Hedge Funds and Financial Crises: 2007 - 2009 Performance Characteristics

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Abstract

We study historical hedge fund performance characteristics with a particular focus on the 2007 – 2009 Financial Crisis (the "Crisis"). Using the Credit Suisse Hedge Fund Indexes as proxies for broader hedge fund industry performance, we apply a factor model based on common investment strategies to determine if the broad industry or any particular hedge fund strategies have been able to deliver excess returns, or alpha. We find evidence that the broad hedge fund index did deliver statistically significant excess monthly returns of 0.39% (4.67% annualized) over the period January 1995 – January 2016, with seven of ten individual strategy indexes contributing. However, our results indicate that these excess returns were delivered primarily during the pre-Crisis period of January 1995 – November 2007. Over this period, the broad index delivered statistically significant monthly excess returns of 0.49% (5.93% annualized), with six of ten individual strategy indexes contributing. Our results do not indicate, however, that hedge funds delivered statistically significant monthly excess returns over the period December 2007 – June 2009 or over the period December 2007 – December 2012, which takes into account the uniquely drawn out recovery from the Crisis. We find that the broad index delivered statistically significant excess monthly returns of 0.23% (2.74% annualized) during the post-Crisis period, though these returns are less than half of the pre-Crisis period returns and only three individual strategy indexes contributed. We posit that this apparent shift in performance characteristics might be the result of a shift in the risk tolerances of hedge fund investors and managers following the Crisis. We conclude that, while hedge funds might certainly serve legitimate purposes in financial markets, they are not immune to financial crises, especially those as severe as the Crisis.

1 Introduction

The growth of the hedge fund industry since the 1990s has been astounding. At year-end 1997 overall industry assets under management were a mere $170 billion. Prior to a sharp decline during the 2007 – 2009 Financial Crisis (the “Crisis”), hedge fund assets under management had reached $3.33 trillion. Hedge funds suffered during the Crisis, as did most other investment entities, but the industry appears to be rebounding. Assets under management through the end of 2015 are once again in excess of $3 trillion and the investor base of hedge funds seems to be diversifying. We seek to quantify hedge fund performance and, in particular, determine whether or not managers can deliver excess returns. In section 1.1 we discuss this goal in more detail. Given that the hedge fund industry is not one that the “common” investor is generally intimately familiar with, we give a brief overview of hedge fund structure, regulation, and strategies in section 1.2. Finally, in section 1.3 we discuss the motivation behind studying the hedge fund industry, particularly during a crisis period.

1.1 Goals of the Study

In this paper we conduct an empirical study of the historical performance of the hedge fund industry with a focus on the Crisis. In particular, we look at hedge fund return characteristics during a number of distinct time periods, including the years leading up to, during, and following the Crisis. Although much empirical work has been done on the historical performance of the hedge fund industry, Getmanky, Lee, and Lo (2015) point out the importance of performing up-to-date analysis. Just

as the industry has evolved drastically in the past, it continues to evolve in the current market environment. Given the turmoil in the United States economy as a result of the most recent financial crisis, as well as the unusually drawn out recovery, it is an especially interesting time to evaluate the most recent performance data.

We are most interested in whether or not there is evidence that hedge fund managers have been able to generate returns in excess of those available to the "common" investor through commonly traded assets such as equities, fixed income, commodities, and foreign exchange products. We might refer to these potential excess returns as "alpha," where α_t represents excess return at time t. The presence of alpha would indicate that investors derive some extra value from allocating capital to hedge funds over standard investment vehicles, such as mutual funds. The empirical evidence on mutual fund returns has generally indicated that managers are unable to provide investors with excess returns. Specifically, Carhart (1997) uses a sample of mutual fund returns to demonstrate that, in general, neither superior stock-picking skills nor better information explain performance persistence in mutual fund returns. Rather, common equity market factors and investment expenses explain performance. Treynor and Mazuy (1966) do not disregard the fact that mutual fund managers may pick undervalued industries and companies and, thus, perform relatively well, but their results do not support the idea that active managers can skillfully outguess the market and predict its direction.

Interestingly, Petajisto (2013) finds that, although the average actively managed mutual fund does not consistently outperform its benchmark, the most heavily actively managed funds have shown some tendency to beat their

benchmarks. He interprets these results as being evidence of possible market inefficiencies that the most active managers can take advantage of through careful security selection. One might posit that, in terms of its manager's active role in security and strategy selection, a typical hedge fund is comparable to a very actively managed mutual fund. In this case, Petajisto's results could be good news for the hedge fund industry.

If hedge fund managers can attribute part of their performance to superior strategy and asset selection or to their ability to gain exposure to risk factors other than those available to the "common" investor, it seems that they might violate some part of the generally accepted principle of efficient markets. First, if hedge funds can leverage quantitative strategies[1] that rely on historical market prices and technical trends, then they seem to violate the idea that asset prices follow a random walk and thus cannot be predicted (Fama 1965). Additionally, if managers are able to find market anomalies and profit from them, they seem to upset the Efficient Markets Hypothesis ("EMH"), most notably explained by Malkiel and Fama (1970). According to the EMH, it should be impossible to outperform the market because asset prices incorporate all relevant information.

We chose to focus on a crisis period because the EMH does not seem to support crises. In particular, the Crisis was characterized by a nationwide bubble in housing prices that subsequently burst, causing disastrous economic results. The

[1] Quantitative strategies use computer algorithms to make trading decisions based on technical analysis. High frequency trading algorithms are frequently blamed for the Flash Crash of 2010, during which the DOW Jones Industrial Average dropped nearly 1000 points in a few minutes.

EMH, however, assumes that investors are rational and prices are efficient. If this was the case, the formation of such asset price bubbles, due mostly to the irrational exuberance of financial market participants, would not occur. Sebastian Mallaby (2010), in his insightful history of the hedge fund industry, notes that the EMH does not seem to apply during crises and uses the crash of 1987 as an example.[2] If investor sentiment can create asset bubbles and markets can subsequently undergo statistically improbable corrections, then it seems that markets are afflicted with underlying inefficiencies. Ideally, a successful hedge fund manager would exploit these inefficiencies and generate excess returns.

The Crisis period will also be useful in allowing us to differentiate between alpha and beta return and ensure that hedge funds did not deliver positive returns leading up to the Crisis simply because they were riskier. While many investment entities performed well prior to the crash, they could only be considered to have had an element of excess value-add if returns were not due to systematic risk alone. In theory, hedge fund managers command performance fees (to be discussed in Section 1.2) precisely because they have the skill to deliver such excess returns to their investors. As such, our empirical interest lies in studying a time period when the EMH is least likely to accurately describe prevailing market conditions, namely a financial crisis.

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[2] Bernhardt and Eckblad (2013) provide a historical overview of this worldwide crash, referred to as "Black Monday." In the United States alone, the Dow Jones Industrial Average dropped 22.6%, the largest one-day decline in history. The rapid increase in activity in U.S. markets, structural flaws within markets, and the advent of products such as portfolio insurance contributed to the crash.

1.2 Hedge Fund Overview

A hedge fund is typically structured as a general / limited partnership, with the general partner being responsible for the operations of the fund and the fund's investors acting as limited partners. A moderate to large portion of the fund's capital often comes from the managers themselves, thus theoretically their interests are aligned with the interests of the limited partners. Managers are generally able to employ a wide variety of strategies that other investment entities might not be able to. Managers can pursue such alternative strategies, which might include short-selling, the use of leverage, or complex option and derivative trades, due to the increased leeway that hedge funds have in terms of regulation. This is certainly not to say, however, that the hedge fund industry is unregulated. Particularly following the Crisis, there have been calls for increased regulation across the entire financial industry, including hedge funds. The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 requires hedge funds with $150 million or more in assets to register with the SEC. Additionally, hedge funds are subject to the anti-fraud provisions of the Securities Act of 1933, must register with the SEC and report quarterly if they have more than 499 investors, and often fall under the jurisdiction of the Commodity Futures Trading Commission.

The Securities Act of 1933 provides companies that offer or sell their securities with various exemptions from registration requirements, one of which is selling only to accredited investors and qualified purchasers. Accredited investors are defined as individuals who have $5 million or more of investments, have net worth of at least $1 million, or have income of at least $200,000 in the last two years. Qualified

purchasers are defined as institutions that have assets over $5 million or at least $25 million of investments or investable assets.[3] Qualified purchasers include a variety of recognizable public pension plans, union pension plans, corporate pension plans, and universities. Likely due to their perceived riskiness, hedge funds are deemed suitable only for individuals and institutions that meet such requirements. However, the increased presence of various pension plans and endowments means that a broader population of financial market participants is at least indirectly exposed to hedge funds.

Most hedge funds share a variety of structural similarities. First, the typical hedge fund fee structure is unlike that of a mutual fund. There is generally a management fee of 1 – 2%, which the manager receives regardless of fund performance, followed by a performance fee of around 20%, which the manager receives dependent on positive returns to the fund. To ensure that managers are not rewarded for poor performance, however, many funds include a highwater mark in their structure. Managers collect a performance fee as long as the fund's returns remain above the mark. If the fund experiences losses managers will not receive performance fees until the performance returns to the mark. Such a structural element ensures that managers make up for any losses before receiving additional fees. Additionally, many hedge funds employ a hurdle rate, typically tied to a benchmark, such as LIBOR plus a spread, which managers must meet before receiving performance fees.

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[3] Source: Managed Funds Association.

Hedge fund investors are often subject to lock-up periods and subsequent withdrawal limitations. An investor must keep all newly invested capital in the fund for a minimum amount of time, perhaps a year, before becoming eligible for withdrawals. Once the investor meets the required lock-up period he will have limited opportunities to withdraw capital, typically on a monthly, quarterly, or yearly basis. Lock-up periods and withdrawal limitations allow managers to pursue relatively illiquid assets and to make trades that take time to converge while also maintaining solvency and compliance with any capital requirements that creditors impose. This is important given that illiquid assets and convergence trades are often central elements of hedge fund strategies.

Hedge funds employ a variety of specific strategies, some of which are described in more detail in Appendix A.1, but Fung and Hsieh (1999) provide a useful general overview. They first differentiate between relative return investing strategies, which seek to outperform a particular benchmark, and absolute return investing strategies, which seek to deliver positive returns regardless of market or economic conditions. Hedge funds fall into the absolute return category and managers take two broad approaches. Managers that use a market timing (directional) strategy attempt to bet on the directions of markets, employing either long or short trades in order to profit from anticipated turns. Managers who implement non-directional (arbitrage) strategies seek to exploit and profit from market anomalies. They structure trades in which they take both long and short positions in similar securities, thus eliminating

systematic market risk, with the expectation that the two securities will converge to their efficient prices over time.[4] Of course, hedge funds employ a wide variety of complex and unique strategies, but these strategies can generally be described as either directional or arbitrage.

1.3 Significance of the Study

The hedge fund industry seems to be evolving in that it is no longer necessarily reserved for elite, wealthy individuals. As Mallaby (2010) discusses, following the realization of possible market inefficiencies after the Black Monday crash in 1987, institutional money began pouring into the industry. In particular, university endowments, such as that of Yale University, began diversifying by investing in hedge funds. A recent market study by consulting firm KPMG, in partnership with the Alternative Investment Management Association and the Managed Funds Association (2015), discusses the evolving environment in which hedge funds are operating. The report finds that the general consensus among surveyed managers is that institutional investors will drive long-term industry growth. In fact, most managers who responded to the survey indicated that they believed pension funds – both public and corporate – would be their primary sources of capital by 2020. Additionally, nearly two-thirds of responding managers indicated that they

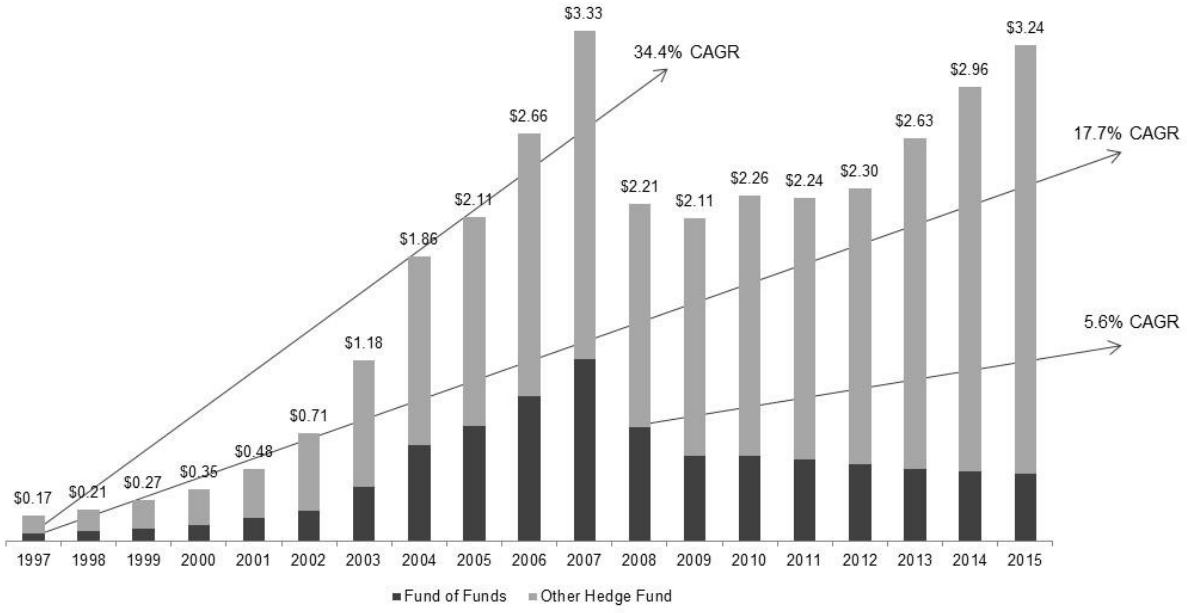
[4] Chincarini (2012) provides a good example of one type of arbitrage trade, which was often employed by hedge fund Long Term Capital Management: the on-the-run / off-the-run trade. Given that large institutional investors often like to hold the most liquid securities, they are more willing to hold on-the-run government bonds. Thus, on-the-run government bonds have a slightly higher price and a slightly lower yield than off-the-run government bonds of the same maturity. Given that the on-the-run bond and the off-the-run bond are essentially the same security, LTCM would go long the off-the-run bond and short the on-the-run bond, then profit when the government released an even newer issue and the former bonds converged in price.

expected the demographics of their clients to become more diverse over the next five years. University endowments, public and corporate pension funds, and other institutional entities, given that they manage money on behalf of “normal” people, expose a much wider population of financial market participants to the risks and returns of the hedge fund industry. While high-net-worth individuals might be willing to take on excessive risk, “normal” people might very well be unwilling to do so without adequate reward in the form of excess returns.

Additionally, aggregate hedge fund industry assets under management are approaching pre-Crisis levels. From 1997 – 2007, industry assets rose dramatically at a compound annual growth rate of 34.4%, peaking at $3.33 trillion before drastically declining during the Crisis. Although industry assets under management have growth far more slowly at a compound annual growth rate of 5.6% from their 2008 level, assets under management through year-end 2015 were $3.24 trillion. Chart 1.3 contains a yearly breakdown of hedge fund assets under management since 1997. The dramatic growth in industry assets leading up to the Crisis may have been a sign of market crowding, a topic discussed in depth by Ludwig Chincarini (2012). Specifically, Chincarini points to crowding in the real estate market as a precipitant of its eventual collapse. Hedge funds, investment banks, brokers, insurance agencies, and other entities that had a stake in the real estate market became stuck with illiquid assets after so-called “copycat” investors fled the market and severely drove down prices. Many of the investors who could not flee subsequently failed when their holdings lost value and they became insolvent.

Although total industry assets under management has risen relatively mildly following the Crisis, it is certainly worth being cautious as the number approaches and eventually exceeds pre-Crisis levels, as it is expected to do. The hedge fund industry is no longer a small and insignificant part of the broader market that only affects wealthy individuals. Instead, assets under management continue to grow and the hedge fund industry is becoming an increasingly entrenched part of the financial market. As more and more financial market participants continue to gain exposure to the exotic risks to which hedge funds offer exposure, empirical studies of hedge fund performance will become increasingly important.

Chart 1.3: Hedge Fund Industry Assets Under Management, 1997 – 2015 (trillions of USD). Source: BarclayHedge.



2 Literature Review

The hedge fund industry has been the subject of much literature, including both qualitative and empirical studies. Main Street's view of hedge funds (and a large part of the financial industry for that matter) seems to be historically negative. Particularly in the wake of the Crisis, hedge funds, investment banks, and other market participants have been called greedy, selfish, and have been held responsible for the economy's drastic decline. Mallaby (2010) alludes to one of the major reasons that the public seems to have such a perception: in 2006, when the hedge fund industry was booming prior to the Crisis, the bottom manager on Alpha Magazine's list of top 25 hedge fund managers reportedly made $240 million. This was nearly 4.5 times even the $54 million that Goldman Sachs CEO, Lloyd Blankfein, received.[5] If such compensation levels are to be tolerated, hedge fund managers must prove their ability to add value.

Mallaby himself believes that hedge funds do play a legitimate role in financial markets. In fact, he argues that the future of finance and the stability of markets would be drastically improved with the continued presence of privately operated hedge funds. He points to a variety of differences between hedge funds and other entities that serve similar roles in the market, such as investment banks, including the following: 1) hedge fund managers have "skin in the game," as their compensation is directly related to fund performance; 2) hedge fund managers do not face the same

[5] The New York Times reported on December 20, 2006 that Lloyd Blankfein received a $53.4 million bonus, in addition to his base salary of $600,000.

conflict of interest as investment bank executives[6]; 3) while investment banks can rely on other internal divisions to cover trading losses, hedge funds are measured by their investment performance alone and have no internal divisions to hide losses; 4) while many Wall Street entities are "too big to fail" without causing serious systemic consequences and harm to tax payers, most hedge funds are "small enough to fail" without harming the overall economy[7]; 5) hedge funds have historically been willing to direct capital to regions where traditional asset managers have hesitated, often aiding economic development in emerging markets.[8]

Among the most important functions that Mallaby discusses, however, is the role of hedge funds as liquidity providers. Though they are often looked down upon, quantitative and high frequency trading hedge funds are a major contributor to pricing efficiency in markets and help to narrow bid-ask spreads. Cao, Liang, Lo, and Petrasek (2014) find that, in general, the contribution of hedge funds to price efficiency is greater than the contributions of other institutional investors, including mutual funds. Pricing efficiency is an important component of market liquidity. Aragon and Strahan (2012) study the impact of the 2008 Lehman Brothers bankruptcy and

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[6] Trading is only one aspect of an investment bank. They also seek fees for various underwriting and advisory services, which have the potential to create conflicts of interest. Mallaby (2010) gives the example of Merrill Lynch and subprime collateralized debt obligations leading up to the Crisis. In the company's quest to create more of these structured products, it held a large number of individual mortgage bonds on its balance sheet and inadvertently became a major investor in the soon-to-be toxic assets.

[7] Mallaby (2010) points to the 2006 collapse of the major hedge fund Amaranth Advisers, which had relatively minimal economy-wide consequences.

[8] When emerging markets began opening up in the 1990s, hedge funds were among the first to direct capital to these underdeveloped areas.

find that the firm's inability to provide prime brokerage services[9] to its hedge fund clients had a negative impact on overall market liquidity. In particular, stocks held by hedge funds that were using Lehman as a prime broker experienced large declines in liquidity compared to otherwise similar stocks that were not held by Lehman-exposed funds.

Chincarini (2012) presents another historical account of hedge funds. He focuses particularly on their relationship to various crises, including the collapse of hedge fund Long Term Capital Management in 1998, the Quant Crisis of 2007, the 2008 collapse of Bear Stearns, the 2008 bankruptcy of Lehman Brothers, and the 2010 Flash Crash. He discusses many of the technical aspects of the strategies employed by Long Term Capital Management, which are beyond the focus of this paper. It is valuable, however, to understand at a fundamental level how hedge funds construct their trades.

As with Mallaby, Chincarini does not believe that hedge funds are necessarily harmful to markets. Leverage, for example, a hotly debated aspect of the industry, is a tool that allows hedge funds to perform their social function as liquidity and efficiency providers. Without leverage, most individual funds simply are not large enough to impact prices. Instead, problems arise when "copycats" enter and crowd markets after observing the positive performance of hedge funds. If these "copycats" subsequently flee the market, they may leave hedge funds, which might otherwise

[9] Hedge funds use prime brokers for a variety of services, including consolidating trade information, providing custodial services for securities, providing margin services so they can borrow securities to short, and providing short term financing to allow them to increase leverage.

have been well-capitalized and able to profit from a particular trade, with illiquid positions. Overcrowding in the real estate market leading up to the Crisis eventually left countless investors holding worthless assets and ultimately contributed to the failure of both Bear Stearns and Lehman Brothers, as well as to the necessity of government conservatorship of Fannie Mae and Freddie Mac.[10]

In addition to more qualitative works, various empirical performance studies have been performed on the hedge fund industry using a variety of methods. Perhaps the most widely used model in studying returns is to use the Fung and Hsieh (2001, 2004) seven-factor model. They choose seven asset-based style factors, directly observable in markets, which account for the general risk components of hedge fund strategies: a market factor and a size factor for equity markets, a bond market and credit spread factor for fixed income markets, and a bond, currency, and commodity lookback straddle[11] to account for trend-following strategies, which aim to buy low and sell high, thus profiting from investor sentiment. Ammann, Huber, and Schmid (2011) find that adding a factor to capture emerging markets risk adds value to the seven-factor model.

Ibbotson, Chen, and Zhu (2011) use a model with traditional betas that capture equity market risk, bond market risk, and money market risk. They argue that

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[10] The Federal National Mortgage Association ("Fannie Mae") is a government-sponsored private corporation, responsible for supporting the secondary market in mortgages. The Federal Home Loan Mortgage Association ("Freddie Mac") is also a government-sponsored private corporation focused on assisting the mortgage market. Both corporations participate in the swap business, in a sense operating as government-sponsored hedge funds.

[11] A lookback straddle consists of two options: a call option that gives the holder the right to buy an asset at the lowest observed price during the life of the call, and a put option that gives the holder the right to sell an asset at the highest observed price during the life of the put. This structure essentially allows the option holder to buy low and sell high, which is the general goal of trend-following strategies.

any returns due to exposure to exotic risks outside of these major asset markets should be considered alpha. They also include lagged betas for the three factors to account for the fact that many hedge fund holdings are relatively illiquid and difficult to constantly mark to market. Using this three-factor model, they perform a return-based style analysis with the goal of identifying the combination of long positions in passive indices that would have most closely replicated the actual performance of a fund over a specified time period. Any variability in performance, as measured by the R-squareds of their regressions, that is not explained by the model is attributed to factors such as the manager's active security selection or market timing. They find an average pre-fee return of 11.42% over the period 1995 – 2009. They deduce that 3.01% of that average return was alpha. Remarkably, they find positive alphas during every year of the last decade, even during the Crisis. They also repeat their analysis using the standard Fung and Hsieh model and find statistically significant alphas during the same period.

More novel methods of empirically measuring historical hedge fund performance have also been employed. Cai and Liang (2012) suggest that the seven factors used by Fung and Hsieh are imperfect risk factors. They argue that returns can be more effectively modeled by applying dynamic linear regression to the factors. They find that with certain hedge fund strategies, particularly emerging markets, alpha dropped significantly and even became negative during crisis years, namely 1998 and 2008. On the other hand, they find that some strategies were able to maintain a statistically significant positive alpha over time, even during crises.

Dichev and Yu (2011) suggest that standard empirical performance measures, which assume that investors buy and hold from inception, do not accurately reflect the actual experience of individual hedge fund investors. They propose using dollar-weighted returns, which reflect the effect of the timing and magnitude of fund flows on investor returns. This is significant, they argue, because the majority of hedge fund investors do not enter a fund at inception, but rather later in the fund's life and in uneven commitments of capital. They find that, when investors in hedge funds are assumed to buy and hold, the average return over 1980 – 2008 is 12.6%. The dollar-weighted return for the same period, however, is 6%, which is hardly above the risk-free rate of return of 5.6% over the same period. While this method may accurately reflect the experience of individual investors in hedge funds, we are more interested in whether the managers are able to produce excess returns for the fund in general. Thus, we feel it is appropriate to use the traditional buy-and-hold measure.

3 Methodology

There are specific problems associated with performing empirical analysis on hedge funds given the relatively private nature of the industry. Section 3.1 discusses the various sources and limitations of hedge fund data. There are a variety of biases that arise in hedge fund databases that must be accounted for if empirical work is to be meaningful. These biases and their remedies are the subject of section 3.2. Finally, in section 3.3 we discuss the main factor model that we will use in our empirical analysis.

3.1 Sources of Hedge Fund Data

Although hedge funds are private investment vehicles and typically are not subject to the same performance reporting requirements as other investment entities, many managers do choose to report performance to a database. Getmansky, Lee, and Lo (2015) discuss some of the most widely used databases, which include Lipper TASS, Morningstar Hedge / CISDM, Hedge Fund Research, BarclayHedge, Albourne, Eurekahedge, eVestment Alliance, HedgeFund.net, HedgeCo.net, Mercer, Russell Mellon, U.S. Offshore Funds Directory, and Wilshire Odyssey. These databases generally report monthly performance data in addition to information on various fund-level attributes.

Reporting to a database is in the best interest of some hedge funds, as it serves as one of their only forms of advertising. Although some large, well-known, and positively performing hedge funds may have no need to solicit new investments (and are often closed to new investments anyways), many smaller and mid-sized hedge funds do find it necessary. Historical performance that indicates success may help managers solicit positive capital inflows. However, the results of a study on hedge fund reporting by Agarwal, Fos, and Jiang (2014) seem to imply that it might not always be economically viable for hedge funds to report to multiple databases. In comparing the population of funds in the CISDM, Eurekahedge, Hedge Fund Research, MSCI, and TASS databases, they find that 71% of the total sample of funds was covered by only one database. They recommend making use of multiple databases in order to capture this lack of symmetry across the various database providers.

Unfortunately, access to hedge fund return databases is costly. While it would be ideal to use sample return data from across a number of databases so as to capture as much of the industry as possible, we are unable to do so in this paper due to the cost barrier. In order to measure hedge fund returns we will use the Credit Suisse Hedge Fund Indexes, compiled by Credit Suisse Hedge Index LLC. These include a broad index of monthly hedge fund returns across strategies as well as indexes of monthly returns on a strategy-by-strategy basis. The Credit Suisse Hedge Fund Indexes are asset-weighted indexes based on the Credit Suisse Hedge Fund Database. Approximately 9,000 worldwide funds are included in the database and the indexes generally represent at least 85% of assets under management in their respective strategy universes. Only funds with a minimum of $50 million under management, a 12-month reporting track record, and audited financial statements are included in the database. The monthly indexes reflect performance net of all fund performance fees and expenses.[12] Given our limited access to hedge fund return data, we must admit and accept the limitations of the empirical capabilities of this paper. We do feel, however, that the Credit Suisse Hedge Fund Indexes are good representations of the industry as a whole and will suffice for the purposes of this paper.

[12] More information is available through Credit Suisse Hedge Index LLC.

3.2 Biases in Hedge Fund Data

Due to the private nature of hedge funds and a general lack of performance reporting requirements, there are a number of important biases in hedge fund databases that, if not addressed, could lead to a significant overstatement of performance. Biases in empirical studies of mutual fund performance are discussed by Brown, Goetzmann, and Ibbotson (1992), who find that the natural pruning of a database of mutual funds leads to an apparent persistence in performance when risk is dispersed among many money managers. This apparent performance persistence is the side effect of many of the biases in hedge fund data, which Ackermann, McEnally, and Ravenscraft (1999) explore in depth. We will focus on the two major biases that any empirical study of hedge funds must account for in order to provide some degree of accuracy.

Given that hedge fund performance reporting is optional, a database provider can only provide the results that hedge fund managers choose to report. Typically a hedge fund will stop reporting data because that fund has failed. It seems reasonable to correlate the failure of any particular hedge fund with poor performance. Looking at the corollary, it also seems reasonable that a fund with positive performance is much less likely to experience failure. Thus, relying on a database that only includes actively reporting funds is likely to lead to an overstatement of the actual aggregate performance of the hedge fund industry, a phenomenon known as survivorship bias. In order to correct for survivorship bias, accurate empirical work should aggregate the performance of both dead funds, using a so-called “graveyard” database, and actively reporting funds. Using monthly return data from 1995 to 2009 from the Lipper

TASS database, Ibbotson, Chen, and Zhu (2011) estimate survivorship bias of 5.21% per year. From a different perspective, one might conclude that, because some hedge funds choose not to report simply because they do not need additional capital, some of the survivorship bias is offset. While this does make logical sense, we have not come across empirical evidence in support of such an idea.

The other concern with hedge fund return data is backfill bias. Since the primary motivation for submitting return data to a hedge fund database is to market their fund, managers generally elect to begin reporting following a period of outperformance (Getmasnky, Lee, Lo 2015). This outperformance might not be representative of the fund's true, long-run performance, however, and so will lead to an overstatement of hedge fund returns during the backfilled periods. The above researchers attempt to correct for backfill bias by deleting any fund returns for dates preceding the fund's entrance into the database. Fung and Hsieh (2000) also propose a method for correcting for backfill bias. By estimating the median incubation period, or lag between the inception date and database entrance data of a fund, for hedge funds in the TASS database to be 343 days, they argue that dropping the first 12 reported monthly returns from each fund corrects for backfill bias. Ibbotson, Chen, and Zhu (2011) find backfill bias of 3.51% per year using Lipper TASS data from 1995 to 2009 when also correcting for survivorship bias.

Given that we are using pre-constructed indexes of hedge fund returns instead of longitudinal data on individual hedge fund returns, we have less control over survivorship and backfill bias. The Credit Suisse Hedge Fund Indexes do attempt to correct for both, however. In order to minimize survivorship bias, funds are not

removed from the indexes until they are fully liquidated or fail to meet the financial reporting requirements, thus the indexes capture the potential negative performance prior to fund failure. Additionally, historic index data is not adjusted as new funds are added to the index and liquidated funds are removed, thus the implied poor performance of dead hedge funds is accounted for historically in the indexes. The indexes attempt to control for backfill bias by only including funds that have a minimum reporting track record of 12 months. The Credit Suisse Hedge Fund Indexes also filter the potential additional noise created by very small hedge funds by only including funds with a minimum of $50 million in assets. This is more restrictive than Cai and Liang (2012), who require minimum assets of $10 million.

3.3 Empirical Model

While the Fung and Hsieh (2001, 2004) factor model is one of the more widely used models in studying hedge fund performance, we would like to use a more intuitive model based on Bianchi, Drew, and Stanley (2008). We use eight factors that represent strategies that are investable to the "common" investor, including the three equity market factors suggested by Fama and French (1992), the momentum factor suggested by Carhart (1997)[13], a worldwide bond market factor, a core commodity market factor, a U.S. Dollar market factor, and a worldwide equity market factor (ex U.S.). In order to ensure that the alphas in our regressions are legitimate measures of potential excess returns, all factors in the model are measured as

[13] The Fama-French factors and the Carhart momentum factor were obtained from Wharton Research Data Services. The factors are also available through Kenneth R. French's research website.

monthly returns in excess of the risk-free rate, or return on the one-month Treasury bill, where applicable.

We regress monthly returns from the Credit Suisse Hedge fund Indexes using the following model:

$$\begin{aligned}(R_t - r_{f_t}) = \alpha_t + \beta_1(R_{m_t} - r_{f_t}) + \beta_2 HML_t + \beta_3 SMB_t + \beta_4 MOMENTUM_t \\ + \beta_5(BCABI_t - r_{f_t}) + \beta_6(TRCC_t - r_{f_t}) + \beta_7(DXY_t - r_{f_t}) \\ + \beta_8(MSCIXUS_t - r_{f_t})\end{aligned}$$

$R_t = monthly\ return\ on\ Credit\ Suisse\ Hedge\ Fund\ Index\ at\ time\ t$
$\alpha_t = monthly\ excess\ return\ of\ Credit\ Suisse\ Hedge\ Fund\ Index\ at\ time\ t$
$r_{f_t} = monthly\ return\ on\ the\ one\ month\ Treasury\ bill\ at\ time\ t$
$R_{m_t} = monthly\ return\ on\ market\ at\ time\ t$
$HML_t = monthly\ performance\ of\ value\ stocks\ relative\ to\ growth\ stocks\ at\ time\ t$
$SMB_t = monthly\ performance\ of\ small\ relative\ to\ large\ cap\ stocks\ at\ time\ t$
$MOMENTUM_t = monthly\ Carhart\ momentum\ factor\ at\ time\ t$
$BCABI_t = monthly\ retun\ on\ the\ Barclays\ Capital\ Aggregate\ Bond\ index\ at\ time\ t$[14]
$TRCC_t = monthly\ return\ on\ the\ Thomson\ Reuters\ CoreCommodity\ index\ at\ time\ t$[15]
$DXY_t = monthly\ return\ on\ the\ U.S.\ Dollar\ Index\ at\ time\ t$[16]
$MSCIXUS_t = monthly\ return\ on\ the\ MSCI\ World\ ex\ U.S.\ index\ at\ time\ t$[17]

In terms of pure equity markets, Eugene Fama (2014) considers the Fama-French three-factor model to be the most successful asset pricing model in empirical tests to date, thus implying the advantage of including additional factors beyond the simple Capital Asset Pricing Model. Today, most financial economists

[14] The Barclays Capital Aggregate Bond index is a global measure of investment grade debt from 24 local currency markets. As it includes treasury, government-related, corporate, and securitized fixed-rate bonds from developed and emerging market issuers, we feel that it is a good representation of the diverse universe of investable fixed income.
[15] The Thomson Reuters CoreCommodity CRB index is a representation of a long-only, broadly diversified investment in commodities, which we feel most accurately reflects the potential strategy of a "common" investor.
[16] The U.S. Dollar Index benchmarks the U.S. dollar against a basket of major world currencies.
[17] The MSCI World ex U.S. index captures the performance of large- and mid-cap equities across 22 of 23 developed market countries, excluding the U.S. The index covers approximately 85% of the free float-adjusted market capitalization in each country.

would agree that the CAPM's designation of the market return as the only meaningful risk factor is far too restrictive, even for evaluating simple equity portfolios. Since hedge fund managers invest in a wide variety of assets beyond equities, we must include additional factors in order to ensure that our model is broad enough to potentially explain hedge fund returns. The advantage we see to the above model is that it represents all the potentially investable assets available to the "common" investor. If the model does not explain the variance in monthly returns of the Credit Suisse Hedge Fund Indexes, or if we find statistically significant monthly excess returns, we can conclude that the "common" investor might derive some benefit from investing in hedge funds.

We want to compare and contrast the performance of the various hedge fund strategies that the Credit Suisse Hedge Fund Indexes track, which are defined in detail in Appendix A.1. In order to do so, we will apply the above model to the broad index as well as to the strategy-specific indexes. Additionally, we have a particular interest in the performance of the hedge fund industry during the Crisis. We will use the model to measure performance over multiple time periods, including before the Crisis, during the Crisis, and the recovery from the Crisis. In particular, we are interested in whether or not hedge funds were able to deliver excess returns during the Crisis and in seeing if there has been any shift in performance characteristics following the Crisis. We expect that, given the uncharacteristic severity of the Crisis as well as the public backlash toward many financial entities, there may have been a fundamental shift in the hedge fund industry. Hedge fund managers today may be more risk-averse and may tend to avoid some of the exotic trades that would have

allowed them to deliver excess returns in the past, as they suffered consequences during the Crisis.

Bianchi, Drew, and Stanley (2008) find evidence of autocorrelation in the first and second moments of their data. In order to control for these effects, they employ Newey and West (1987) heteroscedasticity and autocorrelation-consistent standard errors. While not widespread, we also find evidence of possible autocorrelation in the return data for a few strategies. In addition to the usual OLS standard errors, we report the Newey-West standard errors in order to determine the significance of our excess returns and factors. We do not find that using the Newey-West standard errors has a substantial effect on our results, however.

4 Results

Tables 4.1 – 4.2 present summary statistics of the Credit Suisse Hedge Fund Indexes and the eight factors included in our model, plus the monthly risk-free rate.

Table 4.1: Summary Statistics of Credit Suisse Hedge Fund Indexes.

Index	# Obs	Mean	Std. Dev.	Min	Max	Sharpe	Ann. Mean
All Funds	253	0.71%	2.03%	-7.55%	8.53%	0.25	8.50%
Conv. Arb.	253	0.61%	1.89%	-12.59%	5.81%	0.21	7.30%
Ded. Short Bias	253	-0.37%	4.77%	-11.28%	22.71%	-0.12	-4.43%
Emerg. Markets	253	0.59%	3.80%	-23.03%	15.34%	0.10	7.14%
Eq. Mkt. Neut.	253	0.45%	2.81%	-40.45%	3.66%	0.09	5.37%
Event Driven	253	0.71%	1.80%	-11.77%	4.22%	0.28	8.49%
Fixed In. Arb.	253	0.45%	1.54%	-14.04%	4.33%	0.16	5.36%
Global Macro	253	0.92%	2.60%	-11.55%	10.60%	0.27	11.04%
L/S Equity	253	0.82%	2.70%	-11.43%	13.01%	0.23	9.81%
Mdg. Futures	253	0.48%	3.40%	-9.35%	9.95%	0.08	5.82%
Multi-Strat.	253	0.67%	1.38%	-7.35%	4.28%	0.34	8.08%

Table 4.2: Summary Statistics of Eight Factors and Risk-Free Rate.

Factor	# Obs	Mean	Std. Dev.	Min	Max	Sharpe	Ann. Mean
Market Return	253	0.83%	4.48%	-17.15%	11.35%	0.14	10.01%
High-minus-Low	253	0.18%	3.24%	-13.11%	13.91%	-0.01	2.15%
Small-minus-Big	253	0.15%	3.47%	-16.70%	22.32%	-0.02	1.83%
Momentum	253	0.51%	5.26%	-34.58%	18.38%	0.06	6.17%
Barclays Agg. Bond	253	0.05%	0.83%	-2.55%	2.88%	-0.20	0.55%
TR / CC Commodities	253	0.41%	4.96%	-19.06%	14.60%	0.04	4.91%
U.S. Dollar Index	253	0.06%	2.34%	-5.71%	7.01%	-0.06	0.69%
MSCI World ex U.S.	253	0.30%	4.79%	-20.87%	12.39%	0.02	3.62%
Risk Free Rate	253	0.21%	0.19%	0.00%	0.56%	0.00	2.49%

The monthly volatilities of all investable strategies, including hedge funds, compared to that of the risk-free rate is evident, thus indicting the relative riskiness of most investment strategies. We believe that our monthly deviations are so substantial due to the relatively unfriendly time period we are studying, which includes a number of crises in the late 1990s, the financial crisis in the early 2000s, and the Crisis we are focusing on. Over our sample period of January 1995 – January 2016, the annualized mean return of all hedge funds was 8.50% versus 10.01% for the market, although the sample of hedge funds appears to have performed more consistently given the monthly standard deviation of 2.03% versus 4.48% for the market. Additionally, the Sharpe ratios indicate that the broad index of hedge funds and six individual strategy indexes had better risk-adjusted returns than any of the investable strategies.

Tables 4.3 – 4.7 contain the regression results for the Credit Suisse Hedge Fund Indexes, using OLS standard errors, for five time periods: the entire sample from January 1995 – January 2016, January 1995 – November 2007, December 2007 – June 2009, December 2007 – December 2012, and July 2009 – January

2016. Tables 4.8 – 4.12 contain the regression results for the indexes, using Newey-West standard errors, for the same time periods. Any terms that are statistically significantly different from zero at a 95% confidence level are indicated with three asterisks ("***").

In general the eight factor model that we employ does a good job of explaining the variance in monthly hedge fund returns across strategies. While the goal of most hedge fund managers is to use differentiating strategies that allow their fund to deliver excess returns, these strategies often still depend on many standard assets classes, meaning hedge fund performance is subject to standard market movements to an extent. On a strategy-by-strategy basis, the statistical significance of the eight factors is relatively intuitive and generally in line with what one might expect. For example, dedicated short bias funds depend negatively on the market given their net short positions, and so the coefficient on the market return factor is negative and statistically significant over the sample period; global macro funds look to profit from anticipated price movements in equities, foreign exchange, commodities, and interest rates, and thus the coefficients on the global aggregate credit factor, commodities factor, and U.S. Dollar Index factor are statistically significant over the sample period.

We find that over the sample period, from January 1995 – January 2016, hedge funds in general were able to generate excess returns beyond those available to the "common" investor through the model's eight investable factors. On a strategy-by-strategy basis, only three strategies (four using Newey-West standard errors) did not deliver statistically significant positive excess returns: dedicated short

bias, emerging markets, and equity market neutral (and fixed income arbitrage using Newey-West standard errors). We find that the broad index delivered a monthly excess return of 0.39% (4.67% annualized). The strategy that was able to deliver the largest excess return over the sample period was global macro, with a monthly excess return of 0.73% (8.72% annualized).

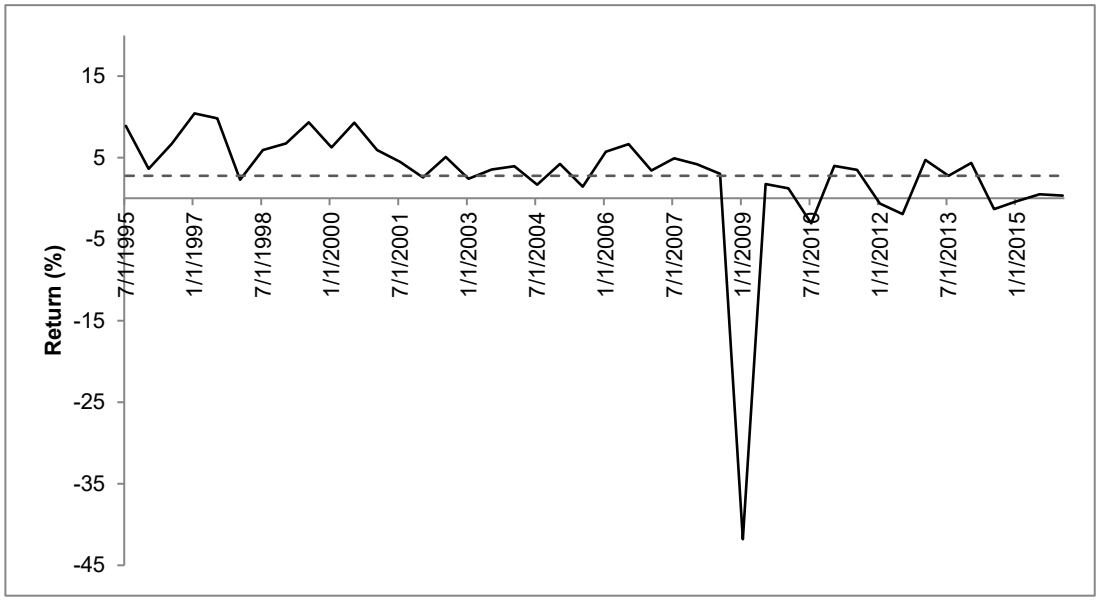
It seems that the widespread excess returns over the broad sample period, however, were driven largely by hedge fund performance prior to the Crisis, from January 1995 – November 2007. During this period there were only four strategies that did not deliver statistically significant positive excess returns: dedicated short bias, emerging markets, fixed income arbitrage, and managed futures. The broad index delivered a monthly excess return of 0.49% (5.93% annualized). Global macro funds were the highest performing strategy classification, delivering a monthly excess return of 0.90% (10.80% annualized). It might also be important to note that this pre-Crisis period captures a number of smaller crisis periods that impacted the hedge fund industry, including the Asian Currency Crisis, Russian Debt Crisis, and the collapse of hedge fund Long Term Capital Management in the late 1990s, as well as the early 2000s recession in the United States. While none of these crises were of the magnitude of the Crisis, it is still noteworthy that hedge funds broadly were able to generate statistically significant positive monthly excess returns over the period.

In general, we find that hedge funds were not immune from the Crisis, as neither the broad index of hedge funds nor any individual strategy indexes were able to deliver statistically significant positive excess returns over the period

December 2007 – June 2009. In fact, we find that all but two strategy classes delivered negative, though statistically insignificant, excess returns. The only statistically significant result was the -4.29% monthly return of the equity market neutral index (although the result is insignificant with Newey-West standard errors). Chart 4.1 presents the six-month performance of the Credit Suisse Hedge Fund equity market neutral index (See appendix A.2 for six-month performance charts of all other strategy indexes). Concurrent with the Lehman Brothers bankruptcy, the strategy collapsed toward the end of 2008. This is no coincidence, as equity market neutral funds are typically quantitative in nature and depend on stable historical pricing data. When the unprecedented Lehman collapse occurred, the stability of such data was severely upset, resulting in astoundingly poor performance for equity market neutral funds.[18]

[18] See Sam Jones's article in the Financial Times blog FTAlphaville at the following: http://ftalphaville.ft.com/2009/10/08/76666/the-pitfalls-of-being-market-neutral/

Chart 4.1: Equity Market Neutral Index Six-Month Returns, 1995 – 2015.



The Crisis was unique in that, unlike the early 2000s recession, for example, the economy's recovery was extremely slow and drawn out. Financial market participants likely felt the recession's effects long after it officially ended. In order to account for this unique feature of the Crisis, we also apply the model to the time period December 2007 – December 2012, incorporating a three year extension past the technical end of the Crisis. This is also beneficial statistically, as the longer time period provides more individual observations of monthly returns, thus strengthening the statistical relevance of our findings. As with the more limited time period, we find no evidence that the broad index of hedge funds delivered statistically significant positive monthly excess returns. Over this extended period, however, the global macro strategy index did provide a statistically significant monthly excess return of 0.43% (5.11% annualized), continuing its strong performance from earlier periods. The results from this extended period bolster our finding that, broadly speaking, hedge funds were unable to deliver excess returns during the Crisis.

On a positive note for the industry, we find that the broad index of hedge funds delivered statistically significant positive monthly excess returns of 0.23% (2.74% annualized) during the post-Crisis period of July 2009 – January 2016. However, it appears that hedge fund performance characteristics have shifted noticeably following the Crisis. The excess returns on the broad index were less than half of the excess returns from the pre-Crisis period. Additionally, only three individual strategy indexes delivered statistically significant positive excess returns: convertible arbitrage, fixed income arbitrage, and multi-strategy. These strategies have been quite successful, however, delivering monthly excess returns of 0.55%, 0.59%, and 0.54% (6.58%, 7.08%, and 6.52% annualized) respectively.

Table 4.3: January 1995 – January 2016, Standard OLS Errors. (*** = statistically significant at 95% level)

January 1995 - January 2016													
	α	α t-stat	R-sq.	Adj. R-sq.	D-W	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	0.39***	4.30	0.57	0.56	1.80	0.15***	0.00	0.09***	0.11***	0.34***	0.08***	0.16***	0.15***
Conv. Arb.	0.42***	3.90	0.29	0.26	1.29	-0.02	0.05	0.05	-0.03	0.17	0.10***	0.12***	0.16***
Ded. Short Bias	-0.04	-0.25	0.74	0.73	1.77	-0.79***	0.10	-0.32***	0.01	0.16	0.04	-0.03	-0.02
Emerg. Markets	0.33	1.81	0.50	0.48	1.56	0.03	-0.07	0.15***	0.06	0.12	0.09***	0.37***	0.51***
Eq. Mkt. Neut.	-0.07	-0.39	0.21	0.18	2.15	0.23***	0.15***	0.03	-0.01	-0.64***	0.11***	-0.14	-0.11
Event Driven	0.36***	4.56	0.58	0.56	1.58	0.11***	0.07***	0.09***	0.03***	-0.11	0.05***	0.11***	0.17***
Fixed In. Arb.	0.24***	2.61	0.26	0.23	1.27	0.02	0.07***	0.03	-0.01	0.24***	0.09***	0.08	0.09***
Global Macro	0.73***	4.61	0.21	0.18	1.78	0.10	0.02	0.02	0.11***	0.85***	0.10***	0.23***	0.08
L/S Equity	0.35***	4.20	0.79	0.78	1.77	0.27***	-0.11***	0.17***	0.16***	0.14	0.04***	0.02	0.19***
Managed Futures	0.50***	2.35	0.17	0.15	1.97	-0.20***	0.03	-0.02	0.14***	1.26***	0.05	0.00	0.21***
Multi-Strat.	0.42***	5.44	0.32	0.30	1.60	0.02	0.02	0.04	0.01	0.03	0.05***	-0.01	0.11***

Table 4.4: January 1995 – November 2007, Standard OLS Errors. (*** = statistically significant at 95% level)

January 1995 - November 2007													
	α	α t-stat	R-sq.	Adj. R-sq.	D-W	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	0.49***	3.50	0.57	0.54	1.83	0.23***	0.05	0.12***	0.15***	0.46***	0.07***	0.19***	0.11
Conv. Arb.	0.42***	3.55	0.12	0.07	1.04	0.06	0.09***	0.09***	0.00	0.02	0.02	0.05	0.01
Ded. Short Bias	0.24	0.98	0.76	0.74	1.69	-0.91***	0.04	-0.29***	-0.02	0.14	0.03	0.08	0.02
Emerg. Markets	0.34	1.10	0.47	0.44	1.55	0.14	0.05	0.20***	0.10	0.13	0.07	0.48***	0.54***
Eq. Mkt. Neut.	0.51***	7.61	0.19	0.14	1.63	0.04	0.00	-0.01	0.00	0.03	0.03***	0.03	0.04
Event Driven	0.50***	4.47	0.52	0.49	1.56	0.17***	0.13***	0.13***	0.02	0.01	0.02	0.09	0.12***
Fixed In. Arb.	0.18	1.78	0.08	0.03	1.36	0.01	0.06	0.04	0.02	0.08	0.04	0.04	0.02
Global Macro	0.90***	3.42	0.23	0.19	1.84	0.23***	0.14	0.08	0.15***	0.90***	0.08	0.29***	0.03
L/S Equity	0.35***	2.88	0.82	0.81	1.86	0.40***	-0.04	0.21***	0.22***	0.21	0.05	-0.01	0.09
Managed Futures	0.39	1.21	0.17	0.12	1.88	-0.18	0.10	0.02	0.10	1.14***	0.12	-0.04	0.24
Multi-Strat.	0.42***	4.19	0.13	0.09	1.79	0.05	0.05	0.07***	0.01	0.00	0.02	-0.07	0.02

Table 4.5: December 2007 – June 2009, Standard OLS Errors. (*** = statistically significant at 95% level)

December 2007 - June 2009													
	α	α t-stat	R-sq.	Adj. R-sq.	D-W	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	-0.54	-1.78	0.92	0.86	2.01	-0.03	-0.31***	0.16	-0.06	-0.33	0.17***	0.13	0.18
Conv. Arb.	-0.64	-0.77	0.82	0.68	1.88	0.19	-0.82***	0.19	-0.18	0.67	0.30***	0.54	0.12
Ded. Short Bias	-1.21	-0.98	0.65	0.38	2.44	-0.53	-0.34	0.26	0.04	-0.19	-0.02	-0.65	-0.08
Emerg. Markets	-0.34	-0.57	0.90	0.81	2.65	-0.04	-0.36	0.05	-0.08	0.14	0.18***	0.11	0.39
Eq. Mkt. Neut.	-4.29***	-2.17	0.72	0.50	2.29	0.55	-0.21	1.42	-0.33	-5.01***	0.41	-0.74	-0.89
Event Driven	-0.31	-0.96	0.89	0.79	1.92	-0.02	-0.24***	0.09	-0.02	-0.38	0.12***	0.23	0.23
Fixed In. Arb.	-0.86	-0.98	0.73	0.51	2.27	0.29	-0.36	0.17	-0.11	0.44	0.31***	0.39	-0.06
Global Macro	-0.24	-0.40	0.71	0.48	2.23	-0.24	-0.25	0.08	-0.08	1.08***	0.27***	0.20	0.09
L/S Equity	0.11	0.52	0.97	0.95	2.65	-0.04	-0.33***	-0.01	0.00	-0.22	0.10	0.13	0.39***
Managed Futures	0.07	0.12	0.79	0.63	2.35	-0.82***	0.22	-0.03	0.02	0.57	0.16***	0.01	0.36
Multi-Strat.	-0.78	-1.75	0.87	0.76	1.62	0.11	-0.52***	0.16	-0.11***	-0.52	0.16***	0.16	0.08

Table 4.6: December 2007 – December 2012, Standard OLS Errors. (*** = statistically significant at 95% level)

December 2007 - December 2012													
	α	α t-stat	R-sq.	Adj. R-sq.	D-W	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	0.22	1.48	0.76	0.73	1.93	0.02	-0.11	0.03	0.01	0.05	0.10***	0.19***	0.23***
Conv. Arb.	0.28	0.99	0.64	0.59	1.48	-0.01	-0.31***	0.05	-0.09	0.80***	0.20***	0.60***	0.35***
Ded. Short Bias	-0.71	-1.97	0.75	0.71	2.15	-0.59***	-0.01	-0.33	0.00	0.80	0.11	-0.05	-0.15
Emerg. Markets	0.17	0.78	0.82	0.80	1.97	-0.05	-0.22***	0.16	-0.01	0.41	0.12***	0.15	0.45***
Eq. Mkt. Neut.	-0.70	-1.13	0.41	0.32	2.18	0.44	0.28	-0.02	-0.24***	-2.46***	0.27	-0.34	-0.49
Event Driven	0.29	1.68	0.73	0.69	1.78	0.00	-0.06	0.08	0.04	-0.29	0.04	0.23***	0.33***
Fixed In. Arb.	0.15	0.60	0.57	0.50	1.50	0.17	-0.09	-0.09	-0.08	0.73***	0.23***	0.41***	0.06
Global Macro	0.43***	2.10	0.47	0.39	2.13	-0.04	-0.12	-0.01	0.00	1.04***	0.17***	0.15	0.07
L/S Equity	0.22	1.67	0.90	0.88	1.85	0.01	-0.19***	0.11	0.05	-0.18	0.05	0.17***	0.42***
Managed Futures	0.49	1.21	0.24	0.12	2.31	-0.29	0.15	-0.16	0.15***	0.77	0.04	-0.15	0.20
Multi-Strat.	0.27	1.60	0.70	0.66	1.42	0.06	-0.21***	0.00	-0.03	-0.08	0.11***	0.27***	0.21***

Table 4.7: July 2009 – January 2016, Standard OLS Errors. (*** = statistically significant at 95% level)

July 2009 - January 2016													
	α	α t-stat	R-sq.	Adj. R-sq.	D-W	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	0.23***	2.48	0.75	0.72	1.96	0.13***	0.00	0.05	0.02	0.33***	0.00	0.02	0.14***
Conv. Arb.	0.55***	4.41	0.57	0.52	1.78	-0.02	0.15***	0.03	-0.07	0.12	0.11***	0.04	0.11
Ded. Short Bias	-0.31	-1.65	0.90	0.89	2.09	-0.47***	0.10	-0.63***	0.12***	0.02	-0.06	-0.19	-0.31***
Emerg. Markets	0.32	1.89	0.69	0.65	1.84	0.03	-0.05	0.10	-0.04	0.21	0.04	-0.02	0.31***
Eq. Mkt. Neut.	0.14	1.16	0.57	0.52	2.05	0.09	0.02	0.00	0.04	-0.23	-0.04	-0.30***	0.05
Event Driven	0.18	1.23	0.69	0.66	1.52	0.13	0.07	0.10	0.00	-0.10	0.01	0.09	0.20***
Fixed In. Arb.	0.59***	6.65	0.36	0.28	1.57	0.02	0.06	0.01	-0.04	0.26***	0.04	-0.01	0.03
Global Macro	0.22	1.69	0.44	0.37	2.21	0.16***	-0.08	-0.02	-0.02	0.90***	0.01	0.07	0.01
L/S Equity	0.16	1.61	0.87	0.86	1.67	0.24***	-0.05	0.09***	0.04	-0.07	-0.03	-0.01	0.21***
Managed Futures	-0.32	-0.93	0.41	0.35	2.17	0.31	0.00	-0.20	0.24	2.24***	-0.12	-0.08	0.02
Multi-Strat.	0.54***	6.33	0.66	0.62	1.86	0.05	0.01	0.05	0.02	0.16	0.01	-0.02	0.13***

Table 4.8: January 1995 – January 2016, Newey-West Errors. (*** = statistically significant at 95% level)

January 1995 - January 2016												
	α	α t-stat	R-sq.	Adj. R-sq.	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	0.39***	4.24	0.57	0.56	0.15***	0.00	0.09***	0.11***	0.34***	0.08***	0.16***	0.15***
Conv. Arb.	0.42***	3.10	0.29	0.26	-0.02	0.05	0.05	-0.03	0.17	0.10***	0.12	0.16***
Ded. Short Bias	-0.04	-0.24	0.74	0.73	-0.79***	0.10	-0.32***	0.01	0.16	0.04	-0.03	-0.02
Emerg. Markets	0.33	1.74	0.50	0.48	0.03	-0.07	0.15***	0.06	0.12	0.09***	0.37***	0.51***
Eq. Mkt. Neut.	-0.07	-0.21	0.21	0.18	0.23	0.15	0.03	-0.01	-0.64	0.11	-0.14***	-0.11
Event Driven	0.36***	3.83	0.58	0.56	0.11***	0.07***	0.09***	0.03	-0.11	0.05***	0.11***	0.17***
Fixed In. Arb.	0.24	1.88	0.26	0.23	0.02	0.07	0.03	-0.01	0.24	0.09***	0.08	0.09***
Global Macro	0.73***	4.64	0.21	0.18	0.10	0.02	0.02	0.11	0.85***	0.10***	0.23***	0.08
L/S Equity	0.35***	3.93	0.79	0.78	0.27***	-0.11***	0.17***	0.16***	0.14	0.04***	0.02	0.19***
Managed Futures	0.50***	2.40	0.17	0.15	-0.20	0.03	-0.02	0.14***	1.26***	0.05	0.00	0.21***
Multi-Strat.	0.42***	4.40	0.32	0.30	0.02	0.02	0.04	0.01	0.03	0.05	-0.01	0.11***

Table 4.9: January 1995 – November 2007, Newey-West Errors. (*** = statistically significant at 95% level)

January 1995 - November 2007												
	α	α t-stat	R-sq.	Adj. R-sq.	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	0.49***	3.55	0.57	0.54	0.23***	0.05	0.12***	0.15***	0.46***	0.07***	0.19***	0.11
Conv. Arb.	0.42***	2.74	0.12	0.07	0.06	0.09***	0.09***	0.00	0.02	0.02	0.05	0.01
Ded. Short Bias	0.24	0.92	0.76	0.74	-0.91***	0.04	-0.29***	-0.02	0.14	0.03	0.08	0.02
Emerg. Markets	0.34	0.97	0.47	0.44	0.14	0.05	0.20***	0.10	0.13	0.07	0.48***	0.54***
Eq. Mkt. Neut.	0.51***	6.62	0.19	0.14	0.04	0.00	-0.01	0.00	0.03	0.03***	0.03	0.04
Event Driven	0.50***	3.67	0.52	0.49	0.17***	0.13***	0.13***	0.02	0.01	0.02	0.09	0.12***
Fixed In. Arb.	0.18	1.51	0.08	0.03	0.01	0.06	0.04	0.02	0.08	0.04***	0.04	0.02
Global Macro	0.90***	3.20	0.23	0.19	0.23	0.14	0.08	0.15***	0.90***	0.08	0.29***	0.03
L/S Equity	0.35***	2.88	0.82	0.81	0.40***	-0.04	0.21***	0.22***	0.21	0.05***	-0.01	0.09***
Managed Futures	0.39	1.12	0.17	0.12	-0.18	0.10	0.02	0.10***	1.14***	0.12	-0.04	0.24
Multi-Strat.	0.42***	4.37	0.13	0.09	0.05	0.05	0.07***	0.01	0.00	0.02	-0.07***	0.02

Table 4.10: December 2007 – June 2009, Newey-West Errors. (*** = statistically significant at 95% level)

December 2007 - June 2009												
	α	α t-stat	R-sq.	Adj. R-sq.	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	-0.54	-1.72	0.92	0.86	-0.03	-0.31***	0.16	-0.06	-0.33	0.17***	0.13	0.18
Conv. Arb.	-0.64	-0.84	0.82	0.68	0.19	-0.82***	0.19	-0.18	0.67	0.30***	0.54***	0.12
Ded. Short Bias	-1.21	-1.94	0.65	0.38	-0.53	-0.34	0.26	0.04	-0.19	-0.02	-0.65	-0.08
Emerg. Markets	-0.34	-0.62	0.90	0.81	-0.04	-0.36***	0.05	-0.08	0.14	0.18***	0.11	0.39***
Eq. Mkt. Neut.	-4.29	-1.93	0.72	0.50	0.55	-0.21	1.42	-0.33	-5.01***	0.41***	-0.74	-0.89
Event Driven	-0.31	-0.66	0.89	0.79	-0.02	-0.24***	0.09	-0.02	-0.38	0.12***	0.23	0.23
Fixed In. Arb.	-0.86	-1.30	0.73	0.51	0.29	-0.36***	0.17	-0.11	0.44	0.31***	0.39	-0.06
Global Macro	-0.24	-0.70	0.71	0.48	-0.24	-0.25	0.08	-0.08	1.08	0.27***	0.20	0.09
L/S Equity	0.11	0.58	0.97	0.95	-0.04	-0.33***	-0.01	0.00	-0.22	0.10***	0.13	0.39***
Managed Futures	0.07	0.23	0.79	0.63	-0.82***	0.22	-0.03	0.02	0.57	0.16***	0.01	0.36
Multi-Strat.	-0.78	-1.60	0.87	0.76	0.11	-0.52***	0.16	-0.11	-0.52	0.16***	0.16	0.08

Table 4.11: December 2007 – December 2012, Newey-West Errors. (*** = statistically significant at 95% level)

December 2007 - December 2012												
	α	α t-stat	R-sq.	Adj. R-sq.	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	0.22	1.38	0.76	0.73	0.02	-0.11	0.03	0.01	0.05	0.10***	0.19***	0.23***
Conv. Arb.	0.28	0.76	0.64	0.59	-0.01	-0.31	0.05	-0.09	0.80	0.20***	0.60***	0.35***
Ded. Short Bias	-0.71	-1.97	0.75	0.71	-0.59***	-0.01	-0.33	0.00	0.80	0.11	-0.05	-0.15
Emerg. Markets	0.17	0.70	0.82	0.80	-0.05	-0.22***	0.16	-0.01	0.41	0.12***	0.15	0.45***
Eq. Mkt. Neut.	-0.70	-1.04	0.41	0.32	0.44	0.28	-0.02	-0.24	-2.46	0.27	-0.34	-0.49
Event Driven	0.29	1.47	0.73	0.69	0.00	-0.06	0.08	0.04	-0.29	0.04	0.23***	0.33***
Fixed In. Arb.	0.15	0.42	0.57	0.50	0.17	-0.09	-0.09	-0.08	0.73	0.23***	0.41***	0.06
Global Macro	0.43***	2.39	0.47	0.39	-0.04	-0.12	-0.01	0.00	1.04***	0.17***	0.15	0.07
L/S Equity	0.22	1.61	0.90	0.88	0.01	-0.19***	0.11	0.05***	-0.18	0.05	0.17***	0.42***
Managed Futures	0.49	1.18	0.24	0.12	-0.29	0.15	-0.16	0.15***	0.77	0.04	-0.15	0.20
Multi-Strat.	0.27	1.22	0.70	0.66	0.06	-0.21***	0.00	-0.03	-0.08	0.11***	0.27***	0.21

Table 4.12: July 2009 – January 2016, Newey-West Errors. (*** = statistically significant at 95% level)

July 2009 - January 2016												
	α	α t-stat	R-sq.	Adj. R-sq.	$R_m - r_f$	HML	SMB	MOMENTUM	BCABI	TRCC	DXY	MSCIXUS
All Strategies	0.23***	2.66	0.75	0.72	0.13***	0.00	0.05	0.02	0.33***	0.00	0.02	0.14***
Conv. Arb.	0.55***	3.99	0.57	0.52	-0.02	0.15***	0.03	-0.07	0.12	0.11***	0.04	0.11
Ded. Short Bias	-0.31	-1.52	0.90	0.89	-0.47***	0.10	-0.63***	0.12***	0.02	-0.06	-0.19***	-0.31***
Emerg. Markets	0.32	1.81	0.69	0.65	0.03	-0.05	0.10	-0.04	0.21	0.04	-0.02	0.31***
Eq. Mkt. Neut.	0.14	1.12	0.57	0.52	0.09	0.02	0.00	0.04	-0.23	-0.04	-0.30***	0.05
Event Driven	0.18	1.21	0.69	0.66	0.13	0.07	0.10	0.00	-0.10	0.01	0.09	0.20***
Fixed In. Arb.	0.59***	6.04	0.36	0.28	0.02	0.06	0.01	-0.04	0.26	0.04	-0.01	0.03
Global Macro	0.22	1.75	0.44	0.37	0.16	-0.08	-0.02	-0.02	0.90***	0.01	0.07	0.01
L/S Equity	0.16	1.61	0.87	0.86	0.24***	-0.05	0.09***	0.04	-0.07	-0.03	-0.01	0.21***
Managed Futures	-0.32	-0.96	0.41	0.35	0.31	0.00	-0.20	0.24***	2.24***	-0.12	-0.08	0.02
Multi-Strat.	0.54***	5.71	0.66	0.62	0.05	0.01	0.05	0.02	0.16	0.01	-0.02	0.13***

5 Conclusion

After decreasing in size dramatically during the Crisis, the hedge fund industry seems to be recovering. Not only are industry assets approaching pre-Crisis levels, but institutional investment in the industry is giving more financial market participants access to hedge fund risks and returns. As a result, up-to-date studies of the industry are important in determining what role, if any, hedge funds should play in financial markets. In this paper, we study hedge fund return data from the Credit Suisse Hedge Fund Indexes over the period January 1995 – January 2016. In particular, we use a factor model that represents eight investable strategies that the "common" investor might follow in order to determine whether or not hedge fund managers were able to deliver excess returns during a number of distinct time periods, including before the Crisis, during the Crisis, and after the Crisis.

We find evidence that hedge fund managers have historically delivered statistically significant positive excess returns, particularly prior to the Crisis. From January 1995 – November 2007, the broad sample of hedge funds that we studied delivered monthly excess returns of 0.49% (5.93% annualized). A number of individual strategy indexes also performed well and delivered statistically significant positive excess returns. However, it seems that there has been a noticeable shift in hedge fund industry performance characteristics. During the period December 2007 – June 2009, we find that neither the broad index of hedge funds nor any individual strategy index delivered statistically significant positive excess returns. We find the results to be similar when we extend the Crisis period to include a portion of the

drawn out recovery. Here, only one individual strategy index, global macro, delivered statistically significant positive monthly excess returns. During the post-Crisis period, from July 2009 – January 2016, hedge fund managers do not seem to have been as successful as they were previously. While we find that the broad index did deliver statistically significant positive monthly excess returns of 0.23% (2.74% annualized), this is substantially less than the pre-Crisis period. Additionally, only three strategy styles seem to have contributed to these excess returns.

The apparent shift in the performance characteristics of the hedge fund industry may be suggestive of a shift in the risk appetites of hedge fund managers. The Crisis may have served as a wake-up call to the dangers of excessive risk-taking behaviors that may have contributed to the positive excess returns that hedge funds delivered prior to the Crisis. The public criticism that has been aimed toward most of the financial industry, including hedge funds, following the Crisis might also have contributed to such a shift in managers' risk appetites. Additionally, the growing size of the hedge fund industry is symptomatic of another likely reason that its performance characteristics have shifted. There are simply a huge number of hedge funds today and managers can only differentiate their strategies to such a degree. Many of the "secrets" that allowed successful fund managers to deliver impressive returns in the 1990s and early 2000s seem to be out. The hedge fund industry may be the next example of a classic problem with perfectly competitive markets: once information about a profitable strategy becomes common knowledge, competitors enter the market and profits vanish.

It is not necessarily a bad thing if hedge fund managers are becoming more risk averse, particularly as more financial market participants gain exposure to hedge fund risks and returns. The pension funds and institutional investors that are slowly becoming the hedge fund industry's largest customers often manage money on behalf of "common" people. Logically, "common" people likely have much lower risk tolerances than the wealthy individuals who were the main hedge fund constituents in the past. In order to continue attracting capital from investors, then, hedge fund managers must understand that positive fund returns cannot simply be the product of increased risk that people are not willing to bear.

It is important to note that, while hedge funds do serve a legitimate role in financial markets and we find that they have been able to deliver positive excess returns historically, they are certainly not immune from financial crises. Even though managers might strive to deliver absolute returns regardless of prevailing market or economic conditions, it is nearly impossible to avoid getting caught up in a systemic event of the magnitude of the Crisis. In general, our results do not indicate that hedge fund managers are able to deliver positive excess returns during such a time. While hedge funds can certainly play a role in a well-diversified investing strategy and do contribute to financial markets in a variety of ways, there should be no expectation that the broad industry or any individual strategy will consistently deliver excess returns, particularly during crisis periods.

A Appendix

A.1 Credit Suisse Hedge Index LLC Strategy Classifications

Credit Suisse Hedge Index LLC breaks the hedge fund universe into ten primary categories. Table A.1 contains the descriptions, taken directly from Credit Suisse Hedge Index LLC, of the individual strategies.

Table A.1: Credit Suisse Hedge Index LLC Strategy Classifications.

Convertible arbitrage funds typically aim to profit from the purchase of convertible securities and the subsequent shorting of the corresponding stock when there is a pricing error made in the conversion factor of the security. Managers of convertible arbitrage funds typically build long positions of convertible and other equity hybrid securities and then hedge the equity component of the long securities positions by shorting the underlying stock or options. The number of shares sold short usually reflects a delta neutral or market neutral ratio. As a result, under normal market conditions, the arbitrageur generally expects the combined position to be insensitive to fluctuations in the price of the underlying stock.

Dedicated short bias funds typically take more short positions than long positions and earn returns by maintaining net short exposure in long and short equities. Detailed individual company research typically forms the core alpha generation driver of dedicated short bias managers, and a focus on companies with weak cash flow generation is common. To affect the short sale, the manager typically borrows the stock from a counterparty and sells it in the market. Short positions are sometimes implemented by selling forward. Risk management often consists of offsetting long positions and stop-loss strategies.

Emerging markets funds typically invest in currencies, debt instruments, equities and other instruments of countries with “emerging” or developing markets (typically measured by GDP per capita). Such countries are considered to be in a transitional phase between developing and developed status. Examples of emerging markets include China, India, Latin America, much of Southeast Asia, parts of Eastern Europe, and parts of Africa. The index has a number of subsectors, including arbitrage, credit and event driven, fixed income bias, and equity bias.

Equity market neutral funds typically take both long and short positions in stocks while seeking to reduce exposure to the systemic risk of the market (i.e., a beta of zero is desired). Equity market neutral funds typically seek to exploit investment opportunities unique to a specific group of stocks, while maintaining a neutral exposure to broad groups of stocks defined for example by sector, industry, market capitalization, country, or region. The index has a number of subsectors including statistical arbitrage, quantitative long/short, fundamental long/short and index arbitrage. Managers often apply leverage to enhance returns.

Event driven funds typically invest in various asset classes and seek to profit from potential mispricing of securities related to a specific corporate or market event. Such events can include: mergers, bankruptcies, financial or operational stress, restructurings, asset sales, recapitalizations, spin-offs, litigation, regulatory and legislative changes as well as other types of corporate events. Event driven funds can invest in equities, fixed income instruments (investment grade, high yield, bank debt, convertible debt and distressed), options and various other derivatives. Many event driven fund managers use a combination of strategies and adjust exposures based on the opportunity sets in each subsector.

Fixed income arbitrage funds typically attempt to generate profits by exploiting inefficiencies and price anomalies between related fixed income securities. Funds often seek to limit volatility by hedging out exposure to the market and interest rate risk. Strategies may include leveraging long and short positions in similar fixed income securities that are related either mathematically or economically. The sector includes credit yield curve relative value trading involving interest rate swaps, government securities and futures; volatility trading involving options; and mortgage-backed securities arbitrage (the mortgage-backed market is primarily U.S.-based and over-the-counter).

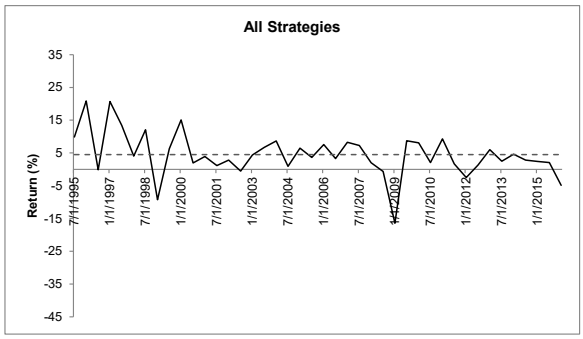
Global macro funds typically focus on identifying extreme price valuations and leverage is often applied on the anticipated price movements in equity, currency, interest rate and commodity markets. Managers typically employ a top-down global approach to concentrate on forecasting how political trends and global macroeconomic events affect the valuation of financial instruments. Profits can be made by correctly anticipating price movements in global markets and having the flexibility to use a broad investment mandate, with the ability to hold positions in practically any market with any instrument. These approaches may be systematic trend following models, or discretionary.

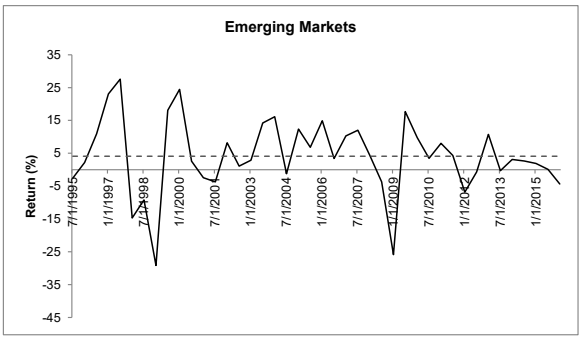
Long/short equity hedge funds typically invest in both long and short sides of equity markets, generally focusing on diversifying or hedging across particular sectors, regions or market capitalizations. Managers typically have the flexibility to shift from value to growth; small to medium to large capitalization stocks; and net long to net short. Managers can also trade equity futures and options as well as equity related securities and debt or build portfolios that are more concentrated than traditional long-only equity funds.

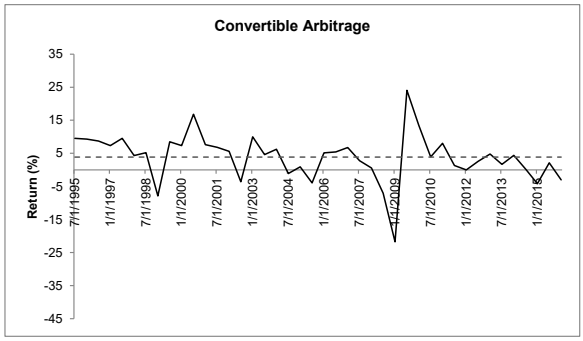
Managed futures funds (often referred to as CTAs or Commodity Trading Advisors) typically focus on investing in listed bond, equity, commodity futures and currency markets, globally. Managers tend to employ systematic trading programs that largely rely upon historical price data and market trends. A significant amount of leverage may be employed since the strategy involves the use of futures contracts. CTAs tend not to have a particular bias towards being net long or net short any particular market.

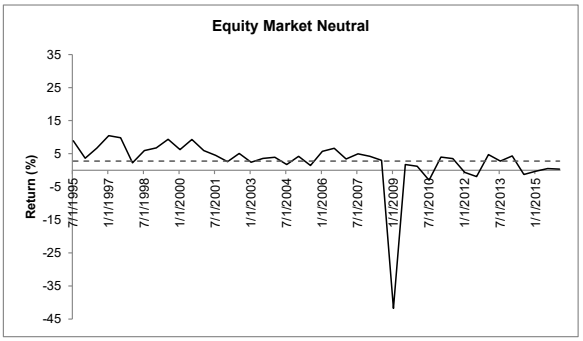
Multi-strategy funds typically are characterized by their ability to allocate capital based on perceived opportunities among several hedge fund strategies. Through the diversification of capital, managers seek to deliver consistently positive returns regardless of the directional movement in equity, interest rate or currency markets. The added diversification benefits may reduce the risk profile and help to smooth returns, reduce volatility and decrease asset-class and single-strategy risks. Strategies adopted in a multi-strategy fund may include, but are not limited to, convertible bond arbitrage, equity long/short, statistical arbitrage and merger arbitrage.

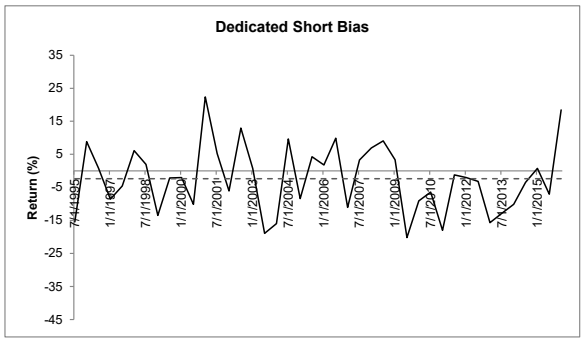
A.2 Credit Suisse Hedge Fund Index Six-Month Returns

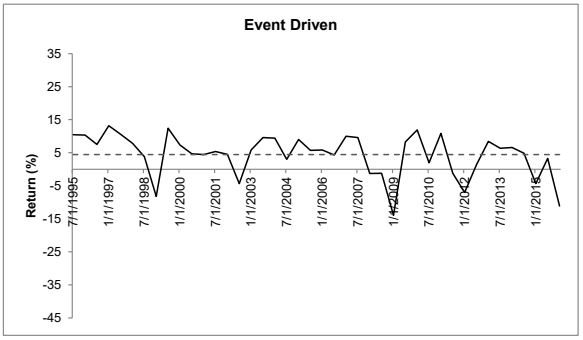


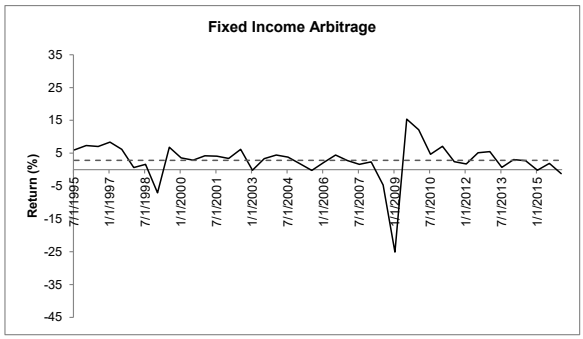











Fixed Income Arbitrage
Return (%)
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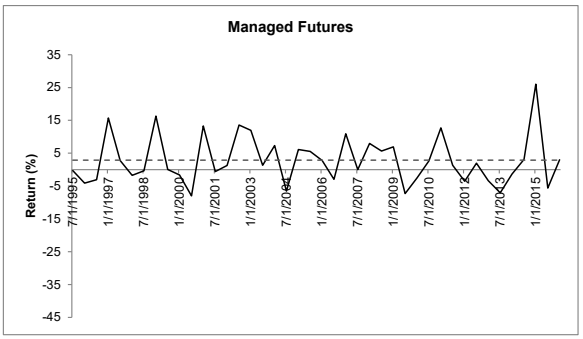
25
15
5
-5
-15
-25
-35
-45
7/1/1995
1/1/1997
7/1/1998
1/1/2000
7/1/2001
1/1/2003
7/1/2004
1/1/2006
7/1/2007
1/1/2009
7/1/2010
1/1/2012
7/1/2013
1/1/2015


Managed Futures
Return (%)
35
25
15
5
-5
-15
-25
-35
-45
7/1/1995
1/1/1997
7/1/1998
1/1/2000
7/1/2001
1/1/2003
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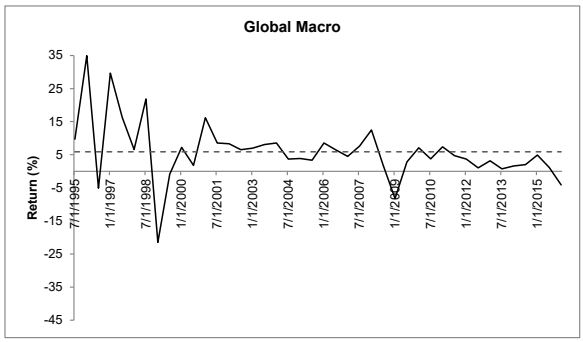
7/1/2010
1/1/2012
7/1/2013
1/1/2015


Global Macro
Return (%)
35
25
15
5
-5
-15
-25
-35
-45
7/1/1995
1/1/1997
7/1/1998
1/1/2000
7/1/2001
1/1/2003
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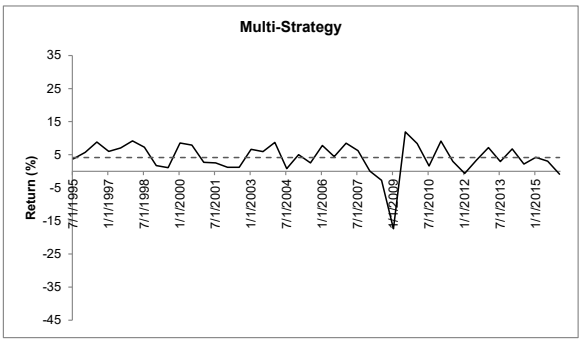
7/1/2010
1/1/2012
7/1/2013
1/1/2015


Multi-Strategy
Return (%)
35
25
15
5
-5
-15
-25
-35
-45
7/1/1995
1/1/1997
7/1/1998
1/1/2000
7/1/2001
1/1/2003
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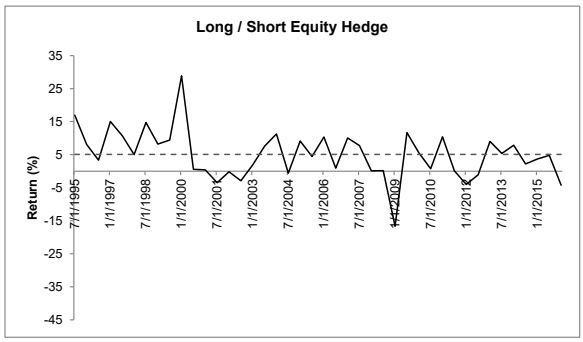
7/1/2010
1/1/2012
7/1/2013
1/1/2015


Long / Short Equity Hedge
Return (%)
35
25
15
5
-5
-15
-25
-35
-45
7/1/1995
1/1/1997
7/1/1998
1/1/2000
7/1/2001
1/1/2003
7/1/2004
1/1/2006
7/1/2007
1/1/2009
7/1/2010
1/1/2012
7/1/2013
1/1/2015

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