

CHAPTER 4

The Trades

Some birds aren't meant to be caged. Their feathers are just too bright.

—Red, *The Shawshank Redemption*

As a portfolio management company, LTCM was characterized by its trades: a group of apparently diversified positions with very small absolute returns, even smaller variance, and very low correlations with one another. This strategy gave them three distinct advantages over their competition.

LTCM selected trades that had very small absolute returns. Many market players, including large institutional traders and money managers, avoid these trades altogether. A dearth of trading left some natural mispricing in these securities. To make the absolute return attractive to investors, LTCM had to use substantial leverage. Some people refer to this strategy as “picking up nickels in front of a steamroller.”

Many of LTCM's trades required simple, clever mathematics to strip out unknown risks and focus on the arbitrage. Investors typically take on all trade risks. Buy a company that exports most of its goods to another country, for instance, and you'll take the fall if the company is poorly managed or the exchange rate shifts, but not in your favor. To focus on just the management risk, an investor uses other transactions to take the foreign exchange rate risk out of the trade. LTCM worked to remove the risks that didn't interest them, or on which they didn't hold strong opinions. In doing this, LTCM traders' mathematical abilities and experience gave them a comparative advantage over other investors.

LTCM constructed very creative financing terms. It profited from trades that looked impossible from a conventional lending perspective because they found clever ways to finance their deals.

LTCM's repo swap arrangement is just one example of the firm's creative financing techniques. Just as banks won't lend a home owner a home's full value, hedge funds can't typically borrow the full value of their collateral in a repo swap. The difference between the loan amount and the collateral value is called a haircut, and it's based on the deal's perceived risk and the collateral's likely liquidity. Before LTCM launched its fund, it negotiated hard to get zero-haircut swap transactions from its counterparties. That let LTCM make margin trades that would have been unaffordable for other hedge funds.

The Japanese warrant trade illustrates another clever LTCM financing idea. The 1990s saw some incredibly cheap Japanese warrants associated with small-cap Japanese stocks. (A warrant is an option to buy company stock at a fixed rate for a set amount of time. It's often associated with a company's preferred stock or bonds.) The warrants traded at a lower price than they would be worth if exercised.

There were institutional reasons that the warrants were cheap. Japanese companies issued debt with warrants attached. The warrants traded actively in Switzerland, but the stock traded only in Japan. Many of these companies had done quite well, so their stock prices went up. Warrant owners wanted to exercise the warrants and take their profits. To do that, though, they would have to exercise the warrant in Switzerland, then sell the stock in Japan. It was easier to just sell the warrants in the Swiss market at a price that reflected the hassle of exercising them.

As the warrants were trading at less than their intrinsic value, an arbitrage firm might have bought the warrants and short sold the related stocks. The strategy could have worked in the United States, but it was difficult to borrow these small-cap Japanese stocks, and to short sell a stock that it doesn't own, a firm has to borrow it first.

LTCM came up with an exact solution. It bought a basket of small-cap stocks in the JASDAQ (Japanese Association of Securities Dealers Automated Quotations Index) with cheap associated warrants and shorted the JASDAQ futures contract. The hedge wasn't a perfect one, because LTCM's short position was on the whole index, and the basket was only a subset of Japanese stocks.

So LTCM made a total return stock swap with another bank. The bank paid LTCM the return on the basket of the other stocks in the JASDAQ and

LTCM paid the bank 30 basis points. The resulting trade had zero risk and essentially no profit or loss, apart from transaction costs and the 30 basis-point financing cost.

Then LTCM borrowed the Japanese stocks *from themselves* and shorted them while also buying the associated cheap warrants. This innovative financing scheme let LTCM borrow nonborrowable stocks and take advantage of an arbitrage opportunity. They called it *index art*.

LTCM's portfolio consisted mainly of fixed-income trades with a smaller fraction in equity-related trades.¹ The firm tended to group trades into two broad themes: *relative value* trades and *convergence* trades. Both types typically involved being long one security and short another security, so as to hedge out various risks. In both trade types, LTCM typically believed that it had identified one or more overvalued securities, which traders would short, and one or more undervalued securities, which traders would go long.

Convergence misvaluations were expected to correct themselves within a specified time frame. Relative value trade misvaluations might or might not correct themselves, and by no specific date.

For example, a convergence trade might involve buying bond A and selling bond B. Bond A was currently much cheaper than bond B. On a specific future date, however, a legal system change would give bond A the same characteristics—and the same trading price—as bond B.

In a situation where bonds A and B are very similar but bond A is cheaper, a relative value trade might involve buying bond A and selling bond B. The reasons that bond A is trading lower than bond B are expected to die out over time, but not by any particular, known date.

In addition to these bread-and-butter trades, LTCM also took *directional* bets, which are common among long-only portfolio managers. A trader might be long Russian bonds, thus taking a direct bet on the behavior of Russian interest rates.

Table 4.1 shows the majority of LTCM's August 1998 positions, which consisted of multiple trades under a general strategy. At that time the short U.S. swap spread, the European cross-swap trade, and the short volatility trade were by far LTCM's largest trades.

Many of these trades had both a liquid component and an illiquid component. (A liquid security is one that can easily be bought and sold near its last traded price, such as a Treasury bond. An illiquid security is one that might be hard to buy or sell; its purchase price may move significantly from the last quoted price.)

TABLE 4.1 The LTCM Portfolio in August 1998

Trade	Name	Trade Type	Profitable When: ^a
Interest Rate Related Trades			
1.	U.S. Short Swap	C	U.S. Swap spread narrows.
2.	Euro Cross Swap	C	Euro Swap spread minus UK swap spread to increase.
3.	Long U.S. Mortgages	RV	Mortgage spread narrows or remains constant.
4.	Swap Curve Japan	RV	10-year swap spread minus 7-year swap to decrease.
5.	Italian Swap Spread	C	Italian swap spread narrows.
6.	Fixed-Income Vol.	RV	Long-term volatility rises relative to short-term volatility.
7.	On-the-Run	C	On-the-run bonds cheapen versus off-the-run bonds.
Equity Related Trades			
8.	Short Equity Vol.	RV	Long-term volatility rises relative to short-term volatility.
9.	Risk Arb Portfolio	C	Company merger deals complete.
10.	Equity Rel. Value	C	Mispriced securities converge.
Directional			
11.	Emerging Market	D	Interest rates on Brazilian C bonds and Russian Euro bonds decline.
12.	Other	D	Included short some high-tech stocks, closed-end fund strategies, convertible and preferred strategies, currency trades, index arbitrage, high-yield, index inclusion trades, and yield curve trades.

Note: LTCM positions as of August 1998. Data obtained from a combination of Perold (2000) and conversations with former LTCM partners. The largest trades are in bold. C represents convergence trades, RV represents relative value trades, and D represents directional trades.

^aMany trades made money if the respective instruments' relative values did not change.

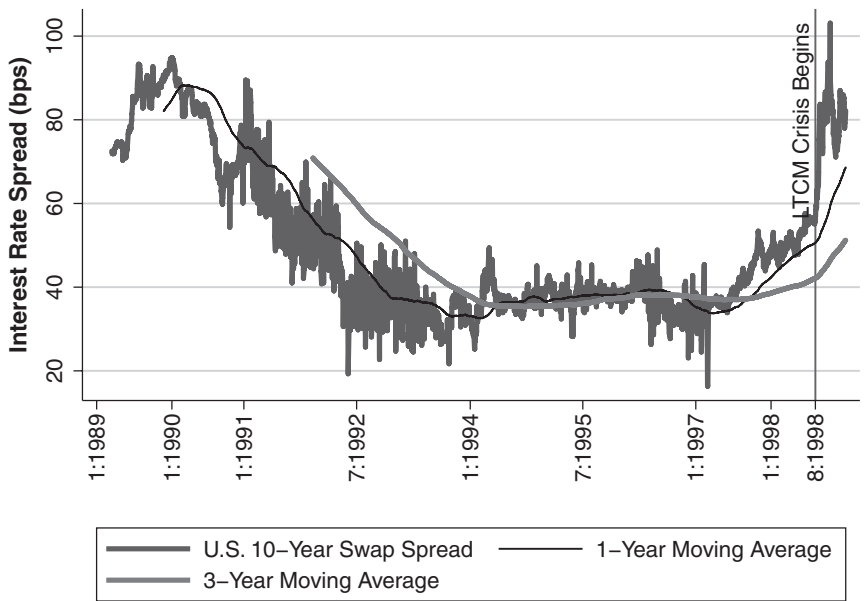
The Short U.S. Swap Trade

LTCM traders made many swap trades during the firm's lifetime. A plain vanilla interest-rate swap is a basic transaction in which one party agrees to pay a floating interest rate to another party over a specific time period, and the other party agrees to pay a fixed interest rate over the same specific time period.

Of course, LTCM traders didn't use the vanilla version. They made money on the swap spread: the difference between a swap interest yield that represents the cost of borrowing between banks, and the government bond yield, which is the government's cost of borrowing.

This spread varies over time depending on the economic climate, the types of investors in the marketplace, and various investment cycles. Figure 4.1 shows the 10-year swap spread in the United States since 1991. This represents the difference in yield between 10-year swaps and 10-year U.S. treasury bonds. The figure also shows the spread's 3-year and 1-year moving averages.

FIGURE 4.1 The Historical Behavior of U.S. 10-Year Swap Spread



Source: Bloomberg.

LTCM typically used swap trades at various maturities, from 1-year all the way to 30-year maturity, and might be long or short the swap spread at any given time, depending on their models and other motivations. (A long swap trade profits when swap spreads widen; a short swap spread trade profits when swap spreads narrow.²) LTCM partners referred to a long swap spread as a view that swaps are expensive relative to treasuries. A short swap spread, by contrast, is often considered a view that swaps are cheap versus treasuries.

Depending on marketplace interest rates, a swap spread trade can offer attractive returns.

A bond portfolio manager might look at a swap spread of 50 basis points, expect that it will widen further, and so go long the swap spread. LTCM typically looked at LIBOR versus repo before making that trade, and might have avoided it if the expected financing gains were too small compared with the spread.³ (A repo transaction is collateralized lending: One party lends cash to another party in exchange for a bond. The repo rate is the interest rate LTCM paid on the cash it borrowed in exchange for a bond offered to a counterparty as collateral. LIBOR is an acronym for the London Interbank Offer Rate. This is the interest rate that LTCM received on the swap in a long swap spread transaction.) If the spread between received LIBOR and paid-out repo stays wide, the trade is more profitable, even if the swap spread moves against the position.

LTCM traders considered how they thought the LIBOR-repo spread would evolve over time, as this would create future financing terms. If the LIBOR traded above repo and LTCM believed that this would continue into the foreseeable future, then going long the swap spread looked favorable on a financing basis.

Next, LTCM asked why the swap spread was at its current level and what it expected the spread to do in the near future. Swaps were marked to market daily, so if the trade moved against LTCM, traders could hold it until convergence as long as they could pay the daily margin calls.

If the swap spread remained steady throughout the life of the trade, LTCM made the positive carry (the difference between LIBOR and repo). If the swap spread widened over the trade's life, LTCM made the spread plus the gains from the widening. If the spread narrowed, LTCM made the positive carry, but lost on the spread on a mark-to-market basis. But if LTCM could hold the trade until maturity, the final profit and loss would be related to the financing carry. These were the basics of the long swap spread trade.

The short swap spread trade's return is approximately equal to the spread, minus financing, minus the spread change. Typically the swap spread is positive and the financing involves paying LIBOR and receiving the reverse repo

rate. Because the reverse repo rate is usually less than LIBOR, short swap spread financing is typically negative. The spread change can be negative or positive, depending on what actually happens to the spread over time.⁴ If the swap spread widens, the short swap spread trade loses. If the swap spread narrows, the swap spread trade gains. Suppose the initial swap spread was 17 basis points and that repo minus LIBOR was -20 basis points. The trade would have what LTCM called negative carry: Regardless of the spread change, spread minus financing equals -3 basis points. If nothing happens, the trade loses 3 basis points per year.

If the swap spread narrowed, as traders expected, then LTCM could unwind the trade at a profit. If the spread did not change, LTCM would lose the small negative carry amount, multiplied over time.

The trade carried two risks. First, if LIBOR rose dramatically over repo, then trade financing would become more expensive, costing more than 3 basis points per year. Second, if the swap spread widened, rather than narrowed, LTCM's two-way mark-to-market would force the firm to supply additional cash to one side of the transaction. With sufficient capital, however, they could hold the trade until the spread became favorable again, until they could no longer bear the losses, or until maturity.⁵ In theory, this trade cost LTCM just the interim financing plus the initial spread, but it required the firm to hold the position until maturity. If the swap spread widened by a large amount and the company could not continue financing the trade, LTCM would lose a lot.

As an example, consider a one-year short swap spread trade, a swap with one year-end payment, a one-year repo, and a shorted one-year Treasury bond. The swap spread could widen enormously in that year. If LTCM could make all the mark-to-market margin calls, however, then by year's end it would have paid just the initial swap spread and the financing cost. In this example, the firm would lose 3 basis points.

This was the reason that LTCM tried to structure swap spread trades with *term repos*. Typical repo transactions are done overnight and are rolled over every day, by mutual counterparty consent. LTCM knew that its business relied on convergence and wanted to minimize financing problems caused by adverse circumstances, so it secured long-term financing. Ideally, it would have wanted to finance for a maturity close to that of its trades, but this was not available in the marketplace. Instead, the firm contracted term repos of three and six months, far longer than the norm.

LTCM generally had two-way mark-to-market on this trade, so that if rising interest rates forced the firm to put cash into the swap half of the trade, LTCM would receive this cash from the repo side of the trade (provided repo

rates also went up). The company's only cash flow exposure was to the swap spread movements. With counterparties typically requiring zero haircuts, this trade usually required no cash outlay, making it even more attractive than it would be to a typical bond manager.

LTCM used both long and short swap spread trades. The long swap trade was better in several ways. It usually had positive carry, and its worst-case scenario was one in which swap rates converged to treasury rates. A short swap trade was more risky. It typically had a negative carry and, in theory, its spread could widen indefinitely. LTCM began August 1998 with a large position in short U.S. swap spreads.

Did this trade make sense in August 1998? Figure 4.1 shows the 10-year swap spread in the U.S. bond market.

By January 1, 1998, the 10-year swap spread had widened to 55 basis points, higher than the 3-year average of 42 basis points and the 1-year average of 46 basis points.⁶ It made some sense to short the swap spread, but the trade wasn't wildly attractive, particularly given its negative financing.⁷

By August 4, 1998, the spread was 65.8 basis points. Since 1991, only five other days had a spread greater than this: 67 basis points on May 30, 1991; 68 basis points on June 28, 1991; 71 basis points on November 7, 1991; 68 basis points on December 31, 1991; and 68 basis points on January 1, 1992. LTCM likely thought that the spread would narrow, as it had in the past.

That didn't happen. On September 18, 1998, the 10-year spread was at 97 basis points.⁸

This short swap trade caused LTCM large losses. In noncrisis circumstances, this may have been a good trade, depending on the spread and expected LIBOR-repo evolution. During crises, however, markets clamor for liquidity, and this is generally not a good trade.

The European Cross-Country Swap Trade (Short UK and Long Europe)

In 1998, LTCM believed that European swap spreads were too narrow, compared with United Kingdom swap spreads. The firm wanted a position that would let it profit from this view. It accomplished this with a combination of swap spread trades in different currencies.

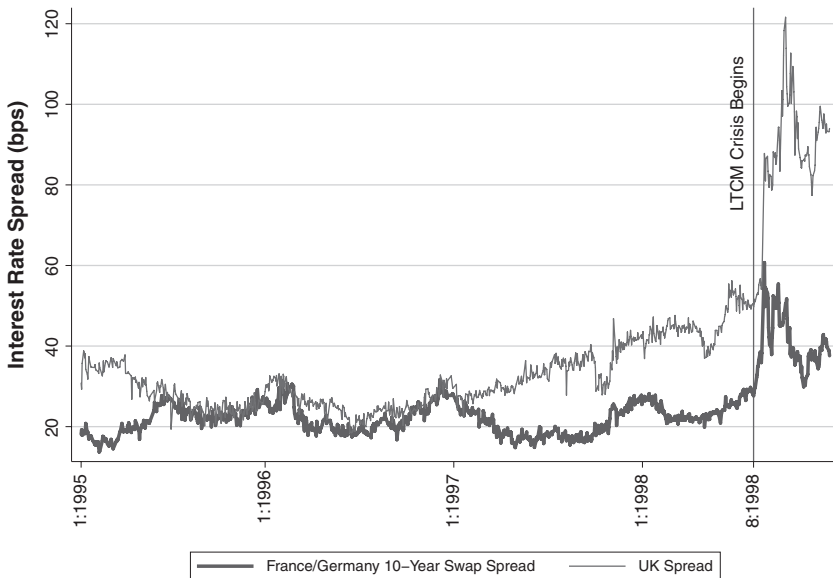
LTCM constructed a position short UK swap spreads and long both German and French swap spreads. The trade made money if the difference between UK spreads and European spreads narrowed. The key was the relative value, not the swap spreads' overall direction.

The company used both economic logic and statistical analysis to choose this trade. In 1998, the single European currency was coming around the corner. Bond market prices reflected market optimism about the change, and UK spreads had widened quite a bit relative to European swap spreads. LTCM believed that the relative movement was overdone.

In early 1998, the UK swap spreads traded around 48 basis points; a combination of German and French spreads traded at about 23 basis points, a difference of 25 basis points (see Figure 4.2). By the beginning of August 1998, the spread was still high at 23 basis points. Since 1995 the average spread had been 10 basis points and the spread's daily standard deviation had been 8 basis points. The spread had reached its largest value prior to 1998—24 basis points—on September 4, 1997. The spread's short history indicated that it was trading at its high end, and that combined with LTCM's views about the Euro to persuade them of the trade's merits.

The Russian crisis, when Russia defaulted on its debt and devalued its currency, had a disproportionate effect on the UK spreads. By October 5, 1998, the spread was 71 basis points. LTCM's large position took enormous losses.

FIGURE 4.2 The Historical Behavior of the 10-Year UK Swap Spread versus the Europe Swap Spread



Source: Bloomberg.

Long U.S. Mortgage Securities Hedged

For relative-value hedge funds, trading a collateral-backed bond versus a Treasury bond is a staple trade. A collateral-backed bond is any bond that has underlying collateral supporting its payment: a mortgage, credit card, or automobile, for example.

LTCM typically used mortgage-backed securities. The firm would go long on mortgage securities such as bonds issued by Freddie (FHLMC), Fannie (FNMA), or Ginnie (GNMA) or a bond backed by a pool of mortgages.⁹ LTCM hedged the interest rate risk by shorting some other security, such as Treasuries or swaps.¹⁰

The trade was essentially a short spread trade but with a spread equaling the mortgage yield minus either the government yield or the swap yield. LTCM was typically short this spread trade because a pool of mortgage bonds typically has a higher yield than do either LIBOR or Treasury bonds. That gave traders a positive yield pickup for an instrument that was in effect backed by the U.S. government.¹¹

Mortgage-backed securities have higher yields than other securities for several reasons. They offer a premium to investors who take on credit risk. The underlying mortgage borrowers may default on their loans and cause losses for the mortgage-backed security's owner.

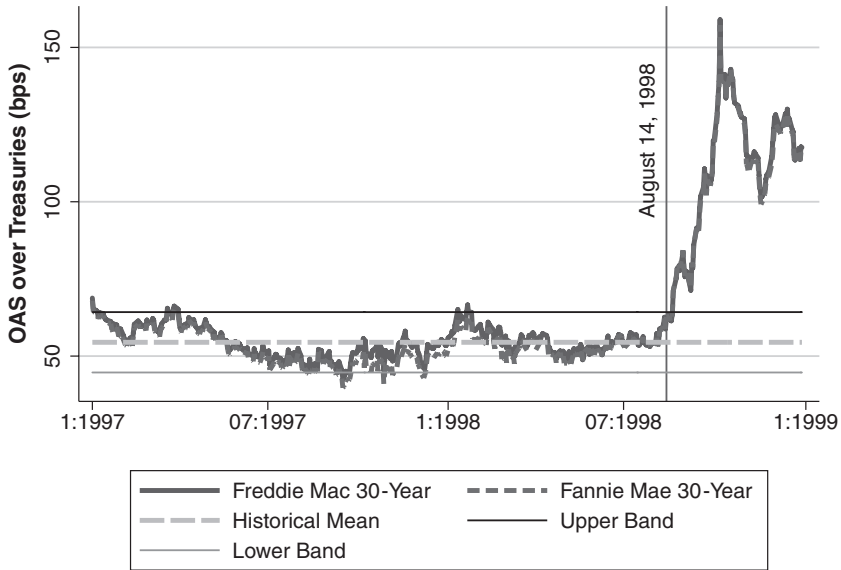
These yields are also higher because the bond can be prepaid, particularly when interest rates decline and many home owners refinance their mortgages. In that situation, an investor receives less than the bond's true price appreciation.¹²

LTCM used proprietary prepayment models to adjust mortgage pool yields to account for estimated prepayment risk. The remaining spread is known as the option-adjusted spread, or OAS. LTCM determined whether the bonds were cheap or expensive after considering them on an option-adjusted basis.

LTCM regularly traded this spread from 1994 to 1998, because these trades, even after adjusting for prepayment, were quite attractive. Figure 4.3 shows the Freddie Mac 30-year and Fannie Mae 30-year mortgage spreads over Treasury yields. The two yields are virtually the same because the companies are offering essentially the same product.

From June 1996 to August 1998, the average spread was 55 basis points with a standard deviation of 5 basis points, making this trade very attractive. As long as yields stayed constant, a trader could make 55 basis points with very low risk, as the Freddie and Fannie mortgage pools were both very secure

FIGURE 4.3 The Option-Adjusted Spread of Freddie Mac and Fannie Mae Mortgages over Treasuries by Maturity



Note: Upper and Lower represent the two standard deviation bands.

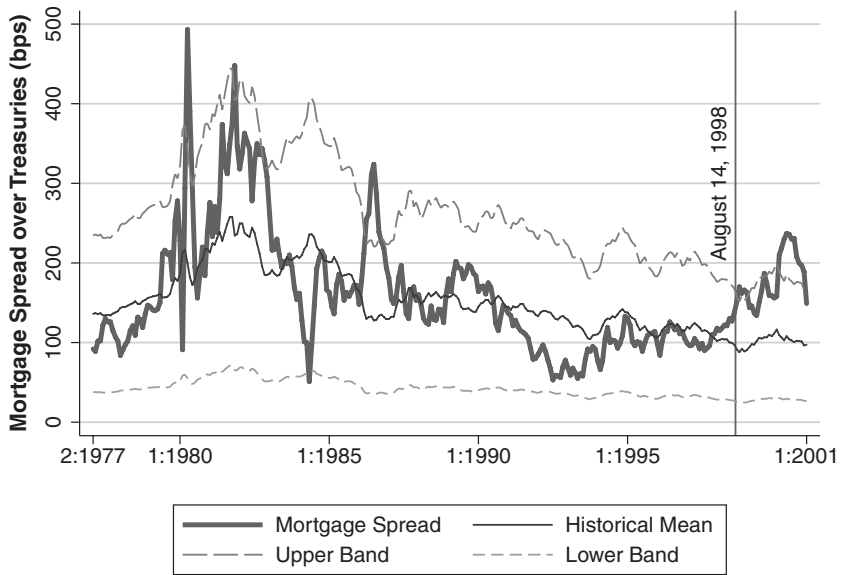
Source: Bloomberg.

and implicitly backed by the U.S. government.¹³ If the spread declined, traders made an even larger return. LTCM might close out the position and realize the profit immediately or even take the opposite position and go long the spread.

By August 1998, the spread was at 55 basis points, around its two-year historical average. Its highest two-year point was 69 basis points and the typical movement was 5 basis points. LTCM held a short spread position, looking forward to an attractive profit with very little risk. LTCM's financing arrangements were such that, even if the spread widened a little, the trade would eventually make money if the company held onto it.

Unfortunately, a mortgage-market tsunami struck in August and September 1998, and LTCM suffered tremendously on this trade. By August 31, 1998, the spread had moved to 84 basis points. On September 22, the spread was at 111 basis points.

How did this happen? Did LTCM rely on too short a horizon to measure trade risk? Or were these highly unusual mortgage spread jumps? Often

FIGURE 4.4 The 30-Year Mortgage Rate Minus 30-Year Treasury Rate

Source: Federal Reserve.

financial innovations don't offer a long history with which to measure risk. This was the case with OAS spreads.

To get a better sense of how mortgage spreads behaved over time, compare 30-year conventional mortgage rates to 30-year constant maturity Treasury bills from 1977 forward. The juxtaposition shows that, from the middle of July 1998 to the end of December 1999, the monthly mortgage spread rose by two standard deviations. (See Figure 4.4.)¹⁴

According to this longer-term measure, the spread increase was large, but not as large as it seemed when compared against a shorter horizon.¹⁵

The Box Spread in Japan

LTCM's models indicated that the three-year swap spread seven years forward in Japan was too high. Traders constructed a position that reflected their prediction that the 10-year swap spreads would tighten versus the 7-year swap spreads.¹⁶

The overall trade was hedged against general interest-rate movements and focused on taking the specific relative value bet—the change in the

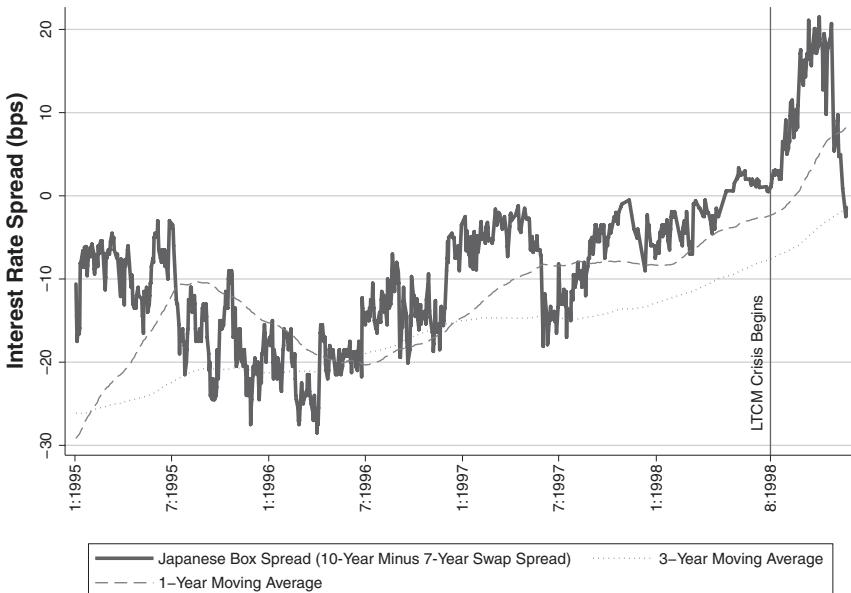
relative swap spreads—that interested LTCM. In relative value lingo, this trade was known as being short the box spread.¹⁷ The trade can be accomplished by going short the 10-year swap spread and going long the 7-year swap spread. Or one could do the opposite, known as being long the box spread.¹⁸

Figure 4.5 is a graph of the 10-year Japanese swap spread minus the 7-year Japanese swap spread. It shows that the 10-year spread increased significantly versus the 7-year spread from July 1997 to July 1998, and was also higher than both the 1-year and 3-year moving averages. To LTCM, this spread looked rich. For this and other reasons, they shorted the box, making a trade that would make money if the spread decreased.

The major risk of this trade was that the relative spread of the 10-year minus the 7-year could widen, rather than narrowing or remaining constant. Even if the spread remained constant, this trade had positive carry.

In August and September 1998, this trade went against LTCM—just like all the others. The spread was around 1 basis point on July 28, 1998. By September 30, it was out to 18 basis points.

FIGURE 4.5 The Historical Behavior of the 10-Year Swap Spread Minus the 7-Year Swap Spread in Japan



Source: Bloomberg.

The Italian Swap Spread

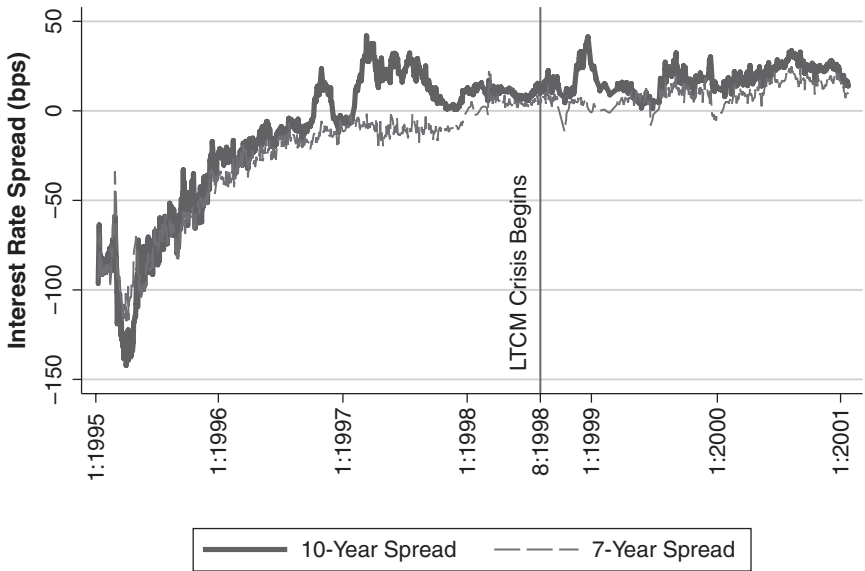
The Italian bond market has always differed a little from most fixed-income markets. The long end of the Italian yield curve often trades at odds with conventional pricing.

Swap yields are usually higher than government bond yields, because investors require compensation for taking the credit risk associated with swaps. In the 1990s, Italian swap yields were lower than Italian government bond yields, also known as Buoni del Tesoro Poliennali or BTPs (see Figure 4.6).

There were some logical reasons for this. The long end of the Italian market was not as actively traded as is the U.S. debt market, so its pricing was less efficient than that of both the U.S. long bond market and the Italian swap market. Investors expected to be paid for taking on political risk. Italy has always carried a large debt, and there is some uncertainty about its interest rate payments.

Perhaps most importantly, Italy levied a 12.5% withholding tax on foreign owners of Italian bonds. Owners could recover the withholding tax by filing

FIGURE 4.6 The Historical Behavior of the 10-Year Italian Swap Spread



Source: Bloomberg.

the right forms, but many institutions found this a hassle and didn't bother. That left friction in the marketplace.

LTCM constructed an institutional arrangement that let the firm go short the swap spread. The trade offered a constant income stream from the higher yield on Italian bonds. As this anomalous spread converged, traders would turn a profit on the converging spread. It was a beautiful trade that other firms had also discovered.

The Italian government announced in March 1995 that it would suspend this withholding tax. The trade converged. In 1997, the tax was eliminated and the market has traded more or less normally since then.

It was one of our biggest trades in the early 1990s. We weren't the only ones doing this, virtually everyone was doing this trade. By 1998, our positions in this trade were small.

—Interview with Eric Rosenfeld, October 4, 2011

LTCM's Italian tango didn't end after the lucrative tax arbitrage trade. Even in 1997, the Italian 7-year maturity bonds were still trading at a discount to the swap. In the 3-month area of the curve, Italian swaps were trading much higher than short-term Italian government bonds (BOT or Buoni Ordinari del Tesoro). LTCM believed that, with time, this anomaly would also disappear as the Euro replaced the lira in 1999 and as Italian capital markets grew more efficient.

Reflecting this belief, LTCM entered into a short swap spread trade, one that was slightly more complicated than a typical swap spread trade. The firm entered into an OTC swap contract with a counterparty in which both parties paid each other a floating interest rate, which varied according to market conditions. LTCM paid the counterparty LIBOR and the counterparty paid LTCM the Italian government yield plus 40 basis points.¹⁹

If the spread tightened over time, LTCM would make money. It could also unwind the swap transaction and realize an immediate profit.

Suppose LTCM initiated the swap contract on January 22, 1998. On this date the spread was around 40 basis points. The 3-month LIBOR was 6.08% and the 3-month BOT was 5.68%.

According to the swap agreement, LTCM paid the counterparty the current LIBOR rate and the counterparty paid LTCM the Italian bond rate plus 40 basis points. At the beginning date, the trade had a net value of zero, because LTCM paid and received the same interest.

Now suppose that over time, as LTCM expected, the LIBOR-BOT spread narrowed. LTCM would receive more than it paid in interest. LTCM could

then hold on to the agreement and receive an ongoing income stream, or close out the position by entering another swap that would lock in all the discounted profits.

In fact, by July 10, 1998, the spread had decreased to -2.5 basis points. LIBOR was 4.875% and the BOT yield was 4.9%. LTCM received an interest payment of 5.30% (the government yield of 4.90 plus 40 basis points) and paid a yield of 4.875% (LIBOR). The firm made a net gain of 42.5 basis points on the trade at every payment date.²⁰

In 1998, these were not large trades in the LTCM portfolio. It does, however, illustrate LTCM trades that used practical financing techniques to provide liquidity to a rather perplexing inefficiency, while simultaneously bringing the firm substantial profits.

Fixed-Income Volatility Trades

A volatility trade bets on how volatile an asset's returns will be. The bet can be a simple one, based on a belief that the volatility will be higher in the future than the market believes, or that it will be lower in the future than the market believes. It could also combine views about relative volatilities. Appropriate trade construction often involves sophisticated financial engineering to remove unwanted bets. In the late 1990s, financial products that bet solely on long-term volatility didn't yet exist. Instead, LTCM traders constructed deals that took a net view on volatility while eliminating other risks.

In order to understand LTCM's volatility trades, some option theory review is helpful. An option gives a holder the right to buy or sell a security at a set price within a given time period. Call options give the holder the right to buy a security at a given price, while put options give the holder the right to sell a security at a given price. For example, suppose you wish to buy a call option on the S&P 500. There are many ways to buy this option and many types of call options to buy. You could buy the option through your brokerage, from an options exchange such as the Chicago Board Option Exchange, or from a bank.

If the S&P 500 is at 1,000 and you buy a call option to buy it at 1,000 with two years to expiration, you have two years to decide whether to buy the S&P 500 at 1,000. Clearly you will do this at some point if the S&P 500 trades above 1,000. A put option works in reverse.

A security option's price is related to many things: the price at which you can buy the security (also known as the strike price), the time you have to decide whether to use the option (also known as time to maturity), the

volatility of the security's returns, prevailing interest rates, and the underlying security price. Both call and put options cost more when volatility is higher or time to maturity is higher. A lower strike price, a higher underlying security price, and a higher interest rate cause call options to be more costly. The reverse is true of put options.

Security price volatility is the important link for this trade. A call and put option give the holder the right to buy or sell a security at a given price, so the higher the security's volatility, the greater the chance that the security's price may move above or below the strike price, letting the investor make a profit. That's why higher volatility means a higher option price. With a formula that relates an option's price to the underlying security's volatility, a trader could convert the option's price into a volatility consistent with that price. This is called *implied volatility*. The Black-Scholes formula, discovered in 1973, is most commonly used for this purpose. It is named after one of LTCM's principals, Myron Scholes, and the late Goldman Sachs partner Fischer Black.

LTCM made volatility trades in both fixed income and equities. In the fixed-income arena, they noticed in 1998 that the implied volatility of 5-year options (i.e., options with five years to maturity) on German-denominated swaps was trading much lower than actual realized volatility. Option prices were trading with an implied volatility of 3 basis points per day, while the realized volatility in the marketplace was closer to 5 basis points. These were essentially options on German interest rates, and the market's volatility assessment was out of step with actual movements in German interest rates.²¹

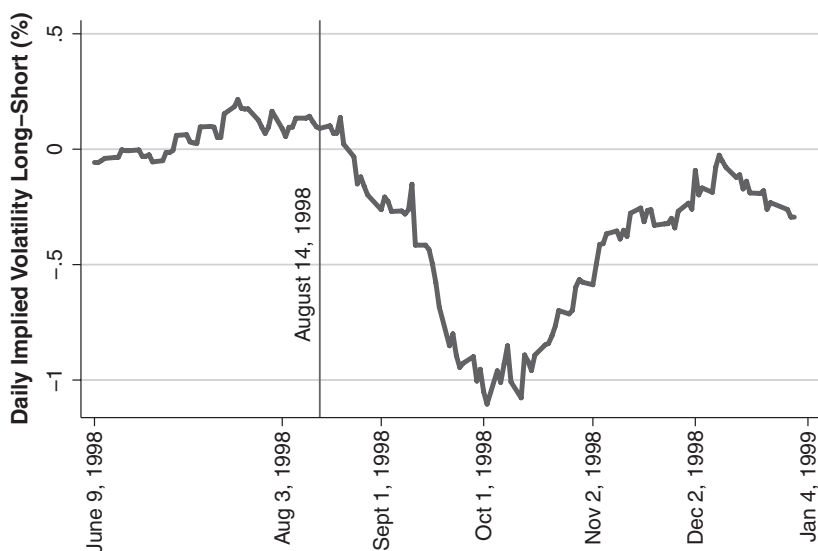
LTCM wanted to go long on volatility at the 5-year mark. Traders hedged the position for interest rate risk, using interest-rate swaps and other short-term options. In other words, LTCM used additional financial instruments to remove all the risk the firm didn't want, including risk associated with interest rates going up or down. The company wanted to focus its bet.

To execute this trade, one might buy 5-year call options on 10-year swaps in Deutschemarks and sell 1-year call options on 10-year swaps in the right proportion to hedge away unwanted risks, such as risks from overall interest rate movements.

Figure 4.7 graphs the difference between the implied volatility of 5-year options and 1-year options. When this went up, LTCM made money. When this went down, LTCM lost money.

Around June 1998, the implied volatilities of short-term and long-term options were about the same. Then, as LTCM predicted, the implied volatility on the 5-year increased, making LTCM profits. Then came the Russian crisis,

FIGURE 4.7 The Difference between Implied Volatility on 5-Year Options and 1-Year Options on 10-Year Euro Swap Rates



Source: Goldman Sachs.

when Russia defaulted on its debt. The volatility spread crashed and took LTCM's position along with it. The same volatility spread collapse took place in the 2008 crash. In market crises, the short-term volatility of fixed-income instruments typically rises much faster than does longer-term volatility.

The On-the-Run and Off-the-Run Trade

One of the most fascinating trades LTCM made is now commonly known as the on-the-run/off-the-run trade. This trade depends on institutional bias and the Treasury bonds' regular auction cycle. LTCM used this trade in a variety of countries and with bonds of various maturities, but the concept always remained the same.

To understand this trade, it's helpful to know a little about institutional behavior. The U.S. government constantly sells debt to finance U.S. operations.²² The U.S. government issues debt of varying maturities, from one month to 30 years.

Auction schedules for these securities vary by security type and government needs. For example, the one-month Treasury bill is auctioned every

week, so every week there is a brand new one-month Treasury bill. The 30-year bond is auctioned less frequently. In the 1990s, the 30-year bond was issued about twice per year. In recent times, however, the 30-year bond has been issued every month.

Traders call a newly issued government bond an on-the-run (OTR) bond. Other, less recently issued bonds are called off-the-run (OFR) bonds.

Many fixed-income mutual fund managers, traders, and other market participants prefer to hold the latest issued government security. The latest issues are usually benchmark bonds in many indices, and many mutual fund managers rebalance their portfolios by selling OFR bonds and buying OTR bonds. Partly because of this, OTR bonds are the most heavily traded bonds of a particular maturity.

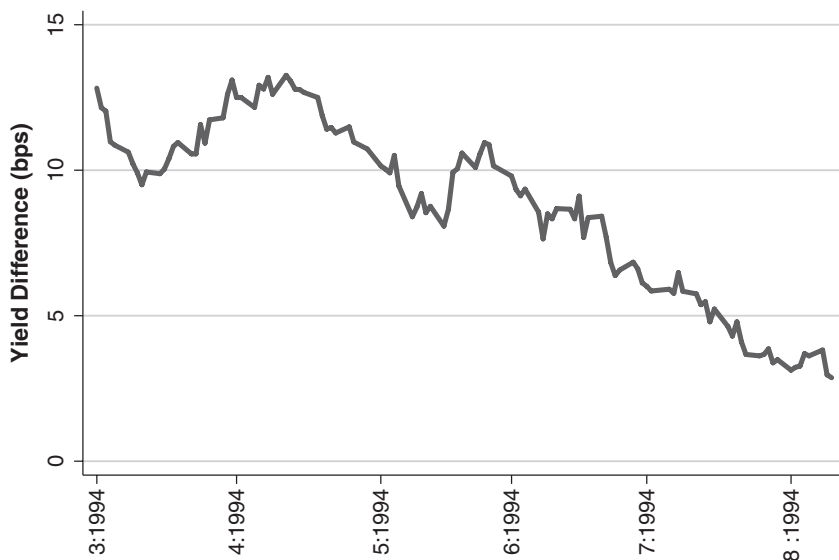
As a result, very closely related OTR and OFR bonds have different yields. Suppose the U.S. government issued a 30-year bond six months ago and now issues a new 30-year bond. One bond is a $29\frac{1}{2}$ -year bond and the other is a 30-year bond, but they are the same kind of instrument. Yet the 30-year bond will trade at a lower yield than the $29\frac{1}{2}$ -year bond. Higher demand for the OTR bond pushes its price slightly higher and its yield slightly lower.

LTCM saw this as another classic opportunity to profit from an inefficient space, one created by institutional and other constraints. LTCM would purchase the cheap OFR bond, and short sell the expensive OTR bond, and wait for the normal business pattern to continue. When a new 30-year bond appeared in six months, the previous 30-year bond would become OFR, the liquidity premium would disappear, and LTCM would make a profit.

LTCM financed this trade using as little capital as possible. That made the trade more efficient and profitable.²³

The minute they put this trade on, it gave LTCM two profit sources. In the 1990s, OFR bonds typically had higher interest payments than OTR bonds, giving LTCM a net positive yield. As time passed, the two bonds' prices converged until, by the time a new OTR bond was issued, they traded at roughly the same price.

See an example of one of these trades in Figure 4.8. The figure shows the difference between the yields of an OFR and an OTR U.S. Treasury bond. LTCM bought the OFR bond issued on May 17, 1993 and sold the OTR bond issued on February 10, 1994.²⁴ Initially, the OFR bond's yield was 12.82 basis points higher than the OTR's yield. Six months after issuance, however, the yield difference between the old 30-year bond and the new 30-year bond

FIGURE 4.8 The On-the-Run, Off-the-Run Typical Convergence

Note: 02/15/23 Maturity Yield Minus 08/15/23 Maturity Yield.

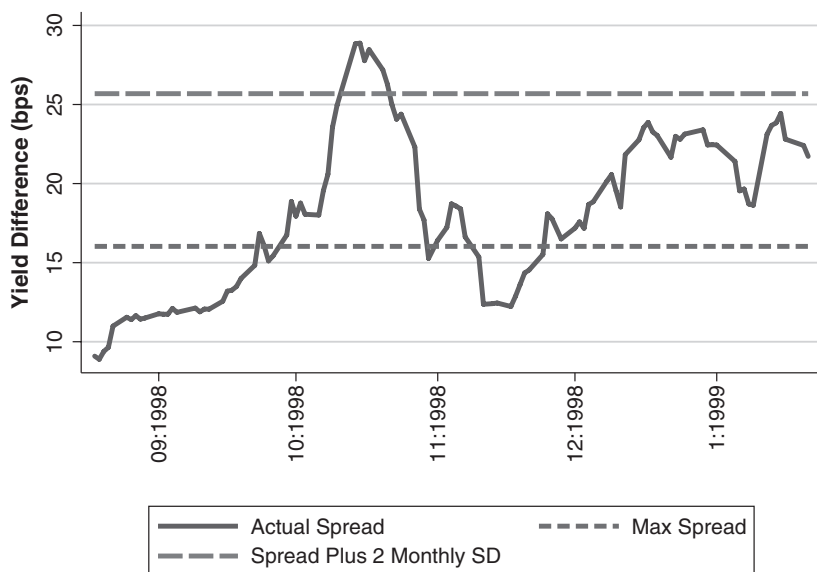
converged to 2.87 basis points. At about that time another new 30-year bond was issued, on August 11, 1994.

This yield convergence meant price convergence and a profit for LTCM. The same pattern occurred continuously until 1998, with this trade forming a stable, income-producing part of LTCM's portfolio. But once again a reasonable trade with solid history began performing erratically in August and September 1998 (see Figure 4.9).

In earlier years the spread had never been higher than 15.72 basis points. Yet by October 17, 1998, the spread was as high as 28.5 basis points—81% higher than any prior peak.²⁵

This was a very unusual move in the spread and, more importantly, just the opposite of what valuation would suggest for two bonds that are almost exactly the same instruments.

The spread's extreme movement forced the shorted bonds' prices up and the long bonds' prices down, giving LTCM a mark-to-market loss on the trade. A trade that had never risen more than 4 basis points from its starting position had risen by four times this amount. This meant huge losses for LTCM. By November 1998 the spread had recovered, perhaps because the copycats and crowds had settled down. It was too late. LTCM had been roasted.²⁶

FIGURE 4.9 The On-the-Run, Off-the-Run Trade Explodes

Note: 11/17/27 Maturity Yield Minus 08/15/28 Maturity Yield.

Short Longer-Term Equity Index Volatility

Though LTCM concentrated mainly on fixed income, they also had a collection of equity trades. Within this area, LTCM used its knowledge of option pricing theory and experience in financial market mechanics to find opportunities, using ideas similar to those they used to find fixed-income volatility trades.

In the equity markets, there are many call and put options that have a maturity of two years or less. Longer-term options, however, are really only available over the counter (OTC), which requires calling an investment bank and asking for a quote on a longer-dated option. The longer-term option market is much less liquid. Traders tend to quote options based on implied volatility, just as in the fixed-income markets. In general, options cost more when market participants believe that future volatility will be higher.

For example, if S&P 500 returns become more volatile or have a higher standard deviation, then an option to buy (call option) or sell (put option) the S&P 500 becomes more valuable, because there is a greater chance that the holder can take advantage of a beneficial price movement.

In 1998, LTCM's pricing models showed that long-term equity options were trading at very high implied volatilities. In other words, banks were charging very high prices for longer-maturity options, relative to short-term options.

LTCM believed that this was due to investor demand for long-term insurance protection and a low supply of these options in the marketplace. At the time, many retail investors demanded longer-term insurance protection for their investment portfolios, and thus drove up prices.

LTCM traders had many ways to take advantage of their view. Overall, they tried to sell expensive long-term options and then dynamically hedge the unwanted risk with futures and short-term options. In option lingo, they wanted to be delta-neutral: focused only on the idea that equity index volatility would be lower than the level market prices implied, with no exposure to equity market price shifts. If volatility turned out to be lower than implied during the five years after the option changed hands, LTCM made a good profit.

LTCM sold options that were priced as if volatility would be as high as 20% per year in the coming years. Historical data, however, suggested that volatility would be only 10 to 13%.

To focus their bet as precisely as possible, LTCM constructed straddles. A long straddle position consists of buying one call option and buying one put option. The position makes money if equity indices go up or down a lot.

LTCM traders took the other side of this position: They sold a call and sold a put option to another commercial bank. The firm was short the straddle. In option lingo, a short straddle position has a very high negative vega value.²⁷

Vega measures the movement in the position's value for a 1% change in volatility. If actual volatility turned out to be lower than the implied volatility of the selling price, LTCM made money over the next few years. But if volatility spiked up, the position would lose money.

This was a frequent trade for LTCM, one it began using in 1994. The firm might be long volatility or short volatility at any given time. In August 1998, LTCM was short volatility. If the major index return volatility remained close to historical averages, or even a bit above those averages, LTCM's positions would profit. They shorted these straddles on equities across the world, including the stock markets of the United States, Germany, France, and England.

LTCM's positions involved two risks. If volatility turned out to be higher than expected, the trade would lose over time. The trade also had an illiquid component. Though some of LTCM's hedging was in the very liquid short-term market, the firm was also short illiquid options that depended on the behavior of a small handful of counterparties. If these counterparties altered

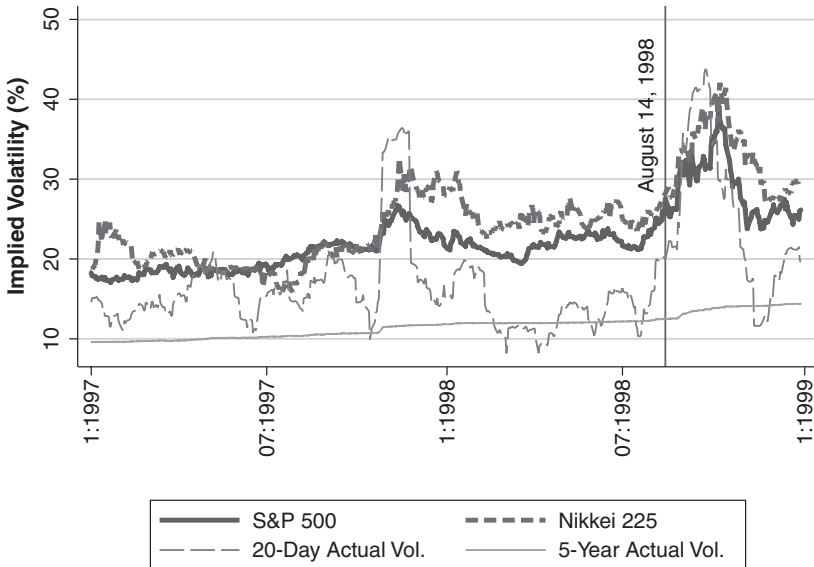
their behavior suddenly—asking for more collateral, for instance, or marking prices much higher against them—the market was not large enough for LTCM to seek alternatives.²⁸

LTCM's aggregate vega on these positions was about \$50 million. That implies that LTCM received an option premium of about \$1.01 billion for selling the straddle.²⁹ According to LTCM partners, they had a vega of \$25 million on the S&P 500 and another \$25 million vega shared in the European equity markets. LTCM's idea was good, but in August and September 1998 it was not practical.

Figure 4.10 plots the implied volatility (according to market prices) of 12-month options on the S&P 500 and the Nikkei, as well as the rolling 20-day and rolling 5-year historical volatility of the S&P 500.

It's clear that the Russian default and LTCM's crisis pushed both short-term actual volatility and one-year options' implied volatility sharply up. On August 3, 1998, the implied volatility on short-term options was 24%, 20-day historical volatility was 16%, and 5-year historical volatility was 12%. By August 31, these three numbers rose to 32%, 32%, and 13% respectively. By September 30, they rose to 34%, 35%, and 14% respectively.

FIGURE 4.10 The Implied Volatility of 12-Month Options on the S&P 500 and the Nikkei 225



Source: Goldman Sachs.

LTCM was short volatility—and volatility had shot through the roof.

But not all of LTCM's positions were in short-term options. The company had shorted long-term options with various counterparties. In most crises short-term option volatility rises much more than long-term volatility, but LTCM's options were being marked at volatilities around 45%. Why was this?

The overall market panic was partly responsible. Fear was high, and that was expressed in short-term volatility numbers. But why was long-term volatility even higher? The illiquid nature of this market was partly to blame, as was market interconnectedness. Other traders knew that LTCM was short volatility. As rumors spread that LTCM might be in trouble, counterparties worried that they would not get paid and marked volatility higher as a cushion. For every one percent volatility increase, LTCM lost \$50M. Dealers' long-term volatility marks on the trade went up 25% from where LTCM had sold it. This alone cost LTCM \$1,250 million (50 times 25) on a mark-to-market basis. When all was said and done, LTCM lost a total \$1,539 million on this trade. As one trader described it:

When it became apparent they were having difficulties, we thought that if they are going to default, we're going to be short a hell of a lot of volatility. So we'd rather be short at 40 than 30, right? So it was clearly in our interest to mark to as high a volatility as possible. That's why everybody pushed the volatility against them, which contributed to their demise in the end.

—Interview with trader, October 1999 (Dunbar 1999)

The short-term crisis had driven LTCM out of the marketplace. Had LTCM's trade been a rational one? Fast-forward to August 2003, five years after the LTCM crisis. The S&P 500's historical volatility turned out to be about 22%. The options that LTCM thought were cheap in 1998 were actually fairly priced. Even if LTCM had survived, the trade would not have made money for them, though their losses would have been much more manageable.³⁰ The 1998 risk models didn't include crowd interconnectedness or the price of liquidity during a crisis.

Risk Arbitrage Trades

Risk arbitrage, also known as merger arbitrage, is a trading strategy used by many hedge funds. In this strategy a trader invests in companies going through a merger, spinoff, acquisition, or similar event.

The most typical trade begins when two companies announce their merger (or similar event). Risk arbitrage attempts to profit from the merger's

completion or failure. Risk arbitrage funds may also take speculative positions in companies that traders think might be bought out or become the subject of a bidding war, but these transactions are the minority. The overwhelming majority of transactions involve trading on companies whose deals have already been publicly announced.

Stock deals and cash deals are the most common trades. In a stock deal, one company buys another in exchange for shares of the acquiring company. In a cash deal, the acquiring company pays cash for each share.³¹

For example, on September 15, 1999, Microsoft wanted to acquire the company Visio. For every share of Visio, MSFT offered to pay 0.45 shares of Microsoft stock. It was a friendly deal and Visio's CEO was happy with the offer. On the first day of trading after the announcement, Visio's price was \$39.875 per share; Microsoft's price was \$92.625 per share. If one believed that the merger would go through, Visio's price should have been \$41.6825 ($0.45 \cdot 92.625$). The price was below that. The difference between the merger price and the stock's actual trading price is called the *arb spread*. This arb spread was \$1.806.

The arb spread exists because there is always a chance that a deal will not go through as scheduled. Even if both companies are very enthusiastic about the merger, there is always a chance that the deal will be delayed, the price renegotiated, or the merger completely abandoned. A deal could take longer than estimated to consummate, tying up capital that could be earning interest. Or regulators could disapprove of the deal for antitrust reasons.

The more the market believes a deal will go through, the smaller the risk-arb spread. If the deal does break, relative prices usually fall to preannouncement levels, giving traders a large negative return.

Risk-arbitrage trades work like this. A trader buys a certain number of Visio shares. For every Visio share, the trader shorts 0.45 shares of Microsoft and waits until the merger is finally completed. If all goes well, the trade will make a \$1.806 profit per share traded. It's not a pure arbitrage because there is a risk that the deal will change or evaporate. It is a quasi-arbitrage.

LTCM created a portfolio of 30 to 40 of these trades. They were not LTCM's specialty, so the firm mainly focused on risk-arb trades with a very small discount—trades where the market thought the deal was very likely to close on time and so the target company's trading price was very close to the deal's actual offer price. LTCM preferred stock deals, which are generally considered less likely to break up.³²

Before the LTCM crisis, most of the market wasn't aware that LTCM was making risk arbitrage trades. When other hedge funds and the media found out, they criticized LTCM for venturing away from its core business.

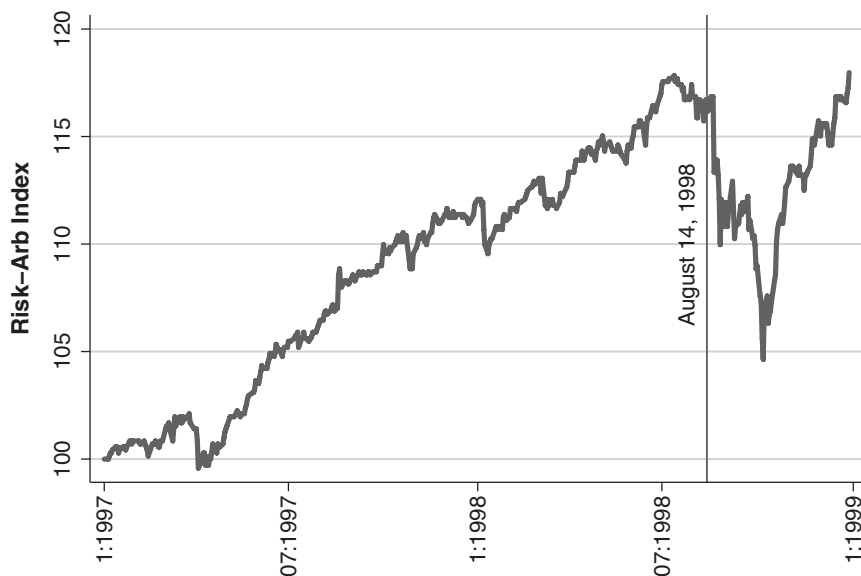
They specifically criticized LTCM for trading deals with very small arb spreads (deals with a high probability of success) because potential gains were so small compared to potential losses on an abandoned deal. LTCM was aware of these concerns and made risk-arb deals for two primary reasons.

First, LTCM was able to finance the trades with zero haircuts using total return stock swaps. Second, risk-arb strategies had a very low correlation with other typical LTCM trades. Choosing low-correlation trades was a central feature of the firm's risk-management system.

Figure 4.11 shows a risk arbitrage portfolio's performance.³³ The index depicts the performance on a \$100 initial investment from January 1997 to January 1999.

This portfolio did quite well throughout 1997 and most of 1998: up almost 18%. When Russia defaulted on its debt and the LTCM crisis began in August and September 1998, this strategy suffered as well. The strategy might seem to have nothing to do with either the Russian default or the LTCM crisis, yet from August 17, 1998, to October 8, 1998, it fell by 10%. Even this atypical portion of LTCM's portfolio performed horribly in the crisis.

FIGURE 4.11 A Diversified Risk Arbitrage Portfolio Index



Source: Bloomberg.

LTCM's losses in this space weren't due to inexperience. LTCM suffered in risk arbitrage, as did all experienced risk arbitrage traders in August and September. Most of them had a trade on the merger of Tellabs, Inc. and Ciena Corporation. On August 21, 1998, Tellabs announced that it might reduce or change its offer for Ciena. Ciena shares fell 45%. That's the equivalent of an atomic bomb in risk arbitrage. That failed deal alone cost LTCM \$160 million.

Equity Relative-Value Trades

Equity relative-value trades are another class of beautiful arbitrage possibilities. These trades work like this. A trader finds two securities that are very similar but are trading at different prices for some understandable reason. The trader buys the cheap security, short sells the expensive security, and waits for the two prices to converge. LTCM had a portfolio of these trades, as did many other hedge funds, including proprietary trading desks such as the Salomon Arb group.

A typical relative-value trade might involve companies whose operating assets were held by two distinct, publicly traded companies, each with equivalent economic claims on the operating assets: the same or similar voting rights, profit shares, and dividends. Many times one of the companies traded at a discount to the other company, even though it had the same value.

Traders worked to understand the discount motivation. Maybe one group of buyers bought one security in one country and another group bought it in another country, both for tax reasons. The investors' different objectives could create a price divergence.

If LTCM grasped the logic behind the divergence and thought prices would eventually converge, they put on the arbitrage.³⁴

In August 1998, LTCM had a very large position in an equity relative-value trade: the Royal Dutch-Shell trade. LTCM was not the only one with this trade. One Salomon arb trader at the time said, "Everyone had that trade on."³⁵

Royal Dutch Shell was a dual-listed company, based on an agreement between Royal Dutch and Shell to be independently incorporated in the Netherlands and England, respectively. In 1907, the companies merged their interests on a 60 to 40 basis while remaining separate, distinct entities. When the company assigns profits, they credit 60% to Royal Dutch and 40% to Shell. By that math, Royal Dutch should be worth 1.5 times as much as Shell.

If this isn't true, the market is not valuing these companies correctly. LTCM might react by going long the cheaper shares and going short the more expensive shares.

Traders would discuss reasons a price discrepancy might exist, as well as whether catalysts might bring the prices back in line. In this case, LTCM believed that different investor clienteles had caused the discrepancy. (U.S. pension funds received a full withholding tax refund on Royal Dutch, but not on Shell. UK taxable corporations received 80 percent of Shell dividends, but only 69 percent of Royal Dutch. LTCM thought that an April 1999 change in British corporation tax law would make Shell more attractive for many tax clienteles.)

There was also a possibility that the dual share class would be combined into one share class in the near future, pushing the two share prices to converge and making LTCM ever more eager to do this trade.³⁶

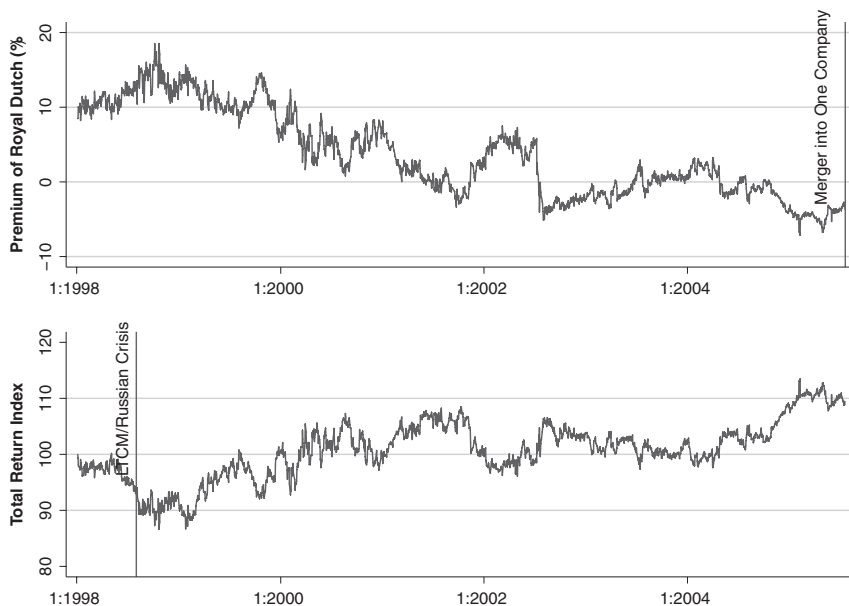
LTCM went long Shell and short Royal Dutch using a zero-haircut total-return swap.³⁷

This trade had some other advantages. Because Shell received the same dollar dividend for a much smaller share price, the trade had a dividend pickup. All else being equal, the swap favored being long Shell by about 35 basis points per year. However, the swap had a financing fee of 70 basis points per year. If the two share prices did not converge, LTCM would lose 35 basis points on this trade every year. And if the misvaluation increased, LTCM would also lose money on the swap payments.

The upper chart in Figure 4.12 shows the percentage premium of Royal Dutch over Shell.³⁸ At the beginning of 1998, Royal Dutch traded at a 10% premium to Shell. The market valued Royal Dutch 10% more than it should have, compared to Shell.

The bottom graph shows LTCM's position starting at 100 in January 1998. The position decreases throughout 1998 and also during the LTCM crisis. From January 2, 1998, to August 3, 1998, the Royal Dutch premium moved against LTCM, going from an overvaluation of 8.13% to an overvaluation of 12.84%. In August and September, things got worse. By September 8, 1998, the overvaluation was 16.03%. By September 8, LTCM had lost 11% on this trade. The trade would eventually go LTCM's way in the next few years, but it didn't in 1998.

LTCM was a long-term player, designed to wait out discrepancies, but market movements did not let it wait beyond 1998. Markets eventually became rational. If LTCM had waited, the trade would have yielded 10% as the stock price discrepancy disappeared.³⁹

FIGURE 4.12 The Royal Dutch-Shell Relative Value Trade

Source: CRSP.

On July 20, 2005, Royal Dutch and Shell merged into one company. Share values aligned almost perfectly, making the convergence trade successful for anyone able to hold the position long enough.⁴⁰

Emerging Market Trades

The majority of LTCM's trades were in fixed income, relative value, and convergence, but the company also had about 20% of its portfolio invested in directional bets. In addition to making equity arbitrage trades and combined on-the-run and off-the-run trades, which look for misvaluations and create trades hoping these misvaluations will be corrected, LTCM also took straight bets on interest rate direction, just like so many other portfolio managers.

For example, LTCM was long Brazilian C bonds, long-term Brazilian government bonds that were payable in U.S. dollars. They were created after the restructuring of Latin American debt in 1994, when the Brady Plan worked to help Latin American governments solve their debt crisis. LTCM's

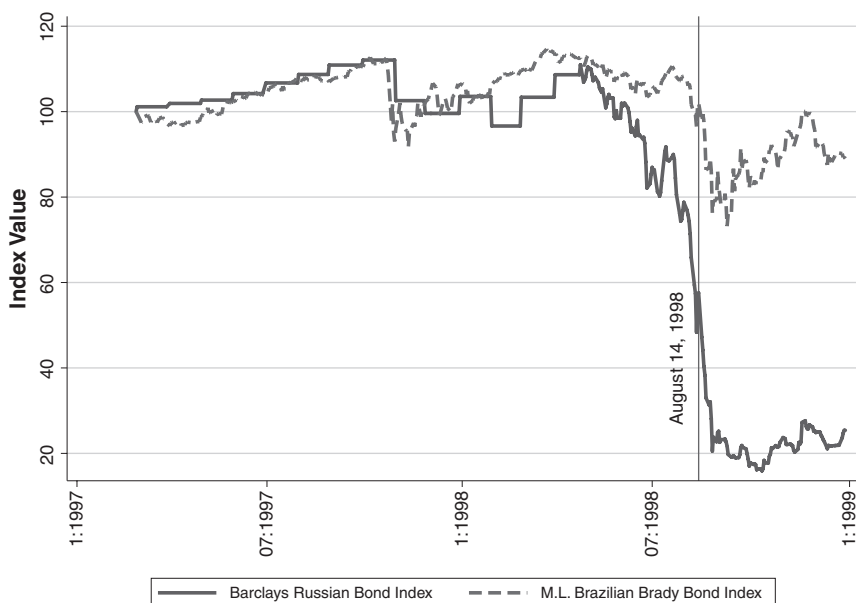
partner, David Mullins, had been a key figure in the administration that created the Brady Plan. Now his team was buying the resulting debt.

(Brazilian government debt is very different from U.S. government debt. It offers high yields, but also high risk. When markets crash, Brazilian debt behaves more like equity than fixed income and usually crashes very fast. Latin American countries have frequently defaulted on their debt, causing large losses on these bonds. For example, after Mexico devalued its currency in December 1994—the so-called Mexican Peso crisis—Brazilian C bonds dropped by 50%.)

LTCM also bought Russian government bonds denominated in Euros. Emerging economies had a history of devaluing their currencies. Debt payable in dollars or Euros was thought to be more secure—if, of course, the country didn't default altogether.

LTCM's direct exposure to Russia, Brazil, and other countries was a small part of its portfolio and was not the principal reason for its troubles. Nevertheless, even these trades did poorly during August and September 1998 (see Figure 4.13). Between January 2, 1998, and August 31, 1998, the Russian

FIGURE 4.13 Russian Bond and Brazilian Brady Bond Return Indices



Source: Datastream and Bloomberg.

trade lost 76% and the Brazilian trade lost 20%. By the end of September the losses were 81% and 21% respectively. LTCM lost a total of \$278 million in emerging market direction trades in 1998.

Other Trades

LTCM had many other trades. The company got agency security exposure by being long interest-only strips of agency-backed pools of fixed-rate residential mortgages, known in the industry as IOs. LTCM hedged the interest rate risk by using swap contracts. This was essentially a mortgage trade.

LTCM also purchased AAA-rated tranches of structured products backed by commercial mortgages and paid fixed rates on swaps, taking advantage of the yield spread. This is also a mortgage trade, one that caused a lot of trouble for hedge funds in 2008.

LTCM's fixed-income portfolio included butterfly yield curve trades. A butterfly trade is typically one in which a trader is long the 30-year bond and the 5-year bond, but short the 10-year bond. The trade is neutral to general interest rate movements, but takes a view that the yield curve will become more hump shaped. A trader could take the other view by changing the long positions to short positions. Either view could apply to any part of the yield curve, not just the 5-10-30 combo.

In 1998, LTCM had a relative butterfly trade on in Germany and the UK. LTCM executed this trade in the swap market. In the UK, it paid fixed interest on the 20-year and 3-year area of the curve, and received fixed in the 7-year area. In Germany, LTCM executed the opposite trade. These trades were structured to benefit from changes in the relative shape of the two yield curves, but were hedged against overall interest rate movements and curve steepening or flattening. LTCM hoped to profit from a mispricing of 21 basis points with this trade.

LTCM engaged in preferred-common arbitrage trades with Japanese banks. The firm was long Japanese banks' preferred shares and short the common stock. These preferred shares were generally trading cheap because their implied options were mispriced.

The fund also made convertible arbitrage trades, where LTCM was either long or short on corporate bonds and short or long the same company's common stock. The trades were constructed to maintain an overall zero exposure to stock price movements and to take advantage of mispricings between certain stocks and their convertible bonds.

LTCM made other directional trades, including being short Japanese government bonds when the bonds' interest rate reached 2% in 1997.

The Portfolio of Trades

By August 1998, LTCM's portfolio had lots of strategies that appeared to be economically and statistically uncorrelated.⁴¹ The firm's portfolio consisted mainly of relative value and convergence trades in the fixed-income swap and bond markets of OECD countries.⁴² These trades were constructed to profit on temporary distortions between security prices.

There were some disturbing trends, however. LTCM was aware of some, but not necessarily aware of others.

Though the majority of LTCM's portfolio was in core relative-value and convergence trades, the fund had ventured into less lovely territory. For example, the portfolio had about 20% in directional bets. These trades looked uncorrelated to the core portfolio, but they didn't offer the same competitive advantages that LTCM had in its other trades, such as inevitable convergence and favorable financing.

Two of LTCM's largest trades didn't look nearly as beautiful as the others. In 1998, LTCM was short the U.S. swap spread. The trade's logic has already been discussed, but not its two distinct dangers. In a world crisis the swap spread would tend to widen as traders fled to quality and switched holdings from interbank debt to U.S. government debt. The spread's widening could be unlimited, as could potential losses.

The long swap spread trade, which LTCM also used from time to time, seemed to have a much more protected downside. If the spread was 20 basis points, then one might argue that the most swap spreads could decline is to zero, not more.⁴³ The short swap spread trade is a convergence trade in theory, but it didn't seem as good as a long swap trade.⁴⁴

The short long-term volatility trade was a short on marketplace volatility. LTCM used the trade when it found long-term volatility very expensive relative to the way it actually behaved. In a crisis, however, volatility typically shoots through the roof. In that case, LTCM would suffer tremendously on a mark-to-market basis, even if they were right about the expensive options in the long run.

LTCM knew these trades weren't perfect, but may have kept them on in the interest of diversification. But crowds were developing, and that was affecting trades. With every call to a dealer, with every cocktail party between dealers, and with every quant trying desperately to reverse engineer LTCM's

success, word traveled and more investors copied LTCM's moves. The beautiful trades were getting ugly, with smaller expected profits and a new danger: the danger that copycats might rush for the exit at inopportune moments and cause dramatic changes among trade correlations. That's just what happened in August and September 1998, when Russia defaulted on its debt, the copycats ran for the exits, and the *Titanic* of hedge funds sank into the chilling water.

CHAPTER 5

The Collapse

... the market knew something that our formula didn't know...

—Fischer Black, 1973

By the start of 1998, LTCM was *the* superstar hedge fund. It had just given a large sum of capital back to its investors, and entered 1998 having had an enormous amount of success.

The returns for the first part of 1998 were -1.26% , 1.24% , -0.30% , and 2.74% respectively: up and down, with no clear direction. LTCM seemed set for a quiet year.

The events that brought down LTCM are shown in Figure 5.1. The end began with unusually bad months in May and June (see Figure 5.2). Salomon's arbitrage trading group closed and the Russian government defaulted on its debt, both unexpectedly. By the fall, LTCM's survival was in question.

Early Summer 1998

In May, LTCM had its greatest monthly loss ever: -6.74% . The firm had substantial losses in June, too: -10.14% . Until then, LTCM had never had back-to-back losing months. LTCM partners canceled their summer vacation plans to sit down during the first two weeks of July and carefully analyze their situation. The partners saw nothing obvious. No large trade created the losses. The losses were spread out through every trade in the LTCM portfolio.