

# RECORD, Volume 30, No. 3\*

---

Annual Meeting and Exhibit  
New York, NY  
October 24–27, 2004

## Session 128PD Hedging Variable Annuity Guarantees

**Track:** Investment

**Moderator:** Michael J. O'Connor

**Panelists:** Brent P. Martonik  
Eshwar Narayan†  
Josie Palazzolo‡

*Summary: The variable annuities designed in recent years include an array of guarantees related to the performance of the underlying funds. At the same time, reinsuring and/or hedging these guarantees has become more difficult and costly. Panelists look at the economic cost of these guarantees, explore some of the methods companies are using to manage their exposures and discuss the practical issues that arise.*

**MR. MICHAEL J. O'CONNOR:** Today we have three speakers. First is Brent Martonik from Sucia Re Management. Brent is an F.S.A. and has a background in trading, equity and fixed-income derivatives. Prior to coming to Sucia Re he was at Safeco as a life actuary in roles ranging from pricing to cash-flow testing. Our second speaker is Eshwar Narayan. His background is with equity-linked products at Wachovia on the sell side, primarily to institutions and the Wachovia capital markets area. Our third speaker is Josie Palazzolo with SunGard Trading & Risk Systems. She's a product manager for risk application solutions for capital markets products and for insurance and hedge funds, and she works with asset trading and risk with depth support of derivatives. She started at the Fed here in New York, then was at J. P. Morgan and is currently at SunGard.

**MR. BRENT P. MARTONIK:** Before we get started, let me ask a couple questions.

---

\*Copyright © 2005, Society of Actuaries

† Eshwar Narayan is Vice President, Wachovia Capital Markets, New York, NY.

‡ Josie Palazzolo is Senior Vice President, Trading & Risk Management, SunGard, New York, NY.

**Note:** The charts referred to in the text are available through the link on the table of contents. .

How many of you work for companies that have issued variable annuities? The majority, I would say. How many people work for companies that are currently hedging the variable annuity guarantees? A few. More than maybe a couple years ago. That's pretty good. For those who didn't raise their hands on hedging variable annuity guarantees for your company, how many expect in the next year or so that your company will begin hedging variable annuity guarantees? A couple. That's different from what I might have thought.

Here's a quick summary of what we're going to go through today. I'll give a presentation on some of the practical aspects of hedging variable annuities. Eshwar will talk about some of the investment banking components of that, namely, prime brokerage agreements, and Josie will talk about risk management, software people and systems, and processes around the trading, which is very important to controlling the operation of risk.

Variable annuities are like a box of chocolates, right? What else would they be like? Variable annuities come in all different flavors. They have different riders; they have benefits from death benefits to living benefits. Imagine a box of chocolates. Take a caramel that looks like it doesn't really stick out a whole lot, but if you know a little bit about options, when the markets go down, the payoff you have to pay goes up. Now, imagine one that's got two lines on it, maybe a coconut cream. If the strike price is sort of at the money when the customer signed up for the variable annuity, the second line could be better because every five years we'll change the strike price, won't we? Then visualize another one with three lines up on the top, maybe it's got nuts inside, and it is even better. We just don't change the strike every five years, but we look back at the last five years and look at the high account values, so we could have three different strike prices. If death benefits are good, maybe living benefits are good too, so we have withdraw benefits here, and we pay off if someone withdraws, pay off if they die, and of course, we have all the various different strike prices as well. Now imagine white-chocolate-coated ones that are sticking out. This is what marketing groups like to do, right, they like to stick out a little bit. The white chocolate one has payoffs that pay if it goes up or down. That's called an enhanced estate benefit (EEB); it's a call option. So if you see a box of chocolates, it actually describes variable annuities.

If you look at the characteristics of variable annuities, they contain innovative features, guaranteeing the performance of the underlying funds or the eventual payout of those funds. These economic values can greatly diminish, or they can significantly increase over time depending on the path of the underlying funds. With the guarantees we're talking about, which are namely guaranteeing the performance of the fund, we call these written put options. Eshwar from investment banking will say written put options are kind of a dangerous thing to have, but this is what's on the balance sheet.

The current situation for variable annuities is they guarantee a function of the product features. I think we have a pretty good understanding of what those

features are with these guaranteed death benefits, withdrawal benefits, income benefits and even EEBs if you're successful in your investing choices. They're a function of mortality and lapse. This isn't a surprise for you as actuaries. They're also a function of the underlying stock prices or interest rates. It goes on and on and on. The evaluation of the variable-annuity guarantees requires specific capital market and actuarial expertise to understand and to evaluate. Now, as a lot of you are aware, the regulatory changes occurring on variable annuities affect your capital calculations and your statutory reserve calculations. For the capital they call it the RBC C-3 phase II, which is going to use an estimation of the fat tail, which is sort of the downside risk of having that variable-annuity guarantee way in the money and maybe not crawling out.

So what are the choices for hedging? There were quite a few people who did not raise their hands when I asked if their companies were hedging the variable annuities, the guarantees, so no hedging is a choice. Buying reinsurance is a choice. I'll talk more about that in a minute. You buy the put options, your sold options. A way to hedge things is to buy the option you sold. That's a good hedge. There's something called delta hedging. You can delta hedge the put option you sold that has some other risks, or you could do a mixture of the above, which people are also doing. Let's look at no hedging.

For a small block, whatever small means, it might actually be reasonable not to hedge. You might find the cost of completing a hedge implementation is too great for the size of the company you run, or for the size of the variable annuity block you have, and you might say, well, it's kind of an uncorrelated risk with my other risk, mortality, lapse, insurance, other annuities, so you're sort of comfortable with that. For a large block, and again, whatever that means, it has something to do with the surplus of the company and the balance sheet and so on; a large block of variable annuities not hedged might be fairly risky. It could be cheap or expensive depending on the results you have. In other words, if it's a put option, the market goes up, you never have to pay out; that was cheap. You received a little premium for your guarantee, you put that into the annual fee structure and you never had to pay out on the guarantee, so you received a risk premium you never had to pay. On the other hand, it could be very expensive. You took that little fee in and the markets went down, and then you had to make all these payments out; you were unhedged. The impact to the company's solvency could be at risk, so this is probably why the regulators are kind of turning up the volume a little bit on trying to get people to do a little more analysis of the potential dangers of these guarantees.

In the future, the regulatory capital and reserve credit will require proper hedging. On the AAA Web site, there's a 78-page document they just created last month that goes into some details of what it means to hedge variable annuities. You have to have a plan, and it has to be board authorized and all these kinds of things. They're pretty serious about what qualifies for real hedging. It's not just like a macro-thing where you can show up and say, "I'm buying options and kind of hedging a little

bit." They want to be specific and show where the tolerance is. It's a true risk-management type of framework.

Now, if you're not hedging, as we know, capital markets can be a little bit risky. Chart 1 is a graph where back in 2000 the S&P 500 was around 1,500, and then it kind of slid down to almost a 50 percent decrease by September 2002. There wasn't one big move in all of that. In fact, I think the biggest move in that period of time was up like 5.8 percent in one day, so there were no 20-percent crashes like in 1987, but during this time period it goes down 50 percent. If you sold variable annuities in September or June 2000, cut it at the money strike price for a guaranteed minimum death benefit (GMDB), you would have struck it at the 1,500 range. That policy, if it still exists today, the person hasn't lapsed and they haven't died, it's kind of "in the money" in option talk. That is a very expensive option to hedge today because it's in the money. You have to kind of pay for it in the moneyness and what remaining optionality exists. Then these go on for a long time, as you know. It's not just like a one-year option. It goes out until the person dies potentially or withdraws. So not hedging in capital markets can be expensive. Let's look at an example.

Take an example of XYZ variable annuity with GMDBs. I have a new policy, 100,000 lives, male, age 45. The average account value is \$100,000, so in total, the size of this block of business is \$10 billion. Probably your marketing group would like to do \$10 billion of variable annuities, right? That would be a success, wouldn't it? Everybody says, "If I could do just a billion, I'd be happy." All the funds are invested in the simple GMDB, kind of in an S&P 500 fund, which is for simplicity, and then we have the mortality table, and you have lapse rates that you assume. I've got 2 percent for 15 years, and 15 percent after that, so when they get to about age 60, they start using their monies by withdrawing. Then I put in a mortality and expense guarantee assessment of 175 basis points, so that includes the fund management cost, and I haven't really included a cost for options. In other words, I just ignored the GMDB for this purpose. When I value that string of put options for this particular set of assumptions, I come up with a \$144 million cost.

Now, this isn't a panel discussion on how you value variable annuity guarantees, it's how to hedge them, so let's assume we can agree that \$144 million is a reasonable number. Now, if this XYZ company is not hedging, and we go through that scenario I showed, it goes down 50 percent. What happens? The first thing that happens is our fund fees lose \$87.5 million. We were earning on \$10 billion 175 basis points, so it's \$175 million when we have \$10 billion. The market goes down, the fund value is now worth \$5 billion, it's not worth \$10 billion anymore, and our fee assessment, our mechanics for that, goes against the remaining fund value of \$5 billion. So instead of getting \$175 million, we're getting \$87.5. Now, that's not unlike having a 30-year mortgage on your house. Every month you make the payment and it's fixed. And you had two incomes at that time when you signed for the house, and now you have one income; it's a little tougher to get through the end of the month.

That's what it's like there. In addition you have the GMDB, which is now in the money; it wasn't hedged. Its loss is \$288 million. It was \$144 million, and now it's \$432 million worth. Now, if you wanted to go out and hedge that, it used to cost \$144 million; you have to spend \$432 million, so now your hedging costs went way up because of the in the moneyness. The takeaway point from the combination of the fees and the loss from the GMDB is that they are correlated. So when you lose on the GMDB, on the payout there, because you're in the money, you've lost on your fees too. There's a substantial amount of company earnings through fees and solvency through the benefits at risk.

Our other choice was to buy reinsurance. If we look at the past, reinsurance was probably priced, everybody would agree, a little bit aggressively in the marketplace. Some people said it was mispriced. What happened is they had losses, the reinsurer on this business called variable annuities, and in that process it doesn't take long for them to wise up: It's not the right thing for the product anymore; and for those people who are in the business of writing variable annuities and looking for reinsurance capacity, it's just not there today. There's some, but not very much. I suspect there will be more in the future. In the future, the pricing for the reinsurance will be done using the current sort of new finance theory, if you will. It will be more expensive, but it will be more in line with what Eshwar in the capital markets would say it's worth, so the reinsurer could hedge your primary insurance in the marketplace if it decided to do so. In addition, to get the regulatory bodies to sort of sign off that your reinsurance is real reinsurance and you've transferred risk and the risk is not kind of a vacuum, it might be that they will require that the reinsurers actually hedge this stuff. And if for nothing else, you'd want to do due diligence to see if the reinsurer you had was actually hedging.

If we look at buying options, it's interesting. You have to figure out, well, what options am I going to buy, and in the actuarial field we're pretty good at modeling, right, so we have to go look at the models. We might have to take a look at this whole grouping of the various policies by decennial age groups, male, female, maybe combined, use a blended table, whatever you have to do. That's what you're good at. Then you have to come up with what mortality, what lapse assumptions, all of that usual actuarial stuff to determine what is, what I call the notional amount. Now, the notional amount is the amount that's potentially going to be exercised against you. It won't necessarily be exercised against you because the notional amount I'm talking about for a guaranteed death benefit is for that group of 100,000 lives. It's pretty likely that somebody will die out of 100,000, age 45. Of those people who die, they'll have a certain account value average. You can find out on average of those people who die, how big that risk is. Now, they might die at a time when their fund is above their strike. It's a put option, so there's no payoff, but they might not. You don't just choose to die, right? They might die at a time when the market value's down. That's a put option. So you need to buy a put option that pays for when the market goes down. This will be a notional amount in the first year, the second year and the third year that you need to buy.

Two points to note are that lapses and mortality are assumptions, right, and only through time and experience will you actually have the right numbers. It's only after the fact, so you have to adjust your mortality experience, your lapse experience — in other words, your notional amounts that you're hedging based upon what are your withdrawals and what are your mortalities over time. The other point is that if you're buying options to hedge your option risk and your variable annuity, they don't hedge your fee income. Your fee income is a straight line, and you make more money when the market goes up. You have higher fund values, same 175 basis points. You make less money on fees when the market goes down, so that's a straight line. That's hedged by having the opposite line, which is shorting the shares, so you don't have a profit if the market goes up, you don't have a loss when the market goes down. You might consider that as sort of a pseudo-equity portfolio inside your variable annuity business. If you have other equities in your balance sheet, you might re-look at that and ask if maybe you have too much equity exposure. Some companies are looking at that in that fashion.

Going back to the XYZ example: So we're buying options. What do we do? We do this usual actuarial thing. We have a male, age 45. We go take a look at the mortality table. We have a death or a withdraw rate, so we have beginning-of-the-year lives, and then we have 187 people die. We have an average account value of \$100,000, almost \$19 million worth of exposure in year one. Then we carry the process through, and we say, OK, it's going to go from 19 to 20 and so on, so every year out for those people who live and then die at year end, we have an amount that is at risk. Each one of the bars in Chart 2 is the notional that we have to hedge, and it tells you the amount of hedge, it doesn't tell you what to buy. In this case we're buying just standard put options. More exotic features would look back to these kinds of things — it would be the option that you would buy — but for this example it's quite simple.

I mentioned the assumptions for lapse and mortality. They are pretty important, especially lapses. I don't know if 2 percent followed by 15 percent after 15 years is a reasonable assumption. I just picked it out of thin air, but what if it were different, how would this graph look? If I simply take the lapse rate and cut it in half, now it's 1 percent. This is a good product, the customers like it, right? They stay around longer if they like it, followed by 7.5 percent. The graph would look like Chart 3. That's the notional you're hedging. So to answer your question on if what you are hedging has much to do with what are you assuming, the take-away point is that lapse rates make a big difference on what you're hedging.

If we go back to the cost of these options, each one of those bars in the notional amount, the first one, you remember, was around \$20 million. This first-year put option at the money cost about \$1 million, or about 5 percent, based upon some very simplified assumptions, which in practice wouldn't be used, of course. Volatility has a term structure to it like a bond curve. For the longer dated options, you'd have a higher ball, which is kind of important to this, as well as the different strike

prices and so on. Using those assumptions, which are kind of fictitious, I come up with a price for each one of those notionals going out there, and then I add them all up, and I come out with \$144 million. Now, if I change the lapse assumption, remember that bars or notionals go way up, don't they? If I calculate those, I come up with these costs in Charts 4 and 5. They're all in the same scale of \$10 million, and I add them up, and I get \$275 million. I get dramatically different values for what I am actually hedging.

Practical considerations: I think I made a point that mortality and lapse do matter. You get by with your best assumptions, and then you have to update like you would any actuarial model. It's not like a FAS 97 unlocking, it's kind of like a prospective thing; and then you just re-hedge your current best-estimated future notionals. More generous product features such as the  $n$ -year ratchets increase option costs;  $n$ -year ratchets are simply like in those chocolates, just changing the strike price. I'm not sure what the strike price is looking forward to today, but I can calculate what the value of that is. The exact offsetting options can't completely hedge exposures simply because they aren't exact. There are assumptions built into mortality and lapse, but buying options rather than not hedging can reduce the volatility of your surplus from a year-to-year basis or from a long-term basis, and this is a little bit about what the RBC is trying to get at.

There's a little bit of a problem, though. I kind of let you down this one. It's that options longer than five to 10 years are really not available for reasonable prices in the capital markets. This is not a surprise to some of you who have looked at hedging your variable annuities or are hedging your variable annuities. It's a bit of a problem because you have these options. You saw that string of options that I showed in the graphs of notionals. Each one of those needs to be bought in theory. They go out past 30 years or 40 years or whatever. You can't buy them from Eshwar, he won't sell them to you, or if he did sell them to you, he would ask for so much money you'd never pay it because your product would not be profitable. You know how it works.

In practice, the exposures after five to 10 years probably are going to be delta hedged. Let me describe what a delta hedge is. In a delta hedge book — this is something I did at my previous employer, Safeco, a lot, so I know it well — you have a curved line (see Chart 6), the option is the curved line, and then for a point that is around 1,100 on the S&P Index in this example, I put a hedge on it. It's a tangent to that curved line, and it's simply going to hedge for small movements in the S&P. Now, what does this cost? Remember the option cost \$144 million? Eshwar would tell you that it costs nothing to put on. You're putting futures on. What's the round trip, Eshwar? About \$5 for a \$300,000 trade. That's not Charles Schwab, that's the bank; it's nothing. So the hedging costs are not the costs of a delta hedging; that movement between hedging is where your costs are. I show in this graph that if the market were to go from 1,100 down to 800, there's this sort of gap here. The option value goes up faster than your hedge. You've shorted shares or futures or whatever, but it goes up linearly, and the option goes up nonlinearly. The

difference is your hedging cost. It would be nice not to have to hedge here, but you'd rather hedge as it kind of creeps along in that direction. That's delta hedging.

What are the risks? There are always risks of implementing the strategy other than buying the exact offsetting thing. There's market risk. There's the large GAAP risk that I pointed out. There are volatility assumptions. There are divided assumptions, you know, what comes up with an option price. There are always different assumptions, and you might not actually, over a long period of time, get them right, just like mortality and lapse. Use your best estimate; use current market parameters, not historical figures. Operational risk is something that has been touched on at this set of meetings. Enterprise risk-management and the like, these types of topics talk a lot about operational risk. They're hard to measure, but they're very big. These headline risks that you read in *The Wall Street Journal* aren't from miscalculating the delta and putting on just a few too many futures or not enough futures, they have to do with world traders: That's operational risk. This is a big deal; this is unauthorized trading. It's inadequate trading in risk-management systems, not being able to control the derivative trader. This is what keeps the boards of directors up at night. It's not the idea that you're trading and hedging, or maybe you're not hedging. That should keep them up, too, I don't know. So delta hedging is ideal for variable annuities if it's done properly and executed and monitored properly.

Going back to the XYZ example, we can buy the option for \$144 million. The expected cost of the delta hedge program is less than \$144 million because you've taken on some risks. My experience is you can save somewhere between 10 percent and 15 percent of the option costs by delta hedging. Now, it's compensation for assuming the risks in the market, these GAAP risks, that if you bought the option from Eshwar, they would have the operational risk and they'd have the GAAP risk, if you buy it from him. If you do it yourself, sure, you'd save a little bit of money, 10 percent to 15 percent of the option cost, but now you have the risk. Delta hedging requires experienced derivatives traders and proper systems with good risk-control procedures, so there is a little bit of investment in people, systems and procedures that has to be done there.

In the derivative space we talked about delta, gamma, vega, rho: these are the sort of Greeks. In this particular example I've put together, it seems like a pretty plain, vanilla variable annuity guarantee, and the measures are 226,000 delta. That's the sensitivity of the underlying S&P. Gamma, that's kind of the measure of the convexity or the curvature, 25,000 per 1 percent move in the S&P. Vega, it's very important, \$9.4 million. That's a pretty good size per one ballpoint change. Rho, that's the interest rate. That risk is \$601,000 per one basis point. That's a big number. Let's look at this now. For delta, \$226,000. What does it all mean? It means if the S&P were to move, the GMD liability would increase by this amount per decrease point, one point in the S&P 500. So for every point the S&P goes down, the company's liability goes up by \$226,000. This is what it is. It's that straight line I showed you in the graph. Now, we would need to short \$226,000 of



shares in the S&P or an equivalent amount of futures in order to hedge this. So if the market goes down, if you short the futures, you'll get cash back to pay for this increased liability, so it's hedged in that sense, but the delta will be needed to be recalculated frequently. Every time the market moves, you have to recalculate the delta, in straight moves, volatility moves. All these things that go into the evaluation of an option and the delta would have to be recalculated, and you might have to adjust your hedge for that. Even if the market didn't move, the other parameters could move, and you might decide you need to readjust; otherwise you would have a market exposure. Are you hedging, or are you trying to take positions in the market? Hopefully you're hedging. Delta is similar to bond duration. It works well for small changes just like bond duration, and it's between hedging, that's the important thing. A new hedge means on that curved line we've just drawn a new tangent line. That's what hedging does. If you don't hedge between the big movements, whether you go five days or one day, then it is between hedges that you have that gap.

Let's look at gamma. Gamma is what I call the sort of ineffectiveness. It's the cost of delta hedging. You have these gaps on each side. \$25,000 per 1 percent move in the S&P means that hedging will lose this amount whether the market moves up or down; it doesn't matter. Either way you lose. This is the cost. You add all those up, you come up with the cost of hedging. It should be that \$144 million number at the end of the term if it was done properly. It's a second order term, right, like an expansion, it's a square. It means that for a 1 percent move, it's \$25,000. For a 10 percent move it's not 10 times 25 or 250, it's 10 times 10: \$2.5 million. So now if we didn't hedge for a number of days and the market actually moved in one direction up or down, it doesn't matter, by 10 percent between hedging, we actually lost \$2.5 million. That's a pretty significant number compared to \$100 million or \$200 million size of something we're trying to hedge. The actual rebalance of a hedge is pretty important. Again, the sum of the gamma losses, if it's hedged right, really is the cost of the option in the delta hedging world.

Looking at vega: Vega is a sensitivity option, value changes in volatility. So \$9.4 million vega per one volatility point means you lose this amount. If an implied volatility moves from 16 percent, which is the number I started with when I calculated the \$144 million number, and goes to 17, it's kind of a small move, right, 16 to 17, but you have \$9.4 million gone. Longer-dated options have a lot larger vega. Vega is the mark-to-market accounting volatility. You could delta hedge, and you could still have an outstanding option that has a vega sensitivity, so it's insignificant. Eshwar would never want to do these elongated options. He would hedge a vega.

So how much can this implied volatility move? It can move 20 points. Look at Chart 7. This is three-month implied volatility. It's the VIX, and this is the time period 1997 through 2003. And you can see that we were kind of in the 16 percent range. That's kind of where we're at today, but then you get these hiccups, right? It goes up like this. The spike at 1998, that's probably the Russian debt crisis. We're

probably familiar with that. It went to 40. Now, there's more than 20 points. Mark that through your income statement and balance sheet, and you'll hear some noise from upstairs, won't you? In 2001, I think Enron is what that spike is. In summer 2002, that was a tough time in the credit world. Enron just went bust, we had WorldCom going bust, we had spreads that were out of this world. This is the heartbeat of the equity market. This is where you see it, and then it came back down, so it looks like an interest rate, but the point is it's pretty volatile. If you have to hedge, I'm hopeful you don't have to hedge right here. If your strategies for hedging don't require that you can keep an open position and then lock it in when it gets bad. That is not a good strategy. That would mean you'd pay a lot of money when it gets back.

Moving on to rho, rho is the sensitivity measure of the option value to changes in interest rates. In my example, I calculated \$601,000 of rho. In this case it means the company gained \$601,000; it increased from 4 percent to 4.01 percent. That's like having a short position in five-year bonds of \$1.4 billion. That's a big number. Now, it would be a smaller position in 10-year bonds. That's usually hedging swaps, euros and these kinds of things, so that shouldn't be a worry, but the thing to do is to understand that the types of options you have in your variable annuities have some interest rate risk. It's a little bit different from having a fixed annuity and having an interest rate risk. The type of feature you have in your variable annuity can significantly change the rho risk. A ratchet, for example, decreases it. This is not a ratchet product.

In summary for delta hedging: Delta hedging is used extensively on Wall Street. It's a powerful tool to hedge variable annuity guarantees. There is an expected cost savings for delta hedging as opposed to buying the option, but there are residual market risks involved. Delta hedging exposes you to significant operational risks and should be done only by experienced traders with proper systems and risk-control procedures. I think for insurance companies, if we look at the problem you've got, a long tail set of put options, you can't buy them. You can't buy in the structured market; you can't buy them in the reinsurance market currently. You need to do maybe some combination of options and shorter-term options and maybe some delta hedging. It's a pretty viable strategy if you have enough size to buy the right systems, buy the right traders, buy the right risk-control procedures. It's a viable solution.

**MR. ESHWAR NARAYAN:** The first thing to say about delta hedging is you can use futures to do these. Futures are an exchange for your products. Most of these are cash settled, and they're available on most major indexes, including the S&P 500, NDX 100 and Russell 2000, which is gaining popularity as the small caps do well. Equity futures primarily trade on the Chicago Mercantile Exchange, which is a very highly credited institution with a very good credit rating. They are very liquid products, and the market is also very deep, which means if you want to sell 100 futures, there will be a bid for the next 500 you are looking to sell. Most of these take about a second or two to execute depending on the size of your order. Most investment banks will also provide you with electronic platforms so you don't really

ever have to talk to a live person. These platforms will automatically integrate with your back office, and you'll get the trade settlement.

Most of these things, as Brent mentioned, have very, very low transaction costs. An S&P 500 future for you to trade it round turn, to buy and sell, will probably cost you \$5 a contract, and the notional of the contract is close to \$300,000, so as you can see, that's a very low transaction cost. The margin requirements are also very low. What you'll be required to do is post an initial margin and then a maintenance margin, which is what the cash flows for mark to market will be taken in and put back into. If you want to tailor your hedging to a much smaller size, minicontracts are also available, so you might want to use a mixture of these two. Minicontracts can be anywhere from one-fifth to half the size depending on what product you're trading.

As I said, these futures are market to market every day, so cash flows will occur if the market moves, and that will basically come out of your initial and maintenance margins. Pricing is very transparent, so if you pick up the phone no one can say that that didn't trade there or this didn't happen. It is very transparent; it is very easy for your auditors. There's always time in sales, and no one can pull the wool over anybody's eyes in these markets.

Now, if you would choose to hedge with options, as everybody here knows, options come in various forms. You have your regular American and European styles, and then you have your more exotic options, which we will get into a little bit later. Exchange-traded options, or listed options as they're known, are the most commonly used options by the investment community. Most people generally trade options in the first three months, so if you are an investment manager and you want to take advantage of movement in a stock, chances are you'll buy the one-month or two-month option prior to earnings. Listed options also provide a very deep and liquid market, especially in index options, which is what I think most of the people here would be using. The market is very deep and very liquid, so you can get relatively large notional sizes traded. The main thing is that listed options are guaranteed by the Options Clearing Corporation (OCC), so if you buy a put option in the listed market, you're actually buying it from the OCC, and if an investment bank is selling it to you, they're selling it to the OCC, so the credit risk is mitigated by the OCC, which is a very highly accredited organization.

There are lots of limitations to listed options, especially when addressing problems such as hedging GMDBs. They're available only for a maturity for two to three years, and it looks like it's not even going to scratch the surface for the kind of hedging you folks are looking to do. They're available only in two styles, American and European, and most index options are European, which means you can exercise the option only on the very last day. Listed options are available only for predetermined expiration dates, so you cannot really match your liabilities against what is available because the expiration dates are already determined.

Now, to fill the void, there are your over-the-counter (OTC) options. You can pretty much tailor OTC options to whatever you need in terms of expiration and style, and most investment banks will be glad to trade these with you, but they're available for maturities of only up to 10 years, and between five and 10 years you will find the pricing and the liquidity is significantly less than four to five years. Now, you need to trade exotic options OTC, because everybody has a different requirement, and as a result, exotic options can fill the void left by the listed options. OTC options are not guaranteed by the Options Clearing Corp.: you have to face the investment bank that you buy from, and the investment bank has to face you, so you're directly dealing with the investment bank. The investment bank is dealing with the insurance company as a counterparty, so there is that counterparty credit risk. You just can't pick up the phone and start trading OTC options. You need documentation and credit approval requirements from the investment bank and vice versa. The investment bank has to have the right kind of credit and structure to deal with the highly accredited insurance company.

After listening to Brent, for most of your liabilities you can use European options, or you can use various exotic options to hedge these. Now, your structures might require a certain kind of option that you'll be able to come up with, but you won't necessarily be able to trade that with an investment bank because most investment banks have their own lists of approved options. These are options where the paperwork has been done, the due diligence has been done, the banks have their own hedging strategies, so as a result they are ready and willing to trade those. Anything beyond that, I'm not saying it cannot be done, but it will take a longer time to get that approved, and having approved options is a very important part for the compliance and legal part of the investment banks to cover our open-ended risk from writing these options. Now, I say exotic options are generally more expensive than vanilla options, which is not always the case. Asian options are cheaper, but if you look at more like a lookback or something like that, it becomes much more expensive.

Insurance companies come with regularly hedged equity and index annuities, and some of the options that they use are listed over here. I don't want to go into the detail of each option, but for an Asian option at the end of near expiration, the value is not determined by one date, but the average of several dates: It can be monthly, quarterly, daily. You know that you can have a forward starting option that's either at the money, which is 100 percent, or slightly out of the money. You can determine the percentage strike and purchase the option to date for a liability that might incur in the future. Cliquet options are just a strip of forward starting options that help you lock in monthly returns or quarterly returns, whatever you might decide to have. Lookback options hedge some of the things that Brent was talking about earlier; these are probably the most expensive among all of the exotic options.

The way I looked at the problem was that these GMDBs create the short put positions that Brent was talking about, and these short put positions occur over

various maturities, over various strikes. So I don't know, but just speculating, it looks like you need at least a strip of put options to hedge some of these liabilities created by these GMDBs. Now, if you buy an option, and you want to reduce the cost of that option, you can write a lower strike option, and this creates what is called a put spread. If the S&P is at 1,100, and you buy the 1,100/900 put spread, this means that you buy the 1,100 strike put, and you sell the 900 strike put against it. What it does is, it just helps you offset some of the heavy premium that you'd be spending on this and manage to collect something for the 900 strike option that you write against it. It is just a way of reducing the cost.

Longer-term options like Brent was talking about can be quite expensive. For example, recently we traded a seven-year option, and the cost of that was close to 20 percent of the underlying. That is quite expensive compared to the fees that you're collecting for these variable annuities. That is one of the main mismatches that I saw. Also, as you hedge these variable annuities, I thought \$10 billion was a good-sized number, but apparently you were only scratching the surface with \$10 billion. There is a limited amount of risk that investment banks and counterparties will absorb from insurance companies, and their risk appetite for writing these options and essentially for you to lay off your risk to them will diminish as the notionals start to increase. In the end, you might need a combination of both OTC options, as the investment bankers' ability to write these options fills up, and listed options and delta hedging to mitigate the risks that are being created.

As I said before, you cannot start trading OTC options immediately. Very specific documentation is required by both our legal compliance and credit departments within an investment bank before an option can be traded, and this can take anywhere between, say, a month, sometimes as long as six months, depending on what the counterparty's requirements are and what the investment bank's requirements are. Counterparties also need to perform due diligence on each other. Most investment banks have a small army of people who have been hired just to make sure that these functions run smoothly. There's legal, there's compliance and there's credit, and then there are the documentation folks. As I said, time is needed for this, one to six months, and the further you plan in advance, the easier it will be because you'll run into a lot of unexpected delays if you don't plan in advance.

Now, the SDA is the Swap Dealers Association. The master agreement covers the legal and credit relationship of all parties. Once you decide to trade OTC options, you will send your financials, your board of directors and your structure to our credit officer, and he comes up with the credit support annex (CSA) that will govern the credit terms for relations between an insurance company and an investment bank. In addition to this, when a trade occurs, we will send what's called a confirmation. It's usually six or seven pages long and governs all the economic terms for each separate transaction, so every listed detail you want to cover will be covered in the confirmation. Beyond that the SDA and the CSA govern anything else, and anything else that might not be covered in the confirmation will be covered and settled by the SDA and the CSA.

**MS. JOSIE PALAZZOLO:** So, what have we learned so far? Well, we've learned that variable annuity guarantees are quite risky, and something that we should be doing is hedging. We learned from Brent that these annuities can be modeled as written put options, so there's the model and the aspect that has been defined. We learned from Eshwar that there are things in the capital markets, in the financial markets, that we can use to effectively hedge these instruments. We also have learned that there are good reasons to do this, and there's also going to be the necessity to do this because regulatory changes are going to force you to do it. We also learned that experienced people are required to handle transactions, to handle modeling and to handle the whole process of having derivatives traders in the organization. And we've learned that large losses can really bring down an organization if you don't know your risks. I'm glad the list is not that long yet, but take it from capital markets and others, you don't really lose as Brent said, if you're not delta hedging. It's not understanding the risks you have and not understanding that a hurricane can come and really take you out.

I'm here to talk to you about tools and what you can do and what you need to do within your organization. We understand that a variable annuity is quite complex, and so you need knowledge in the industry of insurance as well as understanding of the capital markets. You need to translate. I think the most important thing, the first step, is that you need to translate what you have and model it as some kind of financial instrument, and you need to understand what your risks are. So knowing the risk drivers inherent within that variable annuity is very important. Brent nicely said let's model these as put options. Once you model these as put options in the financial world, you need knowledgeable traders, you need control of the trader and you need the capital markets' front and back office systems. Why? Because you're going to hedge them with capital market instruments.

Now, you're going to need hedging tools. Very simply, I guess most of us can do it in a spreadsheet, and Excel is a great tool to use, but it does not have the control that a pure risk system or a treating endless system would have. You need hedging tools that kind of tell you, well, if you want to hedge in futures, we can tell you how many futures to buy. If you want to do "what if" transactions, what if I hedge with this, what is the risk profile of my portfolio, then let me understand what I'm sensitive to, what are the risk drives inherent within my portfolio, and let me understand the accounting treatment of these hedges. If there are futures, you're going to have margin accounts. If there are options, there are other things you have to pay out. With swaps you have cash payments that happen every three or six months.

That whole understanding of modeling and understanding the assumptions — I always say that understanding the assumptions you make, as well as understanding the risk tools, is really a science and art of the industry. There's no right, there's no wrong, it's just if you understand your assumptions, you will model them and understand what you can hedge and cannot hedge. That's the whole process of risk

management, and once you have this all underneath, you can do scenario analysis, not only stressing what your current environment is and understanding what the values of your whole annuities were today, but what if: What if the markets move, what if my interest rates move up, what if the equity index goes to this, what if volatility moves from 25 to 50. All that is exactly what a risk-management tool does. It's really helping you understand what's going to blow you out. It also should help you calculate capital reserves and understand exactly what is inherent, how much you need to put on the side for accounting.

Let's talk about what the risks are underneath this umbrella that you have in this variable annuity. Very clearly, you have market risk. You have interest rate risk, you have equity risk, you also have liquidity risk and I am hopeful you'll use instruments that are quite liquid in the market. You have to understand what you're sensitive to. Have my hedges closed at the risk? Guess what, they might have closed it out today, but what happens if the equity index moves by 5 or 10 percent? If you're only doing delta hedging, all of a sudden you're exposed again, so you need to rebalance your hedges.

There's also credit risk, and when does credit risk happen? If you're using liquid options that are exchange-traded, you don't have the credit risk. However, as Eshwar said, that's not going to help you in really tailoring the type of options that you require, specific maturity dates, specific long-term type of options. That's not readily available. As soon as you enter into an OTC derivative, you have counterparty exposure. Now, granted, most likely you have counterparty exposure to someone like Wachovia, J. P. Morgan, UBS, which are high-end entities. Understand that when that credit exposure is in your favor is when that's the biggest payout from them, and therefore you can incur losses in insuring who you buy from.

Operational risk, I think, is probably going to be the most important thing. You're insurance companies, you're not really built-in capital markets, and you might not have the infrastructure in place such as a capital market shop like a bank, which has invested millions and millions of dollars ensuring that front-office processes and middle-office processes and back-office processes are in place. They are thus ensuring that the trader, who is setting up volatilities and these curves they use for valuation of these instruments, is independent from the back office, which says I'm going to use another set of assumptions, I'm going to control and ensure that the mark to market of these derivatives pricing is on the up and up, and that my trader's not controlling the kind of inputs that go into the pricing of these. You really need to have an infrastructure, as well as policies within the organization, to control the checks and balances of a trading organization. You need very experienced people in front, in back, traders and operations to have this happen correctly, otherwise you find yourself in jeopardy that you really modeled the risks correctly. You feel you've hired your traders and are saying, OK, now I'm all fine and dandy, and not realizing that, I mean, the obvious one you should know, you might have a trader who has done bad trades and just puts them in his drawer, and they don't

flow out to the back office. That whole control process is actually the thing that can blow up on you. It's almost as bad as not hedging. It might even be worse than not hedging, so it's important to understand that.

Let me talk a little bit about the kind of tools that are out there that a risk-management system can have. Risk management is two parts. I sometimes divide it between desk-level risk and something called enterprise-level risk. The difference is the desk-level risk is to ensure that the trader and management at that desk have the tools in place so they can do their effective hedging and they can understand their Greeks, the sensitivities of delta, gamma, rho, and they can actually go out there and help them, what they should be trading in. That's one aspect. Then you need an independent overview control for risk where it's a different group or a different person who is saying, OK, how are you doing it, I'm going to make my own assumptions, and I'm going to value them and do my own scenario analysis and all of that. There are two levels, an enterprise level and then the desk-level trading tools.

Things like desk-level trading tools help in effective hedging. As Brent fairly put it, you need to know your delta, your gamma, your rho. You need to understand this because that's what you're going to go out there and hedge, and when you go and call Eshwar at Wachovia and say, "I need something that will look like this." So you need your trading and risk systems to be able to help you model exactly what you're going out to the market to look for. There's something called VAR, which stands for Value at Risk; it's the amount you can lose over some defined period with some percentage confidence. That is what the capital markets banks use, and regulatory agencies have really latched on to this idea of VAR and force capital markets to have regulatory requirements based on this. It's unclear whether that's what the regulators are going to instill in the insurance market, but something like it will happen. Really, all VAR is is it's a simulation of possible events, of possible market environments, and then looking at the value of your portfolio under each one of those environments, whether it's historical, which means you might decide to take the past 250 days of what the actual market environment has been and replay it on your portfolio today to look at possible outcomes. So that's one. Another way of doing it is called Monte Carlo simulation, which I'm sure you all can teach me a few things about, but it's coming up with probable outcomes that you then replay on the portfolio.

Then there's something called hedge prescription, which pretty much says here's a strip of futures that I can hedge with: Here are the sensitivities, the risk factors that I've calculated. Please tell me how to hedge in the futures market. All risk-management tools pretty much have this, and pretty much you can do an Excel spreadsheet these days as well. Flex hedge is a concept that we came up with, which is a minimization-type tool. It's pretty much saying I'm going to create my hedge pallet. My hedge pallet can have options in it, it can have futures, it can have swaps, it can have Asians. So you create a pallet and say, "Calculate my exposures, my risk profile of the portfolio, the annuity with its hedging instruments, and then



tell me what the best two or three hedges are based on this hedge pallet." It's almost trying to pick out the ones that you should go out in the market and hedge.

P&L decomposition is something that pretty much will explain itself to you. What that is, it explains how you're doing. Not only do you want to know where you are today, you want to know how well have you done in your hedging strategy. How has the exposure changed from one month to today, and tell me how I'm doing. So in the capital market this is a tool that's quite interesting and important. Oh, wow, my delta hedge is working; oh, wow, I got blown up in rho, that's something I didn't think I needed to hedge, or it was diversified away and now it's come back to haunt me. It's a good way of understanding why things have happened, and that's a great learning experience for why it won't happen again once you understand why. Then the credit exposure is you need a tool to pretty much say what your exposures are to your counterparties. How much is my exposure and the value? It's almost like the back flip. These are pretty much the ones where your market environment has gone against you, but you know that you have a hedge, and so someone owes you money, and it's really the amount of how probable it is that that counterparty can pay you that money.

**FROM THE FLOOR:** This may be a really simplistic question, but I am concerned about delta hedges as a cost of rebalancing, particularly if you're in an environment where you most need the hedges. Will the rebalancing cost eat you alive if we're in an environment like the one that so many companies went through a few years ago?

**MR. MARTONIK:** In a delta hedging program you're going to be maybe trading on a daily basis, rehedging with your delta, your short future position, say, as the market goes down. So as the market goes down, you're going to be having a larger short position in futures. As Eshwar said, the actual cost of trading is not a factor in this at all. What was it?

**MR. NARAYAN:** It costs you about \$5 to buy and sell, round turn futures, one contract.

**MR. MARTONIK:** So that's not the cost. The cost of delta hedging is if the market were to gap down between hedging. Now, you may be hedging frequently, which it doesn't cost a lot to do, and the market's moving in a nice manner, which basically is what it has done since 2000. There have been some days that have been not so good, but there haven't been any terrible 20-percent down days. It's a 20-percent down day when the delta hedging loses you money and your experience with volatility between hedges was higher than what you expected. Remember that option cost \$144 million: That assumed a 16-percent volatility or some assumption of volatility. Now, your delta hedging between hedges might experience more than 16-percent volatility. That's when you have an excess cost. It will cost you more than \$144 million by the time you're done. If it's less than 16-percent volatility, your experience is you'll have a savings.

**FROM THE FLOOR:** I think I would disagree with what you're saying on the delta hedging. If you're short an option and you dynamically hedge, each time you dynamically hedge you lose money. You lose money on your gamma. It's not just the cost of purchasing or selling the futures. If you're short a put option or a call option, in fact, if the stock market increases, you're going to have to buy more futures, so you'll have to buy more when the price goes up. Similarly when it decreases, you'll have to sell when it goes down. The inherent act of delta hedging a short option costs money.

**MR. MARTONIK:** Actually, I think we're in 100-percent agreement. It's not that the cost of the rebalancing terms of the hedging costs a \$5 turn, that's not it at all. It's when you had a position in the futures, and the market moved, what we're talking about in regard to the cost of delta hedging is the difference between that curved line that I showed and the straight line. That's what it is. So you're exactly 100 percent right. It's not the transactional cost, it's the sort of ineffectiveness cost, and those are those gaps between rehedging. Each one of those gaps you could add up, and that is your effective cost.

**MR. NARAYAN:** And just to add to that, most traders are very disciplined how they re hedge. If the market moves down only, say, 50 basic index points, they're not going to re hedge, but they might have a certain sliding scale, like every 1 percent move I will re hedge, and from there if it moves down another 2 percent I will re hedge. So as a result if you're disciplined over the longer term, that can help you more than just trading in a haphazard way.

**MR. MARTONIK:** In fact, your risk-management department would have some sort of trading set of parameters, sort of the boundaries of trading. So here are the maximums, and there might be some trigger points in between. That's what Eshwar is talking about. Now, from where I came from, we traded pretty frequently, and we had a very small window of what was the amount that we could be either long or short in the market place when we went home that day. The reason, of course, is remember that square of a change, so if it moves twice, your losses are not twice as large, they're squared, they're four times as big.

**FROM THE FLOOR:** I'd like to compliment the speakers. I think you did a really nice job of outlining the subject including describing the limitations. While clearly there's value in hedging, I'm interested in additional comments about the limitations and maybe particularly thinking about the transfer rights that variable annuity policyholders have. I realized you were using some examples, but the S&P index is not typically the only fund available to variable annuity policyholders. You have a whole array, 40 or 60 funds, that they can choose from and move between, and that, I assume, creates some limitations as well. Maybe this goes back to sort of really simplistic questions. Is there any way that you can characterize what proportion of the risk in variable annuities associated with these writers can effectively, realistically in the practical world be hedged out?

**MR. MARTONIK:** You've got limitations, and you mentioned these transfers between the underlying funds: Call it basis risk, and which is also where I showed an example of S&P 500. So if I handle basis risk in one swoop, I would take your NASDAC or your managed funds. I mean, right now a lot of you are not hedging, right? So some hedge is better than no hedge if we go there. I would probably beta your managed fund to an S&P, so if it's a 1.25 beta, the S&P, instead of having \$20 million notional, I'd have \$20 million times 1.25 in S&P futures to hedge with. In terms of basis risk, insurance companies, for fund transfers and this type of thing, probably are going to have to eat that one. Right now for the reinsurers there is no market for this. It's a great kind of residual risk, but it's one that's out there in the marketplace. For those people who haven't thought about this one yet, you've got an S&P 500 fund or something beta to that, and the market goes down 50 percent — that's what happened, right? And then you get kind of scared, it's human nature, and say, "Let me out of that, that's my net worth, right?" Let me out of that and let me go into bonds. Well, in some sense you just put a sinking point for the insurance company. Now you're in bonds at 4 percent maybe, you're down 50 percent, and now you're in 4 percent bonds. Guess what, you might die, and the insurance company might have to pay. It's kind of a sync. Does that cover the question?

**FROM THE FLOOR:** In part. I guess I'd be interested in comments from any of you, maybe particularly from the capital markets standpoint. It sounds as though you probably wouldn't choose to sell the type of variable annuity product that is currently being sold with the options available.

**MR. NARAYAN:** I think many investment banks have sold much more toxic products, and I'm not saying that this product is toxic. Another limitation is that we're talking about the S&P 500, which is the most liquid index. The minute you step away from this, and with equity index annuities normally you can buy the Russell, the Mid Cap, even the NDX 100, but the minute you step away from the S&P 500, your liquidity goes down, the prices go up, and like I said, the amounts of risks that banks are willing to be short in the Russell or Mid Cap is very different than what they can do in the S&P 500, so that would definitely be a limitation. The larger, more liquid indexes are much better.

**FROM THE FLOOR:** Thank you. That's sort of what I expected. I think one additional risk that I'd say perhaps living benefits have is utilization risk. These options won't pick up that curvature, it's just pure capital markets risk curvature that these things will pick up, so if with the living benefit you're expecting low utilization if markets behave in a fairly — if they go up — if all of a sudden the markets go down, then you have an increase in your expectation of utilization. That also will be something that the insurance company will have to absorb.

**MR. SCOTT H. FRANK:** I just had a couple of comments. I think Eshwar was mentioning, and I don't know if it would be too practical, but I don't think you'd see too many insurance companies do that strategy where you would purchase your put

option at 1,200 and sell at 900, just because I guess under 900 I wouldn't have any protection. So there might be something where you might get somebody to sell a call option and then buy a call option at a higher price so that they get a bigger call insurance, but I don't think practically that example would probably work for most companies. One thing I know just from reading about the stock market's up days where they are going through averages of 10 percent a year, that if I'm out of the market 20 days even in the last 10 years, my average return is 2 or 3 percent or whatever it may be. I see the risk on the delta hedging. Has the same work been done on the down side of the market? As was so well pointed out, I mean, it's a small change. If I wake up in the morning and the S&P futures are down 100 or 200 points, and in fact all these catastrophic scenarios that we're worried about in this area, aren't they in fact more likely to occur on those really down days? So doesn't a delta hedging program have a very high probability of having a very large gap risk, and the investments in this really aren't the answer to what most likely would be the major problem that would come up in that?

**MR. NARAYAN:** Going to the part where we talked about put spreads, you're right, it's not for everybody. If you do have the stomach for only being protected, say, if you buy the 1,200 to 900 put spread, that means your maximum payoff is going to be 300 points, and if you realistically think that since you're already short put options anyway, you realistically think that you can get away with doing that based on what your risk appetite is, then it's a possibility, but it's not for everybody. It is just one of the ways that in the listed option and even the OTC option market people sometimes help mitigate the cost of buying the option. It is just merely a suggestion.

**MR. MARTONIK:** On the gap risk down, it's interesting: I've run this negative gamma position that we're talking about, this risky position, and during the last five years, the biggest movements have not been down. In fact, they've been up, kind of 5.8 percent in the S&P in one day, and that hurts. That kind of hits you a little bit. So what are the probabilities of things going down? I don't know. You can do your own calculations, but one thing I do know is that when the markets are down, one thing that happens first is that there's a limit down, a limit of 60 points roughly.

**MR. NARAYAN:** 70 points.

**MR. MARTONIK:** 70 points now. They change it, I think, every quarter depending on the size of the underlying S&P, for example. So 70 points down is the limit, that's 7 percent. And then you can read up on it, but there are all these different kinds of little levels depending on what time of the day. When that happens there's some probably reason why that happened — make up any example you want, nuclear attack, whatever — but in that environment you can be assured that every central banker in the world, because these things kind of correlate to one another after a big event occurs, is going to be on your side of the table when the market goes down. Now, the Nikkei has gone from 3,000 to kind of 12,000 range without a crash. The NASDAC went from 5,000 to 1,900 without a crash. The S&P went from

1,500 down to 700-something without a crash. The capital markets actually like — don't mind — a nice even move, where even is kind of defined to be less than 5 percent.

Now, take the opposite of that. What happens when the markets go up 10 percent in one day? I don't know why they might go up 10 percent, but suppose they do. Who's going to fight against that volatility for that one day? Nobody. I can make a pretty good case that after 1987 when they instituted all these sorts of catches to the markets moving down that maybe the principal risk is not down, at least not down significantly in one day between hedges. Now, I was running the delta hedging written option position on Sept. 11 — at least I thought I was. Of course, the markets never opened that day. It wasn't until a week later that they opened. Now, we had a loss because the market gapped down 60 at that time, and then the market opened up, and it has some rules to it and it went up a little bit and it went right back down. You remember this. When you're writing options, that is a principal risk.

**MS. PALAZZOLO:** I was going to say that risk-management tools are quite good in normal markets. I think the only thing you have is the stress scenarios that you can apply to your portfolio to understand where the bumps are going to be and perhaps to put away more money in reserves for that rainy day. That's one way you can combat it.

**FROM THE FLOOR:** Just a question to keep exploring this issue of how you deal with the gamma risk of these positions. One straightforward way that you've addressed using is buying options as well as delta hedging, but it sounds like you're implying that markets all go down together, that you can deal with this gamma risk with Treasury futures or anything else that will be there as markets go down. I'd just like to ask you to comment a little more on what works to deal with this gamma risk.

**MR. NARAYAN:** To deal with a short gamma position you need Pepto-Bismol, of course, but other than that, when the market gaps up or down, you can see our traders in the morning all stressed out, and the way they do it, the ones that are successful in the long run, is through discipline. You're not allowed to go home short more than, say, \$50 million notional in SPX, and you have to be disciplined in how you approach it. It comes with a lot of hiccups, and there's a lot of stress involved. If you buy options to hedge yourself instead of just delta hedging, then you get rid of a lot of this gamma risk, and you transfer it over to my trader, who is drinking the Pepto-Bismol. I don't know if it answers your question, it's just that it's more of an art than a science thing that you have to do this, because sometimes the market goes down, and you think it's going to open limit down, and suddenly it bounces back up. After the events of Sept. 11, when the market opened, it opened limit down, and then in a little while, we called it a patriotic bounce, it bounced. And so if you kept your discipline on those days, chances are you'd still lose money, you'd still have a negative P&L, but it will not be as bad as if you were haphazard in the

way you traded things. I hope that answered your question.

**MR. MARTONIK:** I think I'd just finish that one up with one comment. It's that the gamma risk is a risk, right, an operational risk or other risk. They're small compared to not hedging. These are kind of residual risks, but they are valid risks. Operational risks could be a lot bigger than residual risk. They like to pick the company down. That's what happened to Variance, right, all the surplus is gone. That's a bad trade.

**MS. PALAZZOLO:** I think the effect of not hedging is pretty much you're taking a strong view of where the market's going to go, so really all hedging is, is trying to control your market moves. But almost like in the capital markets of asset liability management, if you decide to have a mismatch of risks and have risks in your portfolio, it's a view. It's a view that you're taking a part in the market.

**FROM THE FLOOR:** You talked about moving away from the S&P and how the liquidity goes down, the costs go up. What about the international markets? There's a significant exposure to international funds within the variable annuities. What are the hedging instruments for delta hedging that companies are using that you're seeing? Also, are they then getting into currency hedging as well?

**MR. NARAYAN:** At Wachovia we don't deal with international markets, so I'm going to have to draw on my experience from other banks. There are futures available to hedge on the Nikkei. There are other products called exchanged-traded funds, but I think they tie up too much capital. You can use, say, the MSCI indexes or other indexes that you have out there where futures are not available, but most of the people use these broad-based futures like Nikkei trades on three different exchanges, as well as trades in a dollar-denominated contract on the Chicago Mercantile Exchange. You can also put in what are called quantos, where the currency exposure is taken over by an investment bank for whatever fee they charge, and as a result they deal with your currency exposure. That is only if you can offset your liability 100 percent, and insurance companies are some of the bigger users of FX and FX forwards and so on if they have the exposure. When it comes to international markets, as I said, I'm not as experienced, but these products are available for you to use, and I couldn't comment on the liquidity of these products because I've never actually dealt in them.

**MR. MARTONIK:** I guess there is one other instrument that we didn't really cover in today's topic, which I used a little bit at Safeco. It's called the equity swap. It's like an interest rate swap, but it's equity swap. In my example I think I had \$226,000 of exposure to the S&P. I could have an equity swap that has a similar exposure, exact same payoff, and I wouldn't be trading the futures for some core amount of that delta exposure. If you look at the delta, do your analysis under Josie's world with the risk-management system, you'd find out that that delta is fairly well behaved for a core amount of sort of reasonable boundaries of the S&P's movement. You could put on an S&P 500 swap, or if it were a foreign exchange,

you could do a similar thing with your investment bank for a term, and it's the exact position as having a future. Maybe the future doesn't trade as liquid net, you might like to do an equity swap.