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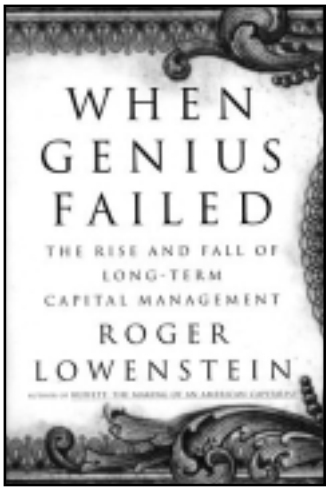
LTCM: Rigorous Empirical Testing Ground for Modern Theories Of Financial Mathematics

When Genius Failed: The Rise and Fall of Long-Term Capital Management. *By Roger Lowenstein, Random House, New York, 2000, 264 pages, $26.95.*

BOOK REVIEW

By James Case



Roger Lowenstein has written an unauthorized history of the "hedge fund" known as Long Term Capital Management (LTCM)—actually a Delaware partnership owned by John W. Meriwether, a handful of his fellow investment professionals, and a few of their wives—which once seemed poised to expand the ruble devaluation of August 1998 into a (worldwide) stock market crash of epic (1929) proportions. Only a $400 billion bail-out organized by the Federal Reserve Bank of New York prevented LTCM from falling into a bankruptcy that would have damaged, if not disabled, the entire global trading system.

Given the veil of secrecy behind which LTCM operated throughout its six-year existence, it seems doubtful that a more authoritative—much less authorized—account will ever be written. It must be stressed, however, that even a certified insider's exposé would fail to qualify for the coveted "books by crooks" designation, since no one involved was ever accused of anything more heinous than bad judgment and possible delusions of grandeur.

The book is of interest to the mathematical sciences community because the LTCM fiasco subjected modern mathematical theories of finance to rigorous empirical testing—testing that the fund failed miserably, in part because the theories on which it relied proved inadequate. It did not fail because the partners were insufficiently committed to the enterprise. Each partner—indeed, each employee—was expected to invest heavily in the fund, and all did, to the extent that at least one of the partners emerged $20 million in debt. Yet all involved remain eligible for employment in the upper echelons of finance, where annual compensation can reach into the tens or even hundreds of millions of dollars.

The book's introduction describes the opening moments of a meeting, held on the afternoon of Wednesday, September 23, 1998, at the Federal Reserve Bank of New York, called by the bank's president, William J. McDonough, to capitalize on what many saw as a possible last chance to halt the spread of a particularly dread disease. The first outbreaks had occurred during the autumn of 1997, when one after another of the vaunted "Asian Tiger" economies fell into recession. Then, just as the epidemic seemed to have been contained, it spread (in the form of the ruble devaluation of August 1998) to Russia. Anyone who wasn't frightened simply failed to understand the situation.

Lowenstein identifies the bankers invited to the containment meeting, and describes the fear that inclined them to cooperate. He also describes their ill-concealed resentment of the "haughty mathematicians" from LTCM—seen as "condescending" in their self-assured mastery of the new financial math—and recounts the stalemate into which the fateful meeting soon fell. Not until the book's penultimate chapter (titled "At the Fed") does the reader learn the nature of the "agreement in principle" eventually hammered out, and of the gaping ambiguities that nearly prevented its implementation.

The first chapter begins the author's reconstruction of the events that led up to the fateful meeting by describing Meriwether's prior career, from his Irish Catholic upbringing on Chicago's South Side to his abbreviated reign over Salomon Brothers' celebrated Arbitrage Group*. Subsequent chapters profile other key figures, their interactions, and the trades on whose outcomes the fund wagered so heavily. Lowenstein, who spent more than a decade as a reporter and columnist for *The Wall Street Journal*, is firmly convinced of the need for effective regulation of the financial industry. Wisely, he confines his opinions on the subject to a brief epilogue.

Although John Meriwether (known as J.M. to his associates) taught high school math before obtaining an MBA from the University of Chicago, he was by no means a professional mathematician. Neither—despite their reputations in the industry—were the others involved in the fund. Most had degrees in business or finance, were computer-literate, and had parlayed their command of the new techniques into rewarding careers. Robert Merton and Myron Scholes were probably the most sophisticated (mathematically) of the group members. Thanks to their roles in the discovery of the famous Black–Scholes formula† for the value of a stock option, they were already rumored—as the fund was being organized during the summer and fall of 1993—to be on the short list of candidates for the Nobel prize in economics. In the fall of 1996, as the fund neared the zenith of its success, they were

*Immortalized by Michael J. Lewis in his best-selling exposé *Liar's Poker*.

†Fisher Black, the third contributor, died in 1994, before the prize was awarded.

named that year's Nobel laureates.

Because the celebrated formula bears his name, Scholes enjoyed the greater celebrity in financial circles, and proved the more effective attractor of start-up funds. Once the enterprise was launched, however, his value to the organization owed more to his entrepreneurial zeal and detailed knowledge of the U.S. tax code than to his (perhaps rusty) analytic skills.

Merton, on the other hand, who did graduate work in applied math at Caltech before switching to economics (and MIT) for his PhD, remains academically and mathematically oriented. Lowenstein quotes an allegedly knowledgeable investment professional to the effect that "Most everything else in finance has been a footnote on what Merton did in the 1970s."

A recurring theme of the book is the "pecking order" among the LTCM partners. From the start, Victor Haghani and Lawrence Hilibrand seemed more influential than the rest. The former was an Iranian-American with a degree in finance from the London School of Economics, and the latter—described by Lowenstein as "probably the nerdiest and surely the brightest" of the partners—held not one but two degrees from MIT. While still in their twenties, they became famous at Salomon for striding into the firm's London or Tokyo offices and announcing to all in attendance that a trade was "very good, but you should be ten times bigger in it." They exuded confidence, both in the new models and in themselves, with no visible erosion in either on the transition from Salomon to LTCM.

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Computers had been in use on Wall Street at least since 1969, when Salomon hired a mathematician named Martin Leibowitz and purchased a shiny new mainframe. By 1980, all manner of historical bond prices had been downloaded into main memory and analyzed in exhaustive detail. It had always been known that only two factors influence the price of a bond: the promised revenue stream and the (small but positive) risk of default. It had also been known that G.E., for instance, was riskier than the U.S. treasury, but less risky than, for instance, Hewlett-Packard, which was in turn riskier than Safeway Stores.

Suddenly, they could estimate how much riskier one bond was than another, and how soon a bond selling at an inappropriate premium might be expected to reclaim its rightful place in the hierarchy of risk. This in turn enabled them to decide how large a "risk premium" to pay for a particular bond. Such premiums are typically measured in "points" representing hundredths of a percent. A treasury note is ordinarily worth about 75 points more than an A bond, which is worth at least a hundred points more than a B (junk) bond. AA and AAA bonds command correspondingly smaller premiums. These "spreads" are deemed axiomatic in the industry.

LTCM's basic plan—to concentrate on "relative value" trades in bond markets around the world—was not unsound. Consider a pair of zero-coupon bonds currently selling for $\$P_0$ and $\$p_0$, respectively. If one were to buy the safer (more expensive) of the two at the current price of $\$P_0$, and sell it at a later date for $\$P$, one would realize a profit (or loss) of $\$P - \$P_0$. And if one were to "sell short" the riskier (cheaper) bond at $\$p_0$ for delivery at the same later date—at which time it would cost $\$p$—one would realize a second profit (or loss) of magnitude $\$p_0 - \$p$. The combination would be advantageous only if the initial price spread $P_0 - p_0$ between the two bonds were narrower than $P - p$, the final one. Such trades are considered particularly safe because computers have proven adept at identifying price spreads that are either inappropriately narrow—meaning that they should be expected to widen over time—or wide. LTCM proposed to bet heavily on large numbers of such seemingly inappropriate spreads to regress toward their historical means.

A substantial portion of the book is devoted to the means by which LTCM contrived to persuade supposedly well-managed banks to lend so much, on such grossly inadequate collateral. The key was mystique—mystique created by Meriwether in assembling a constellation[‡] of Wall Street's brightest stars. Though Merton and Scholes were undeniably two of the brightest, theirs were by no means the only marquee names on the masthead. The rest combined sound academic credentials with spectacular track records as hands-on money managers. The media rarely spoke of them in other than superlatives. After *Institutional Investor* described them as "the best finance faculty in the world," Merton exulted that "This small group . . . attempted to marry the best of finance theory with the best of finance practice."

In the beginning, LTCM's performance exceeded even its members' own immodest expectations. Between the end of February 1994, when trading began, and the end of 1997, the group quadrupled its initial investment of $1.25 billion! Moreover, the growth of its holdings was the steadiest (least volatile) old-timers could remember. The usual pattern of ups and downs was conspicuous only by its absence. For three glorious years, absolutely everything went according to plan.

Whatever technical advantage LTCM may have had over its various competitors lay less in the models employed than in the traders' experience with them. Most of the fund's principals were veterans of the Salomon trading floor (said to have served as the model for the investment bank in Tom Wolfe's *The Bonfire of the Vanities*) or had acquired similar experience elsewhere. Lowenstein suggests that the models themselves dated from the 1970s, and were readily available in the open literature.

Although Lowenstein is distressingly coy about the models actually employed at LTCM, he gives the distinct impression that all or most were firmly embedded in the so-called Black–Scholes environment, where assets are always convertible, costlessly and instantaneously, into cash at prices that evolve as multidimensional Bachelier–Wiener stochastic processes. Simultaneously, and somewhat incongruously, all or most of the principals seemingly subscribed to the efficient markets hypothesis (EMH), which asserts that market prices, representing as they do an up-to-date consensus reached by constant observers of the financial scene, can never actually be wrong. How the EMH is consistent with the belief that bond price spreads are often detectably too wide or too narrow is difficult to explain.

[‡]At its peak, the group included sixteen partners and at least a hundred employees.

If they really expected market prices to evolve as a Bachelier–Wiener process, the partners must have been amazed to learn that successive price vector increments can sometimes depend on one another, as they certainly seemed to do during August and September of 1998. It then appeared—even to disinterested observers—that each decline in the prices on which LTCM's fate rested was spawning some further decline. The result was a catastrophic chain reaction that rendered the fund's decidedly specialized assets all but unsalable. When most needed, buyers were least to be found. At no price did the market seem to want the betting slips the fund so desperately needed to sell! Such is the nature of financial panic, an illness that seems to break out from time to time in every developed nation.

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Reliance on Black–Scholes-type models for the assessment of risk would account for the "famous last words" included in an attachment, co-authored by Merton and Scholes, to Meriwether's first annual shareholders' report. Not only did they warn that the fund could lose money in a bad year, they presented (in tabular form) the precise probabilities with which particular fractions of the fund's value could be lost. The probability that the fund would lose at least 5% of its value in a typical year was given as 12%; the probabilities of losses of 10, 15, or 20% of the fund's value were correspondingly smaller. Extra columns showed how the probabilities could differ in less typical years.

Nowhere in the document was there any attempt to assess the probability that LTCM might lose 85% of its value in a mere five months, as eventually happened between April and September of 1998. Anyone who tried would have found it necessary to calculate the probability that a normal random variable would exceed its expected value by several dozen standard deviations, a figure only slightly larger than the reciprocal of Avogadro's number. Beginning as it does with the distinction between risk and uncertainty, Lowenstein's diagnosis of Merton and Scholes's mistake is worth considering.

In the insurance industry, uncertainty is said to exist whenever a future event could have a variety of outcomes, and to be reducible to risk when probabilities can reasonably be assigned to the various outcomes, or measurable sets of outcomes. Lowenstein observes that uncertain situations fill an apparent continuum. At one extreme are situations of pure uncertainty, in which there is no discernable way of assigning probabilities to the various sets of outcomes. At the other extreme are situations of pure risk, in which—perhaps because the outcomes are governed by successive tosses of a fair coin or rolls of an honest pair of dice—exact probabilities can be assigned to each possible set of outcomes. The two are separated by a host of intermediate situations in which the relevant probabilities exist, but are impossible to determine precisely.

In Lowenstein's opinion, LTCM erred by interpreting Black–Scholes-type models too literally, thus placing unwarranted faith in predictions predicated on precisely normal or lognormal probability distributions, despite the fact that the governing empirical distributions have long been known to have fatter than normal tails. He does not, however, attempt even back-of-the-envelope versions of the quantitative estimates required to establish that the effect he identifies is large enough to account for the size of LTCM's mistakes.

LTCM's sudden need to convert carefully selected assets to cash arose from the fact that virtually all of the vast sums of money it wagered at seemingly short odds were borrowed on little or no collateral. Thus, when inexplicably many of the "horses" on which the fund had wagered heavily appeared to be falling behind in their widely scattered races, creditors grew nervous and began to queue up for repayment of their poorly secured loans. From the beginning, the fund had planned—as Meriwether was careful to disclose to prospective investors—to leverage its bets 20- to 30-fold, meaning that it would have that much more money at risk at any given time than funds available to make good potential losses. In the event of a sustained run of losses, then, no ordinary means would suffice to liquidate the fund's declining assets fast enough to satisfy the unanticipated demand. The meeting at the New York Fed constituted an (ultimately successful) attempt to guarantee the fund's loans by extraordinary means.

The book is at its best when describing the interpersonal interactions and relationships involved in the downfall of LTCM. It also does a good job of describing the nature and magnitude of the bets that went wrong. But it stops regrettably short of identifying the models used to select the ill-advised bets, or of analyzing the evidence alleged to justify such absolute dependence on the models in question. It is a pity that Lowenstein did not enlist a collaborator to flesh out his account with a few technical chapters or appendices.

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