Hedge Funds: An Industry in its Adolescence

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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 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), Schneiweiss and Spurgin (1998), Ackermann, McNally 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 lack luster performance of global equity markets. As a result, asset-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, higher operational standard, to name just a few. Some have referred to this as the institutionalization of the hedge fund industry.

Accompanying this, the 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 it 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, the answer to this question is the key determinant on whether hedge funds provide diversification to a portfolio of conventional assets, and more importantly, whether hedge funds offer returns commensurate to 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 the servicing and financing of 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.

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, there is a tendency for investors 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, ranging from hedge-fund investors, financial intermediaries who provide leverage to hedge funds, as well as 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 to 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 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 hopefully dissuade 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. After all, 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, which must be recognized in order to obtain accurate measures of returns.

Section 4 summarizes the research 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 on *how* and *where* hedge funds do their business are based on extensions of the approach used to model conventional asset managers 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 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 this 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 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 present a research agenda that is 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 US 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, US pension plans are also increasing their investments in hedge funds. According to *Pension and Investments*, the largest 200 US defined benefit pension plans invested $3.2b, or 0.1% of their assets in hedge funds in 2000. This has grown to $21.1b, 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. However, this 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 access the true size of the hedge fund industry.

There are now three commercial databases of hedge funds each having over ten-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 has 4,130 funds (2,431 live and 1,699 defunct), HFR has 5,158 funds (2,939 live and 2,219 defunct), and CISDM has 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 between 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 startup 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. This is dramatically illustrated by the low correlation of hedge fund returns (versus the high correlation of mutual fund returns) to standard asset classes in Fung and Hsieh (1997). Figure 2 is an updated version of this evidence. 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

[3] To this end, we thank MSCI and Eureka Hedge for allowing us access to their data bases.

monthly returns, and we use only the last 60 monthly returns if the fund has a longer history. We regress each fund's returns on eight asset classes comparable to those in Fung and Hsieh (1997),[4] and tabulate the distribution of the R^2s for each group. 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 ten styles.

Convertible Arbitrage are funds that typically buy convertible securities and hedge the credit exposure with short positions of the equity of the issuing firm**. Dedicated Shorts** are specialists in short selling, typically equities. **Emerging Market** are specialists in the securities of developing economies. **Equity Market Neutral** consists of funds typically holding a long-short portfolio of equities with little directional exposure to the stock market. **Event Driven** funds specialize in corporate events, such as merger transactions or corporate restructuring. **Fixed Income Arbitrage** typically holds long-short portfolios of bonds. **Macro** funds bet on directional movements in stocks, bonds, foreign exchange rates, and commodity prices**. Long/Short Equity** funds

[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.

typically have a long-short portfolio of equities with a long bias. **Managed Futures** are specialists in futures trading. 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. In terms of number of funds, Panel A shows the style composition has been quite stable since 1999. In terms of assets under management, Panel B shows that there has been a slight decline in **Macro** (from 15% in 1999 to 10% in 2004) and **Long/Short Equities** (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 years 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 contains the distribution of hedge fund fees. Similar to mutual funds, hedge funds change 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 mere re-labeling -- after all, the old Macro funds are like the modern day multi-strategy firms. This 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. This is 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 are empirical evidence that show 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 the discretion of a hedge fund manager, hedge fund databases can suffer from selection bias, which arises when the hedge finds in a database are not representative of the universe of hedge funds. It is difficult to estimate this 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 closed to new investors choose not to be a part of a database. Thus, it is not clear what is the net effect of selection bias, whether the funds in a database have

[6] Fung and Hsieh (1997) used a database of surviving funds. They explicitly acknowledge the shortcomings, being unable to collect information on delisted funds. 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 US Dollars are included in this update. In general very few hedge funds do not have a version in USD. Therefore, focusing only on USD denominated funds in a way avoids errors that may arise from duplicated funds that are quoted in different currencies.

higher, or lower, returns than funds not in a database. In the future, this can be estimated if we can 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. Ignoring the outlier of undiscovered jewels, this generally means 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 (surviving and defunct) funds.

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). This yields the survivorship bias to be 2.4% for TASS (1.8% for HFR, 2.4% for CISDM). This is consistent with the estimates in prior research using

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

As the industry matures, we believe the severity of survivorship bias will be reduced. This comes from 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% are 'liquidated', 13% are 'closed to new investments/no longer reporting', and the remaining 46% are 'not reporting'. The 'liquidated' defunct group has 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 typically 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 to simply stay as an employee in a comparable investing institutions—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 is 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, it seems logical to 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, where it is typically that 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 backfilled 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, 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 that 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 of 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). This, however, seem to be 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

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 is useful to settle this issue once and for all, by asking data vendors to determine the liquidation value of hedge funds. Another useful avenue to explore is to directly approach the administrators of hedge funds to obtain 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, where 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 standard on their hedge fund counterparties. Last, but not least, regulators are imposing compliance requirements on hedge fund companies that operate in major capital markets.

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

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 is more likely to 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 main supplier of leverage to hedge funds. Given the normal conflict between lender and borrowers in terms of sharing of position risk, 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 in

terms of pricing of portfolio positions. Since auditors to hedge funds naturally have access to primer broker reports, it is not likely that auditors would allow hedge fund managers to use their own prices that are materially different to the prime broker's 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 relative actual investment experience in hedge funds. These 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, 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 section on risk factors.

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, so by definition they reflect actual investment experience in hedge funds. The databases on FoFs suffer less biases (such as survivorship, incubation, etc) than those on individual hedge funds. Also, FoFs charge fees for due diligence and portfolio construction, which are costs of investing in hedge funds borne by the investors but not reflected in the returns of

individual hedge funds.[10] Further 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?* As we proceed, we note that the data biases in the previous section are not likely to affect the types of risk factors we find in hedge funds. Rather, data biases are likely to show up as 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. Agarwal et al (2005) studied convertible arbitrage and Duarte et al (2005) studied fixed income arbitrage. In the following sections (4.1 through 4.6), we will cover most of the 9 major hedge fund styles as described in Section 2.3.

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

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

has been tackled in Fung and Hsieh (2003, 2004a). In this section we review 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. They formed five portfolios of lookback straddles—stock indices, bond futures, interest rate futures, currency futures, and commodity futures. They found that 3 option portfolios (bonds, currencies, and commodities) have strong correlation to trend followers' returns.

Figure 3 provides evidence on the usefulness of the lookback portfolios. Using the regression equation in Fung and Hsieh (2001), we generate out-of-sample forecasts and graph them along with the returns of trend followers (using the CISDM Trend Follower Index).

[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).

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 found that both the merger arbitrage index and Merger Arbitrage funds look at a short position on the stock market. This is illustrated in Figure 4.

This is a reasonable outcome. Basically, merger arbitrageurs are betting on the consummation of a merger. Their return can be viewed as the insurance premium on selling insurance policies against the failure to complete a merger. Typically, mergers fail for idiosyncratic reasons, which 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 sub-strategy in the **Event Driven** style discussed in Section 2.3. The other sub-strategy 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 Ten Year Teasury Constant Maturity Yield.

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 swap 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 funding spread (i.e., the difference between LIBOR and the repo rate.) Yield curve spread trades are "butterflies", betting that the points along the swap curve will move in a certain configuration. 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 5-year interest rate swap. Fixed income volatility trades are bets that the implied volatility of interest rate caps tend 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 hedge funds. Agarwal and Naik (2004) studied equity-oriented hedge funds and Fung and Hsieh (2005) {Is this the right reference?} 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 basically 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. Then we use the coefficients to perform a one-month ahead conditional forecast.[12] Figure 7 shows that the one-month ahead forecast is a very good predictor of the returns of the HFRI Equity Hedge index.

4.5. Risk Factors in Convertible Arbitrage

Using US 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.

[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.

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, Fung, Loon and Naik (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 US 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

Here, we summarize the risk factors of some of the other hedge fund styles.

Figure 8 shows that **Emerging Market** hedge funds' returns 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 sub-strategies 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, rarely hedging their market risk. 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 are missing—**Macro** and **Equity Market Neutral**. **Macro** funds are analyzed in section 4.8. This leaves **Equity Market Neutral** funds. This has been a problematic style to analyze, largely due to difficulties with accurate classification of strategies that fall into this category. To begin with, many funds in HFR and TASS that carry a equity market neutral classification exhibit statistical significant betas to standard equity factors, as found in Patton (2005). In addition, there is another category in the HFR database called Statistical Arbitrage. Statistical Arbitrageurs that operate in equity market should naturally fall within the Equity Market Neutral category. It is unclear to us how these distinctions 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 a better definition of this hedge fund style.

4.7. A Basic Risk Factor Model using Asset-Based Style ("ABS") Factors

Next, we move to the top-down approach of modeling the risk factors of well-diversified portfolios of hedge funds. This is a necessary step for investors, counterparties, and regulators. Investors need to study the major risk factors in hedge fund portfolios to determine how they fit into the rest of their portfolios. 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 7 risk factors to account for the risk of well diversified portfolios of hedge funds. The risk factors are selected from those that explain several 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 riskfree 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 7 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 hedge fund "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 11 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 ten years, they were not especially large against the backdrop of a much longer time period. It is therefore not surprising that LTCM, which by many accounts was many times more levered than a typical fixed income hedge fund, nearly failed.[13]

4.8. Risk Monitoring and Performance Evaluation of Hedge Funds

[13] 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 ten more years of history, they may have avoid their problems in 1998.

The advantage of ABS factors is that, not only are the portfolio level risk factors much more readily observable, they are also investable—by construction, they are derived from traded assets in the public market. This gives us a much more naturally 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, exposure to key risk factors are ways for them to monitor aggregate hedge fund risk in the capital-at-risk calculations. For regulators, it would be easier to monitor concentrated exposures of hedge funds, proprietary desks, and conventional money managers in particular markets for potential liquidity squeezes. We turn to these issues in the next two sections of the paper.

4.9. Capturing the Risk in Macro Hedge Funds

Macro funds are thought to be highly dynamic traders who often bet on directional movements in exchange rates, interest rates, commodities, and stock indices. We have often thought that it would be difficult to capture the dynamic nature of the risk in these funds. However, it turns out that the 7 ABS risk factors can do a reasonably good job capturing the risk to which Macro funds are exposed.

Figure 13 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 7 ABS factors. We use the regression coefficients and the realized values of the 7 ABS factors in the subsequent month to generate the conditional one-month ahead forecast. The realized Macro index is the solid line in Figure 13, while the conditional forecast is the dashed line, from January 1996 until December 2004. The ability of the forecast to track the actual Macro index is evidence that the 7 ABS factors can capture a large part of the risk in Macro funds.

This is perhaps not too surprising. After all, the best known Macro funds are large funds that seem to act like a multi-strategy fund or a FoF than single-strategy specialist hedge funds. 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 from the tactical strategy allocation process of multi-strategy hedge funds. The challenge to academic researchers is how to devise meaningful model that properly measure the value these tactical strategy allocation decisions bring to investors. In some way, evolution of hedge fund strategies is coming full circle from the days where the industry was dominated by Macro funds to one that will be dominated by multi-strategy funds and funds-of-hedge funds. This outcome is consistent with our hedge fund business model in a world where alphas are scarce commodities and economic cycles favoring different strategies at various stages.

5. Hedge Funds and Regulatory Concerns

In the wake of the Asian Currency Crisis of 1997, the International Monetary Fund (IMF) performed a study to follow up on charges by Asian government officials

that hedge funds were the primary culprit for that episode. The result was 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 ground" (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 know-how, and the financial ability to hire consultants with the know how, to understand the risk in hedge funds. They also have sufficient wealth to withstand large losses in hedge funds.

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 briefly review these arguments in light of the recent events, particularly with respect to the rapid growth of the industry since 1998. Papers by

Franklin (2006) and Lo (2006) in the conference will cover these issues in much greater detail.

5.1. Investor Protection

Investor protection falls largely under the purview of the Securities 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, SEC (2004) was adopted in December 2004. SEC (2004) cites the growth of the hedge fund industry, the increasing instances of hedge fund fraud,[14] and the broadening of exposure to hedge funds, especially by institutional investors (e.g. public and private pension funds, universities, endowments, foundations, charitable organization) 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 SEC (2004).

In the first place, registration is not likely to slow down the proliferation of hedge funds 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.

[14] SEC (2004, p. 5) sited 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.

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 detection of and ultimately to 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 results on how registration helped in this respect.

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 bring down the counterparties they deal with, who in turn can take down other financial institutions through their own set of transactions. This chain reaction is referred to as systemic risk. 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. After all, 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 funds.

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 would potentially lead

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 litter value to investors? Investors would certainly like to cut these funds from their portfolio, but would prime brokers be as quick to react 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[15], and found mainly 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 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 fund 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.[16]

[15] Properly known as the Presidential Task Force on arket Mechanisms (1988).

[16] 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.

The view that hedge funds are too small to exert significant market impact was challenged by the near bankruptcy of Long-Term Capital Management 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 common place—here perhaps more research and standardization would help to avoid a proliferation of models that are as bewildering to consumers as opaque hedge funds. Capital requirement 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 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 less 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 7 risk factors from Fung and Hsieh

(2004). 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 have 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 arise is—*can 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 mutli-strategy 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 become hedge fund managers themselves and there is no reason to believe why their services would be priced lower than their competitors. After all, alpha has to be a scarce commodity.

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) will cover these issues in greater detail. Here are some of the obvious 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 that hedge fund managers should invest a substantial amount of their personal wealth alongside the investors of the fund they manage—co-investing. 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. 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. Put different, 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 evolves 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 pull 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 returns.

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 90s, 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 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 default 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, regulator 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.

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Table 1. US 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. Pension & Investment, 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
1996	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
1996	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.

Tabe 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 7 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)

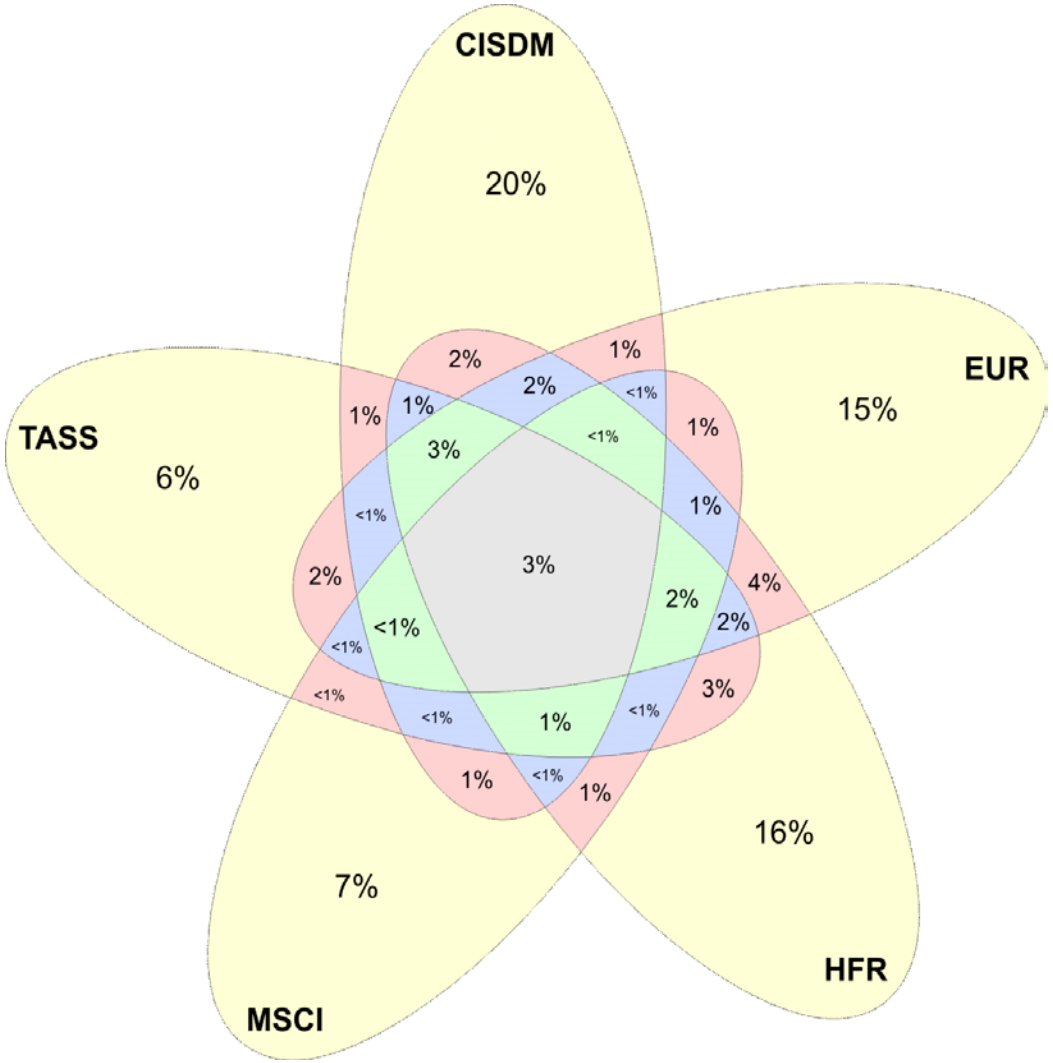


Figure 2. Distribution of R-squares vs Eight Asset Classes

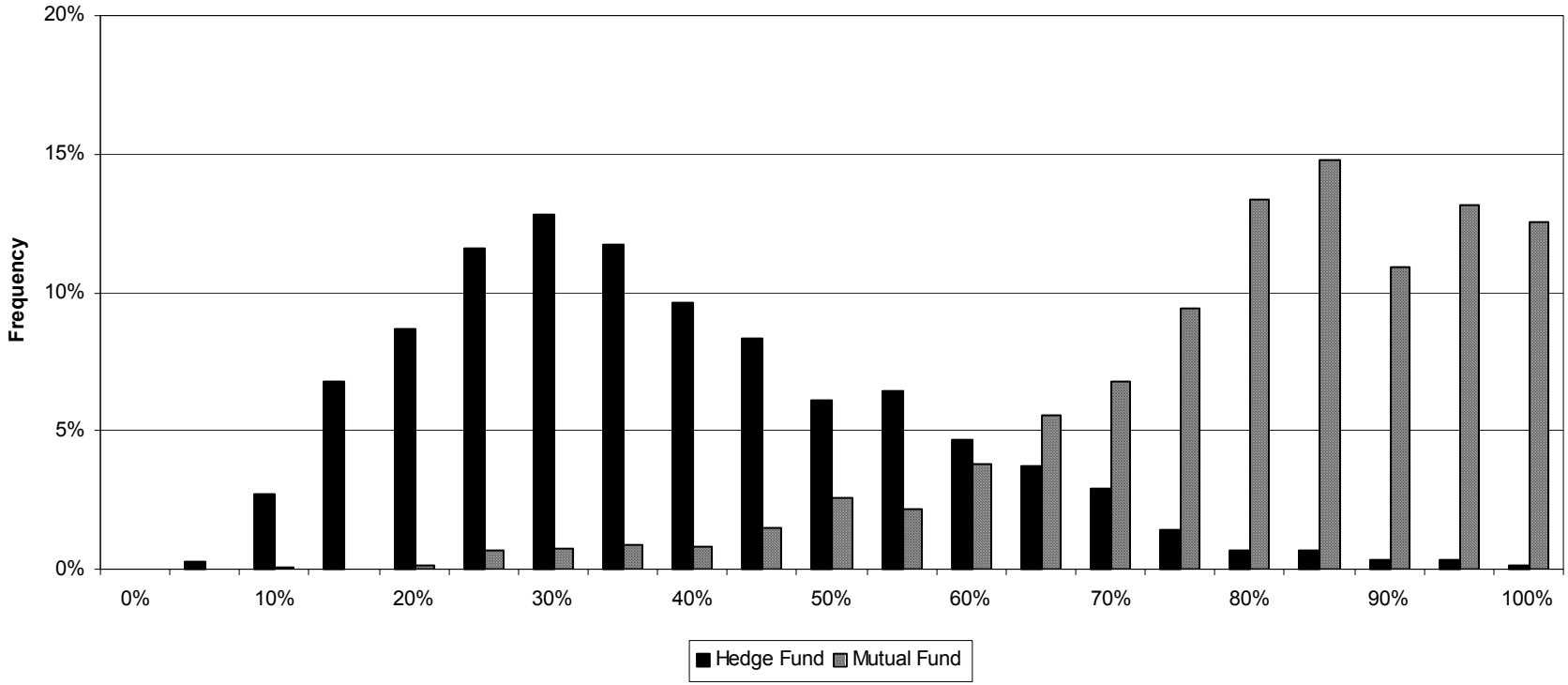


Figure 3. Actual & Predicted Returns of Trend Followers: 1998-2004

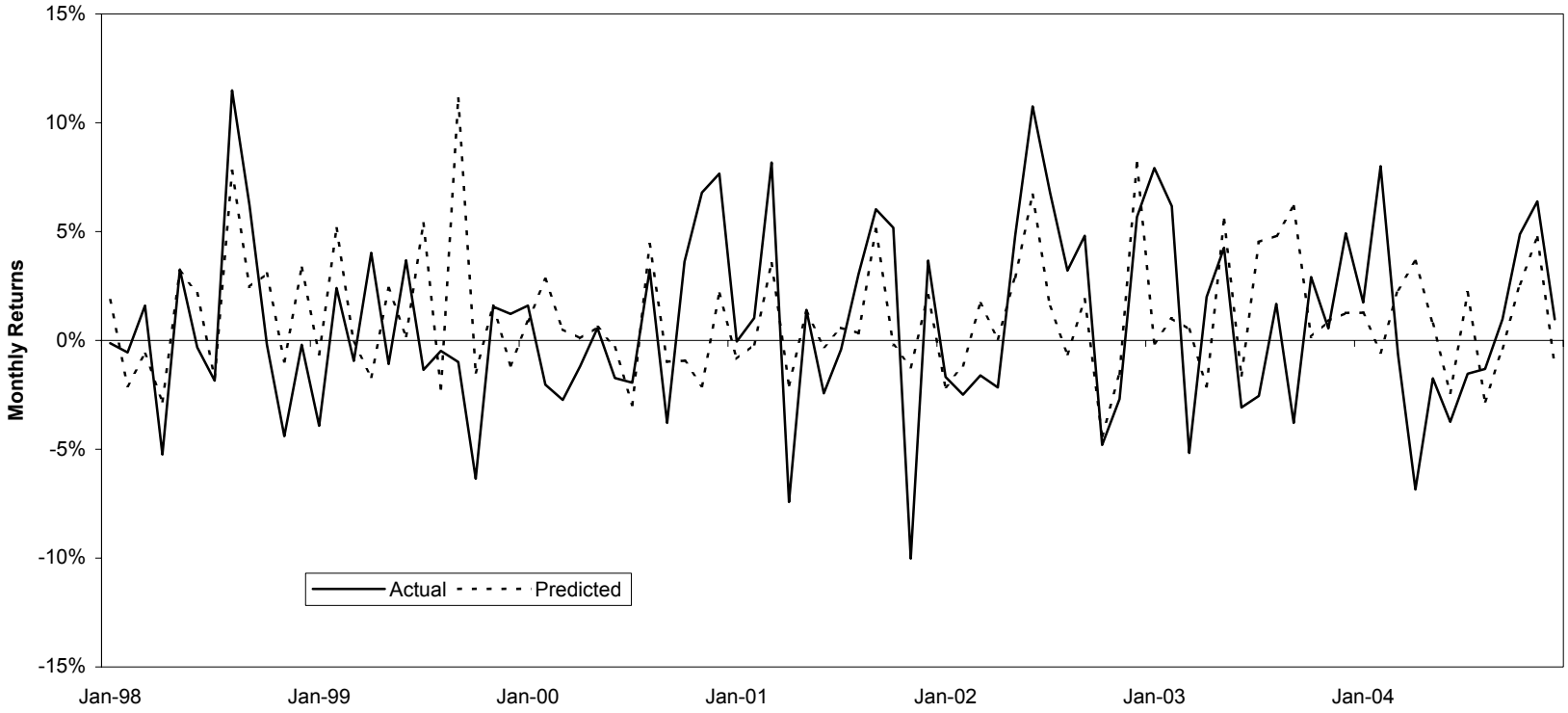


Figure 4. Risk Factor for Merger Arbitrage Hedge Funds: 1994-2004

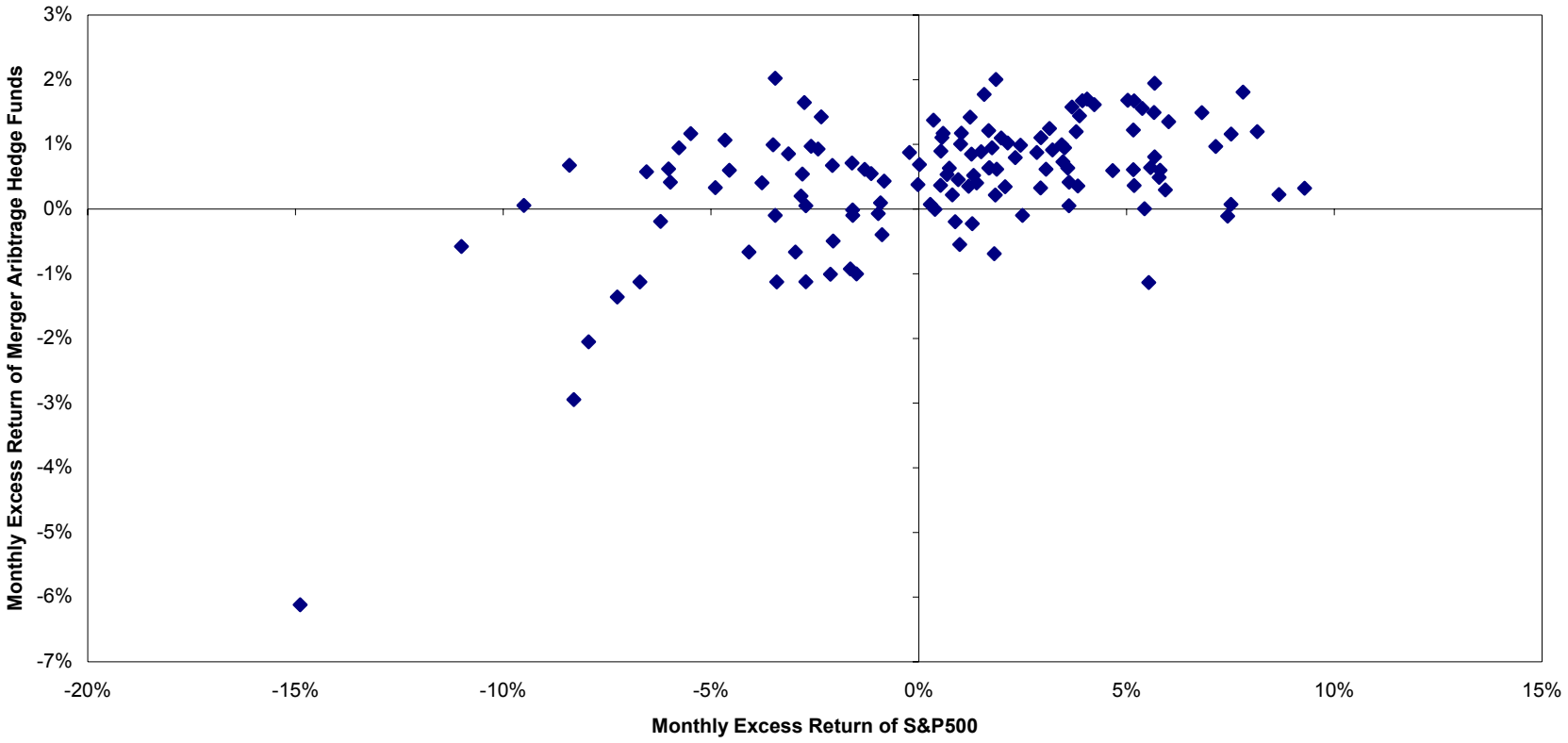


Figure 5. Risk Factor for Fixed Income Hedge Funds: 1990-2004

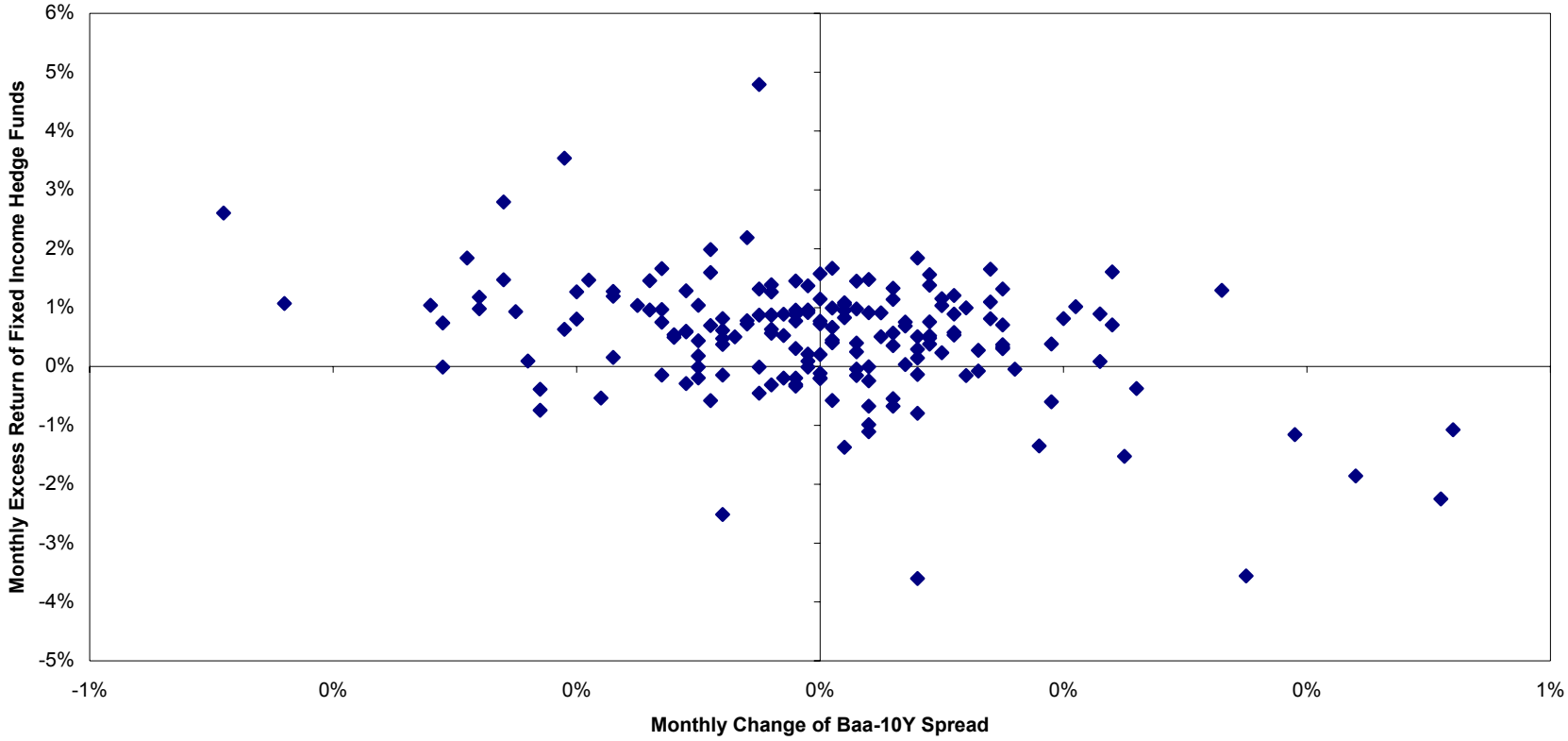


Figure 6. Actual & Predicted Returns of L/S Equity Hedge Funds: 2003-2004

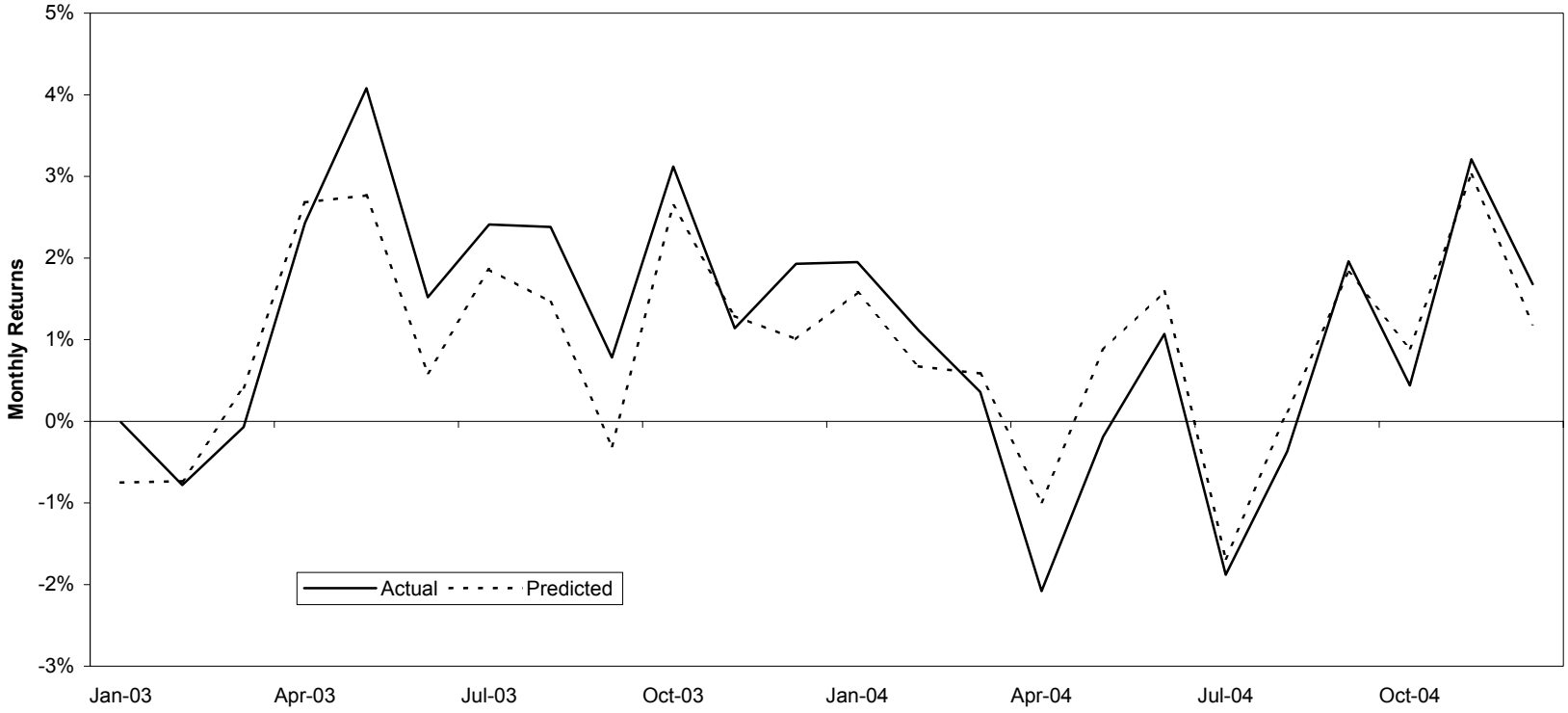


Figure 7. Risk Factor for Convertible Arbitrage Hedge Funds: 1993-2002

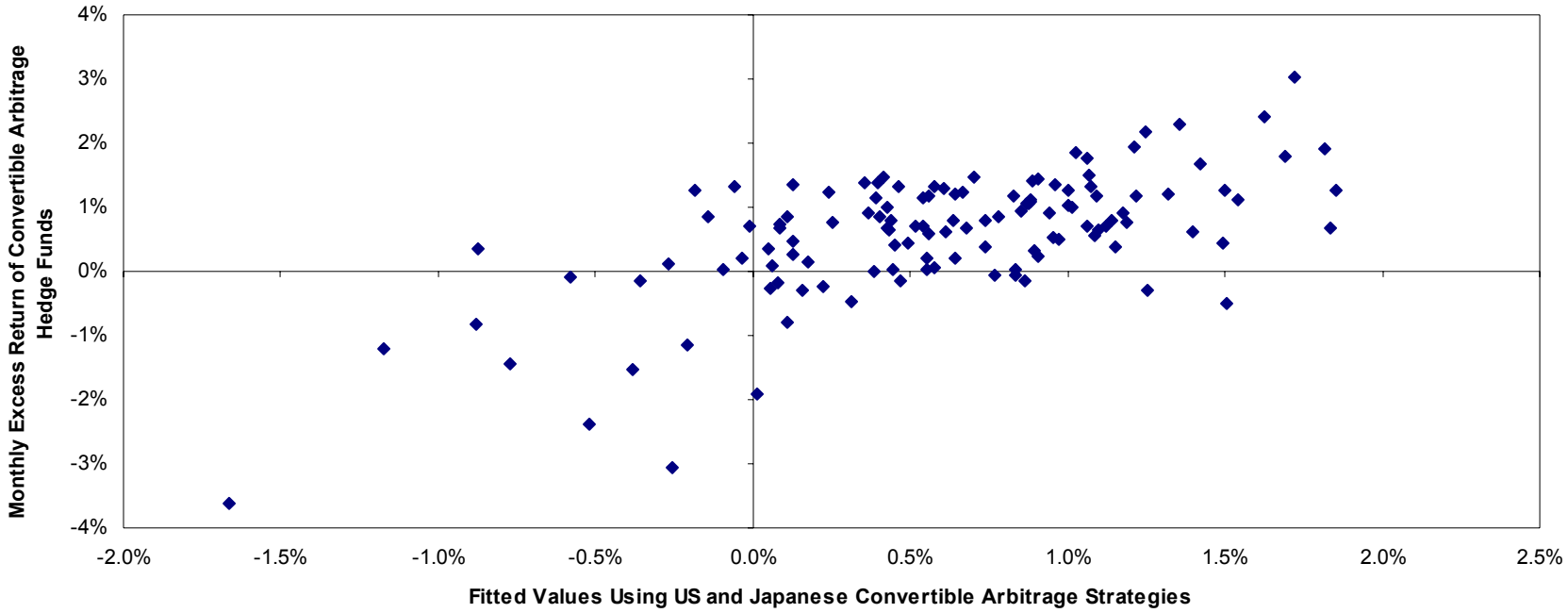


Figure 8. Risk Factor for Emerging Market Hedge Funds: 1994-2004

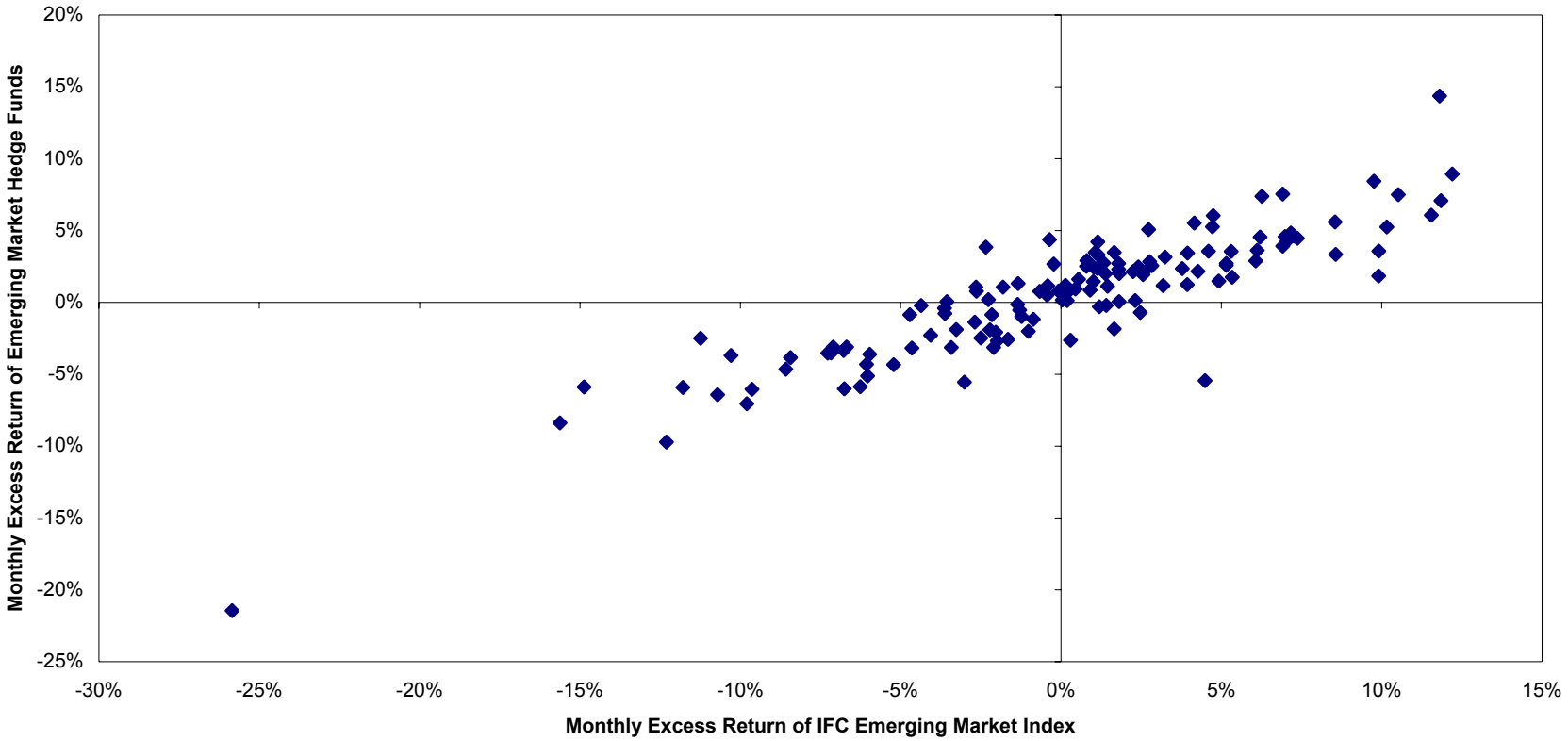


Figure 9. Risk Factor for Distressed Securities Hedge Funds: 1994-2004

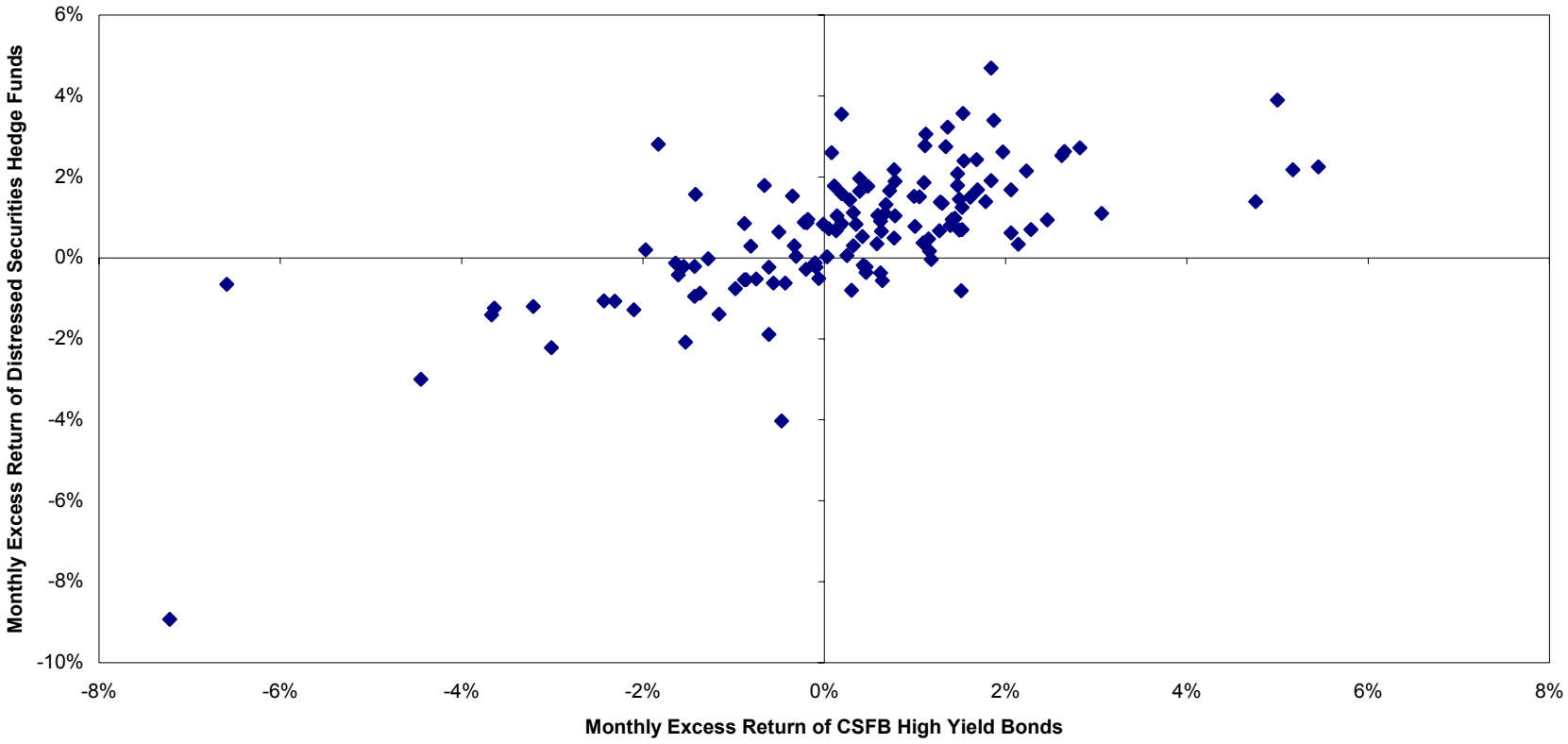


Figure 10. Risk Factor for Long-Biased Equity Hedge Funds: 1994-2004

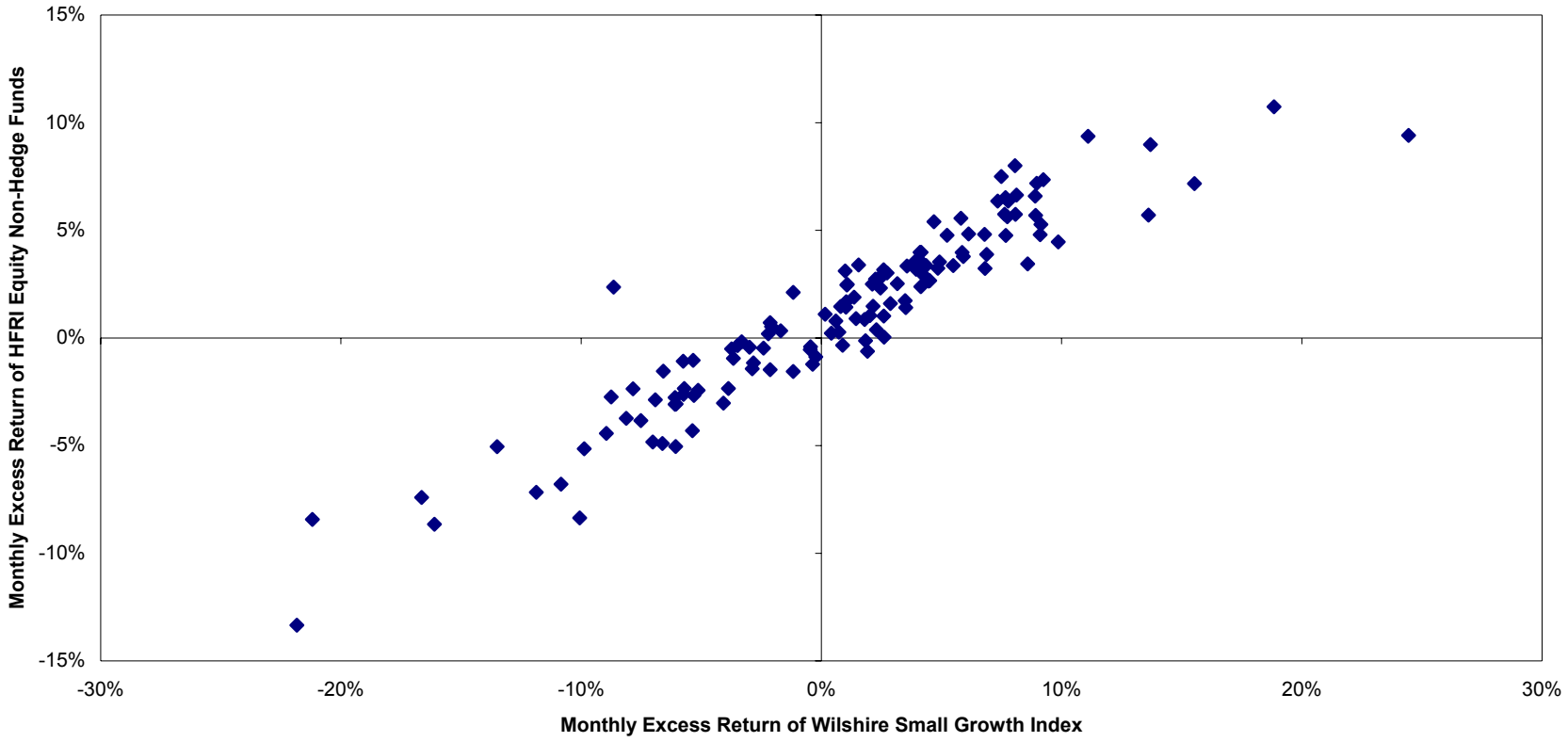


Figure 11. Risk Factor for Short Selling Hedge Funds: 1994-2004

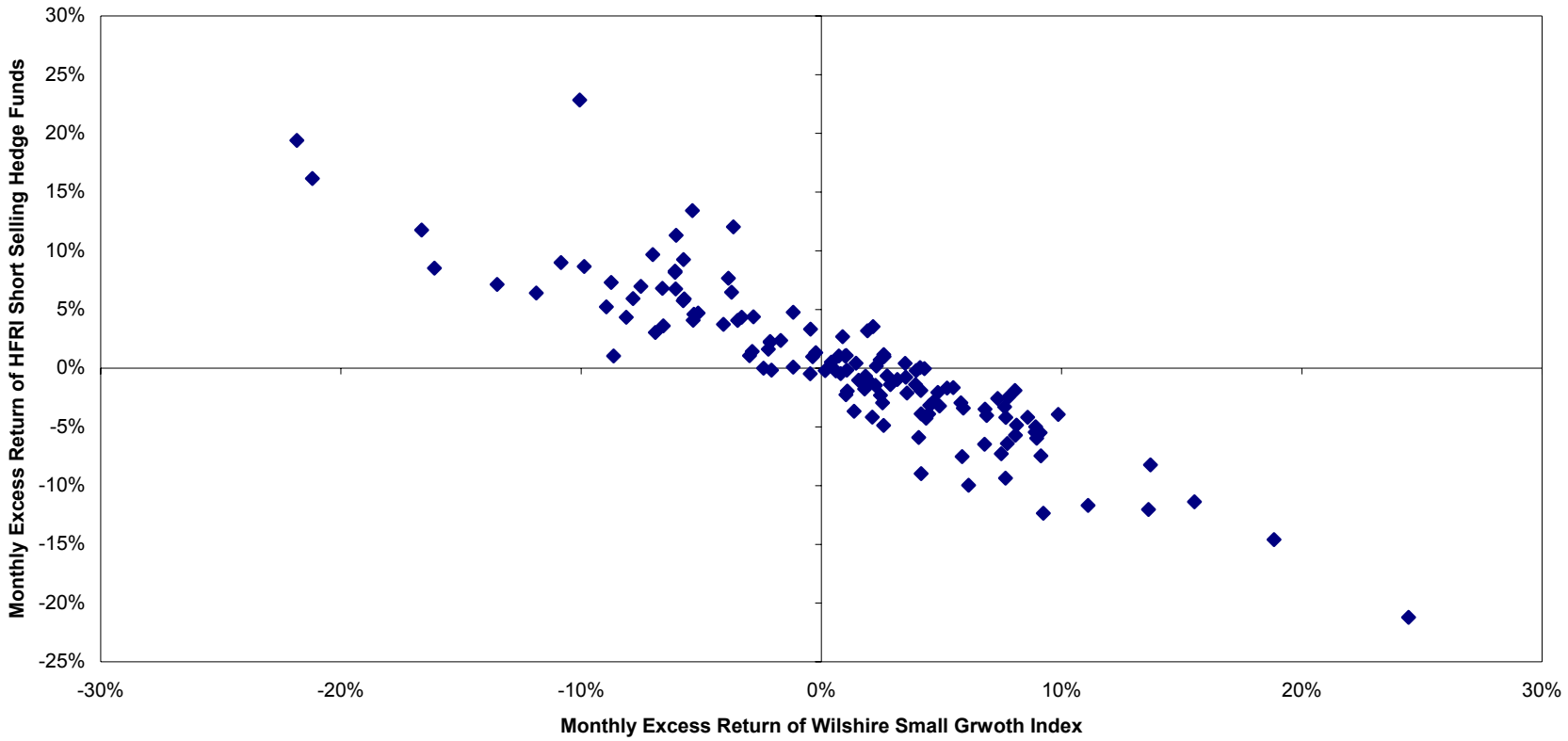


Figure 12. Long History of the Credit Spread

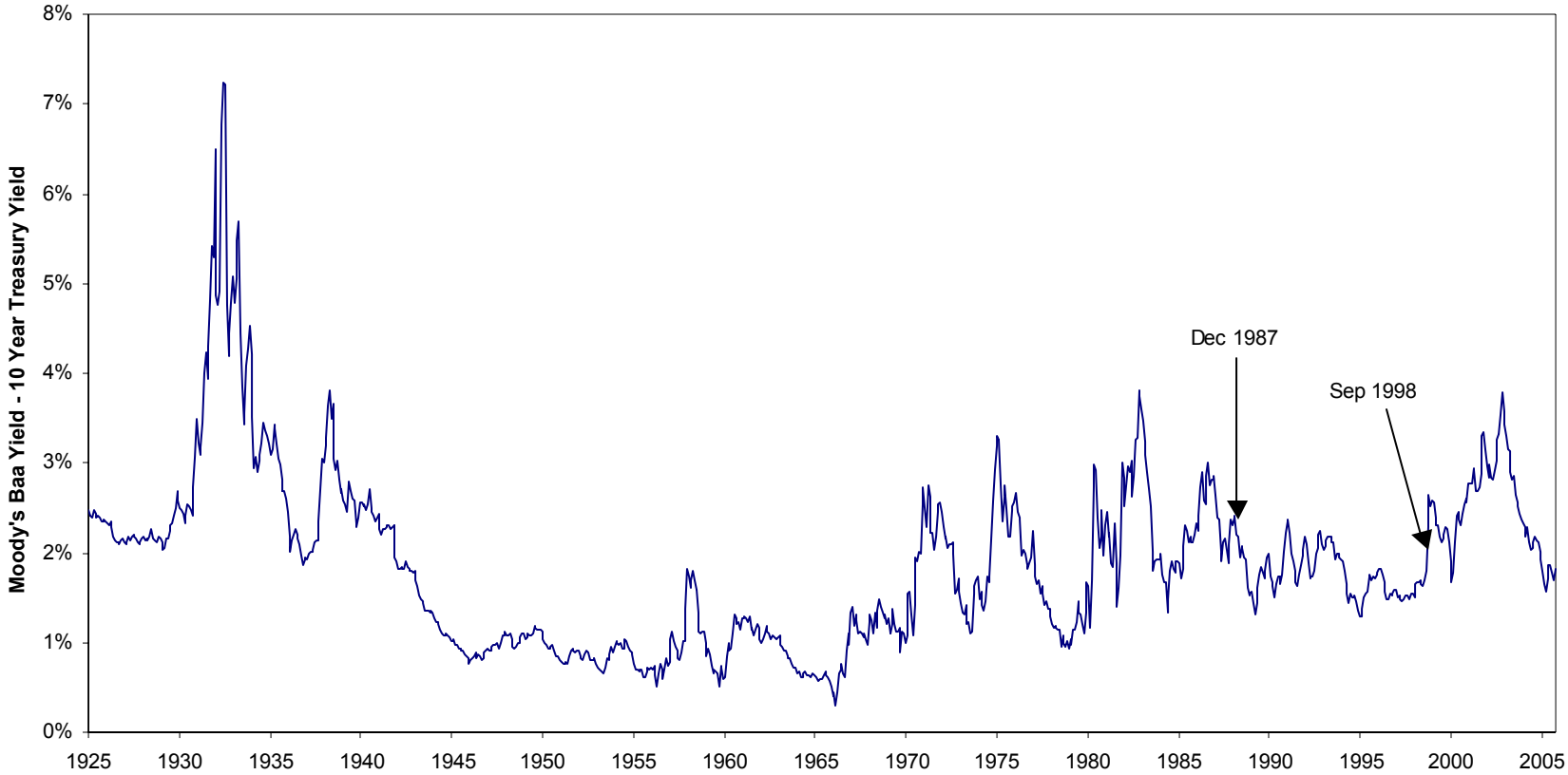
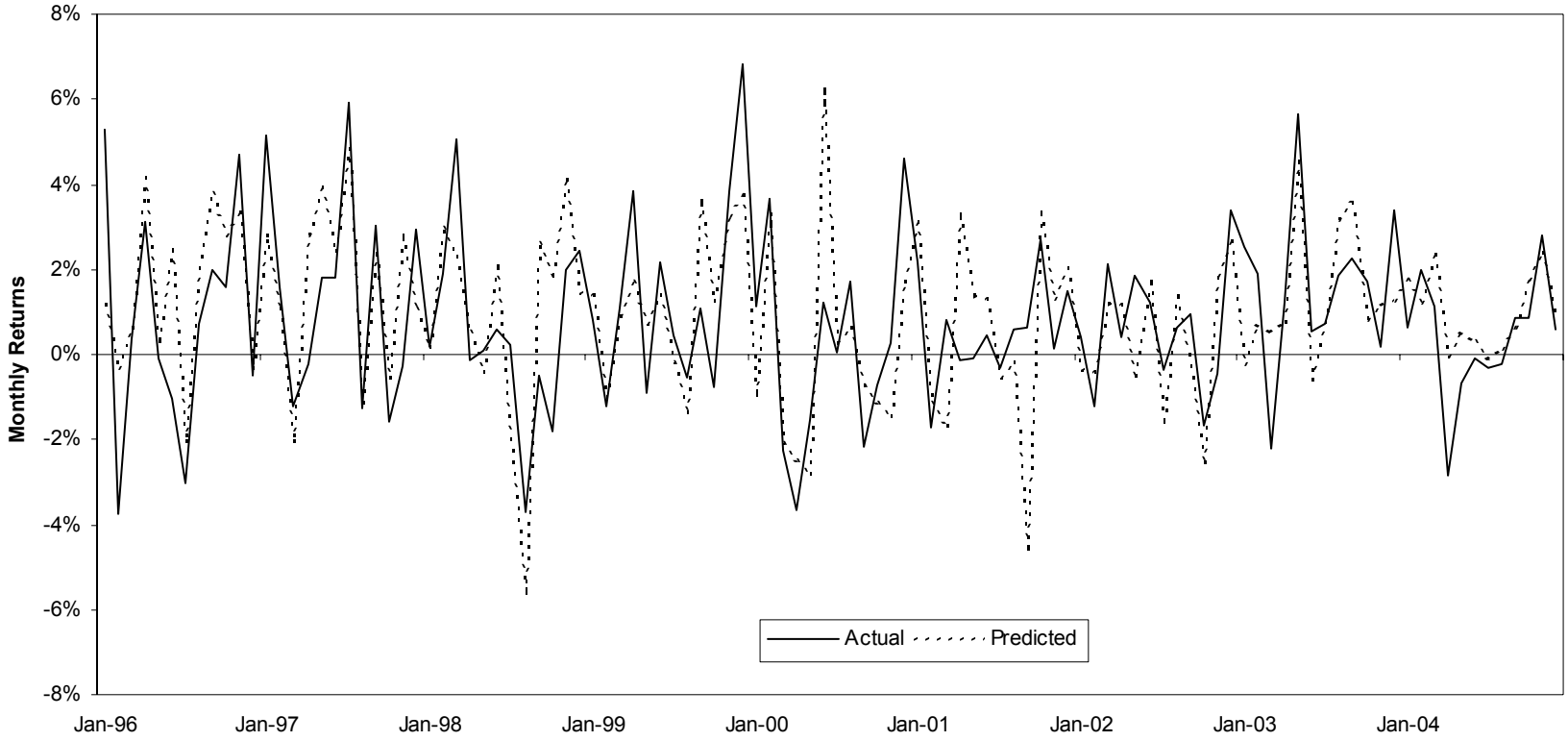


Figure 13. Actual & Predicted Returns of HFRI Macro Funds: 1996-2004



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