Performance of Hedge Funds between January 2005 and April 2009: A Cross Sectional Analysis

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1. Introduction

Hedge funds charge management and incentive fees (typically 1-2% and 15-20% respectively) since they are believed to generate abnormal returns consistently. Hedge funds differ from traditional mutual funds mainly in three ways. First, hedge funds implement a dynamic trading strategy compared to the static, buy-and-hold strategy of mutual funds. Second, hedge funds use leverage to amplify returns while mutual funds generally do not. Third, and perhaps most importantly, hedge funds do not deal with the public; they are private and opaque investment vehicles that are "exempt from the registration, disclosure requirements, and leverage restrictions pertaining to other investment firms." (Fung and Hsieh, 1999, p. 6) Due to the listed reasons, it is harder to evaluate the performance of hedge funds relative to other types of investment companies such as traditional mutual funds, which in turn leads to scarcity of literature on this particular topic.

This paper aims to search for risk exposures of hedge fund returns between January 2005 and April 2009 by using three different models, investigate whether hedge funds can continuously generate abnormal returns throughout this period, and evaluate performances of hedge funds during the recent financial crisis by implementing a cross-sectional analysis.

2. Literature Review

Literature on hedge fund performance is mostly inspired by academics' objective to explain risk exposures of hedge funds and to illustrate whether hedge funds generate abnormal returns. Fung and Hsieh (1999) provide an extensive introduction to the hedge fund industry and analyse how hedge fund performance is different from traditional mutual funds. There is not a single method to measure hedge fund performances, and the performance evaluation technique plays a vital role in determining risk exposures and the composition of hedge fund returns. Bollen and Whaley (2007) conclude that a simple regression-based method is optimal to measure the transformations in hedge fund risk exposures. They further demonstrate that 50% of hedge funds experienced a statistically significant change in risk exposures between 1994 and 2005. Eling and Schuhmacher (2006) show that the choice of performance measure does not influence the evaluation of hedge funds, although the most widely used performance measure, Sharpe ratio, is based on the assumption that returns follow a normal distribution and hedge fund returns are not normal. Fung and Hsieh (2004) build an APT-like model of hedge fund returns with changing risk factor coefficients to exhibit how features of factor loadings on the risk factors help investors understand the changes in hedge fund investment styles over time. Ibbotson et al. (2011) decompose hedge fund returns into fees, beta return and

idiosyncratic component and find the average annualized hedge fund return of 11.13% is composed of 3.43% of fees, 4.70% of beta return and 3.00% of alpha between 1995 and 2009. Bollen (2011) argues that there have been substantial changes in the exposures of hedge funds to different risk factors mainly due to three factors during the financial crisis. First, some managers switched from idiosyncratic trading strategies to trade more liquid assets that are more exposed to traditional risk factors. Second, the correlation across different markets and indices increases during times of stress. Finally, investor withdrawals during financial distress lead to realization of losses that raises the correlation between reported returns and returns of the risk factors. In the following sections, we strive to analyse hedge fund performances between January 2005 and April 2009 by taking the past literature on this topic into account.

3. Data and Methodology

For the following three sections of empirical analysis, we use the Center for International Securities and Derivatives Markets (CISDM) database via Wharton Research Data Services (WRDS). The sample period is from January 2005 to April 2009 in order to demonstrate the impact of the recent financial crisis on hedge fund returns. CISDM database includes hedge fund returns until May 2009; hence the following time period has to be excluded from our research. For each month throughout the time frame, we initially compute the mean returns of all hedge funds excluding indices, funds-of-funds, Commodity Trading Advisors (CTAs) and Commodity Pool Operators (CPOs) to focus the attention purely on hedge funds. To minimize inaccuracies in our analysis, we also discard hedge funds without a specified trading strategy during a given month and hedge funds with no or missing return data. After calculating the monthly mean returns of all hedge funds in a given month, we compute the average monthly returns of hedge funds with different trading strategies. In order to observe the effects of the financial crisis to a better extent and to keep the analysis more simplistic and focused, we choose 7 strategies among 22 different hedge fund trading strategies. Strategies chosen are below:

- Convertible Arbitrage
- Distressed Securities
- Emerging Markets
- Equity Long Only
- Equity Long/Short
- Equity Market Neutral
- Global Macro

Note that management and incentive fees are discarded throughout our analysis due to the negative returns of the funds in the second half of the time frame we analyse. The particular time frame we look at is

already an unusual period for hedge fund returns during which incentive fees failed to materialize due to the considerable number of negative returns, thus we decide to remove fees from our analysis.

4. Key Statistics

This section aims to shed light on the overall performances of all hedge funds and hedge funds according to their trading strategies in comparison with the S&P 500 between January 2005 and April 2009. By also looking at the two sub-periods, namely 2005-07 and 2007-09, we attempt to illustrate how hedge funds performed on average during a boom and a bust.

We use S&P 500 monthly return as the monthly market return and 1 month T-Bill rate for the risk-free rate. Data are collected from Kenneth French's website.[1] Key return statistics for all hedge funds between January 2005 and April 2009 are presented below:

Key Statistics (Monthly)	Risk-free	Average HF Return	Excess HF Return	S&P 500 Return	Market Risk Premium
Mean	0.27%	0.34%	0.07%	-0.28%	-0.55%
St. Dev.	0.13%	2.58%	2.54%	4.75%	4.72%
Min	0.00%	-8.74%	-8.82%	-17.15%	-17.23%
Max	0.44%	4.68%	4.67%	10.20%	10.19%
Skewness	-0.465	-1.373	-1.321	-1.038	-0.969
Kurtosis	-0.934	2.688	2.631	2.498	2.507

Key Statistics (Annualized)	Risk-free	Average HF Return	Excess HF Return	S&P 500 Return	Market Risk Premium
Mean	3.21%	4.10%	0.89%	-3.40%	-6.62%
St. Dev.	0.46%	8.93%	8.82%	16.47%	16.34%

Between January 2005 and April 2009, the average monthly hedge fund return is 0.34% with a monthly volatility of 2.58%. It is barely higher than the monthly average risk-free rate due to the very large negative returns during the last half of the 2005-09 period. Throughout the same period, S&P 500 return -0.28% on average per month with a volatility of 4.75%. Distributions of both mean hedge fund return and excess hedge fund return are negatively skewed with skewness of -1.373 and -1.321 respectively. Negatively skewed distribution implies that most of the monthly returns are concentrated on the right of the mean return while extreme monthly returns lie mostly on the left of the mean return, a consequence of the large negative monthly returns during the financial crisis.

Between January 2005 and April 2009, the average annualized hedge fund return is 4.10% compared to -3.40% annualized return of the S&P 500 throughout the same period. Annualized volatility of hedge fund returns is 8.93% compared to 16.47% annualized volatility of the S&P 500 return. Our sample clearly demonstrates that the average hedge fund return is significantly higher than the S&P 500 return between 2005 and 2009 with a substantially lower volatility.

[1] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Key return statistics for all hedge funds for the January 2005-March 2007 sub-period are displayed below:

Key Statistics (Monthly)	Risk-free	Average HF Return	Excess HF Return	S&P 500 Return	Market Risk Premium
Mean	0.33%	1.08%	0.75%	0.82%	0.50%
St. Dev.	0.09%	1.52%	1.52%	2.13%	2.12%
Min	0.16%	-2.41%	-2.84%	-3.14%	-3.57%
Max	0.44%	3.97%	3.62%	4.16%	3.92%
Skewness	-0.537	-0.601	-0.583	-0.185	-0.147
Kurtosis	-0.972	-0.012	0.018	-0.899	-0.849

Key Statistics (Annualized)	Risk-free	Average HF Return	Excess HF Return	S&P 500 Return	Market Risk Premium
Mean	3.96%	12.98%	9.02%	9.90%	5.94%
St. Dev.	0.30%	5.27%	5.28%	7.38%	7.33%

Between January 2005 and March 2007, the average monthly hedge fund return is 1.08% with a monthly volatility of 1.52%. During this period, S&P 500 return is 0.82% on average per month with a volatility of 2.13%. Distributions of both mean hedge fund return and excess hedge fund return are negatively skewed with skewness of -0.601 and -0.185 respectively.

Between January 2005 and March 2007, the average annualized hedge fund return is 12.98% with an annualized standard deviation of 5.27%. Throughout the same period, the average annualized S&P 500 return is 9.90% with an annualized volatility of 7.38%. Hence, between January 2005 and March 2007, the average hedge fund beat the market from a mean-variance standpoint with a higher return and lower volatility.

Key return statistics for all hedge funds for the April 2007-April 2009 sub-period are presented below:

Key Statistics (Monthly)	Risk-free	Average HF Return	Excess HF Return	S&P 500 Return	Market Risk Premium
Mean	0.20%	-0.46%	-0.66%	-1.48%	-1.68%
St. Dev.	0.14%	3.22%	3.19%	6.34%	6.31%
Min	0.00%	-8.74%	-8.82%	-17.15%	-17.23%
Max	0.44%	4.68%	4.67%	10.20%	10.19%
Skewness	0.270	-0.873	-0.842	-0.416	-0.372
Kurtosis	-1.197	0.760	0.767	0.230	0.267

Key Statistics (Annualized)	Risk-free	Average HF Return	Excess HF Return	S&P 500 Return	Market Risk Premium
Mean	2.41%	-5.48%	-7.90%	-17.76%	-20.18%
St. Dev.	0.50%	11.14%	11.05%	21.97%	21.87%

The recent financial crisis hit the stock market as well as the average hedge fund hard as shown by the mean returns between April 2007 and April 2009. Average monthly hedge fund return is -0.46% compared to the average monthly market return of -1.48%. Both hedge fund returns and the market return are highly volatile during this period, with monthly standard deviations of 3.22% and 6.34% respectively.

Still, even during the financial crisis, the average hedge fund succeeded to beat the market by a significant margin from a mean-variance standpoint. Between April 2007 and April 2009, the average

annualized hedge fund return is -5.48% with an annualized volatility of 11.14%, while the average annualized market return is -17.76% with an annualized standard deviation of 21.97%.

Having looked at the key statistics on all hedge funds between January 2005 and April 2009 briefly, now we turn our attention to look at hedge funds with different trading strategies throughout the same period. Key return statistics for hedge funds with 7 different trading strategies between January 2005 and April 2009 are illustrated below:

Key Statistics (Monthly)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Mean	0.34%	-0.06%	0.02%	0.57%	0.10%	0.36%	0.41%	0.75%
St. Dev.	2.58%	2.81%	2.22%	4.74%	5.03%	2.50%	0.79%	1.18%
Min	-8.74%	-13.37%	-8.47%	-17.92%	-20.62%	-6.97%	-2.44%	-1.25%
Max	4.68%	4.81%	3.36%	10.33%	10.40%	4.63%	1.39%	3.73%
Skewness	-1.373	-2.861	-1.939	-1.411	-1.672	-1.003	-1.539	0.402
Kurtosis	2.688	11.731	4.481	3.994	5.191	1.029	2.729	-0.337

Key Statistics (Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Mean	4.10%	-0.73%	0.28%	6.84%	1.21%	4.37%	4.88%	9.03%
St. Dev.	8.93%	9.74%	7.70%	16.44%	17.43%	8.66%	2.72%	4.10%

In this part of the analysis, we focus only on the annualized values. Global macro and emerging markets funds have the highest average return among the seven trading strategies we observe, with average returns of 9.03% and 6.84% respectively. Convertible arbitrage is the only trading strategy that generated a negative average annualized return throughout this period. First, we should note that the financial crisis had a very large negative impact on the returns of all trading strategies between 2005 and 2009. Second, we observe large negative returns for the convertible arbitrage funds in the first half of 2005, when hedge funds with other trading strategies returned relatively higher returns for their investors, due to the downgrade of General Motors' debt as well as Kirk Kerkorian's bid on the GM stock. Between January 2005 and April 2009, we also observe that hedging strategies such as equity long-short and equity market neutral has relatively high average returns primarily due to their protection against the impact of the subprime mortgage crisis on the US stock market. Finally, trading strategies with the lowest volatility are equity market neutral and global macro between 2005 and 2009. As a consequence, global macro comes across as the most profitable trading strategy from a mean-variance point of view throughout the period we analyse.

Key return statistics for hedge funds according to their trading strategies between January 2005 and March 2007 are presented below:

Key Statistics (Jan 05 - Mar 07/Monthly)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Mean	1.08%	0.53%	0.99%	1.88%	1.39%	1.07%	0.62%	0.75%
St. Dev.	1.52%	1.08%	0.80%	2.82%	2.62%	1.68%	0.34%	1.05%
Min	-2.41%	-2.78%	-0.77%	-4.74%	-5.61%	-2.76%	-0.19%	-0.87%
Max	3.97%	2.47%	2.25%	7.88%	5.90%	4.19%	1.11%	2.76%
Skewness	-0.601	-1.262	-0.338	-0.277	-0.705	-0.593	-0.584	0.408
Kurtosis	-0.012	2.460	-0.682	0.536	0.525	-0.059	-0.084	-0.727

Key Statistics (Jan 05 - Mar 07/Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Mean	12.98%	6.37%	11.90%	22.50%	16.72%	12.83%	7.49%	9.01%
St. Dev.	5.27%	3.73%	2.78%	9.77%	9.07%	5.83%	1.17%	3.64%

Table 5 illustrates that all trading strategies return positive annualized average returns between January 2005 and March 2007. Throughout this period, hedge funds with trading strategies that are most exposed to systematic risk such as emerging markets and equity long-only funds posted the highest returns, with average yearly returns of 22.50% and 16.72% respectively. However, just by looking at the return-volatility trade-off of hedge funds, it is obvious that high average returns posted by the emerging markets and equity long-only funds are mostly as a result of higher risk, as shown by their annualized volatilities of 9.77% and 9.07% respectively. As in the case of the entire period we analyse, distressed securities, equity market neutral and global macro funds achieved returns with the lowest volatility in the 2005-07 sub-period as well. Lastly, global macro strategy is the only strategy with a positive skewness value between January 2005 and March 2007, suggesting that global macro funds had extreme positive returns during this sub-period.

Key return statistics on hedge funds with different trading strategies between April 2007 and April 2009 are displayed below:

Key Statistics (Apr 07 - Apr 09/Monthly)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Mean	-0.46%	-0.70%	-1.02%	-0.84%	-1.30%	-0.40%	0.17%	0.76%
St. Dev.	3.22%	3.84%	2.76%	5.94%	6.52%	3.01%	1.04%	1.34%
Min	-8.74%	-13.37%	-8.47%	-17.92%	-20.62%	-6.97%	-2.44%	-1.25%
Max	4.68%	4.81%	3.36%	10.33%	10.40%	4.63%	1.39%	3.73%
Skewness	-0.873	-1.968	-1.104	-0.967	-1.073	-0.597	-0.801	0.403
Kurtosis	0.760	5.221	1.200	1.892	2.247	-0.130	-0.017	-0.269

Key Statistics (Apr 07 - Apr 09/Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Mean	-5.48%	-8.40%	-12.27%	-10.07%	-15.54%	-4.77%	2.07%	9.06%
St. Dev.	11.14%	13.29%	9.55%	20.56%	22.58%	10.42%	3.60%	4.63%

With a plummeting stock market throughout this sub-period, emerging markets and equity long-only funds posted large negative average returns, with very high volatility. Compared to the 2005-07 sub-period, return distributions of hedge funds with all trading strategies show substantially higher volatility between April 2007 and April 2009. Global macro strategy is the only strategy that exceeded its average yearly return in the previous period, with an annualized mean return of 9.06%. Global macro funds' low volatility in combination with high average return suggests large positive alpha, and we will touch upon this particular phenomenon in the following sections.

5. One-Factor Model (CAPM)

In order to investigate the sources of excess returns hedge funds posted between January 2005 and April 2009, we first use a one-factor model, namely the Capital Asset Pricing Model (CAPM). For the

period between January 2005 and April 2009 and the two sub-periods of January 2005-March 2007 and April 2007-April 2009, we regress excess returns of hedge funds on the market risk premium, denoted by the difference between the monthly S&P 500 return and the 1 month T-Bill rate. Summary statistics for the entire sample period for hedge fund performances under the one-factor model is demonstrated below:

Performance Measures (2005-09 Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Return	4.10%	-0.73%	0.28%	6.84%	1.21%	4.37%	4.88%	9.03%
Excess Return	0.89%	-3.94%	-2.93%	3.63%	-2.00%	1.15%	1.67%	5.82%
Adjusted R Square	0.648	0.360	0.464	0.619	0.777	0.611	0.335	0.096
Alpha	3.78%	-1.56%	-0.84%	8.86%	4.20%	3.88%	2.31%	6.37%
Beta	0.437	0.361	0.316	0.790	0.938	0.412	0.096	0.083
Systematic Beta Return	-2.89%	-2.39%	-2.09%	-5.23%	-6.21%	-2.72%	-0.64%	-0.55%
Sharpe Ratio	0.101	-0.408	-0.391	0.222	-0.116	0.135	0.627	1.440
Treynor Measure	0.020	-0.109	-0.093	0.046	-0.021	0.028	0.174	0.697
Excess Return due to Alpha	425.31%	39.47%	28.70%	244.17%	-209.76%	336.48%	138.12%	109.49%
Excess Return due to Beta	-325.31%	60.53%	71.30%	-144.17%	309.76%	-236.48%	-38.12%	-9.49%

The adjusted R Square of all hedge funds according to the one-factor model is 0.648 between January 2005 and April 2009. This implies that movements in the benchmark index explain 64.8% of the movements of all hedge fund returns. It is a significant value; however, we expect to increase the adjusted R Square by adding more explanatory variables to the model in the following sections of our research. Throughout the entire sample period, all hedge funds have a substantial positive alpha of 3.78% according to the one-factor model. While the average excess market return (market risk premium) is negative, the hedge funds posted a positive excess return on average as a result of the positive alpha in this model. Factor loading on the systematic risk factor, namely market beta, is 0.437 for all hedge funds, suggesting that a 1% increase in the market return led to a 0.437% increase in the average hedge fund return, and vice versa. The systematic beta return, beta multiplied by the average annualized market risk premium, is -2.89% throughout this period. Since the average annualized market risk premium between January 2005 and April 2009 is -6.62%, it is clear to see why systematic beta return is negative for all trading strategies. It should be noted that the negative systematic beta return due to the impact of the financial crisis distort our analysis for the entire sample period, by leading to a significant increase in alpha as a compensation. Indeed, Figure 1 shows that 5 trading strategies among 7 posted positive alpha between January 2005 and April 2009. It also indicates that alpha has a more significant effect on the excess return of the hedge funds in general compared to compensation for systematic market risk.

Between January 2005 and April 2009, the adjusted R Square is the largest for the emerging markets and equity long only trading strategies. This is not particularly surprising, since these two strategies are the most sensitive ones to market fluctuations. Emerging markets strategy still managed to post positive excess returns during the entire sample period thanks to an alpha of 8.86%. The adjusted R Square is lowest at 0.096 for Global Macro funds, shedding light on the successful performance of this strategy during this period. Parallel to this, global macro funds has a market beta of 0.083 (again, the lowest among all strategies), and an alpha of 6.37%. We also observe that equity market neutral funds, another successful

strategy throughout the period we analyse, have a very low market beta of 0.096 that protected itself from the effects of the financial crisis to a great extent. Two strategies with the highest Sharpe ratios, a measure that shows the excess return per unit of risk, are Global Macro and Equity Market Neutral, with Sharpe ratios of 1.440 and 0.627 respectively.

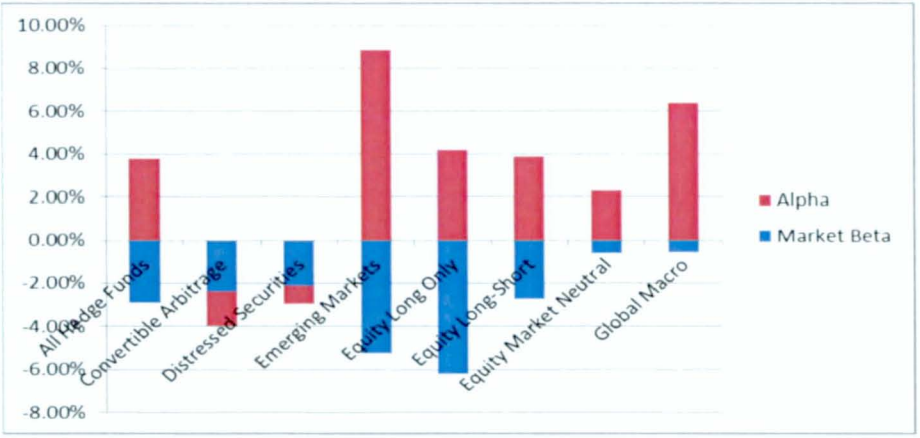

Figure 1: Sources of Hedge Fund Mean Returns between January 2005 and April 2009 under One-Factor Model

Summary statistics for the January 2005-March 2007 for hedge fund performances under the one-factor model is shown below:

Performance Measures (Jan 05 - Mar 07/Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Return	12.98%	6.37%	11.90%	22.50%	16.72%	12.83%	7.49%	9.01%
Excess Return	9.02%	2.42%	7.95%	18.55%	12.77%	8.87%	3.53%	5.05%
Adjusted R Square	0.515	0.088	0.181	0.358	0.635	0.511	0.164	0.344
Alpha	5.90%	1.40%	6.93%	13.65%	6.82%	5.42%	3.08%	3.25%
Beta	0.526	0.170	0.170	0.825	1.001	0.581	0.075	0.302
Systematic Beta Return	3.12%	1.01%	1.01%	4.90%	5.95%	3.45%	0.45%	1.80%
Sharpe Ratio	1.710	0.678	2.936	1.899	1.402	1.518	2.831	1.385
Treynor Measure	0.172	0.142	0.466	0.225	0.128	0.153	0.468	0.167
Excess Return due to Alpha	65.36%	58.10%	87.26%	73.57%	53.40%	61.11%	87.31%	64.44%
Excess Return due to Beta	34.64%	41.90%	12.74%	26.43%	46.60%	38.89%	12.69%	35.56%

Between January 2005 and March 2007, the adjusted R Square for all hedge funds under the one-factor model is 0.515, implying that movements in the benchmark index explain 51.5% of the movements in hedge funds returns. Throughout this period, hedge funds achieved an alpha of 5.90% versus a systematic beta return of 3.12%, generating an excess return of 9.02% on average. Parallel to the significantly positive market risk premium and positive alpha achieved by hedge funds, the Sharpe ratio is very high at 1.710 during this sub-period. 34.64%% of the excess return of all hedge funds between January 2005 and March 2007 is due to systematic market risk while 65.36% is due to alpha.

When we shift our attention to the performances of hedge funds according to trading strategies, it is easy to spot that emerging markets and equity long-only funds, funds with strategies that are most sensitive to market return, posted the highest average annualized returns. Their market betas are 0.825 and 1.001

respectively, suggesting a high correlation between their excess returns and the market risk premium. On top of the high systematic beta return, emerging markets and equity long-only strategies also generated significantly high alphas, 13.65% and 6.82%, that highly contributed to their average excess returns of 18.55% and 12.77% respectively. However, from a mean-variance standpoint, distressed securities and equity market neutral funds are the most profitable strategies during this sub-period. Distressed securities achieved a Sharpe ratio of 2.936 compared to a Sharpe ratio of 2.831 of equity market neutral strategy. Overall, for this sub-period, hedge funds posted significantly higher average returns than the market with substantially lower volatility; however, a greater portion of the excess returns cannot be explained by the market return under the one-factor model, leading to high positive alpha, illustrated by Figure 2.

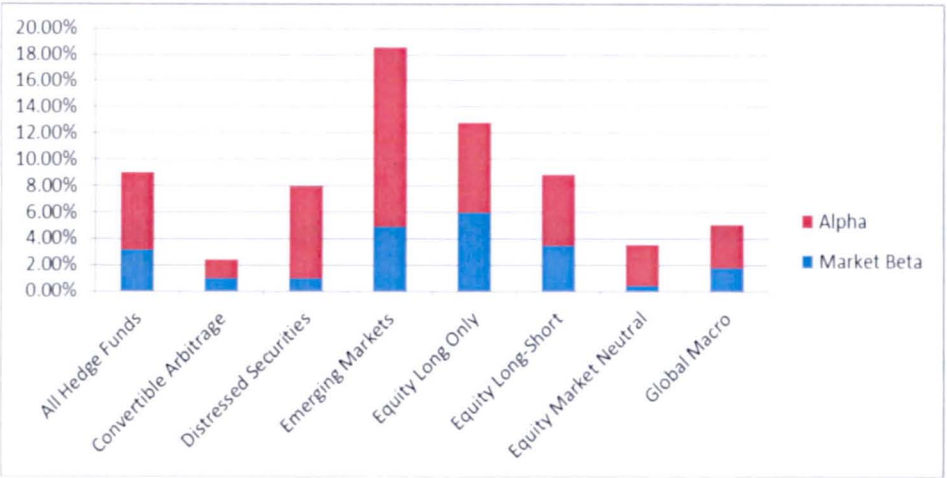

Figure 2: Sources of Hedge Fund Mean Returns between January 2005 and March 2007 under One-Factor Model

Summary statistics for the April 2007-April 2009 for hedge fund performances under the one-factor model is presented below:

Performance Measures (Apr 07 - Apr 09/Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Return	-5.48%	-8.40%	-12.27%	-10.07%	-15.54%	-4.77%	2.07%	9.06%
Excess Return	-7.90%	-10.81%	-14.68%	-12.49%	-17.96%	-7.19%	-0.34%	6.65%
Adjusted R Square	0.651	0.353	0.459	0.646	0.782	0.624	0.314	0.065
Alpha	0.42%	-3.25%	-8.66%	2.86%	0.51%	0.44%	1.59%	7.98%
Beta	0.412	0.375	0.299	0.761	0.915	0.378	0.095	0.066
Systematic Beta Return	-8.32%	-7.56%	-6.02%	-15.35%	-18.46%	-7.63%	-1.92%	-1.33%
Sharpe Ratio	-0.715	-0.813	-1.561	-0.610	-0.798	-0.695	-0.095	1.481
Treynor Measure	-0.192	-0.289	-0.492	-0.164	-0.196	-0.190	-0.036	1.006
Excess Return due to Alpha	-5.32%	30.09%	58.97%	-22.94%	-2.81%	-6.17%	-467.03%	120.06%
Excess Return due to Beta	105.32%	69.91%	41.03%	122.94%	102.81%	106.17%	567.03%	-20.06%

For this period, we find that the market beta is 0.412, lower than that of the 2005-07 sub-period, implying that a 1 per cent increase in the market risk premium led to a 0.412% increase in the average excess return of the hedge fund. However, the adjusted R Square goes up to 0.651 between April 2007 and April 2009, a significant increase compared to the previous sub-period, suggesting that the movements in the benchmark (S&P 500) predict hedge fund returns better during the financial crisis under the one-factor

model. Hence, our market beta throughout this period is a more useful figure, due to higher adjusted R Square, compared to the previous period. All hedge funds managed to achieve a positive alpha of 0.42%, which failed to counteract the impact of the large negative systematic beta return of -8.32% on the average hedge fund excess return. Sharpe ratio is -0.715 between April 2007 and April 2009 for all hedge funds, a negative figure due to negative excess return.

For all trading strategies except Global Macro, the alpha is substantially lower throughout this sub-period. All trading strategies except Global Macro posted negative excess returns between April 2007 and April 2009, and in most cases, the magnitude of these negative excess returns is due to market beta rather than alpha. Figure 3 illustrates this phenomenon. Among all trading strategies, global macro strategy is the only strategy that actually performed better during this period compared to the previous period, with higher excess return and a higher Sharpe ratio. Global macro strategy also has the lowest market beta and lowest adjusted R Square, which simply made it largely insensitive to the plummeting stock market between April 2007 and April 2009. Emerging markets and equity long-only strategies, strategies that are highly sensitive to the fluctuations in the benchmark index with the highest adjusted R Square figures, performed poorly, with excess returns of -12.49% and -17.96%, respectively.

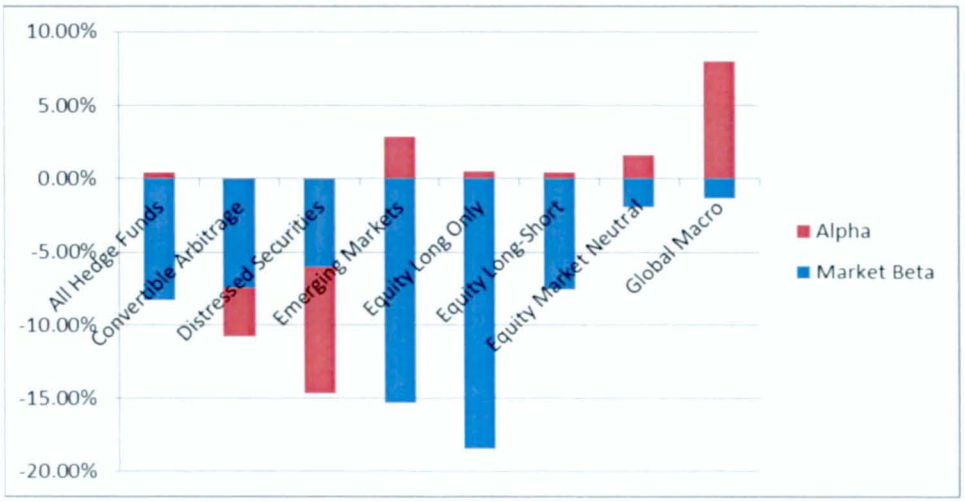

Figure 3: Sources of Hedge Fund Mean Returns between April 2007 and April 2009 under One-Factor Model

Overall, the one-factor model fails to explain the hedge fund returns fully during the sample period we analyse, and the high alphas and relatively low adjusted R Square figures support this argument. Moreover, we observe a significant rise in the adjusted R Square values during the financial crisis, implying that the one-factor model actually works better during this sub-period.

6. Three-Factor Model (Fama-French)

By adding more factors to our model, we expect the model to explain a greater proportion of the variation in hedge fund returns. As an indication for this, we expect adjusted R Square to be higher than that under the one-factor model. For the period between January 2005 and April 2009 and the two sub-periods of January 2005-March 2007 and April 2007-April 2009, we regress excess returns of all hedge funds and hedge funds according to their trading strategies on the market risk premium, SMB (small-minus-big) and HML (high-minus-low) factors.

Key return statistics for the three factors between January 2005 and April 2009 are illustrated below:

Key Statistics (Monthly)	Market Risk Premium	SMB	HML
Mean	-0.55%	0.06%	0.03%
St. Dev.	4.72%	2.24%	2.66%
Min	-17.23%	-4.00%	-9.78%
Max	10.19%	5.37%	5.39%
Skewness	-0.969	0.490	-1.080
Kurtosis	2.507	-0.032	3.105

Key Statistics (Annualized)	Market Risk Premium	SMB	HML
Mean	-6.62%	0.71%	0.42%
St. Dev.	16.34%	7.75%	9.23%

Summary statistics for the entire sample period for hedge fund performances under the three-factor model is presented below:

Performance Measures (2005-09 Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Return	4.10%	-0.73%	0.28%	6.84%	1.21%	4.37%	4.88%	9.03%
Excess Return	0.89%	-3.94%	-2.93%	3.63%	-2.00%	1.15%	1.67%	5.82%
Adjusted R Square	0.681	0.434	0.452	0.635	0.801	0.653	0.334	0.135
Alpha	4.17%	-1.06%	-0.57%	9.78%	4.85%	4.13%	2.42%	6.64%
Beta on the Market	0.483	0.421	0.345	0.891	1.014	0.444	0.109	0.114
Beta on SMB	0.003	0.066	-0.075	-0.190	0.001	0.077	-0.015	-0.020
Beta on HML	-0.220	-0.348	-0.062	-0.285	-0.358	-0.229	-0.046	-0.125
Market Beta Return	-3.19%	-2.78%	-2.28%	-5.90%	-6.71%	-2.94%	-0.72%	-0.76%
SMB Beta Return	0.00%	0.05%	-0.05%	-0.13%	0.00%	0.05%	-0.01%	-0.01%
HML Beta Return	-0.09%	-0.14%	-0.03%	-0.12%	-0.15%	-0.10%	-0.02%	-0.05%
Excess Return due to Risk Factors	-369.81%	73.04%	80.50%	-169.49%	342.13%	-258.54%	-45.07%	-14.12%
Excess Return due to Alpha	469.81%	26.96%	19.50%	269.49%	-242.13%	358.54%	145.07%	114.12%

Between January 2005 and April 2009, market beta for all hedge funds is 0.483, which is higher than that under the one-factor model. Since the average annualized market risk premium is negative during the entire sample period, the model asserts that the positive factor loading on the market drags down the excess return of hedge funds. As a result of the newly added factors, adjusted R Square for all hedge funds during the entire sample period goes up from 0.648 in the one-factor model to 0.681 in the three-factor model. This result suggests that the SMB and HML factors contribute to the explanation of the variation of hedge funds returns by 3.3%. The factor loading on the SMB factor is not significant for all hedge funds with a value of 0.003. Beta on the HML factor is significant and negative, implying that it pushes down hedge fund returns, as the average annualized return of the HML factor between January 2005 and April 2009 is 0.42%. Due to the higher market beta and the negative beta on HML, we observe that alpha is higher under the three-factor

model. The increase in alpha does not undermine the explanatory power of the three-factor model; it is a natural result of the factor loadings on the different risk factors.

Regression on hedge funds with different trading strategies generates similar results. Adjusted R Square goes up for all trading strategies except Distressed Securities and Equity Market Neutral under the three-factor model compared to the one-factor model. Market beta increases for all trading strategies, suggesting that excess returns of all trading strategies become more sensitive to movements in the benchmark index under the three-factor model. Factor loading on the SMB factor is positive for Convertible Arbitrage, Equity Long Only and Equity Long-Short and negative for the other strategies. On the contrary, beta on HML is persistently negative for all trading strategies, dragging down the excess returns as a consequence. Due to the higher market beta and negative beta on the HML factor, alpha is higher for all strategies between January 2005 and April 2009. Figure 4 demonstrates that the newly added factors fail to explain a significant portion of the excess returns generated by the hedge funds with various trading strategies throughout the entire sample period we analyse.

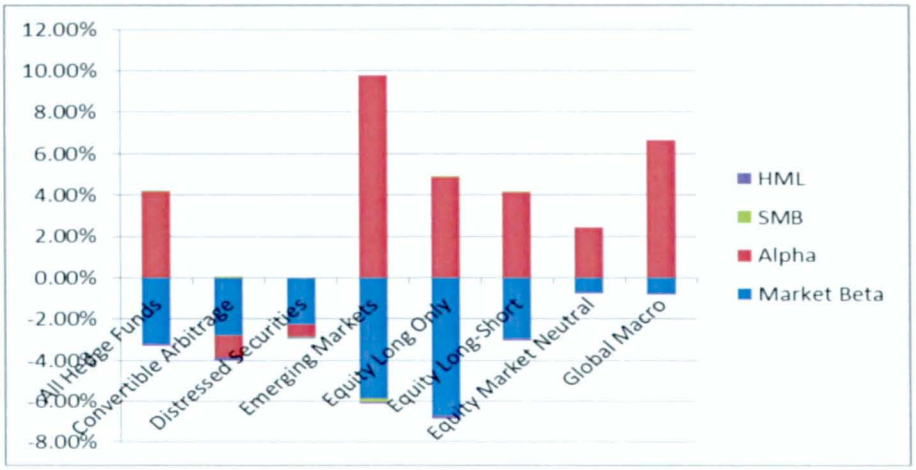

Figure 4: Sources of Hedge Fund Mean Returns between January 2005 and April 2009 under Three-Factor Model

Key return statistics for the three factors between January 2005 and March 2007 are illustrated below:

Key Statistics (Monthly)	Market Risk Premium	SMB	HML
Mean	0.50%	0.02%	0.78%
St. Dev.	2.12%	2.18%	1.54%
Min	-3.57%	-4.00%	-1.87%
Max	3.92%	5.32%	3.29%
Skewness	-0.147	0.377	0.095
Kurtosis	-0.849	0.355	-1.063

Key Statistics (Annualized)	Market Risk Premium	SMB	HML
Mean	5.94%	0.23%	9.31%
St. Dev.	7.33%	7.57%	5.32%

Summary statistics for the January 2005-March 2007 for hedge fund performances under the three-factor model is presented below:

Performance Measures (Jan 05 - Mar 07 Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Return	12.98%	6.37%	11.90%	22.50%	16.72%	12.83%	7.49%	9.01%
Excess Return	9.02%	2.42%	7.95%	18.55%	12.77%	8.87%	3.53%	5.05%
Adjusted R Square	0.637	0.216	0.475	0.381	0.687	0.656	0.364	0.464
Alpha	3.28%	0.07%	5.20%	8.13%	4.57%	2.93%	1.96%	0.50%
Beta on the Market	0.437	0.062	0.085	0.919	0.831	0.437	0.075	0.313
Beta on SMB	0.257	0.234	0.214	0.080	0.375	0.342	0.048	0.100
Beta on HML	0.331	0.206	0.235	0.530	0.341	0.351	0.120	0.287
Market Beta Return	2.60%	0.37%	0.51%	5.46%	4.94%	2.60%	0.45%	1.86%
SMB Beta Return	0.06%	0.05%	0.05%	0.02%	0.09%	0.08%	0.01%	0.02%
HML Beta Return	3.08%	1.92%	2.19%	4.93%	3.18%	3.27%	1.11%	2.67%
Excess Return due to Risk Factors	63.64%	97.00%	34.53%	56.15%	64.23%	66.94%	44.56%	90.12%
Excess Return due to Alpha	36.36%	3.00%	65.47%	43.85%	35.77%	33.06%	55.44%	9.88%

As we mentioned before, the sub-period between January 2005 and March 2007 is a "cleaner" time period to analyse performances of hedge funds thanks to the lack of magnitude of large negative shocks (as in the case of the entire sample period due to the impact of the data during the second sub-period). Hence, it is easier to observe the effect of the inclusion of the newly added factors on the explanation of hedge fund returns during this period. As expected, we observe a substantial increase in the adjusted R Square under the three-factor model compared to the one-factor model. Between January 2005 and March 2007, the adjusted R Square, the figure which measures the usefulness of the explanatory factors in the regression analysis, is 0.637 for all hedge funds, a 12.2% increase compared to the analysis under the CAPM. The beta on the market decreases to 0.437, implying that hedge fund returns become less sensitive to movements in the benchmark, since the newly added factors, namely SMB and HML both have positive and significant factor loadings. As a result of the explanatory power of the new factors, the alpha for all hedge funds goes down during this sub-period, from 5.90% under the one-factor model to 3.28% under the three-factor model. Between January 2005 and March 2007, risk factors explain 63.64% of the hedge fund excess returns while the alpha, the idiosyncratic component, explains 36.36%.

The most important finding in this sub-section is the magnitude of the proportion of hedge fund returns explained by the HML factor. Although the factor loadings on the SMB factor are also positive and significant for all trading strategies, the mean annualized return of the factor itself is not very substantial during this period, only 0.23% on average per annum. On the contrary, the HML factor returned an average annualized return of 9.31% between January 2005 and March 2007, thus the positive factor loadings on the HML factor have great explanatory power. Figure 5 illustrates this phenomenon more vividly. Except Emerging Markets and Equity Long Only strategies, which are highly sensitive to the market, excess return due to HML is greater than that due to the market. In Convertible Arbitrage strategy, the alpha almost disappears as can be seen from Figure 5, and the alpha generated by the Global Macro strategy is only 0.50% in annualized terms, which further demonstrates the improvement from the one-factor model to the three-factor model in explaining the variation in returns of hedge funds. Global Macro strategy, the most

successful strategy overall in all sub-periods, turns out to have very low alpha in the "cleaner" time period, with 90.12% of the excess return explained by the risk factors of the Fama-French model.

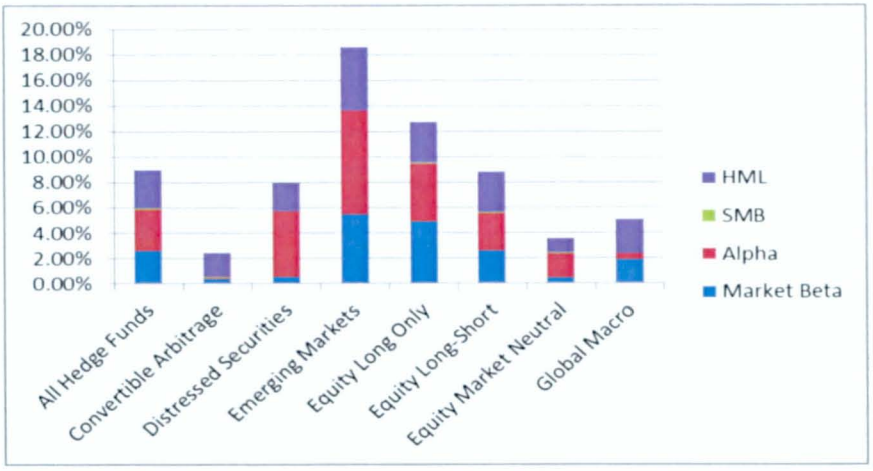

Figure 5: Sources of Hedge Fund Mean Returns between January 2005 and March 2007 under Three-Factor Model

Key return statistics for the three factors between April 2007 and April 2009 are illustrated below:

Key Statistics (Monthly)	Market Risk Premium	SMB	HML
Mean	-1.68%	0.10%	-0.77%
St. Dev.	6.31%	2.34%	3.35%
Min	-17.23%	-3.61%	-9.78%
Max	10.19%	5.37%	5.39%
Skewness	-0.372	0.611	-0.596
Kurtosis	0.267	-0.170	1.339

Key Statistics (Annualized)	Market Risk Premium	SMB	HML
Mean	-20.18%	1.22%	-9.19%
St. Dev.	21.87%	8.10%	11.61%

Summary statistics for the April 2007-April 2009 for hedge fund performances under the three-factor model is presented below:

Performance Measures (Apr 07 - Apr 09/Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Return	-5.48%	-8.40%	-12.27%	-10.07%	-15.54%	-4.77%	2.07%	9.06%
Excess Return	-7.90%	-10.81%	-14.68%	-12.49%	-17.96%	-7.19%	-0.34%	6.65%
Adjusted R Square	0.773	0.626	0.501	0.716	0.850	0.757	0.364	0.228
Alpha	-1.47%	-8.76%	-9.94%	0.77%	-2.56%	-1.63%	0.98%	8.30%
Beta on the Market	0.504	0.473	0.358	0.912	1.052	0.462	0.119	0.125
Beta on SMB	0.032	0.497	0.028	-0.082	0.080	0.075	0.025	-0.181
Beta on HML	-0.402	-0.748	-0.266	-0.571	-0.624	-0.400	-0.115	-0.119
Market Beta Return	-10.16%	-9.54%	-7.23%	-18.40%	-21.23%	-9.32%	-2.40%	-2.52%
SMB Beta Return	0.04%	0.61%	0.03%	-0.10%	0.10%	0.09%	0.03%	-0.22%
HML Beta Return	3.69%	6.87%	2.44%	5.25%	5.73%	3.68%	1.06%	1.09%
Excess Return due to Risk Factors	81.44%	19.03%	32.33%	106.13%	85.74%	77.33%	387.68%	-24.79%
Excess Return due to Alpha	18.56%	80.97%	67.67%	-6.13%	14.26%	22.67%	-287.68%	124.79%

As expected, the adjusted R Square is significantly higher during the financial crisis, increasing from 0.637 in the previous sub-period to 0.773, suggesting that the risk factors explain 77.3% of the variation in the returns of the hedge funds during this period. Alpha becomes negative under the three-factor model

during the financial crisis, mainly due to the impact of the HML factor. The factor loading on the HML factor is negative and significant at -0.402 for all hedge funds, generating to a substantial positive impact on the hedge fund returns, as the average annualized HML factor return throughout this period is -9.19% as shown above. Risk factors explain 81.44% of the variation in hedge fund returns during the financial crisis, while the idiosyncratic component explains only 18.56%, suggesting a significant rise in the explanatory power of the risk factors compared to the previous period.

Our analysis shows that the adjusted R Square is greater than that throughout the previous period for all trading strategies except the Global Macro strategy. Global Macro funds posted an alpha of 8.30% during the financial crisis under the three-factor model, an increase compared to that under the one-factor model, specifically due to the rise in the market beta. We observe that the alphas are mostly in the negative region between April 2007 and April 2009 under the three-factor model primarily due to the inclusion of the HML factor. As the HML factor has negative factor loadings in all trading strategies and therefore creates a positive effect on the returns, the alphas are dragged down. Factor loadings on the SMB factor are not as significant, and the SMB factor fails to explain the differences in the hedge fund returns as demonstrated in Figure 6.

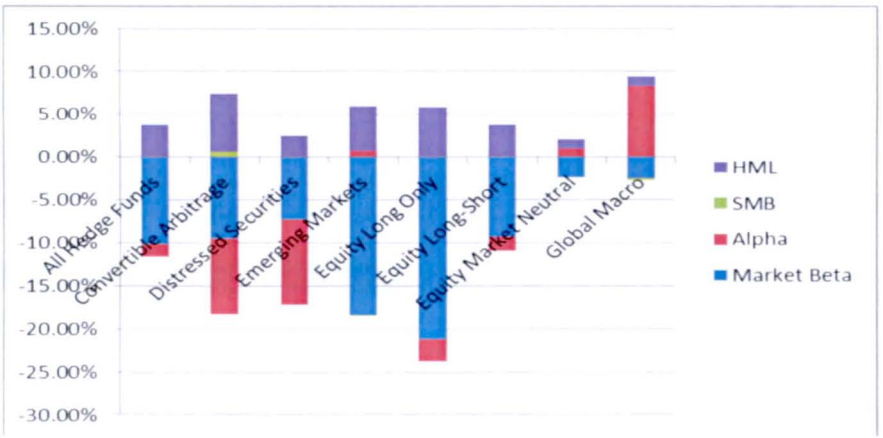

Figure 6: Sources of Hedge Fund Mean Returns between April 2007 and April 2009 under Three-Factor Model

In short, the three-factor model explains the variations in the hedge fund returns better than the one-factor model, as validated by the increase in adjusted R Square and decrease in alpha. We believe that the inclusion of the HMB factor is the key driver of this. As for the cross-sectional analysis, again under the three-factor model, risk factors raise their explanatory power during the financial crisis, suggesting that the model works better during the latter sub-period we analyse.

7. Five-Factor Model

By introducing 3 new factors to our model, we aim to increase the adjusted R Square substantially and decrease the alpha in proportion to excess return in all periods. Since the SMB factor did not have much explanatory power in the previous section, we simply eliminate it from our analysis for this section. We keep the market risk premium and HML factors as they were instrumental in explaining the variation in hedge fund returns. In order to maximize the adjusted R Square, we add three new factors to our model: Barclay Convertible Arbitrage Index[2] monthly return, BofA Merrill Lynch US High Yield B Total Return Index[3] monthly return, MSCI Emerging Market (EM) Index[4] monthly return and Barclay Global Macro Index[5] monthly return. We chose these particular risk factors not only because hedge funds invest in various asset classes but also because we expect that the performance of the trading strategies we chose are likely to depend on the movements on these indices.

Key return statistics for the five factors between January 2005 and April 2009 are displayed below:

Key Statistics (Monthly)	Market Risk Premium	Convertible Arbitrage Index Excess Return	High Yield Index Excess Return	MSCI EM Index Excess Return	Global Macro Index Excess Return
Mean	-0.55%	-0.36%	-0.21%	0.12%	0.25%
St. Dev.	4.72%	2.89%	4.24%	8.47%	1.69%
Min	-17.23%	-13.84%	-20.44%	-32.24%	-3.42%
Max	10.19%	5.66%	12.06%	15.07%	3.62%
Skewness	-0.969	-2.460	-1.575	-1.282	0.052
Kurtosis	2.507	10.271	11.023	3.146	-0.430

Key Statistics (Annualized)	Market Risk Premium	Convertible Arbitrage Index Excess Return	High Yield Index Excess Return	MSCI EM Index Excess Return	Global Macro Index Excess Return
Mean	-6.62%	-4.35%	-2.54%	1.42%	3.01%
St. Dev.	16.34%	10.03%	14.68%	29.35%	5.87%

Summary statistics for the entire sample period for hedge fund performances under the five-factor model is presented below:

Performance Measures (2005-09 Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Return	4.10%	-0.73%	0.28%	6.84%	1.21%	4.37%	4.88%	9.03%
Excess Return	0.89%	-3.94%	-2.93%	3.63%	-2.00%	1.15%	1.67%	5.82%
Adjusted R Square	0.946	0.989	0.668	0.933	0.945	0.904	0.665	0.809
Alpha	1.26%	0.11%	0.08%	3.75%	0.83%	1.23%	1.22%	3.78%
Beta on the Market	0.107	0.019	0.267	0.013	0.385	0.134	-0.018	-0.070
Beta on Conv. Arb. Index Excess Return	0.242	0.929	0.488	0.308	0.374	0.209	0.028	0.010
Beta on High Yield Index Excess Return	-0.044	0.005	-0.189	-0.089	-0.079	-0.037	0.034	-0.013
Beta on MSCI EM Index Excess Return	0.146	-0.001	-0.020	0.467	0.288	0.104	0.041	0.059
Beta on Global Macro Index Excess Return	0.357	0.042	0.139	0.137	0.243	0.493	0.161	0.498
Market Beta Return	-0.71%	-0.13%	-1.77%	-0.08%	-2.55%	-0.89%	0.12%	0.46%
Conv. Arb. Index Beta Return	-1.05%	-4.04%	-2.12%	-1.34%	-1.63%	-0.91%	-0.12%	-0.04%
High Yield Index Beta Return	0.11%	-0.01%	0.48%	0.23%	0.20%	0.09%	-0.09%	0.03%
MSCI EM Index Beta Return	0.21%	0.00%	-0.03%	0.66%	0.41%	0.15%	0.06%	0.08%
Global Macro Index Beta Return	1.08%	0.13%	0.42%	0.41%	0.73%	1.49%	0.48%	1.50%
Excess Return due to Risk Factors	-41.82%	102.84%	102.80%	-3.37%	141.59%	-6.41%	27.03%	34.96%
Excess Return due to Alpha	141.82%	-2.84%	-2.80%	103.37%	-41.59%	106.41%	72.97%	65.04%

As our regression results demonstrate, the beta on the market of all hedge funds is only 0.107 for the entire sample period, implying that the inclusion of factors with explanatory power diminishes the

[2] http://www.barclayhedge.com/research/indices/ghs/Convertible_Arbitrage_Index.html
[3] http://research.stlouisfed.org/fred2/series/BAMLHYH0A2BTRIV/downloaddata?rid=209
[4] http://www.msci.com/products/indices/country_and_regional/em/performance.html
[5] http://www.barclayhedge.com/research/indices/ghs/Global_Macro_Index.html

effectiveness of the market risk premium in explaining the hedge fund returns. Convertible Arbitrage, MSCI EM and Global Macro indices all prove to have significant explanatory power under the five-factor model with higher factor loadings than the market risk premium for all hedge funds. High Yield Index has the lowest explanatory power according to our regression results, with a beta of -0.044 on excess returns of all hedge funds. As a result of the significance of the new factors, the adjusted R Square is 0.946, very close to 1, suggesting that the risk factors we use explain 94.6% of the variation in hedge fund returns between January 2005 and April 2009, a 26.5% improvement compared to the three-factor model. Alpha is 1.26% in annualized terms for all hedge funds, a significant drop compared to the alphas under the CAPM and the Fama-French models.

Although the risk factors have statistically significant factor loadings in most trading strategies, the alphas are still persistent as illustrated by Figure 7. Global Macro and Emerging Markets strategies have the largest positive alphas of 3.78% and 3.75% respectively. This is an unexpected result due to the addition of the specifically chosen risk factors such as the Global Macro Index and MSCI EM Index monthly excess returns. Despite the persistence of the alphas, adjusted R Square is very high in all trading strategies with the exception of Distressed Securities and Equity Market Neutral.

By looking at the factor loadings of each risk factor for every trading strategy, it is also possible to reach an idea of the types of asset classes hedge funds with different trading strategies invest. For instance, Convertible Arbitrage funds mostly invest in convertible securities since its factor loading on the Convertible Arbitrage Index excess return is 0.929. On the opposite end of the spectrum, Equity Market Neutral funds do not have large factor loadings on the risk factors but generated significant alpha relative to the magnitude of their average excess returns over the period, with 72.97% of the returns are due to the alpha. Global Macro Index excess return is the only risk factor that has a significant positive beta in every trading strategy, demonstrating that hedge funds with all trading strategies placed bets on the overall market direction induced by major economic trends during the time period we analyse.

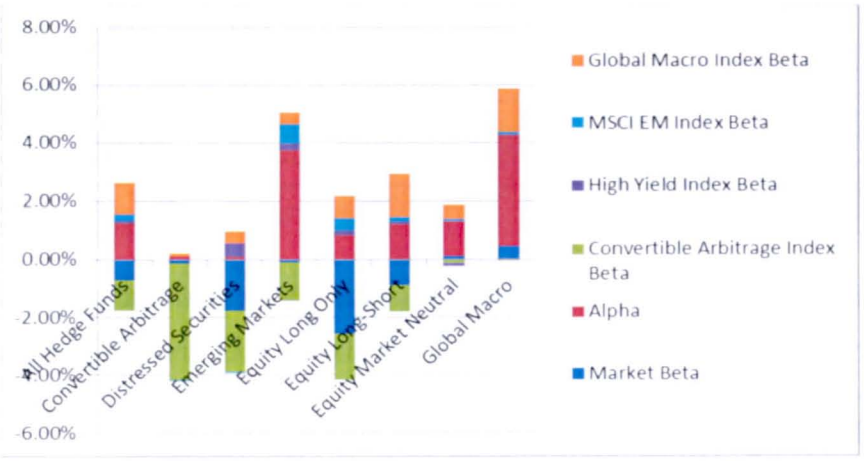

Figure 7: Sources of Hedge Fund Mean Returns between January 2005 and April 2009 under Five-Factor Model

Key return statistics for the three factors between January 2005 and March 2007 are illustrated below:

Key Statistics (Monthly)	Market Risk Premium	Convertible Arbitrage Index Excess Return	High Yield Index Excess Return	MSCI EM Index Excess Return	Global Macro Index Excess Return
Mean	0.50%	0.08%	0.34%	1.66%	0.31%
St. Dev.	2.12%	1.16%	0.91%	5.15%	1.64%
Min	-3.57%	-3.64%	-2.08%	-11.82%	-2.74%
Max	3.92%	2.04%	2.23%	10.03%	3.62%
Skewness	-0.147	-1.470	-0.725	-0.703	0.229
Kurtosis	-0.849	3.126	1.020	0.604	-0.713

Key Statistics (Annualized)	Market Risk Premium	Convertible Arbitrage Index Excess Return	High Yield Index Excess Return	MSCI EM Index Excess Return	Global Macro Index Excess Return
Mean	5.94%	1.02%	4.12%	19.97%	3.70%
St. Dev.	7.33%	4.02%	3.14%	17.84%	5.68%

All risk factors generated positive excess returns between January 2005 and March 2007. Hence, positive factor loadings on the risk factors have positive effect on the hedge fund excess returns throughout this period.

Summary statistics for the January 2005-March 2007 for hedge fund performances under the five-factor model is illustrated below:

Performance Measures (Jan 05 - Mar 07/Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Return	12.98%	6.37%	11.90%	22.50%	16.72%	12.83%	7.49%	9.01%
Excess Return	9.02%	2.42%	7.95%	18.55%	12.77%	8.87%	3.53%	5.05%
Adjusted R Square	0.914	0.982	0.577	0.884	0.844	0.838	0.336	0.850
Alpha	4.11%	1.41%	7.08%	8.27%	4.85%	3.70%	2.63%	2.76%
Beta on the Market	0.060	0.011	0.039	-0.258	0.449	0.111	-0.018	0.032
Beta on Conv. Arb. Index Excess Return	0.224	0.862	0.287	0.123	0.089	0.244	-0.014	0.098
Beta on High Yield Index Excess Return	0.109	0.031	0.015	0.262	-0.074	0.141	0.024	-0.057
Beta on MSCI EM Index Excess Return	0.121	-0.012	-0.058	0.465	0.183	0.099	0.036	0.018
Beta on Global Macro Index Excess Return	0.394	0.050	0.387	0.359	0.491	0.464	0.056	0.504
Market Beta Return	0.36%	0.06%	0.23%	-1.53%	2.67%	0.66%	-0.11%	0.19%
Conv. Arb. Index Beta Return	0.23%	0.88%	0.29%	0.13%	0.09%	0.25%	-0.01%	0.10%
High Yield Index Beta Return	0.45%	0.13%	0.06%	1.08%	-0.31%	0.58%	0.10%	-0.24%
MSCI EM Index Beta Return	2.42%	-0.25%	-1.15%	9.28%	3.65%	1.97%	0.72%	0.37%
Global Macro Index Beta Return	1.46%	0.18%	1.43%	1.33%	1.82%	1.72%	0.21%	1.87%
Excess Return due to Risk Factors	54.45%	41.68%	10.95%	55.43%	62.02%	58.34%	25.54%	45.26%
Excess Return due to Alpha	45.55%	58.32%	89.05%	44.57%	37.98%	41.66%	74.46%	54.74%

All five risk factors have significant positive factor loadings, demonstrating the variety of different asset classes hedge funds invest. Although the alpha for all hedge funds is still substantial at 4.11% in annualized terms, a greater proportion of hedge fund excess returns is explained by the risk factors during the period between January 2005 and March 2007 according to the five-factor model. Alpha generated by all hedge funds under the five-factor model actually turns out to be greater than that under the three-factor model for the same time period; however the risk factors we use in the five-factor model are more accurate than those we used in the three-factor model, demonstrated by the adjusted R Square of 0.914.

When we look closely at the performances of hedge funds with different trading strategies, we observe that positive excess returns are largely driven by the alpha, MSCI EM Index and Global Macro

Index monthly returns. This is mainly due to large positive factor loadings of Global Macro Index excess return and very high average annualized return of the MSCI Emerging Market Index throughout this sub-period. Alphas are large and positive for all trading strategies, suggesting that hedge funds over performed what would be predicted by the risk factors of the five-factor model during a period when all risk factors posted positive excess returns.

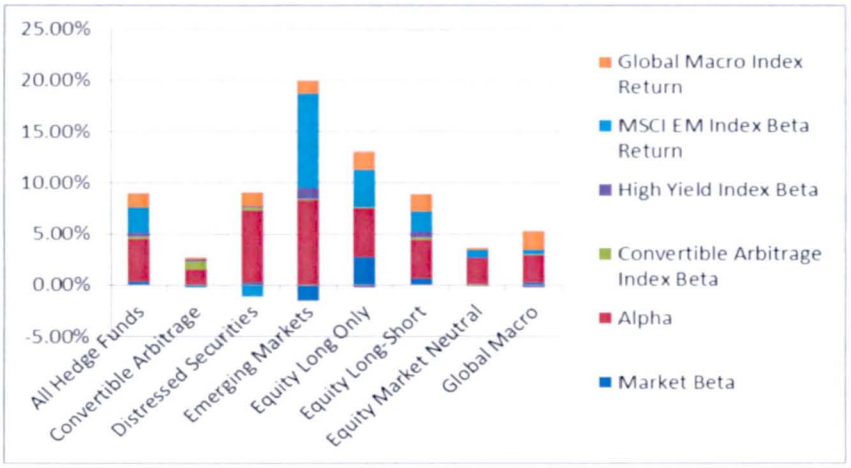

Figure 8: Sources of Hedge Fund Mean Returns between January 2005 and March 2007 under Five-Factor Model

Key return statistics for the three factors between January 2005 and March 2007 are displayed below:

Key Statistics (Monthly)	Market Risk Premium	Convertible Arbitrage Index Excess Return	High Yield Index Excess Return	MSCI EM Index Excess Return	Global Macro Index Excess Return
Mean	-1.68%	-0.85%	-0.81%	-1.55%	0.19%
St. Dev.	6.31%	3.98%	6.04%	10.87%	1.78%
Min	-17.23%	-13.84%	-20.44%	-32.24%	-3.42%
Max	10.19%	5.66%	12.06%	15.07%	3.55%
Skewness	-0.372	-1.692	-0.886	-0.877	-0.077
Kurtosis	0.267	4.555	4.414	1.224	-0.133

Key Statistics (Annualized)	Market Risk Premium	Convertible Arbitrage Index Excess Return	High Yield Index Excess Return	MSCI EM Index Excess Return	Global Macro Index Excess Return
Mean	-20.18%	-10.15%	-9.75%	-18.62%	2.27%
St. Dev.	21.87%	13.80%	20.94%	37.67%	6.18%

As the table above illustrates, all risk factors we use in our five-factor model except the Global Macro Index posted negative average annualized excess returns during the financial crisis. Global Macro Index excess return has the largest average return and lowest volatility during the given period.

Summary statistics for the April 2007-April 2009 for hedge fund performances under the five-factor model is presented below:

Performance Measures (Apr 07 - Apr 09/Annualized)	All Hedge Funds	Convertible Arbitrage	Distressed Securities	Emerging Markets	Equity Long Only	Equity Long-Short	Equity Market Neutral	Global Macro
Return	-5.48%	-8.40%	-12.27%	-10.07%	-15.54%	-4.77%	2.07%	9.06%
Excess Return	-7.90%	-10.81%	-14.68%	-12.49%	-17.96%	-7.19%	-0.34%	6.65%
Adjusted R Square	0.959	0.991	0.685	0.949	0.959	0.923	0.772	0.789
Alpha	-2.27%	-1.23%	-7.18%	-1.52%	-2.70%	-2.44%	-0.11%	4.97%
Beta on the Market	0.099	0.020	0.287	0.052	0.358	0.120	-0.012	-0.099
Beta on Conv. Arb. Index Excess Return	0.237	0.939	0.515	0.353	0.396	0.199	0.032	-0.023
Beta on High Yield Index Excess Return	-0.051	-0.003	-0.208	-0.110	-0.090	-0.039	0.017	-0.004
Beta on MSCI EM Index Excess Return	0.144	-0.005	-0.048	0.425	0.297	0.103	0.036	0.088
Beta on Global Macro Index Excess Return	0.429	0.098	0.257	0.219	0.284	0.550	0.304	0.459
Market Beta Return	-2.01%	-0.41%	-5.79%	-1.04%	-7.23%	-2.42%	0.24%	2.00%
Conv. Arb. Index Beta Return	-2.40%	-9.53%	-5.23%	-3.58%	-4.02%	-2.02%	-0.32%	0.24%
High Yield Index Beta Return	0.50%	0.03%	2.03%	1.07%	0.88%	0.38%	-0.17%	0.04%
MSCI EM Index Beta Return	-2.69%	0.10%	0.90%	-7.91%	-5.53%	-1.92%	-0.67%	-1.64%
Global Macro Index Beta Return	0.97%	0.22%	0.58%	0.50%	0.64%	1.25%	0.69%	1.04%
Excess Return due to Risk Factors	71.30%	88.65%	51.09%	87.80%	84.96%	65.98%	67.37%	25.25%
Excess Return due to Alpha	28.70%	11.35%	48.91%	12.20%	15.04%	34.02%	32.63%	74.75%

The adjusted R Square increases from 0.914 in the previous period to 0.959 during the financial crisis, implying a 4.5% enhancement in the explanatory power of the risk factors throughout the financial crisis. Factor loadings on the risk factors are also significantly higher compared to those throughout the previous period, suggesting that hedge fund returns are more sensitive to movements in the risk factors during the financial crisis, a result that we expected. Alpha (-2.27%) is negative and larger in absolute value compared to that under the three-factor model during the same period, which shows that hedge funds underperformed what would be predicted by the five-factor model during the financial crisis, on the contrary to their over performance throughout the previous sub-period. Finally, 71.30% of the average annualized excess return of all hedge funds is generated by the movements in the risk factors while only 28.70% is due to alpha.

All trading strategies except the Global Macro strategy generated negative alphas between April 2007 and April 2009. However, alphas are small relative to the total impact of the risk factors. Global Macro strategy does not only has positive alpha but also has negative factor loadings on three risk factors with negative average returns throughout this period, which increased its return during the financial crisis. Convertible Arbitrage strategy has a substantially lower alpha during the financial crisis under the five-factor model compared to that under the three-factor model, since its beta on the Convertible Arbitrage Index excess return is 0.939. Hence, with true risk factors, it is possible to eliminate hedge fund alphas to a large degree. Lastly, risk factors raise their explanatory power throughout the 2007-09 sub-period, as excess returns of all trading strategies except the Global Macro strategy are mostly explained by the five factors rather than alphas.

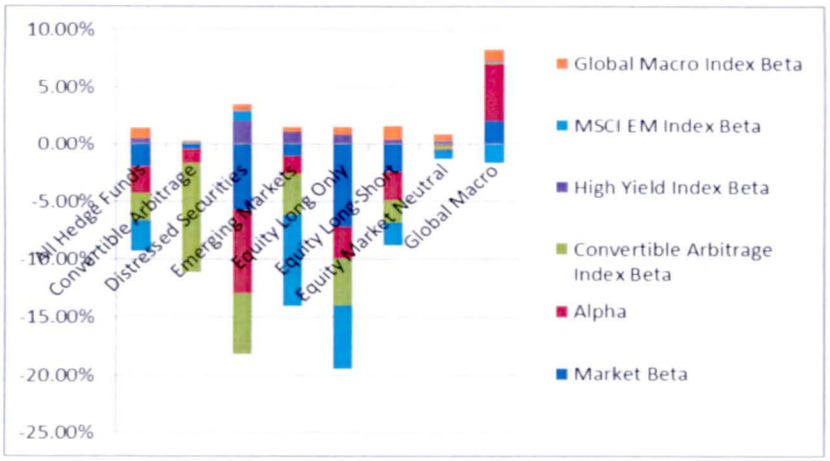

Figure 9: Sources of Hedge Fund Mean Returns between April 2007 and April 2009 under Five-Factor Model

8. Conclusion and Evaluation

Our analysis clearly demonstrates that the five-factor model best captures risk exposures of hedge fund returns between January 2005 and April 2009. Neither one-factor model nor three-factor model fails completely in explaining hedge fund returns throughout the given period; however the substantial increase in the adjusted R Square under the five-factor model is evidence of the success of the latter one. Our findings illustrate that alpha is persistent under all models and during all sub-periods most likely due to hedge funds' idiosyncratic strategies that cannot be explained by the risk factors fully; however during the recent financial crisis, hedge funds failed to generate positive alpha on average. Our work also shows that risk exposures of hedge fund returns shifted dramatically during the recent financial crisis, demonstrated by the sharp rise in the adjusted R Square and changing factor loadings of the risk factors under all three models. Finally, our analysis on hedge funds according to their trading strategies indicates that Global Macro has been the most successful strategy between January 2005 and April 2009 from a mean-variance point of view.

Despite a number of conclusions we drew on the performance of hedge funds throughout the given time frame that are in line with our initial expectations, there are a few limitations of our research that might provide implications on further research. First, our sample time period, which consists of only 52 data points, is relatively short, and this might have resulted in some distortions regarding our regressions. Second, our analysis is a simplistic one; for instance, including hedge fund fee structure could lead to slightly different conclusions. We acknowledge the fact that the inclusion of hedge fund fee structure could have yielded better results; however we did not take it into account not to distort our analysis due to large negative returns of hedge funds during the financial crisis. Finally, our models could include/substitute different risk factors that could possibly capture a greater proportion of the variation in hedge fund returns.

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