appropriate assumptions. We also could look at a single block of new issues as a pricing exercise. Cash flows, profits, accumulated surplus, etc., are then summarized, reflecting the impact of this C-1 Risk experience. We end up, just as for the interest rate risk, working with a range of results. The range is going to run across a set of Monte Carlo samples within scenarios, so that you may need to run several hundred trials. The best way to look at them

is graphically, just as is being done at the Valuation Actuary Symposium. Start putting things up in the form of graphs rather than tables of numbers. The nice thing about a graphic distribution, I think, is that it doesn't matter whether you're graphing the results of 40 results or 50 results or 4,000 results. Once you've gotten to the point of having to look at the output and interpret the graph and make management information, you're getting much more out of the exercise.

I would wrap up this part of my discussion by saying that this analysis is done in the same way as a C-3 Risk analysis. This enables us to combine the two relatively easily and we can then start to address a combination of risk approach to the total investment risk, which Mike is going to discuss in more detail.

Now, let me go through some results. I took a look earlier this year at a Universal Life Test Case, where I put together a very simple block of business and made up some default rate scenarios. I ran 40 Monte Carlos through each. Some testing suggested that was enough to be credible for the particular example studied. I assumed that the salvage value of all the bonds, once we sold them, was 40% of par.

I would like to give some general, qualitative conclusions about what came out of the example. First, it suggested that the Monte Carlo approach that reflects the actual effects of diversification in a statistical way, indicates that the uncertainty of the results can be substantially greater than you would get from a more traditional approach to reflecting default. Now, by traditional approach, I mean a 2% default rate means you reduce the par amount held in your portfolio by 2% or follow a flat annual deduction such as the mandatory securities valuation reserve (MSVR) does for statutory reporting purposes.

It seems that this approach to looking at portfolio diversification is important and does affect results. It suggests that there is, in fact, a lot more going on that one might want to look at, at least for internal management purposes, if not for valuation. In fact, some of the worst cases showed some significant differences depending on whether you used the traditional "x% of par dies off" compared to the Monte Carlo approach. I like the idea of a reserve covering 90% of all outcomes and I found that the worse cases without this sampling process were

equal to the 10th percentile of the results with sampling, which says that you could come up with very different conclusions as far as reserve adequacy.

My conclusions, interestingly, are areas for further research. I've already mentioned the whole question of modeling equities and real property. I would also mention the choice of default rate scenarios is very critical, because the output is a function of what goes in. And there are two approaches. One is a handmade approach. The other is a random-walk, stochastic approach. The latter, in fact, might derive from an economic scenario out of which drops default rates and interest rates and whatever else you might be interested in, like inflation rates.

And the last area for further research, where some of the modeling engineering has just been completed is to combine C-1 and C-3 Risk using these multirisk scenarios. This would lead to a model which we might call an Asset Adequacy Model where we put the C-1 and C-3 back together.

MR. DANIEL J. MCCARTHY: Some years ago I was a member of the C-3 Risk Task Force which spent a lot of time in those years looking at various kinds of asset/liability mismatch problems and Don Cody, who was then the COVARA chairman, asked me if I would become the chair of the nonexistent group known as the C-2 Risk Task Force. He also simultaneously calmed my concerns about this by saying "You really don't have to worry very much about this because this is actually a subject actuaries understand." So he said, "You really won't have to do very much." Bob Stein has never forgiven Don for that remark.

In terms of the C-2 Risk (Pricing Risk), I will focus on mortality and morbidity, as opposed to the expense aspects. There are five dimensions of C-2 Risk that have turned out to be helpful to think about.

The first, which is most likely to happen if we're talking about a brand new venture, a new coverage, something of that sort, is simply missing the expected value. That is to say, simply assuming that something is going to happen in one way, and, all of a sudden, it doesn't. Some examples are the early carriers in providing nursing home coverage. Also, some of the earlier carriers in providing lump sum disability income coverage discovered that you could simply

miss the expected value. That's obviously a pricing risk, but you find out fairly rapidly that it happened and you can deal with it thereafter. You modify your expectations accordingly. And there's not a large amount that can be said about it from a method point of view.

The second aspect of it is simple statistical fluctuation. Harking back to the risk theory kinds of things that some of us studied, this has a characteristic which is somewhat in common with what Don said about investment grade bonds. It's not very interesting. And the reason it's not very interesting is that it doesn't turn out to be the significant risk. Yes, there is a statistical fluctuation risk and, yes, it's worth something, but it's pretty well documented in the literature. There are problems, because you've got different ages and amounts and that kind of thing. However, whatever the counterpart is and whatever coverage you're working on, it never turns out to be the significant risk.

The third risk, which is much more significant, is the interrelationship between persistency and mortality or morbidity. Fortunately, in this area, which is very significant, there are some good papers that have appeared in the literature over the last decade. These illustrate, for example, the relationships between term insurance persistency and term insurance mortality. In the health insurance context, the work illustrates what Bill Blowman's paper called cumulative antiselection. The papers are good. They provide ways to think about other kinds of coverages. In terms of method, they provide a very useful start and a framework in which to set assumptions.

The fourth category, which I will mention and then return to, has to do with coverages that are cyclical over time. Group health insurance is perhaps the most obvious one and we'll return to talk about that in a little more detail. But there are kinds of coverages, and that's one clear example, for which "cycle risks" will tend to dominate just about anything else you can think about. These are, therefore, worthy of study.

The fifth category is the totally unexpected. I think we could clearly put the emergence of the AIDS Risk in that category. It has become so important that both the Society of Actuaries and the Academy have devoted special study to it and, as most of you are aware, literature has begun to emerge. In fact, the Society's AIDS Task Force is meeting again on Thursday of this week. One of

the focuses of that group has been to begin to develop modeling techniques so that one can take some of the emerging literature on the nature of the AIDS Risk and couple that with the need to test a particular block of business. There's some good emerging material on this issue and the Society's task force and the Academy's Life Committee are providing some very useful insights. I would stress for any of you who are thinking about this question and the effect on the finances of a given enterprise, that we're still in the early stages of the learning curve in terms of how to quantify AIDS Risk for pricing or surplus adequacy purposes.

Now let me return to the question of cycle risk. If you look at the combined numerical results of group health carriers over the last two and a half decades, you find that they follow a kind of five-year cycle from peak to peak, or trough to trough, depending upon how you like to look at it. Of course, the degree of those peaks and troughs has varied widely from company to company. The question that is significant is "What is the required contingency margin?" Or rather, "What is a way of measuring the contingency margin that a company in a cyclical business ought to provide for?"

The objective here is not to provide a quantitative answer to that question, but to provide a framework in which to analyze the subcategories for the different types of business, the different experience rating arrangements, the different coverages, the different types of policyholders, and the different sizes of carriers in this business. One must be able to identify the assumptions needed about the degree of the cycle, the ability of the carrier to respond through its ratings mechanisms, the ability of policyholders to react by leaving carriers with deficits, and thus to have a structure within which to think about required margins. Some preliminary work we've done shows that the famous AM Best 4-to-1 requirement for group health insurance might be a needlessly conservative number. Nonetheless, the focus of the exercise is not to provide an answer, but rather to provide a method.

It's always seemed like it would be a good idea if, for this kind of issue, we could do the sort of thing that Joe just illustrated for the C-1 Risk. That is to say, it would be nice to be able to get the methodology on a common grid so that you could combine C-1, C-2, and C-3, all with a common methodology. And that may well be something that is attainable someday. It's beyond the

objectives we set for ourselves now. It's therefore beyond what the forthcoming documents will show. I know that COVARA has under consideration the kinds of research that it will undertake in the future and it may be possible, some day, to get all this stuff on one grid. In the meantime, it seems desirable to have a somewhat cruder method for use by companies in different situations who want to measure the real risks of the health insurance cycle as it applies to their business.

MR. PETER B. DEAKINS: I'm going to talk about some of the things that have been going on in the C-3 area. Then I'll talk about some of the things that we're thinking about doing in the future and some of the conclusions that I've reached. There are not any global conclusions that everybody has reached yet, but I'll give you my conclusions. Then, the last thing I want to do is talk about some of the open issues.

In terms of things that have been going on, there's been tremendous amounts of research over the last 5 or 10 years. It includes how you should approach the problem. There are people speaking and disseminating methodologies and the *Valuation Actuary Handbook* contains a cookbook approach to analyzing the C-3 Risk.

I have expanded on our previous work and put more examples in, trying to illustrate some of the methods for doing this kind of analysis and get to the point where any actuary can pick up this stuff and perform the analysis. It still leaves the question of understanding what the analysis means, but at least the idea is to get to where the techniques are readily available and easily understood. I think we're getting pretty close to that point. If somebody's willing to take the time to study the subject, all the methodologies are there. That's not to say there won't be new methodologies. I think we're in an evolutionary situation and technologies will continue to change. But there's a body of technologies out there and I think it's not that hard to become familiar with them.

Some of the other things that are going on in research is that a lot of people have been wondering if the scenarios for interest rates should be deterministic or stochastic. I've found out that the stochastic scenarios provide a wider range of what's happening, whereas the deterministic scenarios tend to cover certain specific things that somebody has thought of. We're doing some research

and trying to develop some thoughts on the pros and cons of each. There are advantages and disadvantages with each approach and it's up to the actuary to decide which one he wants to use.

Similarly, another issue we've been dealing with is combining different lines of business. Here I think we have a somewhat stronger position. It seems that the answer you get when you look at two lines of business will be much different if you look at them combined than if you look at them separately and then total the required reserves. I think that looking at them combined gives a much better answer. It seems that where the lines are a lot different, the risk ought to be a lot less than their sum.

We're finding that, when you combine lines like single premium deferred annuities (SPDAs) with structured settlements or guaranteed investment contracts (GICs) with structured settlements -- lines with completely different characteristics -- the scenarios that are bad for one might be good for the other. And we find there's a tremendous lessening of the risk that you conclude you're facing. I think this is an area where we're going to conclude that it makes sense to combine different lines.

One of the conclusions I've reached is that cash flow testing at least for now, is the way we have to approach this question. To date, nobody's come up with any other statistical method for evaluating risk that I was comfortable with. But as I mentioned before, it's a dynamic and evolutionary situation. I'm not saying that we'll never have some statistical measures that can be applied to a portfolio. But so far I haven't seen anything that I was comfortable with other than cash flow testing types of approaches.

One of the issues that I think needs to be addressed is this whole idea of reasonable and plausible. These words have been tossed around and I don't have any idea what a reasonable and plausible scenario is. I hope that we don't get into a situation where actuaries are having to determine which scenarios are reasonable and which ones are plausible.

A related area is how important, how valid, is history as a basis for designing scenarios? It occurred to me yesterday that if you were going to use history as a measure, you would certainly say that it was outside the realm of possibility

for the stock market to decline more than 15% in a day. And that makes me wonder, seeing what happened yesterday, how valid are conclusions that interest rates can't go up any higher than they did in the early 1980s? This is an area where we need to come up with some answers -- what's reasonable and what's plausible. Otherwise actuaries are going to find problems by saying that under reasonable and plausible assumptions, this company is or isn't solvent and then what we've said is implausible happens.

The bottom line on all of this is that we can't eliminate risk, so it must be measured. The measures may be imperfect, but I think it's better to have an imperfect measure than to ignore the risks. You have to dig into these issues and get some imperfect answers, but they're better than no answers at all.

And a last thought I have is that some people are thinking that the only reason to get involved in valuation actuary-type analyses is to satisfy Regulation 126 or whatever comes out of other states. I think that's a short-sighted view. I think management needs to be doing this kind of analysis for their own planning purposes and for their own strategic purposes. What I view as prudent management would require analysis such that something like New York's Regulation 126 would be a trivial exercise. You'd have to satisfy it, but it would be something that somebody does in a couple of days, just taking their basic work, and modifying it slightly for the simpler requirements of Regulation 126. I think management should be asking for more sophisticated valuation actuary-type analyses and I think that includes the pricing process. I think the pricing process needs to start incorporating this type of work if we're going to have realistically priced products.

MR. MICHAEL E. MATEJA: The Combination of Risks Task Force was organized in mid-1983 with a charge to understand and quantify combinations of risk and understand the implication of statutory reserves, contingency surplus required, valuation statutes, the early warning test, and corporate planning. When I accepted the job of chairman of the task force, I thought it was an ambitious undertaking. Now, I know it was an ambitious undertaking. In my allotted time I want to share with you a few highlights of our work and offer a few personal observations on what that work means to valuation actuaries.

During the last four years, the task force has produced a series of reports responsive to this charge, and I have been a regular participant in panel discussions at prior Society meetings to present the results of our work as it emerged. Our final report pulls together our prior reports into a single document and includes a 14-page summary. New material in the final report includes the report on combinations of risk by Linda Dinius. It was drawn from material prepared by Jim Geyer and Linda Dinius in 1985, and Jim Geyer made a formal presentation of this material at the New Orleans meeting in 1985. Don Cody's report on mathematical concepts underlying combination of risk represents a summary of the valuable contributions that he made to the task force regarding statistical based approaches to the combination of risks. Oakley Van Slyke is a casualty actuary, and his report on the valuation of business presents another approach to discount cash flows incorporating utility theory.

I must emphasize that the final report of the task force represents a collection of individual reports responsive to the charge of the task force. While the task force has generally embraced the concept that analysis of cash flow is the key to risk analysis and understanding combinations of risk, there is a divergence of opinion on the details. Discounting of cash flows and the merits of cash flow versus statistical approaches are two areas in particular where there is absence of consensus. Despite the failure of the task force to reach consensus on the details, there is unanimity within the task force that all of the work of the task force is valuable.

Risk is indeed a very big issue, and it is somewhat elusive. In retrospect, one of the most profound statements of the task force was included in the preliminary report which outlined how the task force would approach the combination of risks problem. Everyone has an intuitive understanding of risk, but the level of understanding fades as one attempts to bring some discipline to bear. The problem is at the extreme of risk where catastrophe enters the picture.

Any discussions about the extremes of risk always wind up somewhat inconclusive. It has been common to use the 1918 influenza epidemic as a reference for mortality risk, or the 1930s depression as a reference for asset default risk and equity value loss. But the reality is that the world has changed. There can be no assurance that the next epidemic or depression will conveniently produce risks and losses consistent with the past. The stock market collapse of

October 19, 1987 illustrates just how wrong we can be in relying solely on the past as a predictor of the future when it comes to catastrophic risk. There will always be uncertainty in dealing with risk, and I personally believe that it's what we don't know or understand that potentially can do the most damage. We're in a nuclear age, for instance, and I doubt that we fully appreciate what can go wrong in this regard. The environmentalists keep sending out warnings about the damage that we're doing to this planet earth, and some of their catastrophic scenarios just may materialize. Realistically, there is no way to quantify such risks or their potential impact on our business. I mention them only to point out that no matter how much we know and understand about the acknowledged risks that affect our business, we can never be so smug as to assume all is secure. Uncertainty is an ever present reality of the insurance business, and that uncertainty is a function of an unknown dimension of catastrophic risk.

It's been a long time since our industry has faced up to real catastrophe, yet there have been many insolvencies. We have not done an exhaustive analysis, but a study of the insolvencies associated with the 1930s depression indicated that most were attributable to management error or mistake, which I think of as the major type of C-4 Risk. No amount of surplus can assure solvency of an incompetent or irresponsible management. This fact alone suggests to me that there is more to gain in the long run by focusing less on the quantification of risk than by focusing on assuring an understanding of risk and how it can be controlled. Control of risk is fundamental to the insurance business, and I believe there will always be room for improvement in this regard. Conceptually, insolvency can be thought of as a management failure to control the risks assumed.

I want to talk briefly about cash flow analysis, because this was the foundation of the task force's efforts to quantify combinations of risk. It now seems obvious, but in the fall of 1983 it was not easy to accept the simple idea that cash flow deviation is the common denominator of all risk. Asset default, for instance, is simply the failure of an expected cash inflow to be paid, and pricing risk associated with mortality/morbidity is simply a cash outflow greater than was expected. C-3 Risk is fundamentally associated with changing cash flow streams as the interest rate environment changes. This simple concept, at any rate, provided the foundation for most of the work of the task force and we

conclusively demonstrated that it works and that the results are useful. Our commitment to cash flow analysis also provided the focus for a continuing debate about the relative merits of cash flow based approaches versus statistical approaches to the combinations of risk. The task force reports would require careful reading to fully appreciate this issue, but I want to highlight two ideas.

First, any statistical based approach relies first on some cash flow based analysis of individual risks. A little reflection will quickly establish the validity of this statement. So, even a statistical approach to the combination of risks problem can be considered a variant on the basic cash flow analysis approach to the quantification of risks.

Second, a statistically based approach to combinations of risk is a complex mathematical combination of the surplus required to manage each individual risk. It has been hard for me to understand what is considered in the combination process and what is not. Cash flow analysis clearly reveals that surplus requirements for a combination of risks are a very complicated function of valuation reserves, supporting assets, earnings margins, taxes, dividends and many similar factors that affect cash flows. I have never been able to satisfy myself that statistical approaches appropriately reflect all these variables. In the final analysis, it's the availability of cash that permits you to manage risk, and I still have doubts as to whether the cash will be there using the results of statistically based methodologies.

Perhaps the greatest advantage of the cash flow approach, from my firsthand experience, is the ease of understanding at senior management levels. It's a lot easier to talk about increased cash outflow or reduced cash inflow compared to the details of some esoteric statistical formula. Cash flow deviation is an intuitively obvious concept, and discussion helps to establish that there is uncertainty associated with any assumed level of cash flow deviation. From the standpoint of a corporate actuary trying to get senior management to understand something about surplus requirements, cash flow based approaches have some advantages well worth investigating.

Cash flow analysis unfortunately is not easy. In fact, because of the level of detail involved, and the need to process that detail within a computer model, it can become quite complex. Even after this complexity is surmounted, there

remains the problem of interpretation. Understanding what various cash flow streams are telling you is not easy, particularly so when there is a crazy quilt pattern of positive and negative net cash flows. We tried every conceivable approach to discounting cash flows before Jim Geyer, a member of the task force and an associate at the Aetna, stumbled on what we eventually called CFS, Cash Flow Surplus. To compute CFS, you must tax-effect the cash flows and use an after-tax discount rate. The attraction of CFS is that it equates to cash, which I personally think is a very powerful and useful yardstick when you're trying to understand risk relativities. Don Sondergeld, also a task force member, was never comfortable with CFS and favored the use of a risk-free rate of return to discount cash flows in all scenarios. Don is as committed to his approach as I am to CFS which is one of the reasons we couldn't produce a report supported by the entire task force. There is obvious room for more work on the discounting of cash flows.

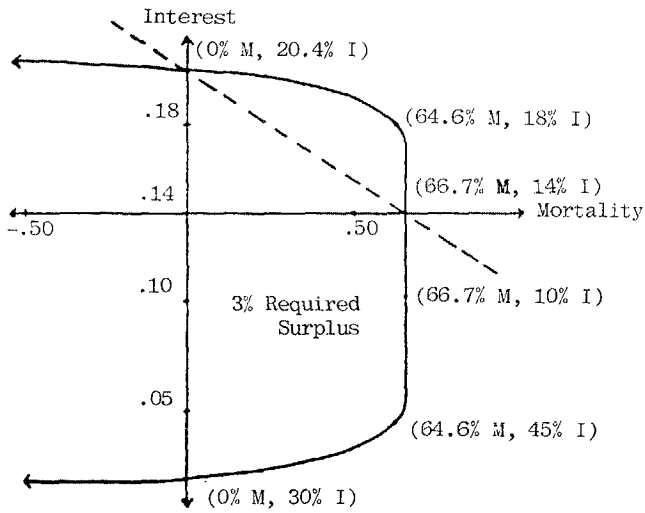
Cash flow analysis clearly permits you to quantify the effect of specific levels of cash flow deviations attributable to different risks. We also believe it can be effective in addressing the problem of developing a surplus level to manage a combination of risks at some level of certainty. This, in fact, is what the Geyer/Dinius work is aimed at. Traditional, statistical approaches use the concepts of dependent and independent variables, which in the case of the former, requires development of covariances between risks. I still don't fully appreciate what happens as a result of the application of the traditional, statistical formulas, but the results are commonly accepted as the surplus level required to manage any combination of risks at the indicated probability level.

Our work to understand how to combine risks using cash flow analysis produced some interesting insights into the problem. I don't have time to review these findings, which are presented in the final report, in detail, but suffice it to say that the unique characteristics of the C-3 Risk give rise to surplus levels for combinations of risk which are at variance with those developed by traditional, statistical approaches. Those of you who reviewed the material presented at the New Orleans meeting will recognize this graphic representation of a "line of constant surplus" for the combination of mortality and mismatch risk.

The horseshoe-shaped curve based on cash flow analysis techniques is rather unusual, and when compared to the curve, actually a straight line, associated

with statistical combination of the same risks, there is some basis to begin appreciating our concerns about relying on statistically based approaches. (See Graph 1.) Our concern here should not be interpreted to mean that statistically based approaches do not work; rather, it means simply that there are apparent differences that are not fully appreciated or understood.

GRAPH 1



To sum up, the work of the Combination of Risks Task Force has clearly added to the understanding of risk and the combination of risks. But we clearly recognize that much work remains. Our "final" report should be regarded as a convenient stopping point rather than the final thoughts on the subject. We hope we have laid the groundwork that will ease the burden for those who choose to follow. For those who choose to follow, we are confident that many interesting challenges remain.

At this point, I would like to focus on some personal thoughts on what the work of the Combination of Risks Task Force (CORTF) means to valuation actuaries and others concerned with the solvency of life insurance companies. It is important to remember that the C-3 Risk Task Force and the other task forces that

followed were established as a result of a general concern about adequacy of valuation reserves and surplus levels. While much has been written about quantification of C-3 Risk and other risks, there is no general consensus on what this work means. Here are my personal views, and I emphasize that these are personal rather than task force views, on what these results mean.

First, valuation of liabilities must consider both the assets and the liabilities. This, of course, is fundamental to dealing with C-3 Risk, and it logically follows that it applies to any combination of other risks with C-3 Risk. The work of the CORTF clearly established that the effect of mortality risk can be magnified by C-3 effects. For example, paying out extra claims in a period of high versus low interest rates will require more assets, all else being equal.

If you accept that reserve adequacy is really a function of the adequacy of asset cash flow adequacy, then there is clearly potential impact on the opinion of a valuation actuary as to whether valuation reserves are adequate or "good and sufficient." This point has been debated at length in various industry and professional groups, with no apparent consensus. There is reason to think, as I see it, that current standards of practice require a valuation actuary to consider both assets and liabilities in forming an opinion about valuation reserves. The requirement may not apply to the total liabilities of an insurance company, but it certainly applies to those liabilities where it is commonly recognized that there is material C-3 Risk.

The next conclusion is based on the simple observation that substantial variations in the level of risk are possible. Most, if not all, of this variation is within the control of management. Anyone who has done C-3 Risk analysis should have an appreciation of this point. If you are dealing with a liability typified by an SPDA product, with a book value withdrawal privilege, you can see great variations in the level of risk depending on asset length. Conceptually, similar variation is present in reserves for other products. A single valuation reserve level, unless it is set very high, will not be adequate for all insurers. This, of course, is the historic approach to valuation reserves, and I have to admit that it has worked reasonably well. But, will it serve us well into the future? We are competing in a new financial services marketplace as opposed to an insurance marketplace, and we may find it impossible to compete if valuation reserves are too high.

If you accept the premise that management is in a position to control the level of risk assumed, then I believe it leads to the idea of valuation reserves that reflect the risks assumed and ultimately to incentives to control risk. New York has introduced this concept into their valuation law as it applies to GIC and annuity reserves. Lower reserves are allowed if the company submits an actuarial opinion and supporting memorandum. The opinion and memorandum, as I view them, represent a demonstration that the company has controlled the risks assumed with these products. The lower GIC reserves in New York, of course, are available in other jurisdictions without fanfare.

The idea of providing incentives in valuation standards to encourage management to control risk needs further discussion in my opinion. It has not been greeted warmly by the NAIC Standing Advisory Committee, which I find hard to understand. I understand the practical tax and theoretical problems, but this is an idea that seems fundamental to our business. It could be critical to our survival in a broadened financial services marketplace. I hope we find a way to do it!

The third and final thought I have picks up on an idea I previously mentioned -- the difficulty of quantifying risk. All risks exhibit both random and nonrandom (i.e., catastrophic) characteristics. The problem, of course, is with the catastrophic risk. How high, or low for that matter, will interest rates go? How severe will the next depression be? Could we have another epidemic? If so, how severe will it be? Experts in these various areas all agree that these events can occur, but there is no agreement on severity, and severity is what ultimately determines surplus levels.

My first lesson in the interest rate area came in the early 1970s when I was pricing the forerunners of today's GIC products. We established 15% interest rates as a 1-in-10,000 level relative to the 9% rates then current. We all know what happened since then. I no longer consider 20% or 25% interest rates beyond the realm of possibility. Interest rates have reached and exceeded these levels in many economies that at one time were as stable as the economy in this country.

We all got another lesson yesterday in the one-day loss potential in the stock market. By any standards, this was a catastrophic plunge, and before yesterday nobody would have considered such a loss even remotely possible.

The difficulty of quantifying risk, particularly at the extremes of risk, presents an interesting problem of what portion of the risk should be managed in valuation reserves and what portion should be managed in surplus. This ultimately leads to the issue of relative responsibility of regulators and company management in managing risks. My personal preference is to let regulators decide on the portion of the risk reflected in valuation reserves and let the marketplace, i.e., management, decide on the portion reflected in surplus levels.

I think the regulatory focus should be on assuring an adequate valuation reserve. It is useful to think of adequacy in probabilistic terms, and I personally think of reserve adequacy at the 90-95% range. Admittedly, setting reserves precisely at this level would be impossible, but this frame of reference should be useful. If regulators could be assured that valuation reserves recognized something like 90-95% of the risk of loss, they perhaps could be more comfortable in leaving surplus levels in the hands of management. With reserve adequacy at the 90-95% level, any reasonable surplus level would bring the overall level of assurance up to the high nineties. Whether the combination of valuation reserves and surplus produces assurance of 99.5% or 99.75% is a moot point. Given the difficulty presented by catastrophic risk, we could waste a lot of time trying to figure out an exact answer. I maintain that no one can set surplus levels to assure solvency at some given level of probability. The only thing that can be said with certainty once valuation reserve levels are set is that more surplus is better than less.

These three points, I believe, suggest that it's time for us to take stock. We've laid some important groundwork -- it's now time to sort out what it means and set a new course into the future.

MR. STEIN: I'd like to make a few comments about where the committee will go in the future, what kind of research we'll be doing, and then take some questions.

I think you can tell by the comments you've heard, that the committee believes it has made a significant statement concerning risk, the measurement of risk, and the ultimate management of risk. I also think the committee generally believes that the methods and procedures, the means to perform these measurements and analyses, are available at the present time. And I think the

committee would agree that they are there in such a form that would enable practicing actuaries to make statements about the adequacy of cash flows in varying circumstances.

The committee and its charge will be changing prospectively. The historical reliance on the C-1, C-2, C-3 and Combination of Risk Task Forces will be changing in the near future. The task forces will be disbanded following the belief that their basic research and development of methods and procedures to analyze risk has been completed and disseminated to the profession. That does not mean that work in these areas will stop. We fully expect that there will be continued analyses in both the C-1 and C-3 areas.

In addition, the NAIC Special Advisory Task Force to study a reconstituted valuation law is underway. COVARA will not be actively involved in that, but, as a research body who has studied these matters for a good many years, the committee is standing by to help address the questions which will arise.

In addition, prospectively the committee will be focusing on some broader aspects of risk management and risk measurement, including the interrelationships between the valuation process, both the valuation of assets and liabilities, and reserves and surplus, and also on how that process interrelates with the pricing and financial management processes of an organization. These are some of the things the committee has done and will be doing in the future.

MR. ALBERT K. CHRISTIANS: I'd like to thank you for doing a good job and for recognizing the uncertainties that the valuation actuaries face, particularly Irwin's comments on how the world changes. I would like to recommend that, as actuarial standards are developed, we recognize that there's some value to be placed on diversity of practice among companies since the world does change. If we're all doing the same thing, if it catches any of us, it'll catch us all. Also, it would be a very bad idea to have the possibility of contagion among companies. In particular, in some of the cash flow testing we may need to consider the possibility that in the scenarios where we get close to being in trouble, the company may face pretty large assessments from the guarantee associations and I haven't seen that particular element put into any of the scenario tests.

Also, I have a question for Irwin and Joe Buff on default risks. If we consider a corporate bond as a combination of some guaranteed payments, which we can assume will be paid with certainty and which we can value by looking at government securities, and some call options, which we can value by option pricing theory, and then some default risk, can we not, by looking at the market price of the bond, assess the default risk by equating it to the residual after we've considered the other two elements? That is, is it possible to analyze default risk other than retrospectively, by seeing what price the market puts on it and, since it can be assumed that we have efficient markets, and come up with another assessment of default risk? I think it's a very good idea to look at historical trends and see what the risk might be if the past continues into the future, but you probably should look at what happens if the risks are what the market prices them at. Have you examined that possibility and seen what kind of results you can get with that approach?

MR. VANDERHOOF: Historically, there was, at one time, an attempt to use the market rating; that is, the difference between the interest promised on a particular bond and the interest promised on the best quality bond. It was never implemented because it just got too complicated. To the more general question you raise about whether the difference between the promised rate and the promised rate on the best quality bond is a suitable measure of risk, well, it is and it isn't. If we start off by saying that the market is efficient and will always put the proper rating on bonds, then you should know that the excess interest you earned is exactly the right amount to compensate for the risk of default. On the other hand, the experience over many years shows that the range of market ratings changes very rapidly and very dramatically and the market is usually not quite that perfect in its assessment of the risks. I have one comment on the risk of junk bonds. During the past 10 years the excess return on junk bonds has gone from between 250 and 550 basis points. The default rate just didn't change that much. While there is clearly an element of correctness in what you say, (that bonds that have higher market ratings are going to have some additional risk of default) it's not proportional and, therefore, I don't see any way of actually using it.

MR. BUFF: I would add a couple of things to Irwin's remarks. First, it's a very tempting approach, but as with many things involving investments, we can learn from our associates on Wall Street who've been doing this for a bit longer

than we have. It turns out that in the latest volume of the *Transactions* there is an article by Richard Sega, "Practical C-1 Risk," which in turn references a paper by Pye, from the *Financial Analysts' Journal* of 1976, I think, that looks at this very question. As I recall the mathematics, the difference between Treasury yields and a junk bond yield is not entirely meant to be the expected compensation for the added risk. It can be broken up into two pieces, one of which represents the expected default costs and the other a premium that you're going to collect, on average, for investing in the junk. The discussion in Rick Sega's article makes it clear, through the mathematics, that in order to make that split of the total premium into its two pieces, you need an assumption about the future default rate. So it seems whatever angle you come at this from, you end up coming back to the basic problem of "What are default rates going to be over the life of the bond from today into the future?"

MR. JOHN A. MEREU: Mr. Buff, in your simulation of cash flow under different default rate scenarios, did you find that the selection of the maximum default rate and the economic cycle was the crucial decision in the process?

MR. BUFF: It depended on whether we were looking at the C-1 only or the C-1 combined with the C-3. In C-1 only, the default assumption becomes critical to the model because it's really a pure C-1 model. For instance, if you look at a disaster scenario with a 10% junk bond default rate in one year that becomes the single critical variable. But in the combined C-1 and C-3, it's a harder question to answer. In that case, you have all of the assumptions for a typical C-3 study and all these other assumptions about diversification rules, default rate scenarios, and salvage value assumptions. In that context, it's very hard to say what the critical areas of risk are. But, in the combined investment risk picture, probably the critical assumptions are the yield curve, the default rate experience, and the assumptions about your own product. But the other very important assumption we're starting to see is the behavior over time of the spread in the marketplace between the different quality assets. This has an effect on the long-term effect of different investment strategies -- buying junk versus investment grade -- and how that spread interacts with default rates, since they're likely to be heavily related in some unpredictable way.

MR. KEVIN M. DOLSKY: This is the first I've heard of measuring the cycle risk associated with health insurance. I wondered if someone could comment on

what the plans are, what might be forthcoming in setting the methodology you referred to regarding cycle risk?

MR. MCCARTHY: First, I want to distinguish between the two points you made -- quantifying and setting the methodology. What we're publishing will show a methodology and, to illustrate it, we'll have some numbers. The numbers, I think, are illustrative, although they bear some relationship to reality. But I would not suggest that they quantify that risk. In fact, I think one of the keys to analyzing the cycle-prone block of business is to know the realities of the way the business was written and the way it's rated. I wouldn't claim, at this point, that it's been subject to the degree of examination, and therefore isn't subject to the degree of sophistication, as some of the analyses that we've talked about in the C-1/C-3 areas. I'd like to think that's attainable some day. I think we'll need to know more about the variables before we can get to that point. There's no point in having the most elaborate technology in the world if you have a limited idea as to how the variables behave. But I think it's an important area for work.

MR. DOLSKY: Do you know if the casualty industry has done something similar in terms of methodology to address cycle risk?

MR. MCCARTHY: As I understand it, their methodology is that you must have $1 of surplus for every $3 of premium. But under that is an understanding of what kind of cycle that enables you to withstand and how you recover from that. It turns out not to be a bad rule. I think, on the average, that for health situations you could demonstrate that it's more like 1-5 or 1-6 rather than 1-3. But I would stress that you need to look at that in the context of a particular issue, and certain categories of that business are much more subject to adverse behavior and limited ability to recover than are others.