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# Faith and Reason in the Mathematics of the Credit Crunch

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*"In the case of AIG, the virus exploded from a freewheeling little 377-person unit in London, and flourished in a climate of opulent pay, lax oversight and blind faith."*

*("Behind crisis at AIG, a fragile web of risks / Tiny London unit set decline in motion", By Gretchen Morgenson, International Herald Tribune, 2008\09\29)*

*"How could so many smart people have got it so wrong? One reason is that their faith in their models' predictive powers led them to ignore what was happening in the real world."*

*("Blinded by science / Financial Regulators have allowed themselves to be bamboozled", Leader, New Scientist, 2008\9\27)*

Professor Richard Dawkins will not be the only one to be shocked and saddened by these references to 'faith', even 'blind faith', in relation to the mathematical models of finance. We all know that faith is the province of religion, not of science, and least of all of mathematics, the very embodiment of reason. The theme of 'Faith and Reason' itself is generally remembered as the attempt by theologians to buttress dogmatic faith by hobbling critical reason.

Yet the term 'faith' is believed by these competent present observers to be relevant to the mathematics at the heart of the multi-dimensional pyramid game that has led to our present catastrophe. Combined with the corruption of quality and the abuse of uncertainty in mathematical models, blind faith in economics and mathematics forms the third element of the toxic mix that has enabled greed and irresponsibility to wreak their destructive way as never before. Mathematics first provided an enabling technology with computers; then with a plausible theo-

rem it offered legitimation for the runaway speculation; and finally, with models of their value, risk and quality, it framed the quantitative specifications of its fantasised products. Mathematics thereby became uniquely toxic, what Warren Buffet has called 'weapons of mass destruction'.

How did it all happen? First, it is now universally acknowledged that the financial markets are driven alternately by greed and fear, rather than by the desire to allocate scarce resources efficiently or to create jobs for every man and woman. Speculative bubbles are as old as free markets, and mass manipulation and delusion are their essential components. The seventeenth-century Dutch managed to ruin themselves over real tulip bulbs; but since then things have got steadily more sophisticated. Until recently there were physical limits on the values that could be manufactured, as the underlying bits of paper required time, space and labour for their individual management. With electronic computers, those restrictions were transcended, and the trap was set.

A more insidious element of the background is a pair of mathematical theorems, named after their authors Black-Scholes and Merton. These were interpreted as proving that under certain conditions, transactions that had previously been illegal for American traders, indeed classed as gambling, could in fact be legitimate. These were variously the 'hedges', in which expected rises were balanced against expected falls in value, and the 'derivatives', essentially bets on something happening, or not. For under certain conditions (relating to the stochastic equilibrium behaviour of prices over time) the theorems

showed that there is a market in which rational decisions, based on calculations, could be made. The theorems had a dramatic history: their authors enjoyed the adulation of the relevant academic and commercial communities; in 1994 the surviving authors founded an investment firm 'Long Term Capital Management' which proposed to use computers to apply the theorem; in 1998 they got the Nobel Prize; and, when the next year the market was hit by unexpected events, they went bust on a very large scale, requiring State intervention to prevent a general collapse. Interestingly, while the markets before the bust behaved according to the assumptions of the theorem, afterwards they did not. Technically, the theorems no longer applied to the real world, and so those trades were once again a form of gambling.<sup>1</sup> But no-one noticed, or if they did, cared. There was absolutely no limit to the complexity, artificiality and obscurity of the products that were created and exchanged, quite legitimately in the eyes of the practitioners and regulators. By this point the game came to depend entirely on the mathematicians.

How were these weird creations to be assigned the necessary numbers that enabled them to be exchanged? No-one had ever bought or sold them before; indeed for many of them it was hard for anyone to say just what they were! But the mathematicians could produce Models. That is, they imagined all the various considerations that could affect the price and risk, got numerical estimates or guesstimates of their influence, tacked on standard probability distributions to include the uncertainties, and pressed Enter. Without the magic numbers that they so obligingly created, there would have been no markets in the 'collateralised debt obligations' (insurance policies on defaults), no pyramided speculation, and no mega collapse. Only in this way could the bounds of reason have been exceeded so grossly.

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Now we consider how it actually happened. Did no-one realise what was going on? Did no-one blow the whistle? In fact, some did, and the strength of the Gadarene syndrome in this case is shown by the quality of the signals that were ignored. Warren Buffet is the great guru of American finance; almost always the marketers hang on his every word. But this time, when he repeatedly warned of the 'toxic' derivatives and hedges, he was ignored. A successful trader turned critic, Nassim Nicholas Taleb, warned about the uncertainties in unpredictable events, his famous 'black swans', and (he claims) he was ridiculed by the economists at the time.<sup>2</sup> They held fast to the official faith: that all rational analysis is of equilibriums; that what goes up must go up forever; and that the social responsibility of every firm is to maximise profits for its shareholders. Since each of these propositions has been amply refuted by ordinary human experience, the only way to describe them is as articles of a Creed. Alan Greenspan, that most worldly-wise of operators, now confesses to have possessed a faith in the unregulated markets that in retrospect seems as sincere and simple as that of a peasant girl in her picture of the Virgin<sup>3</sup>.

A faith out of touch with reality opens the door to corruption, and this was rampant at many if not indeed all levels. The American 'sub-prime' mortgages were corruptly sold, they were corruptly valued, and their packaging and securitisation was shot through with corruption. All that is to be expected as a tendency in any speculative market, and the FBI is now moving in. What was new in

this case was that the credit-rating agencies became an integral part of the game. Quality itself became corrupted, as 'grade-inflation' became the rule<sup>4</sup>. In spite of all protestations to the contrary, the credit agencies had no other option than to share the general faith in individual profit-maximization as the path to the highest societal good. The result was a pervasive doublethink, which of course extended to the State regulators as well. In one sense everyone knew that there was a lot of junk all over the system, but in another sense if it all had AAA ratings and someone else was buying and selling, why not sell and buy?<sup>5</sup>

In fairness to all those in the markets, they were only doing what all governments seemed to be wanting. From the 'Big Bang' in Thatcherite London, through the adoption of 'regulation with a light touch' under Reagan and Clinton, culminating in Gordon Brown's 'three monkeys' Financial Services Agency, strong and clear signals were sent from the State that 'anything goes'. Where governments chose to stay off this particular game, as in Spain and the Lebanon, the banks behaved like banks, and flourished.

Again, the mathematicians made their essential contribution to the merry madness. As one expert analyst has observed, 'the underlying assumptions in the models, such as the importance of the 'normal' probability distribution, the elimination of risk, measurable correlations, etc. are incorrect,' and are easily seen to be so. Further, models developed for one sort of security were transferred, with scarcely more than a change in the name of the key variable, to another that was completely different in character<sup>6</sup>. Being based on recent history, the models had only scanty databases for falling prices, and so eternal optimism was hard-wired into the system. A bear market was, in their paradigm, inconceivable<sup>7</sup>. Here we have the socio-technical construction of ignorance, with a vengeance.

The mathematicians of finance plied their special trade in the context of the general corruption in hyper-complex IT systems (as in those purchased by the UK government<sup>8</sup>) and vacuity in policy-driven mathematical models<sup>9</sup> (of which the Yucca Mountain nuclear-wastes repository is the great classic<sup>10</sup>). Critical, objective reality-testing, the traditional demarcation between faith and reason, has become insubstantial and irrelevant for this computerised hyper-reality. How is the boundary to be drawn now?

All the elements were in place, but it was faith that cemented them into the self-destructive edifice of greed and fantasy. And why, indeed, should anyone lack faith in mathematics? In their own training, the practitioners had imbibed the lesson of the inerrancy of mathematical proof, and the infallibility of the teacher and examiner. The idea that a mathematical formula could be inappropriate to a real-world situation, or simply incorrectly applied, is foreign to almost all instruction in mathematical techniques. Through an unvarying set of examples, aspiring experts learn that for every problem of practice, however complex and subtle it might appear, there is always just one correct numerical answer, expressed precisely to several significant digits. To be sure, for those who want it there is a strong tradition of criticism of statistical practice at every level; but for those who don't want it, they can just use any of the standard packages and happily solve their puzzles.

The naïve faith of these technically-trained practitioners flourishes in a context where quantitative science

reigns supreme as the exemplar of genuine knowledge in all fields, natural and social. Economics becomes the king of the sciences, as it expresses and justifies the world of the cash nexus more perfectly than any other<sup>11</sup>. It had already led to repeated crashes in recent generations, and then been rescued and partially reformed, as by J.M. Keynes. This time, however, combined with the power of computers, the ingenuity of mathematicians and the general unquestioning faith in their products, along with the wholesale corruption of the system, it has created a conceptual edifice of fantasy which may yet bring us all down with it.

The faith that mathematical science provides certainty is a natural product of a scientific culture in which critical reason is systematically neglected and betrayed. In T.S. Kuhn's theory of 'normal science' research, the puzzle-solving ordinary practice depends on uncritical faith in the dogma of the overarching 'paradigm'.<sup>12</sup> In all healthy systems of activity and belief, there is a constant dialectic between the commitments of faith and their testing and tempering by reason. We try to be 'faithful' to what we hold dear, we speak of 'having faith in' the things we cannot prove, or of 'negotiating in good faith' with others.

This present case shows how the disease of blind faith can now infect the science-based intellectual systems as easily as the religious ones, and how the consequent debauchery of reason has outcomes here that are even more disastrous.

<sup>1</sup> Donald McKenzie, *An Engine not a Camera*, MIT Press 2006, p.203.

<sup>2</sup> Bryan Appleyard, 'The Prophet of Boom and Doom', *The Sunday Times Magazine*, 1 June 2008, pp. 33-39

<sup>3</sup> Martin Crutsinge (AP economics writer), 'Greenspan says flaw in market system', ksl.com, 23-10-2008, <http://www.ksl.com/?nid=153&sid=4258957>

<sup>4</sup> Sam Jones, Gillian Tett and Paul J. Davies, 'Moody's error gave top ratings to debt products', *Financial Times*, 21 May 2008.

<sup>5</sup> Michael Lewis, 'The End', Condé Nast Portfolio.com, December 2008; <http://www.portfolio.com/news-markets/national-news/portfolio/2008/11/11/The-End-of-Wall-Streets-Boom>

<sup>6</sup> Paul Wilmott, 'The use, misuse and abuse of mathematics in finance', *Phil. Trans. Roy. Soc. Lond. series A* (2000) 358, 63-73.

<sup>7</sup> Alan Greenspan, 'We will never have a perfect model of risk', *Financial Times*, 16 March 2008.

<sup>8</sup> David Craig with Richard Brooks, *Plundering the Public Sector How New Labour are letting consultants run off with £70 billion of our money*, London, Constable, 2006.

<sup>9</sup> Orrin H. Pilkey & Linda Pilkey-Jarvis, *Useless Arithmetic Why Environmental Scientists Can't Predict the Future*, New York, Columbia University Press, 2007

<sup>10</sup> State of Nevada, letter to NRC Chairman Klein, 10 April 2007, [http://docs.nrdc.org/nuclear/nuc\\_08010701A.pdf](http://docs.nrdc.org/nuclear/nuc_08010701A.pdf)

<sup>11</sup> Jerome Ravetz, 'Economics as an Elite Folk-Science: the Suppression of Uncertainty', *The Journal of Post-Keynesian Economics*, 17/2, Winter 1994/5, 165-184.

<sup>12</sup> Thomas S. Kuhn, 'The Function of Dogma in Scientific Research', pp. 347-69 in A. C. Crombie (ed.). *Scientific Change* (Symposium on the History of Science, University of Oxford, 9-15 July 1961). New York and London: Basic Books and Heineman, 1963.

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