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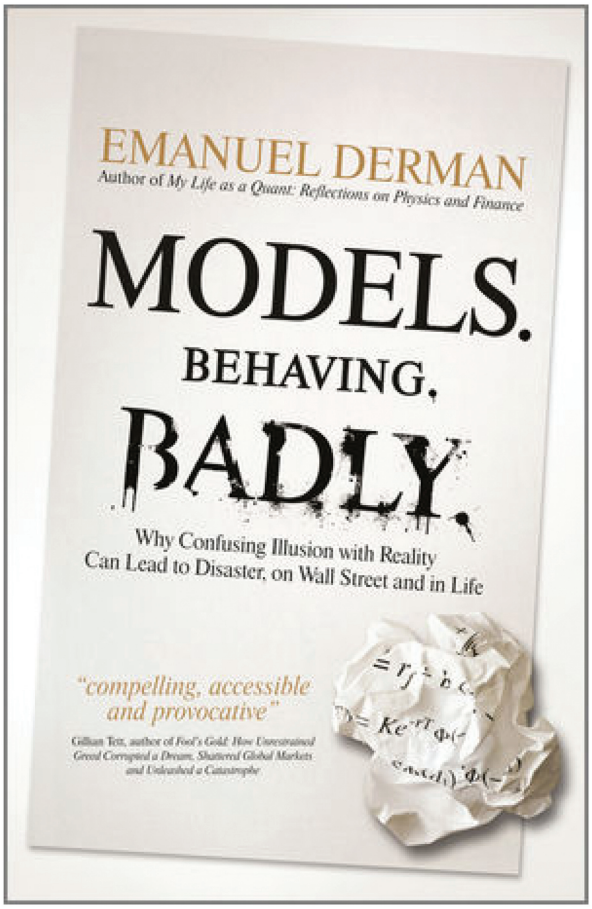
Book review



Models Behaving Badly: Why Confusing Illusion with Reality Can Lead to Disaster, on Wall Street and in Life, by Emanuel Derman, Wiley Finance (2011). Hardback. ISBN: 978-1-1199-6716-3.

> *In theory, theory and practice are the same; in practice, they are not*. (anon.)

This book is a sequel to Professor Derman's *NY Times* bestseller 'My Life as a Quant: Reflections on Physics and Finance', which was written in a happier time and whose themes it develops in light of the ongoing crisis. I found the book highly entertaining, even fascinating, and hard to put down. I expect most readers will react to it similarly. What I particularly liked was the author's easy style in effortlessly mixing personal history, philosophy, hard (natural) science and a grasp of modern financial markets, all of which, along with quotes from Goethe, Schopenhauer and Spinoza, gives him a serious claim to erudition.

The book is divided into three parts of two chapters each. The first part discusses the need for, and limitations of, metaphor, models and theories, with illustrations from recent market events and the contributions to modern physics of Dirac in particular. The essence of the argument of this part is found on p. 59:

> Models are analogies; they always describe one thing relative to something else. Models need a defense or an explanation. Theories, in contrast, are the real thing. They need confirmation rather than explanation. A theory describes an essence. A successful theory can become a fact.

The second part of the book, entitled 'Models Behaving', goes on to treat the 'Absolute', asserting that

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this describes the nature of Spinoza's 'profound analysis of the structure of human emotions', reduced to a nifty diagram by the author (pp. 86-87). An appendix contains a similar summary of Spinoza's analysis of human bondage and freedom. Although perhaps not with the power of Feynman diagrams for the Standard Model of particle physics (also discussed throughout the book) these diagrams are informative. This third chapter is followed by one on the 'Sublime', an overview of the 19th and 20th century development of modern physics and its creators in which 'One cannot escape the feeling that these mathematical formulae have an independent existence and an intelligence of their own'. A reader interested in more detail at a similar level might look at Cox and Forshaw (2011).

'Models Misbehaving' constitutes the third and final part of the book. By now the reader will have understood that the models referred to in this part's title are those of economics and finance. The fifth chapter, entitled 'The Inadequate', describes in clear simple language the 'Law of One Price', otherwise known as the 'No Arbitrage *Assumption*', the 'Efficient Market Model', the author's treatment of what is more commonly termed the 'Efficient Market *Hypothesis*', the trade-off between risk (however described) and return, the Black-Scholes option pricing model, described as 'the best model in all of economics', and the Capital Asset Pricing Model, together with the 'unbearable futility of modelling'. The author is to be commended for his modest reference to his own important contributions to the Black-Derman-Toy short rate, and the Derman-Kani local volatility, lattice models (p. 175), but he should certainly be called to task for omitting reference to the pioneers of Gaussian finance theory, Bachelier, Kendall, Markowitz and Samuelson.

The last short chapter of the book, 'Breaking the Cycle', laudably discusses the recent immorality of financial markets and makes a plea for prudence, morality and principle, both in market participants' behaviour and in their use of financial models. Perhaps more should have been made in the book's conclusion of classical bankers' behaviour, summarized by an old school Flemings banker in Hong Kong as 'giving a banker excess liquidity is like giving a drunk a barrel of beer; you know it will end badly, you just don't know when and where!'

As a trained pure mathematician with a proclivity in applications for social and management science (in spite of having also worked in aerospace, telecommunications and life sciences at both molecular and behavioural levels) my perspective on the matters discussed in this book are very different from the author's. As an undergraduate at Toronto I was warned (by physics teachers) of the dangers of physicists believing their models to be reality. As a graduate student at Carnegie-Mellon I was taught (by great economists) that economics should attempt to *accurately* describe at least small pieces of reality. In this regard it must be admitted that one of my teachers and one of my class mates at CMU, both now Nobel laureates in economics, were the main progenitors of the 'rational expectations hypothesis', anathema to the Carnegie approach to economics of Simon *et al*. Rational expectations under uncertainty are generally held responsible for the 'dynamic stochastic general equilibrium' models used until recently by the world's leading central banks for policy setting in the blinkered way justly criticised in this book. (They had no financial sector whatsoever.)

However, many good economists know that the static theory of competitive economic general equilibrium rigorously developed in Bourbaki mathematical style by Arrow and Debreu in the 1950's (see Arrow and Hahn 1971) is nothing but an elegant description of an 18th century Saturday afternoon in the corn market. It is however interesting to note that the roots of the discretizations employed in Professor Derman's own lattice model contributions, and more generally in 'risk neutral' pricing, are to be found in Arrow and Debreu's extensions of their model to discrete time under uncertainty, which employed 'risk adjusted' prices. At about the time the Standard Model of modern physics was being developed, rigorous continuous space and time versions of Arrow-Debreu dynamic competitive general equilibrium theory were developed in the pioneering work of Radner, Bewley and Rader, and a decade or so later Harrison and Pliska established risk neutral pricing in the same setting. But of course received economic theory deals with much, much more, including individual investment models first developed by Lucas and (in this setting) Merton, to say nothing of earlier theories of monopoly, oligopoly and economic growth so relevant today.

All this suggests that the development of economics and finance (and social science generally) follows the same Kuhnian paradigm (see Kuhn 1996) as that of physics. The difference, which the author of this book appears to ignore, is that the complexity levels of the disciplines of human enquiry increase enormously as we pass from physics, to chemistry, to life sciences, to social sciences. Not surprisingly, mankind has to date made the most progress at the *simplest* – quantum theory notwithstanding – level, just as the mathematical models of derivative pricing and hedging began with equity and have subsequently been extended to FX, rates, commodities and credit.

An alternative viewpoint to that of Professor Derman is given by the physicists Cox and Forshaw in their book:

> The picture of the Universe we inhabit, as revealed by modern physics, is . . . one of underlying simplicity; elegant phenomena dance away out of sight and the diversity of the macroscopic world emerges. This is perhaps the crowning achievement of modern science; the reduction of the tremendous complexity in the world, human beings included, to a description of the behaviour of a handful of tiny subatomic particles and the four forces that act between them. The best descriptions we have of three of the four forces, the strong and weak nuclear forces that operate deep within the atomic nucleus and the electromagnetic force that glues atoms and molecules together, are provided by quantum theory. Only gravity, the weakest but perhaps the most familiar of the four,

> does not *at present* have a satisfactory quantum description. (pp. 3–4, italics added)

Thus the distinction between the 'theories' of physics and the (misbehaving) 'models' of economics and finance might just be a wee bit oversimplified; remember phlogiston. (Similarly, perhaps, the notion of 'physics envy' applying generally to quantitative finance and economics is somewhat overblown.) Nevertheless, Professor Derman has given us a good read which is entertaining and contains much food for thought; it can be highly recommended.

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