

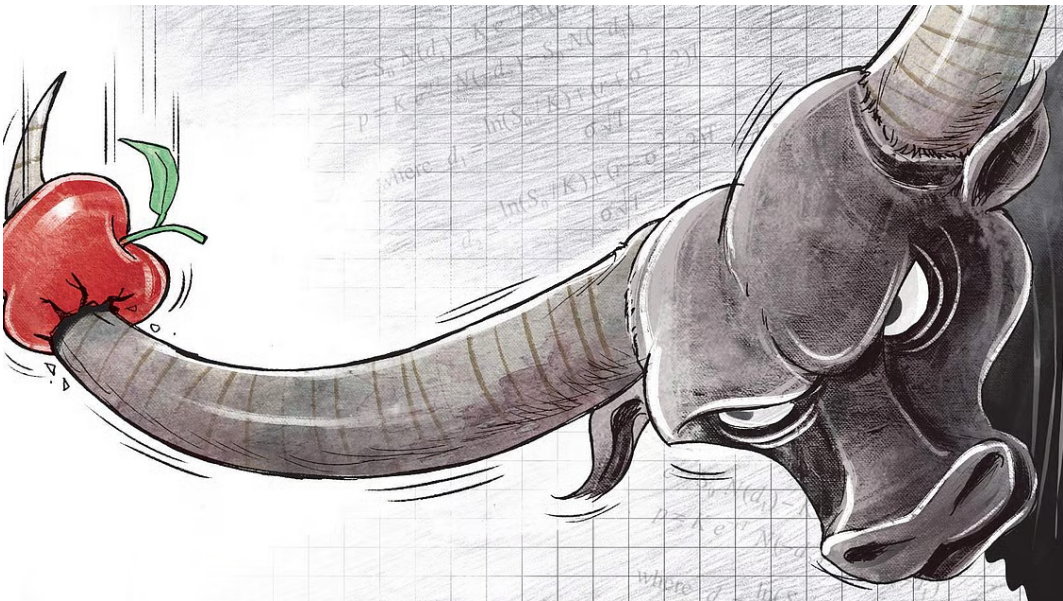


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Opinions

Scientists take on the markets

Albert Einstein lost a good portion of his Nobel money in the stock market crash of 1929. But today, his theory of relativity aids investors



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For centuries, scientists have grappled with the vagaries of finance and markets. Isaac Newton, who discovered the laws of gravity, lost heavily in stock markets in 1720 and remarked that “he could calculate the motions of the heavenly bodies, but not the madness of the people.” Two centuries later, Albert Einstein did not fare any better losing a good portion of his Nobel prize money in the stock market crash of 1929 in the US. Einstein could precisely predict bending of light near a star but realised that money matters were beyond his comprehension. After winning the physics Nobel prize in 1930, C V Raman lost a significant chunk of the prize in an investment in the 1940s that turned out to be a Ponzi scheme.

Curiously, through the 19th century, scientists have attempted to tame the markets using their mathematical tools and have achieved limited success. Most scientists believe that science and markets

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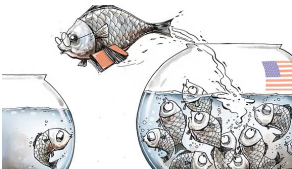
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represent two distinct cultures that cannot be bridged. The laws of science are universal and follow the rule book while markets are often shaped by transient and irrational sentiments of the traders. This ingrained cultural, and sometimes ideological, barrier was first overcome by Louis Bachelier whose doctoral thesis *Theory of Speculation* submitted to the University of Paris in 1900 analysed the stock price movements using mathematical equations. His examiner, one of the giants of 20th century mathematics, Henri Poincare noted that the subject “is somewhat removed from those normally dealt with by other students” in fields of physics and mathematics. This pioneering contribution to understanding the stock price dynamics and physics of a type of random motion of particles called Brownian motion was recognised only decades later.

Bachelier’s work forms the bedrock of financial economics models, especially the Black-Scholes model for options pricing that received the 1997 economics Nobel prize. Options are a form of financial products derived from equities. Unusually for economics, Black-Scholes is a preferred quantitative tool for pricing options even today. The use of Black-Scholes formula requires specialists who understood Bachelier’s work and the related mathematical machinery.

An unexpected set of circumstances created this specialist workforce. By 1980s, the academic jobs for mathematics and physics doctorates were becoming scarce in the US. To tide over the crisis, many doctorates entered Wall Street firms to use their quantitative skills in a setting determined by market sentiments rather than the clinical rules of nature. The insightful book *My Life as a Quant: Reflections on Physics and Finance* by the physicist-turned-quantitative analyst Emanuel Derman captures those buoyant initial years of co-opting scientists to tap stochastic processes and dynamical systems for engineering improved financial returns from the stock markets.

Financial engineering, unknown before 1980s as a professional discipline, was born as a result of these changes reflecting an increased reliance on quantitative techniques. A new breed of market players often called quants entered the scene. Though new for finance, the mathematical techniques they used were standard tools in scientific fields ranging from fundamental particles to astrophysics. Subsequently, the scientists’ engagement with the market leapfrogged from being employees of financial firms to leading them.

As if to avenge the losses suffered by Newton and Einstein, James Simons, a mathematician and physicist of repute at Stony Brook University in New York created a hedge fund in 1982 and hired only science

doctorates as quants. He generated an unprecedented 70 per cent annual returns for more than three decades. His secretive formula for success is unknown but certainly involves advanced math and possibly even unconventional signposts as the cloud cover, phase of the moon and sunspots. It might be quirky, but such forays off the beaten track anticipated the emergence of academic research in econophysics, an area that seeks to apply physics principles and models to understand economics, in particular, of financial markets. Incidentally, econophysics is a term coined at an international meeting of physicists in Kolkata in 1995.

The next frontier where scientists might brush with the markets is the controversial high frequency trading (HFT). This is a form of trading in the primary markets powered by the high-speed computers and sophisticated algorithms without human mediation. Consequently, millions of stocks can be traded in microseconds. Money is made or lost in far less time than it takes to blink an eyelid. In 2017, it was estimated that at least 50 per cent of all equity trades in the American stock exchanges were executed through HFT.

In the last 10 years, some of the flash crashes in the markets have been partly blamed on HFT practices. It is evident that maintaining the integrity and stability of the market transactions is of paramount importance if information travels at speeds close to the speed of light. This necessitates the use of high precision atomic clocks and Einstein's theory of relativity. Beginning 2018, European futures market transactions are time-stamped to microsecond precision by the atomic clock signals provided by the National Physical Laboratory in the UK. Einstein may have lost badly in the stock markets. One century later, his theory of relativity aids the markets operating at ever higher speeds.

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