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CATASTROPHE EXPOSURE

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The panel will discuss a number of issues relating to catastrophe exposure, including: techniques for measuring exposure to catastrophes and the problems of aggregation; how to calculate and monitor losses; and the use of futures contracts as a means of spreading the risk.

MR. PETER K. CLARK: We've got two Englishmen on the panel and a large American audience, but I think we'll leave the international elements at that. I'm not going to follow the example set by the president of Actuarial Approach for Financial Risks (AFIR) and conduct the entire proceedings in French. But I do warn you; David Sanders does speak fluent French, so if the questions get too difficult, we reserve the right to answer in French. I would like to introduce the members of the panel. I'm the actuary and vice president of CNA International Reinsurance, which is a subsidiary of the CNA Insurance Group based in Chicago. I was involved with the Institute of Actuaries' working parties on insurance futures last year, and I shall be discussing insurance futures and their possible use regarding catastrophes.

David Sanders has a B.A. in mathematics from Warwick University and studied for a Ph.D. at Liverpool University. He is a Fellow of the Institute of Actuaries, an Associate of the Society of Actuaries, and a member of the American Academy of Actuaries. He worked as a consultant with Mercer Fraser until 1988, and he is currently actuary for Eagle Star Reinsurance. He tells me he's had four jobs in six years, but they've all been with Eagle Star. Previous to Eagle Star Re, he was an actuary working on commercial business, on strategic control, and on the international division. He has written many papers on insurance issues, including the recent "Option Pricing of Reinsurance," and "When the Wind Blows: An Introduction to Catastrophe Reinsurance Modeling."

And I'm also pleased to introduce Stuart Mathewson. Stuart is a Fellow of the Casualty Actuarial Society and a CPCU. He graduated with an engineering degree, but then saw the light and decided to become an actuary. He's currently a consulting actuary at Tillinghast. He's been involved with catastrophe modeling for seven years, and previously worked for a reinsurance brokerage. Stuart is going to be talking about modeling for catastrophe exposures. David will then discuss some of the problems of using models. And then I will talk about insurance futures.

MR. STUART B. MATHEWSON: I'm going to go over modeling in a fairly brief fashion. That is, I'm going to talk about what it is, where it came from, what we do with it, and how it works. I'm going to try not to get in any more detail than I have to, but there will be time for questions. As a quick overview, my first question is,

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why do we model at all? We got along without it for years. The theoretical idea is that the historical loss base is inadequate. We have a good idea of what was lost to certain catastrophes in the near past; but as you go further back from that, the exposures have changed. The constructions have changed. There are all sorts of reasons why we just don't know enough about what happened in the near past from the loss data itself.

Second, there's become a need for better information. Not only do we run into the 87J and 90A-type storms, and Hurricane Andrew. We've got an earthquake now, which was not a major event that people would have modeled, but is going to be a rather large event in actual loss. People are saying, how big can that loss be? Well, who are these people? Well, management is asking these questions. Shareholders are asking these questions. A. M. Best is asking these questions, and if not yet demanding models, at least asking that people use models to prove that they've given catastrophe management some thought. So we want to find the answer to questions like how big can the loss be? and how likely are those losses? That's why we're doing it.

This is intended to be a very brief history of modeling, at least in simulation modeling for catastrophes. I'm starting with hurricanes. Hurricane models tended to be developed by people with a scientific or mathematical background, who are related to insurance. Dr. Friedman at Travelers did some deterministic modeling. When Karen Clark was at Commercial Union, she began working on a probabilistic model, which developed into what is now her windstorm model, and then E. W. Blanch's model came next, and that got the ball rolling. E. W. Blanch, and then other brokers, started widely marketing it, and all of a sudden this became something that was perceived as possible. Now everyone has to have it.

The earthquake modeling was a little different in that it was developed by engineers who weren't directly related to insurance. Having said that, one of the principal developers was Karl Steinbrugge, who for years ran what is now the Insurance Services Office's (ISO) earthquake area. But when he was actually promoting his modeling, it was as an engineering consultant. John Wiggins was also doing work in the late 1970s and the early 1980s, and his work was then promoted much like the hurricane modeling by brokers, but the modeling actually predated the broker marketing. There are a large number of earthquake models at the moment. They were primarily developed from an engineering base. The difference is that if you're insurance related, mathematically related, you tend to look at things as a whole, and sort of put them together as a whole. You take a portfolio and ask what happens to that portfolio? You work with the law of large numbers and you aim for a reasonable answer. The engineering base says, start with an individual risk, and another individual risk, etcetera, and then add them all together. There are pluses and minuses to both approaches that we can talk about later.

There are other perils, other than those in the U.S. Certainly for the Caribbean there's wind and earthquakes, there has been some modeling done on an individual, consulting-type basis. There are one or two models that are being developed or have been developed for wind in the U.K. I don't know all that's happening in Japan, but from the U.S. side, there are a couple of people who are working with earthquake models for Japan. Australia as yet does not have much modeling. There are places where flood is a problem, and somebody is going to have to come up with some way to at least estimate those in the modeling sense.

How do the models work? Basically, as we see it, all models work about the same. They start with science, the science of what's going on physically, and then they move on to what kind of damage does this expose, which comes out of engineering. Then, having the damage, what happens to the insurance transaction? How much is covered? That's an insurance coverage issue.

Let's start with hurricanes, which start with meteorology. You first simulate a storm using a number of parameters. The basics are that you have the central pressure of the storm, which tells you how strong it is. You have the size, that is the radius of maximum winds. How far out do you have big, strong winds? What direction is it going? Where is it heading? And how fast is it going? Those are the basic parameters. Some models are more detailed than others and add other parameters, to perhaps get a little more accurate, but those are the basic ones. Having simulated the storm, you then calculate wind speeds at locations. These can be an individual location, a longitude-latitude point, or a zip code. Most commonly we use zip code, because zip code is how you're most likely to get the data, on the insurance side, to put into the model.

In a parallel fashion, for earthquakes, we have seismology and geology entering into the simulation. Again, you start with a fault or an area (if you assume a fault is there, but don't know for sure). I saw a talk the other day by a seismologist, and he said his favorite question after the Northridge quake was, how many unknown faults are there? The Northridge quake was on an unknown fault. Somebody asked him that seriously and expected an answer. We can work with faults, but we also know that there are areas, especially in the Los Angeles basin, that have the potential to have the same kinds of earthquakes that happened in Northridge. Those areas have been defined and specified, and modeling is going to have to take that into account. Many of the earthquakes that we're actually seeing are on these unknown faults, and the L.A. basin is where so much of the population is. Using faults or an assumption of a fault, using the magnitude (how strong is the earthquake?), and the ground conditions, we would estimate ground shaking in some fashion. Most earthquake models estimate ground shaking using the Modified Mercalli Intensity (MMI) measure of shaking. This is, on the one hand, the best thing we can use because everybody uses it, and on the other hand, it's the worse thing we can use because it is not a very scientific, meaningful measure. So there are modelers trying to come up with a better way to estimate ground shaking other than the MMI, which is somewhat flakey, at least from a scientific standpoint.

Next is the engineering. You've got a certain amount of shaking. You got a certain amount of wind. What does that do to the structure? There are engineering studies. There are estimates calibrated from, perhaps, actual loss data that says, this is the kind of damage we expect if we get this amount of wind on this kind of structure. There are various levels of detail at which this can be done, but that's the basics. Then those are applied to the exposures that come from the company in appropriate detail. Hopefully zip code detail is available because that's what most models use. And then they're applied, multiplied out, and you get a loss. Now those exposures should be broken out by building contents and time elements separately, because the percentage loss would be expected to be different. Personal and commercial risks are decidedly different. Finally they are broken out by construction types. Certainly for earthquakes, construction-type differences are mandatory. Frame buildings are likely to stand unless they have soft first stories, such as parking garages, under them. Unreinforced brick buildings are not likely to stand in any case. The difference in damage factors could be between 10% and 80%, and that's a rather large difference if you don't have construction detail.

On the windstorm, it's not quite as important, but it is still useful. If you know commercial, construction can be important because of the wind resistiveness of buildings. There are differences, but they're rarely measured on the databases.

And lastly, after we know what's happened to the structures, we need to know how much the insurance company has to pay out or to reinsure. This tends to take into account things like deductibles, which is a minor piece in windstorm at least currently, and a major piece in earthquake. Especially in dwelling business, you expect a 10% deductible is going to wipe out most of your individual losses and leave you with a few total losses. Also, the company needs to know for reinsurance how much they can collect on per risk. Having done all that, you have some estimates for the company, or for the reinsurer, of what can happen in certain instances.

Most of the modeling that we talked about is for the primary insurance companies. David is going to talk to you about how it's a little tougher on the reinsurance side to use modeling, and it is. The modeling is being improved on the reinsurance side but, in general, there are a number of reasons why it's very difficult to feel comfortable with reinsurance modeling. I think it's still a good thing to do. I think it's almost necessary to do it. You have to take into account at the end what you actually have.

On the primary business, we tend to have zip code or even finer detail for risks that we're using to model. For reinsurers, we may have state data or, at best, county data. The exposure data for primary insurance tends to be values-at-risk. Values-at-risk are what we wish to apply these damage factors to, so we use values-at-risk times the damage factor. In reinsurance, often what we have is premiums. Premiums are a rather imperfect proxy for exposures, especially since premiums can move up and down, even if the exposure doesn't. There are some very large imperfections there. Having said that, there are a number of reinsurers who are using CATMAP, which is Karen Clark's reinsurance model. And a number of those are not asking for substantially more detailed data. County data is probably the best they're going to be able to get, but at least it could be exposure data instead of premium data. That will allow some mapping of that county data to zip code to do better modeling. Lastly, on the primary side, we model directly from the exposure. The exposures go in, there are damage percentages, and out come losses. For reinsurance, at least when you're using premiums, when you're using state or county data, it becomes a market-share exercise. The first thing one has to do is find out what they think the market is going to lose for certain events, and then figure out what kind of percentage of that particular market that reinsurer has; this gives an idea of what it can lose. You can see that because of the data, because of the way that you have to model accordingly, you end up with a much less precise answer when you're just using reinsurer data. Again, I think it's worth doing. I think it makes more sense than some rule of thumb, but it doesn't replace a trained eye looking at the exposures, looking at the problems, and coming up with an answer.

The key to this whole idea, then, is what to do with what we get out of the modeling. (Other than because someone tells us we have to, or a reinsurer says, "Do you have an idea of your PML? We will write you if you give us that kind of data.") If someone is making you model, are you doing it for yourself so that you can better manage your business? If so, what do we get out of it? One of the first easy things we get out of it is exposure mapping. You take your exposures, you put them on nice maps that are in a fashion that someone can take a ten-second glance and get a good feel for where the person's business is. When you have 15 minutes to make a decision on a program, it's helpful to have something visual to at least get a start. This is not rocket science. This is taking what people give you and putting it in a mapping program and sending it out again. It just comes out of the process. But because the process is being done, because the exposure stuff is being gathered, it's easy with today's mapping technology to come up with maps that are useful, and not just pretty.

With apologies to reinsurance brokers, they tend to like pretty pictures that the clients perceive as a lot of work. The actuaries tend to want those pictures to say something, and I think we're getting to the point where they actually do. But again, that's just fallout that you could do with any kind of GIS system or mapping product.

The next thing models do is some deterministic modeling where they take a historical storm, or a hypothetical storm, usually based on some sort of history. This is good, because it helps people who have been in the business get a feel for what can happen with today's exposures, with today's levels of concentration, to a company. To answer what can happen in South Carolina if a Hurricane Hugo happens again, that tells somebody something; it's not enough for the whole decision process, but it tells you something. Or if you say, what happens if you take Hugo and run it through Long Island? Again, it tells people something. Now that may not be a good thing, because who knows if Hugo or a storm of that size can actually do that in Long Island. But if you move it 100 or 200 miles north or south, then that can be quite useful. You can also strengthen it. It's also a useful approach to benchmark the model so that when you do probabilistic analysis, you have a comfort level with the model. But I think the main purpose is that everybody that writes property business, and has been in the business any length of time, knows what has happened in the last 10–25 years, and wants to be able to see what could happen if that situation repeats. We know it's not going to repeat. That's the caveat, but it's nice to know "what if" anyway.

What do we get out of probabilistic modeling? Well, what we mean by probabilistic modeling is that we run a large library of events, either earthquakes or hurricanes. This library is large enough so that we hope that we cover most of the events that are physically possible. No matter how big, no matter where they're located, we want to model them if they're physically possible. So if it's physically possible to have a force five storm hit Maine, then you ought to have it in your model. If it isn't, you ought to have the force four. Consider what the biggest thing is that can hit Maine, even if a large hurricane hitting Maine directly is a one-in-a-thousand-year event in itself. Once you have this library, then in some fashion, be it Monte Carlo simulation, or simulation using stratified sampling, put probabilities on each of these events. This will give a size-of-loss distribution. We can get a feel for how likely the real big ones are down to some of the more moderate ones and then, of course, there will be a fair number of small ones that we're not particularly interested in. But this does tell you in a sense how big, or at least how likely certain levels of loss are. What's a one-in-fifty-year event, or what's a one-in-one-hundred-year event? How about a one- in-two-hundred-fifty-year event ?

Thus, when you're making a decision on your catastrophe reinsurance, or something like that, you have an idea how likely things are. Of course, reinsurance decisions aren't the only reason for modeling. Clearly, a company that's well managed knows what its possible downfalls are and will manage accordingly. If you know that you can lose $40 million to a hurricane that is not terribly unlikely in south Florida and your surplus is $50 million, you need to do something to manage that. If you can buy all that reinsurance, that's fine. Otherwise, you need to do something about the exposures in another fashion.

It also will be helpful in the future to develop theoretical rate loads. Currently, the ISO rate loads, and most rate loads, are based on history. History goes back to about 1949 calculating rate loads. That isn't anywhere near enough for earthquake, but it also isn't enough for Florida hurricanes, or for New York hurricanes for that matter. You need to expand this data, to take a lot more years than we have history for, because of the long-return time of these events. From a management standpoint, we can also figure out contributions by producer or contributions by product to the catastrophe problem, and that, again, can help you manage. I think models are important. I think that some sort of modeling needs to be done for a well-managed company to get a feel for what can happen. I think they need to be done, however, with a realistic expectation. David will certainly add to this when he speaks. They don't tell you everything.

A number of people that I've run into in the last few years have expected that if the model tells you that they can lose $10 million, then they need to go buy $10 million worth of reinsurance, and that's the number. It's clear and they're now fine. That's the number. That's their probable maximum loss (PML). First, models are models. If models were perfect, we'd be able to model the stock market and make a great deal of money. Models are a representation of reality, and that's all they are.

In addition, there's a lot of uncertainty around this type of an event, so I'm going to talk about the uncertainty here. We've said that we're trying to put a fence around the ballpark with a model. We don't know where the answer is in that ballpark for certain, but we think we can at least put a fence around it that's useful enough to be a tool, to be a help in coming up with the decision.

There are lots of data concerns. Companies have zip code data or they don't. If they don't, there's mapping involved. Or the zip codes are mailing address zip codes, not location zip codes. This can be reasonably good for primary residences, but not very good for vacation residences, and really lousy for commercial. Large, commercial, multilocation policies tend not to have very good location data. And the bigger they are, like a big policy with 2000 locations, the harder it is. There are some zip code locations, but if you're writing 5% of $10 million excess of $2 million, that becomes a tricky thing to model. You don't know the values, or if you do, you need to somehow aggregate all of those into one occurrence limit. So there are many data issues on the input-data side.

There are data issues on the other side in that we have small, historical samples. We've had one magnitude eight earthquake in California in this century. One is not a very good sample, and yet a lot of modeling for large events comes out of that event, and we have to hope that the physics of the ground in California replicates itself as you move up and down these faults. Hurricanes are much more frequent, but there are some problems. What I'm talking about here is microeffects. In a real hurricane, there isn't a nice smooth model wind pattern. You have little anomolies. In Andrew, there were little patches of things that Dr. Fujita thought were little mini-tornados. Other people have thought they were eyewall effects. Nobody is quite sure what they were, but they did significant little pockets of damage, and you can't model those with anything that has a manageable number of parameters, and come up with anything that makes sense. At that point, you've kind of lost the effect of modeling.

There are microeffects in earthquakes. When you do things on a zip-code level, the ground on one side of the zip code can be different from the other. When you do them at a location level, you believe you know the ground better, except that the current knowledge of what's in the ground and how it works in earthquakes is not nearly as good as we would like it to be. Some people are doing a lot of work on the the geology side to get at that, but there's a lot of uncertainty.

There's also damage percentages. I'd just like to compare Hurricane Andrew, which had significantly higher damage percentages given the wind, than those modeled for Hurricane Gloria back in 1985. There are some physical things happening, but in a sense, you've got a normal distribution of damages and we tend to model the mean; after all, we're making all sorts of assumptions anyway. But the actual damage factors can vary on either side of the mean, and that is adding more uncertainty to the process. So you have to understand the uncertainty, but I think they're very useful to do.

MR. DAVID E. SANDERS: In insurance, the premium per unit of risk is calculated making certain assumptions. One of these assumptions is the independence of risk. In practice, this is not the case. The lack of independence or aggregation of risk is covered by reinsurance. It was assumed the cost of this reinsurance for each unit of risk was less than the elements of aggregation in the base product. It's very surprising that it was done, or is done, on a net-risk-plus-reinsurance basis. In the 1990s, this is all falling down. The reasons are basic. The aggregations are much greater than imagined and the cost of reinsurance coverage is also much higher.

I have had the advantage of seeing both sides of this equation. Until recently, I was heavily involved as actuary to one of the largest, commercial accounts in the U.K., and I am currently actuary to one of the largest London, market-reinsurance companies. Let me give you a brief outline of how this problem of aggregation is controlled. I spoke recently to a finance director, who wondered when reinsurers were going to get their act together, or it might be that they had. It was the insurers who needed to understand the problem.

Let me start with a book of catastrophe excess of loss business. What is the biggest claim that occurred? The answer is simple. I add up all my worldwide coverage and then I add to this my total cover for the regions where I have a specific exposure. Accordingly, I can control my aggregate by limiting the amount of return in any one territory. This is the game we now play. Syndicates and all the professional reinsurers play the same game, making the same sort of calculations. Risk to some is a new game because they took the risk, then reinsured it on and on, creating the infamous London market spiral. PMLs were guessed as low as 35% of the total aggregate. And no one cared much about reinsurance security, creating a recipe for the disaster that finally happened.

Why do we need to aggregate? Let me give you a list of reasons. To assess the exposure of the account. To find out how much we need to reinsure. To limit the capacity of the account. To assess in estimating the reserve required for large losses. To determine the capital needed to support a line of business. All these are well known. These points are also not independent. There are two distinct ways of determining aggregate portfolios. Method A: add up all the covers, a novelty, and multiply by this magic number called the PML factor. Method B: add up all the covers again. Then simulate the losses using a model to determine the PML. And by PML, I mean the maximum likely loss that would occur in that portfolio.

Let's take an example. We'll take a portfolio of U.K. household properties. I know the U.K. quite well, so I'll do that. The total is about £25 billion. This is equivalent to 500,000 houses at £50,000 each. The diversity or risk is such that a PML approach or a similar approach is needed. At 1% per mille, and I don't know whether this number is right or wrong, I get an exposure of £250 million, which is almost certainly beyond the level of most U.K. reinsurance programs that are in operation today. The scientific approach is your simulation programs, based on historic events. Conversely, take a portfolio of property in Melbourne, Australia. I'm told that the PML is 2.5%. There is no history of earthquakes or major catastrophes. How can you tell what the PML is at Sydney? The answer lies somewhere between 5% and 10%. There is no historic experience for these regions. If I had a group of actuaries here and asked them to assess the PML for a London flood, which is the largest potential damage we have in the U.K., where the Thames overflows and floods most of London. I bet these would differ by a factor of as much as five. There is no correct answer. Even the simulation models are difficult to believe, themselves being subject to interpretation of historic data and modeling refinements. The paper on U.K. windstorms presented to GISG two years ago needed "fudge" factors to get the answers to match the actual experience. We, therefore, have a problem, and it's a big one. Since we don't know what the PML really is, how can we manage the exposure? And furthermore, how can we determine whether the reinsurance price is cheap or expensive? The fact that it is five times what was paid three years ago is only a statement of relative costs, and not absolute.

Direct insurers do not have the discipline of reinsurers, but often write for premium and market share, as opposed to the strict management of the risk exposure. Reinsurers believe they do not have to manage their aggregates. Let me explain how this belief could also be misleading, fictional, and downright dangerous. Remember, I started off with a whole account when I placed a 100% PML for the catastrophe risk. However, a reinsurance account is made up of many subaccounts, and these tend to be run independently. Each section will have its own methodology for calculating aggregate exposure.

For example, prorata business will use Cresta Zones and PMLs based on percentages offered by reinsurers. I have a basic hypothesis for testing these assumptions; namely, take the current, latest-worst-case scenario and double it. In practice this tends to happen.

Similar calculations take place in the facultative account and also the marine and aviation accounts.

They protect as appropriate, but limit the aggregate. Now comes the fun. How do you explain to a proportional treaty underwriter that he can't write more in region X because it has been fully utilized by the nonproportional manager? You certainly can't change the Lloyd's syndicate. So each class of business aggregates against you, and the whole issue needs very careful management.

There then comes the difficult bit of aggregating all these exposures together to obtain an idea of the reinsurers aggregate exposure. This needs testing against real, case scenarios. I exclude Tokyo earthquakes and Miami Hurricanes, because we all know about them. But what if a mid-European earthquake or even a meteorite hit on a populated area? Science fiction it isn't! In July of 1994, the remnants of Comet Shoemaker-Levy will hit Jupiter.

What about direct writers? I have one or two observations. Major residential areas are generally established in regions of high risk to natural hazards, such as Miami—windstorm, LA and Tokyo—earthquake. Even the U.K. is not immune. The area of greatest property exposure is based along the M4 "corridor," an area running from Bristol to London. The worst storm on record was in 1703, and documented by Daniel Defoe (Robinson Crusoe). The area of maximum damage was this very "corridor." Indeed, one of the ways of understanding the risks is to simulate storms through the accounts, a practice already undertaken in the U.S. The results have been illuminating and horrifying. I believe it would be fair to say that the maximum level of reinsurance cover available in the U.K. is about 50% of that required to meet a North Sea tidal surge. While it is true that London has a "Thames Barrier" to protect it, the water must go somewhere.

I believe a little time is needed to review the recent losses. The problem has not been with nonmarine risks, but with reinsurance placed in a marine reinsurance market with little or no coinsurance. In other words, if I received a risk, I would reinsure 100% of it and not be required to retain a percentage myself. Marine reinsurance also protected the "whole account" losses of other insurers. They also had two reinstatements, instead of the normal one for nonmarine losses.

In 1989, Armageddon happened. The principal problems were four losses: (1) Hurricane Hugo, (2) Exxon Valdez, (3) Phillips Petroleum, and (4) Arco Platform. There were also earthquakes in San Francisco and Newcastle.

In 1990 we had a series of windstorms hit Europe. The market had not yet realized or addressed the 1989 issue, and was still continuing to write "spiral business." In

1992 this all stopped; capacity dried up because of the realization of the extent of the losses. London market reinsurers have gone bust, and certain Lloyds syndicates are being sued by their names, with losses approaching $1 billion.

The extent of the damage has not really been calculated. I use a curve of the type:

$A(1\text{-}\exp(((\text{days}+D)\ /B)^{**}C))+E$

The factors A to E are my five S's. An example of such a curve is given (in this case it's Hugo): A = Size, B = Slope, C = Shape, D = Shift, a factor I find useful to consider (as sometimes zero). E = SXXT, when it doesn't work! Surprise! The bad news is you don't know what E is until the curve starts to slow down, and some of the 1989 losses are still exhibiting features of the lower reserves.

Then there has been a shortage of capacity. There are two solutions:
(1) increase capacity (Bermuda), (2) newer methods of controlling aggregates and transferring risk.

With respect to Bermuda, I'd like to do a little sum. Let's assume we have a reinsurer operating on whole-account protections at 25 rate on line in excess of Andrew. What is the capital they need to survive?

The answer is $6 million per $1 million premium. Why? Because if there is a substantial loss, the company would pay $4 million on the first loss, $4 million on the second, and have $2 million of premiums.

What is the return on capital? The best return is $1 million premium, plus investment income of $7 million—say $0.5 million. This gives a maximum risk of 25% before expenses and profit share.

If a catastrophe occurs there is potential for substantial losses. Based on this arithmetic, would you insist on a Bermuda Catastrophe reinsurer, or even consider purchasing reinsurance from them? With this savory point in mind, Peter will discuss the new method of controlling aggregate and transfering risks.

MR. CLARK: I'd like to say a few words about insurance futures and their use as reinsurance. The catastrophe insurance futures were first traded by the Chicago Board of Trade in 1992, and at that time that seemed quite the propitious moment to do it. The reinsurance market had a decreasing capacity. Many of the reinsurers had pulled out of the market because of the losses they had experienced. I don't need to remind you of the losses that occurred in the late 1980s and the early 1990s.

These contracts were introduced only a few months after Hurricane Andrew, the largest insured, natural capacity loss. But since then, the results have been disappointing in regard to the trading volume, which has been very low. There are a number of reasons for this. First, it is unclear how they can be accounted for, and second, there is a learning curve. People can be fairly conservative about new products. They are going to wait until other people buy them first before they move into the market. There is a lack of interested sellers. Again, people are being very reluctant to write these contracts because of what they have seen, the high-risk element to them. Third, the imperfect risk transfer means that an insurance company looking for some form of reinsurance would usually prefer to buy tailor-made products, rather than something which may or may not match their inward risk.

I shall start with how insurance futures and options work and the mechanics behind them. They cover three different regions of the U.S.; there's East, Midwest and the West, and there's a national contract as well.

The contracts relate to the losses that are incurred during a three-month period, and they're named after the last month of the quarter. The contracts that are currently traded are December 1993, March 1994, and June 1994, and they will cover the losses expected in October to December of 1993, January to March 1994, and April to June 1994. The contracts are traded for six months after that. The final value of the contract is based upon the reported loss ratio three months after the incurred loss period. So, for example, in the March 1994 contract, we're looking at losses that were incurred between January 1 and March 31, 1994, and it's based on the reported loss ratio at the end of June 1994. The contracts are then traded for another three months, until the end of September.

The contract is priced on a $25,000 base and the value of the contract is determined by multiplying this 25,000 by the reported loss ratio. This ratio is the reported catastrophe loss, three months after the contract period, divided by the industry premium. The industry-wide statistics were taken from the companies who reported to the ISO.

Let's now look at a numerical example. Imagine you're the U.S. company actuary at a U.S. insurance company and you have come to London for reinsurance quotes from leading reinsurance companies. However, the premiums are too high because of the heavy expense load to pay for the actuaries' salaries. You therefore decide to look into buying one of these futures. Here we have a company that has 1% of the market, and it follows the fortunes of the market as a whole. At the beginning of July, the company is looking to buy the contract that covers losses from July to the end of September. Remember that the reported loss ratio at the end of December will determine the final value of the contract, so the company estimates that it might have ultimate catastrophe losses of four million dollars. It has a premium of $30 million. Seventy-five percent of these losses will be reported by the end of December; therefore, the reporting losses will be 75% of $4 million, which is $3 million. And the industry as a whole, of which the company has got 1% of the market, will have ultimate incurred losses of $400 million, premium income of $3 billion and again, 75% of the losses reported by the end of December. This means that the futures price is determined as $2,500, which is calculated as $25,000, which is the basic price of the contract, multiplied by the reported loss of the industry of $300 million, divided by the premium of $3 billion. If the company wishes to hedge its entire position, it will need it to buy 1,600 contracts, and that is calculated as the company's premium of $30 million divided by the product of the base price of $25,000 and the reporting factor of 75%. Table 1 shows the various scenarios of industry reported losses and how the company has hedged its position.

TABLE 1
FUTURES EXAMPLE

Forecasts in July:	
1. Company Incurred Loss	$4 million
2. Company Premium	$30 million
3. Company Reported Loss	75% by December
4. Industry Incurred Loss	$400 million
5. Industry Premium	$3 billion
6. Industry Reported Loss	75% by December
7. Futures Price in July	$2.5 billion (= 25,000 × (4) × (6) / (5))
8. To Hedge 100% of Premium	1,600 contracts need to be bought (= (2) / 25,000 × 100% / (6))

Industry ($m)							
Reported Loss	200	250	300	350	400	450	500
Ultimate Loss	267	333	400	467	533	600	667
9. Futures Price	1,667	2,083	2,500	2,917	3,333	3,750	4,167
Company ($m)							
Expected Loss	4.00	4.00	4.00	4.00	4.00	4.00	4.00
10. Actual Loss	2.67	3.33	4.00	4.67	5.33	6.00	6.67
11. Futures Gain/(Loss)	(1.33)	(0.67)	0.00	0.67	1.33	2.00	2.67
12. Overall Losses ((10)−(11))	4.00	4.00	4.00	4.00	4.00	4.00	4.00

Now we need to look at the advantages and disadvantages of these contracts. The first advantage is that it increases choice. Obviously you have another product on the market that is a substitute for reinsurance. It also increases the flexibility. The company doesn't have a fixed renewal date. It can buy and sell these contracts throughout the period, and it doesn't have pay-back problems with reinsurers. If the reinsurer made the loss in one particular year, there is often an implicit understanding that the reinsured will renew with the same reinsurer in order to allow it to recoup its losses. You also have lower transaction costs. There is no brokerage. Theoretically, it should bring capital into the insurance market, and certainly a couple of years ago there was a lack of capacity in the reinsurance market because of the losses that reinsurance companies had sustained. Unfortunately for CBOT, most of the new capital has gone to Bermuda, so that has not worked out in practice as hoped. However, if it had worked out, then that should theoretically smooth the insurance cycle. It should have been easier for capital to move both in and out of the insurance market.

There is a securities guarantee. CBOT does have strict rules regulating the futures and options market and so, therefore, there is not the financial security problem that could exist if you were reinsuring with a reinsurance company. And lastly, it can increase the role for actuaries in insurance.

Now for the disadvantages. The first one is the mismatching. With reinsurance, you have something that completely matches your inward position. It's a tailor-made product. Here you have to follow the market. Contracts cover large areas in the east, west and the midwestern zones. It is not certain that an individual company's experience is going to mirror that of the industry as a whole. It's interesting to note that there has been some thought about having some European futures contracts, which would cover smaller geographical areas than the U.S. contracts. In some ways, that should be advantageous, since an individual company's exposure is more likely to mirror the markets.

There is a lack of sellers of the contacts. The exposure for those who actually want to write the contracts can be high. And I remember Robert Taylor mentioned during his talk at this meeting's General Session that he wouldn't write options. That advice is heeded by people who could be sellers. There are mark-to-market cash adjustments on daily cash flows. That means if a price changes above a certain percentage in a day, then the writer of the contract has to provide more cash. As insurance futures are probably more unpredictable, more volatile than many other types of futures, this could mean that the daily cash flows, for those that are writing the contracts, could be extremely high. And again, I think that is a disincentive for those who are considering writing them.

No allowance is made for incurred but not reported (IBNR). The final value is based on the reported loss ratio, not on what is considered to be the ultimate loss ratio. The size of the catastrophe affects the reporting pattern of the claim. Intuitively, one might think that major catastrophe insurance companies are going to devote all of their resources to dealing with it quickly. So if you have a big catastrophe, you're going to get a faster reporting pattern than you would on the smaller catastrophe. But for Hurricane Andrew, reporting patterns were actually slower because the area was just so devastated, telecommunications were down, there were problems with transportation, and there were very few accommodations available for loss adjusters.

There is also a perceived problem of insider knowledge. The statistics are based on those submitted by the insurance companies to the ISO. If a contract is sold to an insurance company, the seller may be concerned that the insurance company is privy to information not available to the seller. Furthermore, if the company's data are used for the ISO statistics, the company can influence the value of the index.

There is a lack of understanding. This is a complex subject. This compounds the problem of the reluctance of new entrants to a low-trading volume market.

There is the problem of discontinuities in the price or gapping. This means that there is a jump in the price, and there is no opportunity to trade at the intermediate prices. If you consider what would have happened to the price on the day before Hurricane Andrew and the day after. Because of that, the traditional ways of pricing options does not apply, because you do get these discontinuities in price. It's not a random walk in the price.

And finally, there's the regulatory and accounting uncertainties. Certainly in the U.K., no one quite knows how to account for them. I approached the Department of Trade and Industry, our regulatory authority, and they have not considered the issue in detail. It is unclear whether you can allow for them as you would allow for reinsurance in terms of determining solvency, etc.; it's still very much a gray area. I consider that these contracts represent a good idea, but there are practical problems. It isn't that no one's buying them because no one is buying them. There is certainly potential there, but we felt that the individual products themselves probably didn't fully answer the needs, and really it was a case of going back to the drawing board and coming up with some different projects in order to meet the needs of the market. I don't see these particular contracts taking off, but I think the feeling is that, in the future, a modified product may meet the market needs. Yes, it's a good idea. But it needs further work.

FROM THE FLOOR: I want a clarification. Aren't there caps on the ultimate price of the catastrophe futures?

MR. CLARK: Yes. It's a 200% loss ratio. But you have to bear in mind that this is a loss for a quarter period divided by an annual premium. And, I think, Hurricane Andrew came to about 100%. It is not a practicable limit.

FROM THE FLOOR: I can't resist. How do you determine the liability of an unknown fault? If you have a probabilistic model, how do you account for unknown faults?

MR. MATHEWSON: Oh, that's a good question. Again, here's something on which you can do a scenario. The only way to do probabilities would be to get some scientific information that USGS has said that they think this kind of thing happens every 10,000 years, or something like that, and come up with an idea of how it must have gotten there through time. Unknown faults do have surface representations, they're just not fault-type representations. They tend to be more folds showing as hills. The Santa Monica mountains, for instance, have been built by an "unknown fault." Clearly doing any probabilistic modeling on something you don't really know much about is quite risky for earthquakes; in general, even on known faults, the probabilities are merely ballpark estimates.

MR. SANDERS: Could I comment on this. There's an interesting earthquake that occurred in 1993. It was called the Killera quake, which was in India. There was great loss of life there. That earthquake was interesting; we found that there was no earthquake known in that area. And when they went to look at it, they found no previous earthquake for 65 million years. The geology of the region is known as the Deccan traps, which were created at that time. So here we have an earthquake occurring in a region with no experience for over 65 million years, and this caused a bit of concern to the people. However, if you look at all the earthquakes that occurred in India in the last century, with only one exception, which was near the Himalayas, all of them were in close proxmity to a newly built dam. And this is where human intervention can help create its own earthquake exposure, which you cannot model or simulate. There was also an interesting statistic when I went back in there; it was the Calcutta disaster of October 1737. Now this is an interesting earthquake in that it's documented as one of the worst ones that ever happened; 300,000 people died. There were only 45,000 people in the region at the time, so how could 300,000 people have died? It happened simultaneously with a hurricane that occurred on that same night. When you actually delve back into the real statistics, you find there was no earthquake whatsoever. There was actually a hurricane, which caused flooding in the Bay of Bengal, which caused 3,000 deaths. Be careful of all the statistics and historical data.

FROM THE FLOOR: On these futures, isn't it true that when you buy a future, you can actually have a liability beyond what you paid for the future? When you buy a future, you pay a certain amount, right?

MR. CLARK: You agree to pay a fixed amount at a fixed date in the future.

FROM THE FLOOR: You have a liability beyond that, don't you? If the losses are bad.

MR. MATHEWSON: If you're the buyer of the contract, whatever you put in is the maximum you can lose, because that's what you would lose if there were absolutely no catastrophes and no property losses. As the seller, you can lose up to 200% of the $25,000 contract. So the upside loss problem is on the seller's part. All you can lose, as the buyer, is what you put into it.

FROM THE FLOOR: So it is limited.

MR. MATHEWSON: It's limited for the buyer and it's limited for the seller, but it's not a very practical limit. You can lose a lot as a seller.

FROM THE FLOOR: Say you're a member of the public and not an insurance company. Is your exposure limited?

MR. MATHEWSON: As a buyer or as a seller?

FROM THE FLOOR: No. You're a member. You're not an insurance company. You're a member of the public buying one of these.

MR. CLARK: You would be limited to what you pay for the contract.

FROM THE FLOOR: When you buy a future, you don't pay anything for it. You wait until you sell. A future is a zero-contract exchange. You put up a marginal requirement for it and that margin, if the price moves against you, what you're doing in a future contract is agreeing to make a transaction, 90 days, 6 months from now, and you agree on the price at which you'll make that transaction. But that will change over time. You put a deposit up. The person who buys the contract can lose money by having the price fall below what they originally agreed to, and it could be much more than their margin requirement initially put up. Conversely, the person who sells it is the one that's really at risk for the shock, because then when you get a catastrophe, they would lose a lot more. But I think when you're talking about futures, you shouldn't talk about paying a certain amount and not naming all you're risking, because that's not at all what happens.

MR. CLARK: Yes. I agree with that.

FROM THE FLOOR: Just one more point to that. There is almost no market for futures at the moment and, as Peter mentioned, the market is for options and for slices of the market where you would, in a sense, be taking a piece between an 80% and 100% loss ratio, or some such thing, on the options piece. So they're narrowing the market, and that's what they're trying to get people involved in, because there's much more interest in that than there is in the future itself.

MR. CLARK: Yes. The future would be analogous to proportional reinsurance. So the option would be analogous to excess-of-loss reinsurance. Therefore, the reinsurance companies would be more interested in options than futures.

MR. SANDERS: Basically the option is a stop loss for reinsurance in the same annual, same price as futures, which would go on there. That really is all it is. Now, that brings a question to my mind because there is no stop-loss reinsurance market. If I went to the over-the-counter market, which, in this case, is the London reinsurance market, I cannot possibly buy a whole account protection on the stop-loss basis. These guys from Chicago tried to do something that the experts, the reinsurance experts, would never dream of doing.

FROM THE FLOOR: I was wondering if the future product is deductible. Is that only in the U.S., or have there been other experiences in other countries?

MR. CLARK: They're only in the U.S. now. There are only three areas in the U.S. at the moment, although they are looking into having European areas.

MR. SANDERS: The broker setting up the product has a basic problem, namely getting the statistics. And one of the brokers in the U.K. is trying to gather a database that gives the source of the potential losses, or what amount is being lost on the property account set up. Without these statistics, you can't do a thing. It will go through an over-the-counter type of trading process once they get the statistics. No statistics, no loss ratios, no guide; you're absolutely lost.

MR. SANDERS: These types of products (or similar ones) were written a long time ago in the London market, and they were banned as being illegal. Those products were called Tonnes, in that you could take a bet basically on how much tonnage ships would sink in any one year. Now you had no vested interest in it, but it's the same principle, if you think about it, of what insurance futures are about: a reinsurance contract. The thing that was on the liability side of the account is now on the assets, and thereby waving this magic wand, somehow you change a product that you cannot actually write as a reinsurer, which is illegal because it's betting, you have no vested interest, and by putting it on the other side of the account, it becomes legal. I just don't understand this. This is really people getting partly confused over the same thing.

FROM THE FLOOR: This is a question for both the panel and perhaps the audience. What statistical products could ISO or any other agency produce that would make the futures market more successful?

MR. CLARK: One thing that I think a lot of insurance companies find would be, as Stuart was mentioning earlier, something that's based on losses between certain percentage points; perhaps, loss ratios between 100 and 120, rather than a whole book loss as is currently being traded. When I was on the Institute of Actuaries' working party last year, we were thinking aloud about asbestos and pollution contracts. I'm not saying that's necessarily viable, but it would certainly be one where there would be a market. So at the moment, I think, the disadvantages are that the downside for the writer of these contracts is just so great.

MR. MATHEWSON: I don't know the practical answer of how you get to it. But providing statistics that are directly catastrophe statistics, rather than statistics which are kind of the whole property losses in certain standard ISO categories, might make people a little more comfortable with the process. You must define a catastrophe. An industry loss of $5 million is a catastrophe by the normal definition, but it isn't much of a catastrophe to many individual companies anymore; therefore how you define that would be really fairly tricky.

MR. SANDERS: I would have thought what people would like is, if they are in Orlando, for example, an Orlando company. I'm not interested in what is on the eastern coast, with all the various risk; I actually want something that meets my need. An index that is based on something that happens up in New York does not meet my needs, and that really is a problem, because the people who do want this product are the smaller insurers who are wishing to immunize their losses, but their real exposure is entirely different from region to region.

MR. CLARK: Yes. I certainly think the size of the region is a disadvantage because, as you were saying, you do have a problem that an individual company's experience is more likely to differ from that of the market as a whole, with such large regions.

FROM THE FLOOR: What I would like to add is that you need a seller also for the market, and currently they aren't contracted to deal with the eastern seaboard, or they aren't midwestern contractors to handle all those areas. Contractors tend to be very local. There are very few that cross state lines. We saw a lot of contract surety bonds, and there are very few contractors that cross state lines. They're generally metropolitan based, so they're not going to sell unless you have something that measures the risk in their metropolitan base. If someone is not going to sell unless it offsets something that they know they'll get a gain from, and they're not going to get a gain if the wind blows in Maine and they're a contractor in Orlando. Even so, they're risking that they'll get a lot of or a proportionate share of the business if the wind blows in Orlando. At least that's a better niche, but you're not going to have sellers unless you match the geographic region of the sellers and the geographic region of the buyers, and you can't get bigger than the region for that to work.

FROM THE FLOOR: One way this could work is if we did something like the brokerage house is doing on federal debt. They're doing strips. They're taking out pieces. So you could have a national brokerage out there take the national catastrophe exposure and then split it out based on Florida, based on the east coast. And if we get a large enough market, that might be an actual thing that would happen without ISO having to do it.

I would like to answer the earlier question about catastrophes. ISO could just go back to its catastrophe codes that they used to have through the 1970s, where every catastrophe in excess of the first $1 million and then $5 million was assigned an individual number, and ISO companies had to report that; but they did away with it because they had 80 column cards, and they wanted to put in something else and they had to lose something, so they did away with the catastrophe code. Now if they had kept it in, it would be an extremely valuable piece of information. But they've lost it and they're thinking about whether they should try to reinstate it. The size of the code is of no importance anymore because they've gone away from those codes, fortunately.

MR. SANDERS: I have one comment on using brokers. When we tested this in London, the independence of this fiscal body was actually a key feature. In fact, the broker body was actually pushing this, and some considered that they might have a vested interest in it. And that was the problem. But I agree that somebody ought to do it.