

An Overview of Hedge Fund Strategies

Gregory Connor and Teo Lasarte*

This paper gives an overview of the most common hedge fund strategies, and their implications for portfolio risk and return. The paper is intended as a review of the existing literature rather than as an original contribution to the research frontier. The paper should be accessible to masters-level students in finance, or investment practitioners with good knowledge of modern finance theory. The first section looks at some of the key issues in categorizing hedge fund investment strategies. Section two discusses various long/short strategies; section three, event-driven strategies; section four, tactical trading strategies; and section five, relative value strategies. Section six discusses empirical methods used to identify a hedge fund's strategy based on its past returns, and section seven concludes. A bibliography and a glossary of terms appear at the end of the paper.

1. Categorizing Hedge Fund Investment Strategies

In this section we discuss the key issues in defining hedge fund strategies and some of broader strategy groupings that have been suggested. We will focus on specific, more narrowly defined strategies in later sections.

Hedge funds are speculative investment vehicles designed to exploit superior information held by their managers.¹ Information-based trading requires that the information motivating the trade must be kept secret, at least until after all profitable trades are executed.² A hedge fund manager will only be willing to reveal the full details of his strategy after he has decided that it is no longer worth pursuing. Nonetheless, hedge fund managers are usually willing to describe the general outlines of their strategies, in ways that do not divulge potentially profitable trading information.

Fung and Hsieh (1997) classify a hedge fund's strategy according to both "style" and "location". Here, "style" refers to the type of positions the fund manager is taking, such as going long and short, betting on a particular type of corporate event, or maintaining market-neutrality. "Location" refers to the asset class that the hedge fund invests in, such as fixed income, equity, or currencies.

Another common approach is to separate hedge fund strategies according to whether they are market neutral or directional. Market neutral funds have a low correlation with the overall market return. Directional funds specifically take bets on market movements, and so their returns are often strongly correlated with the market.

* Connor is at London School of Economics, and Lasarte at Standard Life Investment Management. We would like to thank Sheng Li and Abishek Kapur for helpful comments on an earlier draft.

¹ See Connor and Woo (2003) for an introduction to hedge funds.

² In fact, the cost of revealing likely trades is even larger than the lost profit opportunities. Competing traders can "front-run" likely trades and thereby gain from the price impact associated with the other manager's trading behaviour. There is also the risk of a "liquidity squeeze" when the revealed trader seeks to unwind his position.

Amenc, Martellini and Vaissié (2002) distinguish between “return enhancer” strategies and “risk reducer” strategies. They cite distressed securities, event-driven and macro funds as ‘return enhancers’, meaning that these funds seek very high expected return but also increase overall portfolio volatility. On the other hand, convertible arbitrage, fixed income arbitrage, long/short and short selling funds are cited as ‘risk reducers,’ offering positive excess returns while also decreasing overall portfolio volatility.³

Another binary system is to classify hedge funds according to whether their investment approach is systematic or discretionary. Systematic strategies base their trading on complex computer programs. Discretionary funds base their trading decisions on the hedge fund manager’s judgment. Many funds fall between these two extremes.

Hedge funds are often segmented according to the asset class that they invest in. There are hedge funds trading solely in equities; others specialize in fixed income or currencies. Hedge funds can also be grouped according to the geographical location of the assets they trade in (using the term “location” in a more traditional sense than Fung and Hsieh above). For example, some funds may be focused on European assets while others may be limited to emerging markets. A hedge fund that has a mandate to invest in any country is labeled as a global fund.

Many funds are multi-strategy, where the hedge fund manager changes investment strategies depending on market conditions or allocates capital across different strategies simultaneously. A well-documented example is LTCM, which although usually classified as a relative value fund in fact also took positions in merger and takeover events.

One interesting division of hedge funds strategies is according to their historical roots. Some hedge fund strategies trace their lineage back to the original hedge fund industry, which was started by Alfred Winslow Jones in the late 1940’s. Others are descendants of trading desk strategies originally practiced only within brokerage houses and investment banks. Other strategies developed out of commodities and futures trading (particularly but not exclusively currency trading). We will mention a few of these historical roots when we discuss individual strategies later.

It should be noted that any attempt to establish a formal system of classification for hedge fund strategies is limited by the fact that these strategies are continually changing. As investment opportunities shift, hedge fund managers modify their investment plans or design new ones to take advantage of profit opportunities. For example, recently several hedge funds began taking direct positions in leveraged buyouts, previously the domain of private equity firms.

A widespread method of hedge fund investment is the fund of hedge funds approach. Funds of hedge funds allocate their capital by either investing in hedge funds with different strategies, or investing in many hedge funds with the same strategy. We do

³ Here it is important to distinguish between the volatility of the hedge fund considered in isolation and its effect on the total portfolio volatility of the final investor, who typically has only a small part of total wealth invested in the fund.

not consider a fund-of-funds as a separate hedge fund “strategy” -- the strategy classification is more appropriately applied at the individual fund level.

There is no consensus on a formal system of classifying hedge funds. Hedge Fund Research (HFR), one of the main hedge fund databases, lists 30 separate strategies (with some overlap between them). Another widely used database, TASS Research, separates hedge funds into 17 strategy types. Table 1 compares the strategy classifications used by four of the largest index providers.

In the next four sections we will discuss some specific hedge fund strategies, grouping them under four broad themes: long/short, event driven, tactical trading, and relative value.

2. Long/Short Strategies

Long/short strategies exploit the ability of hedge fund managers to freely short equities, an opportunity not available to most portfolio managers operating under traditional investment mandates. Long/short strategies separate individual stock risk from market risk.

Equity Market Neutral Strategy is the classic (and original) hedge fund strategy. This was the strategy proposed by Alfred Winslow Jones, who started the first hedge fund in 1949. A market neutral strategy uses the combination of buys and short-sales (sometimes augmented by options and futures positions) to offset any correlation between the portfolio return and the overall market return.

Alfred Winslow Jones’ motivation for using a market-neutral strategy was his perceived information advantage: he considered himself a stock picker, rather than a market timer. If a portfolio manager is not attempting to speculate on the overall market move, then eliminating its ancillary effect on portfolio return serves to highlight the contribution of the manager’s security selection ability to performance. This also benefits the final investor in the hedge fund. If the final investor knows that the hedge fund allocation will not affect his overall portfolio’s sensitivity to market movements, then the contribution of the hedge fund to portfolio volatility is greatly reduced.

Market neutral investing is related to the concept of portable alpha.⁴ Suppose that a stock selector/fundamental analyst has superior information about the returns of a collection of assets. In the context of a traditional active fund, this information can be used to outperform the market benchmark by over-weighting those securities with forecasts of positive returns and underweighting (or zero-weighting) those with forecast negative returns. Alternatively, the stock selector/fundamental analyst can exploit his superior information via a hedge fund. He takes long positions in the securities he expects to have positive returns and short positions in securities where he expects negative returns. Note that this hedge fund, combined with a benchmark index tracking fund, is essentially identical to the same manager’s traditionally-structured active fund. Due to his superior information, the stock selector/fundamental analyst has “portable alpha” which can be implemented either

⁴ See Kung and Pohlman (2004) for a discussion of portable alpha.

via a hedge fund or via a traditional active fund. The market-neutral hedge fund combined with a benchmark index tracking fund is equivalent to a traditional active fund run by the same manager.⁵

By using a market-neutral hedge fund to exploit his superior information, the stock selector/fundamental analyst allows final investors to make their own choices about the market risk exposures of their aggregate portfolios. With the traditional active fund, the choice of market risk exposure is bundled together with the stock selection decisions. If the stock selector/fundamental analyst perceives no ability to add value in terms of market timing, then it is better for him to leave this decision to final investors and not dilute his overall performance with extraneous sources of return.

Some analysts have questioned the reliability of the “market neutrality” claim of hedge funds so labelled. Patton (2004) differentiates between market neutrality defined as zero correlation with the market return, and “complete neutrality” defined as no dependence (including nonlinear dependencies) between the hedge fund return and market index return. Complete neutrality accounts for options-like relationships between the market return and hedge fund return. For example, the two returns might be unrelated except when the market return is extremely large in magnitude. Patton finds that empirically about a quarter of self-described market neutral hedge funds are not in fact market neutral, using one or both of his two market-neutrality definitions.

Equity long/short is the same as equity market neutral except without any explicit promise to maintain market neutrality. This increases the flexibility of the manager to choose net-long or net-short (positive beta or negative beta) market exposure, while still focussing primarily on stock-selection opportunities. It has the disadvantage from the perspective of the final investor that it is no longer clear how the hedge fund allocation affects overall portfolio risk.

An important variant of equity long/short, **pairs trading** consists of the combined purchase and sale of two similar securities. The rationale is that one security is overvalued relative to the other. Over time, as the market corrects itself, the pairs trading strategy should yield a positive payoff as the prices of the two securities converge, irrespective of movements in the general market. Generally, the two securities picked will be those of two companies that traditionally were similarly valued in the past but where a pricing anomaly not related to fundamentals has appeared. Pairs trading is not restricted to equity securities and can be applied in other asset classes.

Gatev, Goetzmann and Rouwenhorst (1999) analyse the increasing popularity of pairs trading and attempt to simulate its risk-return pattern. Based on an algorithm minimizing the sum of squared deviations between two prices, they identify pairs of securities whose stocks have historically moved closely together. They then devise a trading strategy that takes advantage of any deviation of the spread between the pairs. Even accounting for transaction costs, the authors find that the strategy generates significant excess returns.

⁵ See Connor and Woo (2003) for detailed analysis linking a hedge fund plus tracking index to a traditional active fund.

Pairs trading is related to the more complex strategy called **statistical arbitrage**. A pure arbitrage opportunity is a zero-cost portfolio with zero probability of a strictly negative payoff and a positive probability of a strictly positive payoff. This is a “sure thing - free lunch” and cannot exist in a well-functioning capital market.⁶ A statistical arbitrage opportunity is a zero-cost portfolio where the probability of a negative payoff is very small but not exactly zero. Ross (1976) was the original developer of this concept and used it as the basis of his Arbitrage Pricing Theory. In practice, the statistical arbitrage trader seeks to exploit a pricing discrepancy between related securities while hedging against all pervasive sources of risk: market risk, sector risk and factor-related risk (such as size, growth and value factors) and diversifying asset-specific risk.

Dedicated Short Bias differs from the other long/short strategies in concentrating on the short side and thereby sacrificing the market-neutrality feature. Not surprisingly, this strategy tends to be most effective when markets are declining.

A motivation for dedicated short bias is the concept that, due to the restrictions on short sales by most institutional investors, there are untapped profit opportunities available to investors who can short-sell freely.⁷ Although explicitly not market-neutral on its own, dedicated short bias can have the same diversifying potential as traditional long/short, when it is part of an aggregate portfolio which includes long-only investment mandates.

Usually, short sellers must focus on the shares of companies with large market capitalisations, as they are more liquid and easier to borrow. Aggressive accounting practices open up possibilities for short selling. The shares of Tyco, the US conglomerate subject to an accounting scandal in 2002, were cited as an excellent opportunity for short sellers who were able to read into the company’s misrepresentations before the rest of the market caught on. In this way, short-sellers can contribute to the informational efficiency and corporate monitoring role of capital markets.

3. Event Driven Strategies

Also classified as “special situation” or “special opportunity” strategies, hedge funds that follow this approach look for events that are expected to make an impact over a relatively short period of time: corporate restructuring, stock buybacks, bond upgrades, earnings surprises, spin-offs. Two main divisions within this category are distressed securities investing and risk or merger arbitrage.

The **distressed securities** strategy focuses on the securities of companies experiencing financial difficulties. The term ‘distressed’ security is used broadly. Sometimes, it is used to refer to the securities issued by companies which have defaulted and filed for credit protection. Other times, the term is used in a wider sense to include securities that are priced at a high premium over their safer

⁶ The non-existence of pure arbitrage opportunities is the most fundamental building block of modern asset pricing theory. See Ross (1978) and Harrison and Kreps (1979) for some classic analysis.

⁷ See Diamond and Verchia (1987) for theoretical analysis of short-sale constraints and their effects on market informational efficiency.

counterparts. Hedge funds following a distressed security investment strategy are not limited to a particular asset type. They are active in bonds, stocks, bank debt, trade claims, private placements, warrants, etc. Some hedge funds focusing on distressed securities are active in the entire market; others limit themselves to more specific sectors. For example, some hedge funds may concentrate solely on the telecommunications sector.

This technique attempts to profit from both relative and absolute pricing inefficiencies. The market for distressed securities is often inefficient and illiquid because of factors such as investor irrationality, risk aversion, legal restrictions on holding sub par securities, low coverage by analysts, and lack of research. An active form of this strategy is to buy a substantial proportion of the outstanding security of the distressed company and then attempt to influence the restructuring process. The distressed security strategy generally involves taking long positions, although a hedge fund manager could take short positions in distressed securities he thinks will worsen.

This strategy carries a particular set of risks. Buying distressed securities is tantamount to placing a bet on the comeback of troubled companies. The length of restructuring is hard to forecast. Prices for distressed securities are typically volatile and illiquid. There are legal risks. For example, regulators may prohibit the selling of a company's stock during the restructuring. Interest rate fluctuations will also have an impact on returns. Some hedge funds may hedge this risk using interest rate futures.

The market for distressed security grew in the 1980s in the US as the number of leveraged buyouts and hostile takeovers increased. In Europe, the market is smaller. One of the reasons is that bankruptcy laws in European countries are less transparent than in the US. Japan is a growing market for distressed debt.

The focus of **merger/risk arbitrage** is on the securities of companies involved in mergers and takeovers, both of the acquiring company and the takeover target. Because of the possibility the merger may not go through, the target company's share price usually carries a 'bid premium', a discount to the proposed takeover price (in a cash offer), until the merger or takeover is finally completed. In a stock offer, the mechanics of the merger arbitrage strategy are more complex. The acquirer will offer common stock as a form of payment, either entirely or partially. It is more difficult to evaluate the expected payoffs as the price of the target firm's stock depends on the other company's share price. Usually, when a stock offer is announced, the target firm's share price rises, while the share price of the bidding company falls. The arbitrage strategy usually will involve buying the former and short-selling the latter. As with distressed securities investing, an active form of the strategy is to accumulate large shareholdings in order to influence the merger negotiations and outcome.

Merger arbitrage carries a variety of risks. When there are antitrust issues concerning the merger or takeover, there is the possibility that regulators will block the deal. There is also a financing risk, in that the acquirer could lose the financial backing to carry out the purchase. Some hedge funds invest in a large number of deals simultaneously to hedge their risks. Others take a more concentrated approach.

The volume of mergers and takeovers taking place tends to be highly cyclical, which influences the opportunities for merger arbitrage. During “slow” periods the available profit opportunities are correspondingly small.

An example of a merger arbitrage trade occurred during the takeover of Mannesmann by Vodafone AirTouch. On November 14, 1999 Vodafone announced a bid offer of 53.7 of its shares for each share in Mannesmann. The next day, although Vodafone shares shot up, the bid premium still stood at 22.5%. On February 4, 2000, Vodafone increased its offer to 58.9646 of its shares. Arbitrageurs who had bought shares in Mannesman and sold short shares in Vodafone profited handsomely.

4. Tactical Trading Strategies

Tactical trading strategies attempt to profit by forecasting the overall direction of the market or a market component. The payoffs of hedge funds specializing in this area depend on how well a hedge fund manager can forecast price movements as well as predict the exact timing of these movements.

Macro strategies make large bets based on forecasts of major macroeconomic events such as changes in interest rates, currency movements and stock market performance. In searching for investment opportunities, strategists will take into consideration a diverse set of factors such as geopolitical issues, economic indicators, market trends and liquidity flows. Macro funds are active in a wide variety of markets including foreign exchange, futures, fixed income, equity, as well as both exchange-traded and over-the-counter securities.

Macro funds often take on leverage and actively use derivatives. Managers have substantial flexibility and invest in any country or asset class where they see an opportunity. The strategy relies on the ability to make superior forecasts compared to other market participants and then act swiftly and decisively.

The return profile of macro funds is much more volatile than that of other hedge funds. Part of the reason is that macro funds often trade in instruments that are relatively illiquid. Also, correlation among assets in emerging markets, where these funds often invest, is much higher than in developed markets. There are a unique set of risks in investing in emerging markets such as political hazards and the lack of an adequate legal system.

There is controversy as to whether macro hedge funds contribute to market instability. Some commentators blamed macro funds for contributing to the EMS crisis in 1992, the turbulence in international bond markets in 1994, and the East Asia crisis of 1997-1998. Whether macro-strategy hedge funds were instrumental in the depreciation of East Asian currencies during the crisis of 1997 is also a subject of debate. Eichengreen (2000) and de Brouwer (2001) offer opposing views on the subject.

An example of the type of investment followed by macro funds is the yen carry trade. At its peak in mid-1998, de Brouwer estimates that there was \$200-\$300 billion invested in this strategy, half of it coming from hedge funds. The trade consisted of borrowing Japanese yen, taking advantage of extremely low interest rates in Japan, and investing the proceeds in dollar-denominated assets such as Treasury bills, which

had higher yields. As long as the yen did not appreciate, the strategy provided substantial payoffs.

Commodity Trading Advisors (CTAs)/Managed futures strategies specialize in the commodity and financial futures markets, often employing sophisticated computer driven trading programs. These funds tend to use very precise trading rules to capture price movements, and focus on short-term patterns. Although historically classified as a separate asset class from hedge funds, that distinction has blurred. CTAs are now generally viewed as part of the hedge fund industry.⁸

A **long-only leveraged strategy** is similar to a traditional active management strategy but carries more risk as the strategy involves leverage, on top of an aggressively active portfolio. Funds following this approach are often labelled under the “aggressive growth” title and lie at the boundary separating traditional active funds from hedge funds. These funds do not have any explicit “hedge” features; they are attracted by the lighter regulation and stronger incentive fee structures of the hedge fund industry.

5. Relative Value Strategies

Relative value strategies are designed to take advantage of perceived mispricing among related financial assets, such as a single company’s debt and equity securities. These strategies rely on the long-run tendency of market prices to revert to equilibrium relationships, while deviating in the short-run, providing profit opportunities.

As with the long/short investing approach, this class of strategies involves buying and selling two or more related securities. The risk of these strategies depends upon how closely related are the securities bought and sold short. Generally this strategy is characterized by low volatility and little correlation with the market.

It is common for hedge funds active in relative value strategies to hedge their exposure to the price movements of the underlying securities, interest rates, and broad market movements. Since relative value price discrepancies tend to be small, hedge funds operating in this area tend to be among the most leveraged, in order to magnify potential gains.

Convertible arbitrage: A convertible security (or convertible bond as it is also known) is a fixed income instrument issued either as debt or preferred shares. The holder receives a fixed coupon or preferred dividend payments as well as cash at maturity. In addition, the holder of the bond has the right to convert the security into a certain number of shares instead of receiving the full payment.

The convertible bond is often referred to as a hybrid security and is particularly difficult to value. On the one hand, it can be viewed as corporate debt since it ranks

⁸ Liang (2004) however argues that CTAs follow distinctly different trading strategies from hedge funds.

senior to equity in the case of bankruptcy, and so its value depends on interest rates. On the other hand, it can be analysed as equity in that the holder has the right to convert into a fixed number of common shares. And finally, the security carries an implicit option to exchange the bond for shares. There are often call provisions, where the issuer has the right to buy back the issues, or put provisions, in that holder can redeem the issue at a fixed price. If the share price rises, a convertible bond price will tend to behave similarly to a share price. If the share price falls, convertible prices are more closely related to those of regular bonds.

Convertible securities are typically undervalued relative to an equivalent combination of equity and pure debt securities. First, the market is small, as most convertible issues are rated below investment grade and therefore not suited for many investors. Second, there is a general lack of liquidity in this market. Third, individual convertible issues are often small and are rarely followed by analysts. And fourth, investors may have a natural preference for 'clearer' assets such as traditional bonds or stocks.

Convertible arbitrage strategies typically take a long position in the convertible bond and short the company's equity. In doing so, the investor takes advantage of the undervaluation of the convertible bond while reducing the exposure to the underlying stock price movement. An important parameter in this trade is delta, the proportional change in the value of the convertible bond relative to the change in the underlying stock price. If the stock price increases substantially, convertible bond prices generally increase even more rapidly. The interest on the proceeds from selling short the underlying stock is used to finance the position.

The payoffs on convertible arbitrage are influenced by interest rate movements as well as by changes in credit spreads. There is also a regulatory risk. In 1998, for example, Japanese authorities implemented a set of regulations designed to curb short selling. The Japanese convertible bond market is the largest in the world. It became difficult to short sell stocks and many hedge funds lost money during this period.

Convertible arbitrage strategies are subject to equity risk, interest rate risk and credit risk (since the bond component of convertibles tends to be low grade). Agarwal, Fung, Loon and Naik (2004) find, somewhat surprisingly, that convertible arbitrage funds active in the Japanese market only show significant exposures to equity market risk, not to interest rate or credit risk factors. They conjecture that their findings may not generalize to other convertible bond markets.

Hedge funds are now one of the main sources of liquidity in the convertible bond market. Lhabitat (2002) notes that hedge funds are estimated to own 30% of all convertible bonds outstanding in the US.

Amazon, the online retailer, offers a useful example of how convertible arbitrage strategies can provide payoffs independently of the general market trend. In 1999, the company had a large tranche of outstanding convertible bonds due to mature in 2009. At the time, the company's shares were priced under the assumption of extraordinarily high future growth. However, Amazon's convertible bonds were greatly undervalued. Arbitrageurs bought these securities and shorted Amazon's

stock, while hedging the credit risk. In the following year, even as the price of internet stocks fell, the convertible arbitrage trade yielded high returns as the spread between the valuation of Amazon shares and those of its convertible bonds fell substantially.

Commonly known as ‘cap arb’, **capital arbitrage strategies** exploit mispricing between a company’s debt and equity. A common case of investment opportunities arises when companies are undergoing restructuring processes, as its securities often become mispriced relative to each other.

Equity and debt markets often react to new information differently. For example, a poor earnings announcement might affect a company’s share price immediately but not the price of its debt. Unlike other relative value strategies, capital arbitrage involves taking positions in two different asset classes. In devising a strategy, a hedge fund manager needs to study the correlation between a company’s debt and equity. A more complex example of capital arbitrage involves taking positions in derivatives dependent on one of the assets, such as high yield debt and call options on the stock.

An example of this type of trade would be the case of British Telecom (BT). The company’s debt was downgraded several times during 2001. BT’s bond prices plummeted; however, its share price was somewhat slower to react. Arbitrageurs took advantage of the time lag by taking long positions on BT’s debt and shorting the equity.

Capital arbitrage strategies have grown in popularity in recent years, as telecommunications companies and other technology companies saw their share prices collapse while their bonds were slower to adjust. The growth of credit default swaps, which allow investors to bet on a company’s bond price with relative ease, added to the popularity of this investment strategy.

Fixed income arbitrage strategies attempt to exploit mispricing among fixed income securities. This strategy relies heavily on mathematical models of the term structure of interest rates to identify mispricing and manage positions. There are a number of different techniques that can be identified within the fixed income arbitrage strategy, and some of these are discussed below. Most hedge fund managers engaged in fixed income arbitrage will use several of the techniques, depending upon perceived opportunities. Fixed income arbitrage has its historical roots in the fixed income trading desks of brokerage houses and investment banks.

Yield curve arbitrage involves taking offsetting positions at various points of the yield curve, typically those of a Treasury bill, in response to perceived disequilibrium price relationships. This strategy also can involve looking for pricing imperfections between the futures and cash treasury markets. Hedge funds active in this area often take positions in the futures and swaps markets as an alternative to directly buying or selling bonds.

Consider the following simple scenario. Suppose that the 5-year Treasury bill has a current yield which is substantially above the yield of the 4-year and 6-year bills. Suppose that there is no obvious tax or call provision in the bond which explains this price differential. A yield curve arbitrage strategy would be to buy the relatively

cheap 5-year Treasury bill while shorting the 4-year and 6-year bills. Whatever temporary liquidity pressure has caused the 5-year to be underpriced relative to the 4 and 6-year bills is likely to disappear over time, allowing the manager to unwind the position at a profit. The manager is hedged against general interest rate moves since the 5-year interest rate sensitivity is offset by the short position in the 4 and 6-year bills.

An actual example of a recent fixed income arbitrage trade took place in the first half of 2000. At the time, there were forecasts of a diminished supply of long-term Treasury bonds because of US budget surpluses. This created an excess demand for longer-term issues. As a result, the yield on the 30 year issue was lower than the yield on the 10 year bond, a rare event given that the yield curve is usually upward sloping. Hedge funds took short positions in the shorter-dated bonds, and long positions in the longer-dated securities. Managers were able to unwind at a profit when the normal shape of the term structure was re-established.

Corporate spread arbitrage involves making a bet on the evolution of the interest rate spread between the prices of corporate bonds and Treasury bills. Depending on whether the arbitrageur believes the spread will increase or tighten, the strategy involves taking long and short positions in the two securities. An assessment of the repayment capacity of the corporation issuing the bond can give some indication of where the spread will move. Several authors claim there is some forecasting potential in corporate spreads. A very similar strategy involves taking positions in emerging market debt instead of corporate bonds.

Treasury/eurodollar arbitrage attempts to exploit differences in the yields between Treasury bill rates and those on Eurodollar market. This spread is based on the difference in the credit worthiness of the US government and the main international banks. It is generally quite small but tends to increase during international financial shocks.

A closely related trade was conducted by LTCM in 1994 using Italian securities. The anticipation of the European monetary union and a lack of trust in the Italian government's fiscal policy resulted in a yield on domestic-currency denominated Italian government bonds higher than the Italian lira swap spread in the London interbank market (an agreement to exchange a fixed interest rate for the floating rate). LTCM took advantage of this differential by borrowing at a floating interest rate to buy Italian government bonds. LTCM then repaid the floating rate loan by entering into an interest rate swap, exchanging the fixed payment from the government bond for the floating rate. Given that the fixed amount necessary to carry out this trade was lower than the coupons provided by the government bond (because of a higher yield than the swap spread), LTCM pocketed the difference.

Mortgage arbitrage focuses on mortgage-backed securities (MBS) and their related derivatives. MBS are pools of mortgage-backed debt developed by financial institutions. Historically, these securities presented investors with relatively high yields given relatively low risk. In countries such as the US, agencies such as Ginnie Mae, Fannie Mae and Freddie Mac carry a government-backed guarantee of repayment. Mortgage bonds pay higher interest rates than straight bonds because of the possibility of early repayment and their lack of liquidity.

Mortgage-backed securities are very difficult to price given that homeowners have the option to refinance and repay their loans early. A common trade is to take a long position on a mortgage-backed security and to short a government bond of similar maturity. That way, the investor receives a payoff from the yield differential while hedging the risk from interest rate surprises.

In the early 1990s, mortgage arbitrage was one of the most profitable trades for LTCM. LTCM's traders took long positions in these securities, and short-sold Treasury bonds of similar maturity to hedge interest rate risk. In addition, LTCM used interest rate swaps to hedge for the risk of the yield curve shifting, and bought Treasury bond options to replicate the options implicit in the mortgage-backed securities.

Derivatives arbitrage involves exploiting the difference in pricing between a series of options or between options, futures and the money market. Hedge funds active in this strategy are heavily reliant on mathematical models to exploit investment opportunities.

Stock index futures arbitrage takes advantage of the spread between index futures and price of underlying securities. If the futures price is lower, the manager goes long the future contract while shorting the individual component stocks (or enough of them to create a replicating basket) and waits for the price differential to disappear, and then unwinds the positions at a profit. The opposite arbitrage strategy applies if the futures price is higher than the index-implied price.

ADR arbitrage exploits the difference between the trade prices of American depositary receipts (ADRs) and underlying shares. ADRs are securities issued and traded in a US market such as the New York Stock Exchange and priced in dollars, but backed by foreign-traded shares of a foreign-domiciled company. Sometimes the currency-translated price of the foreign security traded in its home market differs from the ADR price traded on the US market in dollars. Speculators able to act quickly can attempt to exploit these arbitrage price differentials.

6. Identifying Hedge Fund Strategies from Returns

Most hedge fund databases classify hedge funds into strategy groups based solely on self-identification. Time-series analysis is helpful in identifying the risk and return profile of individual hedge funds and hedge fund indices from actual return histories rather than self-reported strategies.

Schneeweis and Spurgin (1996) attempt to explain hedge fund returns based on the type of assets traded and the trading style of the hedge fund managers. They use a broad set of financial and economic indicators, including equity index returns, interest rates, exchange rates and commodity prices, as well as the volatility of these assets and a moving average of commodity and financial futures contract returns. They find that hedge funds are driven by a different set of factors than traditional bond and equity funds.

Martin (2000) also uses this method but first conducts cluster analysis, to group hedge funds according to their particular strategy. After classifying each hedge fund, Martin uses regression analysis to establish a link between the performance of each strategy and a set of economic factors: interest rate swaps, aggregate bond prices, emerging market bond prices, the return on the S&P 500 and the implied volatility on S&P 100 options. Martin finds there is a significant correlation when each strategy is grouped as an index. When the analysis is applied to individual funds the coefficients vary across funds and are not always significant.

Brown and Goetzman (2001) develop a cluster-analysis algorithm which identifies hedge fund strategy groups by minimizing the sum of squares within each group and using a likelihood-based ratio test to identify the optimal number of groups. Brown and Goetzmann do not attempt to link the returns of each strategy to market factors but simply analyse the return and risk profile of each hedge fund strategy cluster. Barès, Gibson and Gyger (2001) use clustering techniques to devise a style consistency test and find that many hedge fund managers do not follow a consistent investment strategy.

Style analysis is a particular application of regression analysis of fund returns in which the explanatory variables are returns on a set of market indices, the regression coefficients must be non-negative, and the sum of the coefficients must add up to one. The coefficient on each market index can be interpreted as the percentage of the portfolio that is allocated to that asset class. Sharpe (1992) developed this model to analyse the returns of traditional investment funds.

Several problems are encountered in applying style analysis to hedge fund returns. First, with hedge funds it is not always clear what are the appropriate market indices to include as explanatory variables. Second, hedge funds often use dynamic trading strategies that switch asset exposures rapidly, and this invalidates the standard regression model. For traditional funds, exposure to an asset class is relatively static and so time-series regression is less problematic. Third, Sharpe's coefficient restrictions (all coefficients nonnegative and summing to one) are not appropriate for most hedge funds. For example, a long-short equity fund could have a positive, negative, or zero exposure to the equity market index, depending upon whether it has under-hedged, over-hedged, or exactly hedged its underlying market positions. No a priori sign restriction on the coefficient is appropriate. Similarly, leverage and the use of derivatives means that the sum of a hedge fund's exposures can easily exceed one.

Fung and Hsieh (1997) modify and extend Sharpe's style analysis to improve its applicability to hedge funds. They attempt to capture the non-linearity displayed in hedge fund returns by including non-linear regressors with options-like payouts. They allocate the hedge fund's returns to three components: the returns of the asset class traded by the fund ("location"), the type of trading strategies followed by the fund, and the amount of leverage used. Fung and Hsieh use a multistep approach. First, they identify five mutually orthogonal components in hedge fund return data using principal component analysis. Second, they construct portfolios of hedge funds correlated with each principal component. They find five different strategies explain much of the data: technically driven strategies which follow trends, opportunistic strategies which place bets on market movements, macro funds, buyers of undervalued securities, and distressed security funds. Third, they then perform a style

analysis for each of the five hedge fund strategy portfolios, regressing returns to traditional asset benchmarks. Fourth, to identify dynamic trading strategies, Fung and Hsieh introduce a technique in which the returns of a hedge fund strategy are analysed in different market environments. The technique involves listing quintiles of returns for one of the different asset classes (equities, government bonds, etc). Hedge fund strategy returns are analysed in each quintile. If a strategy uses a buy-and-hold approach, the returns in the five states of the world should be closely aligned to the asset class. On the other hand, returns that are non-linear and especially large in market extremes are taken as evidence that a hedge fund strategy is following a dynamic trading strategy.⁹ These returns can only be replicated through securities offering non-linear payoffs such as derivatives.

In their empirical analysis, the Fung and Hsieh find that trend-following hedge funds have a return profile similar to a straddle position in US equities. During their sample period the payoffs of opportunistic funds are similar to a call option on gold. Global macro funds had a similar payoff to holding a straddle on the dollar. They construct a model consisting of nine long positions on the traditional assets plus three dynamic trading strategies which can characterize a “substantial part” of the trading strategies of hedge funds.

Agarwal and Naik (2000b) also use modified style analysis to analyse hedge fund strategies. As explanatory variables they construct portfolio returns that include options, to better track the nonlinearities in hedge fund returns. Like Fung and Hsieh they recognize three sources of hedge fund performance: “location”, trading strategy and leverage. They utilize equity, commodity and currency indices to reflect the location element of an investment strategy and as well a collection of zero-net-investment strategies (the difference between small firm and big firms returns, interest rate spreads, etc). To capture the trading strategy element, they use a basket of in-the-money European options (present value of exercise price equals current index value), out-of-the-money options (exercise price is half a standard deviation away from the index value), and a deep out-of-the-money options (exercise price is one standard deviation away from the index value) on several indices. They find that “location” and strategy have useful content, but the difference in excess returns between leveraged and non-leveraged funds is statistically insignificant.

Mitchell and Pulvino (2000) adopt a similar approach. Looking solely at those hedge funds specializing in merger arbitrage, the authors run a regression of hedge fund returns on an equity market index with dummy variables indicating whether returns were above or below a negative 4% threshold level. In flat or rising markets, the average market exposure (beta) of the funds is essentially zero. However, when the market experiences a monthly decrease of over 4%, merger arbitrage funds are positively correlated with the market return. They draw a parallel between investments in the merger arbitrage strategy and holding a long position in a risk-free bond and a short position in a stock index put option.

⁹ Those assets are MSCI US equities, MSCI non-US equities, IFC emerging market equities, JP Morgan US government bonds and JP Morgan non-US government bonds, the one-month eurodollar deposit rate, a trade-weighted dollar exchange rate and the price of gold and a high-yield bond index.

Instead of using option-type returns to capture the non-linearity inherent in hedge fund returns, Lhabitant (2003) uses hedge fund indices. The author uses the nine CSFB/Tremont hedge fund indices in his study. Lhabitant also proposes a rolling window regression to capture changes in hedge fund strategies.

7. Conclusion

Hedge fund strategies are extremely varied. Given this wide diversity, it is appropriate to ask whether there is any common feature to the class of strategies practiced by hedge funds. The surprising answer is yes: there *is* a common theme linking the strategies. Hedge funds focus on strategies that traditional funds cannot undertake, or cannot do well. The three defining characteristics of hedge funds are very strong incentive structures for managers, light regulation, and investment opacity. Hedge funds undertake investment strategies which play to one or more of these strengths. Long-short strategies rely on hedge funds' freedom to short equities and take derivatives positions, both of which are often forbidden for traditional funds, or restricted by funds' investment mandates. Hedge fund strategies requiring razor-sharp decisions in risky environments, such as event-driven strategies and tactical trading strategies, are helped by the very strong management incentives used by hedge funds. The investment opacity of hedge funds is crucial in many relative-value strategies since it prevents other investors from uncovering the fund's positions and squeezing its transactions in illiquid markets.

In contrast to hedge funds, traditional funds are characterized by conservative incentive structures for managers, tight regulation, and investment clarity. This gives traditional funds an advantage for strategies designed to target an asset-class benchmark, with a relatively cautious overlay of active positions. Traditional funds are, and will remain, the dominant vehicle in terms of total asset under management. Hedge funds concentrate on niche strategies where their special features give them a competitive edge over traditional funds.

Table 1: Hedge Fund Strategy Classifications

	<i>Index Provider:</i>	<i>CSFB/ Tremont</i>	<i>MSCI</i>	<i>Standard & Poors</i>	<i>Hedge Fund Research</i>
Strategy Class:	Specific Strategy:				
Event Driven		✓	✓	✓	✓
	Event Driven	✓	✓		✓
	Event Driven Multi-Strategy	✓			
	Merger/Risk Arbitrage	✓	✓	✓	✓
	Distressed	✓		✓	✓
	Special Situation			✓	
Relative Value		✓	✓	✓	✓
	Arbitrage		✓		
	Statistical Arbitrage		✓		
	Specialist Credit		✓		
	Convertible Arbitrage	✓		✓	✓
	Fixed Income Arbitrage	✓		✓	
	Relative Value Arbitrage				✓
Long /Short		✓	✓	✓	✓
	Long/Short equity	✓			
	Dedicated Short-sellers	✓			
	Equity Market Neutral	✓		✓	✓
	Equity Hedge				✓
	Long bias		✓		
	No bias		✓		
	Short bias		✓		
	Variable Bias		✓		
Tactical		✓		✓	✓
	Global Macro	✓		✓	✓
	Managed Futures	✓		✓	
	Equity/Long			✓	
Location		✓	✓		
	Developed Markets		✓		
	Emerging Markets	✓	✓		
	Global		✓		
Multiple Strategy		✓			

Glossary

Absolute Return—Portfolio return without subtracting any benchmark return.

Active Management—Conducting valuation research and then choosing a portfolio in an attempt to outperform the average investor by overweighting undervalued securities and underweighting (or short-selling) overvalued ones. See **Passive Management**.

Active Return—Portfolio return minus the benchmark return.

Active Risk—Standard deviation of active return. The term is also sometimes used to refer to the difference between the risk exposures of the portfolio and the benchmark.

ADR—Securities issued and traded in a US market and priced in dollars, but backed by foreign-traded shares of a foreign-domiciled company,

ADR arbitrage—Strategy exploiting the difference between the trade prices of American depositary receipts (ADRs) and underlying shares.

Aggressive growth strategy—Funds following aggressive and often leveraged long only strategies.

Alpha (or Jensen's Alpha)—The average or expected out-performance of an asset or portfolio, adjusted for market risk. Historical alpha (average outperformance over an earlier sample period) is called *ex-post* alpha, whereas forecast alpha (expected outperformance in the future) is called *ex-ante* alpha.

Alternative Investments—Broad category of investments, other than stocks and bonds, including venture capital, private equity, precious metals, collectibles, and hedge funds.

Arbitrage—In theory, profiting by exploitation of mispriced securities while hedging away all risk. In practice, arbitrage strategies do not eliminate all risk.

Arbitrage Pricing Theory—An asset pricing model that specifies returns as a linear function of multiple factors in an arbitrage free economy.

Beta—Measure of covariation between asset or portfolio return and market index return.

Capital arbitrage strategies—Strategies exploiting mispricing between a company's debt and equity (also known as *Cap Arb*).

Cluster-analysis algorithm—Algorithm to group together similar return profiles, with items in each group as similar to each other and as different from items in other groups as possible.

Commodity Trading Advisor (CTA)—Asset manager who specialises in portfolios consisting of futures and options on commodities or on any other type of underlying security. Some CTA's deal only in futures and options on stocks and bonds and do not trade in any traditional commodity market futures.

Complete market neutrality—A fund with no dependence (including non-linear dependencies) between its return and the market index return. This is stronger than no correlation which covers only linear dependence.

Convertible Arbitrage—Strategy to exploit mispricing between a convertible bond and the underlying security.

Corporate spread arbitrage—Arbitraging the additional yield offered by a corporate bond over ‘riskless’ bond yield (to cover risk of default by corporate borrower) when the default premium is too high.

Credit spreads—Additional yield offered by a risky bond over ‘riskless’ bond yield to cover for risk of default by issuer.

CSFB/Tremont—Hedge fund index provider (for details on strategies covered see Table 1 in the text).

Dedicated short bias—Directional strategy with overall bias of short positions.

Delta—The change in the value of a derivative security relative to the change in the underlying asset price.

Derivative—Financial instrument whose value depends upon the value of an underlying security. Options, forwards, and futures are examples of derivatives.

Derivatives arbitrage—Strategies relying on mathematical models to exploit the difference in pricing between a set of derivatives (options, futures, etc) and the underlying asset prices.

Directional—Describing an investment strategy that relies upon predicting the direction of an overall market movement, rather than the mis-pricing of individual securities. Global macro is an example of a directional strategy, as opposed to for example convertible arbitrage.

Discretionary Trading—Security selection that uses the intuition of portfolio managers as well as computer models.

Distressed Securities—The equity and debt of companies that are in or near bankruptcy or in a similar chaotic situation. Distressed securities may be purchased in an event-driven hedge fund.

Distressed securities strategy—Strategy exploiting relative and absolute mispricing in distressed securities (see Distressed Securities).

Drawdown—The amount lost during a particular measurement period such as a month or year. Maximum drawdown, a common measurement, is the maximum loss during a measurement period, had an investor bought at the highest valuation during the period and sold at the lowest valuation.

Event Driven Strategies—Hedge fund strategies that exploit anomalous pricing of securities due to corporate events such as mergers, financial distress, or debt refinancing.

Equity long/short—Same as equity market neutral except without any explicit promise to maintain market neutrality (see Market Neutral).

Fixed Income Arbitrage—Exploitation of anomalies in debt securities, such as unusual risk premiums, yield curve shapes, or prepayment patterns.

Fund of Funds—Managed portfolio of other hedge funds. Also known as a “fund of hedge funds.”

Global Macro—Hedge fund strategy where large directional bets are made, often on the direction of currency exchange rates or interest rates.

Hedge Fund Research (HFR)—Hedge fund index provider (for details on strategies covered see Table 1 in the text).

High Watermark—Incentive (performance) fee is based upon surpassing an absolute level of success. With a high watermark, a hedge fund that loses in its first year and then merely regains that loss in the second year will not result in the manager receiving an incentive payment for the second year gain.

Location—Method of classification based on asset classes (fixed income, equities, currencies, etc). Also used in the more traditional sense to indicate geographical boundaries chosen by funds.

Long/Short Equity—Hedge fund strategy that is based on skill in security selection, taking both long and short positions. The resulting portfolio is not necessarily market-neutral, because it may exhibit a long-bias or short-bias.

Long-only leveraged strategy—A leveraged and more aggressive version of a traditional active strategy.

Long/short strategies—Strategies separating market risk from individual stock risk and allowing hedge fund managers to use superior information by shorting stocks (examples include market neutral, pairs trading, dedicated short bias, etc).

LTCM—Long Term Capital Management, a multi strategy hedge fund whose spectacular failure in late 1998 created a crisis in global credit markets.

Managed futures strategies—Strategies exploiting short term patterns in futures markets, often employing sophisticated computer driven trading programs to capture price movements.

Market Neutral—Investment strategy that does not count on a specific market movement (also known as non-directional).

Merger Arbitrage—Investment in both companies (the acquirer and takeover candidate) involved in a merger or acquisition, anticipating either the success or failure of the event. Also known as Risk Arbitrage.

Mortgage arbitrage—Strategy exploiting mispricing between MBS and ‘straight bonds’ while hedging away the interest rate risk.

Mortgage-Backed Securities (MBS) —Pools of mortgage-backed debt developed by financial institutions.

Pairs trading—Strategy consisting of the combined purchase and sale of two similar securities to exploit relative mispricing.

Passive management—Buying and holding a representative portfolio in an attempt to earn the market-wide average return without having to research security valuations. See Active Management.

Passive Returns—Returns from holding a benchmark, such as the S&P 500 or MSCI EAFE.

Portable alpha—The concept that superior stock selection ability can be expressed via a variety of different investment vehicles: such as long-only versus long-short funds. (See Alpha).

Relative Value Strategies—Broad category of market-neutral hedge fund strategies that take advantage of anomalies among related financial instruments.

Return-enhancer strategies—Strategies seeking high expected returns, contributing to ‘portfolio volatility’ (examples include distressed securities, macro, event driven strategies).

Risk Arbitrage—see Merger Arbitrage.

Risk-reducer strategies—Strategies offering positive excess returns, often decreasing ‘portfolio volatility’ (convertible arbitrage, convertible arbitrage, long/short funds).

Sharpe Ratio—Average return to a portfolio in excess of the risk-free return divided by the standard deviation of the portfolio return. A higher value indicates a better “reward-to-risk” tradeoff. Also called the reward-to-variability ratio.

Special Situations—Events such as announced mergers and restructurings, spin-offs, hostile takeovers, and bankruptcy situations.

Special opportunity strategies—Strategies used to exploit short term price movements during special situations (see Special Situations).

Special situation strategies—Same as special opportunity strategies.

Statistical arbitrage—Zero-cost portfolio where the probability of a negative payoff is very small but not exactly zero, as opposed to pure arbitrage where that probability is exactly zero.

Stock index futures arbitrage—Strategies exploiting price differential between index futures and price of underlying securities.

Style—Method of classification based on strategy followed (long, short, market neutral, etc).

Style analysis—A particular application of regression analysis of fund returns in which the explanatory variables are returns on a set of market indices, the regression coefficients must be non-negative, and the sum of the coefficients must add up to one.

Survivorship Bias—The statistical bias in performance aggregates due to including data only from live funds, while failing to include dead (liquidated or no longer operating) funds.

Swap spread—Difference in yields involved when exchanging (swapping) a fixed rate for a floating one.

Systematic Trading—Security selection that relies upon the decisions of computer models..

Tactical trading strategies—Strategies attempting to profit by forecasting the overall direction of the market or a market component (examples include macro strategies, CTA, etc).

Tracking Error—How closely a portfolio return follows a benchmark return, usually measured as the standard deviation of active return. Ex-ante tracking error is the forecast value from a risk model whereas ex-post tracking error is the realised value over some earlier measurement period. See Active Risk.

TASS Research—Hedge fund index provider (for details on strategies covered see Table 1 in the text).

Traditional Active Fund—Traditional investment vehicles, using long only strategies, with returns indexed to some market benchmark (see also Active Management).

Treasury/eurodollar arbitrage—Strategy exploiting differences in the yields between Treasury bill rates and in the Eurodollar market based on their view of the differences in the credit worthiness of the US government and the main international banks.

VaR (Value at Risk)—The maximum loss to a portfolio over a given time period with a given level of confidence. For example, if a 10 day VaR at 99% confidence level is \$100,000, then we conclude that 99% of the time the portfolio will not decline more than \$100,000 in value within 10 days.

Watermarks—see High Watermark.

Yield curve arbitrage—Strategies exploiting perceived disequilibrium price relationships by taking offsetting positions at various points of the yield curve.

Bibliography

- Amenc, Noel, Lionel Martellini and Mathieu Vaissi (2002), "Benefits and Risks of Alternative Investment Strategies," working paper, Edhec Business School, Lille.
- Agarwal, Vikas and Narayan Y. Naik (2004), "Risk and Portfolio Decisions Involving Hedge Funds," *Review of Financial Studies* 17, 63 – 98.
- Agarwal, Vikas, Narayan Y. Naik, William Fung and Yee Cheng Loon (2004), "Risks in Hedge Fund Strategies: The Case of Convertible Arbitrage," working paper, Georgia State University.
- Barès, Pierre-Antoine, Rajna Gibson and Sebastien Gyger (2003), "Performance in the Hedge Funds Industry: An Analysis of Short and Long-Term Persistence," *Journal of Alternative Investments*, 6:3, 25-41.
- Brown, J. Stephen, William N. Goetzmann (2001), "Hedge Funds With Style," working paper, Yale School of Management, Yale University, New Haven.
- Connor, Gregory and Mason Woo (2003), "An Introduction to Hedge Funds," working paper, Financial Markets Group, London School of Economics.
- Currie, Anthony and Jennifer Morris (2000), "And Now for Capital Structure Arbitrage," *Euromoney Magazine*, December.
- de Brouwer, Gordon (2001), *Hedge Funds in Emerging Markets*, Cambridge University Press, Cambridge, UK.
- Diamond, D. W., and R. E. Verrecchia (1987), "Constraints on short-selling and asset price adjustment to private information," *Journal of Financial Economics* 18, 277-311.
- Eichengreen, Barry (2000), "Hedge Funds in the New International Financial Architecture," *International Finance*.
- Fung, W., and D.A. Hsieh (1997) "Empirical Characteristics of Dynamic Trading Strategies: The Case of Hedge Funds," *Review of Financial Studies*, 10, 275-302.
- Fung, W., and D.A. Hsieh (2001) "The Risk of Hedge Fund Strategies: Theory and Evidence from Trend Followers," *Review of Financial Studies*, 41 313-341.
- Gatev, Evan G., William N. Goetzmann and K. Geert Rouwenhorst (1999), "Pairs Trading: Performance of a Relative Value Arbitrage Rule," working paper, School of Management, Yale University.
- Harrison, J.M., and D.M. Kreps (1979), "Martingales and Arbitrage in Multiperiod Securities Markets," *Journal of Economic Theory* 20, 381-408.
- Ineichen, Alexander M. (2003), *Absolute Return: The Risk and Opportunities of Hedge Fund Investing*, John Wiley & Sons, Hoboken, New Jersey.

- Kung, Edward and Larry Pohlman (2004), "Portable Alpha," *Journal of Portfolio Management*, 30:3.
- Lhabitant, François-Serge (2002), *Hedge Funds: Myths and Limits*, John Wiley & Sons, New York, USA.
- Lhabitant, François-Serge (2003), "Evaluating Hedge Fund Investments: the Role of Pure Style Indices," Edhec Business School.
- Liang, Bing (2004), "On the Performance of Alternative Investments: CTAs, Hedge Funds and Funds-of-Funds," forthcoming in *Journal of Investment Management*.
- Martin, George (2000), "Making Sense of Hedge Fund Returns: What Matters and What Doesn't," *Derivatives Strategy*.
- Mitchell, Mark, and Todd Pulvino (2001), "Characteristics of Risk in Risk Arbitrage," *Journal of Finance* 56, 2067-2109.
- MSCI (2003), *Investable Hedge Fund Indices Methodology*, Morgan Stanley Capital International Inc.
- Okunev, John and Derek White (2003), "Hedge Fund Risk Factors and Value at Risk of Credit Trading Strategies," working paper, School of Banking and Finance, University of New South Wales.
- Patton, Andrew (2004), "Are "Market Neutral" Hedge Funds Really Market Neutral?" working paper, Financial Markets Group, London School of Economics.
- Ross, S.A. (1976), "The Arbitrage Theory of Capital Asset Pricing," *Journal of Economic Theory* 13, 341-360.
- Ross, S.A. (1978), "A Simple Approach to the Valuation of Risky Streams," *Journal of Business* 51, 453-475.
- Schneeweis, Thomas and Richard Spurgin (1996), "Multi-Factor Models in Managed Futures, Hedge Fund and Mutual Fund Return Estimation," working paper, Center for International Securities and Derivatives Markets, Isenberg School of Management, University of Massachusetts, Amherst.
- Sharpe, W. (1992), "Asset Allocation: Management Style and Performance Measurement," *Journal of Portfolio Management*, 18, 7-19.
- Standard & Poor's (2004), *Standard & Poor's Hedge Fund Index: Structure, Methodology, Definitions, and Practices*, Standard & Poor's Inc.