

MOMENTS ANALYSIS IN RISK AND PERFORMANCE MEASUREMENT

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While hedge funds are well established in the United States and Europe, they have only begun to grow aggressively in Asia. The growth in Asian hedge funds requires a better understanding of their performance and risk, specifically the impact when such funds are included in the investors' portfolios.

In this paper, we will introduce a practical approach in analyzing the risk and performance of Asian hedge funds from the viewpoints of U.S. and Asia-Pacific based equity investors. We focus on the impact when we include Asian hedge funds in their portfolio and examine whether the inclusion helps to insulate the overall portfolio when the market is down, to capture the upside and to reduce the impact of market volatility during extreme events. An advantage of this approach is that it alleviates the problems that can arise if hedge fund returns are skewed and leptokurtic and non-linearly related to the market returns. Our approach also allows for a meaningful economic interpretation of the results.

Based on a sample of 75 individual Asian hedge funds from the Eureka hedge database, we found that while all funds provide diversification in the sense that they are not perfectly correlated with market index returns, only 41 or 55% of the funds are negatively correlated with the S&P 500 index returns in a down-market (defined as the lowest return quartile of the S&P 500). Our results also show that very few of the funds provide downside protection, upside capture and low volatility on the down-side. We conjecture that there is an implicit trade-off between our performance and risk measures that is an interesting question for future research.

Keywords: hedge funds; performance; risk.

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1. Introduction

In 1990, the entire hedge fund industry was estimated at about US\$20 billion. At of 2004, there are close to 7000 hedge funds worldwide, managing more than US\$830 billion. Additionally, about US\$200-300 billion is estimated to be in privately managed accounts. While high net worth individuals remain the main source of capital, hedge funds are becoming more popular among institutional and retail investors. Funds of hedge funds and other hedge fund-linked products are increasingly being marketed to the retail market.

While hedge funds are well established in the United States and Europe, they have only begun to grow aggressively in Asia. The Bank of Bermuda estimated that of hedge funds operating in Asia (including those in Japan and Australia), 30 were established in year 2000 and 20 in 2001. In 2003, 90 new hedge funds were started in Asia, compared with 66 in 2002. Currently estimated at more than US\$15 billion, hedge fund investments in Asia are expected to grow rapidly. Several factors support this view. Asian hedge funds currently account for a tiny slice of the global hedge fund pie and a mere trickle of the total financial wealth of high net worth individuals in Asia. The growth in Asian hedge funds requires a better understanding of their performance and risk, specifically the impact when such funds are included in the investors' portfolios.

In this paper, we will introduce a practical approach in analyzing the risk and performance of Asian hedge funds from the viewpoint of a U.S. and/or global equity investor. We will focus on the impact when we include Asian hedge funds to their portfolio and examine whether the inclusion helps to insulate the overall portfolio when the market is down, when the market is volatile and when the market is hit by extreme events. An advantage of this approach is that it alleviates the problems that can arise if hedge fund returns are skewed and leptokurtic and possibly non-linearly related to the market returns. Section 2 of this paper provides institutional features of Asian hedge funds. The analytical methodology is described in Section 3. Data description and results are provided in Section 4 and Section 5 concludes.

2. Asian Hedge Funds

The Asian hedge fund industry has been rapidly expanding. Being a relatively young market, fewer than 100 hedge funds have been in existence for more than a couple of years. In fact, according to one estimate (as reported in the GFIA website), only about 40 funds have been around for more than five years.) Based on data from the Eureka hedge funds database, the number of funds which invest predominantly in Asia have risen dramatically from around 75 in January of 1999 to around 520 in Dec 2004. This represents a 693% increase over a span of around five years. By size of funds under management, the breakdown is shown in Table 1.

Almost 80% of Asian hedge funds employ either Goldman Sachs or Morgan Stanley as their prime broker. In all, 58% charge management fees of 1- 1.5% and performance fees of 20%. About 14% have a hurdle rate, but all face a high water mark. Almost 70% are opened on a monthly basis for subscriptions and redemptions, and 28% require minimum investment of US\$1,000,000 or higher.

In this paper, we propose a practical approach to filter funds of hedge funds based on past returns. The approach takes into account the fact that even funds of hedge funds returns are possibly skewed and leptokurtic and non-linearly related to market returns. In the use of this approach, investors are assumed to have sophisticated preferences – i.e., they like downside protection, whilst looking for yield enhancement.

3. Investing in Hedge Funds – A Practical Approach

The main motivation for our approach is the finding that hedge funds including funds of hedge funds exhibit non-normal returns and these returns are also non-linearity related to market returns. In particular, the correlation between hedge fund returns and market returns differs under different market conditions.

Traditional asset allocation optimizes the use of equities, bonds, real estate and private equity to invest in a portfolio that maximizes returns and minimizes the portfolio risk. Thus, hedge funds become a natural candidate for enhancing returns in an investment portfolio. Moreover, in a bear market, many investment managers find it uninteresting to merely beat the market index, which may have negative returns. They generally prefer to go short or avoid long positions to have positive returns. Investing in appropriately chosen hedge funds can provide the possibility of obtaining positive “absolute returns”.

It is also generally believed that hedge funds have returns that are generally uncorrelated with the traditional asset classes. In fact, hedge funds may even have a lower risk profile. For example, Morgan Stanley Dean Witter (November 2000, page 1) reported that hedge funds “exhibit a low correlation with traditional asset classes, suggesting that hedge funds should play an important role in strategic asset allocation”.

3.1. Mean, Variance, Skewness and Kurtosis

Due to the type of strategies employed by hedge fund managers, there is strong evidence that hedge fund returns and hedge fund indices returns are not normally distributed. Typically, hedge fund investments are based on absolute return strategies. They are expected to deliver performance regardless of market conditions. To do so, hedge fund managers use two main approaches to achieve absolute return targets: (a) directional (or market timing) and (b) non-directional approaches.

The directional approach dynamically bets on the expected directions of the markets. Funds will invest long or sell-short securities to capture gains from their advance and decline. In contrast, the non-directional approach attempts to extract value from a set of embedded arbitrage opportunities within and across securities. The non-directional approach typically exploits structural anomalies in the financial market.

Mean-variance analysis is appropriate when returns are normally distributed or investors’ preferences are quadratic. The reliability of mean-variance analysis therefore depends on the degree of non-normality of the returns data and the nature of the (non-quadratic) utility function. While the utility function may not be a serious problem, the non-normal distribution of returns presents an issue.

According to Fung and Hsieh (1999a), “... when returns are not normally distributed (as it is the case for hedge funds), the first two moments (i.e. mean and standard deviation) are not sufficient to give an accurate probability.” Fung and Hsieh found that hedge fund returns are leptokurtic or fat-tailed. One likely explanation is that net returns include spreads that are distributed with fat tails.

Many hedge fund indices exhibit relatively low skewness and high kurtosis, especially in the case of funds investing in convertible arbitrage, risk arbitrage and distressed securities. Brooks and Kat (2001) found that hedge fund index returns are not normally distributed. They argued that while hedge funds may offer relatively high means and low variances, such funds give investors third and fourth moment attributes that are exactly the opposite to those that are desirable. Investors obtained a better mean and a lower variance in return for more *negative skewness* and ***higher kurtosis***.

In sum, the dynamic trading strategies of hedge funds render traditional mean-variance measures meaningless. While some hedge funds may have low standard deviations, this does not mean they are relatively “riskless”. In fact, they harbor skewness and kurtosis, which makes them “risky”.

3.2. *Correlation of Returns*

Fung and Hsieh (1997) examined the returns of hedge funds and commodity trading advisers. They found that hedge fund managers and commodity trading advisers generate returns that have low correlations to the returns of mutual funds and standard asset classes. This is the benefit often cited by portfolio managers in their choice of hedge funds as an “alternative investment”. Having an additional asset with a low or negative correlation permits the diversification of risk in a means-variance environment. However, there are complications that arise in the case of hedge funds where correlation based diversification may not be valid.

Fung and Hsieh (2001) stated that “... Risk management in the presence of dynamic trading strategies is also more complex.” Hedge fund managers have a great deal of freedom to generate returns that are uncorrelated with those of other asset classes. But, this freedom comes at a price. Dynamic trading strategies predispose hedge funds to extreme or tail events. Thus, correlations may come at a cost. They cautioned that “periodically the portfolio can become overly concentrated in a small number of markets” and market exposures converge. This would lead to an “implosion” due to diversification.

Lavino (2000, p177) argued that many hedge funds are not *consistently* and *continuously* negatively or poorly correlated with other asset classes over time. Hedge funds also may not have meaningful standard deviations. In fact, many hedge funds have distributions with fat-tails, and so normality assumptions on the distribution of hedge fund returns are generally not correct. This means it is not appropriate that the use of correlation as a gauge to execute portfolio diversification.

Lo (2001) reinforced this view. He explained that many investors participate in hedge funds to diversify their returns, as hedge fund returns seem uncorrelated with market indexes such as the S&P 500. However, uncorrelated events can become synchronized in a crisis, with correlation changing from 0 to 1 overnight. These situations are examples of “phase-locking” behavior encountered in physical and natural science.

Given the statistical characteristics of hedge fund returns, risk and performance measurement of hedge funds are problematic giving rise to problems in choosing hedge funds and understanding the impact when hedge funds are included in a portfolio of assets. Given the significant higher moments and nonlinear relation between hedge fund and market index returns, one possible approach is to employ non-linear estimation methods. One major problem to use of such non-linear approaches is the choice of band-width (See Hardle (1991) for a discussion) so that estimates can be carried out assuming linearity over each band-width. In our case, we will use a more practical approach that can be help in interpretation of the result and

simplify the use of the findings by practitioners. We begin by defining how an investor may select a hedge fund manager. When including a hedge fund asset to a portfolio of indexed equities, we ask the following questions:

- (i) How would including hedge funds in a portfolio insulate it when the market is down and how well is the upside captured when the market is up?
- (ii) How would including hedge funds in a portfolio impact the volatility of a portfolio, when market (index) is up or down?

Investors can rank hedge funds based on these returns and risk criteria in their selection of funds. Based on the returns and risk preferences as well as the securities in their portfolio, they may select funds that help insulate their returns when markets are hit by extreme and volatile events, whilst providing capture of the market on the upside.

Mathematically, we can translate these questions in terms of the first moments between index returns and fund returns and the cross moments between index returns and fund volatility. In the first moments analysis, investors desire hedge fund returns to be positive when the market is down. We will coin this situation – *downside protection*. Further, it is also desirable that hedge fund returns are positively correlated with the market when the market is up. We will call this situation – *upside capture*. Koh, Lee and Phoon (2004) coined the joint outcome as “returns-enhancing diversification. In this paper, the funds that provide “downside protection” and “upside capture” satisfy the first moments criteria.

	Market Up	Market Down
Fund Up	Positive (Desired)	Negative (Desired)
Fund Down	Negative	Positive

For the cross moments analysis, we examine the volatility of the hedge funds in relation to the returns of the market indices. Investors would prefer the following outcomes.

	Market Up	Market Down
Fund Volatility Up	Positive (Desired)	Negative
Fund Volatility Down	Negative	Positive (Desired)

Explicitly, if cross moments are mainly positive for the hedge funds, it means that when the market is down, the volatility of the fund returns is also low and vice versa. When the market is up, increased volatility of the hedge funds’ returns is better tolerated, whilst reduced volatility is desired when markets are down, as investors are unlikely to tolerate increased likelihood of sharp losses in the hedge funds returns during such times. Funds that reduce volatility when the market is down and vice versa when the market is up satisfy the cross moments criteria.

4. Data Description, Empirical Analysis and Results

For our analysis, we only included funds that have a global mandate and that have complete ten years of data (January 1995 to December 2004). As a result, we analyzed 75 Asian hedge funds. Of the hedge funds included in the Asia Hedge Fund Directory of Eureka Hedge, 57% are domiciled in Cayman Islands, while 15% are situated in the British Virgin Islands. The estimated geographical distribution of the Asia-Pacific hedge funds is shown in Table 1. Most of the decision-makers of the funds are located in a number of Asian cities, with Australia, Singapore, and

increasingly China being the preferred locations. Depending on their investment strategies, hedge fund managers may concentrate on one financial market, or a couple of the most liquid markets.

Table 1. Geographical Distribution of Asian Hedge Funds Managers

Country	Distribution (%)
Australia	15
Hong Kong	16
Japan	9
Korea	1
Malaysia	1
Singapore	11
Thailand	1
United Kingdom	23
United States	18

Source: EurekaHedge, 31 December 2004

Table 2 presents a breakdown of the hedge fund strategies employed by 75 hedge funds that had been in existence from January 2000 to August 2004. The long-short equities strategy is the dominant strategy employed by Asian hedge funds, accounting for 58% in our sample.

Table 2. Strategy Classification of Asian Hedge Fund Managers

Strategy Classification	Distribution (%)
CTA	40
Multi-strategy	35
Long/Short Equities	21
Macro	6
Arbitrage	6
Distressed Debt	1
Relative Value	1

Source: EurekaHedge

Traditional U.S. based fund managers and investors may use the S&P 500 as the equity benchmark. For fund manager with an Asian focus, performance may be measured relative to a regional benchmark constructed by Morgan Stanley, like the MSAUCPI.

Table 3 provides summary statistics for skewness and kurtosis as well as test statistics of linearity with market returns for individual hedge funds. It shows that many funds of hedge funds returns are skewed and leptokurtic, non-normal and are not linearly related to the market index returns. Further, though for several funds where the linear relation with S&P 500 cannot be rejected, we reject a linear relation with the MSAUCPI.

To examine the use of our selection criteria, the market index returns were ranked according to the monthly performance. The highest positive index returns months was ranked first followed by the second highest. The hedge fund returns are then matched in that same order. The ranked sample was then divided into four parts: The first quartile being the “up” market, the second and third being “stable” markets and the last, the “down” market.

Effectively, we have pre-selected the estimation “band-width” by defining the selection objective of investors.

Table 3. Skewness, Kurtosis & Normality of Funds of Hedge Funds Returns & Test of Linearity between Hedge Fund Returns and S&P500 and MSAUCPI returns

Hedge Funds	Skewness ¹	Kurtosis	Jarque Bera Test of Normality ²	Linearity Test With S&P ³	Linearity Test With MSAUCPI
HF01	-0.017 (0.958)	-0.503 (0.471)	0.593 (0.743)	3.243 (0.047)	1.001 (0.375)
HF02	0.102 (0.761)	-0.267 (0.702)	0.264 (0.876)	1.074 (0.349)	0.309 (0.735)
HF03	-0.734 (0.029) ⁴	1.962 (0.005)	14.006 (0.001)	0.056 (0.945)	2.175 (0.124)
HF04	-0.949 (0.005)	2.428 (0.001)	22.162 (0.000)	0.155 (0.857)	1.236 (0.299)
HF05	0.554 (0.100)	0.391 (0.575)	3.220 (0.200)	0.778 (0.467)	0.405 (0.669)
HF06	-0.336 (0.319)	1.920 (0.006)	9.656 (0.008)	6.814 (0.002)	0.240 (0.787)
HF07	0.406 (0.227)	0.302 (0.665)	1.753 (0.416)	0.002 (0.998)	1.127 (0.332)
HF08	-0.130 (0.698)	0.261 (0.708)	0.318 (0.853)	0.532 (0.590)	4.051 (0.023)
HF09	3.009 (0.000)	15.609 (0.000)	653.03 (0.000)	0.121 (0.886)	0.324 (0.725)
HF10	-0.223 (0.507)	0.209 (0.764)	0.567 (0.753)	0.115 (0.891)	0.153 (0.858)
HF11	-0.040 (0.905)	0.125 (0.858)	0.051 (0.975)	0.225 (0.799)	0.445 (0.643)
HF12	0.450 (0.181)	0.248 (0.723)	2.031 (0.362)	0.184 (0.832)	6.285 (0.004)
HF13	2.534 (0.000)	10.880 (0.000)	336.16 (0.000)	0.069 (0.933)	0.114 (0.893)
HF14	-0.612 (0.069)	1.156 (0.097)	6.616 (0.037)	1.860 (0.166)	4.847 (0.012)
HF15	0.031 (0.928)	0.044 (0.950)	0.013 (0.993)	0.147 (0.863)	0.256 (0.775)
HF16	0.042 (0.900)	-0.756 (0.279)	1.349 (0.510)	1.723 (0.189)	1.936 (0.154)
HF17	-1.601 (0.000)	5.048 (0.000)	83.388 (0.000)	0.533 (0.590)	11.986 (0.000)
HF18	-1.548 (0.000)	7.494 (0.000)	153.38 (0.000)	3.790 (0.029)	0.628 (0.538)
HF19	-0.642 (0.057)	0.233 (0.738)	3.969 (0.137)	4.204 (0.020)	0.205 (0.816)
HF20	-0.046 (0.891)	0.431 (0.537)	0.452 (0.798)	0.130 (0.878)	0.316 (0.730)
HF21	0.321 (0.340)	-0.127 (0.855)	0.998 (0.607)	1.129 (0.331)	0.764 (0.471)
HF22	1.268 (0.000)	4.213 (0.000)	56.432 (0.000)	2.607 (0.083)	0.092 (0.912)
HF23	0.607 (0.071)	0.228 (0.744)	3.559 (0.169)	0.653 (0.524)	0.622 (0.541)
HF24	1.493 (0.000)	3.580 (0.000)	50.724 (0.000)	2.073 (0.136)	11.635 (0.000)
HF25	-0.534 (0.112)	1.727 (0.013)	9.623 (0.008)	0.783 (0.462)	4.642 (0.014)
HF26	0.652 (0.053)	1.660 (0.017)	10.399 (0.006)	0.365 (0.696)	2.557 (0.087)
HF27	-0.650 (0.053)	0.985 (0.158)	6.210 (0.045)	0.461 (0.633)	0.717 (0.493)
HF28	-0.265 (0.431)	-0.296 (0.672)	0.859 (0.651)	2.705 (0.076)	9.228 (0.000)
HF29	0.053 (0.875)	-0.160 (0.818)	0.086 (0.957)	0.056 (0.946)	1.216 (0.305)
HF30	0.692 (0.040)	2.406 (0.001)	17.976 (0.000)	2.785 (0.071)	0.011 (0.989)
HF31	0.571 (0.090)	1.064 (0.127)	5.682 (0.058)	1.879 (0.163)	0.145 (0.865)
HF32	0.163 (0.629)	-0.133 (0.848)	0.288 (0.866)	0.326 (0.723)	1.419 (0.251)
HF33	0.444 (0.187)	3.170 (0.000)	25.291 (0.000)	0.987 (0.379)	2.408 (0.010)
HF34	0.125 (0.710)	1.580 (0.024)	5.967 (0.051)	0.210 (0.811)	0.678 (0.512)
HF35	-0.390 (0.246)	1.116 (0.110)	4.323 (0.115)	0.802 (0.454)	0.364 (0.696)
HF36	-0.345 (0.305)	0.743 (0.287)	2.397 (0.302)	0.726 (0.489)	1.215 (0.305)
HF37	0.348 (0.300)	3.538 (0.000)	30.346 (0.000)	1.541 (0.223)	0.933 (0.400)
HF38	0.259 (0.442)	-0.080 (0.908)	0.639 (0.727)	0.562 (0.573)	0.327 (0.723)
HF39	-0.436 (0.195)	0.047 (0.946)	1.778 (0.411)	1.371 (0.262)	0.572 (0.568)
HF40	-0.322 (0.338)	0.071 (0.919)	0.982 (0.612)	2.961 (0.061)	1.160 (0.321)
HF41	0.612 (0.069)	4.050 (0.000)	41.754 (0.000)	1.871 (0.164)	0.707 (0.498)

Table 3 (Continued). Skewness, Kurtosis & Normality of Funds of Hedge Funds Returns & Test of Linearity between Hedge Fund Returns and S&P500 and MSAUCPI returns

Hedge Funds	Skewness	Kurtosis	Jarque Bera Test of Normality	Linearity Test With S&P	Linearity Test With MSAUCPI
HF42	0.736 (0.029)	1.950 (0.005)	13.932 (0.000)	0.723 (0.490)	3.662 (0.033)
HF43	-1.010 (0.003)	1.725 (0.013)	16.458 (0.000)	1.998 (0.146)	2.608 (0.083)
HF44	2.001 (0.000)	6.898 (0.000)	148.38 (0.000)	2.813 (0.069)	0.613 (0.546)
HF45	-0.288 (0.392)	2.109 (0.003)	11.149 (0.004)	1.651 (0.202)	1.551 (0.222)
HF46	0.988 (0.003)	1.428 (0.041)	13.866 (0.001)	2.533 (0.089)	2.351 (0.105)
HF47	0.246 (0.465)	0.247 (0.723)	0.705 (0.703)	0.023 (0.978)	3.803 (0.029)
HF48	1.333 (0.000)	1.646 (0.018)	22.915 (0.000)	0.806 (0.452)	0.717 (0.493)
HF49	2.475 (0.000)	9.878 (0.000)	280.72 (0.000)	1.658 (0.200)	0.049 (0.952)
HF50	0.039 (0.907)	-0.010 (0.989)	0.015 (0.992)	0.540 (0.586)	0.094 (0.910)
HF51	-0.306 (0.363)	-0.435 (0.533)	1.315 (0.518)	0.835 (0.439)	0.408 (0.667)
HF52	0.156 (0.642)	0.171 (0.807)	0.296 (0.863)	0.805 (0.453)	0.147 (0.864)
HF53	0.452 (0.179)	0.937 (0.179)	3.952 (0.139)	0.019 (0.981)	1.024 (0.366)
HF54	-0.254 (0.450)	-0.252 (0.718)	0.752 (0.687)	0.931 (0.401)	0.084 (0.919)
HF55	0.118 (0.725)	0.224 (0.749)	0.247 (0.884)	0.916 (0.406)	0.166 (0.848)
HF56	0.305 (0.364)	0.690 (0.323)	1.979 (0.372)	0.270 (0.764)	2.701 (0.077)
HF57	1.013 (0.003)	3.323 (0.000)	35.348 (0.000)	0.376 (0.689)	4.966 (0.011)
HF58	0.531 (0.114)	-0.036 (0.958)	2.639 (0.267)	0.061 (0.941)	0.186 (0.831)
HF59	0.065 (0.847)	0.649 (0.352)	1.023 (0.600)	0.766 (0.470)	1.377 (0.261)
HF60	0.529 (0.116)	0.676 (0.333)	3.678 (0.159)	4.227 (0.020)	0.181 (0.834)
HF61	0.762 (0.024)	2.808 (0.000)	23.817 (0.000)	0.631 (0.536)	1.779 (0.179)
HF62	0.400 (0.234)	-0.309 (0.658)	1.715 (0.424)	2.642 (0.081)	1.661 (0.200)
HF63	0.220 (0.512)	-0.248 (0.722)	0.597 (0.742)	4.162 (0.021)	0.362 (0.698)
HF64	0.091 (0.787)	0.149 (0.831)	0.129 (0.938)	3.937 (0.026)	1.200 (0.309)
HF65	0.019 (0.954)	0.386 (0.580)	0.350 (0.839)	4.191 (0.021)	1.765 (0.181)
HF66	-0.290 (0.389)	1.600 (0.022)	6.755 (0.034)	4.558 (0.015)	0.756 (0.475)
HF67	0.427 (0.205)	-0.389 (0.577)	2.051 (0.359)	0.157 (0.855)	0.635 (0.534)
HF68	-0.785 (0.020)	7.157 (0.000)	125.29 (0.000)	2.329 (0.107)	2.434 (0.098)
HF69	-0.870 (0.010)	1.594 (0.022)	12.996 (0.002)	6.005 (0.005)	1.007 (0.372)
HF70	1.821 (0.000)	5.809 (0.000)	109.71 (0.000)	0.951 (0.393)	6.921 (0.002)
HF71	1.020 (0.002)	9.420 (0.000)	216.78 (0.000)	2.706 (0.076)	1.294 (0.283)
HF72	0.214 (0.524)	2.115 (0.002)	10.871 (0.004)	1.046 (0.359)	0.380 (0.686)
HF73	0.035 (0.916)	0.208 (0.765)	0.113 (0.945)	1.935 (0.155)	0.167 (0.847)
HF74	0.159 (0.636)	-0.298 (0.669)	0.444 (0.801)	2.025 (0.142)	3.864 (0.027)
HF75	-0.123 (0.716)	-0.425 (0.542)	0.562 (0.755)	0.532 (0.591)	0.786 (0.461)

¹ Level of significance in parenthesis

² Jarque-Bera is a test for normality based upon the skewness and kurtosis measures combined.

³ Estimated using a cubic equation as in Tsay (1989). Statistic is distributed F(2,52).

⁴ Shaded cells (at 10% level of significance)

We present the first moments and cross moments results for each fund of hedge funds with the S&P 500 in Table 4. Based on our criteria, we desire a fund that has negative first moment and positive cross moment in down markets (4th quartile) to provide protection or reduce likelihood of large losses on the downside and a fund that has positive first moment and positive cross moment in up markets (1st quartile) for capturing or have increased likelihood of capturing the upside.

TABLE 4. First Moments and Cross Moments of Asian Hedge Funds with S&P500

Hedge Funds	First Moment (1 st quartile)	First Moment (4 th quartile)	Cross Moment (1 st quartile)	Cross Moment (4 th quartile)
HF01	0.025	0.553	-0.086	0.386
HF02	-0.473	0.009	-0.544	0.085
HF03	-0.234	0.212	0.037	-0.176
HF04	-0.096	-0.299	-0.162	0.503
HF05	-0.488	0.561	-0.447	0.451
HF06	-0.314	-0.548	0.421	0.566
HF07	0.200	0.114	0.331	-0.077
HF08	-0.199	0.209	-0.108	-0.155
HF09	0.077	-0.272	-0.318	0.459
HF10	0.112	0.120	0.205	-0.210
HF11	-0.086	-0.066	-0.285	-0.400
HF12	-0.074	0.253	0.048	-0.103
HF13	-0.214	0.202	0.065	0.221
HF14	-0.335	-0.425	0.454	-0.316
HF15	-0.022	-0.045	0.047	0.162
HF16	0.034	0.248	0.250	-0.307
HF17	0.500	0.271	0.405	-0.227
HF18	-0.498	-0.194	0.506	0.460
HF19	-0.582	0.263	0.475	-0.070
HF20	0.406	0.331	0.460	-0.129
HF21	0.176	0.284	0.179	-0.263
HF22	0.412	0.301	0.472	0.149
HF23	-0.416	-0.293	-0.145	-0.121
HF24	-0.123	0.444	-0.410	0.477
HF25	0.533	-0.261	0.127	-0.027
HF26	-0.138	0.276	0.324	0.164
HF27	-0.195	0.202	0.175	0.060
HF28	0.353	-0.668	0.405	-0.732
HF29	0.086	0.242	0.068	-0.121
HF30	-0.528	-0.427	0.376	0.281
HF31	-0.220	-0.394	-0.041	0.517
HF32	-0.044	-0.001	0.027	0.129
HF33	0.040	0.093	-0.134	0.000
HF34	0.196	0.057	0.212	0.031
HF35	0.273	-0.126	0.177	0.433
HF36	0.154	-0.174	0.275	0.312
HF37	0.291	-0.244	0.502	-0.081
HF38	-0.009	-0.186	0.172	0.384
HF39	-0.222	-0.321	-0.070	-0.071
HF40	-0.236	-0.111	-0.207	0.311
HF41	-0.668	0.653	-0.596	0.422

TABLE 4 (Continued). First Moments and Cross Moments of Asian Hedge Funds with S&P500

Hedge Funds	First Moment (1 st quartile)	First Moment (4 th quartile)	Cross Moment (1 st quartile)	Cross Moment (4 th quartile)
HF42	-0.055	0.056	-0.206	0.465
HF43	-0.586	-0.277	-0.320	0.521
HF44	0.112	-0.111	0.288	-0.157
HF45	0.156	-0.392	-0.261	0.449
HF46	-0.336	-0.362	0.320	0.381
HF47	-0.114	-0.252	0.040	-0.031
HF48	-0.147	-0.160	-0.117	0.308
HF49	-0.155	-0.309	-0.088	0.157
HF50	-0.495	0.026	-0.398	-0.038
HF51	-0.480	-0.020	-0.437	0.030
HF52	0.522	0.310	0.452	-0.586
HF53	0.400	0.693	0.333	-0.682
HF54	-0.147	0.347	-0.287	-0.347
HF55	-0.163	-0.004	-0.410	0.502
HF56	-0.280	0.280	-0.062	-0.182
HF57	0.108	-0.373	0.343	-0.183
HF58	-0.087	-0.273	-0.558	0.003
HF59	-0.587	0.087	-0.439	-0.080
HF60	-0.234	0.019	-0.136	0.149
HF61	-0.365	-0.064	-0.247	0.130
HF62	-0.656	0.105	-0.279	-0.098
HF63	-0.280	-0.428	0.125	0.482
HF64	-0.205	-0.489	0.433	0.349
HF65	-0.214	-0.184	0.055	0.390
HF66	0.320	0.213	0.422	0.462
HF67	0.320	0.204	0.346	-0.107
HF68	-0.430	-0.511	-0.275	0.523
HF69	-0.479	-0.579	0.467	0.571
HF70	0.317	-0.693	0.441	0.570
HF71	0.311	0.285	0.482	-0.173
HF72	-0.326	-0.103	-0.422	0.009
HF73	-0.476	-0.021	-0.409	-0.170
HF74	-0.450	-0.225	-0.339	0.362
HF75	-0.251	-0.041	-0.339	0.467

In Table 5, we present the first moments and cross moments results for each Asian hedge funds with S&P 500. Based on our criteria, we desire a fund that has negative first moments and positive cross moments (4th quartile) to provide downside protection and a fund that has positive first moments (1st quartile) and positive cross moments (1st quartile) for capturing or the improved likelihood in capturing the upside.

In Table 6, we segregate the individual hedge funds according to investment strategy. A count of the number of funds that showed the “desired” correlation profile each investment strategy is provided. About half of the funds satisfied the first moments criteria on the downside and cross moments criteria on both the up and downside. However, but only one-third of the funds showed the ability to capture the upside. Our results showed that for U.S. investors holding the S&P 500, Asian hedge funds provided downside protection but not necessarily upside capture. We next ranked the individual hedge funds based on the three

criteria previously discussed. More than 90% of the funds meet at least one criterion and 3 funds met all four criteria.

Table 5. Number of Funds meeting Moments criteria with S&P 500

Investment Strategy	Number of Funds	Funds with First moment (4th quartile)<0	Funds with First moment (1st quartile)>0	Funds with Cross Moment >0 (1st quartile)	Funds with Cross Moment >0 (4th quartile)
Distressed Debt	5	0	3	3	2
Long / Short Equities	44	27	16	24	26
Event Driven	1	1	0	0	1
Multi-Strategy	8	2	3	6	4
CTA	4	2	1	2	2
Other	1	0	0	1	0
Fixed Income	2	2	0	1	1
Relative Value	6	4	2	3	4
Macro	3	3	0	0	3
Convertible Arbitrage	1	0	1	1	1
Total	75	41	26	41	44

	Number of Funds	Percent
Meet zero criterion	6	8%
Meet one criterion	13	17%
Meet two criteria	32	43%
Meet three criteria	21	28%
Meet all criteria	3	4%
Total	75	100%

Tables 6 and 7 present the first moments and cross moments of each Asian hedge fund with the MSAUCPI and the number of funds meeting the various criteria. As a different market index is used (one that is a proxy for global investing) the results for funds meeting the moments criteria did differ from the case when the S&P500 was used. We obtained more instances of funds meeting all four criteria when MSCI World is used compared with the case using the S&P 500 – perhaps reflecting the Asian mandate of the funds. We also found that funds that provided the desired first and cross moment criteria do differ when MSCI World is used rather the S&P500 index. From these finding, the choice of indices used can impact the results obtained.

TABLE 6. First Moments and Cross Moments of Asian Hedge Funds with MSAUCPI

Hedge Funds	First Moment (1 st quartile)	First Moment (4 th quartile)	Cross Moment (1 st quartile)	Cross Moment (4 th quartile)
HF01	-0.303	0.118	-0.289	0.234
HF02	0.328	0.387	0.193	0.199
HF03	-0.206	0.166	-0.328	-0.041
HF04	0.527	0.218	0.305	-0.068
HF05	0.148	-0.169	0.317	-0.054
HF06	0.059	-0.059	0.566	-0.113
HF07	-0.080	0.377	-0.212	-0.069
HF08	-0.106	0.178	-0.019	-0.664
HF09	-0.293	-0.222	-0.056	-0.337
HF10	0.047	0.051	-0.050	0.363
HF11	-0.237	0.172	-0.175	0.274
HF12	0.688	0.255	0.608	-0.237
HF13	-0.339	-0.141	-0.154	0.182
HF14	0.021	-0.495	0.016	-0.116
HF15	-0.019	0.043	0.037	0.083
HF16	0.034	0.315	0.012	-0.517
HF17	0.256	0.667	0.330	-0.756
HF18	0.028	0.337	0.218	-0.114
HF19	0.027	0.240	0.288	-0.069
HF20	-0.049	-0.032	-0.089	-0.482
HF21	0.279	-0.100	0.276	0.079
HF22	-0.013	-0.229	0.045	-0.362
HF23	-0.077	-0.029	-0.394	-0.078
HF24	0.680	0.025	0.583	0.074
HF25	0.667	0.308	0.598	-0.173
HF26	0.210	0.283	0.170	-0.155
HF27	-0.162	0.212	-0.276	0.082
HF28	0.535	-0.016	0.260	0.092
HF29	-0.037	-0.046	0.040	0.196
HF30	-0.185	-0.103	0.121	-0.011
HF31	0.023	0.055	0.193	-0.132
HF32	0.169	-0.063	-0.078	0.091
HF33	-0.463	-0.294	-0.384	-0.342
HF34	-0.120	-0.171	-0.157	-0.359
HF35	0.082	0.182	0.160	-0.048
HF36	-0.245	0.244	-0.129	-0.148
HF37	0.228	0.011	0.181	-0.151
HF38	0.299	0.142	0.299	0.151
HF39	-0.284	0.332	-0.284	0.337
HF40	-0.052	0.259	-0.052	0.310
HF41	-0.185	-0.025	-0.185	0.395

TABLE 6 (Continued). First Moments and Cross Moments of Asian Hedge Funds with MSAUCPI

Hedge Funds	First Moment (1 st quartile)	First Moment (4 th quartile)	Cross Moment (1 st quartile)	Cross Moment (4 th quartile)
HF42	0.436	0.065	0.493	0.229
HF43	0.187	0.223	0.097	-0.180
HF44	0.178	-0.164	0.240	0.051
HF45	0.469	0.361	0.493	-0.350
HF46	0.175	0.496	0.393	-0.621
HF47	0.584	0.582	0.508	-0.547
HF48	0.242	0.254	-0.031	0.171
HF49	0.053	-0.138	-0.028	0.288
HF50	0.053	0.333	0.179	-0.279
HF51	0.535	0.413	0.641	-0.400
HF52	-0.106	0.029	-0.251	-0.152
HF53	-0.089	0.144	-0.201	-0.336
HF54	0.112	-0.029	0.066	0.205
HF55	0.261	-0.078	0.177	0.244
HF56	-0.292	-0.108	-0.135	0.104
HF57	0.655	0.182	0.530	0.197
HF58	0.294	-0.174	0.445	-0.069
HF59	-0.061	0.511	-0.019	-0.664
HF60	0.305	-0.072	0.373	0.069
HF61	0.438	0.634	0.557	-0.552
HF62	0.434	0.410	0.599	-0.372
HF63	0.123	0.143	0.212	-0.133
HF64	-0.008	-0.254	0.139	-0.140
HF65	-0.041	0.489	-0.087	-0.367
HF66	-0.078	-0.162	0.358	0.100
HF67	0.004	0.555	0.294	-0.700
HF68	-0.118	0.191	-0.227	-0.112
HF69	-0.149	0.099	0.168	-0.145
HF70	0.498	-0.168	0.395	-0.074
HF71	0.285	0.528	0.224	-0.438
HF72	-0.086	-0.122	0.064	-0.063
HF73	-0.181	0.232	-0.164	-0.440
HF74	0.018	0.337	-0.184	-0.298
HF75	-0.079	0.080	0.043	-0.228

TABLE 7. Number of Funds meeting Moments Criteria with MSAUCPI

Investment Strategy	Number of Funds	Funds with First moment (4th quartile)<0	Funds with First moment (1st quartile)>0	Funds with Cross moment >0 (1st quartile)	Funds with Cross moment >0 (4th quartile)
Distressed Debt	5	1	1	1	2
Long / Short Equities	44	12	26	30	11
Event Driven	1	0	1	1	0
Multi-Strategy	8	4	6	7	2
CTA	4	3	1	1	1
Other	1	0	1	1	0
Fixed Income	2	2	2	1	1
Relative Value	6	5	4	5	2
Macro	3	1	3	2	2
Convertible Arbitrage	1	1	0	1	1
Total	75	29	45	50	22

	Number of Funds	Percent
Meet zero criterion	10	13%
Meet one criterion	11	15%
Meet two criteria	33	44%
Meet three criteria	15	20%
Meet all criteria	6	8%
Total	75	100%

5. Conclusions

In this paper, we introduced a practical approach in analyzing the risk and performance of funds of hedge funds from the viewpoints of U.S. and Asian equity investors. We focused on the impact when we include global funds of hedge funds in their portfolio and examine whether the inclusion helps to insulate the overall portfolio when the market is down, to capture the upside and to reduce the impact of market volatility during extreme events. An advantage of this approach is that it alleviates the problems that can arise if hedge fund returns are skewed and leptokurtic and non-linearly related to the market returns. Our approach also allows for a meaningful economic interpretation of the results.

Based on a sample of 75 Asian hedge funds from the EurekaHedge database, we found that while all funds provide diversification in the sense that they are not perfectly correlated with market index returns, only 41 or 55% of the funds are negatively correlated with the S&P 500 index returns in a down-market (defined as the lowest return quartile of the S&P 500). Our results also show that very few funds met both our first moments and cross moments criteria. Recent work by Brenner, Ou and Zhang (2004) showed that an option on a straddle can be used to hedge volatility risk. This finding is likely to shed light on our finding on the moments criteria for hedge funds. A put option (or dynamic trading) provides downside protection trading off against upside capture. If volatility risk is to be hedged, it requires a further premium on an option on a straddle. We conjecture that the trade-off

relation between our performance and risk measures provides an interesting question for future research.

Based on our selection criteria, we found that individual fund of hedge funds met from zero to all four criteria ex-post. Based on our selection criteria, we found that individual Asian hedge funds met from zero to all four criteria ex-post. A useful analysis would be to check if any trade-offs exist. The basic tenet of Finance is the existence of a trade-off between expected returns and risk. Hence, we conjecture that funds that performed best in meeting all criteria would provide a lower return on average than one that met none of them. Similarly, we would expect ranking of returns to be inverse to the number of criteria met. On the other hand, possible explanations to perverse results may be explained by the relative skills of manager, incorrect assumptions about the investors, inappropriate choice the market indices used and possibly regulatory, tax and other reasons.

The average returns of the funds meeting different number of criteria were computed. A simple difference in mean test was used to analyze the trade-off. Results are presented in Table 8. We initially expect that funds that meet all 4 criteria would have a higher average return than those that meet 3 criteria and those that meet 3 criteria will have an average return than 2 and so on. The finding is consistent with our conjecture that there is a trade-off. On average funds that meet all four of our criteria provided returns that are lower than those meeting none of our criteria at the 5 percent significant level.

TABLE 8. Results of Difference in Means Tests

Panel 1: Mean and Variance of Portfolio of Hedge Funds					
	Meet zero criterion	Meet 1 criterion	Meet 2 criteria	Meet 3 criteria	Meet all criteria
Mean	0.007615	0.008802	0.008902	0.00711	0.007461
Variance	0.00076	0.000581	0.000715	0.000388	0.002176

Panel 2: Results of test of difference in mean returns					
Expected	One < None*	Two < None	Three < None	Four < None	Two < One
Result	One > None	Two > None	Three < None	Four < None	Two > One
t-value	-0.2425	-0.2501	0.1114	0.0213**	-0.0207**
Expected	Three < One	Four < One	Three < Two	Four < Two	Four < Three
Result	Three < One	Four < One	Three < Two	Four < Two	Four > Three
t-value	0.4066	0.1911	0.4035	0.2005	-0.0518

* < means that the average return of funds that does not satisfy any criterion to be greater than the average returns of funds that satisfy one criterion and so forth...

** significant at 5% level

Shaded results where finding is not as expected.

While we analyzed funds of hedge funds in this paper, our proposed methodology can be applied to other classes of hedge funds and even other types of assets when investors exhibit our specified preferences and where returns exhibit differing relation to held portfolios in up and down markets.

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