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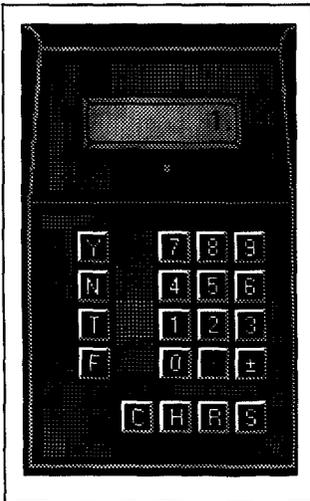
## CREDIT RISK STUDY

Moderator: ARNOLD F. SHAPIRO  
Panelists: WALTER C. BARNES\*  
WARREN R. LUCKNER  
KIN ON TAM  
Recorder: ARNOLD F. SHAPIRO

- Comparative survey of recent and ongoing research related to asset credit risk
- Further analysis of SOA 1986-89 credit risk data

MR. ARNOLD F. SHAPIRO: Kin On Tam is an actuary in the corporate actuarial department at Met Life. He is responsible for cash-flow testing and investment analysis. He has also been involved with several presentations of the results of this credit risk study. Walter C. Barnes is on the faculty at the University of Wisconsin at Madison, in the Real Estate Department, and a principal of Mortgage Analytics. He formerly was the director of real estate research with Travelers Insurance Company. Warren R. Luckner is an actuary in the research department of the Society of Actuaries and has been involved in the private placement side of this study.

One of the goals at this session is to use participant response keypads—an interactive computer technology—to facilitate and encourage audience participation. The focus of this phase of the session is to use keypads to gather immediate feedback from the audience on questions and issues and to provide immediate analysis and display of this feedback. A participant response keypad is a device that allows participants to electronically input their responses to questions. An example of such a keypad is shown in the following figure.



As indicated, the keypads allow the audience to respond with: yes (Y) or no (N), true (T) or false (F), or a number. Once an answer is chosen, the response is sent to the computer by pressing the send (S) button. The other buttons refer to: clear (C), help (H), and recall (R).

The technical aspects of the arrangement are relatively straightforward. The keypads are connected to a notebook computer. True or false and multiple-choice questions are projected on the screen from the computer, and the audience anonymously responds to the questions via their keypads. After all the responses have been forwarded to the computer, they are tabulated and displayed in a bar graph. These tabulations are instantaneous and visible to both the participants and the panel members.

\*Mr. Barnes, not a member of the Society, is on the faculty in the Real Estate Department at the University of Wisconsin-Madison and is a Principal of Mortgage Analytics in Madison, WI.

## RECORD, VOLUME 20

The first general question posed to the audience (and the audience's response) is:

*Have you read the final report on the 1986-89 Credit Risk Loss Experience?*

|     |     |
|-----|-----|
| Yes | 25% |
| No  | 75% |

As indicated, 25% of the respondents have read the final report, 75% have not.

The next general question (and the audience's response) is:

*Have you attended any session prior to this Orlando meeting that included a presentation on any portion of the credit risk study?*

|     |     |
|-----|-----|
| Yes | 60% |
| No  | 40% |

Some 60% of the respondents have attended a credit risk study session prior to this meeting. Given these general observations, let us turn to our first speaker.

MR. KIN ON TAM: My presentation will not exactly duplicate what has been said before at two seminars on the credit risk study, one valuation actuary symposium, a previous Society of Actuaries meeting, and the General Session at this meeting by Mark Doherty. Instead, what I'd like to do is to present new materials by relating the credit risk study to other studies. In fact, I'll be using the credit risk study as a springboard to explore other studies from the standpoint of results and the methodology.

First I'll discuss the credit risk on prior placements, focusing on two statistics, the incidence rate of default and the loss severity, or its compliment, the loss recovery. After prior placements, I'll move on to commercial mortgages. The first order of business will be to give an update on the ACLI delinquency and foreclosure experience. Then I'll bring out an essential difference between the ACLI survey and the credit risk study, the prevalence rate on one hand and the incidence rate on the other.

For the loss severity, which is not part of the ACLI survey, I was going to cover the Snyderman study, but I may have to skip that for lack of time. Finally, I do want to relate the ACLI survey to the Frank Russell Index. Now, let's go back to the computer technology and ask a few questions, the answers for which will be given during my presentation.

*What is Moody's default-recovery ratio for public bonds?*

|          |     |
|----------|-----|
| 70 - 80% | 11% |
| 60 - 70  | 11  |
| 50 - 60  | 44  |
| 40 - 50  | 22  |
| 30 - 40  | 11  |

Note that the question deals with Moody's default recovery ratio, not the loss severity. It's the compliment. How many cents on the dollar does Moody's statistics show that you recover?

## CREDIT RISK STUDY

The actual answer will come later in the presentation. Let's move on to the next question.

*What is the credit risk study's default recovery-ratio for private placements?*

|          |     |
|----------|-----|
| 70 - 80% | 20% |
| 60 - 70  | 40  |
| 50 - 60  | 10  |
| 40 - 50  | 20  |
| 30 - 40  | 10  |

Based on the distribution of responses, there's definitely more interest in private placements than in public bonds. Very interesting. Can everybody see the distribution? So 40% think that the answer is between 60% and 70%. And then it's quite well distributed among the other answers. Very good. Next question please.

*What is the correlation between the inflation-adjusted return on the Frank Russell Index and the ACLI delinquency percent?*

A negative correlation coefficient of:

|          |    |
|----------|----|
| 0 - 20%  | 0% |
| 20 - 40  | 33 |
| 40 - 60  | 22 |
| 60 - 80  | 44 |
| 80 - 100 | 0  |

Note that the Frank Russell Index is a measure of the total return on equity real estate while the ACLI delinquency percentage is a measure of the percentage of commercial mortgages in a delinquent status. They are two completely independent series.

FROM THE FLOOR: It's kind of a risk return thing?

MR. TAM: No. You treat the two series as just independent time series and look at the correlation between the two. There's a negative correlation because, as the market value of equity real estate goes up, delinquency should go down. So there's a correlation, but how well is one determined by the other when you do a regression analysis? That is the question.

On to the next question. There are only two more. In a good real-estate market, the ACLI baseline percentage of delinquent commercial mortgages is about 1%.

*In 1976, that percentage went up to?*

|            |    |
|------------|----|
| 2 x normal | 0% |
| 3 x normal | 25 |
| 4 x normal | 25 |
| 5 x normal | 37 |
| 6 x normal | 13 |

In a good real-estate market, the ACLI baseline percent of delinquent commercial mortgages is about 1%.

*In 1992, that percentage went up to?*

|             |     |
|-------------|-----|
| 2 x normal  | 10% |
| 4 x normal  | 0   |
| 6 x normal  | 20  |
| 8 x normal  | 50  |
| 10 x normal | 20  |

Let's go on to private placements and first of all, the incidence rate. What would be a good benchmark for the incidence rate from the credit risk study? I suppose the incidence rate from under private placement study would be a good benchmark. But since I know of no other study of that nature, the best I can do is to look instead to the public bond experience, such as Moody's.

If you compare Moody's average incidence rate over a 24-year period with the credit risk study's incidence rate over a four-year period, you would see that they don't seem to be very close to each other by rating category. Moody's generally is a little lower, but quite a bit higher in the single B category. However, if we restrict the experience of Moody's to the same four-year period to coincide with the credit risk study, you would see a somewhat different picture. Now the two are closer to each other in the Baa category and the Ba category. But still we have a big difference in the B category.

FROM THE FLOOR: How are the ratings of the credit risk study determined?

MR. TAM: These are the internal ratings of the contributing companies. And that's a very important distinction.

FROM THE FLOOR: Are they at issue or current?

MR. TAM: Of all the incidence rates in the credit risk study, the version that is most readily comparable to the one-year default rate from Moody's is, in fact, the incidence rate by number, not by amount, by the most recent quality rating, not by the earliest. And that's what I am using.

The same phenomenon that we observed, if viewed graphically, would show that the incidence rate of the credit risk study would be right on the top of the four-year average of Moody's for Baa and for Ba. But it's off by a 3:1 ratio for the B category, and it's too low to call for the Aa and A.

Now if we look at Moody's own standard deviations of default, it puts the comparison in the perspective of volatility. The seemingly big difference between Moody's experience and the credit risk study in the incidence rate is only about one standard deviation. And once again, we can consider this situation graphically. If the graph showed Moody's mean incidence rate plus and minus one standard deviation, you would see that the credit risk study's incidence rate is mean plus one standard deviation for the single Baa category, right at the mean for the Ba category, and only a little bit below the mean minus one standard deviation for the single B.

## CREDIT RISK STUDY

FROM THE FLOOR: Kin, did you look at the distribution of Moody's and the private placements? Because just giving a standard deviation may not tell the story, unless the risks are normally distributed.

MR. TAM: I haven't looked at the standard deviation of the private placement in the credit risk study.

FROM THE FLOOR: I believe when we looked at the mortgages, the losses were not normally distributed. So if they're not, the standard deviation may not mean as much.

MR. TAM: Right, and that's a very good point. We have to be very careful with how we interpret the results. If we consider the mean and one standard deviation, there's no default rate that can be two standard deviations below the mean, and so, it's a very skewed distribution, and we have to be a little careful.

Now, can this 3:1 ratio, 3:1 disparity in the single B category, be explained by a high concentration of the private placement B's at the higher end of the B range?

Moody's recent tracking of the public bond experience by a refined rating system has fortunately given us an answer to this question. If you compare Moody's incidence rate, by a refined rating system, and the subdivision of the B category, you will find that the default experience does go according to the refined ratings. For example, in the case of the single B, the high end, the B1 category, is noticeably better. And the lower end, the B3 category, it is noticeably worse. But overall, instead of having a 3:1 ratio to explain away, we have a 2:1 ratio to explain away.

Another consideration is the possibility that the ratings among private placements may not be as well defined. That there may not be a good correlation between the internally assigned ratings by the contributing companies to private placements, and the universal ratings applicable to public bonds. Consider the distribution of the exposure in the credit risk study, by the most recent ratings. If the nominal B category includes a lot of bonds that are truly in the higher category and vice versa, this would make the nominal experience for the B category look better, and experience for the higher grades look a little worse. Also, the disparity in the size of the population by rating may make this difference more keenly felt in the case of the smaller categories than the bigger ones.

How can we test this hypothesis? I'm not certain there is a very sure way, but what I did attempt to do is this. I took the incidence rates from the public bond study, from Moody's, and applied them to the quality distribution of the prior placement study. I took a look at the weighted average on that basis. What I found was that the composite using Moody's 24-year experience, turned out to be 0.6%, the composite based on a four-year average turns out to be 0.7%, and the two of them are, respectively, 20% and 40% higher than the 0.49% corresponding to the credit risk study. Now, is it inconceivable for the public bond experience to be 20% higher than the private placement experience? I would say not. But is it inconceivable for the four-year experience on public to be 40% better than the four-year experience of private placements? The answer turns out to be that it is not inconceivable if the four years turn out to be better than average years for private placements and worse than

average years for public bonds. And that, in fact, turns out to be the case, or at least we have reasons to believe that.

Consider the private placements in or near default, as tracked by the ACLI from 1976 to 1992. The average over the 17-year period is actually 1.15%. The average over the four year period is 0.89%, so it's actually a little lower. For the sake of completeness, if we compare these with the incidence rates from the credit risk study, we see that the alignment is quite remarkable. Now that's with private placements. Let's consider public bonds. In this case, I choose to use Moody's one-year default rate, restricted to the speculative grades only. Based on the experience over the entire period 1970 to 1992, the average is 4.5%. Remember, this is a speculative grade only. But the average restricted to the four years is 5.5%.

So what have we concluded here? I would say that, if you look at the year-by-year and rating-by-rating experience, between privates and publics, you can see a great disparity. But when you normalize over a year-by-year variation, by taking a long-term average, and you normalize for possible inconsistencies in rating systems between the two, all of a sudden the two sides are not that far apart. The private placement experience may still be somewhat better overall, but not by as much as it would seem at first.

Now let me move on to the loss severity or its complement, the recovery rate. Before I do that, let us describe the methodology used by Moody's. Both Moody's and Altman have published loss recoveries of defaulted public bonds by year. Moody's is over 20 years, from 1974 to 1993, and Altman is over eight years from 1985 to 1992. Both use essentially the same methodology. And let me quote you what Moody's has to say:

The most straightforward methodology for calculating recovery rates is not particularly practical. It would track all payments made on a defaulted debt instrument. Discount them back to the date of default and present them as a percentage on a par value of the security. But that approach requires the aging of defaults until full recovery has occurred. By the time such a study could be completed, it already would be out of date. [F]or these reasons, we use a trading price of the defaulted instrument, as a proxy for ultimate recovery. While it is at best a rough estimate, it is, at any rate, a definite measure of the recovery realized by those stockholders, who liquidate a position immediately.

The discounted cash-flow approach, which Moody describes as impractical, is essentially what the credit risk study uses. And with this fundamental difference in mind, are we prepared for the disparity in loss severity, between Moody's and Altman's, and the credit risk study? It is 44% in the case of Moody's, 42% in the case of Altman's, and 71% in the credit risk study.

The average default recovery rates by year are quite volatile from year to year. The year 1987 stood out because of one giant technical default. It's a very well-publicized case involving a litigation of a big corporation that had sizeable public and private debts. Now, if we were to remove that one case from the study, entirely, what would happen to the default recovery ratio? It would make the private

## CREDIT RISK STUDY

placements experience fall to a lower level. This one credit risk event, by itself, makes a difference of four percentage points.

But we have something like a 28-percentage points difference to explain in the first place. What about the seniority? Both Altman and Moody's have established a variation in the loss recovery by seniority. The highest is the senior secured category, followed by the senior unsecured, followed by the senior subordinated, and then subordinated and junior subordinated. This leads to a very natural question. How are private placements distributed with respect to seniority?

Seniority is a field requested by the study, but sparingly furnished by the contributing companies. In any case, based on the informal survey of three companies, we have reason to believe that among private placements, senior unsecured is the norm. And if that is the case, then the relevant benchmark with this kind of comparison is the public bond experience for senior secure, not the overall average among all seniorities. And if that's the case, then you have a difference of ten percentage points, according to Altman and four percentage points according to Moody's. And so, all of a sudden, the disparity is no longer as big.

Consider now some of the contributing factors to the disparity. We already mentioned the giant technical default, which accounts for four percentage points. The seniority bias among private placements may account for eight percentage points. And then we have the tail effect, the difference between using a discounted cash-flow approach and the trading price shortly after default. To the extent that the market may overreact to a public bond defaulting, that trading price shortly after default may actually understate the subsequent recoveries. And then you have the problem of a limited observation period. Basically, we have only four years in the study. And finally, you have the quite often cited covenantal protection, which is supposed to be more pervasive, more complex, and perhaps, more protective in the case of private placements as compared to public bonds. It's hard to quantify the contribution of each of these factors to this disparity in the recovery ratio. Nevertheless, on a qualitative basis, all things considered, all of a sudden the disparity between publics and privates may not seem all that irreconcilable.

Now let's move on to commercial mortgages. The natural study for comparison with a credit risk study is actually the ACLI survey of mortgages, delinquent and foreclosed. What is the difference in scope between the two, the ACLI survey on one hand, and the credit risk study? Well the ACLI survey captures the prevalence rate, not the incidence rate of delinquencies, while the credit risk study attempts to capture the incidence rate. I'll say more about the difference between the two later.

The credit risk study also captures the loss severity; the ACLI survey does not. In addition, beginning in 1988, the ACLI began to capture the delinquent and restructured experience by property type and by region. The credit risk study does that also, along with many other features such as the loan-to-value ratio, the coupon rate, the number of years since issue.

What do I mean by a prevalence rate? Simply, it's the percentage of population in a particular status regardless of the inception of that status. What is the incidence rate? Well, it's the rate of attaining that status. In order to be complete, we should also

## RECORD, VOLUME 20

mention the antithesis of the incidence rate, the rate at which you exit a particular status for a variety of reasons.

So here's a summary of the situation. The ACLI captures the delinquent and restructured percentages as of any point in time. But in a case of foreclosure, it does capture it as an incidence rate, the amount and percentage of mortgages foreclosed since the beginning of the year. So there is one true foreclosure rate.

On page 1,444 of Volume 3 of the *4th AFIR Proceedings* [SOA, Schaumburg, IL, 1994] is a history of the percentage of delinquent mortgages among commercial mortgages, as tracked by the ACLI from 1965 to the last quarter of 1993. It shows that during the good old days, that percentage was only about 1%, but in the mid-1970s, it shot up to about five times that baseline, and in 1992, it went up to almost eight times. This closely matches the incidence rate from the Credit Risk Study.

Since I made such a point about the difference between prevalence and incidence, I have something to explain about the proximity between the two. What I'd like to do is to use a stock and flow analogy to make a point. The prevalence rate is like the level of accumulation in a sink. The incidence rate is the rate of inflow and exit rate is the rate of outflow, which could be on account of a mortgage becoming current again or becoming restructured or becoming foreclosed.

If there were no possibility of any exit, then one would be able to infer the incidence rate from the prevalence rate, just by looking at the level of accumulation from one period to the next. The new delinquencies from  $T$  to  $T + 1$ , is equal to the increase in the delinquent level plus restructures plus new foreclosures and plus new mortgages becoming current again.

I'm going to simplify my derivation a little bit and just get to the bottom line. By means of a substitution, you can get to a somewhat more expanded equation, but where the items of the equation are either known or can be simplified. Once you are willing to make those simplifying assumptions, you really have a way of inferring the new delinquency, a true incidence rate.

Let me just jump to the result of this exercise. Consider, again, the history of the ACLI percentage delinquent. This is the quarterly incidence rate, and it comes way short of the prevalence rate. Why is that? Well, if the actual travel time through delinquency is much longer than a quarter, at any one time when you look at the number of mortgages in a delinquent status, you have not only the new delinquencies from the last quarter, but also the delinquencies from the preceding quarter, and maybe from the one before. So what is a natural thing to do? Let's roll up two quarters at a time. If that comes up short, we accumulate even more, which gives you a four-quarter accumulation, and all of a sudden, you begin to see a close proximity between the prevalence rate and the rolling four-quarter incidence rate. And that is why the prevalence rate from the ACLI is not a bad proxy for the incidence rate from other credit risk studies.

Let me get very quickly to the last part of my presentation, which is relating the ACLI statistics to the Frank Russell Index. The Frank Russell Index measures a total return on unleveraged commercial real estate. It's a completely independent database from

## CREDIT RISK STUDY

the ACLI. The Frank Russell Index minus the return on the consumer price index is an inflation-adjusted total return on the rolling four-quarter basis. Now, total return is so-called because it combines the net operating income and the appreciation in property value. It turns out that there's a very good symmetry between these two curves in the sense that one is almost a mirror image of the other one, about an imaginary horizontal axis.

Well, what is a natural thing to do upon making this observation? How about a regression? When we look at the regression line based on the regression relationship between the two curves, which in some sense, is the actual versus the predicted, it is clear how closely aligned the two are.

When you see such a good correlation, in fact, the  $r^2$  is 92%, you're almost afraid to find something wrong with your analysis. In fact, there are two things wrong. In some sense, I've pulled the wrong dependent variable and the wrong independent variable. What's wrong with the independent variable? I would imagine that a better candidate for it is the appreciation component of the Frank Russell Index not the total return minus the return on the consumer price index. Why is that? When we imagine there is appreciation or depreciation in the market value of property, that has a direct bearing on the loan-to-value ratio, which in turn, has a bearing on the delinquent rate.

What do you do when you make that observation? You make a substitution. As my second regression I substituted the appreciation component of the Frank Russell Index for the inflation-adjusted total return. This time the  $r^2$  is still very high, 91% instead of 92%, and the two are quite comparable to each other.

If you can do two regressions, one at a time, you can do a third regression using both independent variables simultaneously. When this is done, the regression line actually comes even closer to the actual.

I said earlier that I was using the wrong independent variable, but it looks as if the right one and the wrong one are not that far apart.

What about the dependent variable? One would imagine that there's a better candidate for it, and that is, the percentage of new delinquencies, not the percentage in the delinquent status at any point in time.

If I've used the wrong dependent variable, why is it that I still wound up with a pretty good regression? In some sense the answer has been given already, because I spent a good part of my talk describing how, under certain circumstances, the prevalence rate is not a bad proxy for the incidence rate. So while I was not using the true incidence rate, I did come very close, because the prevalence rate turned out to be a pretty good stand-in.

Summarizing, I tried to make a connection between the prevalence rate from the ACLI and the incidence rate from the credit risk study. And then I tried to make a connection between the Frank Russell Index and the ACLI survey. It is my belief that all these time series can tell us a lot about where the market is heading, and I think there's a lot to be gained by studying them very closely, and relating them.

FROM THE FLOOR: You said that for measuring loss severity, Moody's used market value right after the credit event. What do you do in the private study, because you don't have a market for it?

MR. TAM: That's a good question. We used the actual recovered cash flows, if they have come in already. What about the tail in an open-ended situation? We used the best estimate available as to what we can recover by way of a future cash flow. Essentially, we used the discounted cash-flow approach. But the idea is to update the estimate from year to year. With each passing year, you have another year of actual cash flow, and you have a shortening tail. So presumably, you can make a better estimate. The idea is to true up over time.

MR. WALTER C. BARNES: I'm going to be talking about further analysis of the credit risk data or as might be called "Uses and Abuses of the Credit Event Data." Although my talk is going to be on the commercial mortgage side, just about everything that I talk about can also be applied to the private placements.

I want to start out with a couple of questions. My first question (and the audience's response) is:

*Are you familiar with transition matrices and their uses in analyzing mortgages with credit events?*

|     |     |
|-----|-----|
| Yes | 20% |
| No  | 80% |

My second question (and the audience's response) is:

*Would you expect the losses to be higher on a group of restructured mortgages than a group of delinquent mortgages?*

|     |     |
|-----|-----|
| Yes | 11% |
| No  | 89% |

Like Kin, I'm going to hold off on giving this answer until a little later in my presentation.

Since many of you are not familiar with the transition matrix, we'll spend just a little bit of time talking about that.

Several of us became very interested in how we could use the SOA data for uses that the original designers of the project might not have thought of. There were a lot of things that we asked the companies for, but as it turns out, when we were looking to do some further analysis, there were several variables that were not there. One of them was the status at the end of a year. Kin talked about the incidence rates, and it does a very good job of picking that up. However, you're not totally sure what you're getting the incidence of, when a loan is in credit event. In other words, what we did not pick up at the end of a year that the mortgage was being looked at, was whether it was the end of year 1985, 1986, 1987, or 1989. We could pick up that it was in a credit event, or that a credit event had occurred over the study. However, we could not tell if the loan was delinquent in a certain year, and then went to

## CREDIT RISK STUDY

foreclosure, or if it was delinquent, went to restructured category and then to something else after that.

I was doing some work for the asset valuation reserve, and we needed to do that because we wanted to take the data that were available and use them to come up with asset valuation reserve factors. You might ask how we can do it, because those data were not there. Anybody have any ideas? Well, we do what we always do, the next best thing. We actually went to a place where these types of data do exist. Since this study was done on a disaggregate basis, or loan by loan, Mortgage Information Bureau (MIB) had the asset IDs for each of these credit event loans. Since we were only looking at loans that had a credit event, it made the job halfway manageable, because we only had to look in the statement under the different sections of bad loans. I think that's Part II, and then the different sections in Part II, and then there's a Part III for the foreclosed loans. But the MIB has an asset ID, and it has the year the loan was originated, so we can use that as a check. And MIB has the status and the outstanding loan balance. We can use that as a check.

So we went there and obtained, for 1985, 1986, 1987, 1988, and 1989, statuses for all these loans, and then matched them up. Now, there are some problems with doing that. What are some of the problems that you might think of?

FROM THE FLOOR: The ID changes.

MR. BARNES: Typically in the mortgages, that's not that big of a problem, thank goodness. It is in bonds, but it's not with the mortgages, because that would have been unmanageable. What did happen is that the Schedule B's of that time also included a fair amount of residential, so we had to pick that up. There were some large loans out there.

Second, the Schedules did not include restructured mortgages, because not until 1992, did they include restructured mortgages. So we could not tell that. How can we come up with an algorithm to try and fill that in? Once we have these data, what do we then do with them? We do what we always do, we construct tables first, and then graphs second. We had 1,254 loans and this is just going to be a transition from 1986 to 1989, because it shows some nice things. We have this nice little matrix that includes 1,254 loans when we were sampling them. Now these were all credit event loans, so we knew that at the very end, none of them wound up to be active, and they all sort of migrated. Some 496 of them were active. Subsequently, 251 were foreclosed, 94 were in process of foreclosure, 4 restructured, 73 were delinquent, 74 were unknown. "Unknown" was a category that we had to put in there because we didn't want to impose anything. If we saw it, then we counted it restructured. If we could not match a Schedule B entry, and it was a credit event in a certain year, we said that was a restructured loan. That didn't show up in a Schedule B, but showed up on the Society's study, as a credit event loan. Then subsequent to that, we did not want to impose anything if there was no Schedule B entry, but it was still restructured; we said we don't know for sure, so we're just going to call that "unknown."

I was very interested to see Kin's earlier work about the delinquencies versus the Frank Russell, because those of us who do a lot of work in this tend to view a

commercial mortgage as a derivative product. When you loan money on a mortgage, you're really buying a commercial mortgage bond. What really occurred is that you bought a risk-free bond and sold a put option. And the put option is on the value of the property, in that the borrower always has the right to send the keys to you in total defeasance of the debt, if it's a nonrecourse loan. And most of these are. This work is sort of an options analysis, and we're going to get to that shortly.

Consider what happens to our actives when they become the different types of underperforming debt, the delinquents. Put a bunch of loans in a delinquent category, and assuming these transitions are stable over time, (which we don't really have enough of a time series to be able to say that), almost half foreclose; almost half go to an unknown category; a smattering are still in delinquency (that probably means that they've gone out and come back in, because I don't think you can leave a loan in 90-day delinquency for four years); and a smattering are in process of foreclosure.

This kind of points up on restructures, they go to the unknown state. My best guess is that most of those stay in restructured over that time period, because we just don't know. If they went to another category, if they were foreclosed or processed, we would know that. So over this time period most of those that went into what we called restructured, stayed in that category.

The data on the process of foreclosure is very telling. Many people looking at "in process of foreclosure" would say that the probability is 100% that it is gone. That's not true. In fact, at Travelers, where I used to work, and in some of the other companies' disaggregate data, the experience runs about 50/50. In other words, you take 100 of these things, all else equal, and about 50 of them go ahead into foreclosure, and about another 50 go other places. A study was done at the ACLI on another category, the restructured loans. Those conducting the study looked at the data again, and they picked up some of this. It was reported that around 30% of the loans in process of foreclosure actually go back to active. Amazing. Several of them went into the unknown. Some of them stayed in the process of foreclosure, although I think that they probably went out and then came back in.

Now, this is very interesting, but what do we do with it? How are we going to use it? Well, it is useful for helping us focus on the problem. For terms of modeling, I don't know that it is so interesting. However, one of the things that we also got was cash flow. For those who are not familiar with the study, we actually asked the companies, on every credit event loan, for the cash flows from the date of the credit event forward, for the original loan, and for the credit event cash flows.

The foregoing were used to calculate the severities. However, we could now use that and the status information to actually tabulate severities by credit events. What you see in the Society's study are the histograms and the figures for severity. If you can think about this, it has every category in it, because the study looked at approximately 1,250 loans. Some of them were restructured; some of them were foreclosed; some of the loans were delinquent for a while. What we did is to go back and look at the charts on loss distributions, the loan loss severity. We did it a little bit differently than this study did, because we were looking at year-end losses. In other words, the study might have said that a credit event was in 1987, however, from Schedule B, this loan might have been delinquent at the end of 1986. So we went

## CREDIT RISK STUDY

back to the end of 1986, and using the cash flows that we had (Stacy Gale from MIB and I worked a fair amount on this), created an algorithm that would fill in cash flows where needed. It looked at the present value of the original and the credit event cash flows and came up with a loan loss severity for foreclosed loans. Now some very interesting things come out of this, based on the cumulative distribution function (CDF).

An interesting thing is the foreclosed loans, which I will now give you some general statistics on, are not normal. The mean is about 51%, the median is 56, so that actually is fairly close. The interesting thing about it, when the study first came out, people said that we had underestimated the actual losses. I maintain that's not true, because people think about foreclosure when they think about losses. On the foreclosed properties, 50 cents on the dollar of loss is about what properties were actually selling at. There were people who were selling distressed properties, who were actually foreclosing on the loan and then turning around and selling the underlying real estate. They were fetching about 50 cents on the book value dollar of the loan that was booked as of the time of transfer. So that's not a bad measure.

Let's look at some of the others. I think those are much more telling. One that I think is very interesting was based on our derived numbers. I want to go with restructured and then delinquent, to show you the difference. These were much lower losses.

Now, restructured is still a credit event, because something had happened and if you go back in, and even try to work it out, there's a sort of wedge in there, where it's in everyone's best interest to work it out. If you took the property back, the lender thinks it's going to lose more than if it worked with the borrower. Restructuring is in the borrower's best interest as well. In fact, the mean in this category is about 12%, but it's not normally distributed. It has a long tail.

I want to touch on the delinquent. One of the things that I find interesting is that the loans have very similar shapes, except the delinquent is just moved out, and the mean for the delinquent goes up to around 16%.

Now, you might ask, "Why should I care about this? We've gone out there, we've cross-tabbed these, what can we begin to use these for?" Well, I can think of several uses. One of the things that we originally looked at doing with them, was using them for asset valuation reserve factors. How can these losses be used to come up with an asset valuation reserve factor, and do the ones that they produce make some sense? Can we validate them?

Does it make sense to look at our charts and say that at the valuation reserve we're going to try to cover some percentage, then to pick a number based on our CDF? Well, I maintain not. And the reason I do is, because if you only had one loan in your portfolio, it might make sense to do that. Let's assume that this is the right distribution, and you randomly have a restructured loan. So you reach into this restructured loan group, grab one out, and there it is. Is that what most people's portfolios look like? Heavens no! This is the reason that we teach portfolio diversification. So what do we do?

Well, we replicate portfolio diversification. We use a technique called "boot strap-ping," where you would actually assume here that you have a portfolio of 200 restructured loans. There is no size variation. So we just randomly dipped into that distribution discussed earlier, and grabbed 200 loans, added up the losses, and said, "That's an event." We did that again and again and again, and we begin to approach what our portfolios would look like.

Now I maintain this is the type of number that you want to begin to think about if you're going to do some sort of asset valuation reserve, you know, risk-based capital, or whatever you're going to look at. This is the type of numbers, or the type of distribution, that you begin with. There are obviously other things that go into it.

Let me finish with another little plug for some work that several of us have been doing. This is only a beginning. I think that the study is a fascinating one for several reasons. It's not a very long study in terms of time series, but it's a wide study. And for those of you who are familiar with something called "Panel Data Studies," you know that if you look at it properly, great cross-sectional work can be done here. It's a 1985-89 pilot study and it has some time series, but a depth of analysis can be brought to bear on it.

Here are some future directions. I think that some of the most interesting work that could be done on this is, how do you begin to make inference about a group of active loans? Take a group of actives, which is by far the largest category still left. How do you take the stuff that we've done on the credit event mortgages and things that we can infer back from the data, and use that to actually look at the active mortgages? How can you use this to price mortgages? How can you use it for regulatory purposes? How can you use it to help it give you the answers that you want, given that it has such a short time period? That's some of the things that we're working on now, and I'd be happy to answer any questions about it.

MR. WARREN R. LUCKNER: My presentation is focused primarily on the handout that follows this talk, and so my talk is going to be relatively short. The handout has both Mark Carey's name and my name on it. Mark Carey is a staff member for the Federal Reserve Board who is a bright young Ph.D. out of the University of California. He did the note, and since I reviewed it, my name is on it as well. I think it was a mutually beneficial experience.

When Mark Doherty and I were first involved in the credit risk project as representative of the staff from Society of Actuaries, Mark made some contacts at the Federal Reserve Board to indicate what we were doing, and there was a significant amount of interest in what we were doing, so we kept them apprised of the situation. And when we had the final report completed, and the Federal Reserve Board saw a copy of it, Mark Carey of the staff of the board contacted me about perhaps having some access to the information to do some additional analysis. The additional analysis that he was requesting to do was something that we had wanted to do more on, but for a variety of reasons, including priority of tasks and the data that we had, we decided we weren't able to do it at the time that we did the initial study.

There are two things that I'm going to talk about that are additional information for this presentation. The first is the spreads of the private versus spreads of the public,

## CREDIT RISK STUDY

which is what the note's about. Following that, I'm going to make a quick and rough comparison of spreads on the privates versus the basis point loss that we had on the privates.

When we got this request from the Federal Reserve, it had done some work on comparing spreads of privates to spreads on publics, for the years 1990-92. Unfortunately, the people there didn't have any data prior to 1990, and they wanted to extend their work back through the time period for which we had data. So that's why they asked us for permission to use our data. We, at the Society of Actuaries, felt this was an opportunity for actuaries and actuarial techniques to be exposed, and hoped that that would be a mutually beneficial experience. Thus, after we contacted the data contributors and informed them that we would be doing this, we agreed to provide Mark Carey with some information.

Now with any data analysis task, you have data issues and sometimes they overwhelm all other issues. The data issues are detailed in the handout. They revolve around, of course, the question of amount of data, completeness of data, and quality of data. Because of the completeness of data and quality of data issues, we ended up having to change the amount of data we used. We knew up front that the completeness of the data was an issue because we had asked for many characteristics, but we did not get complete information on some of those characteristics. In particular, on quality, we had about 30% information on recent quality ratings and even less on original quality ratings.

So we ended up making some adjustments for this data subset to be processed by the programs that the Federal Reserve staff provided to us. We obviously eliminated some data points. Then we also developed a couple of alternative samples, beyond the usable sample that we developed from our data elimination. We gathered what we called the "trimmed sample," which means that in each cell we took the minimum spread and the maximum spread, and eliminated those as outliers. Then we had a "bounded sample," which was basically a sample that allowed for a reasonable bound on the basis point spread by quality. Any data points beyond those bounds were eliminated from that sample.

Along with the data issues, there were some computation issues. Again, those are detailed in the handout. I'll just emphasize the two most important ones. One was that in the initial request for data for the credit risk study for the 1986-89 time period, we did not request spreads at issue. We requested bond equivalent yield and we had to determine the treasury rate, given the time period. We then subtracted the treasury that we inferred, from the bond equivalent yield to get the spread. In the request that went out for additional information from years 1990-92, we have asked for the spread at issue, so we'll have a more direct way to compare spreads.

The second computation issue is that we adjusted the public's spreads because the data series that was available to Mark Carey was on a 30 year corporate bond, and since most of the privates were less than 30 years and in duration spreads increase with duration or maturity, we ended up making an arbitrary deduction of 20 basis points from the spreads for the publics.

Finally, one of the key issues to keep in mind is that, even though we're talking about bonds and we're talking about bonds issued by similar types of companies, publics and privates are not identical types of investments. So we have to keep that in mind when we do these comparisons. The bottom line is that for comparison, we had four quality rating categories that we could use: A, BBB, BB and B. Moreover, we did it on a quarterly basis, but not all the quarters in all the years were available because of our restriction that there be at least four usable data points in a cell. We preferred to have 10-12.

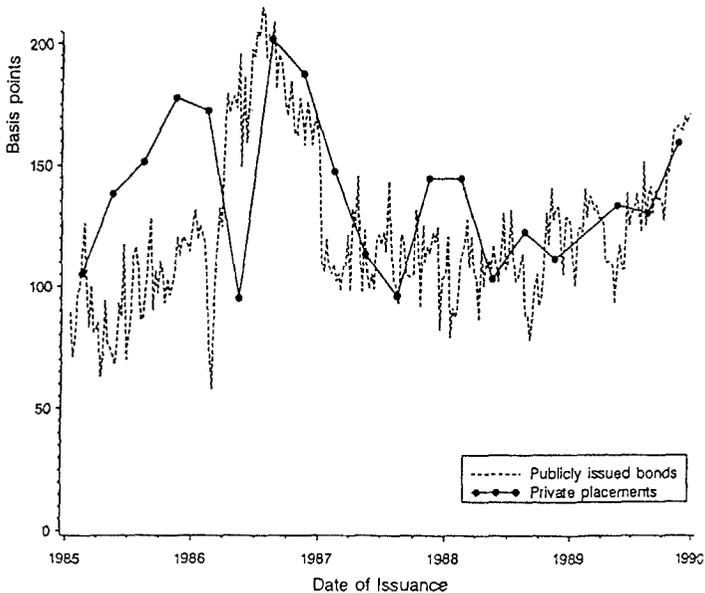
The first comparison that I want to talk about is the privates versus the publics. The parameter we're looking at is the private's spread less the public's spread. Here's my first question (and the audience's response):

*Are spreads on privates greater than spreads on publics for comparable quality?*

|     |     |
|-----|-----|
| Yes | 88% |
| No  | 12% |

The standard actuarial answer applies: it depends. It depends upon the quality and on the time. Chart 1 shows the results for A-rated bonds. In 12 of the 19 quarters privates win. That is, the private's spread was greater than the public's spread. So here we're talking about dependence on the quarter.

CHART 1  
SPREADS FOR A-RATED BONDS



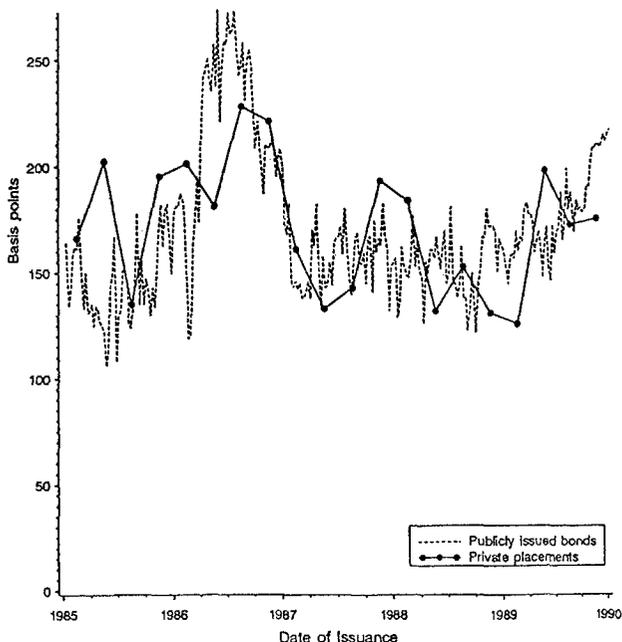
Mark Carey had obtained some anecdotal information by talking to some of the deal makers at companies, and there was an indication that the extra spread that you get

## CREDIT RISK STUDY

on privates is about 31 basis points. The extra cost is about 18 basis points. So the net advantage to privates is 13 basis points. The range that we got from a small sample of dealers was 10-40 basis points. In our comparison, for the entire period, it was 15.5 basis points.

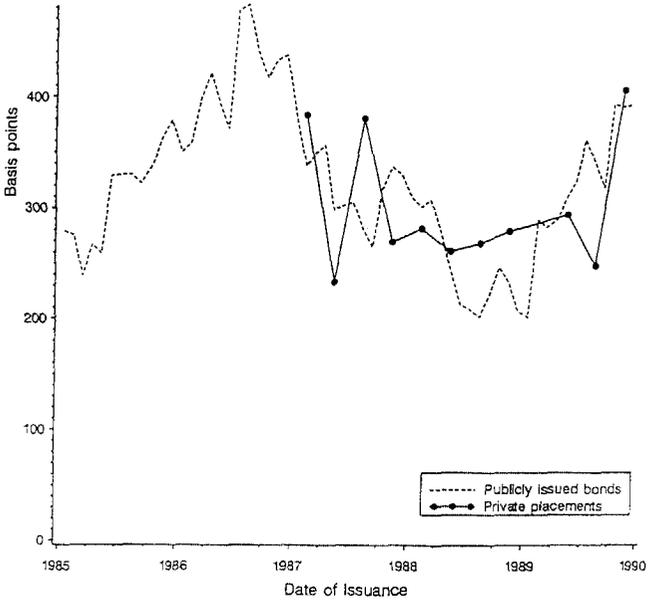
The second category, the BBB rated, is close (Chart 2). Each of the privates and the publics, won ten quarters. Over the entire period, we got a 1.3 basis point difference. There is an advantage to the privates. Why is there a decrease from going from A to AAA? There's some speculation about this. First of all, the internal rating that the company puts on the bond, versus the ratings that the public has, may cause some of this difference. Perhaps more important is the issue of loss control. As you go down in quality rating, the privates get involved with collateral and covenants, which are much more difficult to deal with than doing the public issue, and I don't know that very many even have that. And then there was also an issue of seniority. The privates tend to have higher senior status than the publics. They seem to have senior debt, whereas the publics tend to be junior.

CHART 2  
SPREADS FOR BBB-RATED BONDS



And as you get down to the next one, the BB rated, the publics actually win more quarters. Out of eleven, the publics win six (Chart 3). Over the entire period, we have a 17 basis points advantage over to the publics. Thus, the privates less the publics is -17. That continues the trend and in some sense, there was an indication that this might have been surprisingly close; that is, that there should have been an even greater advantage to publics for that quality rating.

CHART 3  
SPREADS FOR BB-RATED BONDS



Finally, for the B-rated bonds, the last category, there are two things I'll mention. It continues the pattern (Chart 4). There's a clear distinction, and then there's an interesting anomaly here; I'm not sure where that results from, but the pattern for the publics is exactly opposite of the pattern for the privates in that time frame. And over the time periods, there is a 128-basis-point advantage to the publics.

Now I'll get to the second question (and the audience's response):

*In our study, are spreads on privates sufficient to cover credit-risk basis-point loss?*

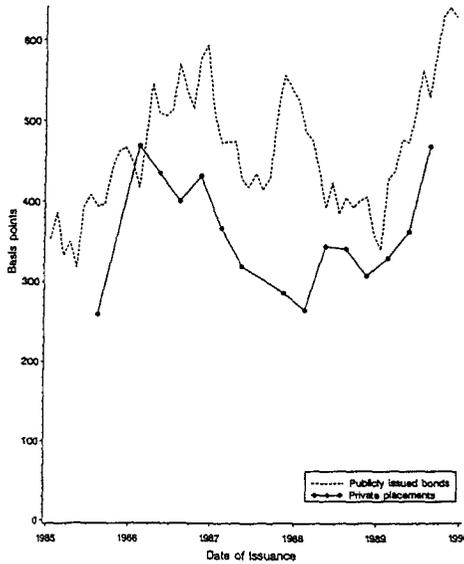
|     |     |
|-----|-----|
| Yes | 67% |
| No  | 33% |

There appear to be many "no" opinions. And the answer is a definite "maybe." The difficulty is, what else is the spread supposed to cover? If you look at the private's mean spread from the note and then the private basis-point loss based on our earliest quality rating from our study, then obviously, the spreads are significantly higher than the loss. But the spread is supposed to cover a number of different things.

The spread is supposed to be compensation for taking on a risk. It's supposed to cover the expense of doing the deal. And it's a question of whether the credit risk was actually considered in your pricing of the spread. That really determines whether the spread covers the basis-point loss.

# CREDIT RISK STUDY

## CHART 4 SPREADS FOR B-RATED BONDS



This is really not quite a legitimate comparison. This is an important, but subtle point. The spreads are for issues during the time period, 1986-89, while the loss is for credit risk events for the same time period, but are issues from many different years. What we really ought to do is a cohort study, which requires more years to obtain enough data.

As a final comment on that, take a look at the note, if you have any questions, feel free to contact Mark or me. It's an additional analysis that we did, which we think is helpful, because we were talking about comparing spreads on privates and publics. I think we obtained some additional information and knowledge.

