Federal Reserve Bank of Atlanta
Financial Market Conference 2006

Hedge Funds: An Industry in Its Adolescence

By
William K.H. Fung*
David A. Hsieh**

This draft dated
June 20, 2006

* Visiting Professor of Finance, BNP Paribas Hedge Fund Centre, London Business School.
**Professor of Finance, Duke University, Fuqua School of Business. Email: david.a.hsieh@duke.edu

1. Introduction

It could be said that the hedge fund industry, compared to its brethren in the asset management arena, was in its infancy up until a decade ago. Information about these funds, both qualitative and quantitative, was not freely available to the general investment public until academic research on hedge funds started in the 1990s, with Fung and Hsieh (1997), Eichengreen et al. (1998), Schneeweis and Spurgin (1998), Ackermann, McEnally and Ravenscraft (1999), and Brown, Goetzmann and Ibbotson (1999).

At the turn of the century, coinciding with the burst of the Internet bubble, institutional investors began increasing their allocation to hedge funds, responding in part to the lackluster performance of global equity markets. As a result, assets-under-management (AUM) by the hedge fund industry grew exponentially and the number of hedge funds doubled over the short span of the last five years by some estimates.[1] This resulted in a clientele shift in the hedge fund industry towards institutional investors. This clientele shift precipitated profound changes in the way hedge funds operate—such as increased transparency, better compliance, and higher operational standard, to name just a few. Some have referred to this as the institutionalization of the hedge fund industry.

Accompanying these changes, a demand for rigorous research into hedge fund performance rose. Coupled with the improved availability of hedge fund databases, there is a now a voluminous body of published studies on hedge funds—professional as well academic in approach. Although there is no official count of academic papers on hedge funds, a reasonable conjecture is that it has grown at an even faster pace than the hedge

[1] HFR estimated the number of hedge funds to be 3,617 as we enter into the new millennium versus the latest estimate of 8,219 as of the end of June, 2005.

fund industry. In this paper, we provide an overview, albeit somewhat biased, on a particular school of thought in this growing body of hedge fund research.

The school of thought to which we refer is the thesis put forward in Fung and Hsieh (1999, p. 317) on the economic rationale of the ***hedge fund business model***:

> Consider the problem confronting a money manager who believes that he has a set of *skills that could earn above average risk adjusted returns*. We are not advocating the existence of such strategies, but merely the hypothesis that the manager believes this to be so. Let us assume that the manager has a limited amount of personal wealth. In order to meet the fixed costs of a trading operation, the manager must leverage his skills and beliefs by attracting external capital. *Basically, he is financing a new venture.* The choice is either equity financing, in the form of a fund, or debt financing, in the form of putting up personal assets as collateral against borrowed capital. In most cases, the manager's personal wealth is insufficient to secure sizeable debt financing. That leaves the formation of a fund as the only practical financing option.

This simple characterization of the hedge fund business model points to a fundamental question frequently found in hedge fund research over the past few years. In order for an opaque "new venture" to prevail in charging investors hefty incentive fees, it must offer returns that are not easily available from more conventional, lower cost alternatives such as mutual funds. Putting aside the implausible hypothesis that superior hedge fund returns reflect the "free lunch" that has escaped other investment professionals, we face the basic questions: *How is superior performance generated, what are the risks and can the superior performance last?* Satisfactory answers to these

questions must begin with a clear understanding of *the systematic risk factors inherent in hedge funds strategies.*

This, in our view, is the foundational question to be addressed in hedge fund research. From an investor's perspective, its answer is the key determinant of whether hedge funds provide diversification to a portfolio of conventional assets and—more importantly—whether hedge funds offer returns commensurate with the fees they charge on a risk-adjusted basis. From the perspective of a counterparty to hedge funds—such as prime brokers, commercial banks and investment banks—this is the key input for assessing the capital-at-risk for engaging in servicing and financing hedge fund businesses. From the regulator's perspective, this is the key question in monitoring the convergence risk of *highly leveraged opinions* that can destabilize markets, creating systemic risk .

Ultimately, hedge fund managers are guided by the desire to maximize the enterprise value of their firms. Like most other investment opportunities, different hedge fund strategies must yield to constraints such as diminishing return to scale (capacity issues) as well as other unrelenting forces of economic cycles (such as strategies falling in and out of favor, often at the mercy of market forces). Rational choices within the hedge fund business model, such as the degree of leverage, the allocation of risk capital to factor-related bets versus delivering alpha to investors must in turn depend on the compensation contract between the hedge fund manager and investors ("the fee structure"). Logically, optimal contracting between investors and hedge fund managers (and, for that matter, between prime brokers and hedge fund managers) must take into account the presence of systematic risk factors inherent in hedge fund strategies.

In times of market stress, investors tend to take flight to liquidity. The transmission mechanism leading to a systemic withdrawal of risk capital from markets is not necessarily market-price driven. An equally plausible proposition is that when faced with inadequate transparency, investors are innately unwilling to absorb performance shocks. Put differently, when opaque investment vehicles perform poorly, it is hard for investors to differentiate between random shocks and systemic adverse causes. Therefore, it is in everyone's interest—hedge-fund investors, financial intermediaries who provide leverage to hedge funds, and the hedge fund managers themselves—to identify the appropriate level of disclosure so as to avoid the risk of a boom-bust capital formation process in the hedge fund industry. It may be impractical for hedge fund managers to publicize details of their trading positions. However, it is important to identify the risk factors that underlie different hedge fund strategies in such a way that helps investors assess the impact of changing market conditions on hedge fund styles.

Finally, better compensation contract design reduces the risk of performance shock and helps to smooth the capital formation process of the hedge fund industry and ultimately enhances the enterprise value of the hedge fund firm. Properly structured, compensation contract design can provide another important deterrent to hedge fund managers engaging in excessive leverage that may otherwise be encouraged by a loosely specified incentive contract. Together with the institutionalization of the hedge fund industry, the desire to enhance the enterprise value of the hedge fund firm will dissuade—hopefully—hedge fund managers from applying excessive leverage. This in turn will better align the interests of hedge fund managers, investors, prime brokers, and regulators. We postulate that a necessary condition for better contract design is the

recognition and proper measurement of systematic risk factors inherent in hedge fund strategies. It stands to reason that investors seeking alpha are likely to price the services of hedge fund managers differently from those seeking leveraged factor-bets.

The rest of the paper proceeds as follows. In section 2, we provide some recent statistics of the hedge fund industry, particularly with respect to the growth in the size of the industry and the emergence of a dominant institutional clientele among hedge fund investors. Here we report empirical evidence where investors seeking alphas allocate capital differently from investors seeking factor bets.

An important prerequisite to estimating systematic risk factors in hedge fund strategies is to have accurate performance history of the hedge fund industry. In section 3, we discuss the problems with biases in hedge fund databases that must be recognized in order to obtain accurate measures of returns.

Section 4 summarizes the research by addressing the fundamental question of systematic risk exposure. We follow the framework in Fung and Hsieh (1997), modeling hedge fund returns as a function of three key elements—*how* they trade, *where* they trade and *how the positions are financed*. The answers to the questions of *how* and *where* hedge funds do their business are based on extensions of the approach used to model conventional investment vehicles such as mutual funds—see for example Sharpe (1992). Here, the systematic risk factors in a number of different hedge fund strategies are examined.

The question of *how hedge fund positions are financed* brings up several unconventional and important issues peculiar to the hedge fund business model. First and foremost, the ability to leverage coupled with the existence of common risk factors

among different hedge fund strategies raise the question of market impact. Put differently, what if most hedge fund managers agree, albeit for different reasons, on the "best trade"? Given that hedge fund bets are generally leveraged, what are the risks of another Long-Term Capital Management (LTCM) incident?

What does academic research have to say on the following question: *Are hedge fund managers the evil geniuses that profit from reeking havoc in capital markets, or do they represent the quintessence of "smart money" providing risk capital to capital markets unencumbered by securities regulations?* Section 5 of the paper provides a brief summary of the empirical findings on this question.

In light of the clientele shift among investors in the hedge fund industry, section 6 reports recent findings on the return experience of alpha-oriented investors. Here we refer to the recent paper by Fung, Hsieh, Naik, and Ramadori (2006). The empirical evidence points to a declining trend of alpha to investors. This is consistent with the implication of the Berk and Green (2004) model. Demand growth for alpha coupled with the layers of fees charged by hedge fund managers and funds-of-hedge fund managers have led to a disproportionate share of returns in favor of product providers at the cost of investors. New research on synthetic hedge funds (replication of hedge-fund-like returns via mathematical models) at a lower cost to investors has been put forward. However, we are not persuaded that it is a realistic solution to the supply–demand imbalance between alpha-producers and alpha-buyers. The price for alpha (implicit in the fee structure) has to be set such that it will encourage an increase in alpha production. Ultimately, better alignment of interest between hedge fund managers and investors through more appropriate compensation contracts must be addressed. A necessary

condition for better contract design is the identification of non-alpha related factor bets inherent in hedge fund returns. In section 7, we conclude this paper with some thoughts on the capital formation process of the hedge fund industry, alpha capacity, and a research agenda much in need of input.

2. Recent Growth in the Hedge Fund Industry

We start with an overview of the recent development in the hedge fund industry—size, number of funds, style composition, and fees.

2.1 Increasing Institutional Demand for Hedge Funds

Demand for hedge funds by U.S. institutional investors have been steadily growing in the last 5 years. According to NACUBO's *Annual Endowment Survey*, the dollar amount and percentage of assets invested in hedge funds have been steadily rising. As shown in Panel A of Table 1, on an equally-weighted basis, endowments have increased allocation from 3.1% in 1999 to 7.3% in 2004. On a dollar-weighted basis, the increase is even more dramatic, from 5.1% in 1999 to 14.7% in 2004. This has taken place across the board, for small as well as the large endowments. The dollar amounts in Panel B show an increase of $11.3b in 2000 to $39.2b in 2004.

Following the lead of university endowments, U.S. pension plans are also increasing their investments in hedge funds. According to *Pension and Investments*, the largest 200 U.S. defined benefit pension plans invested $3.2 billion, or 0.1% of their assets, in hedge funds in 2000. This has grown to $21.1 billion, or 0.7% of their assets, in 2004.

2.2. Growth in Number of Funds and Assets Under Management

The supply of hedge funds has grown with the increase in demand for hedge funds, but the actual size of the hedge fund industry is harder to measure. Unlike the mutual fund industry, hedge funds do not have an industry association to collect and report their information. Instead, hedge funds voluntarily provide information to one or more database vendors. The lack of a uniform reporting standard makes it difficult to assess the true size of the hedge fund industry.

There are now three commercial databases of hedge funds each having more than 10 years of actual data collection experience: CISDM (Center for International Securities and Derivatives Markets, University of Massachusetts, Amherst), HFR (Hedge Fund Research, Chicago), and TASS (Lipper TASS).[2] In this section, we exclude funds-of-funds (FoFs) from consideration to avoid double counting, since FoFs invest in other hedge funds. As of Dec 2004, TASS had 4,130 funds (2,431 live and 1,699 defunct), HFR had 5,158 funds (2,939 live and 2,219 defunct), and CISDM had 3,246 funds (1,315 live and 1,931 defunct).

While many hedge funds report to only a single database, some hedge funds report to more than one database. There is an ongoing project at the BNP Paribas Hedge Fund Centre of the London Business School to merge several databases to achieve a comprehensive picture. A great deal of effort has been expended to get an accurate assessment of the statistical characteristics of the hedge fund industry eliminating the risk

[2] There are two notable entrants to this field—Morgan Stanley Capital International ("MSCI") and Standard and Poors (S&P). Because of their late entry to this field, their data were largely from reconstructed history rather than real-time collection of hedge fund performance. In this paper, we use the TASS database as of Feb 2005, HFR as of Jan 2005, and CISDM as of Dec 2004. We report the results up through Dec 2004.

of double counting due to the lack of a uniform reporting standard in the industry.[3] At the completion of this project, we will have one of the most comprehensive academic hedge fund databases to work with. An early output of this project is Figure 1, which reports the differences among five databases in the form of a Venn diagram.

At the present stage, we quantify the growth of the industry using the three databases, as shown in Table 2. In TASS, the number of hedge funds grew from 1,778 at the end of 1999 to 2,431 at the end of 2004. The growth rate of 37% resulted from 2,111 new funds and 1,258 exiting funds. In HFR, there were 2,062 funds at the end of 1999, growing by 43% to 2,939 at the end of 2004, with 2,552 entries and 1,478 exits. In contrast, the number of funds in CISDM actually fell from 1,470 to 1,315 between 1999 and 2004, with 1,372 entries and 1,412 exits.

A comparable picture emerges from the estimates of industry totals made by various consultants. For example, the HFR *Industry Report* for the third quarter of 2005 estimated that the number of funds grew from 3,102 in 1999 to 5,782 in 2004, and AUMs grew from $456 billion in 1999 to $973 billion in 2004.

From our earlier thesis of the hedge fund business model, a hedge fund is more akin to a start-up than a mutual fund. The high attrition rates (around 10% per year) in hedge funds are comparable to those of young firms. Hedge fund returns also contain substantial idiosyncratic risk, typical of small undiversified firms. Figure 2 illustrates the low correlation of hedge fund returns (versus the high correlation of mutual fund returns) to standard asset classes updating the results reported in Fung and Hsieh (1997). Here we use 2,082 hedge funds in TASS, and 14,927 mutual `funds from the Morningstar Jan 2005 CD. Each fund is required to have at least 36 monthly returns, but only the last 60

[3]Here we thank MSCI and Eureka Hedge for allowing us access to their data bases.

monthly returns if the fund has a longer history. Each fund's returns are regressed on eight asset classes comparable to those in Fung and Hsieh (1997),[4] and the distribution of the R^2s for each group is tabulated. As before, hedge funds (in black bars) have much lower correlation with the asset classes than mutual funds (in stripped bars).

2.3. Changes in Styles and Strategies

Beyond having low correlation to standard asset classes, hedge funds form a heterogeneous group that use many different strategies delivering returns, which can be quite different from each other.[5] Consultants classify hedge funds according to qualitative self-described styles. For example, TASS classifies hedge funds into 10 styles.

Convertible Arbitrage funds typically attempt to extract value by purchasing convertible securities while hedging the equity, credit and interest rate exposures with short positions of the equity of the issuing firm and other appropriate fixed-income related derivatives**. Dedicated Shorts** are funds that specialize in short-selling, securities that are perceived to be overpriced—typically equities. **Emerging Market** funds specialize in trading the securities of developing economies. **Equity Market Neutral** refers to funds typically trading long-short portfolios of equities with little directional exposure to the stock market. **Event Driven** funds specialize in trading corporate events, such as merger transactions or corporate restructuring. **Fixed Income Arbitrage** funds typically trade long-short portfolios of bonds. **Macro** funds bet on directional

[4] MSCI North American equities, MSCI non-US equities, IFC Emerging Market equities, JP Morgan US Government bonds, JP Morgan non-US Government bonds, Gold (London am fixing), Federal Reserve Trade-Weighted Dollar Index, one-month Eurodollar deposit rate (previous month).
[5] Fung and Hsieh (1997) found that the first five principal components explained less than 50 percent of the cross-sectional variation in hedge fund returns.

movements in stocks, bonds, foreign exchange rates, and commodity prices**. Long/Short Equity** funds are typically exposed to a long-short portfolio of equities with a long bias. **Managed Futures** funds are specialists in futures trading—typically employing trend-following strategies. All other strategies are grouped into **Others**. Section 4 will describe the risk factors in many of these styles.

Based on a study performed by TASS, Table 3 shows how the style composition has changed over the years. Regarding the number of funds, Panel A shows the style composition has been quite stable since 1999. As for assets under management, Panel B shows that there has been a slight decline in **Macro** funds (from 15% in 1999 to 10% in 2004) and **Long/Short Equitiy** funds (from 45% to 32%) with an increase in **Others** (from 0.4% to 10%).

The HFR *Industry Report* done in September 2005 provides some additional useful information. In terms of fund age, 13% of hedge funds are less than 1-year old, 18% between 1-2 years, 15% between 2-3 years, 21% between 3-5 years, and 33% are more than 5-years old. In terms of AUM, 21% of hedge funds have less than $10 million, 17% between $10-25 million, 31% between $25-100 million, 12% between $100-200 million, and 19% have more than $200 million.

2.4. Management Fees and Performance Fees

Current hedge fund fees are roughly the same as they were in 1999. Table 4 shows the distribution of hedge fund fees. Similar to mutual funds, hedge funds charge a fixed management fee, as a percent of net assets under management. Panel A in Table 4 shows that more than 70% of hedge funds charge a management fee between 1-2%.

However, unlike mutual funds, hedge funds also charge a performance fee. Panel B in Table 4 shows that roughly 80% of them charge a 20% incentive fee.

2.5. Style Evolution and Changing Investor Clientele

There has been a growing trend for hedge funds to evolve away from single-strategy specialists into multi-strategy entities. A case in point is the creation of a multi-strategy category in the CSFB/Tremont Index in 2003. One might consider *multi-strategy*" to be a modern variation of traditional Macro funds. While Macro funds are known for taking, often highly leveraged, directional bets on conventional asset classes such as stocks, bonds, currencies and currencies globally in an opportunistic manner, nowadays, multi-strategy hedge funds allocate risk capital opportunistically among different hedge fund strategies applied to global markets. Both, macro and multi-strategy hedge funds can be thought of as tactical asset allocators of risk capital.

The emerging dominance of multistrategy hedge funds is consistent with our thesis on the hedge fund business model. Successful hedge fund firms naturally grow and diversify so as to dampen the impact of economic cycles on their performance. Their growth and diversification are a natural consequence of the desire to maximize the enterprise value of the hedge fund management firm. The conventional qualitative approach to assessing the risk of multi-strategy hedge funds is unlikely to yield much insight. A risk-factor approach may well be the only alternative to describing the performance characteristics of this important class of hedge funds.

On the investor side, consistent with our conjecture of an emerging clientele effect, there is empirical evidence that shows behavioral differences in the way capital is

allocated between investors seeking alpha versus investors seeking factor bets. Fung, Hsieh, Naik, and Ramadorai (2006) find that alpha investors have a steady flow of investments to hedge funds, while beta investors exhibit return-chasing behavior similar to mutual fund investors.

3. Statistical Issues in Hedge Fund Data

A proper study of hedge fund returns requires accurately measured data. Hedge fund researchers have been aware of potential biases in hedge fund databases, resulting from the nature of the data collection process. Ackermann et al. (1999) pointed out that hedge fund databases have survivorship bias, liquidation bias, backfill bias, and selection bias.[6] Liang (2000) and Fung and Hsieh (2000a) provided additional discussions. In this section, we provide updates to these issues using three commercial datasets—TASS, HFR, and CISDM.[7]

3.1. Selection Bias

Since inclusion in a database is at the discretion of a hedge fund manager, hedge fund databases can suffer from selection bias. This bias arises when the hedge funds in a database are not representative of the universe of hedge funds. It is difficult to estimate the selection bias, since we are not able to observe funds that are not part of a database.

It is tempting to theorize the direction of selection bias. Since hedge funds are not allowed to advertise, the only way to gain access to investors is to participate in a hedge fund database. One might expect funds that have superior performance would enter a database to attract investors. However, there is a counterbalancing argument. Many successful funds that are closed to new investors choose not to be a part of a database. Thus, it is not clear as to the magnitude as well as direction of the net effect of selection

[6] Fung and Hsieh (1997) used a database of surviving funds. Unable to collect information on delisted funds, they explicitly acknowledge their shortcomings. Their analysis of the styles and risk factors of hedge funds should not be significantly affected by this data issue.

[7] To avoid introducing noise from currency fluctuations, only funds that report in U.S. Dollars are included in this update. In general very few hedge funds do not have a version in U.S.D. Therefore, focusing only on U.S.D.-denominated funds, helps avoids errors that may arise from duplicated funds that are quoted in different currencies.

bias, whether the funds in a database have higher or lower returns than funds not in a database. In the future, the selection bias effect could be estimated if we could gain access to private databases that include hedge funds not in a publicly available database.

3.2. Survivorship Bias

A natural consequence of our hedge fund business model is the simple prediction that a hedge fund ceases to be a viable business proposition if the fund cannot achieve the economy of scale to provide the fund manager the operating leverage. For operational funds, this usually happens when investors are disappointed by the fund's performance and vote with their feet by redeeming their capital. It is also possible that the fund-raising effort of the hedge fund manager failed to attract the critical mass necessary to make the fund a viable business proposition. Without reference to the outlier of undiscovered jewels, it is generally true that surviving (or live) funds have better returns than dead funds. This point has been long recognized in the mutual fund literature, e.g., Brown, Goetzmann, Ibbotson, and Ross (1992) and Malkiel (1995). Following that literature, we measure survivorship bias as the average return of surviving funds in excess of the average return of all funds, both surviving and defunct.

Table 5 provides the annualized average return of live hedge funds in the three databases, from 1994 until 2004. It is 14.4% for TASS (14.3% for HFR, and 15.5% for CISDM). The average return of "live + defunct" funds is 12.0% for TASS (12.5% for HFR, 13.1% for CISDM). Therefore, the survivorship bias is 2.4% for TASS (1.8% for HFR, 2.4% for CISDM). These percentages are consistent with the estimates in prior

research using earlier samples, and they are larger than the survivorship bias in mutual funds, typically found to be between 0.5% and 1.5%.

As the industry matures, we believe the severity of survivorship bias will be reduced, based on the following insight. Hedge funds become defunct for various reasons. Poorly performing funds either liquidate or stop reporting their returns, causing survivorship bias. However, successful funds that are closed to new investments often stop reporting to databases. This latter type of defunct fund would not create a survivorship bias. As of Dec 2004, among defunct funds in HFR, 41% were liquidated, 13% were closed to new investments or no longer reporting, and the remaining 46% were not reporting. The liquidated defunct group had an average annualized return of 7.2% during the 1994-2004 period, while the other two groups both had average returns of 10.8%. As the industry matures, the proportion of the two latter types of defunct funds is likely to increase, mitigating the severity of survivorship bias.

3.3. Incubation Bias (a.k.a., Backfill or Instant History Bias)

A new hedge fund usually undergoes an incubation period to compile a track record. If the track record is respectable, the manager typically enters the fund into a database, which is one of the ways to attract the attention of potential investors. Upon entering the database, the incubation history prior to the entry date is "backfilled." Thus, it is natural to expect that the early part of a fund's history to be biased upwards—where no lemons are on sale, at least during the "honeymoon period."

Since a fund does not disclose the length of its incubation period, we can apply our simple hedge fund business model to infer what would be the reasonable length of an

incubation period. Let us assume that the opportunity cost to a hedge fund manager running his or her own fund is simply to stay as an employee in a comparable investing institution, e.g., at a proprietary trading desk of an investment bank or in another asset management firm. Departing from the comfort of an institutional setting offers the challenge of building a business with potential enterprise value. Also, it offers the hedge fund manager the opportunity to diversify his or her client base. Note that being employed by a single institution is somewhat equivalent to having only a single investor in one's fund. Against these benefits are the opportunity costs—a steady stream of income and the supply of working capital for the business infrastructure.

These are the considerations that a hedge fund manager must weigh during the incubation period. The opportunity costs involved during a fund's incubation period are likely to be substantial, since most managers of a new, fledgling hedge fund are likely to have worked in the lucrative financial industry. Faced with these costs, most managers, logically, would expect the incubation period not to exceed a couple of years on average.

This economic inference is consistent with the drop-out rate of hedge funds from databases. Table 6 provides the hazard rate, that is, the fraction of funds dropping out of a database at a given age, averaged over TASS, HFR, and CISDM. The highest drop out rate occurs when a fund is 14 months of age. Of course, in order to drop out of a database, a fund must have entered it first. Thus the fund age with the highest drop-out rate is a reasonable estimate of the length of the incubation period. Incidentally, the high drop-out rate in hedge funds is similar to that in venture capital firms in which typically only a low percentage (roughly 10%) of new firms are successful.

Using the estimate of 14 months as the incubation period, we deleted the first 14 months of each fund's return. As shown in Table 5, the average annual return for "live + defunct" funds now drops to 10.5% in TASS, leading to the estimate of 1.5% to be the incubation, or backfill bias. HFR and CISDM yield virtually the same estimate (1.4% for HFR, 1.5% for CISDM).[8] This is in line with previous research.

Some researchers use the information from TASS on the entry date of each fund to estimate incubation bias. They treat all the data prior to entry as biased. Unfortunately, this method can lead to extremely long incubation periods. This happens when a fund switches databases. For example, Fund A stops reporting to HFR and starts reporting to TASS. The part of its history after entry into HFR but before entry into TASS is not backfill bias. A similar situation occurred after Tremont Capital Management acquired TASS. Tremont added a significant number of funds from its own database into TASS in September 2001. Since these funds were already tracked by Tremont (but not by TASS), that part of their history subsequent to entry to Tremont but prior to entry to TASS should not be treated as backfilled.

Finally, as the industry grows, the rise in demand for quantitative information on funds in an electronic form is inevitable. More and more, hedge funds that were skeptical about the usefulness of hedge fund databases are slowly but surely overcoming their aversion to reporting their performance. This underscores the importance in understanding the economics of backfill bias versus the quirkiness of changes in data collection methods.

[8] We also tried using other estimates of the incubation period: 10, 15, 16, 22,and 27 months, based on different local peaks of the drop-out rate in the three databases. The resulting estimates of the incubation bias range from 1.1% to 1.9%.

Together, survivorship bias (roughly 2.5%) and incubation bias (around 1.5%) sum to roughly 4% per year. It is important to correct for these biases, particularly when we study hedge fund excess returns (alpha) beyond exposure to systematic risk factors. As we shall see later on, hedge fund alphas are estimated to be around the same order of magnitude.

3.4. Liquidation Bias

Hedge fund data suffers from an additional bias, called liquidation bias that does not have a counterpart in mutual fund data. Liquidation bias refers to the fact that hedge fund managers stop reporting returns to a database before the final liquidation value of a fund. For example, several funds lost all of their capital during the Russian debt crisis in August 1998. However, the managers did not report returns of –100% in August 1998. Instead, the returns ended in July 1998. This causes an upward bias in the observed returns of defunct funds. It also causes value-at-risk (VaR) models, based on observed fund returns, to underestimate the risk of hedge funds.

In order to estimate liquidation bias, we must be able to follow funds until liquidation. This, unfortunately, require substantial resources. Instead, some researchers make arbitrary assumptions about the return of a hedge fund in the liquidating month, e.g., -100% as in Posthuma and van der Sluis (2003). Such an approach seems extreme.

Ackermann et al. (1999) actually had estimates of liquidation bias. They asked the data vendor (HFR in their case) to determine the liquidation value of hedge funds, and

they report that the liquidating return of funds to be 0.7%.[9] This is certainly very far from the extreme assumption of –100%.

In the future, it would be useful to settle this issue by asking data vendors to determine the liquidation value of hedge funds. Another useful avenue to employ is to approach directly the hedge fund administrators for more accurate records of the final liquidation values of funds that ceased to operate.

3.5. Serial Correlation of Hedge Fund Returns

Asness et al. (2001) observed that hedge fund indices have serial correlation, and that their returns are correlated to past returns of market factors such as the S&P500. This can be due to infrequent trading of illiquid securities in their portfolios or to manipulation by managers to smooth their returns. Getmansky et al. (2004) provided a formal statistical model applied to individual hedge funds. Unfortunately, neither Asness et al. (2001) nor Getmansky et al. (2004) can distinguish between the two causes of serial correlation in hedge funds—illiquid securities or return smoothing.

Over the past few years, administrative, accounting, and auditing service providers to the hedge fund industry have been consolidating. Due diligence standards are much higher with the ever-increasing presence of institutional investors in the hedge fund industry. Gone are the days in which a small hedge fund partnership's accounts come from the manager's accountant who happens to be his neighbor. In addition, lenders to hedge funds such as prime brokers and investment banks also impose certain organizational standards on their hedge fund counterparties. Last but not least, regulators are imposing compliance requirements on hedge fund companies that operate in major

[9] See Ackermann et al. (1999), pp. 867-868.

capital markets. Taken together, we would argue that, increasingly, hedge fund managers will find it difficult to manipulate the pricing of their portfolios to smooth returns. Rather, illiquidity of the underlying market in which a hedge fund transacts will more likely be the explanation.

The empirical evidence is certainly consistent with this line of reasoning. First, we observe that hedge funds that trade liquid securities have returns that exhibit little serial correlation. For example, the CSFB/Tremont Managed Futures index has a first order autocorrelation of 0.07, which is not statistically different from zero. This is not a surprising result, since Managed Futures funds tend to trade highly liquid instruments and rely heavily on the liquidity of their position to achieve a higher degree of leverage. In contrast, the CSFB/Tremont Convertible Arbitrage index has a first order autocorrelation of 0.56, which is statistically different from zero. Again, this is not a surprising outcome, since Convertible Arbitrage funds tend to hold convertible bonds (hedging the credit risk with short positions in the equity of the issuing firms), which transact primarily in OTC markets. One could go further to assert that it is precisely the provision of liquidity by Convertible Arbitrageurs that earns them the economic rent (see, for example, Agarwal, Fung, Loon, and Naik (2006)).

Second, we noted from our business model for hedge funds that prime brokers (and investment banks) are the main suppliers of leverage to hedge funds. Given the normal conflict between lenders and borrowers regarding position-risk sharing, it is highly unlikely that primer brokers would share the same optimistic valuation that would allow hedge fund managers to manipulate asset prices to smooth returns. More often than not, the VaR models used by prime brokers (lenders) tend to err on the conservative side

when pricing portfolio positions. Since hedge fund auditors naturally have access to primer broker reports, it is not likely the auditors would allow hedge fund managers to use their own prices that are materially different to the prime brokers' to determine the value of the fund. Nonetheless, more research is needed to determine which of these competing alternatives—illiquidity or return smoothing—is the culprit for the observed serial correlation of hedge fund returns.

3.6. Implication for Hedge Fund Benchmarks

The biases in hedge fund databases raise concerns regarding the ability of hedge fund benchmarks constructed from these databases to reflect actual investment experience. This is particularly evident in the investable indices, which are supposed to reflect actual investment experience in hedge funds. Investable indices have substantially underperformed their respective style benchmarks. For example, the HFRX Equity Hedge Investable Index has an annualized return of 6.6% from its inception in April 2003 until September 2005, which is less than half of the 14.1% annualized return of the corresponding HFRI Equity Hedge Index over the same period. More general issues of hedge fund benchmarks are discussed in the following section.

An alternative is to use the average return of funds-of-funds (FoFs), as suggested in Fung and Hsieh (2000a). FoFs are actual pools of hedge funds, and as such, they directly reflect actual investment experience in hedge funds. The databases on FoFs are less prone to biases (such as survivorship, incubation, etc.) than those on individual hedge funds. Finally, the net (after FoFs fees) performance of FoFs is net of the costs (due diligence and portfolio construction) of investing in hedge funds borne by the investors,

which are typically not reflected in the returns of individual hedge funds.[10] More discussions on this and related topics can be found in section 6.

4. Research on Hedge Fund Risk Factors

In this section, we proceed to address the fundamental question posted in the introduction: *Are there systematic risk factors inherent in hedge fund returns?* It is important to note that the data biases discussed in the previous section generally do not affect the types of risk factors we find in hedge funds. Rather, data biases tend to distort estimates of hedge fund alphas, or the excess return above their exposures to risk factors.

Much research effort has been devoted to understand the risk of hedge funds, particularly in relating hedge fund returns to observable market risk factors. In general, research to-date can be characterized as bottom-up versus top-down. Given the heterogeneity of hedge funds, it is natural to start from a bottom-up approach, where a number of papers have focused on identifying the risk factors inherent in specific styles. For example, Fung and Hsieh (2001) linked the return of managed futures (trend followers) to option straddles. Mitchell and Pulvino (2001) tracked the returns of merger arbitrage funds to a passive merger arbitrage strategy. Duarte et al. (2005) studied fixed income arbitrage strategies replicating the returns of commonly used strategies based on observable prices of fixed-income securities and their derivatives. Agarwal et al. (2006) replicated convertible arbitrage ("CA") returns by mimicking a family of CA strategies using data from the underlying securities. Sections 4.1 to 4.6 provide similar analysis of the nine major hedge fund styles described in Section 2.3.

[10] While the investable indices are FoFs, we are unable to determine the amount of fees charged in these products.

From a top-down perspective, the question can be phrased as follows: *In a diversified portfolio of hedge funds, what are the irreducible risk factors?* This question has been tackled in Fung and Hsieh (2003, 2004a). Taking the two approaches together, this section reviews the status of research starting with strategy specific work leading up to hedge fund portfolio factors.

4.1. Risk factors of Managed Futures (Trend Followers)

The majority of **Managed Futures** funds (discussed in section 2.3) employ a trend-following strategy. Fung and Hsieh (2001) extended the theoretical model in Merton (1981) from market timers to trend followers. Merton (1981) showed that a market timer, who switches between stocks and treasury bills, generates a return profile similar to that of a call option on the market. Fung and Hsieh (2001) generalizes this to a trend follower, who seeks to profit from large up and down movements using both long and short positions. The resulting return profile is similar to that of a lookback straddle.[11]

Using exchange-traded standard straddles in 26 markets, Fung and Hsieh (2001) replicated returns of lookback straddles. Five portfolios of lookback straddles—stock indices, bond futures, interest rate futures, currency futures, and commodity futures—were constructed. Empirical evidence shows that three option portfolios—bonds, currencies, and commodities—have strong correlation to trend followers' returns at a level well beyond previous results. It is intuitively appealing that market volatility has

[11] A lookback straddle consists of a lookback call option and a lookback put option. A lookback call option allows the owner to buy the underlying asset at the lowest price during the life of the call option. A lookback put option allows the owner to sell the underlying asset at the highest price during the life of the put option. The lookback straddle therefore allows the owner to buy at the low and sell at the high. The lookback option was analyzed by Goldman, Sosin, and Gatto (1979).

been a key determinant of trend-following returns. Since the Fung-Hsieh (2001) study, the relationship they reported continued to hold.

Figure 3 provides evidence on the usefulness of the lookback portfolios. The solid line represents the monthly returns of Trend Followers (based on the CISDM Trend Following index). The dotted line graphs the out-of-sample return forecasts of trend followers. These forecasts are generated using the regression coefficients from the regression equation in Fung and Hsieh (2001) which was fit to data ending in 1997, and the realized values of the lookback portfolios starting in 1998. The forecasted returns continued to track the actual returns of trend followers post the Fung and Hsieh (2001) study.

4.2. Risk Factors in Merger Arbitrage

Mitchell and Pulvino (2001) created an index for merger arbitrage returns, using announced mergers from 1964 until 2000. They showed that the merger arbitrage returns are similar to those of merger arbitrage hedge funds. In fact, they observe that both the merger arbitrage index and merger arbitrage funds exhibit characteristics similar to a dynamically adjusted short position on the stock market. This is illustrated in Figure 4.

This is an intuitively appealing observation. Essentially, merger arbitrageurs are betting on the consummation of a merger—in general, they are long "deal" risk. Their return can be viewed as the insurance premium from selling a policy against the failure to complete a merger. Typically, mergers fail for idiosyncratic reasons and can be diversified away in a portfolio of such transactions. However, when the stock market has a severe decline, mergers tend to be called off for a variety of reasons—ranging from

funding and pricing issues to concerns over the long-term prospects of the economy. This is one scenario where there is a convergence of deal-risk that cannot be easily diversified.

We note here that merger arbitrage (also known as risk arbitrage) is a substrategy in the **Event Driven** style discussed in Section 2.3. The other substrategy is Distressed Securities, which is covered in Section 4.6 below.

4.3. Risk Factors in Fixed Income Hedge Funds

Fung and Hsieh (2002) analyzed fixed income hedge funds. They showed that convertible bond funds were strongly correlated to the CSFB Convertible Bond Index. High yield funds were strongly correlated to the CSFB High Yield Bond index. In addition, all styles, including **Fixed Income Arbitrage** (one of the major hedge fund strategies listed in Section 2.3), have correlation to changes in the default spread.

Figure 5 provides support for this view. Here, we graph the HFR Fixed Income Index against the change in credit spread, as proxied by Moody's Baa yield over the 10-Year Teasury constant maturity yield.

In a more recent study by Duarte et al. (2005) created returns using various fixed income arbitrage trades frequently used by hedge funds—the swap spread, yield-curve spreads, mortgage spread, fixed income volatility arbitrage, and capital structure arbitrage.

Essentially, the swap spread trade is a bet that the fixed side of the spread (i.e., the difference between the swap rate and the yield of the Treasury security of the same maturity) will remain higher than the floating side of the spread (i.e., the difference

between LIBOR and the repo rate) while staying within a reasonable range that can be estimated from historical data. Yield-curve spread trades are "butterflies," betting that bond prices (which can be mapped to points along the yield curve) deviate from the overall yield curve only for short-run, tactical liquidity reasons, which dissipates over time. Mortgage spread trades are bets on pre-payment rates, consisting of a long position on a pool of GNMA mortgages financed using a "dollar roll," delta-hedged with a five-year interest rate swap. Fixed income volatility trades are bets that the implied volatility of interest rate caps tends to be higher than the realized volatility of the Eurodollar futures contract. Capital-structure arbitrage or credit arbitrage trades on mispricing among different securities (e.g., debt and equity) issued by the same company.

Durate et al. (2005) found strong correlation between the returns of these strategies and the returns of fixed income arbitrage hedge funds. In addition, many of these strategies have significant exposure to risks in the equity and bond markets.

4.4. Risk factors in Long/Short Equity Hedge Funds

As discussed in section two, the **Long/Short Equity** style accounts for 30-40% of the total number of hedge funds. Agarwal and Naik (2004) studied equity-oriented hedge funds and Fung and Hsieh (2004b) focused on long/short equity funds. Basically, there is strong evidence that long/short equity funds have positive exposure to the stock market, and also exposure to long small-cap/short large-cap positions, which is similar to the SMB factor in the Fama-French (1992) three-factor model for stocks.

Figure 6 provides support for this view. Here, we use the previous 24 months of data to estimate the exposure of long/short equity funds (as proxied by the HFRI Equity

Hedge index) to the S&P500 and the difference between the Russell 2000 and S&P 500. The estimated coefficients are used to perform a one-month-ahead conditional forecast.[12] Figure 6 shows that the one-month-ahead forecast is a very good predictor of the HFRI Equity Hedge index return. An intuitive explanation of these results is as follows. Typically, Long/Short equity hedge fund managers are stock pickers with diverse opinion and ability. As such, individual performance of these managers is likely to be highly idiosyncratic. However, all managers are subject to the basic phenomenon that "under-priced stocks," if exist, are likely to be found among smaller, "under-researched" stocks. On the short-side, liquidity condition in the stock-loan market makes small stocks much less attractive candidates for short sales. This leaves the final question as to whether Long/Short hedge fund managers exhibit market timing ability. This is a topic for ongoing research. Thus far, the empirical evidence does not lend support to such a proposition.

4.5. Risk Factors in Convertible Arbitrage

Using U.S. and Japanese convertible bonds, Agarwal, Fung, Loon, and Naik (2006) created returns for three basic strategies frequently employed by convertible arbitrage funds. The volatility arbitrage strategy is a bet that the imbedded option in the convertible bond is mispriced. The credit arbitrage strategy is a bet that the credit risk in the convertible bond is mispriced. The carry strategy is a combination of these two strategies. The results point to convertible arbitrage hedge funds as providers of liquidity to the Convertible Bond market trading mainly from the long side while hedging the

[12] Specifically, the one-month ahead conditional forecasts use the regression coefficients from the previous 24 months and the realized values of the regressors in the subsequent month.

inherent risk factors of the bond. One interpretation of the Agarwal et al (2006) results is that the return to Convertible Arbitrage hedge funds stems from a liquidity premium paid by issuers of convertible bonds to the hedge fund community.

The returns from these strategies can explain a significant part of the return variation in convertible arbitrage funds. This is illustrated in Figure 7. As in Agarwal et al (2006), the excess return of the HFRI Convertible Arbitrage Index is regressed on the excess returns of the Vanguard Convertible Securities Portfolio (as a proxy for the underlying convertible bonds), and the U.S. and Japanese volatility arbitrage strategy, credit arbitrage strategy, and carry strategy. The adjusted-R^2 of the regression is 0.38.The observed returns are graphed on the vertical axis, while the fitted values of the regression are graphed on the horizontal axis. The upward sloping line is evidence that the risk factors capture a significant part of the variation in the returns of convertible arbitrage funds.

4.6. Risk Factors in Niche Styles

This section summarizes the research findings on risk factors inherent in the other hedge fund styles.

Figure 8 shows that the hedge-fund returns of **Emerging Market** hedge funds are strongly correlated with the IFC Emerging Market stock index.

Figure 9 shows that **Distressed Securities** hedge-funds' returns are strongly correlated with the CSFB High Yield Bond index. As noted earlier, distressed securities is one of the two substrategies in the **Event Driven** style, along with merger arbitrage.

HFR has an index called *Equity Non-Hedge*, consisting of hedge funds that typically trade from the long side leaving their market risk largely unhedged. Figure 10 shows that their monthly excess returns are strongly correlated with the Wilshire Small Growth Stock Index.

Figure 11 shows that **Dedicated Short-**Sellers' returns are strongly negatively correlated with the Wilshire Small Growth stock index.

Thus far, we have covered the risk factors in 7 of the 9 styles described in Section 2.3 (excluding **Others**). Only two styles remain—**Macro** and **Equity Market Neutral**. **Macro** funds are analyzed in section 4.7. **Equity Market Neutral** has been a problematic style to analyze, largely due to difficulties with accurate classification of strategies that fall into this category. Many funds in HFR and TASS carrying the equity market neutral classification exhibit statistical significant betas to standard equity factors; see for example Patton (2005). In addition, there is another category in the HFR database called Statistical Arbitrage comprising of Long/Short equity hedge funds that primarily employ quantitative models to construct factor-neutral portfolios. Statistical Arbitrageurs that operate in equity market should naturally fall within the Equity Market Neutral category. It is unclear to us how these distinct categorizations are made. Taken together, one observes that there are instances where Equity Market Neutral funds have significant betas to equity factors, whereas there are zero-beta equity related strategies that are being placed in a different category. More work is required to arrive at an unambiguous definition of this hedge fund style.

4.7. Capturing the Risk in Macro Hedge Funds

Macro fund managers are known to be highly dynamic traders who often take highly leveraged bets on directional movements in exchange rates, interest rates, commodities, and stock indices. Capturing the risk of Macro funds has been a challenge to researchers given the dynamic nature of the risk in these funds. Here, we present a simple, linear risk factor model that can capture a substantial amount of the risk to which Macro funds are exposed. It turns out that the seven-factor model of Fung and Hsieh (2004a)[13], which was designed for describing the inherent risks in diversified portfolios of hedge funds, does a reasonable job in capturing the risk of Macro funds.

Figure 12 depicts the actual and one-month-ahead conditional forecast of the HFRI Macro index. As in the case of the forecasting exercise for Long/Short equity funds in Figure 6, each month we use the prior 24 months' data to regress the Macro index on the seven risk factors. We use the regression coefficients and the realized values of the seven risk factors in the subsequent month to generate the conditional one-month-ahead forecast. The realized Macro index is the solid line in Figure 12, while the conditional forecast is the dashed line, from January 1996 until December 2004.

Perhaps these results are not too surprising because the best-known Macro funds are large funds that tactically allocate risk capital across a portfolio of "bets" across global markets. Each bet can be thought of a directional strategy on a portfolio of global securities—for example, long Government bonds of one country while funding the position with a short position in fixed-income instruments denominated in another currency so as to maximize the upside potential of the long position at the lowest cost of leverage globally available. The traditional view of a Macro fund's portfolio being guided by a very top-down view of global economic factors is, perhaps, not too different

[13] More detailed descriptions of the Fung and Hsieh (2004a) seven factor model are in sections 4.8. and 4.9.

from the tactical strategy allocation process of a portfolio of different hedge fund strategies. Therefore, tools that work well in capturing the risk characteristics of diversified hedge fund portfolios will find its application in describing the risk in Macro funds.

The challenge to academic researchers is to devise models that properly measure the value these tactical strategy allocation decisions bring to investors.

4.8 A Basic Risk-Factor Model using Asset-Based Style (ABS) Factors

In this section we discuss a top-down approach to modeling the risk factors of diversified hedge fund portfolios. Understanding these risk factors is critical for investors, counterparties, and regulators alike. Investors need to identify the major risk factors in hedge fund portfolios in order to assess the impact on their overall asset allocation profile. Similarly, counterparties to hedge funds and their regulators need to understand the major sources of hedge fund risk to measure capital-at-risk.

Fung and Hsieh (2004a) proposed a basic risk-factor model using seven risk factors to account for the risk of -diversified portfolios of hedge funds. These risk factors are extracted from those that are found to be present in empirical studies on many of the major hedge fund styles. The excess return of the S&P500 (SPMRF) and Small Cap minus Large Cap (SCMLC) are the equity factors most important for long/short equity funds, which comprise 30-40% of the entire industry. The return of the 10-year Treasury bond (BD10RET) above the risk free return, and the return of Baa bonds above the return of the 10-year Treasury bond (BAAMTSY) are the bond factors most important for Fixed Income hedge funds. The three lookback portfolios in bonds (PTFSBD), currencies

(PTFSFX), and commodities (PTFSCOM) are the key risk factors for trend followers or Managed Futures.

Table 7 illustrates the efficacy of the seven risk factors in explaining the returns of several standard hedge fund indices—the HFRI composite index, the CSFB/Tremont composite index, and the MSCI equally-weighted composite index. In addition, the 7 risk factors can explain a high percentage of the variation in the HFR Funds-of-Funds index.

Of general interest to investors is the estimate of a hedge fund's alpha For the hedge fund indices, alpha is between 11 to 27 basis points per month, or 1.32% to 3.24% per year on an NAV basis. As remarked in Section 2, this is on the same order of magnitude as survivorship bias (around 2.5% pa) and incubation bias (around 1.5% pa). Interestingly, the average FoFs does not have any positive alpha.

Note that these top-down risk factors are all based on traded securities and their derivatives, hence we use the term *asset based* to describe them. This is perhaps not too surprising as, by and large, hedge fund portfolios are comprised of conventional securities and their derivatives. This is an important recognition. Having identified readily observable risk factors based on traded assets, we have indirectly circumvented the opaqueness of hedge fund operations—at least for diversified portfolios. Here we have a method for indirectly measuring the systematic risk of hedge fund investing by observing market prices at higher frequency (than monthly NAVs of hedge funds) and with much longer price history.

Figure 13 illustrates the usefulness of a long price history, in the form of the credit spread (Moody's Baa – 10-Year Treasury). Between the end of 1987 and Sep 1998 (the LTCM debacle), credit spreads had stayed in a narrow range, relative to the earlier years.

This explains the particularly good performance and lack of large losses of fixed-income hedge funds during that period, based on the evidence in Section 4.3 and Figure 5 that showed fixed income hedge funds as negatively exposed to this variable. As the credit spread widened after the Russian debt default in August 1998, fixed income hedge funds suffered large losses. While the increase in credit spreads were large relative to the experience of the previous 10 years, they were not especially large against the backdrop of a much longer time period. Therefore, it is not surprising that LTCM, which by many accounts was many times more leveraged than a typical fixed-income hedge fund, nearly failed.[14]

4.9. Risk Monitoring and Performance Evaluation of Hedge Funds

The advantage of ABS factors is not only that their portfolio level risk factors are much more readily observable, but that they are also investable. By construction, they are derived from traded assets in the public market. This provides a much more natural way of defining hedge fund alphas and hedge fund betas, which we refer to as *alternative alphas* and *alternative betas* in Fung and Hsieh (2003).

The immediate application is clear. For investors, alpha buyers now have a way to measure the quality of their hedge fund investment. Beta buyers (investors who prefer leveraged factor bets) can assess whether their capital is exposed to the *right* risk; and both can evaluate whether the fees they paid are appropriate. For counterparties, measuring the exposure to key risk factors offers a market-price-driven metric that aggregates hedge fund risk in capital-at-risk calculations. For regulators, it provides a

[14] LTCM claimed that they experienced a "100-year" flood. But their risk management system reportedly used only 10 years of data, stopping around December 1987. Had they used 10 more years of history, they may have avoided their problems in 1998.

barometer to gauge potential convergence of systemic risk exposures from hedge funds, proprietary desks, and conventional money managers. These issues are explored further in the next two sections of the paper.

5. Hedge Funds and Regulatory Concerns

In the wake of the Asian Currency Crisis of 1997, the International Monetary Fund (IMF) researched into complaints by Asian government officials that hedge funds were the primary culprit for that episode. Their findings were published in May 1998 in the form of Occasional Paper Number 166, conventionally referred to as Eichengreen et al. (1998). The paper addressed three primary regulatory concerns: investor protection, systemic risk, and market integrity. The authors noted that "few regulators see a need for stricter regulation on the first two grounds" (p. 1).

In terms of investor protection, regulators are generally of the view that investors can "fend for themselves" (p. 20). As private investment vehicles, hedge funds are only available to "accredited investors"—wealthy individuals and institutional investors. These sophisticated investors have the savvy, and the financial ability to complement their knowledge by hiring consultants with the know-how to better understand the risk in hedge funds. They also have sufficient wealth to withstand the risk of sizeable losses that might result from hedge fund investing.

In terms of systemic risk, regulators were concerned that banks under their supervision are exposed to counterparty risk in their transactions with hedge funds, but "they regard these as problems best dealt with by existing supervision of banks and other counterparties rather than by new regulations" (p.21).

On the issue of market integrity, Eichengreen et al. (1998) reported that there were concerns "that hedge funds can dominate or manipulate particular markets." (p. 1) But they went on to say that "… many observers are skeptical that hedge funds are large enough to dominate markets." Thus, they arrived at the conclusion that "the case for supervisory and regulatory initiatives directed specifically at hedge funds is not strong" (p. 21).

In this section, we reflect on these arguments in light of the recent events and put forward a number of research questions searching for answers. Papers by Franklin (2006) and Chan et al. (2005) in this conference volume will cover these issues in much greater detail.

5.1. Investor Protection

Investor protection falls largely under the purview of the Securities and Exchange Commission (SEC) and to a lesser extent the Commodity Futures Trading Commission (CFTC). Up until 2003, the SEC has kept a fairly loose rein on hedge funds, taking action usually only in fraud cases. In May 2003, the SEC organized a Hedge Fund Roundtable to discuss "investor protection implications" of hedge funds (SEC Press Release, 2003-40). A staff report, SEC (2003) was published in September 2003, and the rule to require hedge fund advisers to register as investment advisers was adopted in December 2004. SEC (2004) cites the growth of the hedge fund industry, the increasing instances of hedge fund fraud,[15] and the broadening of exposure to hedge funds, especially by institutional investors (e.g., public and private pension funds, universities,

[15] SEC (2004, p. 5) cited 51 hedge fund fraud cases brought by the Commission during 2000-2004, involving $1.1 billion of damages. It also referred to "almost 400 hedge funds (and at least 87 hedge fund advisers)" that were being investigated at that time.

endowments, foundations, and charitable organizations) who have never before invested in hedge funds, as reasons for taking action to register hedge fund advisers.

While registration may not be a particularly onerous task for hedge funds, it is not clear how it can effectively deal with the three concerns raised in the SEC (2004)

In the first place, registration is not likely to slow down the proliferation of hedge fund offerings to small, unsophisticated investors that the SEC is concerned about. It would be more effective to raise the requirement for "accredited investors" to make it harder for less sophisticated investors to qualify for investing in hedge funds.

Secondly, hedge funds that accept money from pension plans are typically registered as investment advisers, a result of the ERISA Act of 1974.

Thirdly, it is unclear how registration relates to the discovery, and ultimately, the deterrence of hedge fund fraud. SEC (2004, p. 5) stated that 51 hedge fund fraud cases were brought by the SEC for damages of $1.1 billion during 2000-4. It would be helpful to have more research on how registration could have helped to prevent fraud in these cases.

5.2. Systemic Risk

Hedge funds can become the transmission mechanism of systemic risk because they borrow from and trade with regulated financial institutions, such as prime brokers and investment banks. Large losses from one or more hedge funds can cause financial distress to the counterparties they deal with, which can in turn generate a domino effect to other financial institutions. This chain reaction is referred to as systemic risk. The LTCM debacle put systemic risk front and center in the mind of regulators. The important point

here is not to focus only on the risk of another LTCM but to be aware of the risk of a convergence of opinion among different hedge funds on the *best trade(s)*. Fung, Hsieh and Tsatsaronis (2000) described this as diversification implosion and provided empirical examples of this phenomenon.

Statistical analyses of hedge fund returns may furnish us with valuable lessons ex-post. However, these tools are generally incapable of sounding the alarm bell before the fire engulfs the entire building. Ultimately, systemic risk exposures estimated from up-to-date position data is needed to offer any chance of providing early warning. A substantial amount of this data is already in the hands of hedge fund counterparties—prime brokers, prime bankers to hedge funds. The question is how to consolidate the information into estimates of systemic risk exposures of the industry as a whole.

Commercial service providers offering consolidation of hedge fund position risk for large hedge fund portfolios are available covering a significant subset of hedge funds that offer their products through managed account platforms. This is an encouraging development. Improved transparency by hedge funds and the availability of better risk management tools to hedge fund investors should help to keep systemic risk in check. As things stand, investors are well placed to rebalance hedge fund portfolios that are overly concentrated in a limited number of factor bets. To this end, the investors' interest and that of the regulators are aligned. Both will benefit from a continuing improvement in transparency from hedge fund managers.

There are, however, a number of conflicts of interest that arise from the financing of hedge funds by regulated financial institutions that cannot be easily resolved. These can be expressed using our simple hedge fund business model. In essence, the hedge fund

manager pledges the equity in the fund as collateral to financial intermediaries such as prime brokers and investment banks against leveraged trading positions. As lenders to the hedge fund, these counterparties hold the equivalent of senior debt claims to the fund as a legal entity. Immediately, as lenders, they are exposed to the downside risk of the hedge fund strategies they finance.

There is an obvious need to assess the systematic risk factors to which a hedge fund strategy is exposed—in a similar manner to an investor of the fund. However, the assessment of the upside potential is less critical (but not irrelevant) to lenders compared to investors of a hedge fund. Good performance by a hedge fund potentially leads to more business for the prime brokers. In reverse, bad performing funds are not good for anyone—investor and prime brokers alike. But what about mediocre funds that generate transactional fees to the prime brokers but offer little value to investors? Investors would certainly like to cut these funds from their portfolio, but would prime brokers be as quick to act as there is no apparent risk to keeping these funds on their books? An interesting question is whether mediocre funds searching for winning trades are more likely to herd—become trend followers of popular trading ideas? The answer to this question will be of importance to investors, financial intermediaries and regulators.

5.3. Market Integrity

A major concern of financial regulators is the potential impact of hedge funds on financial markets. Hedge funds were mentioned in the Brady Commission Report[16] to be net buyers during the October 1987 stock market crash. In an IMF staff report, Eichengreen et al. (1998) conducted interviews with market participants and hedge fund

[16] Properly known as the Presidential Task Force on Market Mechanisms (1988).

managers to gauge the role of hedge funds during various market events, including the ERM Crisis in 1992, Mexican Peso Crisis in 1994, and the Asian Currency Crisis in 1997. Generally speaking, Eichengreen et al. (1998) viewed hedge funds as too small to exert significant impact on financial markets. Fung and Hsieh (2000b) provided some quantitative support using hedge fund returns, including high frequency weekly and daily data collected from public sources.[17]

The view that hedge funds are too small to exert significant market impact was challenged by the near bankruptcy of LTCM in 1998. The recent growth of the hedge fund industry has also brought this issue back into the foreground for regulators. In this section, we put forward the idea that the risk hedge funds pose to market integrity has shifted from the likes of mega currency speculators or a highly leveraged power house like LTCM to that of a convergence of leveraged opinions among funds that individually may easily operate unnoticed. The avoidance of this phenomenon may well require the action of better informed portfolio investors—through greater transparency from the part of hedge fund managers and better access to risk management tools—as well as more discriminating leverage providers to hedge funds—the financial intermediaries.

To this end, there are promising signs in the evolution path the hedge fund industry has taken. Transparency is improving, but more needs to be done. Risk management tools for hedge fund portfolios are becoming commonplace. Perhaps more research and standardization in this area would help to avoid a proliferation of risk management models that are as bewildering to consumers as opaque hedge funds.

[17] More recently, Brunnermeier and Nagel (2004) investigated the role of hedge funds in the technology bubble of 1999-2000. They found little evidence that hedge funds were short tech stocks. Instead, they found evidence consistent with the view that hedge funds rode the bubble on the way up, and then exited relatively quickly in early 2000.

Capital requirements for certain financial institutions—banks and insurance companies—investing into hedge funds are directing them towards demanding more transparency and risk management. Compliance requirements from regulators such as the Financial Stability Authority (FSA) in London together with the institutionalization process of hedge funds have greatly improved the operational integrity of hedge fund firms. These are all helpful and healthy developments in the hedge fund market and certainly look like a much more promising path than imposing direct, specific regulations on hedge funds themselves.

Just as important has been the development in the supply side of hedge fund products. Consistent with our simple model of the hedge fund business, the emergence of multi-strategy hedge fund firms as a solution to the life cycles of hedge fund strategies and the demand for institutional quality products have had positive influence on the hedge fund industry. Hedge fund firms are becoming better organized, better diversified, and more averse to erratic performance that could damage the enterprise value of their firm. Perhaps we are witnessing the maturity of a hedge fund industry that blends the best of the regulatory environment with rational economic behavior on the part of investors, financial intermediaries, and hedge fund managers.

6. Alternative Alpha, Synthetic Hedge Funds, and the Price for Talent

In this section, we turn to the companion question of hedge fund systematic risk (beta) frequently asked by investors: *Do hedge funds achieve excess returns beyond exposure to systematic risk factors*?

6.1. The Search for Alpha—Have All the Low-Hanging Fruits Been Picked?

In our opinion, the cleanest way to assess hedge fund alpha is through the returns of funds-of-funds (FoFs). Data on FoFs have fewer biases than data on individual hedge funds, as pointed out in Fung and Hsieh (2000a), and they reflect the actual investment experience in hedge funds, netting out the cost of due diligence, portfolio construction, etc.

Fung, Hsieh, Naik, and Ramadorai (2006), estimated the alpha of FoFs from the merged TASS, HFR, and CISDM databases, using the seven risk factors from Fung and Hsieh (2004a). While the average FoF does not deliver statistically significant alpha, about 22% has positive alpha (significant at the 95% level). These "have-alpha" FoFs has a higher probability of remaining a "have-alpha" FoF than the remaining "beta-only" FoFs. They tend to have a steady inflow of capital, which does not exhibit return-chasing behavior. In contrast, the "beta-only" FoFs experience both inflows and outflows that have return-chasing behavior.

Additionally, Fung, Hsieh, Naik, and Ramadorai (2006) found that alpha in both have-alpha and have-beta FoFs has declined in the recent period (April 2000 to Dec 2004), relative to earlier periods. This coincides with the large inflow of money into the hedge fund industry and is consistent with the prediction of Berk and Green (2004) that fund flows will drive down the net-of-fee excess returns to zero, so that there should be no excess return to investors in equilibrium.

6.2. Can Cheap Hedge Funds be Created?

If portfolios of hedge funds that are limited to *ready packaged* hedge fund products are suffering from dwindling alphas, the natural question that arises is: C*an synthetic hedge funds be created at a lower cost to investors?*

There is a growing literature on replicating hedge fund returns using statistical techniques. Here we provide a brief review of this approach. Generally there are two main issues to be resolved. It is natural to expect hedge fund managers to have dynamic exposures to factor-bets (beta-bets). This conclusion naturally flows from our simple hedge fund business model. Viewed as a business, the incentive is for the hedge fund manager to maximize his or her enterprise value. To that end, the tendency is to diversify the income stream to the hedge fund management company. This, we believe, has been the primary motive behind the growth of the multistrategy hedge funds (from 0.5% to 12-14% of total capacity). As different strategies are introduced into the portfolio mix, different risk factors will emerge and evolve over time. Statistical techniques without explicit recognition of the changing risk factors are unlikely to be able to explain where the next risk is coming from.

Replicating hedge fund alpha, on the other hand, takes us into the voluminous literature on portable alphas. Fung and Hsieh (2004b) showed that there are portable alphas in equity-related hedge fund strategies. However, we don't believe that these can be replicated by statistical means at a lower cost. After all, why would anyone sell skill at below market equilibrium price? Naturally, those who successfully generate persistent hedge fund alphas will simply join the ranks of hedge fund managers and price their services accordingly. So long as alpha remains a scarce commodity, new discoveries of alternative alpha source is unlikely to depress the market price for alpha.

6.3. Issues on Compensating Talent

Hedge fund returns are a mixture of alpha and beta components with differing production costs and capacity constraints. This leads us directly back to various incentive fee issues in the hedge fund business model. Such a discussion necessarily involves the governance structure to align the managers' incentives with those of the investors. The paper by Lehman (2006) in this conference volume deals with these issues in greater detail. Here are some immediate issues that flow directly from our discussions.

Presumably investors are more willing to pay fees for hard-to-replicate alphas than returns from more easily replicable beta-like exposures. To-date, very few hedge fund contracts explicitly recognize these problems. For instance, rarely does one come across risk-adjusted benchmarks being used as part of the incentive fee hurdle. For now, there are no universally accepted performance benchmarks for different hedge fund strategies. The performance history of investable hedge fund indices has thus far raise more questions than answers to the whole question of benchmarking hedge fund performance.

There is a companion problem to the benchmarking issue in designing incentive fee contracts. Often, and in recognition of the deficiencies of the exiting incentive fee contract, some investors have demanded co-investing, i.e., that hedge fund managers, should invest a substantial amount of their personal wealth alongside the investors of the fund they manage. This reduces the incentive for the manager to maximize the call option features imbedded in the incentive contract by taking unjustifiable risks. For a detailed discussion on these issues, see Goetzmann, Ingersol, and Ross (2003). On the one hand,

this may improve the alignment of interest on the downside, but can also lead to over conservatism by the manager on the upside, as in Carpenter (2000). This is often the case as most hedge fund investors are far more diversified than the hedge fund manager. Of course, the existence of incentive fees mitigates part of this problem. However, precisely how these two features of the hedge fund compensation model should be combined must ultimately depend on the inherent risk of the strategies used by the fund manager. Expressed differently, once again the solution to this problem needs the proper identification of the risk factors underlying different hedge fund strategies.

7. Concluding Remarks

This paper has provided an overview of the growth of the hedge fund industry over the last decade as it evolved into adolescence. Academic research has played a contributory role in publicizing some of the key features of this opaque industry. However, research has a way of uncovering more questions than answers. This is clearly the case with a dynamic, multi-faceted industry like hedge funds. By putting forward a simple model of the hedge fund business, we have pulled together some of the important issues involving investors of hedge fund products, financial intermediaries and regulators into a single framework. This framework reveals a fundamental question common to a number of important concerns regarding the future of the hedge fund industry—namely, the identification of systemic risk factors inherent in hedge fund strategies.

We believe that this is the key input to important questions such as optimal contract design between buyers and sellers of hedge fund products. This in turn has important implications for risk monitoring of hedge funds by financial intermediaries as well as regulators.

In addition, understanding these risk factors helps to clarify seemingly complex and chaotic changes in the hedge fund industry. For example, during the early 1990s, the hedge fund industry was dominated by Macro hedge funds. Today, database vendors report a myriad of hedge fund strategies that have no uniform definition. In reality, our simple hedge fund business model implies that hedge fund managers will diversify in order to maximize the enterprise value of their firm. This is consistent with the growing trend of multi-strategy hedge funds. There are clear similarities between the way in which Macro funds choose factor bets and the tactical strategy allocation process of

multi-strategy hedge funds. Interestingly, both exhibit significant factor correlation to our risk factor model. We would argue that from this perspective, the evolution of hedge fund strategies has been much more linear that it may appear at first glance. Apparent style changes over the last decade are consistent with hedge fund managers maximizing their enterprise value by diversifying the impact of differing life cycles of hedge fund strategies.

The past few years have witnessed acquisition of hedge fund firms by regulated financial institutions. This coupled with our model of the hedge fund business implies that the price discovery process of a hedge fund firm is emerging. From what we have seen thus far, pricing favors those with a steady, diversified stream of fee income. This in turn should reduce the risk of excessive risk-taking by individual hedge fund managers.

However, diversifying behavior by individual hedge funds does not preclude the risk of leveraged opinions converging onto the same set of bets. Consequently risk monitoring of the hedge fund industry should reorient its focus away from mega firms to the convergence of factor bets. For example, many different strategies may individually have valid reasons to take on credit risk, but taken together, the industry as a whole may end up with a dangerous level of concentration on a single risk factor. The management of convergence risk begins with the identification of risk factors common to different hedge fund strategies.

Recognizing potential risk concentration does not in itself remedy the situation. More than likely the prevention of convergence risk involves action by hedge fund investors, financial intermediaries, regulators, and the hedge fund managers themselves.

To this end, better transparency will help investors reshape their portfolios away from excessive exposure to factor bets. Compensation contracts that help identify *me too* type of hedge funds will precipitate withdrawal of capital thereby reducing the risk of herding. Fee structures that reward managers on a risk-adjusted basis will help to steer hedge funds away from unwarranted factor bets that could damage the enterprise value of their firm. Identifying risk factors inherent in hedge fund strategies is a good beginning, but guidance from regulators towards better disclosure and transparency from hedge fund managers is needed to align everyone's interest.

References

Ackerman, Carl, Randall McEnally, and David Ravenscraft, 1999, "The Performance of Hedge Funds: Risk, Return and Incentive," *Journal of Finance*, 54, 833-874.

Agarwal, Vikas, William Fung, Y.C. Loon, and Narayan Naik, 2006, "Risk in Hedge Fund Strategies: the Case of Convertible Arbitrage," Working paper.

Agarwal, Vikas, and Narayan Naik, 2004, "Risks and portfolio decisions Involving hedge funds," *Review of Financial Studies*, 17, 63-98.

Asness, Clifford, Robert Krail, and John Liew, 2001, "Do Hedge Funds Hedge?" *Journal of Portfolio Managemen*t, 20, 6-19.

Berk, Jonathan B. and Richard Green, 2004, "Mutual Fund Flows and Performance in Rational Markets," *Journal of Political Economy*, 112(6), 1269-1295.

Brown, Stephen J., William Goetzmann, and Roger Ibbotson, 1999, "Offshore Hedge Funds: Survival & Performance 1989 – 1995," *Journal of Business*, 72, 91-118.

Brown, Stephen J., William Goetzmann, Roger Ibbotson, and Stephan A. Ross, 1992, "Survivorship Bias in Performance Studies," *Review of Financial Studies*, 5, 553-580.

Brunnermeier, Markus, and Stefan Nagel, 2004, "Hedge Funds and the Technology Bubble," *Journal of Finance*, 59, 2013-2040.

Carpenter, Jennifer, 2000, "Does option compensation increase managerial risk apetite?" *Journal of Finance*, 55, 2311-2331.

Chan, Nicholas, Mila Getmansky, Shane Haas, and Andrew W. Lo, 2005,"Systemic Risk and Hedge Funds," Working paper.

Durate, Jefferson, Francis Longstaff, and Fan Yu, 2005, "Risk and Return in Fixed Income Arbitrage: Nickels in Front of a Steamroller?" Working paper.

Eichengreen, Barry, David Mathieson, B. Chadha, A. Jansen, Laura Kodres, and S. Sharma, 1998, *Hedge Fund and Financial Market Dynamics*, Washington, DC: International Monetary Fund (Occasional Paper No. 166).

Fama, Eugene, and Kenneth French, 1992, "The cross-section of expected stock returns," *Journal of Finance*, 47, 427-465.

Franklin, Edward, 2006, "Investor Protection", Working paper.

Fung, William, and David A. Hsieh, 1997, "Empirical Characteristics of Dynamic Trading Strategies: The Case of Hedge Funds," *Review of Financial Studies*, 10, 275-302.

Fung, William, and David A. Hsieh, 1999, "A Primer on Hedge Funds," *Journal of Empirical Finance*, 6, 309-331.

Fung, William, and David A. Hsieh, 2000a, "Performance Characteristics of Hedge Funds and Commodity Funds: Natural vs. Spurious Biases," *Journal of Financial and Quantitative Analysis*, 35, 291-307.

Fung, William, and David A. Hsieh, 2000b, "Measuring the Market Impact of Hedge Funds," *Journal of Empirical Finance*, 7, 1-36.

Fung, William, and David A. Hsieh, 2001, "The Risk in Hedge Fund Strategies: Theory and Evidence from Trend Followers," *Review of Financial Studies*, 14, 313-341.

Fung, William, and David A. Hsieh, 2002, "The Risk in Fixed-Income Hedge Fund Styles," *Journal of Fixed Income*, 12, 16-27.

Fung, William, and David A. Hsieh, 2003, "The Risks in Hedge Fund Strategies: Alternative Alphas and Alternative Betas," in Lars Jaeger (ed), *The New Generation of Risk Management for Hedge Funds and Private Equity Funds*, London: Euromoney Institutional Investor PLC, 72-87.

Fung, William, and David A. Hsieh, 2004a, "Hedge Fund Benchmarks: A Risk Based Approach," *Financial Analyst Journal*, 60, 65-80.

Fung, William, and David A. Hsieh, 2004b, "Extracting Portable Alphas from Equity Long-Short Hedge Funds," *Journal of Investment Management*, 2, 57-75.

Fung, William, David A. Hsieh, N. Naik, and T. Ramadorai, 2005, "Hedge Funds: Performance, Risk and Capital Formation," Working paper.

Fung, William, David A. Hsieh, and Konstantinos Tsatsaronis, 2000, "Do Hedge Funds Disrupt Emerging Markets," *Wharton-Brookings Papers on Financial Services*, 377-421.

Getmansky, Mila, Andrew W. Lo, and Igor Makarov, 2004, "An econometric model of serial correlation and liquidity in hedge fund returns," *Journal of Financial Economics*, 74, 529-609.

Goetzmann, William N., Jonathan E. Ingersol, and Stephen A. Ross, 2003, "High Water Marks and Hedge Fund Management Contracts," *Journal of Finance*, 58, 1685-1718.

Goldman, M. Barry, Howard Sosin, and Mary Ann Gatto, 1979, "Path Dependent Options: 'Buy at the Low, Sell at the High'," *Journal of Finance* 34, 1111-1127.

Lehman, Bruce, 2006, "Corporate Governance and Hedge Fund Management," Working paper.

Liang, Bing, 2000, "Hedge Funds: the Living and the Dead," *Journal of Financial and Quantitative Analysis*, 35, 309-326.

Malkiel, Burton, 1995, "Returns from Investing in Equity Mutual Funds 1971 to 1991," *Journal of Finance*, 50, 549-572.

Merton, Robert C., 1981, "On market timing and investment performance I: An equilibrium theory of value for market forecasts," *Journal of Business*, 54, 363-407.

Mitchell, Mark, and Todd Pulvino, 2001, "Characteristics of risk in risk arbitrage," *Journal of Finance*, 56, 2135-75.

Patton, Andrew, 2004, "Are 'market neutral' hedge funds really market neutral?" Working paper.

Posthuma, Nolke, and Pieter J. van der Sluis, 2003, "A Reality Check on Hedge Fund Returns," Working paper.

Presidential Task Force on Market Mechanisms, 1988, *Report*. Washington DC: Presidential Task Force on Market Mechanisms.

President's Working Group on Financial Markets, 1999, *Hedge Funds, Leverage, and the Lessons of Long-Term Capital Management*.

Schneeweis, Thomas, and Richard Spurgin, 1998, "Multifactor Analysis of Hedge Fund, Managed Futures, and Mutual Fund Return and Risk Characteristics." *Journal of Alternative Investments*, 1, 1-24.

Securities Exchange Commission, 2003, *Implications of the Growth of Hedge Funds*, Staff Report, Washington DC: SEC.

Securities Exchange Commission, 2004, *Registration Under the Advisers Act of Certain Hedge Fund Advisers*, Release No. IA-2333, Washington, DC: SEC.

Sharpe, William, 1992, "Asset allocation: Management style and performance measurement," *Journal of Portfolio Management*, 18, 7-19.

Table 1. U.S. Institutional Assets Allocated to Hedge Funds

	All University Endowment (EW) EW	All University Endowment (DW) DW	Top 200 DB Pension DW
Panel A. % of Assets			
1993	0.70%		
1994	1.50%		
1995	1.60%		
1996	1.80%		
1997	2.20%		
1998	2.80%		
1999	3.10%	5.10%	
2000	3.00%	4.70%	
2001	4.20%	6.10%	0.11%
2002	5.10%	11.30%	0.33%
2003	6.10%	13.50%	0.50%
2004	7.30%	14.70%	0.66%
Panel B. Amounts in $b			
2000		11.3	
2001		14.4	3.2
2002		25.1	8.5
2003		31.1	14.4
2004		39.2	21.1

Source: NACUBO, *Annual Endowment Survey*, various issues;
Pensions & Investments, various issues

Table 2. Number of Funds in TASS, HFR, CISDM

	TASS (as of Feb 2005)				HFR (as of Jan 2005)				CISDM (as of Dec 2004)			
Year	Start	Entry	Exit	End	Start	Entry	Exit	End	Start	Entry	Exit	End
1994	650	211	29	832	823	270	23	1,070	513	224	25	712
1995	832	249	58	1,023	1,070	384	55	1,399	712	220	98	834
1996	1,023	295	119	1,199	1,399	374	171	1,602	834	293	87	1,040
1997	1,199	316	90	1,425	1,602	374	172	1,804	1,040	334	117	1,257
1998	1,425	307	145	1,587	1,804	381	320	1,865	1,257	290	192	1,355
1999	1,587	367	176	1,778	1,865	419	222	2,062	1,355	313	198	1,470
2000	1,778	365	206	1,937	2,062	407	310	2,159	1,470	256	191	1,535
2001	1,937	384	229	2,092	2,159	451	251	2,359	1,535	249	216	1,568
2002	2,092	406	233	2,265	2,359	489	252	2,596	1,568	257	233	1,592
2003	2,265	339	221	2,383	2,596	457	245	2,808	1,592	164	234	1,522
2004	2,383	250	193	2,431	2,808	329	198	2,939	1,522	133	340	1,315

Table 3. Changes in Style Composition

Year	Convertible Arbitrage	Dedicated Shorts	Emerging Market	Equity Market Neutral	Event Driven	Fixed Income Arbitrage	Macro	Long/Short Equity	Managed Futures	Other	Total # / $b
Panel A. Number of Funds											
1994	5%	2%	9%	2%	10%	5%	8%	29%	28%	3%	832
1995	5%	1%	10%	3%	10%	4%	8%	31%	24%	2%	1,023
1996	5%	1%	10%	4%	11%	5%	7%	35%	20%	3%	1,199
1997	4%	1%	11%	4%	11%	5%	7%	36%	17%	3%	1,425
1998	4%	1%	10%	5%	12%	4%	7%	39%	15%	3%	1,587
1999	4%	1%	9%	6%	11%	4%	6%	41%	13%	3%	1,778
2000	5%	1%	8%	6%	11%	4%	5%	46%	11%	4%	1,937
2001	5%	1%	7%	7%	12%	4%	4%	45%	10%	4%	2,092
2002	6%	1%	6%	8%	12%	5%	5%	44%	8%	4%	2,265
2003	6%	1%	6%	9%	12%	5%	6%	43%	8%	5%	2,383
2004	6%	1%	6%	8%	12%	6%	6%	43%	9%	5%	2,431
Panel B. Assets Under Management											
1994	1%	0.3%	13%	2%	13%	7%	32%	26%	6%	0.3%	57.0
1995	2%	0.2%	10%	2%	13%	7%	30%	30%	6%	0.2%	72.3
1996	3%	0.3%	10%	3%	15%	8%	26%	30%	4%	0.5%	99.1
1997	4%	0.2%	10%	3%	16%	8%	26%	29%	3%	0.4%	144.6
1998	4%	0.4%	5%	4%	17%	8%	24%	33%	4%	0.4%	153.8
1999	4%	0.3%	5%	5%	16%	6%	15%	45%	3%	0.4%	197.2
2000	5%	0.3%	3%	6%	18%	5%	10%	49%	3%	0.3%	217.7
2001	8%	0.3%	3%	7%	20%	5%	9%	44%	3%	0.5%	261.4

2002	8%	0.5%	3%	8%	19%	6%	10%	38%	3%	4.5%	310.3
2003	8%	0.2%	3%	7%	17%	7%	11%	33%	5%	8.5%	489.5
2004	6%	0.2%	4%	5%	19%	7%	10%	32%	5%	10.1%	673.8

Source: TASS

Table 4. Distribution of Management Fees and Incentive Fees in Live Funds

	TASS	HFR	CISDM
Panel A. Management Fees			
0-0.99%	5%	3%	4%
1-1.99%	73%	72%	78%
2-2.99%	20%	22%	17%
3% & up	3%	2%	1%
Panel B. Incentive Fees			
0-19.99%	10%	10%	18%
20%	85%	86%	78%
20.01% & up	5%	4%	4%

Table 5. Average Annual Returns: 1994-2004

	TASS	HFR	CISDM
Live	14.4%	14.3%	15.5%
Live+Defunct	12.0%	12.5%	13.1%
Live+Defunct (excl first 14m)	10.5%	11.2%	11.6%
Survivorship Bias	2.4%	1.8%	2.4%
Incubation Bias	1.5%	1.4%	1.5%

Table 6. Drop-Out Rate By Fund Age

Fund Age Months	TASS	HFR	CISDM	ALL
1	33%	89%	69%	85%
2	10%	37%	71%	36%
3	22%	43%	44%	40%
4	40%	39%	71%	48%
5	34%	50%	76%	49%
6	28%	31%	43%	34%
7	50%	41%	61%	48%
8	30%	25%	67%	36%
9	48%	46%	50%	48%
10	29%	53%	85%	51%
11	36%	47%	61%	46%
12	54%	38%	55%	46%
13	57%	36%	81%	54%
14	40%	61%	85%	59%
15	61%	39%	72%	54%
16	59%	48%	74%	60%
17	51%	51%	77%	56%
18	47%	40%	79%	52%
19	55%	56%	62%	57%
20	49%	43%	77%	53%
21	52%	51%	77%	58%
22	49%	45%	86%	54%
23	32%	27%	66%	40%
24	57%	30%	52%	44%
25	38%	47%	78%	51%
26	37%	49%	70%	48%
27	63%	43%	60%	53%
28	54%	46%	74%	55%
29	39%	59%	75%	55%
30	55%	36%	51%	47%
31	52%	42%	59%	50%
32	48%	45%	72%	54%
33	57%	50%	68%	57%
34	44%	61%	74%	57%

35	41%	41%	66%	47%
36	63%	30%	31%	38%
60	45%	47%	64%	51%
120	37%	40%	53%	43%
>120	24%	32%	43%	32%

Table 7. Regression of Hedge Fund Composite Indices on Seven Risk Factors: Apr 2000 - Dec 2004

Risk Factors	**HFRI Composite**	**CTI Composite**	**MSCI Composite**	**HFR FOF**
Constant	**0.0011**	0.0017	**0.0027**	-0.0006
SPMRF	**0.3126**	**0.1837**	**0.1653**	**0.1572**
SCMLC	**0.2292**	**0.1650**	**0.1654**	**0.1408**
BD10RET	**0.1661**	**0.2314**	**0.1794**	**0.1764**
BAAMTSY	0.1656	0.1103	0.0697	**0.1941**
PTFSBD	-0.0002	-0.0043	0.0020	-0.0021
PTFSFX	**0.0108**	**0.0150**	**0.0187**	0.0122
PTFSCOM	**0.0218**	0.0186	0.0083	0.0184
R^2	0.876	0.612	0.763	0.691

Notes: bold figures indicate statistical significance at the 1% level.

Figure 1. Hedge Fund Universe in 2005 (TASS, HFR, CISDM, Eureka Hedge, and MSCI)

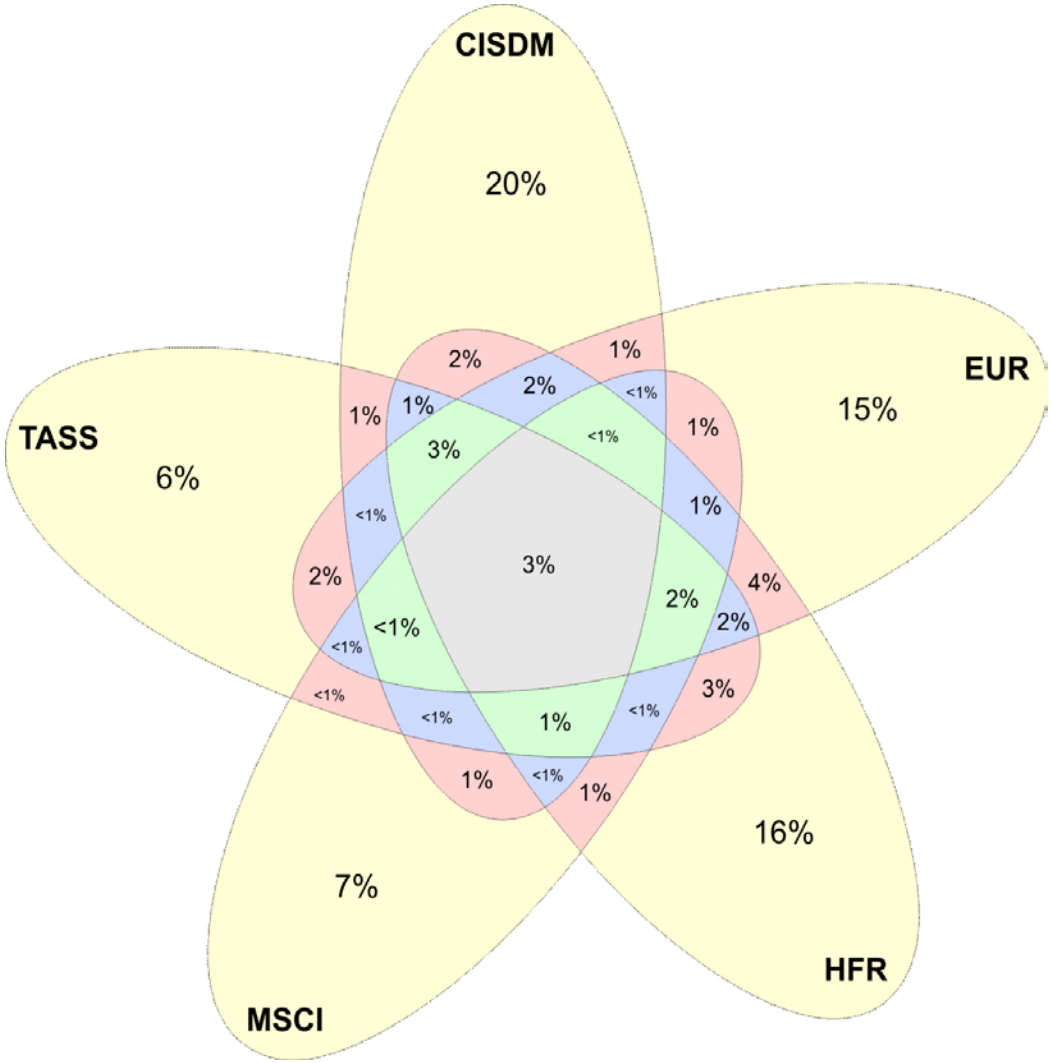

Figure 2. Distribution of R-squares vs Eight Asset Classes

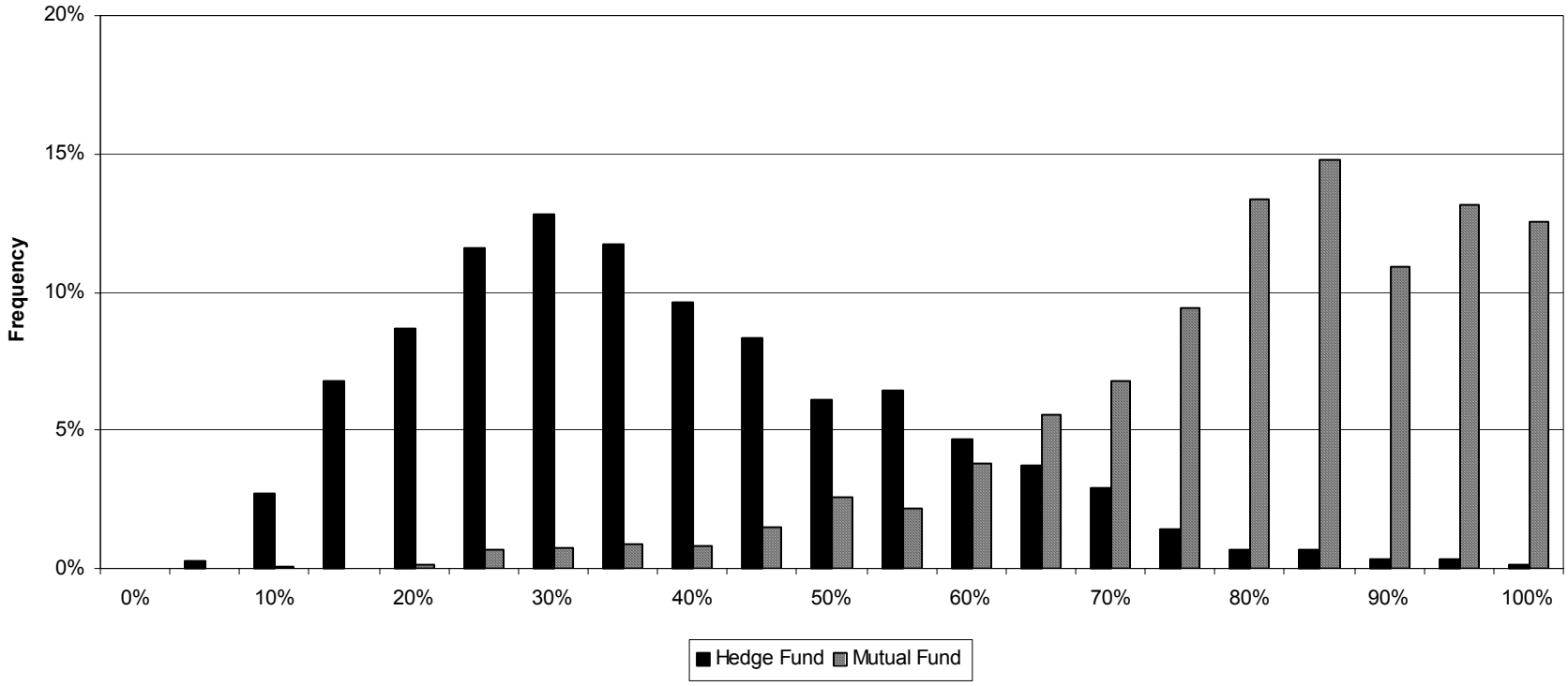

Figure 3. Actual & Predicted Returns of Trend Followers: 1998-2004

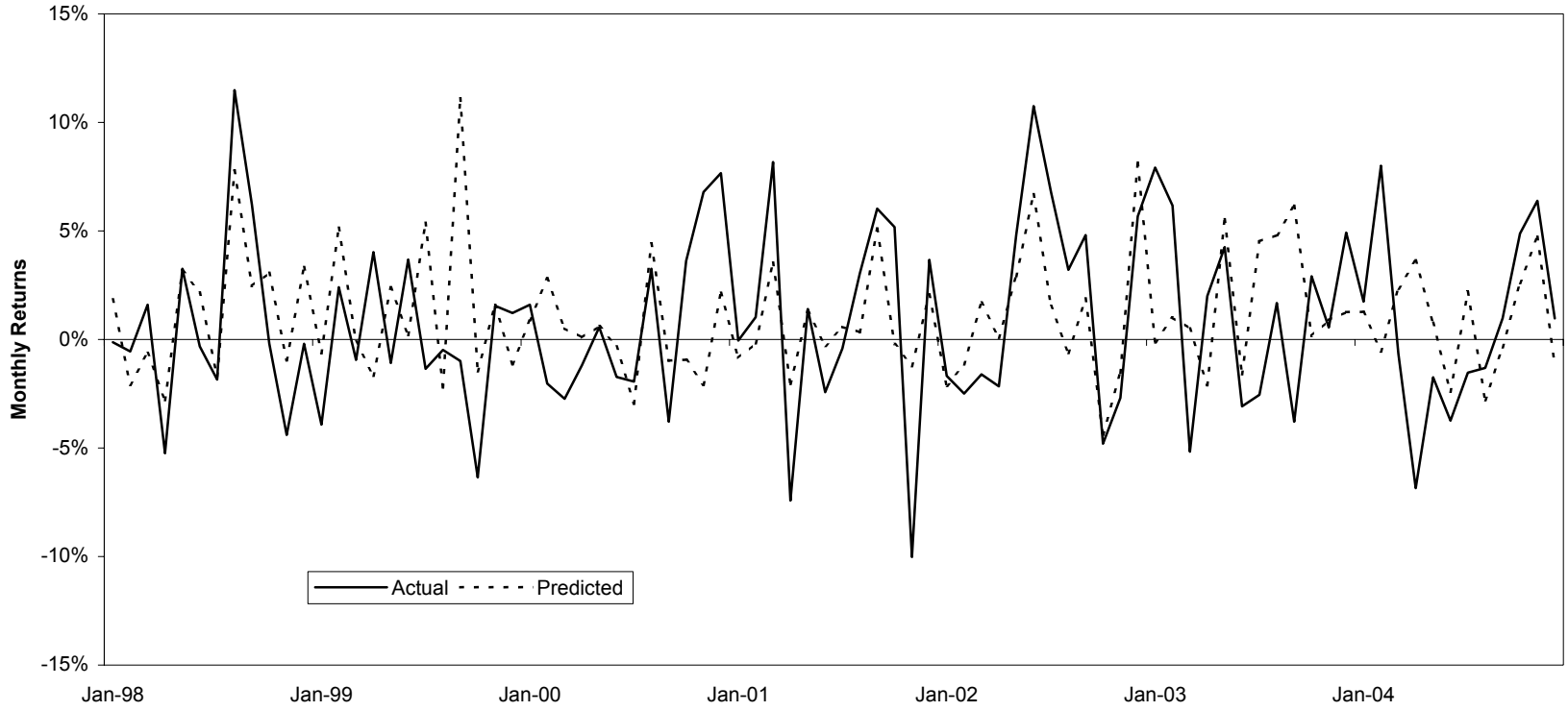

Figure 4. Risk Factor for Merger Arbitrage Hedge Funds: 1994-2004

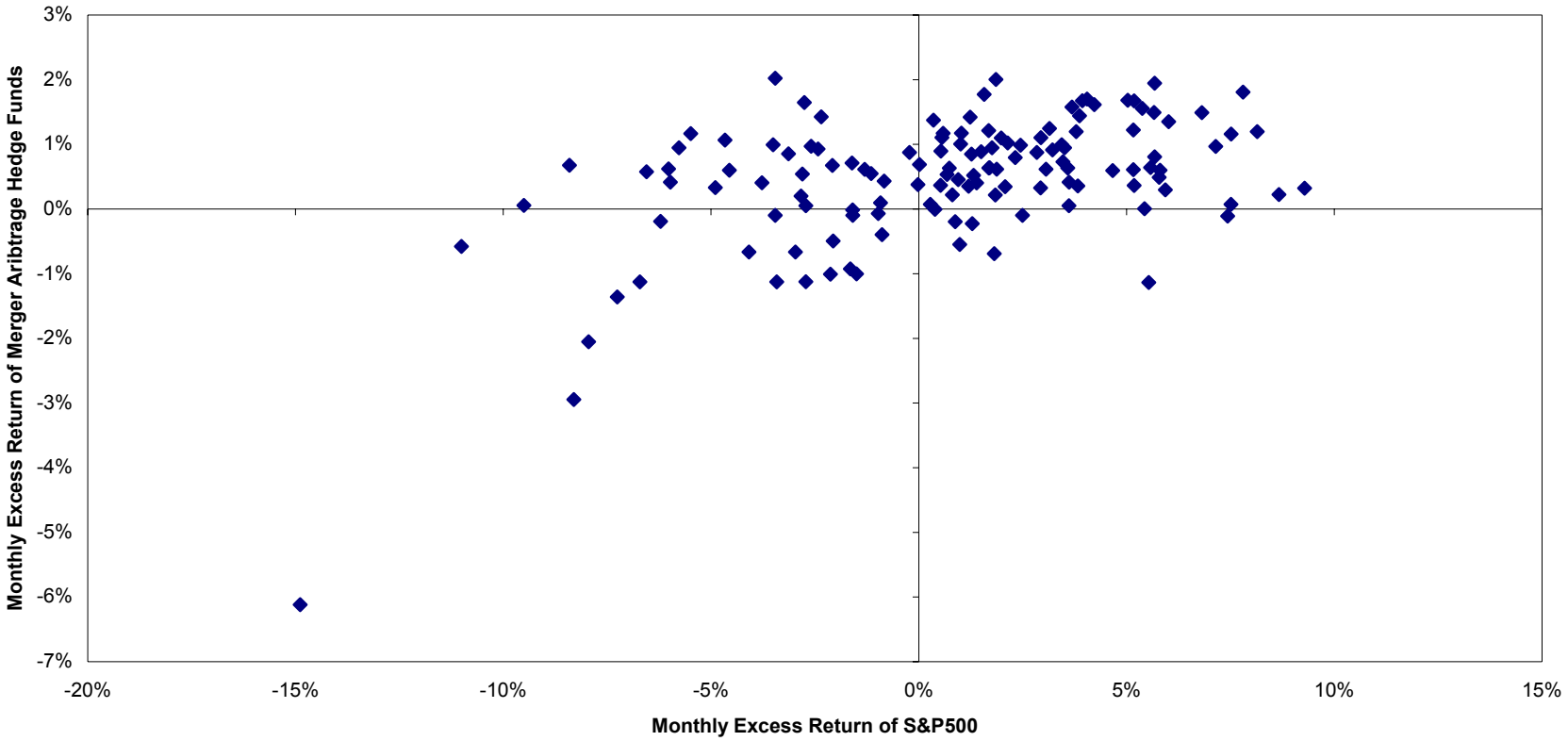

Figure 5. Risk Factor for Fixed Income Hedge Funds: 1990-2004

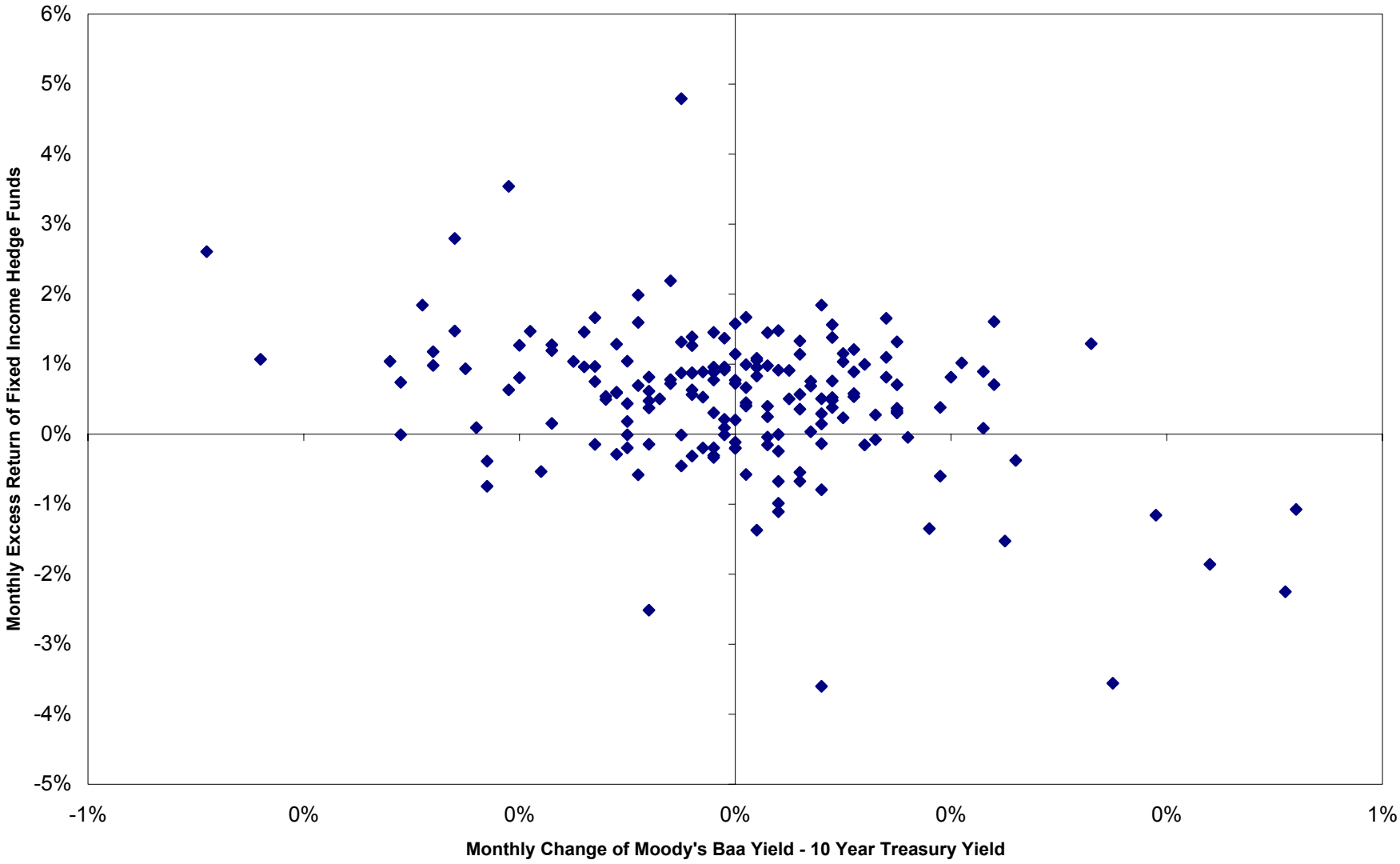

Figure 6. Actual & Predicted Returns of L/S Equity Hedge Funds: 2003-2004

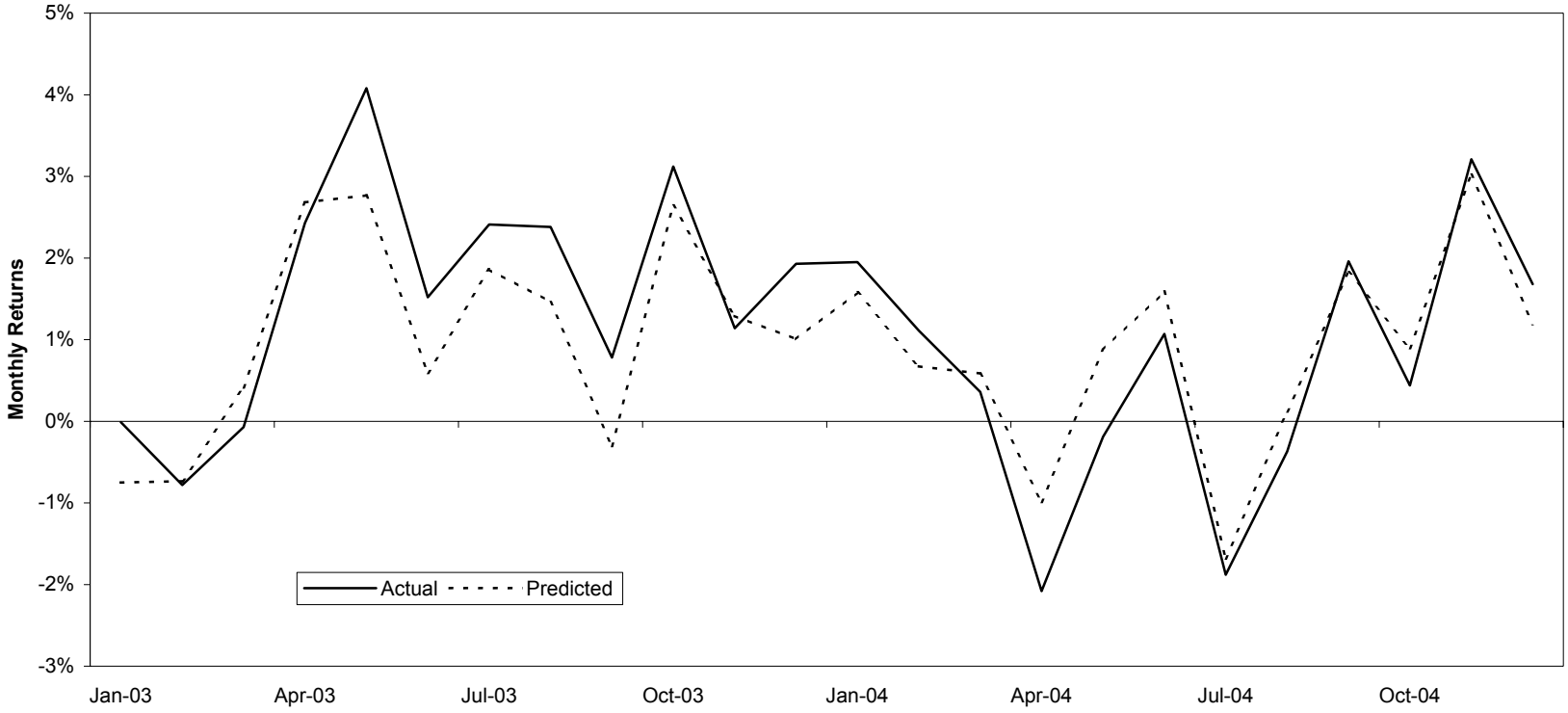

Figure 7. Risk Factor for Convertible Arbitrage Hedge Funds: 1993-2002

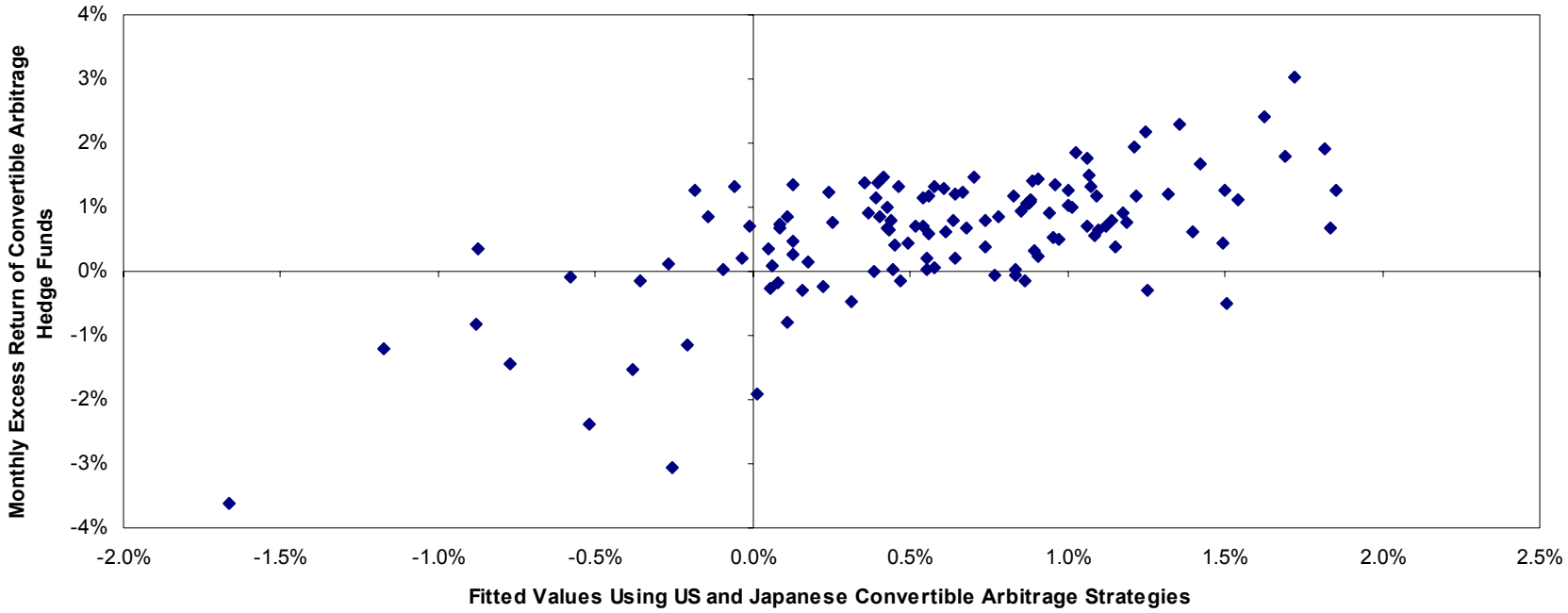

Figure 8. Risk Factor for Emerging Market Hedge Funds: 1994-2004

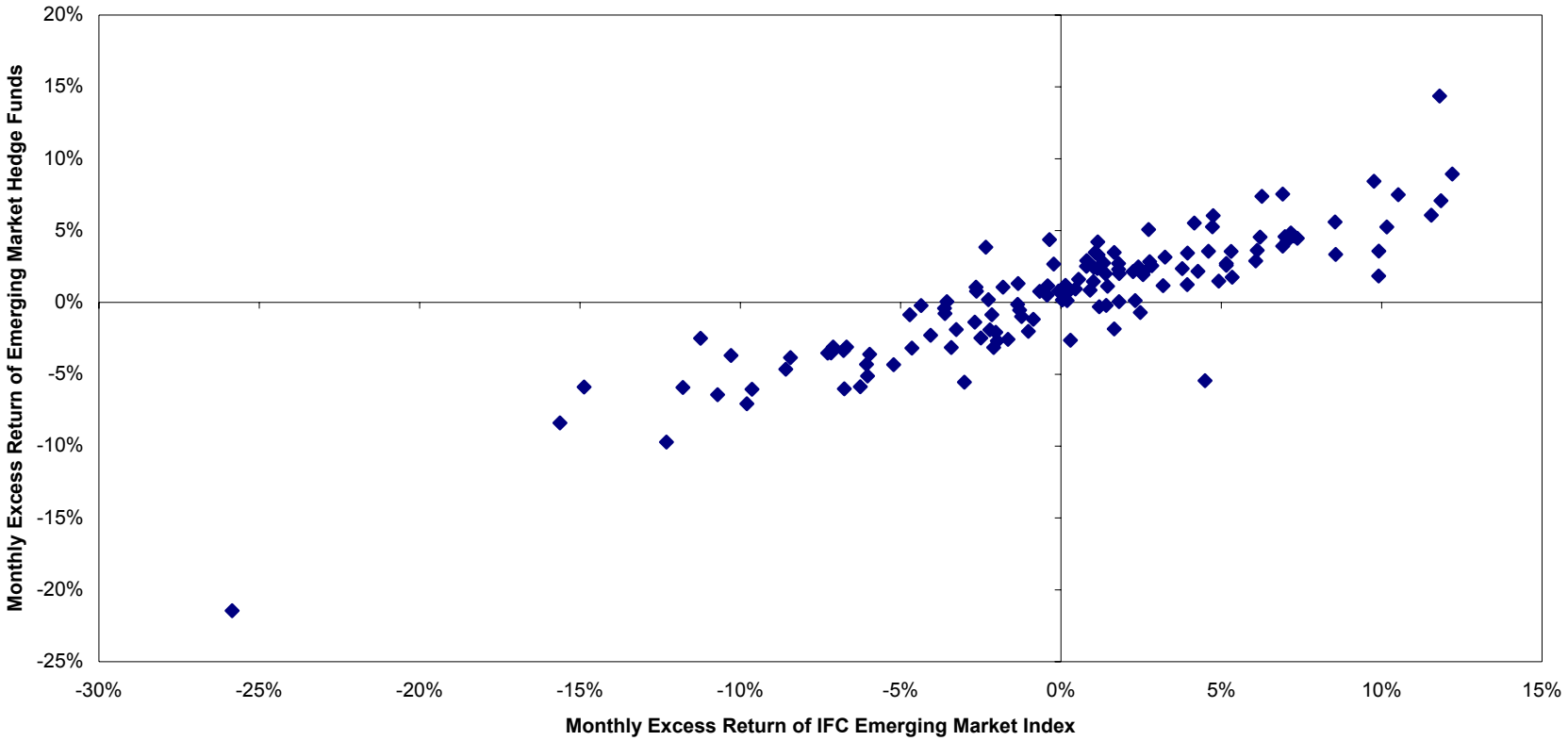

Figure 9. Risk Factor for Distressed Securities Hedge Funds: 1994-2004

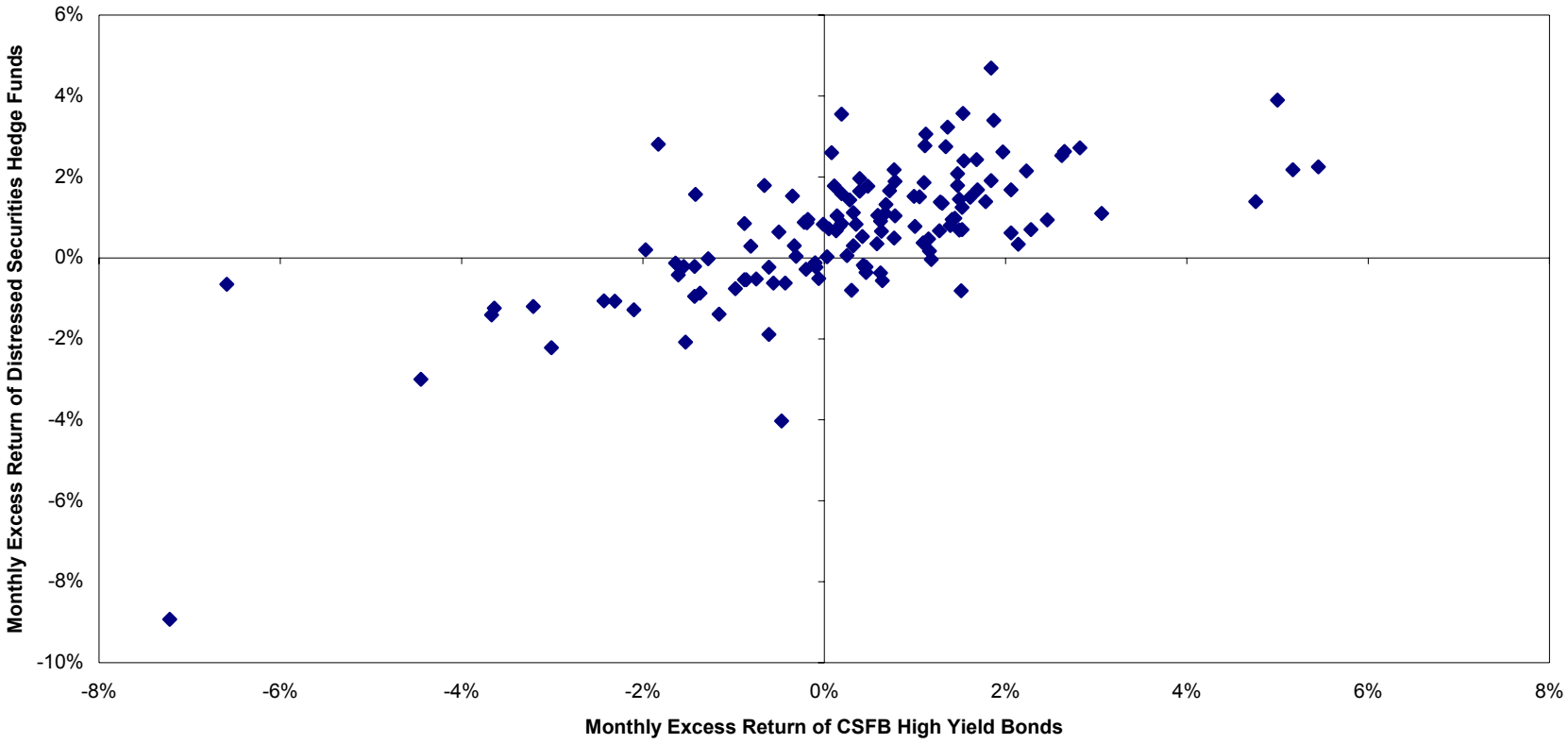

Figure 10. Risk Factor for Long-Biased Equity Hedge Funds: 1994-2004

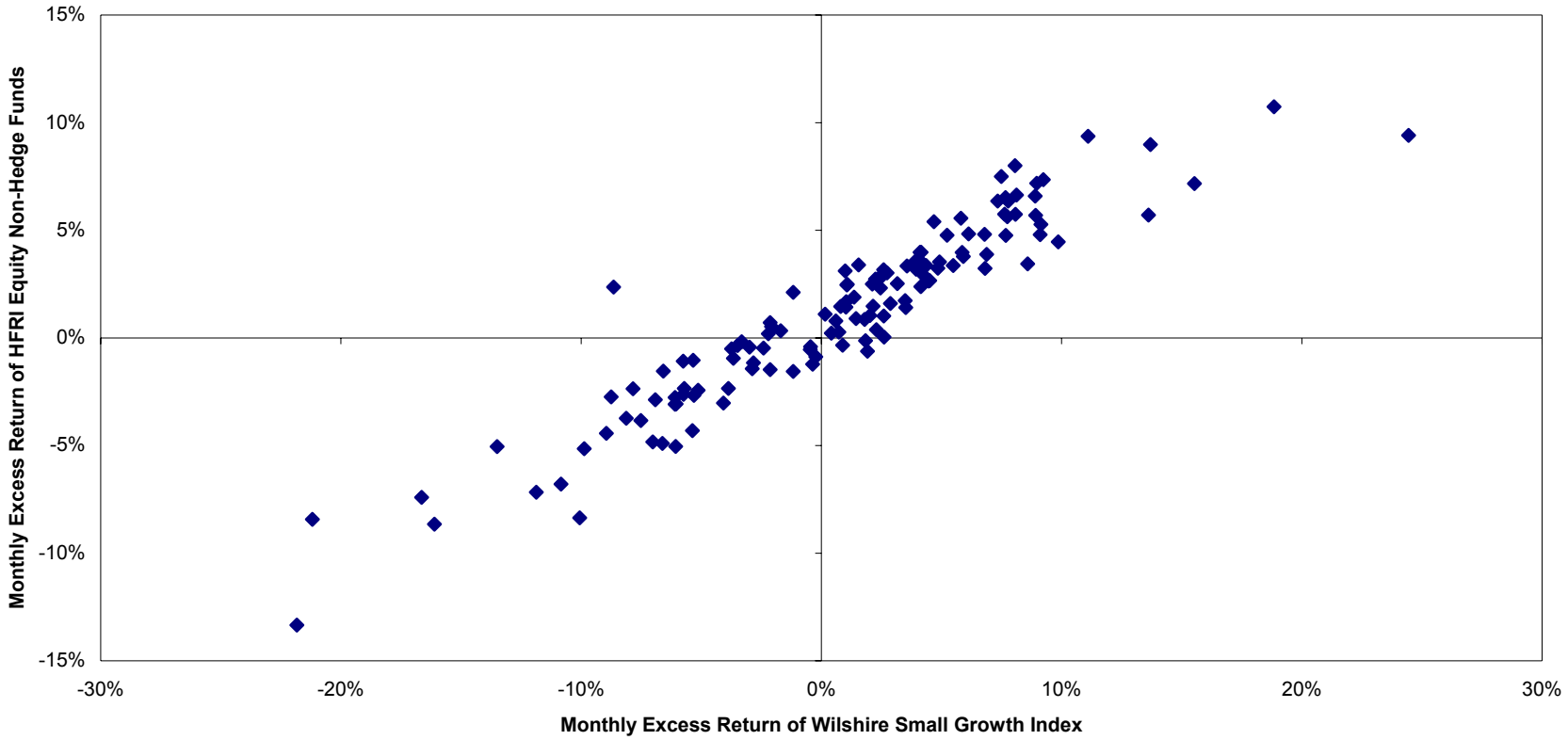

Figure 11. Risk Factor for Short-Selling Hedge Funds: 1994-2004

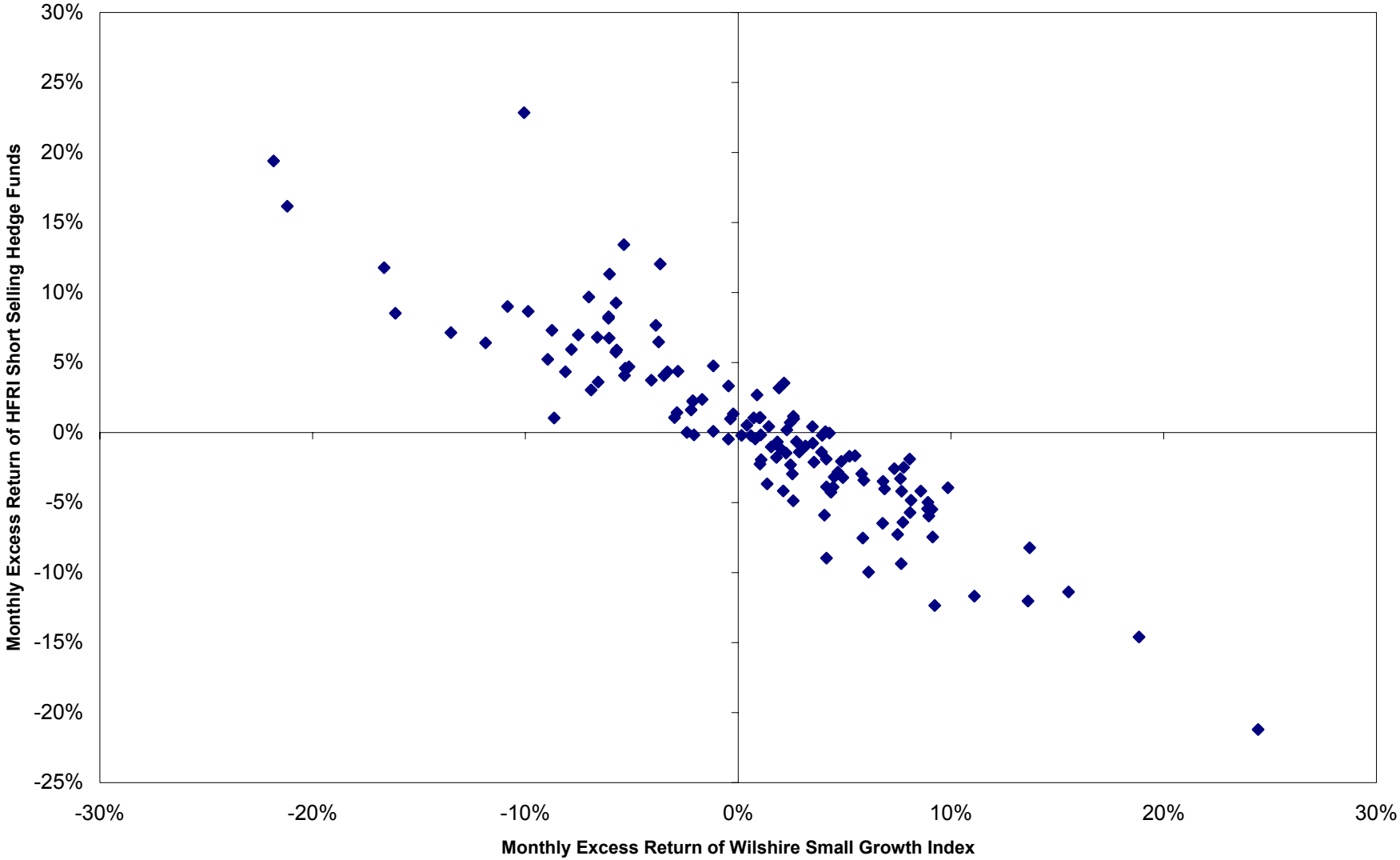

Figure 12. Actual & Predicted Returns of HFRI Macro Funds: 1996-2004

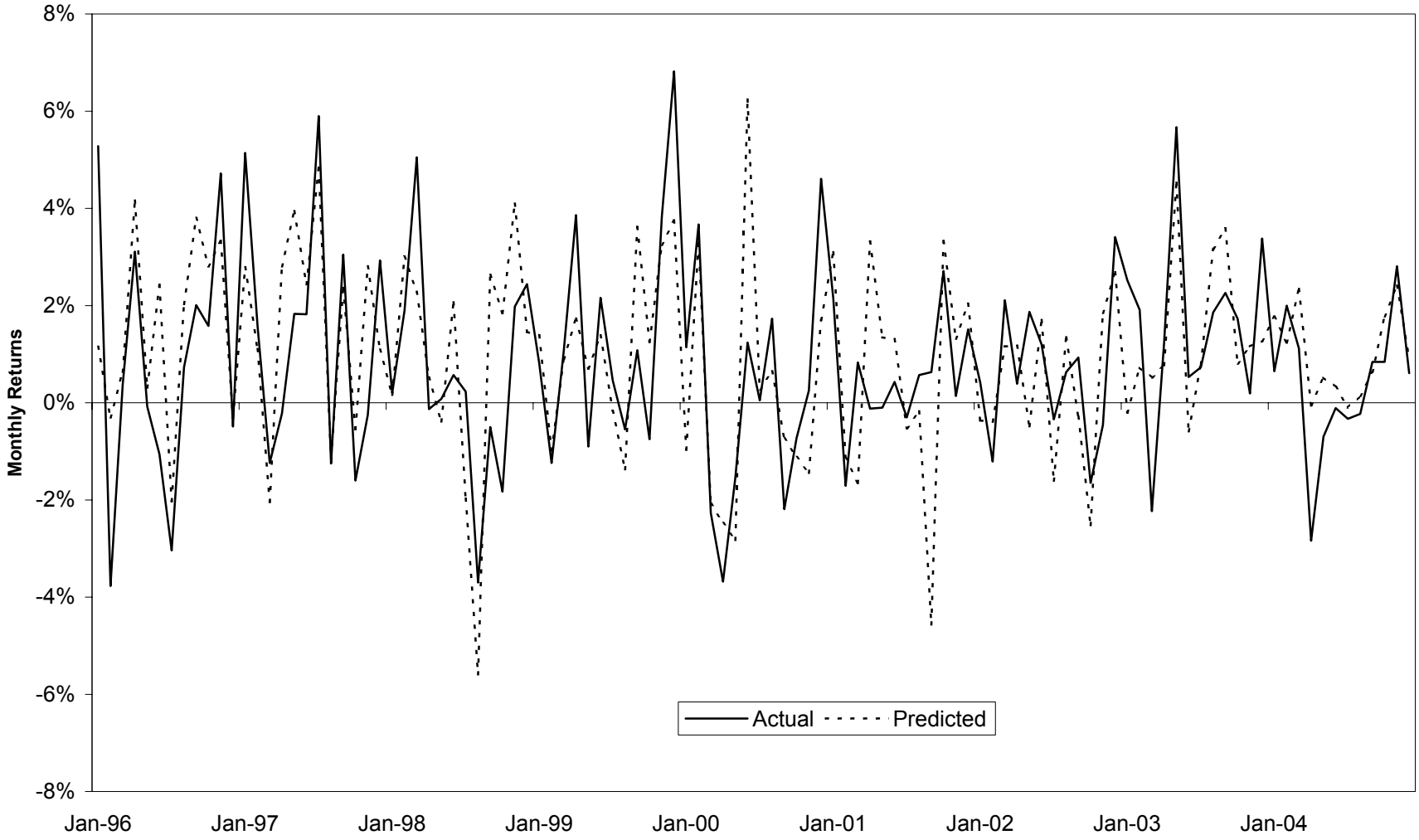

Figure 13. Long History of the Credit Spread