
The Einsteins of Wall Street

Jeremy Bernstein

If you decide you don't have to get A's, you can learn an enormous amount in college.

—I.I. RABI

IN THE spring of 1969, I got the somewhat lunatic idea of going to the Northwest Frontier of Pakistan to see the high mountains—K-2, Nanga Parbat, and the like. As it happened, I had a Pakistani colleague in physics with a connection to both the University of Islamabad and the Ford Foundation. He arranged for me to become a Ford Foundation visiting professor at the university, and before taking up my teaching duties I managed to explore all sorts of places on the frontier that are now presumably inaccessible to travelers.

In Islamabad I led a pleasant but somewhat lonely existence—until, after about a month, I heard a pair of English-speaking voices that turned out to belong to another Ford Foundation professor and his wife. This was not any old professor. It was Marshall Stone, one of the world's best mathematicians. In addition to creating, at the University of Chicago, the leading school of mathematics in the country, Stone had also been the teacher of my teacher at Harvard, George Mackey, who had interested me in the mathematical foundations of quantum theory. Now here he was, accompanied

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by his rather recently acquired wife Vila, a very attractive and voluble Yugoslavian.

The three of us spent a good deal of time together—Stone, an inveterate traveler, had also come to Pakistan to visit the frontier—and in the course of it Vila mentioned that she had a daughter in New York whom I might like to meet. When I returned to the States, I called this young woman. She was seeing someone at the time, but she thought that her beau and I might have things to talk about. He was, she said, studying “derivatives,” which in calculus refers to the rate of change along a curve. Since this is one of the first things one learns in calculus, I assumed that he was a beginner, which did not seem to promise much by way of conversation. In the event, he turned out to be an amiable chap by the name of Myron.

I forget what we talked about. But I do dimly remember that at one point his girlfriend whispered in my ear that Myron was going to win the Nobel Prize someday. She turned out to be right about that, although it took a while: in 1997, Myron Scholes and Robert Merton shared the Nobel Prize in economics. Together with Fischer Black, who had died two years earlier (and who will come into this story later on), Scholes had created what is known as the Black-Scholes equation, published in 1973. Merton invented another approach to the same problem.

The Black-Scholes equation does indeed deal with derivatives, but in another sense: that is, in-

vestment instruments, like options on stocks or bonds, whose present value is “derived” from the projected future values of the financial commodities that underlie them. The Black-Scholes equation, with its many adumbrations, is used to assess the market value of such options at any given point in time. It is the Newton’s Law, or the Schrödinger equation, of the whole field of financial engineering that makes these markets operate.

I HAD more or less forgotten about all this until reading a new book by Emanuel Derman called *My Life As A Quant: Reflections on Physics and Finance*.^{*} A “quant” is the rubric used on Wall Street and elsewhere to denote people who practice quantitative financial analysis—financial engineering—for which the Black-Scholes equation is a prototype. Physics comes into Derman’s memoir because he has a Ph.D. in physics from Columbia and was one of the early pows (Physicists on Wall Street), having joined the financial firm of Goldman Sachs in 1985.

The first part of Derman’s book traces the somewhat unlikely steps that took him from his native Cape Town, South Africa, first to Columbia and then via the AT&T Bell Labs and elsewhere to Wall Street. As he notes in his book, our paths crossed at various times. I do not have specific memories of our meetings, but both of us are theoretical elementary-particle physicists, and our world is not large.

Derman arrived in New York in 1966. The physics department at Columbia was then still under the aegis of I.I. Rabi, whose standards were extremely high. Apart from Rabi himself, there were other present and future Nobel Prize winners. You had to be very good, and very determined, to survive in that department.

Derman, who remarks wryly that about 10 percent of his projected life span was spent getting a Ph.D. at Columbia, wrote his thesis on what we refer to as “phenomenology”—deriving some underlying theory to make a model that either predicts or explains an experimental result. From the sound of it, Derman’s was a very respectable piece of work, one that incidentally required him to learn to use the rather primitive computer facilities that were then available. The thesis was good enough to get him a post-doctoral position at the University of Pennsylvania.

The next several years were difficult. Derman moved from one temporary academic job to another, usually in cities where he was separated from his

wife, until finally taking a position in the business-systems center at Bell Labs in New Jersey, to which he could commute from New York. Although he seems to have hated Bell—his chapter on it is called “In the Penal Colony”—in those years the place was full of people at the top of their fields, including Arno Penzias, Robert Wilson, and other past and future Nobelists.[†]

At Bell, Derman wanted to join the research group working on the UNIX operating system—the multi-user, multi-task system that now runs computer complexes around the world. But all his requests were denied, and by the early 1980’s he had had enough. By coincidence, this happened to be the time when the major brokerage firms were building up their financial-engineering departments and were headhunting at places like Bell.

II

THE BROKERAGE business had changed: from merely selling stocks and bonds, it was now dealing in all sorts of derivatives, which play an important role in the marketplace in diversifying risk and maintaining price stability. For example, the firm of Salomon Brothers had put together a powerful group of analysts under John Meriwether; one of its consultants was Robert Merton, the Harvard professor who would later share the Nobel Prize with Scholes (and whose father, also Robert but with a different middle initial, was a noted sociologist of science at Columbia). Similarly deep into derivatives was Goldman Sachs; it was there, in December 1985, that Derman took a job in the financial-strategies group and had his first encounter with Black-Scholes.

If you put “Black-Scholes” into Google, you will come up with something like 128,000 entries. Most of them are technical; some, clearly by ex-physicists, offer to tutor you for a considerable fee. While wandering through this jungle I came across the perfect site for my purposes. It is called “Black-Scholes the Easy Way,” and can be found at <http://homepage.mac.com/j.norstad>. The person who put it up, John Norstad, is a computer scientist whose notes, representing his own learning process, are very unassuming and clear. In what follows I will use Norstad’s examples.

In the early 80’s, as I mentioned, financial institutions were doing a substantial business in the sale of derivatives. A typical example is a stock option.

^{*} Wiley, 288 pp., \$29.95.

[†] I wrote a series of linked profiles of some of these physicists that was published as a book in 1984, *Three Degrees Above Zero*.

This involves a contract between two parties that allows you, the buyer, to purchase a particular stock at a future time from the seller at a specified price called the “strike price”—which is often the price of the stock itself when you buy the option.

Until that future time, you do not own the stock itself, only the option to buy it. If, when you do buy it, the value of the stock has gone up, you will be “in the money.” If it has gone down, you will be “out of the money”—that is, out the cost of the option.*

The question is: what should be the price of the option when you buy it? This is what the Black-Scholes equation purports to compute. To see what is involved, I will, following Norstad, consider a “toy” model—i.e., one that illustrates many of the general features of the problem without the mathematical complexity. I can then tell you some of what you would have to include for the full-blown Black-Scholes model.

In the toy model, there is a stock whose current value is \$100—the strike price. What makes the model a toy is that, at the time the option is to be exercised, there will be only two possible prices: \$120 and \$80. (In the real world, there will of course be a continuum of prices.) Also, the kind of option I am considering here is known as a “European call option”—it can only be exercised at one definite time in the future, whereas an “American call option” can be exercised at any time. (I have no idea where these terms come from.) Finally, I will assume that the probability of the stock’s rising to \$120 is $\frac{3}{4}$ while the probability of its falling to \$80 is $\frac{1}{4}$.

What should you be willing to pay for the option? At first sight this seems simple enough. With the specified probabilities, the expected outcome is $(\frac{3}{4} \times \$20) + (\frac{1}{4} \times \$0)$, or \$15. Thus, the option on the \$100 stock should be worth \$15 to you, and you can expect to earn another \$5 if you buy it.

NOT SO fast, however. This would be true if the seller were not engaging in financial engineering—an activity that goes under the general heading of arbitrage. *With* arbitrage, one can gain a certain profit and incur no risk at all. Not only that, but the cost of the arbitrage itself is what determines the cost of the option. This changes everything—and explains why the financial institutions were hiring quants by the carload.

Here is how arbitrage works in the case we have been examining. Assume again that you are the buyer, and assume that I am the seller. Now assume that a friendly bank is willing to lend me money interest-free. (To see how interest payments would

modify the results, look at Norstad’s website.) Assume finally that I can buy fractional shares of the \$100 stock itself from a friendly broker, commission-free. By means of these assumptions, to use another term of art, we have made the problem “frictionless.”

Now suppose you have calculated the expected outcomes according to the formula presented above and are willing to give me \$15 to buy the option. I will now show how, no matter what the real outcome might be, I can always come away with \$5 for myself.

It works like this. I take your \$15 and put \$5 of it in my pocket; you will never see it again. Then I borrow \$40 from my friendly bank as “leverage.” Next, with your \$10 and the borrowed \$40, I buy a half-share of the stock. This is called the “hedge.” It has now cost me \$10 to replicate the option, and this will turn out to be its true value.

How so? If the final price is \$120, you will exercise your option and ask me to buy the stock for you at \$100. What I will then do is to sell my half-share for \$60, repay the bank its \$40, and add the remaining \$20 to the \$100 you have given me to buy the share at its current price, which is the price you agreed to pay. I have not lost on the run-up in the price of the stock, and I have still pocketed the \$5.

If, on the other hand, the final price is \$80, you will not exercise your option and you will be out your \$15. I, however, will sell my half-share for \$40, which I will then return to the bank, again still pocketing the \$5.

What all this amounts to is that if you have given me \$15 for the option, you have overpaid by \$5. If you think about it, the \$10 price is a kind of tipping point, an “equilibrium price” at which it is not profitable for me either to buy or to sell. If I can sell the option for *more* than \$10, I will make money; if someone wants to sell me the option for *less* than \$10, I will buy it and again make money. And that is how Black and Scholes approached the problem of option evaluation using arbitrage: find the price at which there is equilibrium between buying and selling.

What about Merton and his different approach, which as it happens is the one that is now more generally used? To understand that approach, note

* This is actually a “call” option. One can also buy a “put,” in which you have the option to *sell* the stock at the strike price. In a put option, you would normally want the stock to fall, since you can then sell it for more than it is worth. A theorem demonstrates that, for a given stock, and under the conditions where the Black-Scholes equation is valid, the values of a put option and a call option are related. This is called the “put-call parity theorem.”

that in finding the correct option price in the presence of arbitrage, the probabilities $\frac{3}{4}$ and $\frac{1}{4}$, which we used earlier to compute our expected gain, played no role. In real life, indeed, there is little likelihood that we would ever be given these probabilities in any reliable way. Even the presence of a buyer is in an important sense irrelevant.

To see why that is so, suppose you constructed a portfolio that consisted of \$10 plus a \$40 loan from a friendly bank, which you then invested in a half-share of the stock. This is called a “synthetic option.” If you were to sell this stock at the time when its value was either \$120 or \$80, the amount you would gain or lose would be the same as the gain or loss in the preceding example where the buyer paid \$10 for the *option* to buy at a future time. The essence of Merton’s approach is to show that one can, in general, construct synthetic options that cost the same as real options and that have the same outcomes. This is what these brokerage firms do—they construct synthetic options.

WHATEVER THE difference in their approach, Black, Scholes, and Merton all had to confront the fact that in the real world, unlike in our toy model, we do not have just two future prices but a continuum. This gets us into the question of how you can predict the future of a stock price. Black and Scholes adopted a model according to which stock prices follow a “random walk,” also known as a “drunkard’s walk.”

Let us stipulate that a drunkard begins his walk at a lamppost and that, with each step, he can go two feet in a totally random direction. How far away from the lamppost, on average, will the drunkard get after a given number of steps? Many people would say nowhere, since he could end up going in circles. But on average that is not the case: the path may appear jagged, but the distance from the lamppost continually increases. Indeed, the average distance will increase as the square root of the number of steps (or, technically speaking, the square root of the average of the square of the distance).

This drunkard’s walk is itself an example of “Brownian motion,” where the square-root feature generally shows up. The phenomenon is named after the discovery in 1827 by the Scottish botanist Robert Brown that microscopic pollen grains suspended in water execute a curious dancing motion. Here the “drunkard” is a pollen, driven hither and yon (as was later understood) by its collisions with invisible water molecules. The distance traveled by

the pollen, Albert Einstein showed in 1905, is proportional to the square root of the time during which it is observed.

Assuming that stock prices follow a continuous random walk, Black and Scholes could make a prediction for the future distribution of the price of a stock. (Specifically, they analyzed the logarithm of the price.) In his book, Derman provides a graph plotting this distribution. The prices form a kind of wedge on the graph, with the pointed end at the initial price and the wedge continually widening as time goes by and the price becomes more and more uncertain. Knowing a stock’s probable future prices, Black and Scholes were then able to derive an equation for the value of the option at any given moment. It is a differential equation, involving the sort of derivatives that I mistakenly thought Scholes was learning about when I met him.

Since the value of the stock is constantly changing—unlike in our toy example, where the value changes only once—the hedge must also be constantly adjusted. Generally, the price of the option will be the total price of this constantly adjusted hedge. That is the price that people who sell these options have to compute.

Most equations of this kind have no simple solutions, but remarkably Black and Scholes found an exact one. What made their job easier was the fact that, suitably transformed, their equation is a familiar one in physics. It arises in the diffusion of heat, which takes place as hot molecules randomly collide with colder ones, giving up some of their energy; eventually, the two groups of molecules reach a common temperature. Since heat diffusion has been studied for well over a century, there are a lot of mathematical tools available.

Nevertheless, to me as a physicist, the Black-Scholes model is quite odd. All physical theories are models. Quantum electrodynamics, for example, which is the most precise theory ever created, operates in a model universe that contains only electrons and quanta of light—photons. The rest of the real universe, with its neutrons, protons, mesons, and the like, is ignored. The object of this model, like all other models in physics, is to predict the future. If the model is correct, then the numbers and curves one calculates with it will be confirmed by experiment. If not, the model is incorrect.

But the Black-Scholes model is quite different. It uses a model of the *future* to describe the *present*. In the absence of this model, or some equivalent of it, present stock options have no reasonable assigned value. What then is the test of the model?

Presumably, it is that if one uses it as a guide to buy these options and, as a result, goes broke, one will be inclined to re-examine the assumptions.

Presumably.

III

Markets can remain irrational longer than you can remain solvent.

—John Maynard Keynes

WHEN DERMAN came to Goldman Sachs in 1985, the use of the Black-Scholes equation to evaluate options had become commonplace. It had gotten off to a somewhat rocky start. In 1968, Scholes became an assistant professor of finance at MIT; Black was a consultant for the Arthur D. Little company in Cambridge. The two of them began collaborating on various economics problems. At MIT there was also Paul Samuelson, one of the creators of modern mathematical economics. Samuelson had studied the use of Brownian motion to predict stock prices, and two of his own students had written theses attempting thereby to derive values for options. But it was left to Black and Scholes to finish the job.

They first derived their equation in 1969, submitting the results a year later to the *Journal of Political Economy*. The paper was rejected. Next they tried the *Review of Economics and Statistics*, which also turned it down. Revising and simplifying, they sent it back to the *Journal of Political Economy*, which finally published it in the May/June 1973 number under the title, "Pricing of Options and Corporate Liabilities." Merton published his own, somewhat more general paper, "Theory of Rational Option Pricing," in the *Bell Journal of Economics and Management Science* at about the same time. These turned out to be two of the most influential papers ever published in economic theory.

The original work was done on stock options. By the 1980's, the problem had become how to extend it to bond options. At Goldman, the first attempt involved using the Black-Scholes equation, but by the time Derman came to the firm it was understood that this had limited validity. In the first place, future bond prices follow a different curve from future stock prices because of the fact that at the expiration date, the bond price returns to par (its initial offering price). Thus, the spread of future bond prices has a banana-like shape rather than a wedge.

In the second place, bond prices tend to be connected to each other. Familiar examples are Treasury bonds of different durations. Their prices

tend to move in concert. This does not happen with stocks, whose prices vary independently.

The first problem could be dealt with by focusing on the yield: the average annual percentage return of the bond if purchased at its present price and then held to maturity. But the problem of the interconnection of bonds was much more serious. And this is where Fischer Black enters Derman's story. Black, who had joined Goldman in 1984, invited Derman to collaborate with him and another quant named Bill Toy to make a new model for pricing bond options that would take these interconnections into account.

Fischer Black is certainly the hero of Derman's book. He sounds like a wonderful man. Having money was never one of his major interests: he liked to point with pride to the fact that, of all Goldman's partners, he had the fewest shares in the firm. He was also one of the first academics to be hired on Wall Street, having been brought in by Robert Rubin, then Goldman's chairman. His great strength was his lucidity. He did not like clutter—mental or otherwise. Derman found that if he had a specific question, Black was very ready to try to answer it, but otherwise he was not very responsive.

By 1986, Black, Derman, and Toy had created a bond-option model that seemed to work. To make the model useful to traders, there had to be a computer program enabling them to estimate rapidly the price of the bond options they were selling, and one of the things Derman was able to bring to the collaboration was the skill at computer programming that he had acquired at Bell Labs. They created such a program, but because of Black's fastidiousness it took almost four years before a paper that he considered satisfactory could be published. Thanks to its simplicity and accessibility to traders, the BDT model, as it would be known, became widely used in the industry.

In 1988, after he had been at Goldman for a relatively short time, Derman decided that he needed a change of scene. He interviewed at Salomon Brothers, where eventually he took a job for a very unhappy year, after which he returned to Goldman. Of the groups at Salomon that he interviewed with, one, hand-picked by John Meriwether, enjoyed the reputation of being the savviest derivative traders on Wall Street. Derman did not get the job.

This was probably fortunate. Ten years later, this same group precipitated a crisis that led to a near-total meltdown of the world's financial markets.

IV

IN READING about this near meltdown—Roger Lowenstein’s book *When Genius Failed* (2000) is an excellent source—I have been struck by the difference between it and the other financial scandals that we are now familiar with: Enron, Global Crossing, and the rest.

For one thing, there is the matter of scale: while the Enron scandal was a financial disaster for a large number of people, it was never a threat to the system as a whole. For another, there is the matter of intent: many of the people involved in these scandals have ended up in jail for participating in criminal activities. But for those involved in Long Term Capital Management (LTCM), which is what Meriwether’s hedge fund was called, there was no criminal intent.

I am not even sure how interested in money the members of this group were, except as a measure of their smartness. The investment genius Bernie Cornfeld used to ask prospective employees of International Overseas Services—another financial disaster—“Do you sincerely want to be rich?” By this he meant: would you sell your sister? Had Meriwether’s gang been asked this question, I think they might have had some difficulty answering.

Not long after Meriwether started his fund in 1993, he successfully recruited both Merton and Scholes. In his 1997 Nobel Prize autobiography, written a year before the final catastrophe, Merton was euphoric about the fund:

The distinctive LTCM experience from the beginning to the present characterizes the theme of productive interaction of finance theory and finance practice. Indeed, in a twist on the more familiar version of that theme, the major investment magazine, *Institutional Investor*, characterized the remarkable collection of people at LTCM as “the best financial faculty in the world.”

One wonders what the Nobel committee made of this, to say nothing of what they, and the editors of *Institutional Investor*, would make of it the following year when the “best financial faculty in the world” came close to wrecking the entire world’s financial infrastructure.

The “dean” of this dream faculty, John Meriwether, was born into a middle-class Catholic family in Chicago in 1947. Educated in very strict parochial schools, he was a good student but not exceptional. He was, however, an extremely good golfer, and while working at the Flossmor Country Club he was

selected for a college scholarship awarded only to caddies. He chose to attend Northwestern and then the University of Chicago to study business. One of his classmates at Chicago was Jon Corzine, now a Senator, who as CEO of Goldman became involved in the LTCM denouement.

In 1973, Meriwether went to work at Salomon. This was just before the explosion in derivative trading. In 1977, he began assembling the arbitrage group at Salomon, the same people with whom Derman had his unsuccessful interview and who later formed the core of LTCM.

In assembling his group, Meriwether sought people from anywhere who were smarter than anyone else—smarter even than he was. He had no complexes about this, and no problem in seeking misfits from academia so long as they were brilliant. These people, who were characterized by another Salomon trader as “a bunch of guys who would be playing with their slide rules at Bell Labs” if they had not been tapped by Meriwether, loved the financial-engineering models. They saw in the market a universe of inefficiency—a salad of incorrectly priced derivatives that they could gobble up while waiting for what they were certain would be the market’s return to efficiency, at which point they would make a killing.

For several years, Meriwether’s group thrived and Meriwether became richer and richer, investing in thoroughbred horses but remaining the rather unassuming parochial schoolboy he had been. There was nothing in his group, then or later, that remotely resembled the sort of partying that Bernie Cornfeld was famous for in Geneva. Meriwether’s very tightknit group played liar’s poker or golf together; what they did not do was to explain to outsiders anything about their trading. Banks and brokerage houses put in millions and millions without having any real idea of how the money was being invested. All that mattered to them was that out of the black box, vast returns kept appearing.

HERE IS a little analogy that may be useful in understanding the denouement. A scheme guarantees that I will win \$1,000 at the roulette wheel in Monte Carlo. I will bet \$1,000 on red. If it comes up red, I will collect. If it comes up black, I will bet \$2,000 on the next turn of the wheel. If it comes up black again, I will double my bet. And so on. Unless the wheel is crooked, it must sooner or later come up red, and I will win my \$1,000.

But there are limits. If, for example, the wheel comes up black ten times in a row, my next bet will run into the millions. What then? Once I start the game I cannot stop, unless I either hit red or am pre-

pared to pay off the last bet. Perhaps I can persuade a bank to lend me the money—the leverage—to keep going. But if not, Keynes's maxim about the irrationality of the markets will have come true. The bank may want its money back, or the casino may decide that I have reached my limit and it will no longer accept a bet from me.

Either of these situations is potentially catastrophic, and both of them, in a manner of speaking, came to apply to LTCM. The key to everything was the assumption that the market would behave rationally—the same continuity of behavior that was one of the assumptions behind the Black-Scholes formula. For if the drunk on his random walk were suddenly to fall down a manhole, all bets would be off.

In late summer 1998, the fund had \$3.6 billion in capital, which made this unknown firm in Greenwich, Connecticut a larger financial enterprise than any of the major brokerage houses on Wall Street. But during a five-week period in August and September they lost it all. They were wiped out. The “faculty” sustained personal losses of \$1.9 billion.

To get a flavor of the catastrophe, consider again our toy model. The model is a toy because there are only two outcomes for the stock—\$120 or \$80. The difference between these numbers—the spread—is a measure of the risk, reflected in the amount that the hedge will cost us. In our example it was \$10—the price of the option. But suppose we widen the spread to \$140 and \$60, or \$80. If we do the algebra, we will find that the cost of the hedge has risen to \$13.33.

In the real world, where we do not have only two outcomes, we must have some theory of future volatility. This is what LTCM thought it had. Its traders looked for stocks whose volatility, in their view, had been overestimated. Japan was a good source, which is why the firm opened an office in Tokyo. Owners of these stocks were ready to pay LTCM a premium to create a hedge. They were betting that, just as the roulette wheel has to come up red, in the course of time the market would behave rationally and the volatility—the spread—would relax to the predicted value. (As opposed to “real arbitrage,” which occurs when two identical commodities have been priced differently, so that the two prices *must* converge, this sort of guessing, or hoping for convergence, is known as “statistical arbitrage.”)

But there was an additional element. LTCM was not playing the game with its own money. It was playing with borrowed money. Taking advantage of the very loose regulation at the time—Alan Greenspan thought, and still thinks, that hedge funds should not be regulated at all—LTCM was able to give borrowed money to banks, which would then set

up accounts, or “swaps,” mirroring in terms of profits and loss the stock that LTCM wanted to buy. There was no limit on this, and banks were just shoveling money at the firm.

By the spring of 1998 it was already becoming unglued. Instead of narrowing, the spreads were becoming wider. This meant that LTCM had lost its bet on the option cost. It had also begun to make investments directly in stocks, and these were also losing money. Markets around the world were sinking. In August, Russia defaulted on its external debts, causing further chaos. Everyone was looking for liquidity, and LTCM, with its huge positions, could not unload. To add to everything, it had an arrangement with the firm of Bear Stearns, which acted as its broker of record on the understanding that it would stop carrying out transactions if the reserve it held from LTCM—its “cash in the box”—fell below \$500 million. This was money based on LTCM's assets, which were rapidly melting away, which meant that the roulette wheel might stop, putting LTCM out of business.

Meriwether tried without success to borrow money from everyone he knew, including Warren Buffet and George Soros. But by the middle of September it was clear that without outside help the company would collapse and that, because of its intertwining relationships with banks and brokerages both here and abroad, the market itself might collapse. By the end of September, in a much-criticized move, the Federal Reserve orchestrated a rescue in which fourteen banks provided \$3.65 billion to take over the fund. Long Term Capital Management was through.

DESPITE THEIR losses, the partners came out of this debacle as wealthy men. Nor did their professional lives seem to have been destroyed. Merton is now a professor at the Harvard Business School. Scholes is a partner in a firm in Menlo Park called Oak Hill Capital Management. Meriwether, hardly missing a beat, started a new firm called JWM Partners, the roster of whose associates includes several names familiar from LTCM.

As for financial engineering, to judge by Derman's courses at Columbia, where he now runs the financial-engineering program, it too is thriving. And Black-Scholes-Merton? So far as I know, its reputation still rides high. All in all, I cannot help thinking of Albert Einstein's reply when asked what he would say if experiments failed to confirm his theory of gravitation. “Then I would have felt sorry for the dear Lord,” Einstein responded. “The theory is correct.”