

subordination of the financial sector to the real economy. Although the book seems somewhat incomplete in chapter 7 – as it devotes little space to illustrate policy remedies – the author states, ‘This study was not about policy prescriptions. Indeed, it was largely critical by going to great lengths to show that policy prescriptions derived from the NAIRU theory will not work . . .’ (p. 175). Indeed, recent tax competition policies adopted by many states in Europe, are at odds with the author’s proposal. Finally, how to subordinate the financial sector to the real economy is very hard to realise in the current phase of strong globalisation, even theoretically.

To sum up, this book is strong in its analytics, providing a truly comprehensive discussion of the economic literature on unemployment and gives some valuable insights, thus making it an important reference source for individuals interested in reforming European economic architecture.

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Benoit B. Mandelbrot, Richard L. Hudson, *The (mis) behaviour of markets: A Fractal View of Risk, Ruin and Reward*, Basic Books, New York, 2004, ISBN 0-465-04355-0

The (mis) Behaviour of Markets presents Mandelbrot’s work on applying the tools of fractal geometry—the study of roughness in nature—to the study of financial markets. The book reflects the outcome of an intellectual adventure across the boundaries of academic specialisation, motivated by Mandelbrot’s belief that the current tools used to analyse and predict price fluctuations and to analyse market behaviour in financial markets are flawed by assumption, construction and implementation.

Mandelbrot would replace the Efficient Market Hypothesis of his student, Eugene Fama, with its assumptions of Gaussian distributions of commodity price changes, identical rational investors, and independently moving prices, with his multifractal model of price changes in financial markets. This—i.e., Mandelbrot’s alternative—is a model of price changes based on the faithful reproduction of phenomena observed in real-world data such as cotton and wheat prices and long run stock prices of private companies. Mandelbrot finds fat tails in the distribution of price changes, long term dependence of a stock price on events in its history, and explains the volatility in the market through the use of multifractal time. Multifractal time allows the inspection of the ‘slow’ and ‘fast’ trading times of the market(s) in question through a kind of magnifying glass. The alternative theory of multifractal analysis is developed through personal vignettes in the second section of the book. The third part of the book is a vision statement of what financial engineering *could* do, given a reframing of the standard questions of finance along largely fractal lines.

Much of the book is an appeal to two separate traditions, tracing out the development of both types of analyses through sketches of the men who originated them. The authors aver that Black, Scholes, Merton and Markowitz are the intellectual descendants of Pierre-Simon de Laplace and Louis Bachelier, whose doctoral dissertation on Brownian motion in the Bourse predated Einstein's work on that topic by 5 years. We learn again through vignettes that Mandelbrot takes as inspiration another tradition—Zipf, Lévy, Cauchy, Kolmogorov and Hurst—on whose theoretical and empirical shoulders he has constructed his fractal and multifractal geometric approaches and their economic applications.

The multifractal model is orthogonal to EMH/CAPM/Black-Scholes in its assumptions. Real world high frequency financial data shows a distribution of small price changes interspersed with rare and unpredictably large ones. The Gaussian distribution assumed by these models does not take account of the observed fat tails inside of the bell curve. The assumption that price movements of a stock today are independent of its movements yesterday is replaced with a theory of dependence and 'memory', where all of the past movements of the stock have some bearing on its present and future movements. The authors claim that their simulated markets bear more resemblance to actual market turbulence than orthodox models.

The originality of the book lies in its non-technical and pictorial description of fractal finance and fractals, which are "patterns or objects whose parts echo the whole, only scaled down" (p. 208). The reader is encouraged to create the fractal patterns they see with pen and paper, and once this is done, the simplicity and power of the techniques Mandelbrot has developed become obvious. Mandelbrot is at pains to show how his view of financial markets changed through time along with his own investigations into fractal geometry. He shows us how to create a fractal structure through two pictorial essays which develop and then extends the fractal model to include the latest multifractal model. He claims that the latest model simulates the dynamic motion of prices in a market more closely than the standard models familiar to every undergraduate economics student.

The theory is based on data analysis but spiced throughout with asides on Mandelbrot's career, from his PhD work to his battles with journal editors and co-authors to get his work published in leading economic journals. Mandelbrot carps "[i]f the time a modern scientist must lavish on publicity were redirected to discovery, what marvels would we see?" (p. 189). There are many distinguished living and deceased great economists who have had to struggle much harder than Mandelbrot to get their original voices heard. Even Paul Samuelson, whose ringing endorsement of Mandelbrot's efforts in economics is carried as a blurb, complains in his *Foundations of Economic Analysis* (1983, p. xxv):

I doled out the articles to as many different publications as would tolerate them. . . The last laugh is on the scientist: the quality of the papers that the editors rejected was, if anything, a little better than the rest.

The book is largely successful in its twin aims of introducing the fractals approach to finance and showing Mandelbrot's work in the best possible light, perhaps with an eye towards a future Nobel Prize in Economics. This is not an entirely fanciful hope.

Reference

Samuelson, Paul A., 1983. *Foundations of Economic Analysis*. Harvard University Press, Cambridge, MA.

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