

## *BOOK REVIEW ARTICLE*

### **Yes! There are Limits to Arbitrage: Lessons from the Collapse of Long Term Capital Management**

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**Key Words:** Long Term Capital Management, hedge funds, arbitrage, leverage, New York Federal Reserve

### **Inventing Money: The Story of Long Term Capital Management and the Legends Behind It**

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John Wiley & Sons, 2000

Long Term Capital Management was an extremely large hedge fund whose potential collapse threatened the stability of the world financial system before it was saved by a Federal Reserve-orchestrated rescue. The legends behind this limited partnership are the people who created it. These include fabled Salomon bond trader John Meriwether and two Nobel Prize winners, Myron Scholes and Merton Miller. The first part of the book manages to tell the story of the founders. In the course of this story, it covers topics such as the emergence of modern option theory (a problem both Miller and Scholes had worked on), arbitrage arguments in theoretical finance, and arbitrage as a business.

Probably the most valuable part of the book is the insight it gives into the sophisticated arbitrage business. In textbook theory all packages of securities that provide the same payoffs should provide the same returns. If they do not, arbitrageurs would be able to construct "money machines" that provide a risk-free return. In practice, the price of various assets is set by supply and demand in different markets, and prices do not meet the no-arbitrage conditions. This creates profit opportunities for arbitrage firms. Long Term Capital Management was

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the largest of such firms, and its history provides an insight into this aspect of the financial markets. Some may read the book merely for the story of the personalities and the firm, but for financial economists the greatest value is probably in the account of the strategies the LTCM and similar firms followed (the stories of other similar operations are worked in).

What are some of these? Meriwether, the ex-Salomon Brothers bond trader who founded LTCM, had made much money in Treasury trades that exploited the fact that new Treasury bonds when issued ("on-the-run bonds") were actively traded and more liquid than the more seasoned bonds ("off-the-run"). This caused them to sell at higher prices than other Treasury bonds with almost the same maturity. Later, when the newly issued Treasury bonds had been around a while and were "seasoned" they would trade at prices similar to those of the older Treasuries. By selling (shorting) the new bonds and buying seasoned ones, an arbitrage profit could be earned when the new bonds came to be priced on the same basis as the older ones. Meriwether put the new firm into the business of making such trades.

Another successful business was issuing long-term options on European indices. European banks had found that customers desired investments that guaranteed them at least the money they had paid for an investment, but which gave them the upside potential of stocks. Such "structured" products are possible by buying a zero-coupon bond that pays off the guaranteed principal plus a long-term option. LTCM became a leader in the business of providing such options, and figured out ways to hedge their own exposures. Later, the problem of maintaining the capital required to mark these options to market was to help bring the firm down.

There are accounts of very complex deals that involved trying to profit from the addition of Italy to the European Monetary Union. This meant that the much higher Italian interest rates would fall to the general European level. Then there were discrepancies in the structure of the term premium on swaps in Germany versus Great Britain. One problem Dunbar had in writing this book was the need to explain the various complex financial instruments used (such as swaps) as he goes. Generally, he does a good job of this, although it does delay the narrative some in the earlier chapters.

What brought LTCM down? The firm was built on the idea that there were discrepancies in the prices for various assets in the market such that it was possible to build hedged positions that essentially

guaranteed a profit. If one asset in the position went up, another would normally go down. Thus risk was reduced, and ideally, eliminated. Eventually, discrepancies in prices would disappear, and the firm would earn a profit. To make such arbitraging of small differences sufficiently profitable it was necessary to have incredibly large amounts of capital. Fortunately, such capital could be raised. The founders of the firm included two Nobel Prize winners (Miller and Scholes), Meriwether, who had made a fortune in bond trading at Salomon Brothers, and ex-associates of his from Salomon Brothers. With such distinguished founders the fund was able to start business in 1994 with over a billion dollars in investor capital.

The book is partially the founders' stories. These should interest those concerned with either the history of modern financial theory or with Wall Street. Much space is devoted to Meriwether's bond trading at Salomon Brothers. This operation brought Salomon Brothers down through violating a Federal Reserve Board rule that limited any firm to only 35% of the bonds sold at one auction.

The fund was organized under the laws of the Cayman Islands for regulatory and tax reasons. The actual management of the portfolio was done by Long Term Capital Management. This was organized as a limited partnership and operated from Greenwich, Connecticut. LTCM was to receive annually 2% of the capital as a management fee, and 25% of the profits. Investors had to put up a minimum of \$10 million and could not withdraw their funds for at least three years. Such a vast pool of capital had the potential for making the seven principals incredibly rich. It also had the potential for destroying them, since many of the partners put most of their personal capital into the venture. Initially, LTCM was highly profitable and the equity capital grew to 4.87 billion dollars by 1998.

However, the reason LTCM is a fit subject for books is its use of leverage. The last publicly-available balance sheet for the portfolio showed total liabilities of \$124.5 billion. This, along with the equity, made total assets \$129 billion. However, the really remarkable part was in off-balance sheet items. Total derivative positions had a notational value of \$1.25 trillion. This is an incredible sum to be controlled by a small partnership that few had even heard of.

How was such leverage possible? Those trading with LTCM were unaware of how leveraged it was. As is customary for hedge funds, LTCM kept secret the nature of its positions. Others might have duplicated its strategies if its positions were known. Each of the parties

dealing with it knew merely it was very large and had very prestigious and experienced people running it. They did not view the trades made with it as particularly risky.

Finance textbooks have long presumed that essentially infinite leverage was possible if the proceeds of a short sale were used to take offsetting long positions. LTCM came closer to realizing the theory than many of its critics, including myself, had realized was practical. Most of the assets and liabilities were in the form of fully collateralized positions in which short positions had collateral pledged against them. The use of off-balance-sheet fixed income swaps in which one firm exchanges the payments from one set of bonds for the payments from another set of bonds (such as fixed-interest payments for floating-rate payments) further added to the leverage.

Normally when a short sale is made the firm lending the securities receives a security payment equal to the proceeds of the sale. The value of the position is marked to market each day so that if the security rises in price the lender of the security is protected. In addition, there is usually a little bit of extra security, perhaps 2%, sometimes referred to as a "haircut". Thus, if the borrower of the security is unable to meet a market call the lender is still secured. LTCM had enough clout (as did some other very large hedge funds) to avoid having to put up this extra security. Presumably, the other parties thought LTCM was large enough and diversified enough that it would always be able to meet its obligations. Trusting it, they did not require actual proof of this proposition.

Paradoxically, these relatively generous terms were one of the factors that brought the firm down. Once massive losses were experienced, the counterparties to trades began to have doubts about their security and naturally were concerned. On the long-term options the firm had issued, the counterparties had the privilege of deciding what the mark-to-market requirements were. This was because reliable market quotes were scarce. Naturally, when LTCM began to appear shaky, the counterparties used this flexibility to choose valuations that required more capital be put up. This reduced the capital available for other purposes, contributing to the collapse.

Paradoxically, shortly before the collapse (i.e., in December 1997), the management was so confident that it returned \$2.7 billion to its investors. The partners felt that the remaining capital (\$4.7 billion) was adequate to finance the profitable opportunities they had identified. Returning this capital raised the returns to the remaining investors

(which included the principals). This increased the leverage from 18.3 to 27.7.

LTCM, like its competitors, had risk-control procedures in place. They used a method called Value-at-Risk, which attempted to estimate how much the firm had exposed to various trades. If losses exceeded a pre-set limit, the firm was to reduce its positions. This procedure was actually required by regulators for big banks, which were the competitors of LTCM. However, LTCM was itself unregulated (a result of being a non-bank Cayman Island organization). Their Risk Aggregator model (which allowed for the correlations between different risks they were exposed to) said they would lose no more than \$339 million (10% of capital) in ninety-nine out of a hundred months. However, such models often fail adequately to consider risks that are not in the recent historical record (which is where the relevant statistics come from).

In May and June of 1998, LTCM lost money and breached its Value-at-Risk measures. LTCM management blamed this on a competitor shutting down its bond arbitrage operation. Salomon had been engaging in trades similar to those of LTCM, and it was plausible that their attempts to unwind their positions would move markets against LTCM. This could be interpreted as a one-time unfavorable event. However, this large loss led to a decision to reduce LTCM's positions. This was only a few months after the decision to return capital to the investors.

The issue then became which positions to cut back. One possibility was a proportionate reduction. This would mean exiting some rather illiquid positions and taking some losses. Instead, the decision was to exit from the most liquid positions. This kept the firm in what it considered to be the most profitable trades. However, it also meant that later when the firm experienced further losses it had few liquid positions it could sell off to further reduce its exposure.

The final crisis came when Russia defaulted on her debts. While a default had been expected, Russia unexpectedly forbid its banks to honor foreign exchange contracts for a month. This created large losses for many foreign banks, and caused the bankruptcy of one large hedge fund, the High-Risk Opportunities Fund. While LTCM took some losses on Russia, most of the damage was indirect. Other banks and traders did not know who was solvent and who was in trouble. The risk managers in firms administering their Value-at-Risk systems required their firms to reduce exposures. Looking for positions to get out of,

banks and hedge funds sold their positions in the more liquid swap and government bond markets. This general liquidation lowered prices in these markets, causing the typical bank or hedge fund to experience further losses. This produced yet another wave of liquidations as risk-management systems required further reductions in positions.

Thus, in aggregate, the risk management systems contributed to the very problem they were intended to solve. The basic problem was that the theory presumed that markets would be liquid and that one could offload positions onto other parties at near-prevailing prices if circumstances made it necessary. Yet, since a buyer is needed for every seller, all investors cannot sell at the same time. The problem is similar to one that helped produce the 1987 crash (this episode is discussed in Miller 2000). Then, practitioners of modern financial theory had developed the idea of *portfolio insurance*, which depended on being able to sell in time to limit losses to acceptable amounts. However, when large sums of money were managed in this way, everyone could not sell at the same time.

Thus, in August of 1998 the large pools of money that had been trying to exploit discrepancies between the prices of related securities were all trying to reduce their positions at the same time. Since it was the trading by the large pools of capital that had been keeping the price discrepancies from being even larger, the cessation and unwinding of their arbitrage activities resulted in the discrepancies getting larger, and most of the funds experiencing losses.

There was a general search for safety and liquidity, with the prices of the liquid securities being bid up. Many of the LTCM trades had involved being short the more liquid securities and buying equivalent less liquid securities. This caused widespread losses for LTCM in trades that at first would not appear to have anything much to do with each other.

By August it became clear that additional capital was needed and frantic efforts were made to find it. However, it was too late and investors who at the beginning of the year (when LTCM still had an impressive record) would jump to invest were no longer willing. August brought the firm a loss of \$1.85 billion. Once the magnitude of the losses became known, others who had traded with them were naturally concerned and used their ability (mentioned above) to mark positions to market to make themselves more secure.

Because the LTCM portfolio was located in the Cayman Islands whose laws (unlike those in the U.S.) did not provide for immediate

liquidation of positions in the event of bankruptcy, parties that had the opposite positions to LTCM could have their positions tied up for months while a bankruptcy was conducted. The counterparties included many of the world's large financial institutions whose finances would be adversely affected. This made them willing to consider a takeover.

The New York Federal Reserve got involved because of the risk to the stability of the financial system, and brokered an arrangement in which a consortium of large banks and financial institution refinanced LTCM.

Naturally, there can be debate about whether the Federal Reserve should get involved in saving private firms and pressuring other firms into participating in a rescue. This book reveals it was probably unnecessary. At the last moment, Goldman-Sachs had negotiated a deal where Warren Buffet would finance a take-over, buying the existing investors out for \$250 million and then, with others, putting an additional \$4 billion into the fund, with Goldman-Sachs traders taking over management of the fund. Meriwether and the founders would lose both their jobs and the bulk of the money they had put into creating LTCM (they held about 40% of the equity). However, Meriwether declined this offer, claiming he lacked the legal authority to accept.

Dunbar argues that he knew that once the Federal Reserve had gotten publicly involved it had to produce a deal and avoid a collapse of LTCM. Thus, Meriwether could reject this deal and expect that a better offer would emerge (aided by Federal Reserve pressure). The Federal Reserve brokered an arrangement in which a consortium of large banks and financial institution put \$3.625 billion into the firm. The original investors retained their stake (now worth about \$400 million, appreciably more than the rejected buyout offer), although it would now be only about 10% of the portfolio. A committee of the new investors was given control, although Meriwether and other former principals retained jobs (at \$250,000 per year). Thus, the Federal Reserve intervention may not have been necessary to prevent a sudden collapse of LTCM. Instead, the chief effect was to reduce the financial loss to the original investors, including those who made the decisions to take on the risks that eventually failed.

What are the lessons for financial theory? One appears to be that risk-free financial arbitrage isn't really possible. There is always credit risk. Trades that depend on markets remaining and pricing discrepancies shrinking to zero over time are exposed to the risk that the discrepancies will instead become bigger at some point, making it



impossible to maintain the positions. This is a real obstacle to arbitrage. Indeed, Shleifer (2000) uses LTCM experience to support his argument that there are limits to the ability of arbitrage to prevent mispricing of securities.

Also investments that in ordinary time appear to be diversified (being in different countries or in types of securities) may become correlated if there is a flight to safety. Even if a position has been constructed that appears to lock in a profit, it is necessary to have adequate capital to maintain the positions, because the mispricing being exploited may get worse before it moves in the anticipated direction.

It also raises again a question about the traditional hedge fund incentive structure, where the managers get a base fee (2% of assets for LTCM), plus a share of the profits (25% for LTCM). Fund managers can do extremely well if the fund succeeds. In the good years, LTCM profits exceeded a billion dollars. If the fund fails, the investors take the loss, not the fund itself. This is a structure that encourages the taking of large risks. Bets that most likely will pay off with modest profits (as a percentage of the sums invested, which can be large in absolute dollars), but that have a small chance of very large losses will be encouraged. The LTCM story could have easily turned out differently with the principals becoming extremely rich.

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## **The Impact of Lawlessness on Pakistan's Economic Performance 1960-95**

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The authors demonstrate the relation between periods of heightened lawlessness in Pakistan between the years 1960 and 1995, and variations in economic performance.

**Key Words:** Pakistan, Gross National Product, lawlessness, corruption.

### **I. Introduction**

It may be readily conceived that the socioeconomic impact of lawlessness in a society, whether arising from corruption in the public and private sectors, perversion of rules and procedures, abuse of power, crime including white-collar crime, almost invariably has negative microeconomic and macroeconomic effects on economic performance. Since its birth in 1947, Pakistan has suffered to a lesser or greater extent from lawlessness, causing one British journalist, E. Duncan, to observe in 1989 that:

Lawlessness goes all through society. The robberies, kidnappings and riots are the extreme fringes of it; but people do not much obey the traffic laws or tax laws either.... There are too many people around the ladder of power who are cheating. .... A minister of the Sindh provincial government was robbed at Heathrow (London airport) of a brief case containing fifty million rupees in cash. He did not report it to the police. ... Politicians have political

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<sup>1</sup> This paper is based on research by the senior author for his doctorate, recently completed at the University of the Punjab, Lahore. S.M. Ghazanfar is Professor and Chair, Department of Economics, University of Idaho, Moscow, Idaho (USA); and Rafiq Ahmad is Professor Emeritus (Economics), and former Vice Chancellor, University of the Punjab, Lahore, Pakistan; both served on the senior author's committee.