Not an exact science

Spurred by Andrew Haldane's speech that criticised models as unfit for purpose, **John Thirwell** shares his opinion of current modelling techniques

I am continually impressed by the confidence with which economists make forecasts, despite the actual outcomes, insurers price liability or catastrophe risks, despite 1 in 500 year events happening more than once a lifetime, or indeed financial services firms attempting to quantify operational risk which, just as with insurance perils and economics, is at the mercy of the behaviour of both human beings and nature. Even meteorologists, whose computers can process a petaflop of calculations per second, admit that by day five, weather forecasts are pretty well impossible.

When Friedrich von Hayek accepted the Nobel prize for economics in 1973, his speech was entitled 'The pretence of knowledge'. In it he said something which struck a chord with me:

'Unlike the position in the physical sciences, in economics and other disciplines which deal with essentially complex phenomena, the aspects of the events to be accounted for about which we can get quantitative data are necessarily limited and may not include the important ones.'

For complex phenomena read the major risks faced by financial firms. Twenty years later, another Nobel prizewinner, Professor Kenneth Arrow, wrote an article 'I know a hawk from a handsaw', in which he came up with the comment:

'Our knowledge of the way things work, in society or in nature, comes trailing clouds of vagueness. Vast ills have followed belief in certainty.'

Apart from being delighted to hear an economist quote from both *Hamlet* and Wordsworth, what struck me was that both were warning of the dangers of believing that we can predict the future to any great degree of certainty and that Arrow was saying that even the physical sciences, 'nature' in his language, were equally unpredictable – to the level of certainty demanded.

Perhaps, to use a distinction first identified in 1921 by Frank Knight in *Risk, uncertainty and profit*, the fundamental problem is that we confuse risk, where the statistical distribution can be calculated or known, with uncertainty, where the distribution cannot be calculated or is unknown. That's why Hayek called his paper 'The *pretence* →

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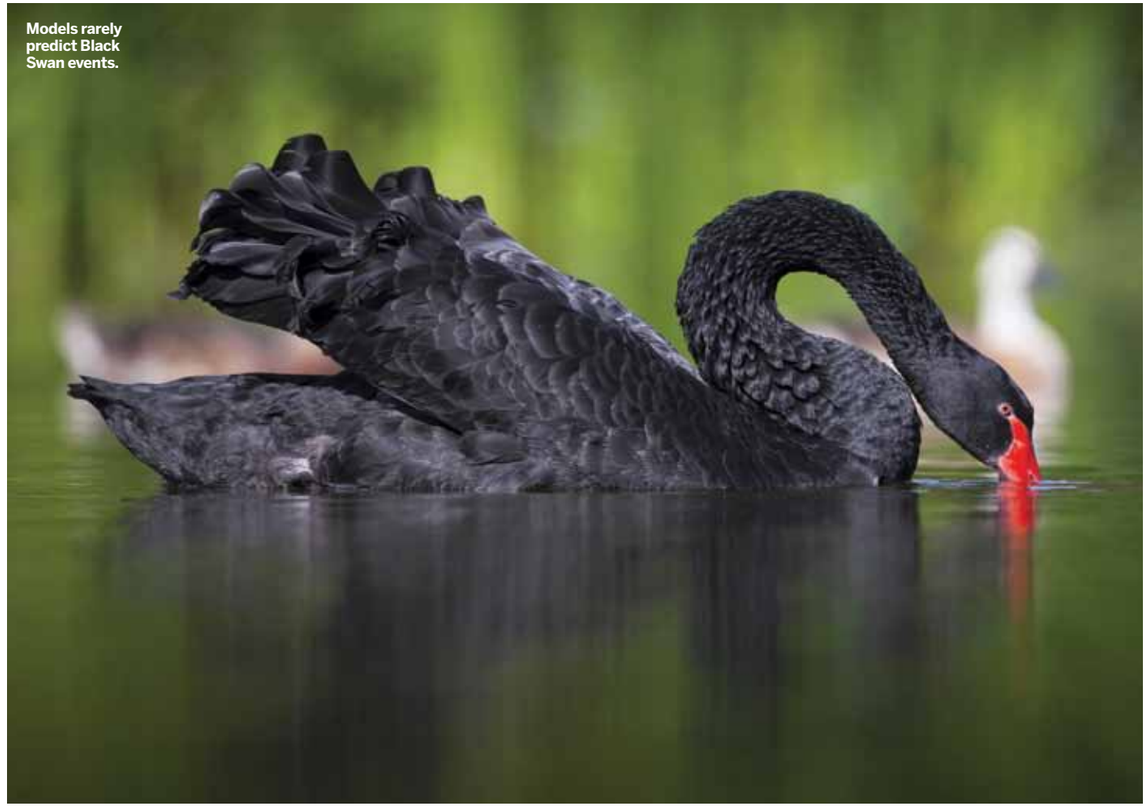
Models rarely predict Black Swan events.

of knowledge'.

All of this came back to me when I read the speech given in early June by Andrew Haldane, Executive Director, Financial Stability at the Bank of England at a conference about the financial crisis at Edinburgh Business School. His central thesis was that, whether in economics or financial services, we have relied on the Gaussian or normal distribution to attempt to understand the risks we face, especially the tail risks but, fundamentally, the bell curve is simply unfit for this purpose.

As he acknowledged, it's the point Nassim Taleb was making in *Fooled by randomness*. Can we honestly say that normality is a good description of the behaviour of the real-world, which is an inter-related and complex system? The question is not new. It's one which has been posed since the end of the nineteenth century. Perhaps now, after what we are still going through, we may at last pay attention and try and find an answer.

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So what is the answer? The one which Haldane gives, as do others beavering away in complexity sciences, is power law distributions. I'll avoid the maths but, as we know, with normal distributions, large events become increasingly rare at a rapid rate. With power law distributions large events are *more* likely.

Under normal distribution mean and variance are all that matters. For power laws with sufficiently fat tails, the mean and variance may not even exist. Fat tails are a regularity. The future is subject to large lurches. That seems to me more like the non-normal world we live in.

To give some idea of the differences, Haldane looked at a 3 sigma fall in GDP (using a century of data) and equity prices (using three centuries), the difference between normal and power law distributions is of an order of 8. With earthquakes it is even greater. The tail is in fact 3000 times more severe than normal statistics would show. And it's the same with commodity prices, city sizes, wealth, words and wars.

He also points out the severe limitations of VaR, citing the trader whose 99% VaR limit is $10 million but who can easily construct a portfolio within that limit which delivers a 1% chance of a $1 billion loss. But the key issue is that trading depends on traders, whose behaviours are both unpredictable and unobservable to other traders. As Haldane points out, that is a serious risk management gap. As poet and preacher John Donne put it in the seventeenth century, 'No man is an island'.

Even when traders do act in predictable ways, prompted either by herd instinct, or by chasing the same objective, such as the competitive search for yield, the sand pile analogy breaks in. A tipping point is reached, causing the sand-pile to collapse in an uncontrolled cascade, which feels like a pretty good image of the crisis. We are back to the chaotic impact of Lorenz's butterfly effect.

So the trick for social scientists and financial services managers is to try and understand how these networks behave and make their assessments accordingly. One attempt was made by Haldane himself together with Professor Robert May, a former Government Chief Scientific Officer. In the January 2011 edition of the scientific journal *Nature*, they published a paper in which they sought to understand systemic risk through the medium of biology. They used two examples, super-spreaders of disease and how animals adapt to food networks. How many firms – or their regulators – truly understood where they stood within the global financial system?

It's a huge challenge, not just in itself, but even more in asking economists and financial services managers, including regulators, to ditch the tools they've known and loved all their lives, the comfortable world of Gaussian normal distributions, of the bell curve, and instead embrace the very messy and complex world of power law statistics, behavioural economics, chaos theory and possibly even biology.

It will require an enormous leap of the imagination, but it's what's needed if we are to make any progress and truly understand what the tail looks like and be able to plan accordingly. If the attempt is not made, we will be doomed to suffer even greater catastrophes in our increasingly complex and inter-connected world. TRU


Understanding systemic risk via biology.

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