

Wall Street, Chaos Theory and Fractal Geometry

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Martin Hutchinson writes: Mathematician Benoit B. Mandelbrot, the inventor of fractal geometry, died Oct. 14, 2010.

As mathematicians go, Mandelbrot was very likely the best of the last half-century. And that brilliance extended to the financial markets. In fact, his ground breaking insights into the operations of the stock market could have been used to avert the 2008 crash - had those insights only been heeded.

But Mandelbrot - for all his stock market genius - has been largely ignored by Wall Street.

As investors, let's not make the same mistake.

Modern Financial Tomfoolery

Back in 1962, the "Modern Finance" revolution was just getting started, but its theories already had an iron grip at the University of Chicago, Carnegie-Mellon and other centers of quantitative finance.

Franco Modigliani and Merton Miller had already unveiled the Modigliani-Miller Theorem (MMM), in which the two authors argue that companies should leverage themselves as much as possible because of the tax advantages offered by high levels of debt.

Harry Markovitz had already offered up his Modern Portfolio Theory (MPT), which holds that you should spread your risk as much as possible, rather than trying to find the best investments. Eugene Fama's Efficient Market Hypothesis (EMH) was still three years in the future.

But all the modern financial theories rested on the same underlying assumption, that market prices moved in a "random walk," so that their movements could be measured through a Gaussian/normal distribution. This was important because the Gaussian distribution has very thin "tails" - in other words, the chances of a price move 10 or 20 times the normal daily move was vanishingly small.

Mandelbrot went to the trouble of actually measuring the behavior of market prices (with no data services and primitive computers, this was much more work than it would be today). His study covered cotton prices, for which a century-long data series already existed.

He discovered that price movements did follow a normal ("bell curve") distribution - and noted that big jumps were far more common than the Gaussian theory dictated. In technical terms, cotton prices obeyed a Pareto-Levy distribution with "alpha" of 1.7 - instead of the bell-curve alpha of 2.0.

Mandelbrot got no thanks from the Modern Finance guys. While seven of them went on to win Nobel prizes, Mandelbrot's job offer from the University of Chicago was rescinded. The poor chap had to go and work for an industrial research operation ...

at button-down International Business Machines Corp. (NYSE: IBM), no less. He was actually 75 before he got his first tenured academic position - at Yale in 1999.

Being a productive guy, Mandelbrot went on to invent fractal geometry, which gave him other insights into market behavior, notably that market movements are "self-similar" and "scalable." In other words, the price movements that take place over the period of several minutes will resemble price movements that take place over the period of several years.

Mandelbrot's 1982 magnum opus - "The Fractal Geometry of Nature" - contained a defiant chapter on how stock markets failed to behave as the theorists claimed.

In theory, for instance, big market crashes should never happen. That's because the "tails" in a bell-curve distribution are so thin, meaning the probability of such a market collapse should be infinitesimal.

As we all know, however, that's just not the case. In fact, according to Mandelbrot, a market crash should occur about once a decade.

Given the fact that we've had major crashes in 1987, 1998 and 2008 - roughly once a decade - it's clear that Mandelbrot made a pretty good prediction.

Meanwhile, the Nobel Prize-winning Modern Finance theorists went on to invent stuff that Mandelbrot had already proved to be completely wrong.

For instance, the 1973 Black-Scholes options-valuation equation was nonsense - it grossly undervalued "out-of-the-money" options, and traders had to fix it with a completely imaginary options-valuation "smile."

The 1990-93 "Value-at-Risk" (VaR) risk-management system - beloved by Wall Street during the 15-year span from 1993-2008 - rested on the spurious assumption that you could control risk by looking only at the modest market moves occurring on 99% of days - without worrying about the much-larger jumps that Mandelbrot had proved would happen on the remaining 1% of trading days.

As early as 1998, events proved that this theorem didn't work right, either. But this didn't stop Wall Street from using it, because it allowed firms to take on more-profitable leverage.

In 2004, Mandelbrot updated his theories with the book "The (Mis)Behavior of Markets," using it as an opportunity to provide all kinds of data on how markets really worked.

It was voted "Best Business Book of the Year."

And it was ignored by Wall Street.

New (Wall Street) Inventions, Same Old Story

Wall Street was making too much money gambling with other people's capital. Institutions didn't want to hear about anything that might persuade customers to question their beliefs or their methods.

The crash came in 2008, just as Mandelbrot had forecast. The options-valuation models assessing credit-default swaps proved hopelessly wrong and the Value-at-Risk models assessing overall risk pushed several of their users into bankruptcy. Inevitably, taxpayers were called in to bail out the misguided traders and risk managers - the ones, at least, that hadn't had the misfortune of being teamed with Lehman Brothers Holdings (PINK: LEHMQ).

What's more alarming is that in the thousands of pages of legislation and regulations that have been written since the crash, very little attention has been paid to Mandelbrot's work.

It's no use raising capital requirements and toughening up risk-management standards if the underlying methodology remains hopelessly flawed. Doubling the capital cushion won't do it - even at that level, the cushion remains woefully inadequate for some of the risks that have become more prevalent in the markets of today.

For credit-default swaps, for instance, the capital cushion should actually be multiplied by 50 - or even 100.

Not surprisingly, that's not happening.

And that means we will be getting another crash. This time around, however, Mandelbrot's prognosticative timing may be off: You can bet the next financial reckoning will arrive long before 2018.

But until Mandelbrot's wisdom is embraced by the traders, risk-managers, regulators and other institutions that we refer to as "Wall Street," another crash is inevitable.

As I said, Mandelbrot was the best mathematician of the last 50 years. "The (Mis)Behavior of Markets" is essential reading if you're at all math-tolerant. Even without it, we can learn from him.

And that puts us a good couple of steps ahead of Wall Street - which hasn't bothered to do so.

Action to Take: Don't replicate Wall Street's egregious errors. For investors such as us, the lesson is inescapable: The chance of a really big loss is greater than your broker will admit.

However, the chance of a really big gain is just as high. Position yourself correctly and you can reap a profit far in excess of what the conventional bell-curve forecast would have you believe. To protect yourself, buy some out-of-the-money, long-dated options. As Mandelbrot demonstrates, the models Wall Street employs uses to value these securities actually undervalues them - at least compared to the odds of a big move that puts the options "in the money" ... and puts a big profit in your pocket.