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A qualitative study of
Long-Term Capital Management

MVE220 - Financial Risk

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Introduction:
Long-term capital management was a hedge fund founded and run by John Meriwether and two Nobel-prize winning economists, Robert Merton and Myron Schoels, mostly known for their contribution to the Black-Scholes-Merton model. Founded in 1994, the hedge fund performed spectacular returns of about 40% a year for the first three years, before in 1998 going bankrupt and needing to be bailed out by the US government for a whopping sum of $3.6 billion.

Background of the fund:
LTCM was known on Wall Street when it opened up as the All star hedge fund, quite deservingly so. Because the three main partners of the firm were John Meriwether, Robert Merton and Myron Scholes.

Starting off, a hedge fund much like a mutual fund (Or a “normal fund”) are portfolios consisting of pooled funds from many investors with the goal of achieving returns through diversification. By pooling funds the fund managers aim to use investment capital from multiple investors to invest in assets fitting a specific strategy. The main differences between these two types are that hedge funds are private and usually aimed towards clients with a high net value, further there are different regulations regarding hedge funds making it possible to pursue a more aggressive investing strategy through trading with options, leveraging, short-selling and other alternative strategies.

John Meriwether was in charge of running this fund. Before LTCM he worked for the investment bank Solomon brothers. Meriwether had started out his career as a bond trader before moving up the ranks and becoming the Head of Bond Trading and vice chairman of the board, Solomon Brothers which was back then the second largest investment bank in the world.

The other two limited partners of the firm came from a more academic background.

Myron Scholes was a professor at MIT who did his doctorate at the University of Chicago, under Eugene Farma, known as the father of the efficient market hypothesis and later also a Nobel prize winner. Robert Merton shared a similar path to Scholes, but earned his doctorate in economics at MIT under the legendary economist Paul Samuelson, also a Nobel prize winner, known for his work in Macroeconomics and for acting as an advisor for US Presidents John F. Kennedy and Lyndon Johnson.

Other partners included several bond traders who before LTCM had very distinguished and recognized careers at Wall Street. Other superstar partners included David Mullins, back then the vice chairman of the Federal reserve.

Not surprisingly, at the start of the fund in 1994, people were eager to be a part of this fund and the partners of the fund managed to raise $1.3 billion.

Black-Scholes-Merton and the Black-Scholes formula:
In 1968, Scholes joined the MIT faculty and met Fischer Black. Black and Scholes developed a first glance of what we today would call the Black-Scholes Option Pricing model. Here they showed how the price of a stock option could be determined on only five underlying variables; the price of the stock, the volatility of the stock, the exercise price, the time to maturity of the option and the interest rate. Black and Scholes academic research was first rejected in 1970, giving them some time to try it out in the markets before finally publishing the article in June 1973, titled “The Pricing of Options and Corporate Liabilities”. Later that same year, Merton published his own article titled “Theory of rational option pricing” further expanding on the mathematical rationality behind Black and Scholes paper, thus becoming the Black-Scholes-Merton formula.

Fisher Black went on to work for Goldman Sachs as a quantitative director before passing away early. In 1997, Scholes and Merton were awarded the nobel prize in economics for their findings.

Fund strategy:
LTCM would in today's terms be called a highly leveraged quantitative hedge fund, who used advanced computers and models to find mispricings in value, called arbitrage. Not wanting to reveal their strategy to close the arbitrage opportunities, the exact strategy and models used were kept secret.
But what is known is that the overall strategy was to use quantitative models to find deviations in intrinsic value between different asset classes and currencies. The main objective was to put their superior academic minds to use and continue to develop superior quantitative models that could spot these price deviations and then use the very experienced traders to execute these trades.

There were four main types of trade:

- Convergence among U.S., Japan, and European sovereign bonds;
- Convergence among European sovereign bonds;
- Convergence between on-the-run and off-the-run U.S. government bonds.
- Long positions in emerging markets sovereigns, hedged back to dollars.

But since these differences often were very tiny the fund needed to take very big positions for these trades to make a significant profit, and therefore had to be very highly leveraged, and operated for most of its history with a debt to equity ratio of 30 to 1.

Downturn:
Before the LTCM’s crash in late 1998, LTCM achieved stunning returns of about 40% a year for the years 1994 until 1997. A byproduct of this meant that at this time the fund's positions in some illiquid markets had grown so big that there were no longer enough buyers left, this resulted in a decreased return for 1997 with “only” 17% which at the time was the average for hedge funds. At the start of 1998, the firm had almost $7 billion in AUM(assets under management) but due to “lack of investment opportunities”, LTCM returned $3 billion dollars to their investors. With then 4 billion in assets under management and the total value of the portfolio at some $100 billion LTCM started searching for new investment opportunities.

The growth of LTCM attracted more competition and the arbitrages that the fund had exploited earlier were no longer as effective, this led them to foreign currencies and emerging-market debt. Myron Scholes was not pleased with these new riskier investments and publicly expressed doubt when LTCM took a major position in the Norwegian kroner as he meant that the fund ”didn’t possess any informational advantage in this area”, and it didn’t take long for Scholes' skepticism to be justified, in June 1998 the fund returned -10% which was the biggest monthly loss to date.

The 17th august 1998 the Russian financial crisis struck, the government devalued the ruble and defaulted on their domestic debt. While a financial crisis most certainly would impose arbitrages on the market, LTCM were not in a state to utilize these volatile movements. On the 17th of august the Russian ruble traded at 6.43 rubles to one dollar and the Russian Central bank imposed a “floating peg”, this meant that they had a fixed trading band between 6.0 to 9.3 rubles per dollar and if the ruble exceeded this band the central bank used foreign reserves to buy rubles and if the ruble receded this band the Central bank would sell their currency. This floating peg was kept until the 2 september of 1998 when they instead abandoned this approach and let the ruble to float freely, by the 21st of september only 19 days later their currency traded 21 rubles per one dollar meaning that it lost more than two thirds of its value in just over a month.

How did this financial crisis affect LTCM?
The crisis saw investors dumping any remotely risky market and fled into the most secure instruments within the “risk-free” U.S government bond market. Ultimately, this resulted in an enormous liquidity crisis which affected LTCM’s portfolio severely.

The 1st september of 1998 midst the Russian financial crisis LTCM’s capital had shrunk to 2.3 billion dollar. John Meriwether announced the massive losses and offered the opportunity to invest in the fund “on special terms”. Further he informed existing investors that they were not allowed to withdraw more than 12% of their investment and nothing at all until December that year.
The 22nd september the assets under management only amounted to 600 Million dollars, and their portfolio hadn’t shrunken significantly meaning that their leverage now was even greater and Banks started to doubt the funds ability to meet its margin calls meaning that if this was any other case, liquidation would be next on the agenda but since LTCM owned such great positions the banks feared the potential outcome of what a liquidation could oppose on the rest of the market.

Bailout and aftermath:
Interviews of former employees of the fund described at the time that their mathematical and statistical models showed the probability of losing a 100% of the fund's value in one year was $1/10^{24}$. And yet the impossible or the very very unlikely happend, they lost everything or would have gone on to lose everything unless rescued in less than a year.

Since the fund was very highly leveraged, when it began to lose money, the same principles of leverage that had been used in their favor earlier, began now to work against them. When their positions went down, the banks which lent money to LTCM then wanted the fund to put in more security, which was not possible since LTCM was simply not liquid enough. The banks involved then demanded to see the fund books to grasp their current assets and to determine the riskiness. One bank after another another began to realize just how leveraged the fund was and the many risks that the fund was involved in and that their would be low chances of getting their money back and that things was going to get worse, so banks started shorting (betting against) the funds positions to try and mitigate their losses.

John Meriwether and his partners tried to raise additional capital to try and get their liquidity under control but failed, then realizing in late September of 1998, that for the fund to survive, their options were very limited and began to look into selling the fund. Goldman Sachs, AIG and Warren Buffett's Berkshire Hataway gave the partners of LTCM an offer to buy the fund for $250 Million and to take control and run its operations, meaning that they would have to put up at least $3.75B to do so, however Meriwether and his partners decided not to take the offer.

Since many banks and highly influential people on Wall Street were invested in the firm, they began to put pressure on the Federal Reserve to try and prevent the fund from going bankrupt, fearing that it could lead to a severe financial recession since LTCM had just so much unsellable derivatives and so very widespread international that the whole world was involved. It became just “Too big to fail”

But since no single bank was big enough and willing to take the risk all by themselves, the federal reserve stepped in to help and create and incentivize more banks to join. Finally 6 banks joined forces and bailed out the fund for a total of $3.625B by the major creditors to avoid a wider collapse in the financial markets. The banks which took part of the bailout then book control over the fund and ran it for an additional year trying to the best it could with its positions, before closing it. Afterwards, the total losses were calculated to be $4.6B.

How did the partners of the firm went on to do after LTCM:
Myron Scholes and Robert Merton, went on to serve as advisors on risk management for many highly respectable institutions and banks.

John Meriwether, the man in charge of LTCM opened up in 1999, only a year after the LTCM collapse, a new fund with very similar strategies as those used in LTCM. That hedge fund in turn went on to do quite well in the years 1999 - 2007 outperforming the SP500 but then in the period of the financial crises in 2007 - 2009, the fund performed very poorly losing over 50% of its value. Before Meriwether decided to close that fund and wait out the recession before finally starting his third hedge fund in 2010.

Analysis:
The initial cause for the collapse of the “all-star hedge fund” was Russia's default on its government obligations. LTCM hedged these obligations called GKO's by owning short positions on the ruble meaning that if Russia defaulted on its bonds the currency would collapse and so a profit could be made there. What they couldn't have known was the fact that as the Russian ruble collapsed, the Banks issuing these short positions collapsed with it. Although this was a huge loss for LTCM this wasn't the final blow that brought down the fund.

What in reality caused the downfall of LTCM was the “flight to liquidity” in the global bond markets as a result of the Russian financial crisis. Investors sought assets more liquid than bonds and this resulted in a flood of assets into the U.S treasury market.
The U.S treasury market can be divided into two categories, “on-the-run”-treasuries and “off-the-run”-treasuries, “on-the-run”-treasuries are the latest released bath of treasuries by the government, and “of-the-run” are those released in any batch prior to the latest one. Since “on-the-run”-treasuries are more scarce than “off-the-run” they’re therefore more liquid and since investors searched for liquidity “on-the-run”-treasuries soared which created a huge price gap between these two different treasuries.

Ultimately what brought down LTCM was their miscalculations regarding their exposure to change in “price” of liquidity, when liquidity became more valuable its short positions rose in price relative to their long position meaning that they were totally unhedged to one single risk factor.

Lessons to be learned:
LTCM, like many predecessors in the case of highly-leveraged quantitative firms, exploited the deviation between market value and “fair value”. This strategy required patience and a trust from the investors that no matter any short term negative result the market value would eventually converge towards its fair value. The fund managers succeeded with this task and convinced their stakeholders by informing them the fair values were hedged and therefore their prediction would occur sooner or later, hence “LONG TERM capital management”.

What LTCM didn’t take into consideration enough was the patience of their lenders, since the fund conducted business in normal state with a debt to equity ratio about 30 to 1 there wasn’t any huge margins to rely on. When then the fund wasn’t hedged towards the change in price of liquidity their leverage increased to 250 to 1 which made it impossible for their lenders to rely on their predictions of the fair price.
This problem was actually raised early on in the funding process of the hedge fund when John Meriwther approached Warren Buffet and Charlie Munger who both turned down the offer deeming the strategy to be too risky.

In Roger Lowenstein book “When Genius Failed” which is a story about LTCM, where he conducted interviews of employees of the LTCM, of the banks that bailed out the fund and the federal reserve. He describes that the lessons to be learned are that even great models created by the greatest minds in the industry can’t foresee the irrational behavior of their fellow human beings.

To conclude this history of “When genius failed” we must take with us the lesson of Murphy's law meaning that everything that can go wrong, will go wrong.

Further reading:

https://en.wikipedia.org/wiki/Long-Term_Capital_Management
https://www.bauer.uh.edu/rsusmel/7386/ltcm-2.htm
When Genius Failed - The Rise and Fall of Long Term Capital Management. Written by Lowenstein R.
https://www.goldmansachs.com/our-firm/history/moments/1973-black-scholes.html