B.A.J. **11**, IV, 591-594 (2005)

GUEST EDITORIAL

LOST IN TRANSLATION

By P. P. Boyle

It is an honour to be invited to write a guest editorial for the *British Actuarial Journal*. The first two guest editorials by David Wilkie and Ragnar Norberg discussed the connection between progress in actuarial science and advances in cognate disciplines. In the third, Greg Taylor discussed the absorption of new ideas, and how sometimes there is a struggle prior to obtaining the profession's benediction. In 2004, Jed Frees examined the role of journals in building the knowledge base of the profession. One of the main purposes of a journal is to communicate new ideas through formal papers. This is an efficient method of presenting the results, but there are fascinating aspects of the research process which are lost in the transfer. I decided to use this editorial to discuss some of the things which tend to be omitted when papers are published.

We can illustrate this with an example. Many of us have experienced the contrast between listening to an author's presentation of a talk and reading the subsequent paper. In the talk one is more likely to learn about the ideas which did not work, the tortuous path to the result and the various accidents and strokes of good fortune associated with the endeavour. The paper, on the other hand, tends to be cut and dried and neatly wrapped up. In the paper the author describes the problem and explains the proposed solution. It is rare to learn from a published paper about the difficult detours and the various frustrating failures.

Failure is a feature of the terrain. Stephen Gould once remarked about biological research: "Over 90 percent of the day's work generally turns out to be for naught, and then you still have to clean out the mouse cage." We can make a strong case that so called errors are a useful ingredient of the learning process. It is important to learn what does not work, because this could give a clue as to what might work. The word error comes from the Latin word *erarre*, which means to wander. This wandering can lead to a much deeper understanding of the problem.

Published papers, by their nature, spend little time discussing the intuition that sometimes plays an important role in the research enterprise. Intuition is not easy to define, but it refers to those flashes of insight or hunches which tell something useful about a situation by leapfrogging over the detailed analysis. Of course intuition can be cultivated, and, as one of my colleagues often remarks, intuition does depend on your background.

In any paper there is an invisible stream of associations, accidents and

coincidences which has an influence on the research outcome. It would be impractical, and perhaps impossible, to incorporate these into the formal paper. Nevertheless, even some knowledge of this background can provide insight into the research in much the same way as the extra features on a DVD enrich our appreciation of a film.

I will use a couple of examples from my own experience to illustrate the nature of the influences and accidents which can shape the research process. The justification for using them is that they are the ones with which I am familiar. In addition, one of them has a connection with the *Journal of the Institute of Actuaries*, one of the predecessors of the current journal.

Options and Insurance

As an actuarial student in Dublin in the late 1960s and early 1970s I survived rather than enjoyed sitting for actuarial exams. However, they introduced me to Redington's 1952 classic paper on immunisation. Redington proposed the idea of locally matching the sensitivities of the assets and the liabilities to interest rate risk. This foreshadowed the hedging arguments of the Black Scholes Merton option theory. Redington assumed that interest rates changed by a parallel shift of the yield curve. This was the most obvious type of assumption on the grounds of simplicity. It also accorded pretty well with the empirical observations. Interest rates for different maturities tend to move together, but not by exactly the same amounts. All in all, Redington's assumption was quite reasonable.

Around this time, from my work in the insurance company, I became aware of the unit linked or equity linked insurance products. These products often contained a maturity guarantee under which the policy holder was guaranteed to receive at least the total premiums paid. The traditional actuarial methods in use at the time were not really suitable for handling these guarantees. I was aware of the problem, but had no idea of how it could be solved.

After a short stint in Liverpool with a firm of consulting actuaries, I moved in 1973 to the University of British Columbia in Canada. The Dean, Philip White, was building a finance department and had recently hired Michael Brennan and Bob White from MIT, both of whom had learned about modern option pricing theory from Scholes and Merton. I recall giving an early seminar to the finance group and mentioning the problem of the maturity guarantees. Michael excitedly pointed out that this contract was a put option and that it could be priced and also hedged using the Black Scholes Merton technology. We wrote a few papers on how maturity guarantees could be handled in an option framework. This approach was treated with some healthy actuarial scepticism by the Maturity Guarantees Working Party. Coincidentally, Colm Fagan, who was a fellow student of

mine in Dublin, independently developed an option type approach to the problem in a very original piece of work.

These models dealt with stock price movements. Interest rate models were beginning to be developed in the mid 1970s. Michael Brennan and his doctoral student Eduardo Schwartz were working on developing a stochastic interest rate model at this time. As a result, they invited other researchers working on this topic to speak to our finance group. I heard Oldrich Vasicek explain his new interest rate model and John Cox outline the Cox Ingersoll Ross model in 1976. It was not until 1985 that the Cox Ingersoll Ross model was published in *Econometrica*.

One of the key assumptions of these new interest rate models was the no arbitrage assumption. Basically, this means that in an efficient capital market it is impossible to make risk free profits with no money down. There is no free lunch. The Vasicek model and the Cox Ingersoll Ross model had this assumption built into their very foundations.

As I listened to these new interest rate theories, I recalled one aspect of Redington's paper which had intrigued me. During the discussion of the paper, C. D. Rich had remarked:

> "How delightful it would be if the funds of a life office could be so invested that, on any change of the rate of interest — whether up or down — a profit would always emerge."

Rich had noticed that the term structure movements implicit in Redington's paper, namely a parallel yield shift, would lead to arbitrage profits. Rich's intuition was correct. The models of Vasicek and Cox Ingersoll Ross provided a resolution to Rich's conundrum, since their dynamics did not admit arbitrage. In 1978 I wrote a short article in the *Journal of the Institute of Actuaries* that made this point, and introduced these models to the actuarial community.

The main reason why I was able to write this paper was due to good luck. I was fortunate to be working in a place where I learned about stochastic interest rate models well before they were published. This was long before the internet enabled the rapid dissemination of research results which we enjoy today. I was also lucky that C. D. Rich's remark had piqued my curiosity on the puzzle in Redington's paper. My little note did not involve any new research, since it tried to explain some newly minted finance models to an actuarial audience. In the light of the story of guaranteed annuity options, the concluding paragraph of this 1978 paper may be of interest:

> "There are other problems in actuarial science which can be attacked within the framework of a stochastic term structure. These include a range of situations where financial options are granted to an insured. For example an endowment insurance maturing at age 65 may include guaranteed conversion rates (to a life annuity). The valuation of an option of this type could be placed on a more scientific basis within the framework of a stochastic model of interest rates. In fact many of the features and riders

found in insurance contracts can be regarded as options. These may involve financial options, mortality options or combinations of the two. It is suggested that the stochastic models discussed in this paper will prove useful in pricing such options."

Summary

Published papers can often convey the impression that the results were obtained by proceeding directly along a clear path. In practice, progress is often more faltering and indirect. Luck also can play an important role. Although I have just cited a couple of personal examples, these aspects of the research process appear to be fairly common.

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