Actuaries' contributions

Shane Whelan tries to explain why actuaries failed to capitalise on their century-old head start in the field of financial economics.

HANS BÜHLMANN POSED A RIDDLE a few years ago. 'Looking back', he said, 'it is difficult to understand why the approaches and solutions developed for today's financial sector, which are clearly orientated towards mathematics, or to be more precise towards probability theory, did not originate from the breeding ground of actuarial thinking'. A recent paper in the *BAJ* (Vol 8, Part I) hints at a disturbing reason. The paper, 'A Primer in Financial Economics', takes a few detours in mapping out the terrain of financial economics that shows that actuaries anticipated important insights in financial economics, but failed to develop their ideas or disseminate them to a broader audience. It was as if actuarial science in the 20th century developed in a parallel world, complete with its own symbols and language.

At the start of the 20th century, actuaries were in pole position to develop a science of finance. First, the profession laid claim to the whole field of applied statistics and probability, a discipline itself in its infancy. Second, the actuary's educational attainments were high by the academic standards of the time. Third, the actuary would daily meet novel and demanding problems, which could be expected to lead to new and non-trivial solutions. It can come as little surprise to learn that 19th-century actuaries can claim priority on a number of discoveries.

Important discoveries

The constant growth dividend discount model, often attributed to 20th-century economists (eg Williams, Durand, or Gordon) can be found in Todhunter's *The Institute of Actuaries Textbook on Compound Interest and Annuities Certain* (1901) and, in fact, can be traced back further to a footnote by Sprague to Makeham's 'On the Theory of Annuities Certain', *Journal of the Institute of Actuaries and Assurance Magazine* (1869), vol XIV, 189–99.

Nineteenth-century actuaries – or French actuaries at any rate – also had a good rule of thumb to price options. Consider the following statement:

> In order to get an idea of the real [option] premium on each transaction, one must estimate the mean deviation of prices in a given time interval... the mean deviation of prices is proportional to the square root of the number of days.

This quote is from the *Journal des Actuaries Français* and predates Bachelier's thesis, 'Théorie de la Spéculation', by over a quarter of a century. It is from Émile Dormoy's 'Théorie mathématique des jeux de hasard' (1873) when he cites the work of Regnault a decade earlier. True, it is only an empirical rule with no theoretical justification and refers to the mean deviation of prices rather than the standard deviation. However, it was clear that French actuaries had a reasonable idea of how to price options before Bachelier's work. It is also frequently maintained in economic circles that Bachelier's work was lost until rediscovered in the 1950s by Savage and Samuelson. Yet the essentials of Bachelier's model appeared as early as 1908 in a textbook by the French actuary Alfred Barriol, which went into several editions.

The 20th century

As the 20th century progressed, the actuarial profession did not fulfil its earlier promise in the theoretical field. However, three initiatives deserve mention. In 1925 John Maynard Keynes encouraged actuaries to devote more time to studying the capital markets:

> It is a task well adapted to the training and mentality of actuaries, and not the less important, I fancy, to the future of the insurance industry than the further improvement of Life Tables.

Charles Douglas heard this call (his paper quotes from a different part of Keynes's article) and read to the Faculty of Actuaries in 1929 his reply, 'The Statistical Groundwork of Investment Policy'. This prompted the Faculty and Institute to combine resources in order to continuously collect data and develop stockmarket indices. However, the key analysis of the data was not undertaken by an actuary but by Maurice Kendall who, in 1953, analysed the database to give key empirical support to the weak form of the efficient market hypothesis.

Karl Borch, a prolific academic actuary, gave an equilibrium model of risk in his *Econometrica* paper of 1962, pre-empting Sharpe's insights a couple of years later when he interpreted CAPM in this way. Also his two-and-a-half-page self-contained critique of any portfolio theory based on just the first two moments of the return distribution, which allows him to conclude that '... I continue to use mean-variance analysis in teaching, but I shall warn students that such analysis must not be taken seriously and applied in practice', should be mandatory reading for any actuarial student.

Without doubt, the key result of financial economics after the demarcation of the discipline by Bachelier is the insight into option pricing by Black, Scholes, and Merton. Actuaries cannot claim a prior here but can make a case for the next best thing – an independent discovery of the basic idea in Colm Fagan's paper to the Society of Actuaries in Ireland in 1977. Interestingly, Colm sees his work as a generalisation of Redington's immunisation – both being dynamic investment strategies designed to keep the market

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value of the assets and liabilities equal at all times by imposing certain constraints on the assets.

I am sure, with greater diligence, I could find many more important insights made by actuaries. Even so, it has to be admitted that we did not fulfil our early promise. From pole position at the start of the 20th century, the profession has slipped down the grid somewhat – or perhaps even been lapped, as some of our more pessimistic commentators maintain.

Failure to communicate

Our brief overview of actuaries' contributions poses an obvious question: why did the discoveries we made not find their way to a more general audience? Karl Borch argued (in the related context of the development of risk theory) that we simply failed to communicate with others because we created our own language:

> One reason may be that for a long time insurance – together with gambling – was the only practical application of probability theory. Actuaries had the field to themselves, and tended to formulate their results as solutions to insurance problems, without taking the trouble of explaining their general nature. As probability theory found other applications, it was apparently easier to rediscover the results than to trace them in existing literature, where they were hidden behind clouds of insurance jargon.

So the wider world ignored our journals but, equally, we did not pay attention to their output and demonstrate how our techniques could shed light on its problems. This two-way communication should have been undertaken by academic actuaries, but not much headway has been made in the 20th century. So, in turn, we must ask why so few actuaries devoted themselves to solving the profession's most challenging problems (or why our unresolved problems did not attract wider academic attention).

What unresolved problems?

The Irish and UK profession had solved almost all its problems with the phenomenal success of the with-profits policy. Its success gave actuaries a comfortable cushion of capital so that an accurate valuation and pricing of risk was not demanded. Also the pay-off of the contract was sufficiently opaque that competition was muted, creating little incentive to optimise the underlying investment strategy and performance. In short, the with-profits policy allowed actuaries to dodge all the difficult pricing, valuation, capital allocation, and investment management problems that we would otherwise have been forced to face. The trick we learned from the with-profits contract – to maintain discretion over key contract terms like the benefits to be paid – was to be widely replicated in the new areas actuaries entered into, such as pension funds (eg discretionary increases, discretionary treatment of early leavers) or unit-linked contracts (discretionary mortality and expense charges). The result was that actuarial science was fossilised in the cosy cocoon offered by with-profits. Our education system reflected the demands placed on the working actuary, with the result, as Professor Bühlmann put it, 'that until only 20 years ago actuarial exams [in the UK and US] contained little on mathematics from the 20th century'. Finally, with the key problem facing our profession being how to exercise our discretion equitably, little research of a mathematical nature needed to be done. Actuarial departments withered in universities, depriving the profession of its vital link with the emerging, and related, probability-based modelling disciplines.

The next century

So are we likely to punch to our true weight in the 21st century? We are beginning to adopt a different language, our education system is firmly in the 20th century (and fighting to remain up with developments), and actuarial outposts in universities are re-establishing and deepening links with other disciplines. All these recent developments are positive, but they do not take us back to the relative position we enjoyed at the start of the last century. We have no monopoly on applying probability theory. Our educational attainments are high, but many now can make the same claim. The key question, if you agree with the above analysis, is whether we actuaries still reserve sufficient room for discretionary judgement in our professional work to stifle our mathematical creativity.

But let us end on a positive note. Our profession still attracts the mathematically bright and our new education system tries to exploit this. 'This long-term advantage should not be underestimated', says Hans Bühlmann. Having defeated the optimists in the last century, let us hope that we can now defeat the pessimists. ❑

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