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MODELLING AND MANAGING RISK

By P. J. Sweeting

[Presented to the Institute of Actuaries, 30 April 2007, in Manchester,
and to the Faculty of Actuaries, 19 November 2007]

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ABSTRACT OF THE DISCUSSION HELD BY THE FACULTY OF ACTUARIES

Mr P. J. Sweeting, F.I.A. (introducing the paper)**:** This paper has a number of purposes. First, it is intended to give a very broad overview of the risks faced by the different types of financial institutions. It is also intended to describe the methods which these institutions use, and should use, to model and to manage these risks.

I took the deliberate decision to leave this paper equation free. This decision was taken because I felt that it would be better to give a clear reference of where a full exposition of the mathematics could be found rather than to give a few randomly distributed equations around the paper. However, even doing this, the paper still runs to over 40 pages, and even at this length I can only skim the surface of the subject of modelling and managing risk.

It is some months since I first wrote the paper, and I will now speak about some of the key points of the paper, and will also share some thoughts which I have had since the paper was first produced.

For me, one of the key themes in the paper relates to credit risk. In one way the new approaches to rating individual companies suggest a number of avenues which insurers might want to explore when considering the methods which they use for premium rating and reserving. However, whilst credit rating agencies do have undoubted skills when modelling individual firms, both in terms of the mathematical models which they use and also the more subjective approaches which they employ when considering a firm's willingness to pay, I get the impression that they struggle when considering the interactions of multiple risks.

In the paper I give the example of the value of the pension scheme sponsor covenant. I have seen little evidence that rating agencies are allowing for the interaction between the value of the firm and the assets and liabilities of a pension scheme when they are assessing this covenant. This is surely the key factor, and it is a factor which actuaries are well able to assess.

I mentioned this fact when I presented the paper to the Institute of Actuaries (*B.A.J.* **13**, 579-636), and it was pointed out to me that there are already a number of actuaries working in the credit rating industry. However, I feel that we should be getting even more involved in this work, both inside the credit rating industry and also independently of it.

Another area of credit rating which I think should attract the attention of actuaries relates to collateralised debt obligations (CDOs). Now, the first stage in producing a CDO is to pool a number of underlying investments, such as corporate bonds or mortgages. Then the pool is effectively divided into a number of new securities, with different classes which have different levels of expected risk and return. These securities are bond like, so, effectively, you get back the capital which you invest, plus a level of interest, less an allowance for any defaults in the underlying investments.

It is the way in which these defaults are allowed for which is particularly interesting. For the

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riskiest tranche of securities, known as the equity tranche, the full force of any defaults is felt. However, in compensation for being the riskiest tranche, these securities also have the highest expected return. Investors in the next most senior tranche would receive their capital plus interest in full, unless the capital of the equity tranche has been completely wiped out by default. Only then do the defaults start eating into the next tranche. This continues right up until the super senior tranche, where the investors get the full capital and interest, unless all other tranches have been exhausted. This certainty has a price. The securities in this tranche also have the lowest expected rate of return. Clearly, it is crucial that the interaction between the underlying investments is modelled correctly. In particular, it is well known that the price movements of securities might be reasonably unrelated if these movements are small. The prices will tend to move together if you get a credit crunch. The direction in which the prices move in this situation is down.

What this means is that you cannot model these relationships accurately using just correlation. Copulas offer a much better solution. While the CDO market is undoubtedly going to be smaller in the future than it has been in the past, it is still a market where actuaries should be looking to make an impression, given the mathematical skills which are involved here.

It is also worth noting that the tranching approach, which is used with CDOs, does offer a novel way to securitise some of the risks carried by insurers and by pension schemes. I should be interested to hear of the extent to which this has been considered by such organisations, or even implemented so far.

The second theme in the paper which I should like to discuss is the modelling of different types of risks in a consistent manner. I have already spoken about one aspect of this, taking into account the asset allocation and funding of a pension scheme when assessing the sponsor covenant. However, there are many other areas where such an approach could be beneficial. At an obvious level, the projected interest rates used to value pension scheme liabilities should be consistent with the projected asset values used to put a number on the pension scheme assets in each scenario of a stochastic asset/liability modelling exercise.

Consistency is also important between risks which are less obviously connected. For example, if the difference between the deferred and the ongoing benefits in a pension scheme is significant, then it is worth considering whether to take into account the link between, say, withdrawal rates and economic conditions. When the economy is weak, a firm is more likely to make employees redundant, thus changing their status from active member to deferred pensioner within the pension scheme. This will offset the lower asset values which the pension scheme is likely to experience if the economy does turn down.

Of course, if a firm's reaction to a weakening economy is to grant early retirement, then this could exacerbate a pension scheme's poorer funding ratio; but this, too, should be modelled. I think that the consistency between these different aspects, if you can model it, is very important.

Similarly, and perhaps more importantly, there is merit in modelling lapse rates in insurance policies consistently with the economic and market conditions which those insurance companies face. Higher lapses, particularly early in a policy's life, can result in that policy generating a loss rather than a profit for the insurer. If these lapses coincide with a downturn in the equity market, as might be likely, this could have serious consequences for the insurer's solvency.

It is not just lapses which are linked to the economy. Many classes of insurance will also experience high claim rates when the economy is weak, and modelling this consistently with what is happening to the assets which the insurer is holding is important.

Since writing the paper, I have had many thoughts about the extent to which some risks can be modelled adequately. The fat tails of market risk, the chance of multiple catastrophes affecting a general insurer, the huge uncertainty surrounding future mortality improvements, all pose enormous challenges. However, is the answer to apply increasingly high confidence levels to the models used? A number of writers, such as Taleb (of Black Swan fame), and Mandelbrot (the authority on fractals), have demonstrated just how difficult it is to get a real handle on the likelihood of these really extreme events. As Riccardo Rebonato (Rebonato, 2007) points out,

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under Solvency II and Basel II, the quoted confidence levels are such that insolvency would only be expected once in many hundreds of years. However, the datasets used to assess this risk are often so limited that they exclude, not only the 1929 equity market crash, but sometimes even the turmoil in 1987.

How can these levels of confidence be achieved for assets or insurance classes which have existed for only a few years? This is not to say that modelling risk is pointless. What I am saying is that the smaller the probabilities get, the less reliable the models become. It must be remembered that, even if models are accurate, a small probability merely tells us that something is unlikely, not that it is impossible.

Perhaps a different approach is needed. Rebonato (2007) recommends more reliance on rules of thumb and less on increasingly complex models. The more complex the model, the more faith people tend to have in the results of that model. That is often wrong.

There is, though, another strategy. Rather than just try to limit the level of risk to a certain finite probability, instead calculate the level beyond which losses will be unacceptable, and then get rid of those risks. Reinsure them, buy them out, securitise them, but remove them from the equation. It may be impossible to remove some risks. In addition, other issues, such as credit risks, may always remain, but this may be preferable to holding onto risks which, however unlikely, could result in insolvency.

Finally, I want to comment on the scope of the paper. As the title says, the paper looks at how to model and how to manage risk. When I wrote the paper I took it for granted that the risks being dealt with were what they were: pension benefits had already been granted; loans had already been made; insurance policies had already been written. Of course, this ignores a major influence which actuaries and others in the finance sector have on these risks — that is control over the risks which will be taken on.

For pension schemes, it means, among other things, considering the nature of the scheme: defined benefit, defined contribution, or something else. Insurers must consider the types of policies which they write — guaranteed annuity rates spring to mind — and also the type and the extent of underwriting which they use. Banks must consider the creditworthiness of those to whom they will lend money and the terms on which money is lent, as has been made abundantly clear by the recent events in the United States mortgage market.

How much are these factors considered and how much should they be considered? Also what, if anything, can these different businesses learn from each other in this area?

Reference

Rebonato, R. (2007). *Plight of the fortune tellers: why we need to manage financial risk differently*. Princeton University Press.

Mr R. R. Ainslie, F.F.A. (opening the discussion)**:** The author sets out to produce what he calls a 'review'. What he has produced is a wide-ranging generalist paper, and he has deliberately not looked to delve into the deeper mathematics behind many of the techniques which he describes. He has aimed to produce a comprehensive overview, and the way in which he has coupled it with the extensive use of references for those wishing to investigate further works well. Whilst the absence of complex mathematics makes the paper easy to read, the importance of complex mathematics is never far from the surface.

In the paper the author sets himself four objectives:

— to assess the techniques currently available for financial risk management;
— to discuss their use by different financial entities;
— to show where different types of organisation are making the best use of the approaches available; and
— to highlight where there is room for improvement.

The paper separately considers banks, insurance companies and defined benefit pension schemes.

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The author starts by looking at financial institutions. I found the discussion in ¶2.1 very thought provoking, in the consideration of the roles of the various stakeholders — the author might, indeed, have developed the arguments further. The dual nature of with-profits policyholders as both customers and equity suppliers to insurance companies was particularly interesting. It made me wonder about the degree to which insurance companies understand that duality, and the degree to which they go to understand the risk appetite of these customers, and to translate that into investment and strategic decisions, using the equity which they supply.

The representation of pension scheme members primarily as debt holders is also interesting. Given that the customers of insurance companies are protected by the individual capital assessment (ICA) regime, and corporate investors have the benefit of the Financial Reporting Council (FRC), the position of the scheme members, when viewed in this framework, does seem less satisfactory. It would be interesting to hear other views on this aspect.

In Section 3 the author moves on to 'Some Views of Risk'. In his consideration of Solvency II, he focuses mainly on Pillar 2. I would find interesting his views on Pillar 3, and where that might develop.

Under Solvency II, we will face the need to have many of our capital models approved, if we wish to use them. This is a great new challenge. It is clear that much work will be required; knowledge transfer and benefiting from work done by actuaries and non-actuaries in other industries in the techniques to which the author refers could be of great assistance.

In Section 4 the author moves on to the 'Risks Faced by Institutions'. If I have a minor criticism of the paper, it is that, in ¶4.2, he does mention lapses on insurance products, particularly as a correlation of economic circumstances. I feel that this could be developed further, with lapsation as a risk considered in its own right. It is clear for insurance companies, in particular, that there is easy availability of mortality and morbidity risk transfer through reinsurance to the market. We know that the products which many companies sell are heavily loaded upfront with back-end charges. We also know that there are no published data on lapses across the industry. This, to me, makes lapses, possibly, the most significant insurance risk faced by insurance companies or by the owners of insurance companies. It does not seem to me to have received, yet, the attention which it deserves as an insurance risk.

In ¶4.5.4, the author comments, under the context of liquidity risk (with the benefit of hindsight, it is, of course, somewhat unfortunately timed), that: "it is only in exceptional circumstances that the excess of outflows over inflows will amount to a large proportion of the banks's assets (a 'run on the bank')." The paper was produced in April 2007, and we have seen a run on a bank in the intervening months.

Reading this paper from an insurance company perspective, one might have leapt to the conclusion that the banking modelling techniques were well in advance of those deployed by insurance companies. What I think that the problem of the Northern Rock Bank highlights is the point which the author made earlier, that, as actuaries, we need to ensure that our modelling remains a tool of our business objectives rather than an objective in its own right.

Section 5 proceeds to provide a very useful overview of the techniques available for 'Measuring and Modelling Risks', with Section 6 as a companion piece, looking at 'Assessing Scenarios'.

As the author mentioned earlier, I felt that Section 5 draws out, very effectively, the need to consider carefully the tail of the distribution when modelling risk and, indeed, the difficulties in so doing, and suggestions as to how to approach that were helpful. I particularly enjoyed the reference, in ¶5.1.10, to a technique described as 'visual inspection'. Clearly, this proves that 'judgement' is never far from the surface in risk management!

Section 5.5 on 'Credit Risk' was, I felt, perhaps the most interesting section in the paper. Much work has been done in the field, with the reference to the work by de Servigny & Renault (2004) being particularly interesting. The absence of any particular reference in this section of the paper to that major credit risk faced by insurers, namely, reinsurer default, is suggestive to me that much work needs to be done in this particular field of credit risk.

Both Sections 5 and 6 imply that there is a danger in over-complex modelling. They suggest that businesses should look first to develop an understanding of the risks, and then develop proportionately sophisticated techniques. I agree with this approach.

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Section 7 is, perhaps, the lightest section of the paper. For example, the author touches only briefly on operational risk. One observation which I have in this field, which relates to the author's remarks on behavioural risk, is that firms need to take great care in implementing enterprise risk management (ERM) techniques when they are reliant on people. I have observed a tendency to view risk management as a box-ticking exercise, designed to make the risk managers go away. Here we are left with the worst of all risk-management worlds: poor real risk management disguised as apparently comprehensive risk management. There is much more which could be developed in this area.

Turning to the conclusion; in ¶8.1.3 the author suggests: "not only that actuaries have a role to play in a far broader range of risk management activities, but that many actuaries already have the skills and knowledge necessary so to do."

Considering mortality and longevity risk, where the profession has been, recently, at the heart of developing a new industry in longevity risk transfer, and managing understanding of that risk, the kind of role which we can have in developing profitable business opportunities and managing risk for employers is clear.

Coming back to the original objectives of the paper, I feel that it succeeds best when considering pension schemes and banks, and is somewhat lighter and less convincing on insurance company risks. I fear that this may be more a reflection of the sophistication and maturity of techniques being used in insurance companies than a criticism of the author.

So, I would agree with the comment that actuaries have 'skills', though, perhaps, the paper itself suggests that 'knowledge' is an area in which we can still work hard, and that there are still things which we can learn.

The President (Mr J. S. R. Ritchie, O.B.E., F.F.A.): I was very struck in reading ¶3.6 about defined benefit pensions in the United Kingdom. I quote from ¶3.6.2: "Whilst the funding valuation is important, the first area with which the trustees (and therefore, in practice, the Scheme Actuary) should be concerned is the buyout valuation — given that the Pension Protection Fund covers only a proportion of the benefits accrued, the cost of securing accrued benefits with an insurance company is paramount. The Scheme Actuary should ensure that the projected contributions will be sufficient to maintain solvency on a buyout basis, with an adequate degree of confidence over the projection period, given the proposed investment strategy. The funding valuation can then be assessed with reference to the minimum contribution rate acceptable for each asset allocation on the buyout basis."

Most practising pensions actuaries today would regard that as an extremely strong statement of funding principles, and probably much stronger than the large majority of private sector defined benefit schemes in the U.K. adhere to at the moment.

I am wondering whether the author, since he wrote the paper, has had any feedback from pensions actuaries concerning the strength of his remarks in that section relative to current practice?

Mr Sweeting: I have not. I like to think that it is because they think that I am right, but I do not want to admit it! However, I still stand by that comment. I think that there is always the risk that a company will not be around to look after the pension scheme tomorrow, next week, or certainly over a much shorter time horizon than many of the investment strategies which are being considered have to run. I believe that the argument is that the investment strategy is a long-term investment strategy, but, as Maynard Keynes pointed out, markets can remain irrational for longer than you can remain solvent. I think that this is something which pension schemes have to consider.

My belief is that, 20 years ago, that is probably how pension schemes would have been run. You would have looked to make sure that you were solvent on a buyout basis, and then looked at how much you wanted to fund the ongoing benefits on top. This is where you would allow for discretionary benefits.

Two things have changed over that period. The first thing which has changed is that many of the benefits which used to be discretionary benefits, and therefore did not need to be included in

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the buyout valuation, have become guaranteed benefits. For example, with increases to pensions in payment; you would pay if there was enough money there. If there was not, then you might pay a lower increase in any particular year. There was a much greater degree of the sharing of risk between the sponsor and the member. You do not have that now. You have LPI for benefits since 1997, and reducing the LPI when the inflation rate has fallen does not really help much. That has increased the level of benefits which are being covered in a buyout valuation substantially.

Something else which has happened over the past 20 years, or probably over a much shorter period, is that long-term interest rates, both real and nominal, have plummeted. That has meant that the value of buyout benefit is now far higher than many people would have expected. Even when I started carrying out pension scheme valuations we had double-digit long-term interest rates, which makes many benefits seem relatively cheap to guarantee. When you are looking at long-term real interest rates of only around one per cent per annum, then the benefits get very expensive.

These two factors mean that the buyout basis is now a very strong basis. Somewhere, probably around ten years ago, the buyout basis and the ongoing basis flipped around, and the buyout liabilities became higher than the ongoing liabilities. I do not think that that means that the view of the buyout basis as the most important basis should change. I still think that it is important that pension schemes should be covered on a buyout basis, even if most of them are not.

Professor A. J. G. Cairns, F.F.A.: In his introduction the author spoke about the remarks which Riccardo Rebonato made in his book about the meaning of a 99% confidence level (Rebonato, 2007). I am familiar with this issue from much of the modelling work which I have done over recent years, such as on longevity risk. Often you have relatively little data. When you are doing your modelling you do the best that you can, but when you are going to those sorts of probability levels, it is very much just indicative of the more extreme events which can happen, rather than being an exact assessment of the probability.

Certainly, when I look at those sorts of levels, what you are trying to do in the modelling work are two things. One is to identify some of the bad things which can happen, and, if they are unpalatable, then, as you say, you really ought to be trying to transfer that risk in the process of some good packaging of risk management. The other thing which comes to mind under these circumstances is, perhaps, more to do with the longer-term horizons at which we have to look in insurance. That is, we have to be very much more focused on looking at a range of different models. Thus, rather than being very much focused on the one model and placing complete faith in the results of that model, down to the extreme probabilities, you ought to be trying out different models to see which things can go wrong in extreme circumstances. If you look at different models, then all of them will probably highlight a number of different and bad things which can go wrong. If you were to focus on just one particular model, then you are likely to miss a number of bad scenarios.

So, looking at a range of models as well as some individual scenarios is always a good thing. There are some very good examples which I use in my own teaching. Northern Rock is one and Long Term Capital Management (LTCM) is another. Too much reliance, perhaps, on a limited number of scenarios, or too much focus on one particular model, brought disaster to particular organisations.

Mr Sweeting: One of the things which Riccardo Rebonato said before he launched his book (Rebonato, 2007) made me think that this issue with modelling is as much an operational risk issue as anything else, in that, if you go to a quantitative analyst who spent a long-time doing his mathematics degree, his PhD, his actuarial exams, or whatever, and you say: "I have these returns. What I want you to do is to try to model the way in which they move and the way in which they interact, and come up with a 99.5% confidence interval." He is not going to say: "Is that really the best approach?" He is going to say: "Fantastic! Here are some sums which I can do which actually put into practice all these years of study!" This is a real operational risk issue.

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You will find that quantitative analysts are able easily to find statistical distributions and copula distributions which will link those distributions and will describe perfectly well the data, and will give you a number. Whether that is the right approach or not is what they should be considering. That is what Rebonato (2007) considers in his book, which, coming from someone who is as quantitative as he is, is quite an admission.

The President (Mr J. S. R. Ritchie, O.B.E., F.F.A.): If you were writing this paper from scratch today, how different would it be as a result of the experience of Northern Rock?

Mr Sweeting: The section on liquidity might be a little longer! Having said that, I think that I have just about covered myself in the paper when I said that it is only in extreme circumstances that that can happen. I think that it was a fairly extreme circumstance. It also reinforces my comments that, just because something it is unlikely, it does not mean that it is impossible. As Professor Cairns said, if something is too extreme a risk, it is important to try to get rid of it.

Mr. I. A. Farr, F.F.A.: The author refers to defined benefit pension schemes both in the paper and in his presentation. He also touched on risk sharing as being a possible way of controlling risks for these schemes.

This is a very topical subject, because, at the current time, the Government has been consulting on a new type of risk sharing for pension schemes. I have always thought that it was bizarre that, in the U.K., something like 98% of private sector pension arrangements either have 100% of the risk borne by the employer or 100% of the risk borne by the employees. There are only about 2% where the risks are shared. That is what the author is saying, let us have more risk sharing as a way of managing risk.

What is happening is that, in the Government's response to the External Reviewer's paper concerning the deregulatory review of private pensions, it has put forward a type of conditional indexation which is based on a model proposed by the Association of Consulting Actuaries (ACA). That model is a career average scheme, under which you would target future indexation increases, pre and post retirement, supported by prudent reserves under scheme specific funding. These future targeted increases would be conditional upon the financial health of the scheme. This is quite important, because we all know that active membership of defined benefit schemes in the private sector has been diminishing in recent years. In the Pensions Commission report of Lord Turner, he showed that in 1995 there were 5 million active members of open defined benefit plans in the U.K. in the private sector, which dropped to 2 million in 2004.

The ACA recently carried out a survey, and we think that that points to there being currently, not 2 million, but only 900,000 active members of open defined benefit plans in the U.K. So, there is a massive gap in the type of pension provision between the public sector and the private sector, which could soon start to cause strains in society.

The indexation of pensions is a very sensitive subject. The Government has recently ruled out the removal of LPI for future service defined benefit pensions. We have seen, also, a negative reaction from the trade union movement and from others to the Government's proposal to reduce the cap for revaluation of deferred benefits from 5% p.a. to 2.5% p.a. Nevertheless, something has to be done if the private sector is not going to become virtually 100% defined contribution in the very near future.

There is a Pensions Bill before Parliament at the current time. There is space in that Pensions Bill for some changes to the law, and one possibility is conditional indexation. I hope that the Government takes that lifeline for the benefit of the nation as a whole.

Mr Sweeting: The proposal for capping the deferred pension revaluation is, I think, a real waste of time. The proposal is to limit the cap on RPI to 2.5%, when most economists reckon that the CPI target of 2% is roughly equivalent to an RPI of 2.8%, so you have 0.3% difference. Because it is a deferred pension revaluation, it is not each year. It is averaged over the whole period of deferral. It is potentially going to make a very small change, apart from in administration, where you have yet another class of benefit, depending on when someone left active service.

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Rather than playing around the edges with something like that, it makes far more sense to leave defined benefit pensions as they are, and just have a third type of pure risk-sharing pension scheme. Whether it has targeted increases or whether it has no guarantees and pure discretion is less important. Another improvement could be made for deferred pensioners. Guarantees on the increase in deferral could be avoided, provided that a career average revalued earnings approach was used, so that the increases given to active members were the same as those given to people who have left service. The whole point of putting in protection for deferred pensioners is that there is nobody there to look out for them: they have left the firm, they are not current employees, they cannot strike; they are not pensioners, so they do not have the pensioner lobby. However, if you guarantee that you are going to treat them in the same way as active members, by giving them a career average revalued earnings type increase, then that protection is no longer needed.

That would be a way forward, and a way of managing risk. I suspect that one of the reasons why some parties are not too keen on that approach is that they fear that, if there is a decent alternative to defined benefit pension schemes which is not defined contribution, many people might go for it and leave defined benefits behind. I think that people are recognising that the cost of defined benefit provision, at the moment, is so high that it is probably not going to be around for much longer in its present form.

Mr H. R. D. Taylor, F.F.A.: It seems to me that not all risks faced by financial institutions in the U.K. can either be identified or pre-hedged to limit impact. There will always be an element of unknown risk. Another large unknown factor is the scale and the speed with which something which has been already identified as a risk could actually go wrong. Such risk events and their impact may be underestimated, as experienced recently by investors and depositors in Northern Rock.

So, the question is: "Given that as a backdrop for any enterprise risk management, and also noting the keys to successful risk management outlined in ¶8.2, just how well prepared do you think that U.K. financial services' companies are in their ability to respond quickly to the unknown?" I suppose that a fast, effective response involves at least: early detection, situation analysis, generating options; and then taking action to limit the risk and its impact, or even to remove it altogether for damage limitation.

Mr Sweeting: Almost by definition, it is impossible to do much about the risks which you are unable to identify. It is possible to look at what sort of business you have, what sort of liabilities you have, the areas where those liabilities could increase, and the assets which you have in areas where those assets could fall.

In terms of the scale and the speed of those changes, the main area where that is an issue is in terms of liquidity risk. If you have determined that, once your liabilities go above a certain level or your assets fall below a certain level, you have a problem, then you can put in some sort of reinsurance arrangement or securitisation beyond those limits. You are still left with problems of what happens if that market starts to fail, and you cannot get money from the reinsurer when you need it, which goes on to the area of analysing the credit risk of the reinsurers, as was mentioned earlier.

Of all the risks, the financial ones are the easy ones. The operational risks are the really tricky ones. You may have all the financial modelling capabilities available to you in place and everything modelled correctly, but it is a very difficult thing to foresee that having a trader married to someone who works in the back office of the firm is an issue, and that the records of trades might be hidden from you.

In any operational setup, it is going to be very difficult to work out where problems might arise. I cannot see many ways of dealing with these. There are still many financial risks which are not being properly modelled or managed. That sort of stop loss type approach is not being put into place where it could be, and where problems could be prevented.

Mr C. J. Thomson, F.F.A.: I have spent the past seven years in a company which, before

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LTCM and Northern Rock, was a byword for financial problems. Equitable Life had something of a reputation as being associated with the kind of disaster which you want to avoid.

The common theme has already been mentioned. There was a business model which assumed that the sun would always shine. In other words, the company underestimated the risks which it was running. It had not analysed those properly. It did not have the capital to run them. That is not something which you will necessarily get from your analysis. It is something which you ought to be able to see, and, if you follow actuarial principles as they have been set out for the last generation or two, then you will manage to avoid some of the more obvious pitfalls.

I like the concept of trying to preserve final salary pension funds by getting people to understand who takes the risk. All power to Mr Farr's elbow in getting members of pension funds to understand that they bear a share of the risk in a defined benefit scheme, and to be happy with that.

In my experience, when you tell people that they share part of the risks, it is amazing how quickly they run for the hills. There are very few people who volunteer to share the consequences of the risks which have been run. It is, therefore, vital in the modern world that it is spelt out in words of 'one syllable' precisely who runs a risk, otherwise you will find that even the Government will say that it does not. Even when the Parliamentary Ombudsman tells them that they have run the risk, the Government is still denying it. Policyholders bought their products willingly, but now they feel that they were mis-sold. Even if you have the technical evidence to support a sale, the FSA might still decide that you ought to have a mis-selling review, because your mortgage endowment did not actually repay the mortgage. The customer has saved an enormous amount of interest payments, but has a shortfall on his mortgage endowment. Was anything done post sale to bring this link home to the customers? So, if you are going to say that the risks are as you would like them to be, you need to make certain that every piece of paper clarifies who runs what risk and have the risks there to be seen.

Going back to the basics of modelling, the ICA type of activity, I would echo what has been said earlier. Do not believe your model. By all means have a complex model. It is useful in understanding the complexities of your business, but, at the end of the day, the rational test of what it is telling you should be looked at, and you should kick it around as hard as you can in order to see whether you believe it.

I have been impressed how often, in dealing with life risks, or in looking at some of the general insurance risks, and in talking to people about the one in 200 probability which is now enshrined everywhere, that the sort of events to which they relate, when you think in terms of hurricanes, floods and earthquakes, actually look like once every 50 year events! I do not think that people understand what is a one in 200 years probability. Of course we follow the ICA rules, but I wonder if the level of capital which might be required if we actually push the model that far could be even higher than the capital levels which we have today.

It was suggested by the author, in his introduction, that selling on risk was something which you should always be able to do, financially, and, if there is a sophisticated developed market, then I think that that is probably right. Again, arguing from my own company's experience, there is a piece of work written ten years ago by my predecessors, which said that the risk of low interest rates was one which could not be justified hedging against. What they actually meant was that they did not have enough capital in order to be able to hedge low interest rate risk, and, therefore, they simply ran that risk. The better alternative is to be strong enough to run the risk yourself, and to consider whether to self-insure or not. For interest, in 2007 we bought out our low interest rate risk, because the price at which we could hedge it was more attractive than keeping the risk in the fund.

Mr M. A. Potter, F.I.A.: Since the publication of the paper there has been the publication of the 'Library of Techniques for the Actuarial Profession' (CMIB, 2007) to be used for looking at improvement factors for longevity. I wonder if the author has any comments on the usefulness of the library.

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REFERENCE

CMIB (2007). Continuous Mortality Investigation Bureau, Working paper no. 27.

Mr Sweeting: My own view is that, given the skills which actuaries have and have developed over the years, and the skills which most actuaries have in taking a mortality experience and working out what base table would be appropriate to apply, based on that population, it is unfair to expect that actuaries are also just as able to work out what sort of projection basis they should be using — in effect, to put a library of 40 different projections in front of them and to say: "Pick one of these. It is at your own discretion." You need to be, not just a statistician, but also a biologist and a gerontologist to make those decisions. I do not think that it is fair to expect actuaries to be able to make that decision.

I also think that it is potentially pointless, because what is going to happen is that a few people will start using, say, the long cohort projection basis, and then everybody else will start using the same basis, not because they have done their own independent research to suggest that, on all the evidence available, the long cohort projection basis is the most appropriate, but because everybody else is using it. All that you really end up doing is creating a herd mentality, where people look at what everyone else is doing, and then follow that, rather than make subjective decisions. If that is going to happen, then I think that it is better that there is some sort of recommendation as to what a reasonable projection basis will be, and then suggest that there are some which are stronger and some which are weaker, and that you might have a particular view that your population is different from the average population. I do not agree with the approach of saying: "Take your pick."

The President (Mr J. S. R. Ritchie, O.B.E., F.F.A.): I have a supplementary question to that. We know that the Board for Actuarial Standards is planning to do some work in this area in 2008. Do you think that that is an appropriate and helpful way to tackle this? Do you think that the Board for Actuarial Standards should lay out some kind of 'guidelines for actuaries'?

Mr Sweeting: Not really. It would be more helpful if the CMI were asked to give its best estimate of its central estimate of mortality projections.

While the Board for Actuarial Standards will be able to draw on a great deal of expertise, the people who are best able to make those decisions are the people who study it more or less full time.

As we have already seen, estimating future mortality is really difficult. It is even more difficult if the only tools which you have are statistical. There are people there who produce the tables who are not just using statistics, but who are also using broader skills than those available to actuaries. Until we start teaching actuaries how to use those sorts of skills, I think that it is best left to the experts to make a recommendation.

Mr J. A. Porteous, F.F.A.: It strikes me that companies in the U.K. are adopting a fairly responsible attitude to funding their way out of current situations, and that they are not entirely going to fund on a full buyout basis, because, essentially, they can see ways of adding value elsewhere.

There is a risk involved, and I think that the Pensions Protection Fund is a laudable way of sharing that risk. The alternative to risk sharing for the members, by saying: "Some of you may not get your whole pension from the PPF", is that the members get all the risk. There are not many companies which will say: "We will carry on this scheme on a tougher and tougher basis." When they went into the business of funding pensions, they did not expect all these guarantees to be thrust upon them. Also, they did not expect to be forced to fund to a much higher standard.

I would be interested if you give the same advice to the Fidelity equity analysts. If we are to value pension schemes on the assumption that companies become insolvent, do you value equities on the assumption that the company goes bust as well? It is possible that companies can

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survive, so why do we not take some recognition of that? Speaking as a member of a defined benefit scheme, I am quite happy to share the risk, because I would rather stand a good chance of getting my pension than having to make all the decisions on defined contribution (DC) provision myself.

If we look at the average member of the U.K. population, we are not very sophisticated from an investment angle. Surveys on DC schemes suggest that people do not make investment decisions. People do not plan properly for their retirement. Is it not better to leave the risk for the people who spend their time looking at managing that risk, for example the sponsoring companies and also the trustees of pension schemes? Trustees have managed to run pension schemes so that many people get their pensions, so why can we not just leave them alone to get on with it?

Mr Sweeting: For an investor in equities, there is always the risk that one of the equities will go bust, but, as an investor in equities, you can diversify that risk. You can invest in many shares, and if one or two of them go bust then it is a shame, but it is not a great hardship, because most do not.

If you are a member of a pension scheme you have a very large, undiversifiable risk, with the risk of your sponsor disappearing. If your sponsor does disappear when there is an equity market downturn, then you are in trouble. One thing about the sponsor covenant is that there is a correlation between what happens to equity markets and when firms go bust. So, even though most pension schemes and most sponsors will be okay, that is not much consolation to the members of pension schemes where the sponsor goes bust and they are not okay.

Also, the way in which analysts might look at the pension scheme might be completely different from the way in which trustees allow for the pension scheme liabilities. Up until recently, it is more likely to have been an FRS 17 type basis. Increasingly, analysts look at the liabilities as debts which the employer has, and look at the assets which they hold, which is, economically, what they are.

No matter what basis you use for FRS 17, no matter what basis you use for funding of the pension scheme liabilities and the assets, that does not change the economic reality of what the pension scheme liabilities are, which is deferred remuneration, a promise to pay benefits at some point in the future and to hold assets against that promise.

The sponsor might feel that it has better ways of investing the assets rather than to put them into the pension scheme. You could argue that, from the market's point of view, any deficit which they have, any pension liabilities which they have, are just debt anyway, and they could easily just raise some debt in the debt capital markets, put the money into the pension scheme, and take a nice tax saving from having paid the money into the pension scheme sooner rather than later. The market would not regard the pension scheme any differently, provided that it had a reasonable credit rating. There is a great deal of argument in favour of that. There have been various pieces of research, going back to the 1970s, on that sort of tax arbitrage.

For many sponsors, in theory, it is better if they do not invest in equities in the pension scheme at all, and they just put it all in debt, because that makes the firm a lot less risky. If the firm thinks that it has a competitive advantage, then it can try to make money by investing in its core business rather than by investing in a portfolio of equities in the pension scheme.

There are many reasons why sponsors might want to fully fund schemes on a more conservative basis than they are doing at the moment, and to concentrate on their core businesses. Having those views is probably why I am working in fund management rather than as an investment consultant these days. It is not a great way of making money from your clients to suggest that they completely de-risk their pension schemes and dispense with my services!

I agree, to an extent, that it is rather harsh on firms to have been offered the kind of schemes where there was an element of risk sharing in the past, and then suddenly, over a relatively short time horizon, they have been assaulted with a huge number of guarantees coinciding with a very large fall in interest rates, which has meant that the liability is much greater than they thought that it ever would be. I do not think that that necessarily means that they should be

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allowing for, or dealing with, the liabilities in a way which does not use the buyout basis as the most important method.

The President (Mr J. S. R. Ritchie, O.B.E., F.F.A.): In recent months the rating agencies have come in for a fair amount of criticism. What do you think is the role of the rating agencies in helping actuaries to model and to manage risk? To what extent do you think that the criticisms to which the rating agencies have been subject are well-founded, and to what extent is it simply criticising with the benefit of hindsight?

Mr Sweeting: Most of the skills which rating agencies have, I believe, are looking at a single firm. The main criticism in that area is that the changes in ratings usually come right after some bad news has come out, rather than some time before it, which is not particularly helpful. Having a company downgraded once it has given you some bad news is something which I could do! The value comes in being able to act ahead of that.

Having said that, they do use some interesting mathematical techniques for assessing the creditworthiness of individual firms. One of the ones which I discussed in ¶5.5.7 is called '*k*-nearest neighbour approach'. You look at a firm, you look at the various characteristics of the firm, and then you put in the characteristics of firms which are similar to that. You see which of these have actually defaulted. You judge a firm by the company which it keeps, as de Servigny & Renault (2004) say. That is a really interesting approach. I am sure that there must be ways in which that kind of approach could be applied to certain types of insurance and pensions risk.

Where I do not think that rating agencies are as strong, apart from the fact that they often act after an event has occurred, is looking at putting a variety of risks together, and I think that CDOs are a key area where they have fallen short. I understand that the way in which they look at the relationship between different credits is to look at the correlation between them, which is just crazy, given that everybody knows that correlations increase sharply when you get a credit crunch. The economy turns down, the spreads on all credits move out, no matter how they have been moving when there have been small changes in the market. If you are just using correlation on credit rating on an issue of CDOs, it is bound to be wrong and to understate the risk. That sort of simplistic approach is probably what has damaged the rating agencies a great deal, particularly in relation to CDOs. Actuaries are very capable of adding to the discussion and doing things far better than they have been done so far.

The President (Mr J. S. R. Ritchie, O.B.E., F.F.A.): It seems that that is an interesting area in which actuaries can become more involved in the future.

Mr K. J. Tindall, F.F.A.: I come back to ¶3.6.2, and a point which was raised earlier. One of the sentences there states that the Scheme Actuary should ensure that the projected contributions are sufficient to maintain solvency. This probably goes beyond the GN9 requirements. Perhaps this is something at which the BAS will look when it reviews the guidance note. I think that GN9 says that you have to comment on the contributions and on how to maintain solvency. To me, the key phrase there is: "with an adequate degree of confidence". I think that that takes into account contingent assets and employer covenant as well, which I think is really where the regulator is coming from.

My question is: "Do you think that Solvency II, as described in ¶3.3.3, would provide a more appropriate analysis of all the risks for a defined benefit scheme?" I am thinking, in particular, of small schemes which probably do not analyse the risks as fully as they should, in particular with regard to the employer covenant.

Mr Sweeting: I think that Solvency II would be helpful for pension schemes, but, more important than that, is the principle of saying: "What sort of risks can I not stand?", and then get rid of those. That is something which, even under Solvency II, does not necessarily happen.

One of the issues with the insurance approach is the one in 200 years event. There is a spurious confidence in statistical models. If you look at something like the strength of the

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sponsor covenant, if the sponsor is really that strong, and there is that much confidence in it being around for long enough to look after any debts which there are in the pension scheme, if it is a big enough pension scheme, it should be really cheap to go to an investment bank and put a derivative in place which will protect you if the sponsor disappears. That would be a way of absolutely guaranteeing the deficit if you have the right kind of derivative in place.

Insurance regulation could be helpful for pension schemes. The full weight of that regime on very small pension schemes would cause them to close if they have not already. It is more the principle of deciding that there is a certain risk, and that I cannot take any more than that, and limiting that risk absolutely rather than looking at probabilities and tails of statistical distributions.

The President (Mr J. S. R. Ritchie, O.B.E., F.F.A.): You have given, very helpfully, a very long list of references in the paper. I wonder whether you might be able to identify some particularly good starting points for actuaries who are in different areas of practice to get up the learning curve in modelling and managing risk?

Mr Sweeting: The first couple of books which I would recommend are not on the list, because I have read them since I wrote the paper. Rather than being deep and impenetrable textbooks, they are as close as you can get to finance light reading. These are Rebonato's book, *The Plight of the Fortune Tellers* (2007), which is really useful in some of the insights which it gives, and for standing back and being able to see the wood for the trees, which is often a real problem with much of the modelling literature. The other worthwhile book is *Fooled by Randomness* (Taleb, 2007a), and a further book of his, *Black Swan* (Taleb, 2007b), is also worth reading.

In terms of the reading list, de Servigny & Renault (2004) is interesting, because there was virtually nothing in the book which I had come across before. Most of it concerned completely new concepts and new ways of dealing with credit risk. When you think that you know a little about something, it is quite refreshing to find such a book, because often there is very little new and interesting in textbooks.

In terms of the others which I think are useful, Black (1980) gives a good insight. It coincides with my view of some of the issues round pension schemes. It is not always palatable, and, in many ways, it is simplistic, but there are many useful truths in there.

I have yet to find a really accessible book on copulas. Cherubini *et al.* (2004) has a few nuggets, from which I was able to get some useful information on how you can model copulas. There has been a SIAS paper on copulas, and also the latest Finance and Investment Conference covered these areas.

Most of the other references are papers on very specific issues rather than overviews. So, it depends really on your particular interest.

References

Taleb, N. N. (2007a). *Fooled by randomness: the hidden role of chance in life and in the markets.* Penguin, London.

Taleb, N. N. (2007b). *The black swan: the impact of the highly improbable.* Penguin, London.

Dr D. C. Bowie, F.F.A. (closing the discussion)**:** The discussion of this paper takes place in a broader context, where actuaries are intending to discover a wider arena of influence in risk management. The profession has, of course, a long history of involvement with modelling and managing risk in various important areas of the economy, although it can be difficult sometimes to see a common framework across the disciplines. It is still not particularly edifying to witness a discussion between a pensions actuary, a life actuary and an investment actuary on, say, the valuation of LPI annuities. However, we should not delude ourselves; the world of risk management is not waiting for actuaries before moving on.

The paper is one which deals explicitly with the breadth of the topic rather than going into any depth on particular topics. The opener mentioned and appreciated the absence of equations,

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but there were sufficient snippets about kernel functions, *z*-scores, jump diffusion processes and copulas to keep the most technically minded interested. The opener also wondered whether more could be made in exploring the stakeholder model sketched out in the paper.

The contributions from the floor fell broadly into two areas: comments on the special nature of the pensions industry compared with life and banking, and the issues introduced by model risk when modelling and managing risk.

The President and Mr Tindall picked up on the quite different risk environment that pensions finds itself in, and discussed the particular challenges which it brings. The pensions industry seems to have developed quite differently from the insurance and banking industries in terms of risk management. Although not exactly the same, there is a lot of commonality between the regulatory regimes surrounding banking and insurance, as encapsulated in the emerging Basel II and Solvency II agreements.

Mr Porteous offered a defence of the general approach adopted within pensions in the light of its rather different context. Mr Farr called for risk-sharing approaches to be adopted as a means of managing the risks, and, in particular, asked for support for conditional indexation as the means for implementing such risk sharing. He suggested that innovation in risk sharing was an area where actuaries could contribute significantly. Mr Thomson added his support, and emphasised that communication of the risks and their nature to all stakeholders was the key aspect.

Pensions has, perhaps, struggled with a fundamental problem, in that, even if the risks are measured and there is a willingness to manage them by the various stakeholders, the governance arrangements seem to thwart effective implementation or to encourage head-in-the-sand behaviour, something to which the author alludes in ¶7.3.3. I applaud and encourage his efforts to demonstrate that the notions of economic capital and market consistent pricing/valuation can be made to work in the area. Starting with such notions, at least makes for much more effective communication with the rest of the risk management community.

In a talk at the 2007 Pensions Convention, I recommended this paper as a key one for pensions actuaries; not so much for instant applicability, but in order to sketch out what else is being done in the area of risk management and to encourage a wider perspective.

The unifying themes in risk management across insurance, banking and pensions are difficult to identify clearly. The link between capital and risk management is one such area identified in the paper, and reiterated by Mr Thomson in his contribution.

In terms of managing risk capital, the paper identifies the CDO structure as being the prototypical arrangement for repackaging risks for investors. CDOs and similar structured credit arrangements have not had a great press recently with the credit crisis. In particular, they do not seem to package liquidity risks very coherently, and it seems that concentrations of risk can build up unnoticed.

The second major theme was model risk. The area of quantifying risks and the models used for so doing was queried several times during the evening. Mr Potter, Professor Cairns, Mr Taylor and Mr Thomson articulated possible concerns about relying on model-based risk assessments, especially when it comes to the more extreme events. The opener suggested that some risks, such as lapse risk and assessments of extreme risks, were worthy of further study.

What is the nature of the profession's future participation in this area; to what extent do we go for the grand unifier's role; or do we dust off our geeky heritage and tackle specific risk-modelling issues?

What is clear is that risk management is a large part of our future. In the bookshop at the City Airport in London, the shelf which has grown fastest has been the one on risk management (including the books mentioned by the author in response to the President's question). While quite a few of us here use that airport, I do not imagine that it is solely actuaries buying and writing these books — the profession has much to learn.

I do wonder whether risk management is the most helpful label for what we can do in this area. As mentioned in the discussion by several contributors, risk management can often degenerate into a box-ticking exercise and become a drag on the business, rather than be an

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integral and creative part. I was encouraged, at a recent Action Group for Banking meeting, to see that much of the modelling which actuaries would probably label as risk modelling is called 'profitability assessment'. That, or some similar generalisation, provides, to my mind, a more direct link between risk management and value generation, together with a much more attractive role for current and future actuaries.

Mr Sweeting (replying)**:** Something which the closer has said really struck a chord. The world is not waiting for actuaries. The world is not going to sit around and think: "We have these big problems; what we could really do with is an actuary, because we know they have the right skill set."

There are many areas where there are not many actuaries working, where they could make a great deal of difference. It is a subject which is close to my heart. I look at these areas, and I see opportunities for actuaries to be involved. I do not think that this is the kind of thing where we can look at the leadership of the Profession to try to push actuaries into those areas. It is down to individual actuaries. If they see roles available to them in the organisations in which they are working, or in other organisations, where they can make a difference and use their skills to get the Actuarial Profession into new areas, then they really should do it. It is very unlikely that, in an area of finance where there are no actuaries working, you will see job advertisements saying: "We do not have any actuaries, but we really thought that we could do with them for this sort of not typically actuarial job." It is up to us to move into those areas. That really is important.

My other point is this. As I mentioned before, the limited information on insurance companies in the paper is not down to the techniques used by insurance companies, it is down to the fact that I do not know as much about them as I do about pension schemes and, to an extent, banks. Also, I am sure that there are insights which people have into things like the links between modelling lapses and particular types of insurance claims and market risk. For people who work for insurance companies and who look at these issues, it would be interesting to see the extent to which these are allowed for. It shows where there should be developments on which parts of the profession can start working.

There is something else which I accidentally omitted from my introductory comments to get people thinking, and that is for us to look at situations like Northern Rock and the situation with the sub-prime market in the U.S.A. Are these areas where people think that, if actuaries had been involved, there might have been less of a mess? Is there a way in which we would have tackled that problem where we would have done a better job than the job which was actually carried out, and, if so, how would we have tackled it better?

The President (Mr J. S. R. Ritchie, O.B.E., F.F.A.): The author has given us a very informative paper. Not only has he had to work hard in writing it and presenting it to us, we have also worked him hard all through the discussion, in replying to points as they were made. I think that you have given us very good value. It has been a most interesting and worthwhile paper and discussion.

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