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**Hedge Fund Industry: Performance Measurement,  
Statistical Properties and Fund Characteristics**

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# **An Analysis of Hedge Fund Strategies: Survivorship Bias, Backfill Bias and Performance Persistence**

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## **Abstract**

In this paper, I study survivorship bias and backfill bias in hedge fund returns and performance persistence of various hedge fund strategies over eleven years period, from January 1994 to December 2006. Using both live and dead monthly net of all fee hedge fund return data, I estimate the magnitude of survivorship bias and backfill bias. Results of these two biases by investment styles indicate that biases are different across styles. For the full sample, I find an average survivorship bias of 2.49% per year, due mainly to higher attrition rate among market timing, equity non-hedge, equity market neutral, sector and regulation D hedge fund strategies. With respect to the backfill bias, I estimate an average bias of 1.04% per year for the full sample. I also find bias in estimates of the standard deviation, skewness and kurtosis of individual hedge fund returns. Using a multi-factor model of Fung and Hsieh (2004), the analysis of performance indicates that 42% of the hedge funds significantly outperformed the market during the whole sample period and magnitude of fund's excess returns differ with investment style. Finally, using parametric and non-parametric methods, the analysis of persistence over 1 year horizon indicates different degree of persistence depending on the hedge fund strategy. The results also indicate that both winners and losers hedge fund managers persist for the most of investment styles. This implies that investors can make their investment decision for the second year based on the performance of funds in the first year for the most of strategies.

## I. CONCLUSIONS

Using a large database of hedge funds, this study estimates the impact of survivorship bias and backfill bias on hedge fund returns and examines the performance persistence of each hedge fund strategy during the period January 1994 to December 2006. The following is our results:

First, I find that the degree of survivorship bias across mean and volatility of returns varies across investment styles. Strategies such as convertible arbitrage, distressed securities, equity hedge, even driven, market timing and relative value arbitrage have significant less survivorship bias, which reflects the relatively small difference in performance between surviving and defunct funds. This may be attributed to the small incidence of defunct funds among these strategies. Focusing only on surviving funds will overestimate the average hedge fund return by 2.49% per year. In addition, I extend on prior research by examining the impact of survivorship bias on higher moments (standard deviation, skewness and kurtosis). Results show that ignoring defunct funds may lead to a significant overestimation of the standard deviation and skewness as well as underestimation of the kurtosis of individual hedge fund returns. With respect to the backfill bias, the estimation indicates that this bias overestimate the average hedge fund return by 1.04% per year. The analysis of the higher moments show that this bias may lead to an underestimation of the standard deviation and kurtosis as well as overestimation of the skewness.

Summarizing, our results suggest that not taking into account these two biases will lead investors to overestimate the hedge fund returns.

Second, based on a sample that is relatively free of biases, I accurately examine the abnormal performance of hedge fund across each investment styles using the seven-factor model proposed by Fung and Hsieh (2004). This model consists of the three trend-following risk factors on bonds, currencies and commodities; two equity-oriented risk factors and two bond-oriented risk factors. For each fund in the sample, I regress the net-of-fee monthly excess return (in excess of the risk-free rate) on the excess returns earned by traditional buy-and-hold and primitive trend following strategies. I find a positive alpha for all investment styles. More specifically, out of 17 investment styles, 8 show significant evidence of superior hedge fund performance over the sample period. Summarizing, our results report that 42% of the hedge funds have added significant value during the entire sample period.

Finally, In order to test for performance persistence, I apply both parametric and non parametric methods. I investigate time horizon of 1 year because in light of notice and redemption periods the knowledge of short-term persistence of up to six months reported by nearly all authors does not add a great deal of value for investors. I carry out relevant tests on raw returns, alphas, and appraisal ratios to assess performance persistence. Following Agarwal and Naik (2000b), Alpha is defined as the return of a fund using a particular strategy minus the average return for all funds following the same strategy and appraisal ratio is defined as alpha divided by the residual standard deviation resulting from the regression of the hedge fund return on the average return of all funds using the same strategy. For most of the investment styles (convertible arbitrage, emerging markets, equity hedge, fixed income, equity market neutral, merger arbitrage, sector, etc...), I find that both contingency table and regression analysis show significant evidence of performance persistence in raw returns, alphas and appraisal ratios. In addition, I also find that there are differences in the level of persistence depending on the investment styles. I then follow Harri and Brorsen (2004) and conclude that persistence is related to the type of hedge fund strategy followed.

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## Appendix 1

### HFR Strategy Definitions

Convertible Arbitrage involves purchasing a portfolio of convertible securities, generally convertible bonds, and hedging a portion of the equity risk by selling short the underlying common stock. Certain managers may also seek to hedge interest rate exposure under some circumstances. Most managers employ some degree of leverage, ranging from zero to 6:1. The equity hedge ratio may range from 30 to 100 percent. The average grade of bond in a typical portfolio is BB-, with individual ratings ranging from AA to CCC. However, as the default risk of the company is hedged by shorting the underlying common stock, the risk is considerably better than the ranging of the unhedged bond indicates.

Distressed Securities strategies invest in, and may sell short, the securities of companies where the security’s price has been , or is expected to be, affected by a distressed situation. This may involve reorganizations, bankruptcies, distressed sales and other corporate restructurings. Depending on the manager’s style, investments may be made in bank debt, corporate debt, trade claims, common stock, preferred stock and warrants. Strategies may be sub-categorized as “high-yield” or “orphan equities”. Leverage may be used by some managers. Fund managers may run a market hedge using S&P put options or put options spreads.

Emerging Markets funds invest in securities of companies or the sovereign debt of developing or “emerging” countries. Investments are primarily long. “Emerging Market” include countries in Latin America, Eastern Europe, the former Soviet Union, Africa and parts of Asia. Emerging Markets – Global funds will shift their weightings among these regions according to market conditions and manager perspectives. In addition, some managers invest solely in individual regions. Emerging Markets – Asia involves investing in the emerging market of Asia. Emerging Markets – Eastern Europe/CIS funds concentrate their investment activities in the nations of Eastern Europe and the CIS (the former Soviet Union). Emerging Markets – Latina America is a strategy that entails investing throughout Central and South America.

Equity Hedge investing consists of a core holding of long equities hedged at all times with short sales of stocks and/or stock index options. Some manager maintain a substantial portion of assets within a hedged structure and commonly employ leverage. Where short sales are used, hedged assets may be comprised of an equal dollar value of long and short stock positions. Other variations use short sales unrelated to long holdings and/or puts on the S&P 500 index and put spreads. Conservative funds mitigate market risk by maintaining market exposure from zero to 100 percent. Aggressive fund may magnify market risk by exceeding

100 percent exposure and, in some instances, maintain short exposure. In addition to equities, some funds may have limited assets invested in other type of securities.

Equity Market Neutral investing seeks to profit by exploiting pricing inefficiencies between related equity securities, neutralizing exposure to market risk by combining long and short positions. One example of this strategy is to built portfolios made up of long positions in the strongest companies in several industries and taking corresponding short positions in those showing signs of weakness.

Equity Market Neutral: Statistical Arbitrage utilizes quantitative analysis of technical factors to exploit pricing inefficiencies between related equity securities, neutralizing exposure to market risk by combining long and short positions. The strategy is based on quantitative models for selecting specific stocks with equal dollar amounts comprising the long and short sides of the portfolio. Portfolios are typically structured to be market, industry, sector, and dollar neutral.

Equity Non-Hedge funds are predominately long equities although they have the ability to hedge with short sales of stocks and/or stock index options. These funds are commonly known as “stock-pickers”. Some funds employ leverage to enhance returns. When market conditions warrant, managers may implement a hedge in the portfolio. Funds may also opportunistically short individual stocks. The important distinction between equity non-hedge funds and equity hedge funds is equity non-hedge funds do not always have a hedge in place. In addition to equities, some funds may have limited assets invested in other types of securities.

Event-Driven is also known as “corporate life cycle” investing. This involves investing in opportunities created by significant transactional events, such as spin-offs, mergers and acquisitions, bankruptcy reorganizations, recapitalizations and share buybacks. The portfolio of some Event-Driven managers may shift in majority weighting between Risk Arbitrage and Distressed Securities, while others may take a broader scope. Instruments include long and short common and preferred stocks, as well as debt securities and options. Leverage may be used by some managers. Funds managers may hedge against market risk by purchasing S&P put options or put option spreads.

Fixed Income: Arbitrage is a market neutral hedging strategy that seeks to profit by exploiting pricing inefficiencies between related fixed income securities while neutralizing exposure to interest rate risk. Fixed Income Arbitrage is a generic description of a variety of strategies involving investment in fixed income instruments, and weighted in an attempt to eliminate or reduce exposure to change in the yield curve. Managers attempt to exploit relative mispricing between related sets of fixed income securities. The generic types of fixed income hedging trades include: yield-curve arbitrage, corporate versus Treasury yield spreads, municipal bond versus Treasury yield spreads and cash versus futures.

Fixed Income: Convertible Bonds funds are primarily long only convertible bonds. Convertible bonds have both fixed income and equity characteristics. If the underlying common stock appreciates, the convertible bond’s value should rise to reflect this increased value. Downside protection is offered because if the underlying common stock declines, the convertible bond’s value can decline only to the point where it behaves like a straight bond.

Fixed Income: Diversified funds may invest in a variety of fixed income strategies. While many invest in multiple strategies, others may focus on a single strategy less followed by most fixed income hedge funds. Areas of focus include municipal bonds, corporate bonds, and global fixed income securities.

Fixed Income: High-Yield managers invest in non-investment grade debt. Objectives may

range from high current income to acquisition of undervalued instruments. Emphasis is placed on assessing credit risk of the issuer. Some of the available high-yield instruments include extendible/reset securities, increasing-rate notes, pay-in-kind securities, step-up coupon securities, split-coupon securities, split-coupon securities and usable bonds.

Fixed Income: Mortgage-Backed funds invest in mortgage-backed securities. Many funds focus solely on AAA-rated bonds. Instruments include: government agency, government sponsored enterprise, private-label fixed- or adjustable-rate mortgage pass-through securities, fixed- or adjustable-rate collateralized mortgage obligations (CMOs), real estate mortgage investments conduits (REMICs) and stripped mortgage-backed securities (SMBSs). Funds may look to capitalize on security-specific mispricings. Hedging of prepayment risk and interest rate risk is common. Leverage may be used, as well as futures, short sales and options.

Macro involves investing by making leveraged bets on anticipated price movements of stock markets, interest rates, foreign exchange and physical commodities. Macro managers employ a “top-down” global approach, and may invest in any markets using any instruments to participate in expected market movements. These movements may result from forecasted shifts in world economies, political fortunes or global supply and demand for resources, both physical and financial. Exchange-traded and over-the-counter derivatives are often used to magnify these price movements.

Market Timing involves allocating assets among investments by switching into investments that appear to be beginning an uptrend, and switching out of investments that appear to be starting a downtrend. This primarily consists of switching between mutual funds and money markets. Typically, technical trend-following indicators are used to determine the direction of a fund and identify buy and sell signals. In an up move “buy signal”, money is transferred from a money market fund into a mutual fund in an attempt to capture a capital gain. In a down move “sell signal”, the assets in the mutual fund are sold and moved back into the money market for safe keeping until the next up move. The goal is to avoid being invested in mutual funds during a market decline.

Merger Arbitrage, sometimes called Risk Arbitrages, involves investment in event-driven situations such as leveraged buy-outs, mergers and hostile takeovers. Normally, the stock of an acquisition target appreciates while the acquiring company’s stock decreases in value. These strategies generate returns by purchasing stock of the company being acquired, and in some instances, selling short the stock of the acquiring company. Managers may employ the use of equity options as a low-risk alternative to the outright purchase or sale of common stock. Most Merger Arbitrage funds hedge against market risk by purchasing S&P put options or put option spreads.

Regulation D managers invest in Regulation D securities, sometimes referred to as structured discount convertibles. The securities are privately offered to the investment manager by companies in need of timely financing and the terms are negotiated. The terms of any particular deal are reflective of the negotiating strength of the issuing company. Once a deal is closed, there is a waiting period for the private shares offering to be registered with the SEC. The manager can only convert into private shares and cannot trade them publicly during this period; therefore their investment is illiquid until it becomes registered. Managers will hedge with common stock until the registration becomes effective and then liquidate the position gradually.

Relative Value Arbitrage attempts to take advantage of relative pricing discrepancies between instruments including equities, debt, options and futures. Managers may use mathematical, fundamental, or technical analysis to determine misvaluations. Securities may be mispriced relative to the underlying security, related securities, groups of securities, or the overall

market. Many funds use leverage and seek opportunities globally. Arbitrage strategies include dividend arbitrage, pairs trading, options arbitrage and yield curve trading.

Sector: Energy is a strategy that focuses on investment within the energy sector. Investments can be long and short in various instruments with funds either diversified across the entire sector or specializing within a sub-sector.

Sector: Financial is a strategy that invests in securities of bank holding companies, banks, thrifts, insurance companies, mortgage banks and various other financial services companies.

Sector: Healthcare/Biotechnology funds invest in companies involved in the healthcare, pharmaceutical, biotechnology, and medical device areas.

Sector: Metals/Mining funds invest in securities of companies primarily focused on mining, processing and dealing in precious metals and others commodities. Some funds may employ arbitrage strategies on a worldwide basis.

Sector: Real Estate involves investing in securities of real estate investments trusts (REITs) and other real estate companies. Some funds may also invest directly in real estate property.

Sector: Technology funds emphasize investment in securities of the technology arena. Some of the sub-sectors include multimedia, networking, PC producers, retailers, semiconductors, software, and telecommunications.

Short Selling involves the sale of a security not owned by the seller; a technique used to take advantage of an anticipated price decline. To effect a short sale, the seller borrows securities from a third party in order to make delivery to the purchaser. The seller returns the borrowed securities to the lender by purchasing the securities in the open market. If the seller can buy that stock back at a lower price, a profit results. If the price rises, however, a loss results. A short seller must generally pledge other securities or cash with the lender in an amount equal to the market price of the borrowed securities. This deposit may be increased or decreased in response to the changes in the market price of the borrowed securities.

# **The Risk-Adjusted Performance and Diversification**

## **Benefits of Funds of Hedge Funds**

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### **Abstract**

In this paper, I study the performance, risk, fund characteristics and diversification potential of 1188 funds of hedge funds (FOHFs) for the period from January 1995 to December 2005. Differing from previous studies that investigate FOHFs as a sub-strategy of the hedge fund universe, I separate these two groups as two distinctive investment classes. I find several interesting results. First, FOHFs and the four sub-strategies (conservative, diversified, market defensive and strategic) earn positive excess returns and a high Fung and Hsieh 7-factor alpha during the sample period. Second, FOHFs and the four sub-strategies underperform the hedge funds index on both a risk-adjusted and a non-adjusted basis. These results can be mainly explained by the double fee structure inherent in FOHFs. Third, the correlations between FOF indices and equity index (S&P500) are lower than correlations between hedge fund index and equity indices. Finally, the correlations of hedge fund index and FOF indices with equity index are different under different market conditions. In other words, hedge funds and FOHFs are positively correlated with the equity index in the bear markets but uncorrelated with the equity in the bull markets. Compared to hedge fund index, FOF indices have lower correlation with equity index in both bull and bear markets, indicating that FOHFs provide better diversification benefits than individual hedge funds. Adding traditional asset to investor's FOHF portfolio can provide better diversification benefits than individual hedge funds.

## I. CONCLUSIONS

In this paper, I employ a comprehensive database on fund of hedge funds and various hedge fund indices to investigate the issues of performance, risk, and diversification benefits in the hedge fund industry over the period 1995-2005. Unlike previous studies which only look at the aggregate universe of hedge fund investments, I distinguish FOHFs investment class from other alternative investment in order to study differences and similarities. The main conclusions can be summarized as follows:

First, FOF composite index and the four sub-strategies indices appear to underperform the hedge fund index on a risk-adjusted (performance is measured by both Sharpe ratio and Fung and Hsieh (2004) seven-factor model) and a non-adjusted basis (performance is measured by raw returns). This underperformance is mainly explained by the double fee structure inherent in FOHFs. This finding is in accordance with Goetzmann and Ibbotson (1999), Kat and Lu (2002) and Amin and Kat (2003).

Second, it is well documented in the literature that using FOHF data avoid many of the measurement biases, and this can also explains the poor performance of FOHF compared to hedge fund performance. In order to examine the survivorship bias of FOHFs, I use the two conventional measures. The first is based on the difference between mean returns on live and dead funds (see Ackermann et al., (1999)). The second is based on the difference between mean returns on live funds and all funds (see Liang (2000)). I find that focusing on live funds only will overestimate the average returns of FOHF by around 2.60% per year using the first measure and 0.69% per year using the second measure. In addition, there are substantial differences in returns and volatility between live and dead funds. For almost each year during the sample period, funds identified as dead have lower returns and higher volatility than live funds, confirming the findings of Brown et al., (1992). Since FOHFs are protected against bad performance by diversification, survivorship bias in FOHF and attrition rate tend to be relatively small. With respect to backfill bias, I use the standard methodology and delete the first twelve observations for each fund in the database. The yearly return of the portfolio that invests in all funds is 10.49%. Eliminating the first 12 months of returns for each fund reduces the return of about 0.68% per year. These values reveal that survivorship bias and backfill bias cause an upward bias in performance measurement results. However, there is no doubt that these funds continue to present attractive opportunities.

Finally, The correlation coefficients between FOF indices and equity indices are lower than correlations between the hedge fund index and equity indices. In addition, the correlation

structures in the bull markets are different from those in the bear markets. Hedge funds and FOF are highly correlated with the S&P500 index in the down markets. This may be explained by the lack of liquidity supply during market crisis. Intuitively, these results are not desirable for investors which need low correlation in the down markets to reduce the downside risk. However, I find that FOF indices offer considerably lower correlation with the S&P500 than hedge fund index in both bull and bear markets. Therefore, during the down markets, when FOHF and individual hedge fund are not well hedged, adding equity and bond to investor's FOHF portfolio may increase the diversification effect hence improve their risk-return trade-off. This indicates that FOHFs provide better diversification benefits than individual hedge funds.



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