# Phelim Boyle

Shane Whelan joins in with the celebrations of Phelim Boyle's career.

'Phelim Boyle' is perhaps the most concise answer to the question: what has Ireland ever contributed to actuarial science? Phelim introduced Monte Carlo methods to price options, co-created the Asian option, wrote almost 100 papers, and wrote or contributed to several books. Aside from his famous contributions to financial economics, his publications range over the full gamut of actuarial science – from mortality to the assessment of damages in court cases, and from tailoring investment strategies to life assurance accounting.

## Financial engineer of the year

Phelim's research has been noted by many awards, including some of the most prestigious awards of the actuarial profession – the Redington award, the Centennial Gold Medal, and the Dave Halmstad prize. His work, though, has had more influence outside the profession and this was dramatically acknowledged in December 2005 when Phelim was named the 'financial engineer of the year' – an award that may be regarded as the Nobel prize in finance (in fact, three out of the other dozen winners also won a Nobel prize).

Dr Boyle qualified as an actuary (FIA) in 1972 and would have been the 18th actuary in Ireland had he stayed. But he left his job as an actuarial student in Irish Life the previous year, having helped convert industrial branch premiums into the new decimal system, to move to the comparatively exciting position of pension consultant at the Liverpool office of the consulting actuaries, Duncan C Fraser & Co. However, he did not stay long in that position and moved again in 1973 to Canada, first for an academic position with the University of British Columbia and then, almost a decade later, to the University of Waterloo where he remains as the J Page R Wadsworth Professor of Finance. While his career change to academia was facilitated by the PhD in relativity he gained from Trinity College Dublin in 1970, his teaching and research was always to be in finance and actuarial science.

The Society of Actuaries in Ireland celebrated Professor Boyle's career on 22 March 2006 when Phelim was made the Society's seventh honorary fellow. Inevitably, he drew a large crowd, some of whom were his former work colleagues from his student days with Irish Life. Almost all honorary actuaries attended, including Dr Garret FitzGerald (Ireland's former *taoiseach* or prime minister). Prior to receiving his fellowship, Phelim set out in his understated manner the major threat to our profession with his address, 'Financial engineers are here to stay'.

Financial engineers use modern theories in finance, coupled with sophisticated mathematics and numerical methods, to create and manage desirable financial products. In a job brief that is uncomfortably similar to that of an actuary's, he outlined how they design, construct, and price products in trading rooms, model and construct hedges, develop trading strategies to mitigate risk, and build risk management systems. Quite simply, financial engineers respond to a demand for sophisticated financial products, often with embedded guarantees and options.

Actuarial science, of course, used cutting-edge mathematics at the time of its genesis – probability, compound interest, and mortality – to create desirable products. Like today, those products had embedded options and guarantees – the option of continuation on set terms and a guarantee on benefits. However, the limitations of the technology of the time required the pooling of money so it loses its identification with an individual, which, when coupled with the commercial requirement to add margins, created surplus and the need to allocate it. The pooling system provides collective security but at the cost of a rough justice – and, he emphasised, often we don't know just how rough that justice is. The pooling system, with

### Key ideas in finance: the magnificent seven

1 **The no-arbitrage principle** Two identical cashflows must have the same price.

2 **Mean-variance portfolio selection** If investment reward is taken to be the expected return and investment risk to be the standard deviation of returns, and we know these values, then portfolio selection is a relatively straightforward optimization problem.

3 **Capital structure irrelevance** The ideal capital structure of a firm (the optimum debt/equity mix) does not exist (under certain assumptions).

4 **The capital asset pricing model (CAPM)** A theory that accounts for an individual asset's ex-ante excess return (over the risk-free rate) as related linearly to the expected excess returns from all risky assets, ie, $E[R_i] - r_f = \beta_i(E[R_m] - r_f)$

5 **Equilibrium** The notion that the expected return, and therefore the expected price evolution, of a risky asset is a function of its relationship with all other risky assets as captured by CAPM or other market pricing models.

6 **The Black-Scholes-Merton option pricing formula**

7 **Portfolio selection in continuous time** a risk-averse investor who wishes to maximise expected utility will, under certain assumptions, maintain a constant fraction of their wealth in risky assets, the fixed proportion given by the Merton ratio, ie, [risk premium on risky assets]/[Variance of risky asset returns x individual's relative risk aversion factor]

its associated lack of transparency and broad attempt at individual equity, is now out of step with market demands. Crucially, though, the guarantees that are now demanded by the market fit uneasily in the pooling system. Quoting Redington on the 'thorny area of guarantees' which 'attempt to borrow from the pooling system', he concluded with Redington that such developments are 'naturally troublesome' in the with-profits model. Dr Boyle argued that the optimal modern contract design is unit-linked with guarantees – combining the demands for transparency and individual equity, with security provided through the guarantees.

## The magnificent seven

So what toolkit, aside from mathematical aptitude, is necessary to design and manage such products? Phelim outlined the 'magnificent seven' insights that financial economics has given over the last half-century (see box, overleaf). Perhaps the surprise on the list is portfolio selection in continuous time, the field created by Merton, but Phelim insists that this was not there just to make up the number but that 'Merton's model is as beautiful as the Black-Scholes-Merton formula' and necessary to cope with dynamic investment conditions.

Phelim took us through an optimal contract design he was working on with a collaborator, Weidong Tian. It was an unapologetic academic treatment that attempted to square the circle of a product that maximises the policyholder's utility subject to a maturity guarantee and, with a set probability level, delivers the upside of an equity index. This is a generalisation of the standard guaranteed equity-tracker and he briefly explored under what conditions the product exists.

He concluded his address by arguing that financial engineers and actuaries can learn a lot from one another. While the examples he employed were drawn from insurance, his arguments carried through to pension schemes. Financial engineers are strong on technique but actuaries – the oldest risk management profession in the world – have the advantages of quality control in technical competencies, professionalism and discipline. He finished with a question: can we combine the best of both worlds?

It was clear by the end of his address that the threat to our profession was not financial engineers but our own inertia. As a young pupil in Dreenan School in County Derry, Phelim was nicknamed the 'Bard of Armagh' but his message was first put in verse by another Irish poet:

'It seems again that it is time to learn,
In this untiring, crumbling place of growth
To which, for the time being, I return.'

Thomas Kinsella, *Mirror in February*. □

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