

**1997 VALUATION ACTUARY
SYMPOSIUM PROCEEDINGS**

SESSION 21

Advanced Topics in Annuity Modeling

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ADVANCED TOPICS IN ANNUITY MODELING

MR. PETER D. TILLEY: I've worked with Great-West Life in Denver for about 17 years now. The first 11 years were spent on the product side, so I was pricing products and thinking I was doing a good job until about six years ago, when I moved over to the corporate side and realized all the mistakes I've been making for the first eleven years. I've been running the asset/liability management (ALM) operations in Denver for six years. I've been modeling annuities, life insurance, long-term disability, and the whole gamut of the products that Great-West sells.

Frank Sabatini is a Partner with Ernst & Young LLP located in Hartford, Connecticut. He heads up Ernst & Young's National ALM and Related Services practice. He speaks at all sorts of sessions. I went to a particularly entertaining one in Montreal back in June where, if we have time to get into it later, there's some asset segmentation issues around annuities that Frank spoke very well on.

Ross Osborn has ten years of experience at Nationwide, which sells a complete gamut of liability products, annuities, and life insurance. He has pricing experience and ALM experience. He's currently working in ALM in the corporate risk area. Both Russ's and my companies use one of the commercially available software packages. You have a 50/50 chance of guessing which one since there are really only two that are widely available for ALM use. We can talk about the kinds of concerns or the kinds of issues that come up around using the commercially available software packages. Frank uses both as he just pointed out to me. So he is quite a knowledgeable PTS and TAS user. There may be fine points between the way modeling assumptions are put into these two software packages. So with that introduction, let's jump right into the topic of construction of annuity models.

It is possible, albeit not a good idea, to build a deferred annuity model with just one cell. You can take all the deferred annuity business that you have, lump it all into one category, and put that reserve amount in with some average assumptions. I don't think it's a particularly good idea. You need to expand the number of cells that you use, but I'd like Frank's input on what sorts of things

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that you look at when you're deciding how far to expand your model. If you take 10,000 policies and make 10,000 cells with them, you get a very specific model, but it's going to take you until the end of the year to run one scenario. Frank, what sort of things do you look for when you're trying to decide the optimum number of cells?

MR. FRANCIS P. SABATINI: There are some basic rules that I have used to construct annuity models. There are three elements that drive annuity model results. They are crediting strategy, lapse, and investment strategy. If you accept that as a given, you can work backwards to construct the model. Notice that I didn't mention mortality. There is one cell for each issue year and for each plan type, and that's about it. Maybe there is a split between qualified and nonqualified business within an issue year if you have a significant number of qualified policies. That's all you need to construct an annuity model. If you have more than one issue age, you have too many. So the model is split by plan type, issue year, and qualified/nonqualified.

MR. TILLEY: Would you think that something like the distribution system would be an important factor in setting up the cells?

MR. SABATINI: I forgot about that. If you have a plan type that's using different distribution systems, then you want to split your annuity model by distribution system because it's going to impact your lapse assumptions.

MR. TILLEY: When you say distribution system, I guess we're not talking about the West Coast branch versus the East Coast branch. What are some of the keys?

MR. SABATINI: The keys are primarily banks, stockbrokers, broker-dealers or any clear distinction between how the product is being distributed. If you have one plan type, and you're distributing it in bank markets and you're also distributing it through a career agency force, then a split is necessary. What's going to be hard is figuring out how your in-force business splits by distribution system. That's going to be the challenge.

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You're going to see much different lapse experience by distribution system; and you really want to split your models. The other way to do it is to make sure that from a plan type identification process, you could issue the same product but with different plan types for different distribution systems.

MR. TILLEY: Russ, when you're looking at setting up a model and putting the number of cells together to maximize the efficiency of your run time, do you take a different approach depending upon the kind of project you're doing? So if you're looking at an ALM run, would you take a more detailed approach than if you're doing, for example, regulatory testing?

MR. RUSSELL A. OSBORN: Yes, I would. You can generally gain yourself some significant run time enhancements and model simplification for reserve adequacy testing and other regulatory testing. You can generally err on the side of conservatism, and conservative assumptions usually allow you to simplify matters. In the case of a fancy policy feature, you can just simplify the model, or you can just use the worst case situation. You can also blend cells of different types together. In the case of ALM, it's much more imperative to get the right answer, so you want to be a little more specific.

MR. TILLEY: Frank, so far we've been talking about a deferred annuity block. I know your thoughts on single premium immediate annuities (SPIAs). I'll ask you the question anyway. For SPIAs, and pay-out annuities, I know you feel that only one cell is necessary, and you would think that mortality would be a really key factor for SPIAs. So how do you accomplish that one-cell modeling?

MR. SABATINI: It's actually easy. You're basically dealing with a fixed benefit stream. If you have a reserve or benefit system that can produce projected reserves and benefits for the in-force block, adjusting the benefits for experience mortality, that's all that is needed. You basically have two vectors. One is benefits and one is reserves that you can import into whatever software package you're using to do your ALM work. So if your administrative or reserve systems can give you that information, then modeling an immediate annuity block should take a day, at most. The hard part

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is getting those systems to do it. The big concern we'll get into is validation and making sure that you get the reserve patterns right.

MR. TILLEY: That was a nice segue into validation, Frank. Any issues on the construction of models or the number of cells?

MS. GRACE L. ROKOSZ: I'm wondering how much attention you would pay to the split between single premium deferred annuities and renewal premium deferred annuities. We have many plans that can be renewal premium; naturally, not every contractholder exercises that option. The surrender charge is different depending upon the one-day deposit.

MR. TILLEY: Standard nonforfeiture law is very different for the cash values.

MR. OSBORN: Any block of policies that varies by surrender charge warrants splitting into different cells. It's often useful to split on a premium deposit basis instead of splitting on an issue-year basis.

If you have flexible premium deferred annuities, you can break those up into cells according to when the premium actually comes in. Do your surrender charges vary based on the deposit year or are they based on issue year?

MS. ROKOSZ: Our surrender charges are a function of how much premium came in when. For example, if somebody deposits a chunk of money into a variable annuity and later deposits a chunk of money into a fixed, three-year fund, they can take out money years later based on a surrender charge of the money that stayed in variable, (assuming there are no transfers), even if they actually move the money from the fixed. So even though constructing the model based on deposits rather than on contract issue sounds good, one thing that bothers me from a theoretical point of view is that you can't tell which deposit carries which surrender charge because the surrender charges are calculated on a contract basis.

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MR. SABATINI: Are they on an issue-year basis or on a deposit basis?

MS. ROKOSZ: They are based on a deposit basis.

MR. SABATINI: The deposit may have gone into the variable account and then transferred over to a fixed account?

MS. ROKOSZ: I'm assuming no transfers whatsoever. The money that's in the fixed account is just as free to leave as if it were as old as the variable. The first money out gets the oldest money in surrender charges. In other words, first in/first out, even if you take it out of a completely different fund. I don't know if this is a common plan design or not. Maybe we're unique.

MR. SABATINI: I haven't seen it. It's a tougher modeling problem.

MR. OSBORN: Yes, that sounds more complex than the typical case. It sounds like you would need to go back and model each flexible premium deferred annuity (FPDA) based on the issue-year basis and have some assumptions regarding the premium distribution by policy year within that. Actually, this type of arrangement is not that unusual. However, such contracts require either: (1) issue year cells with aggregate surrender charge assumptions that already consider the pattern of money deposits and withdrawals, or (2) a model so complex that it would be unmanageable.

If you can't model such a product, how can you price it? You can simplify the model by choosing to err on the conservative side, assuming money out is as old as possible.

MR. SABATINI: It is basically a weighted average surrender charge.

MR. TILLEY: I think if I were modeling that one for regulatory purposes where conservatism is a good thing, I'd probably model it with no surrender charges assuming that product design eventually does get down to a no-surrender-charge position.

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FROM THE FLOOR: There is too much that is too recent to do that.

MR. TILLEY: What if you looked at what your lowest surrender charge is on the block. I might go with that technique just to get the job done before April. Any other questions on construction?

Validating a model is something in which Frank has a great amount of experience because he looks at clients' models. Frank, what are the sort of things that you look for in a model to validate it in your own mind?

MR. SABATINI: How many people think you should validate the beginning reserves? Beginning premium? Beginning investment income? I'm assuming validation is the first year of your model to your most recent experience, last quarter annualized or last year. Benefits? Expenses? Deaths?

In other words, should you validate every line item on the income statement? Based on the audience response there is a consensus that the line item validation needs to be done. You can't build a good model without reproducing the income statement and balance sheet elements. That's the easy part. The hard part is looking at the progression of reserves and all of those income statement line items over time in a level scenario context. You should then examine the behavior of all of those items across representative nonlevel scenarios to test the various dynamic elements of the model.

Look at whether the crediting strategy is really working the way you thought it would. Would management really take this position in terms of setting crediting rates given the scenario that I'm trying to validate? Are the lapses consistent with what we would expect them to be? So it's a really serious and somewhat time intensive review of the model and its behavior not only in a static first-year context but also as the model behaves over time. You don't want to see models where you validate to your starting expected net gain from operations (say \$5 million).

About three years into the model, net gain from operations is \$25 million in a static context. We actually put into spreadsheet format much of the stuff that we're doing in terms of comparing what

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we expect to be the value that we're looking at versus the model. And it's true that some of the recent experience would include new business and other items that you need to adjust for. You need to kind of back out some of these elements, but it can be done. Spending the time to really validate a model usually results in a certain level of comfort, in terms of whatever task you're doing. Whether it's asset adequacy or ALM, knowing that you have a sound model that you've looked over carefully and feel comfortable with is important.

MR. OSBORN: I think I can add a couple of points. Validation will generally involve asking many questions of people in other areas of your company. First and foremost, make sure that you're speaking the same language. Do you mean the same thing when you say *spread*, and do you mean the same thing when you say *cash out*? I generally find that it's useful to ask the same question twice when you speak with an administrative department or the sales department. Ask them the same question twice from a different perspective. Make sure you get the same answer.

If you're talking about a large scale model with many cells or many different issue years, then it's useful to break out individual cells and run the model to look at it from a pricing perspective to make sure that the pattern of earnings for a given issue year cell looks like what you would expect. That's often a good way to troubleshoot your model.

MR. SABATINI: There are other things, such as beginning credited rates. Your model should produce the same starting credited rate that your in-force business would actually produce. You probably need to look at individual cells, and at the weighted average resulting credited rate out of the model versus what you think that weighted average is for the in-force business. On day one, they shouldn't be terribly different. You shouldn't see dramatic changes in your credited rates in aggregate or on a cell-by-cell basis. A natural consequence of some of the modeling is that you go in and fix the starting credited rate to the next reset date; then the model will kick in and reset. If you start at 6%, and the next thing you know is you're at 5.25%, you'd never take that cell down 75 basis points. So it's those kinds of details that you really need to worry about.

MR. TILLEY: I know at my company the focus on these starting balances is much more on the asset side than something like policy counts. When would things like a policy count really be an important assumption for you, Russ?

MR. OSBORN: If policy count is one of the drivers for your expense allocation, then you certainly need to keep track of a policy count. You also have to be careful about some of the older blocks of business. Many companies will have a small block that's on a different administrative system than the bulk of their business. Some policies may even be administered by hand. You may find that such administrative anomalies can be the source of difference between what you're seeing in your model, and what you see in your blue book.

MR. TILLEY: Any questions on validation?

MR. SABATINI: There's one other thought on construction and validation that we didn't get to. Actually Russ brought up the idea that you might want to construct your model based on account value size or premium size. The average policy size is \$20,000 or \$30,000 for most annuity blocks, but if you have a large number of \$100,000 deposits, you might even want to split the model if you think that they're going to exhibit different lapse experience.

MR. TILLEY: Speaking of experience, let's get to assumptions. The assumptions in a rigorous deferred annuity model depend on the dynamics between the way your product is designed, the surrender charge structures, your credited rate strategy, what your competition is doing, your investment strategy, and the kinds of assets that you're starting with on an in-force block. Russ, how do you really get a grip on all this to begin the modeling process and set the lapse assumption that drives off all of these structures, strategies and kinds of assets, the lapse assumption which is probably the most important of the benefits assumptions on an annuity block.

MR. OSBORN: There are two parts to this -- the base lapse rate and, of course, the dynamic element. Both of these are extremely important drivers of the final answer, especially when you're

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doing any sort of ALM analysis under multiple scenarios. The base lapse itself is going to be a prime determinant of the optimal investment strategy, and it can have significant influence on an optimal product strategy.

In a previous discussion among ourselves, we asked, “Where can you get information on lapse rates?” I think we all agreed that the actuary knows more about lapse rates than any external sources. The channels your company has developed are unique. Experience studies done on a regular basis are very important when developing these assumptions.

In addition, when we talk about dynamic lapses, everything gets very interesting. Modeling actuaries always like to joke about this assumption because it’s the one they know the least about. It also seems to be the one that drives the results the most. Here’s an idea that you can try. I think that it can be useful, in showing results to management, to show what it looks like under different assumptions regarding dynamic lapses. Present your results under different lapse “temperatures,” maybe on a graph. You can define lapse temperature in terms of the volatility component in your lapse formula. Show what your results look like under different values for that volatility. You can express this in the same way that option traders and investment professionals talk about implied volatility inherent in the price of an asset.

The actuary can talk about implied volatility of policyholder behavior. I think that can help management develop an intuition into what’s going on because when it comes down to setting this dynamic lapse assumption, the actuary often is making an important business decision that involves taking a position on what policyholder lapses will be. It can be very subjective because, even if you have data studies from the past that show policyholder behavior, the future can be very different.

Just as a matter of comparison, you can look at the mortgage market in the early 1980s and look at some of the prepayment assumptions in mortgage pass throughs that investors in mortgage pass throughs and collateralized mortgage obligations (CMOs) made. They assumed that a large portion of the mortgagees would hang on to their mortgages regardless of what interest rates did. However,

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when interest rates actually dropped, a whole new industry developed around refinancing mortgages. The whole ball game changed.

Well, the same thing can happen in the case of SPDAs, or other annuities, when interest rates go up. We're already starting to see it. The banks and the brokers are really turning up the heat on rollovers, so it's something to think about. I know Frank can give some good information about statistical studies of past data.

MR. SABATINI: I agree with everything that Russ has said. I think the basic step you need to go through is to first and foremost, have an ongoing process that produces durational lapse studies. If you don't have that data to support your lapse function, you're flying blind. To illustrate this point consider the following. Frequently, when working with new clients, I'll ask what the duration of the deferred annuity block is. But then I'll learn that the lapse assumption used was not based on experience, and it might have been used for regulatory testing. My answer to that is, I have no idea what the duration is.

Another comment on Russ's point is that we'll look at things like duration as if it's some sort of point estimate. If you believe in the principle that we really don't know what the policyholder behavior is, we can take a best guess, and we might also have an optimistic and pessimistic lapse dynamic. It's going to force you into a point estimate plus or minus something. The notion that duration is a point estimate on annuities is something that needs to be reevaluated.

The other thing that we haven't talked about yet is whether dynamic lapse is really dynamic. Here's the contrary view: I believe having had the experience of looking at different company experience, that distribution systems are driving lapse dynamics.

Banks are hiring people full time to roll over the deferred annuities as they come to the end of the surrender charge. Why? A new commission. A new concept. It's something that our career agents and our brokers haven't figured out yet.

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You can look at 30% or 40% end-of-surrender charge lapse experience. This is real experience for companies that has nothing to do with excess lapse. So, if you have distribution driving lapse and if you're also 1% or 2% behind the competition at the point in time they get to the end of surrender charge, is 40% lapse going to go to 80%? Maybe it will go to 50%. I think the distribution system, and your understanding of that distribution system, really factors into whether or not you show greater emphasis on the base lapse assumptions and less emphasis on dynamic lapse. Or vice versa.

MR. OSBORN: I would agree with that.

MR. SABATINI: Anybody want to argue that point? I'm not taking a position one way or the other. I'm just saying the distribution system is going to very heavily drive base lapse. You need to understand it, and you need to understand how dynamic it might be if you're either more or less competitive.

The other thing is, how many people are seeing increased lapses on annuities because there are 1035 exchanges into variable annuities? How about equity-indexed products? I'm actually surprised, because I know of a number of companies that are seeing increased lapsation as fixed accounts are experiencing 1035 exchanges over to variable annuities. Based on the data that they're extracting, the money leaves the company and that brings a whole new dynamic into dynamic lapse.

MR. TILLEY: So you're suggesting that you'd have to somehow in your scenarios look at what the stock market might be doing as an alternative investment for the policyholder?

MR. SABATINI: It's a possibility. I think we need to wait and see what experience emerges. On the equity-indexed product side, is it all new money? I don't think so. So it's coming from somewhere. I doubt that it's coming from variable annuities. If you wanted to be in the equity markets, you wouldn't want to go from equities into an equity-indexed product. It's probably coming from bank accounts, CDs or from existing fixed accounts. So you need to worry about that dynamic as you consider your lapse assumption.

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I can't emphasize enough the importance of durational lapse studies. I used to be a staunch believer in the idea that you shouldn't see any kind of high lapse rates until the surrender charge was completely gone. I've seen some situations now where people have had double-digit lapse rates in policies that are one year away from the end of surrender charges which has implications for surrender charge structure -- 7%, 6%, 5%, 4%, 3%, 2%, 1%. I've seen the 1% in some recent experience and it didn't stop anyone. That's equivalent to zero. Smaller surrender charges toward the end of the surrender charge pattern are not acting as enough of a disincentive to surrender.

You thought you had a seven-year surrender charge product that is now a six-year surrender charge product because you're looking at 18% lapses in year six. Those are things that are really important and have an impact on ALM work.

MR. TILLEY: Frank, on the durational lapse, would it be prudent to take your base lapse rate up as you approach the end of the surrender period, rather than have it just sort of go along at 5% and then hit a cliff?

MR. SABATINI: Yes. I actually think it should parallel your experience. But experience tends to be a pattern of 2, 4, 6 for a seven-year surrender charge and something like 6, 6, 8, 10, 40 depending on the distribution system.

It's basically grading up towards the end of the surrender charge. The notion is that it grades up gradually and then spikes. Depending on your surrender charge structure, I'm suggesting that spike lapses can begin a year or two before the end of surrender charge period, and that has nothing to do with how competitive the product really is. It is entirely correlated with how plugged in the distribution system is to the customer base and where they are in the surrender charge structure.

MR. TILLEY: At the risk of turning this from an interview format to a debate format, I'll just take small issue with one thing you said about equity-indexed annuities. Our marketing folks think that the variable annuity is a great potential source of business for equity-indexed annuities. If people

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are uncomfortable with where the market has reached over the last two or three years, and they're starting to get a little nervous perhaps with some corrections over the past few weeks, this may be a way to lock in their gains and still continue to participate at a lower level in what's going to happen in Standard & Poor's (S&P) over the next five to seven years.

So I think that the equity-indexed annuity is certainly cannibalizing existing business. I'm not sure it's all coming from the fixed side though. I think if we had anyone here from Keyport or Lincoln Benefit, it would be great to hear whether the lapse assumptions on either fixed annuities or variable annuities are going to be impacted by this new product design. No volunteers. They're probably all in the equity index forum a couple doors down.

Having covered lapses quite thoroughly, one of the things that really comes into the lapse dynamic is the investment strategy and the disinvestment strategy. Could you just address those for us?

MR. SABATINI: We spend all this time building these wonderful 5,000-cell models. Then we reinvest in a ten-year single A bond. There's a disconnect in the level of precision. I guess it's okay if you're doing regulatory work. But if you're really investing in CMOs and mortgage-backed securities, and high-yield bonds, and then assume a ten-year A rated bond, there's a bit of a disconnect.

If you're doing ALM work though, and you really want to understand what's going on, then I think there needs to be more care in finding out exactly what that investment strategy is if you're not familiar with it. You must also take the time to model it. And I'd rather degrade run time because I'm buying 15 different assets every time I make an asset purchase, but they reflect my actual investment strategy more than simplifying my run time. If anything, I'll get rid of model cells and take greater care in terms of building a model with as few cells as possible, that I'm able to validate, collapse the smaller plans together and have the right reinvestment strategy. I feel that it is terribly important, especially to the extent that you're buying assets with any kind of embedded options.

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MR. OSBORN: The optionality is one important thing. The other one is, if you're using too simple of an investment strategy, then your model could produce asset cash flows that all occur on one specific date. If you put all investable cash into a seven-year or ten-year bond, then you'll see all of your rollovers occurring at that one point in time. You would see that in reality. In the model, you've increased the volatility you report because you have all of your money in that one asset. The return after that point can be highly dependent on what interest rates just happen to be right at that point of rollover.

MR. SABATINI: That's an excellent point. The other thing you need to worry about in terms of actually building your liability model is you must be careful that you don't end up with models where you have monthly cash flows on liabilities and annual cash flows on assets. So you really need to worry about how you're modeling both the assets and liabilities. You want to get the cash flows on a consistent basis. You want to worry about things like cash tolerance and what assets are being purchased and all that stuff to get it as close to reality because you can end up with large borrowed balances and a sudden big asset purchase. You'll find out that that will distort the results.

There's a time to get down into the details. Understanding how that model is behaving and what asset purchases are taking place and when cash flows are being generated are really important.

MR. TILLEY: And I would add that even if your company investment policy is really to stay away from assets with lots of optionality, you really are focusing on noncallable bonds. It's going to make a big difference in your model if you do a bullet bond versus a sink fund bond. This applies particularly to ALM work, where the cash flows are so important. If your company does a great deal of private placements, as mine does, you see a variety of patterns. You can make some assumptions as to what a five-year bond really means. Is it a bond that pays 20% between years three and seven, or is it a bond that pays 100% in year five? It can make quite a difference in the results of a multiscenario test.

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MR. OSBORN: Another interesting thing you can try is, if you're using one strategy throughout a projection, you can look at some measure of the duration of your assets at issue, say your average weighted life, and then trace the portfolio along with its rollovers invested at that same strategy. Trace what that average weighted life does over time, and it will not be level. What happens is, the earlier rollovers are going to occur, and then you're going to take those and reinvest them. Suppose you invest half of your money in three-year bonds and half in ten-year bonds. After three years, you need to reinvest half of your money. Take half and put it in ten-year bonds and half in three-year bonds. You just changed the average life on your assets, and you can get some pretty weird looking patterns before it levels out.

MR. SABATINI: One of the things that I'm fond of doing when building a lapse assumption is back testing it. In other words, apply your lapse function to history. Historically, you know where interest rates were, you know where competitor rates were, and you know what your account values were. So why not go back a couple of years and see if your lapse function can reproduce actual company history. It's a reasonableness test. I think that's something you might want to try if you're able to do it.

MR. TILLEY: Since you took us back to lapses, Frank, when you're looking at back testing, how far back do you go? The reason that I ask that question is because of seasoning. Russ brought up the mortgage-backed experience. Let me draw a parallel over on the lapse side as well. Let's say someone has been with your company for quite some time, and they've been through a variety of interest rate environments, and they still didn't lapse. We have policyholders who bought a policy from us back in the late 1970s with a 7% credited rate. When National Investors was crediting 15.5% in 1981 and 1982, much of our block left, but there were people that didn't.

If someone was offered the opportunity to double their interest rate, make their surrender charges back in about six months, and then just be ahead of the game from then on, are they really going to be as sensitive to lapses the next time interest rates spike? If you have a block that's well seasoned,

even if it's through the surrender charge period, how do you factor that in, and how do you layer that into the back testing philosophy?

MR. OSBORN: The more of your lapses you get into that base lapse function, as Frank pointed out earlier, the more you help solve that problem. I do think it's useful to assume some sort of seasoning. You can assume, for example, that a portion of that block is going to be rational and the other is "brain dead" as we say. You can prevent your dynamic lapses from cutting into the brain dead segment.

MR. SABATINI: Your lapse studies should tell you what's going on. We're just beginning to get experience that's a couple of years beyond the surrender charge. The basic question is, everybody knows we have spike lapses. It's a question of how big the spike is. You heard us argue that the spike is correlated with the distribution system, and I guess that same concept will carry back down through two, three or four years beyond the end of surrender charges, so you should start seeing that experience emerge.

Russ said that, at some point, those orphan policyholders or the people who really aren't paying attention are generally going to be indifferent, and to the extent that you can factor that into your modeling, that would be great. How do you do that? One way to do it is to create different cell structures. You get the brain dead and the not-so-brain dead.

MR. TILLEY: We call them active and passive.

MR. OSBORN: Or hot and cold.

MR. TILLEY: Before I let you talk about disinvestment, I have one last thing on the investment strategy. The models allow us to put in a spread over Treasury or a spread over the risk-free rate. How dynamic should that spread be?

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MR. SABATINI: If you have looked at experience and observed experience, spreads change with a variety of dynamics, and most of it is interest rate related. We've done some regressions on spread relationships over time. We have found that there is a fair amount of correlation between level of spreads and interest rates. Although Peter will argue that it has come undone, interest rates go up, spreads narrow, interest rates go down, spreads narrow. Ignoring Peter's current view, ideally you would like to get a dynamic, particularly as it impacts purchases, that reflects as much of reality as you possibly can. So you want to reflect changes in spread levels for different changes in interest rates.

MR. OSBORN: I think our computing power is getting to the point where we can just now afford to add stochastic variables to our model. Most people are using stochastic interest rates and a few have added inflation and equity returns for modeling equity-indexed annuities (EIAs) and variable annuities. I think the next stochastic variables to add to the list are spread on future asset purchases and perhaps default rates on assets. Of course, you would incorporate the observed correlations that you would expect between the various factors in that model.

MR. TILLEY: It sounds like a call for papers, Russ.

MR. SABATINI: It also sounds like if there are a hundred interest rate scenarios there are now a million total scenarios.

MR. OSBORN: It doesn't have to be that bad. You don't have to have the entire cross product because you can set up a multifactor model that has a correlation matrix between the various factors. If you take random samples from the multi-factor space, then it will require more scenarios, but not a million. It might be more on the order of 1,000 or 2,000.

There's another technique termed *low-discrepancy scenarios* that allow you to efficiently sample from your probability space.

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MR. TILLEY: You can talk to Faye Albert or Irwin Vanderhoof about that one. I think we're finally at the *D* word, disinvestment. In every model there reaches a point where you have to do something with a negative number.

MR. SABATINI: Let's take a little survey. How many people have had, at their companies, net negative cash flow at any point over the past ten years?

MR. TILLEY: This is total company not one product.

MR. SABATINI: Total company now.

MR. TILLEY: All the hands came down.

MR. SABATINI: Of those companies, how many borrowed? Two. How many sold assets? Now in terms of companies with segments, I have a series of questions. Assuming either you have one total portfolio for the company or you're segmented, I think the questions will apply. If one segment or the company had negative cash flow what would be the likely outcome? Would it be that the company would borrow? Would the company use new premium flows? Lots of hands. If it's segmented, would you use new premium flow from other segments? A few hands there. Would you sell assets? A couple. Would you sell the highest capital gain? No hands.

Would you sell prorata? I guess you're getting my point, and that is, that at least the consensus is that the last thing any company is going to do, in terms of funding any kind of cash needs, is borrow or sell assets. The conclusion that I have drawn is that the best disinvestment strategy is to purchase negative assets, especially if you're dealing with an in-force block. It's basically just the way of recognizing the fact that you have new premium in and you use that new premium to fund the out flow.

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It's also from a cash-flow testing point of view, a way of developing a negative Interest Maintenance Reserve (IMR), and if you can push that capital loss farther out on a present value basis, in terms of surplus impact, it's going to help you. In reality, it's the most likely outcome. Now if you have a company where you have multiple lines of business, and you're doing cash-flow testing for the different lines, at some point you can add the models together and see if any of the scenarios that you're dealing with had a net total company negative cash flow. In that case, maybe you have to go back in and assume that something other than one segment borrowing cash flow from another or relying on new premium is the method.

One of the greatest benefits about a disinvestment strategy in which you purchase negative assets is it removes the need to produce market values in the model. If you don't have to sell assets, you don't have to have market values. You don't have to validate market values at the beginning of the model. You can shut off all the option gobbledygook. Run time improves. Russ will argue that, if you're purchasing assets with options, you need to turn that stuff on. The whole operation becomes much more efficient, and it's closer to reality. It also allows you, if you're using different models and you're starting to look at total company results, to add them together. Now, it's true that one line could be purchasing five-year negative assets and another line could be purchasing ten-year negative assets. So you can have some mismatch, but that's where you start coordinating across the company in terms of assumptions. Russ, what are you doing in your models for disinvestment?

MR. OSBORN: We're using the "negative asset" disinvestment strategy that Frank mentioned because we have a special case. We have synthetic segmentation where different lines can own portions of the same assets. The lines have ownership factors by asset acquisition quarter that reflect that. What happens is, in each quarter of investment, every line owns a portion of the assets that were acquired for that quarter based on their investment needs for that quarter. If there's a decrease in the amount of liabilities, a particular line or segment can have a negative investment need. In this case, the line, in effect, owns a negative portion of the assets for that quarter. Therefore, our model reflects our actual ongoing policy.

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MR. SABATINI: In terms of models, I'd like to ask questions in terms of what the company would do. How many people have models that sell assets? How many people borrow? How many people purchase negative assets? It's about one-third for each. How many people have disinvestment strategies that are consistent with the way the company would actually behave? We need to see a higher number of hands.

MR. TILLEY: The purpose of the model is to replicate what you think is really going to happen. Russ, where do you come up with competitor data? When you're comparing in any particular strategy for your credited rates, or your lapse assumptions, something that involves the use of competitor credited rates, what kind of data sources do you go to? Is it more typical to see competitors rates that are based on new money, or do you see some sort of a moving average lag?

MR. OSBORN: Actually it's probably a better question for Frank because everything I would say I just learned from him.

MR. SABATINI: We take a pretty simple approach to defining credited rate behavior. We would argue that the following sequence should take place. Identify your competitors. If you don't know who they are, find out. There are different ways to do that, but don't just ask your marketing guys because generally the competitor of the week is the guy with the highest rate. Then get their crediting rate histories on new money and then analyze them. Use regressions. Based on those regressions you'll come up with a pretty good competitor rate. The rule of thumb is that the market does not price off new money and doesn't price off of a portfolio rate. The market generally lags any kind of upward movement in interest rates, and it generally lags any downward moves in interest rates. To build a good model, you need a good competitor rate. You want to bring in a competitor rate dynamic that actually reflects your competitors, to the extent that you can understand them and that actually reflects the historical behavior.

There are a number of publications where you can obtain databases, and where you can get histories on your competitor rates. You want to be careful about whether or not those histories include or

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exclude bonus rates and things of that sort. I guess the basic point I'm making is, do the research, do the analysis, and build in a good competitor rate. The competitor rate says, the five-year Treasury, minus 35 basis points, reproduces what you think is the current competitor's rate, but it is not one that's going to hold up dynamically in a stochastic model. I would argue that, when interest rates go down, credited rates on annuity products go down in lock step. You study those data that are not going to be supported by the actual behavior of your competitors. It also assumes that, when interest rates go up, credited rates move up on a one-to-one basis with changes in interest rates. The data would suggest that that doesn't happen until you meet a threshold, at which point, the rule of thumb is, if you can price an annuity with new money and produce a higher credited rate than the one that you were pricing last week based on where your competitors were and where your portfolio rate was, then you'll credit that higher rate. You can buy the assets, so there's a switchover point.

I guess my point is, some sort of Treasury index minus or plus a margin is probably not an accurate reflection of the competitor rate, and it has implications in terms of the dynamics of the model and lapses. That's particularly true if you're dealing with scenarios that are going up and down.

MR. OSBORN: This has a lot to do with the fact that many companies out there are sort of managing their earnings on a total portfolio basis. When rates are coming down, they're subsidizing their new business credited rates with earnings off their old block. When rates go up, you have the opposite situation going on, and that's why you tend to see that lag on competitors rates relative to new money rates.

MR. SABATINI: It kind of goes back to the validation question. You really want to build the model on a dynamic basis that is as valid as you can get it, based on the information you have on hand. You have the behavioral history of your competition, and there are instances where the targeted competition may not behave in sync with the industry in general. There may be second order differences, and it's worth capturing that. The key point is capturing the real market dynamics

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as you understand it. Then you have more credibility to model, and it has implications for crediting strategy as well as for lapses.

MR. OSBORN: We should probably mention also that there are some external sources available and a publication called the *Fischer Index*. I understand that there are a number of web sites where you can get such information.

MR. TILLEY: There was something in the latest issue of *The Financial Reporter*, the Financial Reporting Section newsletter. There was an article on sources for things like annuity rates. I think it was www.annuity.com. It sounds simple enough to be right.

I think there are a couple of other miscellaneous benefits, depending on the kind of block of annuities we're modeling. We've been focusing on deferred annuities, but another benefit that could be an important modeling one, depending on the company, would be the annuitization rate. So it's not just the lapses, but people that hit retirement age might want to start taking a payout. What kind of guideline do you use when you're deciding what to put in for annuitization or whether to use it at all?

MR. SABATINI: It depends on experience. I guess the rule of thumb is, if you're actually getting a fair number of annuitizations, it's in your best interest to reflect it. Of course, there are a number of companies that sell products, such as two-tier products, that, by their nature, are going to produce a fair number of annuitizations. Again, it's important to build in that whole annuitization dynamic properly. Capture the true pricing, as well as what kind of annuitizations people are taking, as best you can. Are they purchasing three-year certain? Five-year certain? Are they purchasing any kind of certain-and-life types of structures? Reflect that because it's going to have a pretty big impact.

As a general rule, unless you're really aggressive in pricing, settlement options will tend to improve the embedded profitability of the product. It will change the durational structure of the liability. So,

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to the extent that you have experience, you need to look at whether it's material enough. You need to model it in.

MR. TILLEY: One of the complications that certainly comes to my mind on that is, if you're dealing with a product where you have a relatively short investment strategy and all of a sudden you build an annuitization factor in. You might have people taking 10- or 20-year term certain or life incomes. How do you model the dynamic of the investment on that? If you continue along with the same investment policy, you could see some very interesting results once annuitization is underway.

MR. SABATINI: It's a trial and error process, isn't it?

MR. OSBORN: That's also going to depend very heavily on what you actually do when funds are transferred from your accumulation line to your payout line in your company. Do you actually do a physical transfer of assets? What sort of administrative approach is taken there with respect to the assets backing these liabilities?

MR. TILLEY: That's a good point, Russ. Let's go back to credited rate strategies. Does the credited rate strategy have to be dynamic as well? Do you have to have a credited rate strategy that's changing as a result of different circumstances or different scenarios that you're getting?

MR. OSBORN: A key consideration here is that the model crediting strategy be a realistic reflection of what's actually going to happen. I know that a number of companies are, for example, crediting a fixed spread off of the portfolio rate. (We could probably spend an entire session talking about the disadvantages of doing that.) Consider the following question: when doing multiple scenario testing, in a scenario in which interest rates rise 400 basis points, and you're getting dynamic lapses that cause your assets to sustain capital losses that bring your portfolio rate down, (perhaps even negative), are you really going to credit your floor guarantee when market interest rates are 600 or 700 basis points above that? I think the answer is no. You might want to ask this question of your sales or marketing departments. I think they'll be horrified by such a suggestion.

When such a scenario actually develops, there's going to be significant distribution pressure to keep those rates somewhat close to market.

I think it's very important to find out what's really going to happen at your company when you're in this situation. You must spell that out in the strategy that you're modeling.

MR. TILLEY: Even in the situation where you're crediting off a portfolio rate, and that's the strategy you have in the model, it's possible to overlay an assumption that says, in any event I won't credit less than $x\%$ or more than $y\%$ of the competitor rate. That can bring a little more reality into the picture. As interest rates are plummeting, if you decide that you don't want to credit less than 85% of the competitor in any situation, that can override.

MR. SABATINI: I think the key goes back to my earlier point. My general experience is that you can ask a company what they think they do, and then go back and look at their historical credited rates and find out what they actually do. The rule of thumb is don't assume that the two will be equal. It's really important if you're building a sound credible model to get an understanding of what your crediting behavior has been. Even if you're doing it in a stochastic context, remember the bulk of the scenarios are going to be where interest rates have been historically. So you want to get as much of your corporate behavior in there as possible. Don't be constrained by the software that you're using.

Find out what your real crediting strategy is. Do a regression of some sort or an analysis of your historical credited rate. Regress them to your competitors, to interest rates, or to whatever you think you need to. Do the analysis and understand the behavior, and then get it into the model.

As both Russ and Peter have pointed out, you need to ask the question, if interest rates do this, what will we do? I think you need to go to management and ask them that question. If interest rates go up 3% from today's level and our portfolio rate remains essentially unchanged, what are we going

to do with our renewal rate? The answer to that question is key because it has implications on the entire set of model results. It goes back to back testing.

I've worked with some clients where we've gone back and said, did the formula that we've developed for our credited rate reproduce historical credited rates? It's at least a good starting point. Then you need to bring in the extremes.

The other thing is, if you want to improve run time, get away from the portfolio rate methodology because now you don't have to wait for the model to calculate the portfolio rate to deduct the spread. Go back and figure out if the cash-flow changed. It doesn't have to iterate, and you'll have a much faster, and maybe a better model.

MR. STEPHEN A. J. SEDLAK: This is less of a question and more of an observation. I'm one of Russ's cohorts. In many respects when rates go up and you're faced with this choice of what rate to credit, it's very analogous to asking yourself, who do I want to borrow from? Do I want to borrow outside or from the rest of my company or my enterprise? Or, do I want to borrow from the policyholders? I think, in general, the answer you'll get is, the policyholders will give you a better rate and you'll get a better deal. You'll probably tend to want to keep that credited rate up to the point where the policyholders don't lapse very much. You basically then strike your deal in that way. Realistically, if it ever happens, I can see everybody calling up their ALM shop and saying, what are our alternatives? What will happen? I would hope they do.

MR. TILLEY: That's a good point. Frank was talking about back testing and looking at what companies actually did under a variety of interest scenarios. It wouldn't be much use at my company, because back in 1981, we had two big blocks of portfolio annuities: one is on the individual side and one is on the group side. We took two very different strategies. I don't think the division heads talked to each other too much, so that would be a hard one to regress because we did both.

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MR. SABATINI: And I'm focused on recent experience and you have to factor in management changes and all that other stuff. Even over the past four or five years, we've had a run-up and a run-down in rates. We've had enough dynamic to get a sense of historical management behavior.

MR. TILLEY: We could talk about a couple of other topics. Frank, you touched briefly on the variable annuity. And I know that you have some more things to say about how to model or how we should be thinking about modeling our variable annuity blocks.

MR. SABATINI: I think we're at the beginning stages as our variable annuity blocks begin to grow. I'm sure much of the cash-flow testing is not and has not been sophisticated. In reality, if you're starting to look at risk issues or earnings volatility issues, you really have the whole dynamic. What is the variable annuity context? You have fixed and variable accounts, equity accounts and bond accounts. Premium gets allocated to them in terms of new sales. You have the transfer dynamic.

In theory, you really want to build a fully integrated dynamic model. One that has both interest rates and dynamic equity market performance. If you have large bond accounts, you might want to build in bond performance. So basically, for every scenario set, you have interest rates, equity market performance, bond performance, and some sort of condensing of the variable accounts and representative cells.

The argument goes that if interest rates go up and the equity markets go down, what's going to happen to the balance of funds in the accounts? What's going to happen to lapses? Is all the money in the equity account going to move over to fixed? Is it going to leave? To really start to address and understand those risk issues, as well as adequacy issues, I think you need to start looking at fully integrated models within a stochastic context in that way. I don't believe that you can go out and buy one of those today, although by working with some of the existing software that exists today, you can get pretty close.

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Understanding it is one of the interesting things. How many people with variable annuities have studied their transfer dynamics? Is it what you would think it is? No hands. Should we be doing durational transfer studies? I think you need to start understanding the dynamic of the business and worrying about building a more dynamic model as it relates to the variable business.

MR. OSBORN: That can certainly be a significant risk. There are many different dynamics going on there. I think it's important that we start to try to develop more capability in analyzing these transfers and maybe pushing on the vendors, if necessary, to upgrade the capabilities there.

One thing I'd like to be able to do is model transfers in both directions separately. In general, some segment of your policyholders is going to be nearing retirement and they have some sort of strategy for getting out of variable and moving money to fixed. You would expect some sort of base transfer-to-fixed rate. In addition, you're going to have the dynamic component, which is going to be some complex function of how well the equity market is doing and how well your fixed rate compares to other investments out there. On the flip side, another significant portion of the policyholders are going to be moving stuff to variable on a regular basis. I think it is something we need to look at.

I believe many companies with very large blocks of business with transferability have very little understanding of just how much risk there is because no one has actually spent the resources to qualify it. Depending on the product design, it could be significant.

MR. SABATINI: That's especially true if, let's say, interest rates rise. Depending on how your transfers are treated when they move back to fixed, it could be very problematic. It also depends on how the crediting rates were being set or the timing.

In theory, you could actually move out of the old fixed bucket of the renewal rate into equities for one day and back again, especially if you're giving new money rates on transfers and renewal rates on what was there. Don't think that that can't happen. In the institutional GIC markets, that was a big issue in the early 1980s. You would need more of a herd mentality to have that happen. But

if you're in a situation where you're currently at 5.5% on your renewal annuity, and if transferring from equities back into fixed could get you 8%, I'd go to equities for a day.

MR. OSBORN: You also have to watch out when your policy has some sort of built-in guarantees for money in the fixed account but doesn't look at the history of where the money has been. For example, there's the return-of-premium on death feature. If you have your money in a variable account, and the stock market crashes, you can easily lock in that benefit by moving to a fixed account. Of course, in that case, you have to die to get it, but the point is still valid. Another thing to consider in some of the group markets, like 457 for example, is the way the market is moving. Employers are setting up funds with several companies. The individuals can choose to transfer their monies between different companies. For these products, we need to be able to model intercompany transfers in which money may leave your variable account entirely. The money is not moving to fixed, but to a fund in another company. Also, money can transfer back into your funds from another company. The intercompany transfers will depend on a comparison between competitor returns and return on your account.

MR. SEDLAK: There's another risk you might want to comment on in the variable annuities and that is spread compression. This comes about because you have a great deal of volatility in the underlying funds, upon which your risk charges are dependent. However, your expenses are fairly inelastic.

MR. SABATINI: That was my point. If you're not modeling the changes in the equity markets and their impact on fee levels against the fixed expense base, that's a dynamic in and of itself.

MR. TILLEY: You can at least try to quantify the risk by going to the option market as my company did about a year ago. What we did was we actually ended up purchasing an out-of-the-money put. Put baskets look at the mix of funds that we had, fixed income versus equities, international, domestic, all sorts of things. We came up with a basket of puts that tracked fairly well with how the performance of the fund should go.

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As it turned out, as in many of the derivatives or insurance policies that I buy, it didn't pay. It's one of those instances when you're happy it didn't pay. The market has gone up substantially since we bought it, so the put is deeper out of the money than it was when I bought it. That can at least give you a perspective as to just how much it would cost to take that risk away. We did one with a 10% deductible. I think you would find that at-the-money options to protect your fee income are extremely expensive, and they would be much more expensive this year than they were last year, because the implied volatilities in the equity option markets are that much higher. Sometimes you can get the attention of senior management with just a dollar number on the risk even if there is no particular purchase of a derivative. That can cause some strategies to change up at the senior levels. So that's a very good point.

