2000 Valuation Actuary Symposium
Washington, D.C.
September 14–15, 2000

Session 20PD
Innovative Investment Vehicles: Modeling Considerations

Panelists: Catherine E. Ehrlich
Frederick R. Jackson

Summary: Low interest rates have created a market for higher yielding assets. These higher yields come at a price. In addition to the collateralized mortgage obligation (CMO) and pass-through structure, insurers are familiar with other innovative structures that have arisen, including:

- *Call options and put option*
- *Packaging lower quality credit into higher rated "structured" securities*
- *Packaging lower quality credits into higher rated "structured" securities*
- *Private placements*
- *Asset-backed securities with alternative collateral*

This session discusses the modeling of these securities in cash-flowing testing and asset/liabilities management (ALM) analysis.

MR. FREDERICK R. JACKSON: I work for Scudder Insurance Asset Management. Cathy Ehrlich is going to be the first speaker. She is a consulting actuary in the New York office of Milliman & Robertson. She formerly was a senior vice-president at Capital Management Sciences, a BondEdge Software provider.

MS. CATHERINE E. EHRLICH: This presentation is devoid of formulas and a lot of specifics. When I talk to nonactuarial audiences, I often like to put in a lot of numbers and formulas and confuse them. I think you guys scared me a little bit. I decided I'd go the other route and talk more about the general idea of what we're trying to do in modeling innovative investment vehicles.

During the first part of my talk, I'm just going to really talk about the challenges of investing innovatively, from both the investment management side and the valuation and risk management side. Insurance companies have a structure in which different people do the actual investment management than those who are doing the valuation and the risk management. People that are in the front lines on the investment side oftentimes have access to different models and different types of information than those of us who are doing the valuation and risk management. There are different types of challenges for both functions. I'll go through those a little bit.

I'm going to talk about a couple of specific investment types: call and put options and collateralized debt obligations (CDOs). It would be a stretch to say that call and put options are innovative because they've been out there for so long. I think they are really the fundamental building blocks of many of the innovative vehicles that we are investing in today. If you can understand the modeling considerations of the call and put options, then you can figure out how to rearrange things to make it look like the investment you're actually trying to model.

In my very unscientific sampling of some former clients and colleagues, I found that the one innovative vehicle they told me that needed to be covered was collateralized debt obligations. When I was at CMS, we did not cover CDOs for a lot of the reasons that I'll discuss. I'll just give you some background as to what those security types are and why many companies might find them challenging to model.

On the investment management front, when you're buying a new security type and managing it in a portfolio, you need to obtain some information. The first thing you need to understand is what

is the structure of the security? When is it going to pay me money? How much is it going to pay me? Under what circumstances is that going to change? You need to understand whether there is collateral. Is it a package of small consumer receivables? Is it one very large bond with a corporate treasurer on the other side of the transaction making decisions that can help me or hurt me?

Once you understand how your specific security works, you need to price that going forward. It's usually very easy to get a price of a security when you want to buy it. It is sometimes very hard to get a price of that security six months or a year down the road. It is often very, very hard to get prices of similar types of securities so that you can really calibrate your model. When I was at CMS, whenever we wanted to put up a new security type, it was a huge data challenge for us. First, we had to make sure that we understood all of the structure underlying the security, and second, we had to get the data. Terms and conditions of bonds are generally available, but anything that is relatively new and relatively illiquid when privately placed is going to be very problematic for price quotes. What you're really going to need to do in a lot of your work is to be able to price the security in a variety of scenarios that the security type has never experienced.

Another challenge is projecting cash flows under different scenarios, which gets back to obtaining information about the structure of the security. In the current economic environment, i.e., if nothing changes, I can see how my cash flows are projected. However, I also need to know how my security pays me if default rates go up, and if interest rates go down, for example. For something that is not a structured security it is fairly easy to project the cash flows. When you get into some of the more complicated structures, you really need a very good tool to help you figure out when you're going to receive cash flows for the tranche that you bought.

Next, you really need to be able to quantify the impact of the security on the overall portfolio. It is a good idea for a fairly plain vanilla security as well. We can all figure out how to market-value-weight things. You can also figure out, based on the duration of your security and the duration of your portfolio, how that's going to impact things. I've had some pretty sophisticated clients that get into more leveraged securities. They are surprised when they run that out in their portfolio, and it represents more risk that they expected.

Finally, when you invest in a new security type, you need to make sure that you are looking at all the right measures. In a fixed-income world, prior to the introduction of more sophisticated investment vehicles, you could know what the yield and the maturity of a security was, and you could feel comfortable that you knew how to project things. You knew what your risk was. When things like callable bonds and collateralized mortgage obligations were introduced, you not only needed to know what its modified MacAulay duration was; you also needed its effective duration and its effective convexity. You needed to understand your option-adjusted spread (OAS) and your vega (price sensitivity to a change in volatility) because there are a lot of other types of risk factors that you need to make sure you're quantifying. You can put a new security in your portfolio, and according to all the old measures, it looks fine. However, there might be some hidden risk there that you're not quantifying.

On the valuation or risk management side, there are different challenges because you're not directly talking to the broker trying to sell you the security. You need to get information about the security in a different way. My basic premise is that innovative investments are generally complicated and require sophisticated software to manage them. I worked for a software company for six years, so I believe strongly that it's important to have a good computer system to help you manage the risks in your investment portfolio.

A software company is going to have a lag when it comes to modeling innovative investments. These companies need to understand the market and to see how many people are actually going to invest in the security type. They need to ask the following questions: Am I able to get the data? Am I able to get prices? Am I able to do a proper job of analyzing the security? Do my existing analytical models handle the type of risks that are encompassed in that security?

When a new security type came out, what did CMS do? They would talk to clients to find out who's investing in it. They wanted to see if this was just a "flash in the pan" or if it was worth investing a lot of time and energy to enhance the system. When a new vehicle comes out, there is definitely going to be a lag with commercially available software. That doesn't mean you can't do a reasonable job of guessing at some values using some spreadsheets, but if you want the

analysis of this security type to be a part of a big valuation or risk management project, those ad hoc kind of solutions might not work for you.

Therefore, you're going to have to think about selecting some software. There are a lot of different things that should factor into your decision when selecting software. The first is home-grown versus commercially available. The commercially available software solution is standardized, not customized the way you would want it at your company, but readily available in the marketplace. It also has a very obvious price tag associated with it. Home-grown software can be tailored to your perspective. It does require that you invest a certain amount of time, energy, and money in data, obtaining price quotes and developing the analytics. I often tell people you have a choice between a standard, expensive system and a customized, very expensive system. CMS had a number of clients that subscribed to our software while they were developing their own in-house software. They were very good, long-time clients. CMS had other clients that had developed their own software, and then found it was very costly because of Y2K and because of maintenance issues dealing with that software. They found a commercially available package that more suited their needs.

Another trend that I've noticed in the marketplace is a trend toward hybrids. Because of the component architecture that's available in the software world, you can take models from different applications and combine them. You could have a database from one place and an interest rate generator from another place; for example you can make them all talk to each other and come up with something that might be more tailored to your needs.

Scope

Another factor in your decision is the scope. Are you looking to analyze one particular security type? Are you looking to analyze your fixed-income portfolio? Are you looking to analyze the entire company? There are many good structuring tools out there that work for one, specific security type. If you try to model a different security type in a structuring tool, you will not get good results. Therefore, you couldn't analyze your whole portfolio. If that's what your needs are, you need to consider whether that precision on the investment vehicle side is worth giving up so you can look at the whole portfolio or patch things together.

Time Horizon

The time horizon for the analysis is also going to vary depending on what your needs are. You could be interested in how things look over the next one to ten days, or you could be interested in how things look over the next 50 years. A system that does a really good job of projecting things for the next day is not going to do as well over 50 years and vice versa.

Functionality

The most obvious question that I came across in working with insurance companies are: are you trying to project cash flows according to interest rate changes or are you trying to value securities that include options?

If your system is terribly precise for one security type for a short time period, you will not be able to get results in a timely fashion for large portfolios or long timeframes. If you do something that looks really good for the big picture, then a single security analysis might not look as precise as you'd like it.

Input Variables

What are the input variables you want to deal with?

Compatibility

How does it work with the other systems that you have? There are a lot of old legacy systems out there that need to be combined with some of the newer things. You need to make sure everything can play well with each other.

Consistency

The final issue regarding selecting software is consistency. If you decide to use one set of software on the valuation side because you are worried about a time horizon, a portfolio, and other constraints, and the investment department uses something completely different, you can spend a lot of time reconciling or explaining why your results indicate this investment is really pretty risky, but doesn't tie into the investment export who believes he obtained sufficient reward

for the risk he undertook. You need to make sure that selecting your software doesn't prevent you from communicating well with the investment department.

If you are primarily concerned with valuation, how would you answer those questions? Generally, your primary need is for cash-flow projection. You're also looking for something with a very long time horizon. The reinvestment or disinvestment strategy will determine your need for option valuation. If you are usually borrowing rather than selling assets, you don't need something that's going to be very precise in market valuing your assets over time. You just need something that can figure out when the cash flows occur. If, however, you want to put in a disinvestment strategy that allows you to sell assets, you will need something more sophisticated to market value those strange, new investments that you've put in your portfolio.

In most valuation systems, the key driver is the yield curve. In many of the new investment vehicles that we're encountering, there are many other variables that can cause the cash flows of that security to vary. CDOs, for example, have a lot of default risk. That will interplay with the call options in the underlying securities. You not only have to be able to model call options; you have to be able to model default risk on a sophisticated basis. You need to understand how interest rates and default rates interrelate if you're going to do a good job of valuing some of the newer investment vehicles.

If you're looking at things from a risk management perspective, the answers to all these questions are different. Your primary need in risk management is for option valuation. This is particularly true in a VAR-type risk management or an analysis of the risk in your earnings projections. You're generally not looking over a 50-year or 70-year time horizon. You want to know how things are going to change in the next day, ten days, month, or quarter. Your needed precision over the short term is much higher than in a valuation system. The timing of short-term cash flows is more important in this type of analysis. You can't just lump everything together and say it happens at the end of the year. You need to be careful about when the cash flows are occurring. This type of analysis is trying to look at all of the risks in your portfolio, not just the interest rate risk. You're going to be concerned about both the level and shape of yield curves. You're going to be concerned about default rates, currency exchange rates, equity returns, or

whatever other type of risk you have in your portfolio. Therefore, you need a very complex type of model for a risk management system.

Next, I'll discuss some specific investment vehicles. Call and put options are the backbone of many sophisticated investment vehicles. Understanding what needs to be done to model call and put options will help you understand what you need to do to model some of the more innovative products that are out there.

The basic things you need to know to model a call or put option is, what's the underlying security? I have a call or a put to buy or sell something. What is the vehicle that I am buying or selling? At what price do I have the option to buy or sell? What's the expiration date, or is it a series of dates or a continuous period? What's the premium and how much am I paying for it? What's the size of the contract? The list of things you need is not very long at all. Once you know that, then you can put it all together and do some valuation.

In practice, most calls that we encounter are embedded in bond portfolios. The BondEdge package did not have an explicit call option model, but it did model call options because they were embedded in bond portfolios. The technology existed in the software to analyze cells separately, but because most clients only encountered call options embedded in their bond portfolios, there was no need to pull it out separately.

Puts and calls can also be used as building blocks for other security types, like caps, and floors. For example, a cap would be a series of calls on interest rates. However, a cap is a call on the interest rate, which has different characteristics than a call on the bond.

Let's discuss option valuation issues. Option valuation was originally developed for the equity market. How do we use the basic information on the call or the put to value the option? In the bond world, things are different from equity options because the underlying instrument changes over time. If you have a call on a bond, that bond looks different today than it did two years ago. If you have a call on a common share, it's going to look the same today as it did two years ago. It's still a share. The maturity period and the property that the price of the bond will approach

par over time means that you cannot use a standard Black Scholes type model for valuation. This is something that really characterizes the bond calls from any other kind of calls.

You also need to consider the correlation of short-term and long-term yields. You need to worry about the shape of the yield curve when you're valuing these options. Since the price approaches par, the price volatility declines over time. Therefore, you can't assume that volatility is constant. In the equity world, we can use a constant volatility, but in fixed income that assumption is not valid. Many interest rate models incorporate mean-reversion to better model bond price behavior. The short end of the curve is much more volatile than the long end of the curve. The model understands that as the bond gets shorter, it's going to behave differently. Time to expiration is another issue because a lot of the calls that we see are not just one-time calls.

How do we put all that together and figure out how to value them? The first type of model people try to put some calls with was a Black Scholes model, which was taken from the equity markets. The equity market assumed that the distribution of underlying prices was lognormal. That might work well in the equity markets, but that's not how prices are distributed in the bond market. We needed to move to another generation of models, which I'll call yield curve models. In yield curve models, you can project yield curves in order to understand how the bond prices work from the underlying yield curves. Black Scholes will work very well for caps and floors where you're not worried about the underlying bond. It's going to be problematic in the bond world. Many people, when valuing caps and floors, use a Black Scholes model because interest rates have different characteristics than bonds.

I know of three different types of yield curve models. The first is the arbitrage-free binomial lattice model. Interest rates start in a certain spot and go up or down, in discrete time steps and in discrete amounts. This produces a whole tree of interest rates. I think we've all seen an interest rate lattice. It's a very intuitive way of thinking about interest rate changes. You can use a lattice to solve your valuation equation. If you use probabilities of each of those interest rate paths occurring, you can project your cash flows over each path and derive an expected value, which is really the price of your option.

There are faster and more stable models out there. Physicists came up with the idea of using differential equations to solve these kinds of problems. Rather than just looking at one lattice, a differential equation can sample the entire universe of interest rates between now and the time *n* when the bond matures.

This approach starts with the price of the bond at maturity and then takes one step back in time from then. Across the whole spectrum, I can figure out what the price would be if the yield curve was at any level across the whole range of possible yield curves. I can do that at every step as I move down towards the present time. Then I can use a differential equation methodology to solve that kind of problem. It's not as easy to draw a nice, little picture. It's not as intuitive as a lattice, but it's actually faster and more stable than solving a lattice problem because you're sampling the whole space, rather than a subset of that space. Arbitrage-free binomial lattice and differential equation models are probably the two most popular ways of valuing options.

The third type of model is Monte Carlo simulation. I think we all are pretty familiar with Monte Carlo simulation. Generally, in the securities world, we use Monte Carlo simulation when the cash flows are path-dependent. If I'm at time X, and interest rates are 10%, I need to know where interest rates were at each point since the security was issued to figure out how much the payment will be now. That's not really true with a callable bond. If the bond still exists, and interest rates are 10%, you can figure out if it's going to get called or not. It doesn't matter where interest rates were in the past. In the mortgage market and areas where you see path-dependency, you need to know where things were.

The only way to value path-dependent securities is by using Monte Carlo simulation. Say I wanted to cover this whole floor with tiles. Monte Carlo simulation is analogous to turning around , closing my eyes, and throwing tiles over my back. It would take me a lot of throws to completely cover the whole floor. Similarly, you need a lot of trials to cover the whole sample space in a Monte Carlo simulation.

There are other types of approaches to sampling that space. I might stand in that corner, and throw ten tiles. Then, I'm going to take one step to the left and throw ten tiles. You could come

up with some sort of pattern that would enable you to cover the floor with a fewer number of tiles. That methodology is analogous to a reduced variance technique. There are other techniques that people have come up with to cover the whole sample space without having to have 10,000 or 50,000 scenarios.

Depending on the security type, the part of the yield curve that is important, and the timing of important interest rates changes, it is possible to use a technique. This is analogous to opening my eyes when throwing tiles rather than closing my eyes when throwing. At CMS, a couple of different models were employed in the system to do Monte Carlo simulations. The model for mortgage-backed securities will get good results in fewer than 50 paths. For more complicated securities, or security types where you need to worry about more points on the yield curve or shorter time horizons in which things can change, you need to employ a different approach. They have employed a suite of different valuation models, depending on the security type.

If you are looking at a new security type, and if you are putting it into some existing model and trying to make this existing model work, is it a reasonable valuation tool? Is it a reasonable valuation model for this type of security? If you have something that has call and put options or a series of call and put options, on an underlying bond, you don't want to use a Black Scholes model because it's not going to help you get a good answer for your valuation. You'd want to look at a different type of model. If you have something that's more path-dependent, you need to use a model with Monte Carlo technology.

You can test the reliability of a reduced variance Monte Carlo in a couple of different ways. One is to have some sort of technology that allows you to do a full Monte Carlo simulation. Find the price using 50,000 trials; then find the number of paths until the reduced variance technique model converges to the right answer. Or, you can calibrate it against real-world prices if you can get a good source of quotes. Oftentimes, it can be hard to get good quotes.

I've looked at different studies to see what type of yield curve model is the best to use. That is, should you model the short rate or the forward rate? How many factors should you be looking at? That is also dependent on what type of security you're trying to analyze. In a lot of the work

we did at CMS, based on the type of securities we were looking at, we could not find any reason to go to more than a one-factor model. You just didn't pick up any additional precision, and you'd spend a lot of time. There may be a lot of security types that do need a two-factor model. You need to be aware of what security type you're analyzing and what the risk are. Much of that involves a little bit of trial and error and comparison shopping.

The next vehicles I will discuss are CDOs. My understanding of CDOs is from an academic approach. I have not actually invested in them, and while I was at CMS, it did not model these. I was aware of the issues of CDOs because we had people asking us for them, and there was a lot of reasons we couldn't model them. You will not be able to invest in a CDO based on what I tell you. You will have some understanding of some of the modeling issues involved. A collateralized debt obligation is an asset-backed security that has bought some set of securities or loans as collateral. The cash flows generated by those assets are allocated to different tranches on the liability side.

There are two types of CDOs. You can either securitize a portfolio of securities, which would be a collateralized bond obligation (CBO). Those securities tend to be high-yield bonds. By packaging them all together, you can create a higher quality investment and give the investor some benefit of diversification. Or, you can securitize a package of commercial loan obligations (CLOs). There are hybrids of these two types.

There are two basic transaction types and two reasons an issuer would do this. One is a balance sheet arbitrage or balance sheet transaction. Banks have a lot of commercial loans on their books. They want to reduce their required capital by selling off some of the commercial loans in the marketplace. It's cheaper for them to do it using a CDO than in other ways. They're kind of arbitraging their capital requirements.

The second type is an arbitrage transaction. An arbitrage transaction is done to exploit the difference between investment grade funding and high-yield investing. It's advantageous for them to buy high-yield bonds and then sell off the cash flows. Balance sheet transactions tend to be CLOs. Arbitrage transactions tend to be CBOs.

Arbitrage transactions are either cash-flow transactions or market-value transactions. A cash-flow transaction gets its value from the cash flows that are generated from the bond portfolio that are promised to the buyers of the tranches or the securities. A market-value transaction looks a lot like a hedge fund. The portfolio manager has the ability to trade securities. As an investor, you don't really know what the underlying collaterals are; you don't have one package of securities that stays there forever. This is the newest part of the marketplace, and I think it's also probably the part that's growing the fastest. In all cases, the collateral is the limited number of commercial borrowers. It's different than a credit card transaction where you have a lot of little credits. This has up to 50 names in a portfolio of securities. That is an important modeling consideration because the law of large numbers isn't going to help you out very much with only 50 credits. You need to know something about the credits that are in that portfolio. This is a growing part of the asset-backed security market (ABS) market. It has twice the issuance as credit card ABS in the U.S. It's also pretty big in Europe.

There are many analytical complications because there are different types of structures. You can't know it's a CDO and know exactly how it's going to behave. You need to spend some time with this prospectus and understand what the security looks like before you can model it. You have different types of underlying assets. You can have a mixture of high-yield bonds and commercial loans. They're also starting to put more derivative securities in the package of collateral to help it behave better. There are also different management rules. They can have a reinvestment period. For the first four years, for example, the principal payments received from this portfolio of funds can be invested in new assets. If you can project out the starting portfolio, you have some reasonable idea of what the cash flows are going to look like, but it can change over time.

You can't really analyze CDOs in the same way you would a traditional ABS because of the collateral and also because the servicing function is different. In a traditional ABS, the issuer of the ABS transaction tends to be the underwriter of those credit cards or those home equity loans. In a CDO, the servicing function is outsourced because you have a portfolio manager who has bought bonds. He's not making sure that the cash flows are happening the way they're supposed to happen.

The structure is also different from a traditional ABS. CDOs commonly have more than one noninvestment grade tranche. They have a longer reinvestment period than an ABS would have. They tend to have a longer average life. They're around for a longer period of time, perhaps up to ten years. Most of them have been privately placed so far, which makes the data harder to come by.

When you're modeling these things, what do you have to worry about? Because they're commercial loans and because they are high-yield bonds, the default risk is far more important in modeling these things than in most of your other fixed-income investments. Because it's not a huge portfolio, it has a limited number of names. You really need to understand the credits in that portfolio. Rating agencies will do a very good job of looking at the credits. You can probably rely on them to a certain extent, but I think it requires an improvement in how most people are modeling the default risk in bonds. The structuring tools might also need modifications. Most structuring tools would take a basket of securities and break it up into a lot of little tranches. Since they were designed for CMOs, they assumed a very homogeneous kind of collateral. We know that these mortgages all act similarly when there are many of them. Modifying an existing system to handle new security types is never as clean as if you start from scratch. When you're on the leading edge of the investment world, you oftentimes don't have the luxury of developing a whole system just for this one type. You will probably need to play around with a structuring tool to make it handle this type of security correctly. Getting good prices on these securities will also be challenging because they're new.

In conclusion, innovative investment vehicles can add value to your portfolio, but you need to take more responsibility for certain aspects. You can't expect that the systems that you have available to you will automatically have the right modeling assumptions. You can't expect that you're going to have the right data that will be timely enough to back up those systems. You need to take more responsibility for understanding the structures and the terms and conditions of the deals in which you're invested.

MR. FREDERICK R. JACKSON: Cathy's presentation gives a software firm bias. My presentation will give an investment firm bias. I work daily with the actual investors. She made an earlier statement about how that sophisticated software is needed to manage complicated, innovative investments. I would make the comment that sophisticated investment professionals are needed to manage complicated investment vehicles. I think you'll see the difference in the biases based on our different backgrounds.

Innovative equals higher yielding. I'm not going to use the term *yield pig* or *yield hog*, but that's what some of our portfolio managers say. There is a very different focus. Pension funds focus on total return or what a coupon will offer, as well as the unrealized and realized capital gains and losses. Life companies more typically seek yield. When I first started in this position seven or eight years ago with my investment firm, I understood coupons and yields but not too much about total return. Over time, the total return focus that most investment professionals have is not really as important as the income bias and the yield bias of life insurance companies. That tends to be very important. The people who manage insurance assets need to recognize that. Most of them do. There's a price for these higher yielding innovative structures, and I think the price is revealed in higher default risks, cash-flow volatility due to interest rate risk, liquidity, premium, and often a combination of the above.

I won't be talking too much about the commercial software. I'll show an example or two because it does help when I talk about the three investment structures that I wanted to address. There is commercial software assistance for publicly-traded mortgage-backed securities, CMOs, and asset backeds. There is also commercially available software. It's typically not cheap, as Cathy mentioned. I think Intex is the most widely known vendor. They do a lot of reverse engineering of these deals. They probably have the widest database. Capital Management Sciences isn't quite as wide in its coverage, but it is much more user friendly to the insurance industry. They are extremely supportive of the interfaces that feed the Chalke system, the Milliman and Robertson (M&R) system, and the Tillinghast system. It is very user friendly as opposed to Solomon Brothers Yield Book. It is a very useful system on a security-by-security basis that a lot of our portfolio managers like, but it tends to not be as interface friendly. There

are others. There's Derivative Solutions and Algorithmics. I'm sure I'm slighting some other folks, but those are the ones I'm most familiar with.

Regulatory scrutiny of both of these companies was significant. There was some disapproval of their process. A company was asked to consider redoing the asset adequacy work that they convinced the Insurance Department they needed to do because these scenarios that they were covering were the least compromised. That particular year, they got away without having to redo the asset adequacy work, but they were required to purchase the commercial alternative.

I think Illinois' Larry Gorski has a requirement that modeling capabilities really should support the risk assumed. Whether it's derivative structures or not, I think it's a very good rule-of-thumb. If you're going to play in some of these asset classes, you need to have the software that will support your delving in these asset categories.

I have some general observations about most fixed-income, innovative investment classes. The first and most important point is that active management of a portfolio is usually a must. A buy-and-hold is not really a cost-effective option. I think the reason for that is because upside appreciation, unlike stocks, is limited. With a bond maturing at par, there's no appreciation. However, say you receive a capital gain at 102 or 103 (that is, if spreads tighten due to upgrades or interest rates fall significantly, and a capital gain is harvested). You can achieve a modest capital gain for which there's some upside. The downside potential is definitely much greater than the upside in the event of a downgrade or default. You can go a lot lower than you can go up in these bonds. An active management approach, which I'll talk more about, is very important.

I have some other general observations. A research group, either internally or externally, should be in place to monitor credit situations in specific structures so that early action can be taken as downgrades and defaults occur. With life companies pursuing yield, risk is assumed, and unfavorable events are best identified early and managed actively. I think it's important to recognize that loss experience is really a combination of downgrades, defaults, and the recovery

percentages. When there is a default, the security does not go away. You can recover a significant portion of that principal in most cases.

I'll tell about one painful lesson learned. When we compare the earlier CMO asset-backed example resulting in a regulatory risk slap, that really is kind of a trivial response. I'll refer to one specific situation where there's approximately a $300 million total CMO or asset-backed security portfolio. The $150 million portfolio is private. We'll focus a little bit on the $150 million public portion of this. In the $150 million public portfolio, consistent with a yield focus, this particular institution kind of loaded up on high yielding, well-known names and held. It took a position of holding these particular structures. The credits were not followed after initial purchase. There is a diversification rule-of-thumb that we typically have written up in investment guidelines for insurance companies we manage assets for. It is typical to not have more than a 2% position of one issuer. That's pretty much a function of the state laws as well.

With industry consolidation, this particular $150 million portfolio had an approximate 33% concentration in one issuer, and that position was held. The credit went south, and 90 cents on the dollar, on average, was realizable for the credits of that insurer. We avoided an annual professional management fee from a staff (from outside or inside) hired to actively manage this. However, a principal loss of $5 million was realized. That means there would be about 20 years of paying the people to analyze that kind of portfolio. I think it's prudent to actively manage. If you plan these asset classes without professional management, either internally or externally, you kind of play at your own peril.

Let's discuss what happens when commercial alternatives fail to provide coverage. I guess that's where the focus is for me. I won't necessarily provide any final answers, but I'll talk about how my firm actually invests. I think it's very helpful for me when I'm thinking about trying to model these structures. Unusual, sometimes nonpublic structures require a best effort, special attention approach or just a rough wave of the hand. We're not really going to do too much, and more often than not, the rough wave of the hand is really what happens. There is not a lot of special attention paid to some of these complex securities. You just think you put them on the books. They have an 8%–12% return, and they're going to stay that way forever. That really doesn't

work any better than not actively managing the securities. You really need to be actively modeling these securities as well. I'll get into specifics here.

I want to talk about three asset classes. I don't know if they would qualify as the latest and greatest or the most innovative, but they go back to my definition of innovative equaling high yield. That's why I've included them here. I'll talk a little bit about private placements, high-yield bonds, and leveraged bank loans. I don't know too much about leveraged bank loans, but I'll make some comments about that. I have more comments on the private placements and high-yield bonds.

There are some issues for the investment actuary who does elect the special attention route. You would select a tool to implement. I personally have used CMS's security calculator, and it allows for local modeling where the database fails to cover. That helps provide coverage on private placements, on certain types of mortgages, bullet structures, and other structures. It's a pretty useful tool. There are other systems. I believe Intex or some that interface with Intex allow for closest fits of securities to securities that are within a database.

Let's talk about private placements for a few minutes. We have a private placement, high-yield, collateralized debt obligation group at my firm that kind of brings these functions together. There are a lot of similarities. I had several conversations with a woman who heads up the group there. I've dealt with her for several years. She's very knowledgeable in this field, and a lot of what I take is what I've learned from her over the last several years.

What are the reasons for modeling? You have to model these securities if your management seeks the yield that's there. Private placements are expected to earn a 30-40 basis-point premium over comparable publics or a group will pass on the deal for industrials. One of this woman's comments was that it's largely viewed as a liquidity premium. Some of that's illusory in that the bond market kind of went away from us a few years ago, and it really was not that liquid. We kind of lost liquidity a few years back in a very tough situation. Some of the illiquidity exists in privates. It really also exists in the public market as well, and we found that out in a painful way a few years back.

Often no public comps really exist. You need to do relative value evaluations that are made on a total return rather than a yield basis. The people that deal in these markets do not have the yield focus that most life insurance companies have, so they make relative value evaluations.

Brokers typically offer deals based on cookie-cutter assumptions that make posted yields attractive. You can't just buy into the fact that somebody says the security's going to earn 9%, 10%, 11%, or 12%. At the time of purchase (and after the fact for in-force modelers), duty requires buyers to stress test these securities and really see how real those yields are and when these yields might really go away. It goes back to that loss experience issue and what you really realize. This is my point. Ultimate return is buried in the actual loss experience or the default/recovery profile.

Some of these cookie-cutter assumptions that the brokers will provide are as follows. Regarding pricing of corporates, there is an assumed 2% default and maybe a 50% recovery. High yield has a higher default, especially lately. It might have a 30% default assumption and a 50% recovery assumption. Leveraged bank loans have approximately a 20% default assumption currently, and an 80% recovery assumption. You can either take these at face value, which is what the brokers would have you do, or our group would test additional assumptions themselves. In some cases, you can go back to the underwriters and say, "Please test these securities at different default and recovery levels." You either prevail upon your underwriter or do it yourself.

The parameters used to price these deals can be helpful to the modeler who is stress testing the in-force portfolio. It's really a lot like the liability stress testing. We're seeing more and more of that and doing more of it ourselves. As I said, in some situations with some of our portfolios and some of our clients, you don't have the time to do some of this testing. It's kind of a trade-off. The non-cookie-cutter, break-even points that our group looks at, as in stress testing, are typically along these lines.

Regarding corporates, we look at a 4%, 50% recovery, rather than a 2%, 50% recovery. On high yield, we go 40% default, 50% recovery. I think that's a significant change. That was

30% default versus 50% recovery. We're talking a 40% default, 30% recovery. The high-yield market is a lot dicier right now than it was two years ago.

Leveraged bank loans typically stress test at 30% default and 50% recovery, and if there isn't reasonable breakeven around these levels, then our group would perhaps pass on these securities. These are today's assumptions. These will be changing in a few years or within another timeframe, but they will not hold still. This is really what's in effect currently, at least for our group.

Another piece of evidence of the dynamic nature of these markets is that equity participation has changed. Two years ago, underwriters sought 6%–7% equity participation. Today, seeking 10%–15% is more common. That's just an indication of the increased risk in these markets. These portfolios should not be bought and held. Default and downgrades occur and must be managed by professionals with workout experience. Similarly, I think the asset modeling needs to be updated to reflect the current dynamics.

High-yield bonds are junk. Catherine doesn't like it when I call them *junk*, but they really used to be called *junk.* We're dealing largely with a pure relative value plane in comparison to what else is out there. That's what they're looking at. Again, we're dealing with 100% downside and a limited upside reward is involved here. The term originally was exponential risk continuum, and we kind of talked about it a little bit. It's more like a logarithmic risk continuum. As you step down in quality from BBB to BB to B, the risk goes up significantly.

Stress testing of portfolios and regular consultation with investment professionals is a must and is an actively managed asset class. In 1998, we saw typical BB spreads that were 250 basis points over Treasuries. We're currently looking at some 600 basis points over Treasuries. The market does change. As asset modelers, you can't make your assumptions at the time you put these securities on the books. You have to be talking to people who know what the changes are in the markets and be able to update your models if you're dealing in these securities.

The two, main rules of the game are: diversify risk by industry and issuer, and actively manage the exposures. Sector specialists often actively manage the total return benchmarks. As I said before, they don't cater to the yield-oriented, buy-and-hold life companies. Modelers should actively manage as well.

The leveraged bank loans are kind of a relatively new asset class for life companies. The banks have been doing this for a while, and Cathy made some references to these bank loans. They're a high-yielding, structured product with derivatives actually leveraging returns. In some cases, the derivatives might be used to manage risk. In some cases, they're actually used to leverage the returns and increase the risk in these products. The leveraging actually increases the return, but it's also increasing the risk. The loans are floating rate structures with quarterly London Interbank Offered Rate (LIBOR) resets. There is equal default risk, which is the same quality high-yield bonds. There is often a claim of 9%–13% yields. I won't say returns because the return is what you actually experience. That's not uncommon. These are very attractive yields that are quoted.

There are significantly higher recovery rates than high-yield bonds because they're collateralized with the stock of subsidiaries and, in some cases, with all company assets. This leads to the higher recovery rates.

The one interesting and important thing is the return correlations with other asset classes are nonexistent, except for a modest relationship to high yield. For that very reason, they're a good portfolio diversifier. As I said before, it's a relatively new asset class for insurers. They are risky. But some of these things have blown up, and it's very important to have a group that delves in these bank loans that really knows what it is doing. If you press me any further on leveraged bank loans, you'll see my ignorance. I'm just coming up to speed myself on these.

In conclusion, actively manage these innovative investment vehicles for success. You'll notice that I did not give you a cookie cutter, innovative, asset modeling process. I'm basically putting it back to you. If you're not going to take the wave-of-the-hand approach, and if you're not going to find the answer in the commercially available software solutions on some of these innovative

products, then you really need to decide what you're going to do with respect to a best-practices approach versus practicality of time and available resources. It's kind of a trade-off. Wherever possible, actively manage these structures as well with recognition of the changing dynamics of the class and a need to construct stress-testing environments or stochastic processes might make sense. That's a stretch at this point. That's it for my presentation. I think we will take some questions now.

MR. WILLIAM A. ZEHNER: I have a question for Cathy regarding these defaults and other assets, like these collateralized debt obligations. When there's a default, what is left as far as recovery, and how is that handled? For instance, if one of these bonds does default, does the holder of the bond have to wait to get out of the bond because a bunch of payments are going to be forthcoming in the future?

MS. EHRLICH: Right.

MR. ZEHNER: I want to know what actually happens.

MS. EHRLICH: In modeling a CDO, there generally is some percentage recovery assumed so that the whole structure doesn't fall apart if one or two bonds default. There's a certain minimal level of default the structure can easily handle. If you have a lot of calls happening at the same time, you'll have defaults happening, and many of the call premiums will help pay off the defaults. At a certain point, if you get too many defaults in one structure, then there are covenants that will unwind the deal. Generally, it's going to hurt the more subordinated tranches first. Then, at some point, if there are too many defaults, they're going to have to unwind a deal with a covenant to get out of it. Did that kind of answer your question?

MR. ZEHNER: Yes.

MS. EHRLICH: I think it was a big question. I wasn't sure I handled all of it.

MR. JACKSON: When we're looking at a private placement analyst, one of the things that you're always asking is not just whether they have experience analyzing these credits at issue. You also want to know what kind of workout experience they have? There's negotiation that's involved after the deal goes south, and it's very much an art. Much experience is needed to take an active part in the workout of a deal. What's leftover is not a given when a default occurs or a downgrade occurs.

MR. ZEHNER: I have one other question. When you get these cash flows from Intec or any of the other services, what kind of default if any, is built into the cash flows you're getting from them?

MS. EHRLICH: For much of what CMS models, like the agency-backed CMOs, there isn't a default-assumption, and that's the beauty of the agency backing it. You don't really need to have it. CMS does not actively model default risk. The system is designed to model the interest rate risk. I can't remember if there's some basic level of default on some of the CMBS structures. I just don't remember if that's built in. It's not a variable that you can play with.

MR. JACKSON: Typically, when we use CMS and interface with the ALFA system, we provide the asset classes. We provide the cash-flow projections by asset class because the consultant or, if we're involved with it, the individual at the other end taking it into the ALFA system will be providing the default assumption. It's really not CMS, for the most part, making that determination. It's a function of the asset/liability modeling (ALM) system that's brought in.

MS. EHRLICH: The ALFA system would be getting it from the user.

MR. JACKSON: It's going to vary by the time you're in. You can't make one assumption that you will put in place and hold. The spreads differ from 1998 to 2000. There's never a prepayment model that's right. The only thing you can be sure of is it will be changing on a regular basis. Similarly, as for the kind of default assumptions and the recovery rates, you really need to be able to talk to investment professionals who are following these asset classes to see what the changes are over time in these assumptions. You really need someone to talk to.

Hopefully you have a good investment department to go to or some source. There are some historical studies done by Moody's and Altman that we tend to look at when we're making our calls. Knowing what's going on currently is very important.

MR. DAVID J. MERKEL: I work on the asset side. I actually evaluate these things for purchase, and then I do my surveillance afterward. That is 75% of my job. The other 25% is helping cash-flow testing. As I try to shoehorn these into our cash-flow testing models, I find that there might be five weaknesses with your ability to get these into models. The first one is pricing, which you brought up. It's even a shade worse because if you get something really innovative, and only one firm on the street is issuing it, you can go to all the other desks on the street. They might give you a low-ball bid. Even if you're not asking for a bid, they just won't know. Nobody has done it. You're relying on one desk and their analysis of it to tell you exactly what's going on.

Second, most of our models and most of our regulations are Treasury based, and with the increasing loss of Treasuries, we're having to find new bases from which to price things. When I came to our firm, my boss came to me and said, "Hey, Treasuries have really dropped. Why haven't prepayment speeds picked up?" I made a naive guess that proved correct. I said that it is probably because the banks' cost of funds hasn't changed. It seems that everything is moving to a swap basis. Regulations and software haven't caught up.

The next one is there are some things you can't model. Even if you had the best modeling system that could do CDOs, they come out with something new. We just passed on a deal mainly because of the complexity. We're relatively conservative on this stuff where it's a CDO of CDOs. Other CMBS that contain other CMBS tranches within them are a bear to model. I can actually get it for CMBS because the tools exist, and I can model the CMBS stuff, but you don't have a chance with the CDO of CDOs. The innovation usually means illiquidity because you buy this instrument. There is only one firm on the street. If you go to another firm to try to get a real bid, it won't do it. It will give you a low-ball bid. It might hand you off to its provider of the liquidity department. It's their job to scalp you. So, it's difficult to actively manage this stuff.

Finally, most of the innovative stuff hasn't been through a bear market cycle yet. The rating agencies are just working off the back of the envelope trying to decide what it is going to be like. What would happen in a real stress situation? What would happen during 1973–74? What would happen from 1979 through 1982? What would happen from 1929 through 1945? They have no idea because all of these contain a lot of embedded leverage in them that has not really been tested out.

There is a lot that we don't know regarding much of this stuff. I'm the one mathematician in a nonmathematical shop. I end up saying to my qualitative brethren that the models are just a help. The models are just a guide. Use your common sense because there is the too-smart-for-your-own-good risk that's getting ignored.

MS. EHRLICH: We appreciate your comments.

MR. JACKSON: I guess I would pick up on one of those points regarding the complexity issue. I'll go back to Gorski's statement. A conservative approach would say, don't buy what you have no chance to manage because, as you're saying, if these are totally unknowns, and there is no experience, and you have no clue, then that 14% yield is probably not going to be realized. There is a tremendous risk. If you can't evaluate that and find some way to quantify that, then you try to avoid it. Our credit group, for the traditional securities, doesn't like us to buy or take over portfolios on credit that it doesn't cover because it is worried that those will go south. It's not covering them or watching them closely. It doesn't want that responsibility because they know what kind of horror shows you can get in just a traditional bond market. Forget the CDO of CDO of CDO.

MR. MERKEL: If nobody is able to really qualitatively measure the risk in these things, how are the rating agencies assigning investment grade ratings to a lot of the tranches of these?

MR. JACKSON: Clearly, they're much smarter than we are.

MS. EHRLICH: Rating agencies can go back and look at historical default rates and apply those to the bonds. They know how to check credit quality on a bond. That's what they've been doing for a while. They can look at how the structure is set up. They can say, "If this is the default rate, I can see how that's going to impact the different structures." That doesn't mean they can tell you how it should be priced, but they can tell you what the risk is. I think the problem that many of us have is that we can't get the prices. We can't get enough data on those bonds. The rating agencies are able, for some CBOs to go in and look at the credit quality of the bonds. They're good at that. I've also seen studies where people will back-test CBOs. What if we did a CBO in the 1980s or the 1991 period when there were high default rates, just to see how it would play out? This is an asset class that has been around for about five years. It's just that they are much longer in duration than an asset-backed security. The stuff that was sold five years ago is still around. You don't have that kind of empirical knowledge. But there are some things out there that can help you. When you are managing it on a day-to-day basis, there isn't a lot of information.

MR. JACKSON: One of the things that I know our credit group does is it tries to add value in an investment management relationship by beating the agencies to the punch. The group tries to see where management is not up to the task of protecting its bonds. They try to find a bad credit situation developing before the rating agencies will downgrade it. The rating agencies have credit analysts as well who have certain coverage responsibilities. We hope that in our firm or in the case of any of our competitors, the research groups could anticipate a credit going south and get out of that position that's deteriorating because they recognize something in advance of the rating agencies' analysts.