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Long-Term Capital Management, L.P. (A)

In September 1997, the principals at Long-Term Capital Management, L.P. (LTCM) were considering the firm's future. The fund that LTCM managed, Long-Term Capital Portfolio, L.P. ("the Fund"), had commenced operations with $1 billion of capital in early 1994, and had subsequently raised an additional $2 billion. After three and a half years of investment returns that far exceeded even the principals' expectations, the Fund's net capital now stood at $6.7 billion. The principals' personal share of this capital had risen from $146 million to $1.6 billion. Due to the limitations imposed by available market liquidity, the principals recognized that it would be impractical to increase position sizes commensurate with the performance-induced increase in capital. Consequently, they believed it would be difficult to sustain high rates of return on the current capital base, and had to consider whether it was a prudent and opportune moment to return capital to the Fund's investors.

Background on LTCM

LTCM was formed to engage in trading strategies that would exploit market pricing discrepancies. Because the firm employed strategies designed to make money over long horizons—six months to two years or more—it adopted a long-term financing structure designed to allow it to withstand short-term market fluctuations. In many of its trades, the firm was in effect a seller of liquidity—that is, many trades involved taking long and offsetting short positions, where the long positions were in instruments that were relatively less liquid than the short positions. LTCM generally sought to hedge the risk-exposure components of its positions that were not expected to add incremental value to portfolio performance, and to increase the value-added component of its risk exposures by borrowing to increase the size of its positions. The Fund's positions were diversified across many markets.

LTCM's trades often involved complex proprietary trading strategies aided by the use of sophisticated analytical models. The firm's principals possessed particular expertise in the development of such strategies and in analyzing newly created instruments and new markets. The firm directed considerable resources to building and evolving state-of-the-art software and financial modeling technologies. A substantial number of LTCM's employees were involved in research or in the development and support of technology.

LTCM was headed by Mr. John Meriwether who had established fame as a pioneer of fixed-income arbitrage at Salomon Brothers in the early 1980s, and for having built Salomon's profitable Fixed-Income Arbitrage group. Before leaving in 1991, John Meriwether had been Vice Chairman of

Professor André F. Perold prepared this case as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Salomon Brothers in charge of the firm's worldwide Fixed Income Trading, Fixed-Income Arbitrage and Foreign Exchange businesses. Several of LTCM's founding principals had, years earlier, been recruited to Salomon's Fixed-Income Arbitrage group by Meriwether, and had held senior positions at Salomon. In 1994, Salomon Inc. disclosed that its proprietary trading activities had generated more than 100% of Salomon Brothers' pre-tax income in 1990-1992, and a substantial fraction of its net income in 1993, as reproduced below:

Pre-tax Income of Salomon Brothers ($ millions)[1]

	1993	1992	1991	1990
Proprietary Trading	416	1,416	1,103	485
Other Businesses	1,159	(26)	(67)	(69)

In September 1997, LTCM had 15 principals and about 150 non-principal employees, up from 11 principals and 30 non-principal employees when it commenced trading in February 1994. The firm operated out of offices in Greenwich, Connecticut; London; and Tokyo. This geographical dispersion was to facilitate information gathering and trading in all time zones. However, for decision-making and control purposes, the firm operated as a single unit.

Outside of LTCM's principals and employees, the investors in the Fund were a variety of financial institutions and wealthy individuals, the latter category representing less than 4% of the Fund. Many of the Fund's most significant investors were commercial banks and other financial institutions with which LTCM had established strategic relationships. These organizations had strong presences in targeted geographical locations throughout the world, and provided informed insights from a local perspective on macro-economic policies and financial issues that may affect their regional markets and geographic areas. Most of the Fund's capital represented investments by non-U.S. entities.

The Fund was structured as an off-shore limited partnership. The partnership structure was preferable to a traditional corporate form because it avoided double taxation while still providing investors with limited liability. Investors did not invest in the Fund directly, however, but rather through a series of investment vehicles. The Fund employed a "hub-and-spoke" structure involving multiple entities to satisfy the disparate tax, regulatory and other needs of its investors, including a series of off-shore vehicles for foreign investors who did not to wish to invest in the United States. Each of these entities invested all of its assets in the Fund and consequently received the same pre-tax return. Taxable U.S. investors invested in the Fund through a Delaware limited partnership, Long-Term Capital Partners, L.P.

As compensation for managing the Fund, LTCM received a base fee of ½% per quarter (2% per annum) of the net asset value (NAV) of the Fund, plus an incentive fee equal to 25% of the yearly increase in the Fund's NAV. The incentive fee was subject to a "high water mark" in that the year-on-year increase in the Fund's NAV was defined as the difference between the current end-of-year NAV and the highest NAV recorded at any prior year end. The use of a high-water mark meant that following a year in which the Fund suffered a decline in NAV, the Fund would first have to recover those losses before any incentive fee would be paid. LTCM's fee was structurally similar to but higher than the typical 1% base and 20% incentive fee charged by many hedge funds.

Since inception, the Fund's returns after fees had been 19.9% from February 24 through December 31, 1994 (unannualized), 42.8% in 1995, 40.8% in 1996, and 11.1% in 1997 through August (unannualized.) See **Exhibit 1** for monthly gross and net returns. These returns were achieved

[1] Source: Salomon Inc. 1993 Annual Report

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without exposure to the stock market as discussed further below. LTCM's incentive fees had been commensurately substantial, and the firm's principals had elected to reinvest into the Fund nearly all of their after-tax earnings. In addition, nearly all of the firm's employees had chosen to participate in a deferred-compensation plan under which the return on the deferred amounts was linked to the Fund return.

While the Fund's structure was similar to that of a typical hedge fund, its trading strategies were more in line with those of a capital market intermediary. When investors or issuers needed to change their positions or risk exposures, they would go to an investment bank or dealer to buy or sell securities or structured products. In turn, the dealer would utilize the capital markets to cover this exposure. LTCM was often on the other end of these transactions, in some sense wholesaling risk to the intermediary who was working directly with clients. LTCM viewed its main competitors as the trading desks at large Wall Street firms rather than traditional hedge funds.

Trading Strategies

LTCM engaged primarily in *convergence* and *relative value* strategies. Both types of strategy involved taking long and offsetting short positions in instruments that were close substitutes. For example, recently-issued (so-called on-the-run) U.S. Treasury bonds typically traded at slightly lower yields (higher prices) than comparable maturity but older (so-called off-the-run) Treasury bonds. If this spread were sufficiently wide, LTCM might purchase the off-the-run bond, and sell short the lower-yielding on-the-run bond. With attractive financing rates, this position would make money if held to maturity. The position also stood to make significant profits if the yield spread, and hence the value differential, narrowed. (This narrowing was in fact quite likely as soon as the Treasury issued its next bond with that maturity, since both the long and the short would then be off-the-run.)

LTCM used the term *convergence trade* when there was a specifiable future date by which convergence in the value of the positions should occur. Such trades usually involved instruments such as bonds and derivative instruments, which had near to medium-term fixed maturities. With *relative value* trades, convergence was expected but not guaranteed except perhaps over a very long horizon.

While convergence and relative value trades were its hallmark strategies, LTCM also engaged to a limited extent in trades that did not have a convergence element. These included so-called *directional trades*, which were positions such as an unhedged long position in French government bonds that was exposed to broad market movements.

LTCM had a strong preference for strategies that exposed the Fund to little or no default risk. The firm therefore generally avoided outright long positions in high-yield corporate bonds or emerging-market sovereign debt. However, the Fund did have some relative-value trades that included these instruments, such as being long the debt and short the equity of a particular corporation.

LTCM believed that most of its trading opportunities arose as a result of dislocations in the financial markets caused by institutional demands. For example, French insurance companies had to buy large amounts of French government bonds at certain points on the yield curve; Japanese banks had large needs to receive fixed and pay floating in yen-denominated swaps; and when the Federal Reserve Bank raised U.S. interest rates in 1994, European investors became large sellers of futures on U.S. Treasury bonds. In each of these instances, LTCM structured trades to take the other side, providing liquidity to meet these institutional demands. The firm would build models to find mispricings created by such demands, but would also identify the reason for the mispricing before initiating a trade.

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Swap-spread example

The following "swap-spread" example illustrates many of the features of a position that LTCM would consider taking. Interest-rate swaps are contractual agreements in which one party agrees to pay another a fixed rate in exchange for a floating rate (usually Libor), applied to a quantity called the "notional amount". (Normally the fixed rate is chosen so that the contract has zero value when it is executed, although subsequent market movements will make its value positive or negative.) An interest-rate swap—receiving fixed and paying floating, say—has the same net cash flows as a position which involves lending at fixed rate and borrowing at a floating rate. As lending at a fixed rate and borrowing at a floating rate can be accomplished by purchasing Treasury bonds with floating-rate financing, a potential arbitrage opportunity arises when the "swap spread"—the spread between the fixed rate on the swap and the yield on a Treasury bond of comparable duration—is sufficiently wide or narrow.

The profitability of such an arbitrage opportunity depends on the cost of financing the purchase of a Treasury bond. It is common for dealers, hedge funds, and other leveraged investors to finance the purchase of Treasury bonds through the use of repurchase agreements, or "repos", which involve pledging the bond as collateral. Repos can be arranged on an overnight or on a term basis. In recent years, the differential between six-month Libor and the six-month term repo rate had averaged around 20 basis points, with relatively little variation.

On February 8, 1997, U.S. Treasury bonds of approximately 20-year maturity were yielding 6.77%. Interest-rate swaps of similar duration were being quoted at 6.94% versus Libor. At 17 basis points (6.94% - 6.77%), the swap spread was at the low end of its historical range of 17 to 32 basis points since 1994 (**Exhibit 2**.)

At a swap spread of 17 basis points, and a repo rate of libor minus 20 basis points, LTCM could establish a position with a "positive carry" of three basis points as follows:

- Purchase $250 million, say, of 20 year Treasury bonds, 100% financed at the repo rate;[2]
- Enter into a 20-year interest-rate swap agreement to pay 6.94% and receive six-month libor (with the net difference between these two paid semiannually), on a notional amount of $250 million.

Because the bonds were purchased with 100% financing, this position initially would involve no net cash outlay, and the net flow X to the Fund would be:

X = (6.77% – repo rate) – (6.94% – libor)
= (libor – repo) – (6.94% – 6.77%)
= (libor – repo) – Swap spread
= 20 – 17
= 3 basis points per annum on $250 million, or $75K per annum.[3]

[2] Actually, investors typically obtained 98% rather than 100% financing in the U.S. Treasury repo market. LTCM and certain other institutions obtained 99%. The 1% "haircut" usually did not materially affect the profitability of a trade, although it was of importance for liquidity management as discussed later in the case.

[3] This calculation assumes that the bonds are trading at par. For bonds trading above or below par, there would be an additional semiannual cash flow derived from the difference between the yield-to-maturity and the coupon yields of the bonds as well as the accretion to par of the price of the bond. The present value of these differential cash flows, while zero initially, is sensitive to changes in interest rates, and LTCM would hedge out this risk where necessary.

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LTCM's assessment of this trade was the following: First, the trade represented nearly a "pure" arbitrage, in which the Fund would make a little money if it held the position to maturity. This was actually the worst-case outcome provided that the firm had the capital and the patience to maintain the position, and provided also that the Treasury bonds could be financed throughout at an average rate no worse than Libor – 20. (By itself, the 3 basis point net spread would be insufficient to warrant taking a position. Since the Fund would actually incur a 1% haircut on the financing of the Treasury bond, the spread represented only a 3% return on working capital.)

Second, there was the potential to profit significantly from volatility in the swap spread. If the swap spread widened, the value of the bonds would increase relative to the value of the swap contract, and LTCM would be able to unwind its position at a profit well before the maturity of the position. If the swap spread narrowed, the portfolio would suffer a mark-to-market loss, but LTCM then could stay with the position rather than unwinding it. Indeed, since the trade then would be more attractive, LTCM would add to the position unless it were up against a limit. As long as the Fund had adequate capital, and the financing rates on Treasury bonds did not deteriorate relative to Libor, an eventual profit was nearly certain.

LTCM's believed that the primary reason for the swap spread being so narrow in early 1997 was the tightness of corporate bond spreads—corporations could issue long-term fixed-rate debt at very low spreads to Treasurys. This led to substantial issuance, part of which was swapped; i.e., the issuers chose to receive fixed and pay floating, effectively converting their liability to floating-rate debt. In addition, in October 1996, the U.S. Federal Reserve had decided to count as Bank Tier 1 capital "Trust Preferred Stock," an equity structure that had the tax treatment of debt for the issuer. There was a flurry of issuance by banks, much of it with long maturities, and much of it swapped into floating, thus also becoming a factor in the narrowing of swap spreads.

LTCM considered the 17 basis point swap spread to be at a temporary low, and expected it to widen. The firm began buying Treasury bonds, and paying fixed versus receiving libor on swaps.[4] Between January and April, 1997, LTCM built the position to an exposure of $5 million per basis point of swap spread—a position size so that for each one basis point increase or decrease in the swap spread, the value of the bond position would increase or decrease relative to the value of the swap agreement by $5 million. The overall position had a notional size of approximately $5 billion,[5] and LTCM had been able to put it in place at an average swap spread of 18 basis points. By mid summer of 1997, the swap spread had widened considerably, and LTCM had been able to unwind the position during July-September at an average swap spread of 25 basis points, for a profit of about $35 million.

This trade is a good example of what LTCM considered to be an ideal trade: It had considerable option value related to excess spread volatility, and it made money on a hold-to-maturity basis assuming "normal" financing. Many of LTCM's trades had much higher expected hold-to-maturity profits than in this swap-spread example, although making money on a hold-to-maturity basis was not a requirement for LTCM to put on a trade. LTCM might expect to lose a little

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[4] LTCM also did combinations of 10 and 30 yr swaps, still buying 20 year Treasurys. This really represented two trades: the first being the swap spread trade—purchasing 20 year Treasury bonds and paying fixed vs. Libor on 20 year swaps; the second being a "butterfly" trade involving receiving fixed vs. Libor on 20 year swaps, and paying fixed vs. Libor on 10 year and 30 year swaps. In the butterfly trade, LTCM was attempting to exploit the fact that 20 year swap rates were high relative to 10 year and 30 year swap rates. "Chaining" the swap spread and the butterfly trades together in this manner permitted LTCM to avoid the transaction costs it would otherwise face in taking offsetting positions in the same instrument, here 20 year fixed-for-floating swap agreements.

[5] The trade was distributed over many issues, from the 8.75s of 2017 to the 8.75s of 2020; it also involved an approximately $3 billion long position in U.S. Treasury bond futures, for which the "cheapest to deliver" bond was the 11.25s of 2015.

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money on a hold-to-maturity basis provided there was a substantial probability of an eventual favorable spread change, which would allow LTCM to take the trade off early. And, as already mentioned, if the spread went the other way, LTCM would simply wait or do even more of the trade. Finally, in a market disruption event—which typically would result in a flight to liquidity—this particular trade would do well since it involved being long the liquid instrument.

At times, LTCM was on the opposite side of the swap-spread trade—when the swap spread was especially wide. In this case, LTCM would enter into interest-rate swap agreements to receive fixed in return for paying Libor, and the firm would short-sell Treasury bonds. The short sale of Treasury bonds was effected through the use of so-called reverse repurchase agreements, or "reverse repos". In a reverse repo, the Fund would lend money to a counterparty collateralized by the bond LTCM wished to short. There was a normal five basis point bid-offer spread between repos and reverse repos. However, because LTCM wanted a particular bond as collateral, it would receive less than the general reverse repo rate on its loan, typically 15 basis points less. Having received the bond as collateral, LTCM would then sell it. The proceeds of the sale would fund the loan made to obtain the collateral in the first place.

In general, because of financing frictions, many trades had a "no arbitrage zone". For example, if Treasury bonds could be financed in the repo market at Libor – 20, and borrowed in the reverse repo market to earn Libor – 40, then the no-arbitrage zone for swap spreads was between 20 and 40 basis points. For swap spreads within the no-arbitrage zone, one would not be able to make money on a hold-to-maturity basis whether long or short the swap spread. LTCM typically would put on trades inside but near the edges of the no-arbitrage zone and attempt to capture the option value related to excess volatility of spreads.

Other trades

Since inception, LTCM had as many as 10 distinct categories of trades on at any one time. Some of the trades on its books had been initiated in 1994, while others—such as the above swap-spread trade—had converged quite quickly and had been liquidated within six months. The following are representative of LTCM's large trades to date:

Fixed-rate residential mortgages. This trade consisted of taking long positions in FNMA, FHLMC, and GNMA pools of fixed-rate residential mortgages and hedging the interest-rate exposure with interest-rate swaps. The interest-rate exposure of these securities is more complicated than for ordinary fixed-rate bonds, because homeowners tend to refinance their mortgages when interest rates fall, and these prepayments flow through to the securities as early redemptions. The underlying mortgages are collateralized by the borrowers' homes, and the securities are further credit enhanced by guarantees from quasi-governmental agencies. (GNMA mortgage pools are actually backed by the full faith and credit of the United States government.) These essentially-default-free instruments were trading at significant spreads to Libor—as high as 25 basis points—adjusted for the homeowner's prepayment option.

LTCM used a proprietary model of prepayment behavior to simultaneously estimate the fair value of the mortgage pools and the sensitivity of that value to interest-rate movements. The firm could finance these securities at Libor–12.5 basis points (with 2% haircuts)[6] which created a positive carry of 37.5 basis points per annum. The Fund had large positions at various times from 1994 into 1997—as high as $10 million per basis point of spread (which corresponds to about $20 billion market value of mortgages).

[6] These financing terms were less favorable than for U.S. Treasury bonds which could be financed with 1% haircuts at Libor – 20.

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LTCM believed this trade opportunity arose because pools of residential mortgages are complicated securities whose analysis requires a prepayment model. Many investors lacked the expertise to analyze them, or were unwilling to bear the associated risk of errors in the prepayment model.

Japanese government bond swap spread. Similar to the U.S. Treasury bond swap spread trade, this trade involved long positions in Japanese Government Bonds ("JGBs") and in futures contracts on those bonds, hedged by paying fixed and receiving Libor on yen-denominated interest-rate swaps. The bonds were financed in yen in the repo market. Although the swap spread got as narrow as 5 basis points while LTCM was building its position in 1995, the carry was slightly negative, because the financing rate on the bonds was approximately Libor flat. However, LTCM believed that a general increase in the efficiency of financing markets over time would lead to financing rates for JGBs gradually falling below Libor (similar to financing rates for the government bonds of the US, the UK, and Germany). In addition, the swap spread was at its low versus recent history, largely because Japanese banks were entering into swap agreements to receive fixed and pay floating in hopes of benefiting from the low short-term yen interest rates. The Fund's peak exposure for this trade was also about $10 million per basis point. This trade converged considerably and was substantially reduced within a year.

Yield-curve relative-value trades. Expressed in terms of forward rates, the term structure of interest rates often has anomalous bulges or dips far into the future. For example, forward interest rates for years 4 to 7 might be significantly higher than would seem appropriate, given the rates for years 0 to 3 and for years 8 onward. Often LTCM concluded that such a bulge was due to investor preferences for specific maturities (and not due to investor expectations of a peculiar path for future short-term interest rates). LTCM would enter into a "butterfly" trade, which, in this example, might be implemented by paying fixed in three-year swaps, receiving fixed in seven-year swaps, and paying fixed in ten-year swaps. The proportions would be adjusted so that the position had exposure neither to a uniform rise or fall in yields, nor to a typical steepening or flattening of the yield curve.

LTCM did many of these trades over the years, principally in the UK, French, German and Japanese markets.[7] A typical exposure in a single market was $3 million per basis point of relative misvaluation. These butterfly trades were not true convergence trades, because if they were held for long periods of time, their profitability would ultimately depend on the path of short-term rates. Usually these trades converged fairly quickly and were taken off, but not always. The Fund had lost a significant amount of money from a butterfly trade in France when the relative misvaluations along the forward curve remained constant for an extended period, and the particular trade that LTCM had structured had negative carry under those conditions.

Selling volatility. This strategy, implemented when favorable pricing developed in 1997, involved selling long-maturity put and call options on broad stock market indexes (principally the U.S. S&P 500, the French CAC, the German DAX, and the U.K. FTSE indexes), and dynamically hedging the position so that it had no exposure to the index level itself. The Fund would sell options with maturities of five years to dealers seeking to repackage these options into structured investment products for retail investors. For example, a popular retail product was a fixed-income note with upside participation in the stock market. Financial intermediaries could structure such notes by purchasing a bond and a call option on the equity index, or by purchasing the underlying index plus a put option on the index. They would then issue the note to investors at a markup.

LTCM generally traded options with strike prices equal to the forward price of the index (which equals the current index level plus interest minus dividends). To a first approximation, the

[7] Yield curves in the United States were usually priced far more efficiently, in part because of the presence of Eurodollar futures going out ten years, which made it relatively easy to locate and arbitrage the anomalies.

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fair value of an option struck at the forward price is proportional to the expected volatility of the underlying index.[8] However, beginning in 1997 LTCM was able to sell options at prices that would be appropriate only if expected volatility over the next five years were substantially higher than both the observed historical volatility and the volatility assumptions implicit in the pricing of near-term index options. For example, during the 1990s, the volatility of the S&P 500 index (annualized standard deviation of daily returns) had been in the range of 10-13% per annum. LTCM was able to sell five-year S&P 500 options at prices consistent with volatility expectations of 20% per annum. The firm felt that the rise in option prices was due to strong demand for downside protection, and the lack of supply of long-term index options. The firm did not believe it likely that S&P 500 index volatility would average 20% on a sustained basis.

To price options, LTCM used a proprietary model of stock price dynamics which it also used to assess risk exposures. LTCM would simultaneously sell both puts and calls on an index, which eliminated any immediate exposure to movements in the index. This meant that the Fund's risk exposure was mostly that future index volatility would increase. Volatility risk was measured by "vega," which measured the amount by which the value of the option increased or decreased for every one-percentage-point increase or decrease in expected volatility. As the level of the index moved, the position would take on net long or short exposure to the index, and LTCM would hedge this exposure with stock index futures. The firm also would sometimes hedge some of its exposure by purchasing short-term index options.

By September 1997, LTCM had written index options with an aggregate vega of $30 million. Thus, for example, if the firm had sold the options at implied volatilities of 20%, and the actual volatility over the next five years turned out to be 13%, LTCM would make $210 million over that period. (Alternatively, if the option prices converged to an implied volatility of 13%, and LTCM unwound the position, the profit would be $210 million.) The option premia that LTCM received in selling options would be posted as collateral against this position, and the collateral would be adjusted over time to reflect changes in the market value of the options.

Risk arbitrage. Following the announcement of the acquisition of one corporation by another, the target company's shares tended to trade at a discount to the consideration offered—usually shares of the acquirer ("stock deals") or cash ("cash deals"). Only some of the discount could be explained by the time value of money or the risk of the acquisition not being consummated (a "break"). Risk arbitrageurs would attempt to capture the spread by purchasing the shares of the target company and (in stock deals) selling short the shares of the acquirer. LTCM believed the spread existed because there were fewer natural holders of the target's shares while the merger was being completed, and because many of the target's shareholders preferred to take profits and not bear the risk of a deal break.

Because LTCM had no competitive advantage in predicting the outcome of an announced merger, the firm's strategy was to participate in situations where the risk of a break was manifestly very small. Thus, the firm avoided hostile takeovers as well as mergers that faced significant regulatory hurdles. LTCM also preferred stock deals to cash deals because it believed the latter were more likely to break or be renegotiated if the stock market declined significantly. Stock deals also tended to have higher expected profits because selling short was difficult and/or costly for many investors.

The less risky deals naturally had lower spreads, but due to two important advantages, the Fund could still profit. First, the Fund could finance the trades very efficiently. Through total-return

[8] According the Black-Scholes formula, the value of a t-year European put or call option struck at the forward price is proportional to $2N(\frac{1}{2}\sigma\sqrt{t}) - 1$ which is approximately equal to $0.4\sigma\sqrt{t}$, where N(.) is the cumulative normal distribution function, and σ is the annualized volatility of the underlying instrument.

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swaps, LTCM would finance the positions with zero haircuts. Its cost of carrying a position was therefore limited to the spread it paid dealers on the swaps, typically a net spread of 75 basis points per annum. Second, for any particular merger, LTCM considered the risk of a break to be nearly uncorrelated with its other strategies. This meant that risk-arbitrage positions added little incremental risk to the overall portfolio (see below for a discussion of portfolio risk management.) The spreads therefore did not have to be large in order for risk arbitrage to enhance the reward-to-risk ratio (the Sharpe Ratio) of the Fund.

In contrast, in order for stand-alone risk-arbitrage firms to achieve an adequate Sharpe Ratio, they needed much higher expected profits, typically requiring expected returns at least 5% over Libor on an unleveraged basis. To the extent that their activities determined merger spreads, the high required returns of these players represented a profit opportunity for LTCM.

In 1997, the Fund's risk arbitrage portfolio contained about $5 billion of long positions (plus offsetting shorts where appropriate) involving over 30 different merger situations, almost all of which were U.S. companies. The holding period of a particular position depended on the time for the merger to be completed, and varied from a few months to over a year. A 5% net spread on these positions represented $250 million of expected annual incremental profits.

Equity relative value trades--Royal Dutch and Shell. For tax and corporate governance reasons, all operating assets of the Royal Dutch /Shell Group were held through two holding companies—Shell Transport & Trading plc. and Royal Dutch Petroleum N.V. They represented economically equivalent claims on the operating assets of the Royal Dutch/Shell Group in terms of voting rights, share of profits, and share of dividends. Royal Dutch was listed in Amsterdam with ADR's listed in New York, and Shell was listed in London. Royal Dutch was a member of the S&P 500, Eurotop-100, and Eurostoxx-50 stock indexes and Shell was a member of the U.K. FTSE-100 index. Depending on the domicile and tax status of various investors with respect to their local tax rates, foreign tax credits, and witholding taxes, each investor class would have a tax preference for receiving coprorate income through either Royal Dutch or Shell shares.[9] However, due to a corporate taxation reform in the U.K., the relative tax treatment of Royal Dutch and Shell shares was due to change in April 1999 in favor of Shell for most tax clienteles, and LTCM believed that would make Shell a preferred share class for several large investor classes. Royal Dutch shares were also more liquid. Since 1992, Royal Dutch shares had been trading at a premium to Shell, reaching a high of 16% in 1996. In 1997, the trading range of the premium was between 7% and 12%.

Through a zero-haircut total-return swap, LTCM took a long position in Shell and a short position in Royal Dutch to exploit the likelihood that the premium would narrow. LTCM varied its position size as a function of the premium to take advantage of the short-term volatility, and in 1997 was long about $1 billion of Shell (and correspondingly short Royal Dutch). This trade, and others like it, were relative value trades but not strictly convergence trades because even though LTCM thought there was a significant probability that company would convert its multiple share listings into one—which would remove the price discrepancy—this event was not guaranteed to happen. The carry on this trade consisted of two components: LTCM would receive a higher dividend yield on Shell (due to same dollar dividend amount but lower share price) than it would pay on Royal Dutch, creating a positive 'dividend pick-up.' On the other hand, LTCM would pay the financing friction in the total return swap. At a 10% premium, 3.5% per annum dividend yield, and 70 basis points per annum financing friction, the carry of the trade would be slightly negative (350 bp * 10% - 70 bp = -35bp), so if the company never converted the two shares into one and if the premium did not

[9] For example, U.S. pension funds received a full witholding tax refund on Royal Dutch, but not on Shell (i.e. they would receive 100% of declared dividends by holding Royal Dutch, and only 85% by holding Shell); on the other hand UK taxable corporates would prefer holding Shell—after tax they would receive 80% of dividends on Shell and only 69% on Royal Dutch.

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narrow, the Fund would lose money on this trade over time at a rate of 0.35% of the notional amount per year.

Portfolio Risk and Leverage

LTCM structured its trades so as to require minimal, if any, initial outlay of capital. All of the Fund's contractual agreements were self financing, and for most securities LTCM was able to obtain 100% financing on a fully collateralized basis. (In certain cases, the Fund had to accept small financing "haircuts" such as with U.S. Treasury bonds where the Fund had to provide funding for 1% of the purchase price.)

The 100%-financing and long-short structure of LTCM's trades had important implications for how the firm should think about leverage and risk management. First, since a fully-financed position had no explicit equity investment, it was not possible to work directly with measures such as return on equity. Second, risk could not be measured by the notional sizes of the positions. In particular, the risk of a long-short position depended entirely on the degree to which the profits on the long position could deviate from the profits on the short position. For example, a stand-alone position in twenty-year U.S. Treasury bonds exposed the investor to interest-rate risk as well as to other risk factors such as the liquidity of the particular instrument. A stand-alone position in a twenty-year interest-rate swap also exposed the investor to these risks. However, in the U.S. Treasury swap-spread trade—being long the Treasury bonds and paying fixed on the swaps—the exposure to interest-rate risk cancelled out, leaving LTCM with only the risk that the swap spread would narrow. In a long-short position, LTCM thus could isolate the risk to which it wished to be exposed, a risk which, in the abovementioned U.S. Treasury swap-spread example, the firm deemed to be small. Of course, a long-short position could be very risky when the risk of one leg was unrelated to the risk of the other.

In general, LTCM measured risk in terms of the probability distribution of potential profits and losses. This included use of "value-at-risk" measures that were commonly employed by financial institutions. For example, on its $5 billion notional position in the U.S. Treasury swap-spread trade, the Fund would make or lose about $5 million for each basis point change in the swap spread. The firm expected the swap spread to widen to 23 basis points over twelve months, with a standard deviation of seven basis points. Thus, the expected profit on the trade to a one-year horizon was $25 million, and the standard deviation was $35 million.

Important to LTCM's assessment of risk was the belief that as pricing discrepancies became more pronounced, trades based on these discrepancies would attract more capital from arbitrageurs and other investors, and thus the downside risk of a trade generally diminished as valuations became more extreme. Leveraged investors who did not require wide spreads to earn large profits usually would be first to exploit misvaluations. As spreads widened, unleveraged investors would start to commit capital. In the case of extreme misvaluations, issuers might find it attractive to increase the supply of the overvalued instrument in question.

LTCM also employed economic stress testing which involved analyzing how the Fund's positions would perform if a low probability, high impact event occurred. For example, the Fund had many positions that would be affected by a breakup of the Economic and Monetary Union (EMU) that was scheduled to be completed on January 1, 1999 in Europe. LTCM would regularly estimate the profit and loss implications of such an event, and if the expected net outcome were a loss, it might restructure the positions to reduce the risk.

In assessing risk, LTCM also analyzed how the profits of its various positions were correlated. At the margin, a position that was uncorrelated with the remainder of the portfolio contributed relatively little risk, and therefore could be held in larger size. **Exhibit 3** illustrates how

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the risk of a portfolio increases with the number of positions, depending on the correlation between the profits of the individual positions. It considers the case of N positions each with the same stand-alone standard deviation of annual profits of $100 million. In the case of N perfectly correlated positions, the standard deviation of annual profits is $100N million. At the margin, each position contributes $100 million to the risk of the portfolio. In contrast, in the case of N uncorrelated positions, the standard deviation of annual profits is only $100√N million. Here, the marginal risk contribution of the Nth position is much smaller. As shown in **Exhibit 3**, the 10th uncorrelated position increases the portfolio standard deviation by only $16 million even though its standard deviation of profits would be $100 million if held stand alone.[10]

LTCM measured risk over both a one-year horizon and a one-month horizon. Over long horizons, the firm viewed the prices of financial instruments as being determined by their fundamental value. Thus, the long-run risk of a position was determined mainly by the risk of changes in fundamental value. Over short horizons, the prices of financial instruments were also affected by traders' need to transact in a world of less than perfect liquidity. LTCM's estimates of short-term risk thus tended to be higher than long-run risk. For example, in the U.S. Treasury swap-spread trade, LTCM felt the monthly standard deviation was 4 basis points, which annualized to nearly 14 basis points. The difference between this and the 7 basis points mentioned earlier is due to the impact of the trading decisions of market participants. The firm viewed liquidity-related risk as being relatively short-lived (less than a year), and considered it mostly a source of opportunities.

LTCM used a different correlation structure for a one-month horizon than a one-year horizon. For a one-year horizon, the firm tended to base the correlations on its view of the correlations of the fundamental factors that affected the trades. For example, the fundamental risk of a hedged position in interest-only mortgage strips (called IOs) came from errors in the prepayment model. The fundamental risk of being short swap spreads was that the spread of reverse-repo rates to libor might average wider than anticipated. The firm believed that the correlation between these particular fundamental risks was virtually zero.

Over short horizons, LTCM factored in price movements caused by traders' short-term liquidity needs. In estimating the correlations of one-month returns, the firm assumed that the various categories of trades in the portfolio were always positively correlated because many other institutions had the same trades on. This was a conservative assumption in that LTCM assumed the short-horizon correlation to be positive regardless of which side of a trade the Fund was on. For one-year horizons, the firm assumed short-term liquidity demands created positive but small correlations.

LTCM's stated intention was to take on an amount of risk corresponding to a standard deviation of NAV of 20% per annum. In addition, from the way in which LTCM structured its trades, the portfolio would have minimal exposures to broad-market stock, bond and currency risks—effectively a "triple net zero beta."

To determine the optimal position sizes for the trades, LTCM would calculate the mean-variance efficient frontier based on its estimates of risk, expected profit, and correlation for each trade. In practice, however, the Fund's actual and estimated volatility had been much less than 20% (see **Exhibit 4**.) Constrained by market liquidity, LTCM thus far had found it impractical to put on trades in sufficient size to attain a risk level of 20%.

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[10] With uncorrelated risks, the Sharpe Ratio of the portfolio—the portfolio's expected return in excess of the risk-free rate divided by the standard deviation—becomes infinitely large as N goes to infinity. With no haircuts, and therefore with no requirement for working capital, position sizes can be chosen (decreasing in N) so that the portfolio's expected return goes to infinity and the portfolio standard deviation of return goes to zero as N goes to infinity.

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In September, 1997, the Fund had a daily standard deviation of $45 million per day. This equated to an annualized standard deviation (assuming no mean reversion in the portfolio's returns) of $720 million, which represented only a 10.7% risk level relative to the Fund's $6.7 billion of capital. This risk level not only was much lower than the Fund's long-run goal of 20%, but it was also lower than the risk level of $60 million/day or $960 million per annum (assuming no mean reversion in the portfolio's returns) that LTCM's risk models were predicting for the particular trades in place. LTCM also estimated that its positions had expected annual trading profits of $750 million. These profits did not include about $350 million in annual interest that the Fund would earn on its equity capital. These figures implied that it would take more than a "ten sigma" event for the Fund to lose all of its investor capital in one year, or a thirty-sigma event for the Fund to lose all of its capital in one month.

Leverage

While institutionally-defined leverage was not a particularly meaningful gauge of risk, external constituencies such as regulatory authorities and certain lenders and counterparties nevertheless monitored leverage as a measure of risk. Institutionally, leverage was defined as the ratio of total assets to equity capital, where the "assets" were primarily long positions in securities and reverse repos, and equity capital represented the difference between total assets and liabilities, where liabilities included all secured and unsecured obligations of the Fund including short positions. The market values of the contractual agreements appeared on the balance sheet as either assets or liabilities, depending on whether their values had become positive or negative to the Fund. (The notional amounts of contractuals and futures, on the other hand, were recorded off balance sheet and did not count in the calculation of leverage.)

Consider, for example, an institution capitalized with $100 of equity, which is invested in cash. Suppose further that this institution purchases $500 of 10-year U.S. Treasury bonds, 100% financed through a repo transaction. The institution's balance sheet would be as follows:

Table 1

10-year U.S. Treasury bonds	$500	Collateralized financing (repurchase agreement)	$500
Cash	100	Equity	100
Total assets	$600	Total liabilities	$600

This institution is leveraged 6:1. If, instead of purchasing the U.S. Treasury bonds financed at a floating rate (the repo rate), the institution enters into a swap to receive fixed and pay floating on a notional $500 (an economically equivalent position in terms of interest rate exposure), the institution would have only cash and equity on its balance sheet, and its leverage ratio would be 1:1. Finally, if the institution with the balance sheet in **Table 1** were to enter into an additional but offsetting position in which it sells short a comparable maturity U.S. Treasury bond (say, a 9.75 year maturity) that it borrows through a reverse repo transaction, its balance sheet would be as in **Table 2**:

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Table 2

10-year Treasury bonds	$500	Collateralized financing (repurchase agreement)	$500
Collateralized lending (reverse repo agreement)	500	9.75-year Treasury bonds sold short	500
Cash	100	Equity	100
Total assets	$1,100	Total liabilities	$1,100

The leverage increases to 11:1, even though the offsetting short position in 9.75-year Treasury bonds vastly reduces the risk of the portfolio.[11]

At the end of August 1997, the Fund's balance sheet held $126.4 billion in assets, and equity capital of $6.7 billion. The Fund was therefore leveraged 19:1, which was at the lower end of the historical range of 19:1 to 31:1 for the Fund since it had reached global scale in 1995 (see **Exhibit 5**), and comparable to the leverage ratios of major banks and securities firms (see **Exhibit 6**.)

While LTCM did not explicitly attempt to control the Fund's leverage ratio, it could often implement trades more efficiently with the use of contractual agreements (see below). Because the notional amounts of contractuals and futures were recorded off-balance sheet, their use had the effect of reducing the Fund's leverage. In August 1997, the gross notional size of the Fund's off-balance sheet positions was approximately $1 trillion. This figure was misleading, however, because it simply summed the absolute values of the notional amounts of the contractuals and futures, even when their risks were offsetting.[12] In particular, when LTCM wished to exit a position, it usually would be costly to terminate a contractual, and the firm would instead enter into an offsetting contractual (often with a different counterparty). For example, rather than terminate a $100 million 10-year swap in which the Fund received fixed versus paying Libor, LTCM would find the best offer to execute a new $100 million swap in which the Fund paid fixed versus receiving Libor. Instead of decreasing by $100 million, the swap notional would actually increase by $100 million, even though the interest-rate risk of the original swap had been perfectly offset. The notional size of the swap book thus tended to grow over time simply in the course of the firm trading its portfolio.

[11] Under standard accounting conventions, the borrowing under the repurchase agreement and the lending under the reverse repurchase agreement could be netted for balance sheet purposes provided that the repurchase agreement and the reverse repurchase agreement were entered into with the same institution, had the same maturity, and were in the same currency, and provided also that the bonds being financed had similar characteristics, e.g., both were Treasurys. In that case, the firm's balance sheet would show only long and short positions in U.S. Treasury bonds, and cash and equity, and the firm would be leveraged 6:1.

[12] The Fund's off-balance-sheet holdings included deposit futures contracts such as Eurodollar futures. These contracts made or lost only $25 per basis-point change in Libor on a notional $1 million. Thus, a large notional position in Eurodollar futures contracts would not necessarily represent a large risk, even if it were unhedged. In addition, it took a large Eurodollar futures position to replicate the payoffs on a fixed-for-floating interest-rate swap. For example, it would take 40 Eurodollar futures contracts to create the equivalent of a 10-year interest-rate swap of fixed versus three-month Libor. The notional size of this Eurodollar futures position thus would be 40 times the notional size of the economically-equivalent ten-year swap position.

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Long-term Financing

As previously mentioned, LTCM recognized at the outset that many of its trading opportunities would arise as a result of liquidity-demanding trades by other market participants. This meant that exiting the Fund's positions quickly would be very costly. Moreover, the firm's trades generally were structured to exploit the option value inherent in excess spread volatility. Thus, it was essential to be able to hold positions for an extended period of time and to have the capacity to increase them if spreads moved in the unfavorable direction. Should the firm find itself in a situation where financing became very expensive or unavailable, it needed the ability to liquidate positions in a slow and orderly fashion.

LTCM's strategy accordingly was to use long-term financing, which it obtained in a variety of ways. First, the firm obtained long-term equity capital by subjecting investors initially to a three-year lock-up. In 1996, LTCM modified the lock-up requirement by allowing new investors to remove up to a third of their capital in each of years 2, 3 and 4 following an investment in the Fund. For all investors, capital left in the Fund that could have been withdrawn was considered to be a new investment and therefore subject to this withdrawal schedule. The modified approach allowed the firm to stagger the maturities of the Fund's equity capital while keeping the same average maturity, and thus to avoid dates when a large amount of equity capital could be withdrawn.

Second, although the Fund could not routinely issue unsecured debt as do traditional financial institutions (see **Exhibit 6**), the Fund had been able to obtain $230 million of unsecured term loans, with maturities of about three years. In addition, the firm had negotiated a $700 million unsecured revolving line of credit from a syndicate of 25 commercial banks. The Fund could draw upon any or all of the line at any time, and had to renew the facility annually. LTCM wanted to be sure it could always count on the availability of this credit and insisted that (unlike most revolving credit facilities) the agreement contain no Material Adverse Change clause, or any other covenant subject to discretionary interpretation by the lenders. Instead, the agreement provided that the Fund could not have any of the facility drawn if the Fund's NAV had fallen 50% or more during the calendar year, as measured at an "accounting period." This covenant was notable in that is was based on the marked-to-market NAV of the Fund rather than the Fund's leverage.

Finally, while many market participants financed positions in the overnight and short-term repo markets, LTCM chose to finance most of the Fund's securities positions through the use of term repos with longer maturities—usually 6-12 months—even at the cost of somewhat less favorable rates. The firm wanted to guard against being forced to liquidate its positions quickly due to a disruption in the financing markets that made it difficult to roll over its repo financing. LTCM constantly monitored the maturity structure of its repo agreements to make sure that the average maturity wasn't shrinking.

Liquidity Management

LTCM financed all the Fund's trades on a fully collateralized basis, and the firm also required its counterparties to symmetrically collateralize their obligations to the Fund. As the value of a position would fluctuate over time, there would be a collateral surplus or shortfall, and LTCM and its counterparties would need to keep the collateral in balance. This was accomplished through a process referred to as "two-way mark to market."

To illustrate the process, consider the previously mentioned swap-spread trade with an initial long position of $250 million worth of Treasury bonds, assumed to have been 100% financed in a repo transaction. The $250 million loan incurred to purchase this bond would be fully collateralized by the bond itself. If over the next day the value of the bonds fell to $240 million, there

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would be a collateral shortfall, and the Fund would have to post an additional $10 million of collateral. This additional collateral could be cash or any other securities that were acceptable under the terms of the repurchase agreement. Conversely, if the bond position appreciated to $260 million dollars, the counterparty would send the Fund $10 million of collateral.

Contractuals were structured similarly. That is, contractuals were revalued daily, and collateral would flow into or out of the Fund dollar for dollar commensurate with the change in the values of the contractuals.

LTCM considered the use of two-way mark to market for contractuals essential for liquidity management. In the swap-spread example, if the value of the Treasury bond position fell by $10 million, the value of the offsetting swap agreement would rise by $10 million (unless the swap spread had widened or narrowed), and LTCM would be able to use the collateral inflow related to the swap to fund the collateral outflow related to the bond. Without the use of two-way mark-to-market on contractuals, the Fund would have to pay out cash in this instance even though the net value of the trade had not changed. Financial institutions tended not to have two-way mark-to-market agreements with all their customers, and traditionally would fund interim cash flow deficits resulting from the asymmetry by issuing commercial paper or other unsecured debt.

In the example above, the Fund would face net capital inflows or outflows only if the collateral flows did not perfectly offset, which would occur when the Fund was gaining or losing on the overall trade. LTCM generally tried to structure its trades so that, ideally, and up to financing haircuts, the only flow of capital would be related to net mark-to-market gains or losses on its positions. These gains or losses would accrue to or subtract from the Fund's equity. Upon liquidation of a position, the net cumulative inflow or outflow of collateral over the life of the trade, together with the carry, would correspond precisely to the net profit or loss on the trade. Moreover, the daily rebalancing of collateral did not change the long-term nature of its financing and contractual agreements, thus allowing LTCM to stay in a trade, or liquidate it slowly, provided the Fund had the equity to withstand interim mark-to-market losses.

The Fund's uses of working capital were financing haircuts on bond positions (where applicable) and margin requirements for equity and futures positions.[13] The Fund's sources of working capital were its unsecured term debt, its line of credit, and its investor equity. In managing the Fund's liquidity, LTCM's chief concern was with the possibility that secured financing might become difficult to obtain or prohibitively expensive, which could occur in the event of an external market disruption or if the Fund found itself in some type of difficulty. LTCM estimated the theoretical "worst case" haircuts that it might face when financing positions at a time of severe stress. For example, the firm assumed that financing haircuts could increase from 0% to 2% on German government bonds, 0% to 5% on Italian government bonds, and that it might face haircuts as high as 10% on instruments such as AAA-rated commercial mortgages which the firm presently could finance with 2% haircuts. Of course, these theoretical haircuts could only be incurred upon the maturity of the existing financings of the various positions, and these maturities were staggered over time. LTCM thus could forecast a worst-case schedule of potential liquidity needs over time, and was careful to structure its financing so that the Fund would not be forced to liquidate positions rapidly solely due to disruptions in the financing markets. In September 1997, although the Fund's sources of working capital totaled $7.63 billion, its uses of working capital were less than $1.7 billion—$200 million for haircuts on bond positions, $500 million for margin requirements on equity positions, $780 million for margin on futures positions, and about $200 million for miscellaneous operational purposes.

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[13] Futures margin requirements were set by the futures exchanges, and varied considerably depending on the riskiness of the contracts. For example, margin requirements were approximately 0.03% of notional for Eurodollar futures, 1.8% of notional for U.S. Treasury bond futures, and 7% of notional for stock index futures. Equity margin requirements varied considerably by jurisdiction. Under Regulation T, U.S. investors could leverage equity positions at most two to one.

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LTCM believed the combination of its structure of long-term financing, its careful management of liquidity, its large capital base, the transparency created by mark-to-market accounting, and the low risk of its portfolio all combined to give dealers a high degree of comfort. In turn, this resulted in the Fund receiving favorable financing terms relative to other market participants. Dealers derived significant revenues from their trades with the Fund, and they became very competitive in seeking LTCM's business.

Back Office

To make its approach operational, LTCM had to invest heavily in back-office technology. At any time, the firm would have many trades on in large sizes. For example, in September, 1997, the portfolio contained approximately 100 different strategies and 7,600 positions of all types, of which 6,700 were separate contractual agreements.

LTCM usually would transact with multiple counterparties in the execution of a single strategy. In particular, to get the best execution, the firm often executed the different legs of a trade with different counterparties. For example, in the swap-spread trade, it might execute the long position in Treasury bonds with one dealer, and the offsetting interest-rate swaps with another. Over the course of building up a $5 billion position in this trade, LTCM might have involved as many as five dealers, and its back office would have to manage the transactions and collateral flows associated with each of these counterparties.

While it could outsource many of the functions associated with the clearing and settlement of transactions in securities (mostly with the securities firm Bear Stearns & Co.), LTCM internalized most of the back-office functions associated with contractual agreements, due to the complexity and advanced nature of many of the firm's trades. This also helped maintain the confidentiality of its positions. LTCM chose Bear Stearns as a clearing agent partly because Bear Stearns was committed to customer businesses rather than being focused on proprietary trading, and thus there were fewer conflicts of interest.

LTCM had executed contractual or repurchase agreements with 55 separate counterparties. With each counterparty, the firm would have a master swap agreement that would permit some netting of collateral flows. Full netting was difficult to achieve since LTCM typically would transact with multiple legal entities within the same firm (domestic financing, international financing, and contractuals) and large financial institutions tended not to have the capability of performing intrafirm netting. LTCM's back office typically managed three collateral flows per day with each of its major counterparties.

Regulatory Oversight and Disclosure

LTCM was subject to regulatory oversight by a primary regulator in each of its geographic locations. In the United States, by virtue of its trading in futures contracts, the management company was formally registered as a Commodity Pool Operator. The firm thus was regulated by the Commodity Futures Trading Commission and the National Futures Association. Similarly, in the United Kingdom, LTCM was regulated by the Financial Services Authority and the Securities and Futures Authority. In Japan, LTCM was regulated by the Ministry of Finance. This regulation was less intense than that applicable to a commercial bank or broker-dealer in that the Fund faced no capital requirements per se.

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LTCM disclosed pertinent information to the regulators on a periodic basis. In particular, the firm disclosed the Fund's balance sheet and off balance sheet positions annually. LTCM also was subject to on-site examinations and audits.

For competitive reasons, LTCM did not disclose individual positions. However, lenders and other counterparties received quarterly balance sheets showing aggregate assets, debt, total liabilities, equity and leverage, and annual financial statements with audited balance sheets including off balance sheet contractual and derivative obligations.

The Issue of Fund Size

The issue of fund size arose as a result of the Fund's extraordinary investment performance. During 1996 alone, the Fund earned profits before fees of $2 billion following the rapid convergence of some of LTCM's larger trades. For LTCM's principals, two key determinations would have to underlie any decision to return capital: That the Fund's positions had reached a size where they were no longer scalable; and that the Fund was excessively capitalized given the level of risk in the portfolio and the Fund's liquidity needs.

With respect to the scalability of positions, LTCM had found that the gains that could be obtained by adjusting the size of positions in response to changes in relative value were limited by market liquidity. On many occasions strategies had converged before LTCM had been able build its positions to the desired size. In these cases the trades were profitable, but the dollar profitability would have been the same even if the Fund had been smaller. The firm had also experienced many instances in which prices moved adversely while LTCM was attempting to exit a position after it had converged, suggesting that the firm's trades were having a larger market impact. Both of these problems would arise more frequently, the principals realized, if the position sizes were increased further.

To assess capital adequacy, LTCM thought of the risk level of the portfolio in terms of both the economic risk of the trades—as measured by potential marked-to-market losses in the Fund's NAV—and also the Fund's potential liquidity needs. As already mentioned, LTCM had thus far found it impractical to scale the trades to a level where the portfolio risk reached the firm's stated target of a 20% standard deviation of NAV. The firm's current expectations were for excess returns of about $750 million over the next year, with an annualized standard deviation of daily profits of $720 million. This standard deviation was only 11% of equity capital.

In addition, LTCM's estimates of the Fund's liquidity needs in an adverse funding scenario were well below its currently available sources of liquidity. The principals believed that, from a risk and liquidity management perspective, the Fund could comfortably sustain its present and anticipated trades on two thirds of its present capital base. And if that were the case, it meant that the marginal expected return on the last $2 billion of the Fund's capital was little more than Libor before fees, and approximately Libor – 2% after fees.

Given these assessments, LTCM faced an interesting array of choices. One alternative was to make the Fund a large, low-risk investment vehicle with expected returns much lower than the returns that had been achieved to date. Under this approach, LTCM would inform the investors about the return prospects going forward, but would not require any investor to withdraw capital. As long as the Sharpe Ratio remained high, many institutional investors who were able to leverage their investments would still find the Fund attractive. However, other investors, possibly including principals and employees of LTCM, might choose to withdraw some capital.

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Another option was to shrink the Fund's capital base so as to return the risk to its historical level. The principals believed that this would provide an expected return closer to (though still less than) the historical returns. Since the marginal return on incremental capital in the fund was low, sending capital back to investors would give them the opportunity to seek more profitable investments elsewhere. Under this option, the principals would have to decide which investors to redeem. For example, the principals could choose to withdraw mostly their own capital; or they could leave their own capital in place and redeem outside investors. If they redeemed outside investors, they could redeem all investors proportionately, or they could distinguish between founding and later investors. They also could choose to return investment profits to investors but not their original capital. In the extreme, LTCM's strategy could be to redeem all outside investors over time, and manage a fund consisting solely of principals' and employees' capital.

In general, the principals felt that a core long-run objective should be to maximize the value of the management company (LTCM). While the above choices did not necessarily exclude other actions, the principals wanted to think broadly about the firm's choices. For example, as a specialist in financial technology, and with its lean organization, LTCM might be very attractive to a large institution wishing to reengineer its financial intermediation businesses. Such an institution might be willing to pay a very high price for LTCM. LTCM also could consider a public share offering which would be a means to raising truly permanent equity capital. In addition, the availability of traded equity and a market valuation of the firm would make it easier to negotiate the compensation and ownership claims with existing and future employees that arose in the ordinary course of building and managing any professional services firm.

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Exhibit 1 LTCM monthly returns

	Fund Capital ($billions)	Gross Monthly Performance[a]	Net Monthly Performance[b]	Index of Net Performance
				1.00
Mar-94	$1.1	-1.1%	-1.3%	0.99
Apr-94	$1.1	1.4%	0.8%	1.00
May-94	$1.2	6.8%	5.3%	1.05
Jun-94	$1.2	-3.9%	-2.9%	1.02
Jul-94	$1.4	11.6%	8.4%	1.10
Aug-94	$1.5	3.8%	3.0%	1.14
Sep-94	$1.5	-0.4%	-0.3%	1.13
Oct-94	$1.5	1.0%	0.4%	1.14
Nov-94	$1.6	7.7%	6.1%	1.21
Dec-94	$1.6	-0.8%	-0.5%	1.20
Jan-95	$1.8	6.5%	4.5%	1.25
Feb-95	$1.8	-0.8%	-0.6%	1.25
Mar-95	$1.8	3.2%	2.5%	1.28
Apr-95	$2.2	2.4%	1.7%	1.30
May-95	$2.4	6.2%	4.9%	1.36
Jun-95	$2.5	1.2%	1.0%	1.37
Jul-95	$3.0	5.3%	4.0%	1.43
Aug-95	$3.1	3.5%	2.7%	1.47
Sep-95	$3.3	8.3%	6.6%	1.56
Oct-95	$3.5	4.1%	3.0%	1.61
Nov-95	$3.7	3.5%	2.8%	1.66
Dec-95	$3.6	4.2%	3.4%	1.71
Jan-96	$4.0	8.8%	6.2%	1.82
Feb-96	$4.1	4.2%	3.2%	1.88
Mar-96	$4.1	1.4%	1.1%	1.90
Apr-96	$4.7	11.1%	8.1%	2.05
May-96	$4.6	1.7%	1.4%	2.08
Jun-96	$5.1	6.6%	5.3%	2.19
Jul-96	$5.2	1.9%	1.1%	2.21
Aug-96	$5.2	-0.3%	-0.2%	2.21
Sep-96	$5.5	7.1%	5.7%	2.33
Oct-96	$5.5	-0.3%	-0.6%	2.32
Nov-96	$5.6	1.3%	1.1%	2.34
Dec-96	$5.2	3.5%	2.9%	2.41
Jan-97	$5.6	6.1%	4.2%	2.51
Feb-97	$5.7	0.6%	0.5%	2.52
Mar-97	$5.8	2.1%	1.6%	2.56
Apr-97	$5.9	1.8%	1.0%	2.59
May-97	$6.0	4.2%	3.2%	2.67
Jun-97	$6.2	-1.8%	-1.4%	2.63
Jul-97	$6.2	1.8%	1.0%	2.66
Aug-97	$6.7	0.8%	0.7%	2.68

Source: LTCM

[a] Gross of all fees.
[b] Net of fees paid to LTCM.

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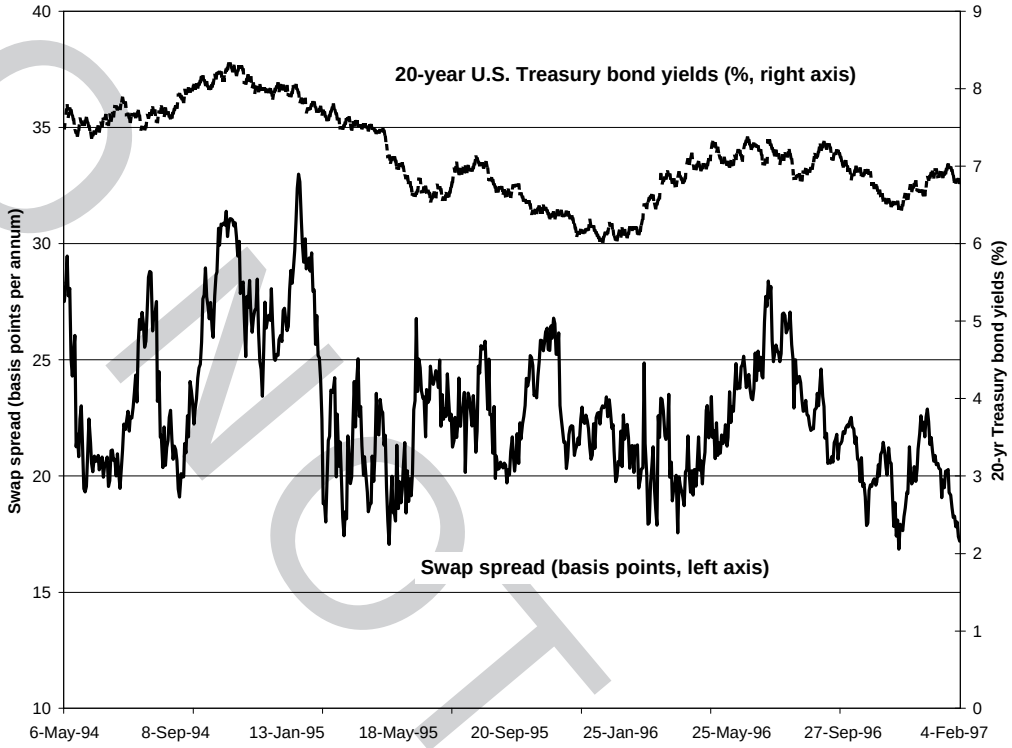
Exhibit 2 20-year U.S. Treasury bond yields and swap spreads



Source: LTCM

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Exhibit 3 Portfolio risk for N positions (Standard deviation of annual profits, $ millions) [a]

Number of Positions (N)	Portfolio Risk if Position Profits are Perfectly Correlated	Incremental Risk	Portfolio Risk if Position Profits are Uncorrelated	Incremental Risk
1	100		100	
2	200	100	141	41
3	300	100	173	32
4	400	100	200	27
5	500	100	224	24
6	600	100	245	21
7	700	100	265	20
8	800	100	283	18
9	900	100	300	17
10	1,000	100	316	16

Source: LTCM

Exhibit 4 Standard deviation of monthly returns

	1994 (Mar-Dec)	1995	1996	1997 (Jan-Aug)
Fund Gross	4.80%	2.45%	3.68%	2.56%
Fund Net	3.46%	1.80%	2.68%	2.02%
S&P 500	3.04%	1.50%	3.15%	4.65%

Source: LTCM

[a] Each position is assumed to have the same stand-alone risk of $100 million (standard deviation of annual profits.)

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Exhibit 5 The Fund's total assets, capital and leverage (June, 1994 to August, 1997)

Month	Total Assets ($billions)	Total Capital ($billions)	Leverage Ratio	Capital Ratio
Jun-94	17.4	1.2	14.5	6.9%
Jul-94	18.6	1.4	13.7	7.3%
Aug-94	23.0	1.5	15.7	6.4%
Sep-94	25.8	1.5	17.7	5.6%
Oct-94	26.2	1.5	17.7	5.7%
Nov-94	28.7	1.6	17.9	5.6%
Dec-94	29.5	1.6	18.1	5.5%
Jan-95	31.5	1.8	17.6	5.7%
Feb-95	29.8	1.8	16.7	6.0%
Mar-95	39.7	1.8	21.6	4.6%
Apr-95	43.7	2.2	20.2	5.0%
May-95	49.7	2.4	20.6	4.8%
Jun-95	59.8	2.5	23.8	4.2%
Jul-95	64.8	3.0	21.6	4.6%
Aug-95	72.0	3.1	23.3	4.3%
Sep-95	86.0	3.3	26.1	3.8%
Oct-95	101.3	3.5	28.7	3.5%
Nov-95	106.4	3.7	29.1	3.4%
Dec-95	102.0	3.6	28.3	3.5%
Jan-96	112.2	4.0	28.3	3.5%
Feb-96	115.4	4.1	27.9	3.6%
Mar-96	127.3	4.1	31.2	3.2%
Apr-96	134.7	4.7	28.9	3.5%
May-96	139.2	4.6	30.0	3.3%
Jun-96	125.7	5.1	24.7	4.0%
Jul-96	130.3	5.2	25.0	4.0%
Aug-96	130.8	5.2	25.2	4.0%
Sep-96	129.7	5.5	23.4	4.3%
Oct-96	125.8	5.5	22.7	4.4%
Nov-96	129.0	5.6	22.9	4.4%
Dec-96	132.4	5.2	25.6	3.9%
Jan-97	137.6	5.6	24.6	4.1%
Feb-97	130.1	5.7	22.8	4.4%
Mar-97	121.8	5.8	21.2	4.7%
Apr-97	111.9	5.9	19.1	5.2%
May-97	122.1	6.0	20.3	4.9%
Jun-97	123.4	6.2	19.8	5.1%
Jul-97	128.6	6.2	20.8	4.8%
Aug-97	126.4	6.7	19.0	5.3%
		Average	22.5	4.6%

Source: LTCM

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Exhibit 6 Comparative Balance Sheet and Other Financial Information ($ millions, Fiscal Year End 1996) [a]

	Salomon Inc.	Morgan Stanley	Lehman Brothers	Bankers Trust	Chase Manhattan
Net income	617	1,029	416	612	3,366[b]
Assets					
Cash and short-term instruments	1,230	7,709	2,837	5,352	22,949
Collateralized lending (reverse repurchase agreements, securities borrowed)	72,698	100,137	52,991	34,662	28,966
Financial instruments owned	113,796	70,747	61,453	56,839	108,502
Commercial loans and other loans				15,053	151,543
Other assets	7,157	17,853	11,315	8,329	24,139
Total assets	194,881	196,446	128,596	120,235	336,099
Liabilities					
Commercial paper	1,106	14,153	3,074	8,080	4,500
Other unsecured short-term borrowings	5,711	6,308	5,128	11,315	9,231
Deposits				30,315	180,921
Short sales (instruments sold, not yet repurchased)	83,507	37,168	26,364	12,128	38,136
Collateralized financing (repurchase agreements, securities loaned)	79,127	92,271	62,415	23,000	53,868
Long-term debt	13,370	14,498	15,922	11,839	12,714
Other liabilities	7,203	24,645	11,819	14,418	15,185
Total liabilities	190,024	189,043	124,722	114,751	314,555
Shareholders' equity	4,587	7,403	3,874	5,484	21,544
Leverage ratio	42.5x	26.5x	33.2x	21.9x	15.6x
Contractual agreements (notional amounts)	1,981,300	1,317,000	1,516,822	1,803,369	5,712,100

Source: LTCM

[a] Source: Company annual reports
[b] Before restructuring charge.

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