

# **On the Contribution of Multi-factors to Hedge Fund Returns**

**Dimitrios Koutmos<sup>1</sup> and Gregory Koutmos<sup>2</sup>**

## **Abstract**

This study evaluates the contribution of multi-factors to the returns of hedge fund indices, across several investment styles. The asset pricing models considered are the market factor model and the five factor Fama and French model augmented with the momentum factor. Based on monthly returns for 13 hedge fund indices representing different investment styles from January 1994 to January 2024, our empirical results show that major return contributions come from the market risk factor as well as the alpha factor. The effect of multi-factors, such as size, value, momentum, profitability, and investment, is minimal in terms of both their impact on the variance as well as the expected return of hedge fund indices. The multi-factors manage to marginally reduce the average contribution of the alpha return factor, whereas the contribution of the market factor is unaffected by the inclusion of additional factors.

**JEL classification numbers:** G12, G17, G20.

**Keywords:** CAPM, Hedge funds, Return Contributions, Risk Factors.

---

<sup>1</sup> Associate Professor of Finance, College of Business, Texas A&M University-Corpus Christi.

<sup>2</sup> Gerald M. Levin Professor of Finance, Charles F. Dolan School of Business, Fairfield University.

## 1. Introduction

Research on multi-factors has grown by leaps and bounds since Fama and French (1992, 1993) proposed their now famous three-factor model to overcome shortcomings of the CAPM. In light of earlier work by Basu (1977), Stattman (1980), Banz (1981), Rosenberg, Reid, and Lanstein (1985), and Bhandari (1988) on patterns in the cross-section of stock returns missed by market betas, Fama and French (1992, 1993) augment the market factor with size and value (book-to-market equity) risk factors. The intuition is that the additional factors compensate for “distress risk” that is not fully captured by the market factor. This line of reasoning has subsequently been further explored by Amihud (2002), Griffin and Lemmon (2002), Arshanapalli, Fabozzi, and Nelson (2006), Cambell, Hilscher, and Szilagyi (2008), and Simpson and Ramchander (2008).

Based on momentum findings identified by Jagadeesh and Titman (1993), Carhart (1997) further augmented Fama and French’s three-factor model by including a momentum factor (see also Grinblatt and Moskowitz, 2004). Subsequent studies have shown that momentum is both market dependent (see Chordia and Shivakumar, 2002 and Cooper, Gutierrez, and Hameed, 2004) and credit quality dependent (see Avramov, Chordia, Jostova, and Philipov, 2007). More recently Fama and French (2015) proposed a five factor model by augmenting the initial three factor model with two additional factors namely a profitability factor and an investment factor.

Aghassi et al. (2023) define factor investing as “a systematic tilting toward a style/theme implemented across a diversified set of assets”, and present evidence about the pros and cons of factor investing. Arnott et al. (2019) argue that factor investing is very extensive and there is a variety of financial products that offer choices to investors. They caution however, that users of such products should be aware of issues related to reliability of factors, the risks involved and the correlations among factors.

Despite the extensive literature pertaining to the ability of multi-factors to explain stock returns, much less effort has been devoted to the role of multi-factors in explaining the performance of hedge funds despite their growing importance in the financial markets. The growth in money under management (AUM) by hedge funds has been spectacular during the last fifteen years. As of the fourth quarter of 2022, the amount stood at 4.84 trillion US dollars according to *Barclays' Alternative Investment Database*. By comparison, the AUM stood at 1.7 trillion by the end of 2012 (a 284% increase over 10 years).

There are many reasons for this growth. Hedge funds have a great deal of flexibility given that they are largely unregulated pools of money managed by professional managers. Such flexibility allows managers to exploit perceived market inefficiencies more easily than traditional buy-and-hold mutual fund managers.

More specifically, hedge funds can use leverage, take short positions and use derivative securities in their hedging, speculative and arbitrage activities. Another measure of the importance of hedge funds is their trading activity which according to Stulz (2007) accounts for approximately half the trading in the New York and London stock exchanges.

The performance of hedge fund managers and the compensation structure has been a subject of considerable research in the academic world as well as a subject of intense debate in the investment world. As discussed in Stulz (2007), typically the total fee consists of the standard management fee plus an incentive fee. The first, ranges between 1%-2% and the latter is calculated as a percentage of the profits that can range between 15%-25%. There are many variations and many stipulations about the particular incentive fee structure but in all instances the higher fees charged by hedge fund managers are based on the perceived ability of these managers to earn "alpha returns", i.e., returns that cannot be explained (replicated) by common risk factors. Ibbotson, Chen and Zhou (2011) find that during the period 1995-2009, hedge funds were able to add a significant amount of alpha to a typical portfolio consisting of stocks bonds and cash. On average, the alpha return was 3% whereas, beta exposure contributed 4.7% during the same period. Ackermann, McEnally and Ravenscraft (1999) find that hedge funds consistently outperform mutual funds, but not standard market indices.

There is no general agreement as to what constitutes "alpha returns" or, equivalently what is the appropriate set of risk factors to use when estimating alpha. In most cases the statistical framework used is based on the Capital Asset Pricing Model whereby excess returns on the hedge fund are regressed against excess returns on a suitable proxy for the market portfolio. The intercept of the regression is the alpha return component. In most cases the model is extended to include additional factors on the assumption that the market index used as a proxy for the market portfolio does not adequately describe the cross section of the expected returns of speculative assets in general and stock returns in particular. The choice of appropriate factors has been a matter of intense debate in general and in the area of hedge funds in particular. Asness et al. (2001) use the single index model with the market factor being the single factor. They use both contemporaneous and lagged market index values to capture the high serial correlation in hedge fund returns that they attribute to asset illiquidity. Fung and Hsieh (2004) argue for the use of asset based style factors (ABS) and they report that up to 90% of return variation in diversified hedge fund portfolios can be explained by such factors.

For stock returns, Fama and French (2015) recommended a five-factor model containing market, size, value, profitability and investment as factors. They argued that this new model outperforms other asset pricing models and therefore should be used to obtain expected returns in practice. Fama and French (2016) presented supporting international empirical evidence for their five factor-model. Closely related to the five-factor model, Hou, Xue, and Zhang (2015) proposed a  $q$ -factor model including an investment and a profitability factor (return on equity). Other studies by Fung and Hsieh (2004) and Ammann et al. (2013) have proposed seven-

factor and eight-factor models, respectively. Chan, Chen, and Hsieh (1985) and Chen, Roll, and Ross (1986) tested different sets of macroeconomic variables as factors in asset pricing (see also Cochrane (2011)). French, Wu, and Li (2016) studied the relative importance of stock characteristics for explaining stock returns. They evaluated the relative explanatory power of market, size, value, momentum, volatility, and liquidity factors for the U.K. market. Based on their relative contribution to the fit of the model and to the proportion of months the factor returns are statistically significant, the results indicated that momentum (liquidity) is the most (least) important factor.

In this paper we study the ability of multi-factors to explain the performance of hedge fund indices in terms of their average return and variability. We use the Fama and French (2015) multi-factors plus the momentum factor introduced by Carhart (1997). The alpha return is simply the part of the return that cannot be explained by standardized multi-factors.

## 2. Methodology

In line with Zhang (2005), Ang and Chen (2007), and Adrian and Franzoni (2009), we specify the conditional CAPM model such that the expected return on an asset is proportional to the conditional market factor loading and the corresponding conditional market factor risk premium, or:

$$E_{t-1}[r_{i,t}^e] = E_{t-1}[\beta_{i,t}] E_{t-1}[r_{m,t}^e], \quad (1)$$

where  $r_{i,t}^e$  denotes the excess return on asset  $i$ ,  $i=1, \dots, N$ ,  $\beta_{i,t}$  is the market factor loading for asset  $i$ , and  $E_{t-1}[r_{m,t}^e]$  is the corresponding conditional market risk premium. The conditional market factor loading (beta) is defined as:

$$\beta_{i,t|t-1} = E_{t-1}[\beta_{i,t}] = cov_{t-1}(r_{i,t}^e, r_{m,t}^e) / var_{t-1}(r_{m,t}^e). \quad (2)$$

An empirical version of the conditional CAPM model will then take the form:

$$r_{i,t}^e = \alpha_{i,t} + \beta_{i,t} r_{m,t}^e + \varepsilon_{i,t}, \quad (3)$$

where  $E_{t-1}[\alpha_{i,t}] = 0$ , and  $\varepsilon_{i,t}$  are i.i.d. normal and uncorrelated with  $r_{m,t}^e$ . A corresponding empirical multifactor asset pricing model is given by

$$r_{i,t}^e = \alpha_{i,t} + \sum_{k=1}^K \beta_{i,k,t} f_{k,t} + \varepsilon_{i,t}, \quad (4)$$

where again  $\beta_{i,k,t}$  is the time-varying loading on factor  $k$ ,  $k=1, \dots, K$ , and  $f_{k,t}$  is the corresponding value of the risk factor at time  $t$ . Of course, when the factors are uncorrelated, the conditional factor loadings can be written in the form of equation (2).

A traditional approach in evaluating the contribution of an individual factor is to utilize standardized slope coefficients which amounts to multiplying the regression coefficient by the standard deviations of the corresponding factor. This makes the standardized coefficient reflect the contribution of one standard deviation change of the factor on the dependent variable (c.f. Bali, Engle, and Murray 2016, p.96). While standardization makes the slope coefficients comparable, they reflect the contribution of the variability of the explanatory variable on the dependent variable. In asset pricing, like CAPM, the focus is in the relation of the expected return to the underlying risk factors rather than explaining variability in the returns. Accordingly, our aim is to propose a measure that captures each factor's contribution to the expected return/risk factor relationship.

Assuming that the factor loadings are stationary, linear regression will provide unbiased estimates of the unconditional expectation  $E[\beta_{i,k,t}]$ . Furthermore, according to the basic characteristics of linear regression, the average residual is equal to zero, and the linear regression will cross the averages of the dependent and independent variables. As a consequence, at the mean of factors, all asset pricing models estimated by linear regression deliver by definition the same expected excess return as the average sample excess return for the portfolio. Hence, at the mean all models have exactly the same expected excess return independently of which and how many factors are included. Putting it differently, the estimated single factor model in equation (3) and the estimated multifactor model in equation (4) will imply the same sample average for the left-hand variable.<sup>3</sup> This provides a plausible benchmarking point for comparing the economic contribution of different individual as well as groups of risk factors in an asset pricing model of type (4). Based on this mean benchmarking intuition, we can define the individual *factor return contribution* (FRC) of a risk factor  $k$  in a specific model  $l$  as follows:

$$\text{FRC} = E[\beta_{i,k,t,l}] * E[f_{k,t}] / \sum_{k=1}^K E[\beta_{i,k,t,l}] * E[f_{k,t}], \quad (5)$$

where  $K$  is the number of factors in model  $l$ . In the empirical version, the unconditional  $E[\beta_{i,k,t,l}]$  is substituted for the corresponding linear regression estimate, and the unconditional  $E[f_{k,t}]$  is estimated using the total sample average. The alpha return  $\alpha_{i,k,t,l}$  is treated as a loading with expected premium equal to one.

---

<sup>3</sup> For example, taking expectations and dividing by the expected return in equation (3) for each asset yields:  $\frac{E(r_{i,t}^e)}{E(r_{i,t}^e)} = \frac{\alpha_i}{E(r_{i,t}^e)} + \frac{\beta_i E(r_{m,t}^e)}{E(r_{i,t}^e)} = 100\%$ . This decomposes the expected return into the part attributed to alpha and the part attributed to the market factor. A similar expected return decomposition can be applied to any multifactor model. When comparing across models we chose the one that minimizes the contribution of the alpha return.

Also, an *average factor return contribution (AFRC)* across a group of assets can be calculated as follows:

$$AFRC_{k,l} = \frac{1}{N} \sum_{i=1}^N \frac{E[\beta_{i,k,t,l}] * E[f_{k,t}]}{\sum_{k=1}^K E[\beta_{i,k,t,l}] * E[f_{k,t}]} \quad (6)$$

where  $K$  is the number of factors in model  $l$ , and  $N$  is the number of assets or portfolios.<sup>4</sup>

### 3. Data

The data used in this study are monthly returns on hedge funds indices with the following investment styles: Hedge fund index (HEDG), Convertible arbitrage (CARB), Emerging markets (EMMKT), Equity market neutral (EQNTR), Event driven (EDRV), Event Driven Distressed (EDDIST), Event Driven Multi Strategy (EDMS), Event Driven Risk Arbitrage (EDRARB), Fixed Income Arbitrage (FIARB), Global macro (GLMAC), Long/Short equity (LOSHO), Managed futures (MGFUT) and Multi-strategy (MULTI).

The data are monthly returns covering the period January 1994 to January 2024 and are obtained from the Credit Suisse/Tremont Hedge Fund Index ([www.hedgeindex.com](http://www.hedgeindex.com)). These indices have been used by several studies including Asness et al. (2001).

In addition we use monthly return data on the following factors: Market factor (MKT), Size factor (SMB), Value factor (HML), profitability factor (RMW), investment factor (CMA) and momentum factor (MOM), all of which are obtained from Professor French's Data Library. These data sets are publicly accessible here: [https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). There is a total of 361 monthly return observations for all variables used in the analysis.

### 4. Main Findings

Table (1.A.) reports the preliminary statistics on the factors. All factors have positive average returns, with the market factor having the highest average. The skewness and kurtosis statistics as well as the Jarque-Bera statistic, suggest that all series are not normally distributed. Among the factors, the market has the highest Sharpe Ratio. Table (1.B.) reports the preliminary statistics for the hedge fund indices. All average values are positive but normality is rejected in all cases. The Sharpe Ratio is highest for the Multi Strategy Index (MULTI) followed by the overall hedge fund index (HEDG). It should be noted however, that the non-normality and the presence of serial correlation in the returns overstates the Sharpe Index values.

Tables (2.A.) and (2.B.) report the pairwise correlations among the risk factors and the hedge fund indices respectively. There are several instances of high and

---

<sup>4</sup> The FRC metric is similar to the one used by Knif et al. (2019).

significant correlations among the risk factors. In general, correlation values greater than .15 or, smaller than -0.15 are statistically significant at the 5% level given the sample size. This suggests that there is sizable overlapping information across risk factors. The correlation between the profitability (CMA) and the value (HML) is 0.65 implying very high degree of overlapping information contained in these factors. Similarly, several pairwise correlations among hedge fund indices are significant suggesting that there are common factors driving hedge fund index returns.

Table 3 reports the results of the market model where the single risk factor is the market factor. The alpha factor is significant in the case of the overall hedge fund index (HEDG), the event driven distressed (EDDIST), the event driven risk arbitrage (EDRARB), the global macro (GLMAC) and the multi strategy (MULTI). Almost all indices have significant exposure to the market risk factor with the exception of managed futures (MGFUT). The moving average parameter  $\phi$  is significant with the exception of equity neutral (EQNTR) and managed futures (MGFUT). This is in accordance with the findings of several studies including Asness et al. (2001) and Getmansky et al. (2004). The latter study suggests that the autocorrelation of hedge funds can be used as a measure of illiquidity of their assets. The market factor alone can explain a rather high percentage of the variation of the hedge fund returns. The average adjusted  $R^2$  across all cases is 31%. This suggesting that on average 31% of the variability in hedge fund returns can be explained by the market factor. There is variation however, with the highest value of  $R^2$  being 58%, for long-short (LOSH) and the lowest value being -0.0022 for managed futures (MGFUT).

**Table 1.A.: Descriptive Statistics**

<i>Panel A: Risk Factors</i>									
	<b>Mean</b>	<b>Median</b>	<b>Max</b>	<b>Min</b>	<b>Std. Dev.</b>	<b>Skewness</b>	<b>Kurtosis</b>	<b>J-B</b>	<b>SR</b>
MKT	0.9078	1.4200	13.6500	-17.1500	4.5179	-0.5994	3.9750	35.9155	0.1589
SMB	0.0897	-0.0500	18.2800	-15.3200	3.1294	0.3713	7.0225	251.6841	0.0287
HML	0.1203	-0.0200	12.7500	-13.8700	3.3549	0.1593	5.3167	82.2575	0.0359
RMW	0.3815	0.4100	13.0700	-18.6500	2.7396	-0.3673	11.8557	1187.7360	0.1393
CMA	0.2110	-0.0100	9.0700	-7.2200	2.2329	0.4801	4.7570	60.3044	0.0945
MOM	0.3513	0.5000	18.2000	-34.3000	4.8781	-1.4356	12.6100	1513.1311	0.0720
RF	0.1894	0.1400	0.5600	0.0000	0.1771	0.3738	1.5676	39.2697	1.0694

**Table 1.B: Descriptive Statistics**

<i>Panel B: Hedge Fund Styles</i>									
	<b>Mean</b>	<b>Median</b>	<b>Max</b>	<b>Min</b>	<b>Std. Dev.</b>	<b>Skewness</b>	<b>Kurtosis</b>	<b>J-B</b>	<b>SR</b>
HEDG	0.5719	0.5972	8.1837	-7.8493	1.8899	-0.4057	6.9355	242.87	0.2064
CVARB	0.4844	0.6620	5.6450	-13.4583	1.7560	-2.9299	24.1093	7219.09	0.1723
EMMKT	0.5001	0.7656	15.1995	-26.1703	3.6809	-1.2543	12.0855	1336.29	0.0864
EQNTR	0.3201	0.5190	4.2442	-51.8404	3.0013	-14.6220	254.2631	962491.60	0.0460
EDRV	0.5867	0.8122	6.5323	-14.4644	1.9207	-2.6047	18.9590	4239.16	0.2107
EDDIST	0.6357	0.8001	6.6736	-13.3015	1.8075	-2.2346	16.7836	3158.19	0.2511
EDMS	0.5598	0.7558	6.6627	-16.9458	2.1317	-2.4965	18.7563	4109.25	0.1773
EDRARB	0.4564	0.4952	5.8704	-6.5611	1.2786	-0.7422	8.6279	509.55	0.2146
FIARB	0.3998	0.5867	4.2436	-15.1235	1.4502	-5.0513	45.4312	28616.25	0.1503
GLMAC	0.7194	0.7834	10.0721	-12.2745	2.4915	-0.1156	7.4474	298.32	0.2158
LOSHO	0.6359	0.7248	12.2284	-12.1433	2.5202	-0.2615	6.7938	220.61	0.1801
MGFUT	0.3844	0.2680	9.4873	-9.8211	3.1681	-0.0632	3.0633	0.30	0.0639
MULTI	0.5719	0.6961	4.1882	-7.6311	1.4347	-1.6544	9.8478	870.00	0.2718

Notes: HEDG=Hedge fund index; CARB=Convertible arbitrage; EMMKT=Emerging markets; ENTR=Equity market neutral; EDRV=Event driven; EDDIST=Event Driven Distressed; EDMS=Event Driven Multi Strategy; EDRARB=Event Driven Risk Arbitrage; FIARB=Fixed Income Arbitrage; GLMAC=Global macro; LOSHO=Long/Short equity; MGFUT=Managed futures; MULTI=Multi -Strategy; MKT=Market Factor; SMB=Size Factor; HML=Value Factor; RMW=Profitability Factor; CMA=Investment Factor; MOM=Momentum Factor, RF=risk-free rate.

J-B is the Jarque-Bera statistic testing for normality. SR is the Sharpe ratio.

**Table 2.A.: Pairwise Correlations**

<i>Panel A: Risk Factors</i>						
	<b>MKT</b>	<b>SMB</b>	<b>HML</b>	<b>RMW</b>	<b>CMA</b>	<b>MOM</b>
MKT	1.0000	0.2345	-0.0871	-0.3526	-0.3075	-0.3116
SMB	0.2345	1.0000	0.0060	-0.4691	-0.0198	-0.0553
HML	-0.0871	0.0060	1.0000	0.3633	0.6445	-0.2113
RMW	-0.3526	-0.4691	0.3633	1.0000	0.2549	0.0563
CMA	-0.3075	-0.0198	0.6445	0.2549	1.0000	0.0333
MOM	-0.3116	-0.0553	-0.2113	0.0563	0.0333	1.0000

**Table 2.B.: Pairwise Correlations**

*Panel B: Correlations Among Hedge Fund Index Returns*

	HEDG	CVARB	EMMKT	EQNTR	EVDRV	EDDIST	EDMS	EDRARB	FIARB	GLMAC	LOSHO	MGFUT
HEDG	1.000	0.578	0.699	0.297	0.767	0.714	0.762	0.535	0.564	0.790	0.841	0.222
CVARB	0.578	1.000	0.487	0.208	0.656	0.624	0.638	0.503	0.764	0.342	0.481	-0.068
EMMKT	0.699	0.487	1.000	0.163	0.661	0.632	0.646	0.502	0.432	0.414	0.663	-0.033
EQNTR	0.297	0.208	0.163	1.000	0.272	0.312	0.234	0.182	0.314	0.085	0.223	0.006
EDRV	0.767	0.656	0.661	0.272	1.000	0.926	0.975	0.708	0.543	0.418	0.746	-0.005
EDDIST	0.714	0.624	0.632	0.312	0.926	1.000	0.830	0.606	0.524	0.384	0.680	-0.016
EDMS	0.762	0.638	0.646	0.234	0.975	0.830	1.000	0.693	0.526	0.433	0.734	0.003
EDRARB	0.535	0.503	0.502	0.182	0.708	0.606	0.693	1.000	0.351	0.259	0.580	-0.026
FIARB	0.564	0.764	0.432	0.314	0.543	0.524	0.526	0.351	1.000	0.388	0.409	-0.057
GLMAC	0.790	0.342	0.414	0.085	0.418	0.384	0.433	0.259	0.388	1.000	0.440	0.349
LOSHO	0.841	0.481	0.663	0.223	0.746	0.680	0.734	0.580	0.409	0.440	1.000	0.075
MGFUT	0.222	-0.068	-0.033	0.006	-0.005	-0.016	0.003	-0.026	-0.057	0.349	0.075	1.000
MULTI	0.577	0.666	0.314	0.347	0.594	0.526	0.594	0.424	0.602	0.334	0.522	0.128

Notes: Correlation values greater than .15 in absolute terms are statistically significant at 5% and sample size=361. HEDG=Hedge fund index; CARB=Convertible arbitrage; EMMKT=Emerging markets; ENTR=Equity market neutral; EDRV=Event driven; EDDIST=Event Driven Distressed; EDMS=Event Driven Multi Strategy; EDRARB=Event Driven Risk Arbitrage; FIARB=Fixed Income Arbitrage; GLMAC=Global macro; LOSHO=Long/Short equity; MGFUT=Managed futures; MULTI=Multi –Strategy; MKT=Market Factor; SMB=Size Factor; HML=Value Factor; RMW=Profitability Factor; CMA=Investment Factor; MOM=Momentum Factor, RF=risk-free rate.

**Table 3: Market Model**

$$r_{i,t} - r_f = a + b_m (r_{m,t} - r_f) + \varphi \varepsilon_{i,t-1} + \varepsilon_t$$

		<b>a</b>	<b>b<sub>m</sub></b>	<b>φ</b>	<b>Q(12)</b>	<b>R<sup>2</sup></b>
HEDG	Coeff	0.1996	0.2553	0.1561	15.1840	0.4131
	t-stat	2.238*	20.047*	4.614*		
CVARB	Coeff	0.2078	0.1184	0.3502	24.6843	0.2730
	t-stat	1.668	9.157*	15.551*		
EMMKT	Coeff	0.0056	0.4317	0.3224	18.7635	0.3724
	t-stat	0.026	15.063*	7.965*		
EQNTR	Coeff	0.0128	0.1641	-0.0183	5.9973	0.0525
	t-stat	0.033	2.384*	-0.109		
EDRV	COEFF	0.1991	0.2774	0.2316	18.5845	0.5054
	t-stat	1.891	22.464*	6.116*		
EDDIST	Coeff	0.2838	0.2282	0.2349	32.3153	0.4216
	t-stat	2.789*	18.404*	4.259*		
EDMS	Coeff	0.1540	0.3026	0.2111	13.4854	0.4708
	t-stat	1.307	21.334*	5.904*		
EDRARB	Coeff	0.1587	0.1497	0.1761	11.9908	0.3295
	t-stat	2.450*	16.255*	4.646*		
FIARB	Coeff	0.1557	0.0790	0.4794	11.7818	0.3027
	t-stat	1.192	6.812*	18.761*		
GLMAC	Coeff	0.4190	0.1546	0.1464	35.6209	0.0836
	t-stat	2.857*	6.327*	3.986*		
LOSHO	Coeff	0.1481	0.4160	0.1244	15.9485	0.5810
	t-stat	1.492	26.895*	4.428*		
MGFUT	Coeff	0.2348	-0.0555	-0.0049	15.4438	-0.0022
	t-stat	1.378	-1.635	-0.092		
MULTI	Coeff	0.2936	0.1244	0.1432	10.8241	0.1962
	t-stat	3.355*	10.890*	4.285*		

Notes: (\*) denotes statistical significance at the 5% level at least. Q(12) is the Ljung-Box statistic testing for serial correlation in the residuals up to 12 lags. It follows  $\chi^2$  with 12 degrees of freedom. The 5% critical value is 21.026. R<sup>2</sup> is the adjusted R-squared. The average across all indices is 30.77%.

HEDG=Hedge fund index; CARB=Convertible arbitrage; EMMKT=Emerging markets; ENTR=Equity market neutral; EDRV=Event driven; EDDIST=Event Driven Distressed; EDMS=Event Driven Multi Strategy; EDRARB=Event Driven Risk Arbitrage; FIARB=Fixed Income Arbitrage; GLMAC=Global macro; LOSHO=Long/Short equity; MGFUT=Managed futures; MULTI=Multi –Strategy; MKT=Market Factor; SMB=Size Factor; HML=Value Factor; RMW=Profitability Factor; CMA=Investment Factor; MOM=Momentum Factor, RF=risk-free rate.

Table 4 reports the findings from the estimation of the multifactor model. The average  $R^2$  is higher compared to the single factor model (35% vs. 31%) suggesting a better fit overall. Thus, in terms of explaining the variance of hedge fund returns the multi-factor model does a marginally better job. The alpha parameter remains significant for the overall hedge fund index and the same style indices as with the single factor model i.e., in 5 out of 13 cases. This is potentially significant as it suggests that the alpha returns in these cases are real and not simply smart beta returns. The market index remains significant in 11 out of 13 cases. The size factor is significant in 8 out of 13 cases, the value factor in 5 out of 13, the profitability factor in 1 out of 13, the investment factor in 2 of 13 and the momentum factor in 5 out of 13 cases. Overall, the evidence shows that the market factor is the most significant explanatory variable followed by the size, the value and momentum factors. The profitability and the investment factors are not important variables for the modeling of hedge fund returns. The moving average parameter  $\varphi$  is significant with minor exceptions suggesting that serial correlation is an important feature of hedge fund returns possibly to asset illiquidity.

Table (5.A.) provides a detailed breakdown of the Factor Return Contribution (FRC) using the market or, single factor model. The market factor is responsible for 48% of the returns of the overall hedge fund index (HEDG), with the remaining 52% being attributed to the alpha factor. There is considerable variation across individual hedge fund indices. Surprisingly, the emerging markets index (EMMKT) shows 100% of its returns being driven by the market index with zero alpha returns. It can be argued that in this specific case investors are paying alpha fees for beta returns. The opposite extreme case is the managed futures index (MGFUT) where the market contributes a negative 20% and with the alpha return being 120%. It can be argued that managed futures are offering investors pura alpha returns. The average factor return contribution (AFRC) across all indices is split between 44% due to the market factor and 56% due to the alpha factor.

Table (5.B.) provides a detailed breakdown of the Factor Return Contribution (FRC) using the multi-factor model. The contribution of the market factor remains quite robust for the average hedge fund index (HEDGE) contributing 49% to the overall return, the alpha return contributes 47% and the momentum factor 9%. The remaining factors, i.e., SMB, HML, RMW and CMA contribute collectively minimally negative to the overall return. Interestingly, this pattern repeats across almost all hedge fund indices, i.e., the market and alpha factor are the main contributors to hedge fund returns. Looking at the averages across all indices, it can be seen that the market factor contribution remains unchanged at 44% of total return. It appears that the addition factors are impacting slightly the alpha return contribution reducing it from 56% (in the single index model) to 52% (in the multi-factor model).

**Table 4: Multifactor Model**

$$r_{i,t} = a + b_m r_{m,t} + b_{SML}(SML_t) + b_{HML}(HML_t) + b_{RMW}(RMW_t) + b_{CMA}(CMA_t) + b_{MOM}(MOM_t) + \varphi \varepsilon_{i,t-1} + \varepsilon_t$$

		<b>a</b>	<b>b<sub>m</sub></b>	<b>b<sub>SMB</sub></b>	<b>b<sub>HML</sub></b>	<b>b<sub>RMW</sub></b>	<b>b<sub>CMA</sub></b>	<b>b<sub>MOM</sub></b>	<b>φ</b>	<b>R<sup>2</sup></b>
HEDG	Coeff	0.1792	0.2644	0.0563	0.0443	-0.0625	-0.0383	0.1002	0.1315	0.4811
	t-stat	2.120*	16.769*	2.261*	1.855	-1.657	-0.9625	6.403*	3.562*	
CVARB	Coeff	0.2186	0.1024	0.0719	0.0133	0.0136	-0.0005	-0.0331	0.3542	0.2903
	t-stat	1.666	6.176*	2.470*	0.526	0.339	-0.0117	-1.962*	13.882*	
EMMKT	Coeff	0.0341	0.4046	0.1203	-0.0084	-0.0250	-0.1378	0.0585	0.3267	0.3920
	t-stat	0.151	10.488*	2.058*	-0.126	-0.295	-1.3555	1.442	8.064*	
EQNTR	Coeff	0.0851	0.1336	-0.0081	0.2451	-0.1067	-0.2107	0.0173	-0.0290	0.0765
	t-stat	0.225	1.641	-0.062	2.023*	-0.616	-1.0713	0.217	-0.2946	
EDRV	Coeff	0.1703	0.2723	0.1305	0.0770	0.0362	-0.0425	0.0206	0.2027	0.5539
	t-stat	1.7070	16.856*	4.586*	3.643*	0.967	-1.0990	1.3815	4.612*	
EDDIST	Coeff	0.2938	0.2095	0.1043	0.0850	-0.0026	-0.0681	-0.000	0.2080	0.4618
	t-stat	2.872*	13.423*	4.238*	3.705*	-0.080	-1.8167	-0.0609	3.374*	
EDMS	Coeff	0.1083	0.3029	0.1474	0.0849	0.0456	-0.0371	0.0368	0.1859	0.5234
	t-stat	0.998	15.711*	4.316*	3.456*	1.031	-0.8132	2.099*	4.479*	
EDRARB	Coeff	0.1472	0.1427	0.0914	0.0125	0.0002	0.0253	0.0050	0.1730	0.3786
	t-stat	2.229*	11.367*	4.452*	0.701	0.007	0.8293	0.444	3.959*	
FIARB	Coeff	0.1681	0.0708	0.0219	0.0624	-0.0045	-0.0600	-0.0032	0.4688	0.3093
	t-stat	1.308	4.536*	0.9248	2.918*	-0.120	-1.6759	-0.165	16.097*	
GLMAC	Coeff	0.3467	0.1931	0.0001	0.0869	-0.0274	0.0350	0.1055	0.1204	0.1159
	t-stat	2.332*	7.1528	0.0019	1.887	-0.426	0.5164	4.162*	2.932*	
LOSHO	Coeff	0.1450	0.407	0.1348	0.0023	-0.0645	-0.1392	0.1454	0.1440	0.7143
	t-stat	1.7482	24.8686	5.902*	0.097	-2.039*	-3.8935	11.032*	3.131*	
MGFUT	Coeff	0.0642	0.0326	-0.0198	-0.0416	0.0917	0.1577	0.1304	-0.0031	0.0348
	t-stat	0.370	0.809	-0.347	-0.574	1.225	1.5863	3.377*	-0.0581	
MULTI	Coeff	0.2816	0.1269	0.0315	0.0131	-0.0079	0.0159	0.0157	0.1370	0.1949
	t-stat	3.119*	8.754*	1.142	0.595	-0.202	0.3569	0.882	3.769*	

Notes: (\*) denotes statistical significance at the 5% level at least. R<sup>2</sup> is the adjusted R-squared. The average across all indices is 35%. HEDG=Hedge fund index; CARB=Convertible arbitrage; EMMKT=Emerging markets; ENTR=Equity market neutral; EDRV=Event driven; EDDIST=Event Driven Distressed; EDMS=Event Driven Multi Strategy; EDRARB=Event Driven Risk Arbitrage; FIARB=Fixed Income Arbitrage; GLMAC=Global macro; LOSHO=Long/Short equity; MGFUT=Managed futures; MULTI=Multi – Strategy; MKT=Market Factor; SMB=Size Factor; HML=Value Factor; RMW=Profitability Factor; CMA=Investment Factor; MOM=Momentum Factor, RF=risk-free rate.

**Table 5.A.: Expected Return Contributions**

<i>Panel A: Market Model</i>			
		$a_i$	<b>MKT</b>
HEDG	FRC	0.5218	0.4795
CVARB	FRC	0.7043	0.2883
EMMKT	FRC	0.0181	0.9983
EQNTR	FRC	0.0980	0.9024
EDRV	FRC	0.5012	0.5015
EDDIST	FRC	0.6359	0.3673
EDMS	FRC	0.4158	0.5869
EDRARB	FRC	0.5945	0.4030
FIARB	FRC	0.7402	0.2699
GLMAC	FRC	0.7906	0.2096
LOSHO	FRC	0.3317	0.6695
MGFUT	ERC	1.2043	-0.2044
MULTI	FRC	0.7678	0.2336
<b>Average</b>	<b>AFRC</b>	<b>0.5621</b>	<b>0.4379</b>

**Table 5.B.: Expected Return Contributions**

<i>Panel B: Multi-Factor Model</i>								
		$a_i$	<b>MKT</b>	<b>SMB</b>	<b>HML</b>	<b>RMW</b>	<b>CMA</b>	<b>MOM</b>
HEDG	FRC	0.4685	0.4967	0.0132	0.0139	-0.0623	-0.0211	0.0920
CVARB	FRC	0.7411	0.2495	0.0219	0.0054	0.0176	-0.0004	-0.0394
EMMKT	FRC	0.1097	0.9358	0.0347	-0.0032	-0.0307	-0.0936	0.0661
EQNTR	FRC	0.6515	0.7345	-0.0056	0.2257	-0.3116	-0.3403	0.0464
EDRV	FRC	0.4286	0.4924	0.0295	0.0233	0.0347	-0.0226	0.0182
EDDIST	FRC	0.6583	0.3372	0.0210	0.0229	-0.0022	-0.0322	-0.0007
EDMS	FRC	0.2925	0.5876	0.0357	0.0276	0.0470	-0.0211	0.0349
EDRARB	FRC	0.5515	0.3841	0.0307	0.0056	0.0003	0.0200	0.0065
FIARB	FRC	0.7992	0.2418	0.0093	0.0357	-0.0081	-0.0602	-0.0053
GLMAC	FRC	0.6541	0.2618	0.0000	0.0197	-0.0197	0.0139	0.0699
LOSHO	FRC	0.3247	0.6556	0.0271	0.0006	-0.0552	-0.0658	0.1144
MGFUT	FRC	0.3295	0.1203	-0.0091	-0.0257	0.1794	0.1707	0.2350
MULTI	FRC	0.7363	0.2383	0.0074	0.0041	-0.0079	0.0088	0.0145
<b>Average</b>	<b>AFRC</b>	<b>0.5172</b>	<b>0.4398</b>	<b>0.0165</b>	<b>0.0273</b>	<b>-0.0168</b>	<b>-0.0340</b>	<b>0.0500</b>

Notes: FRC=Factor Return Contribution; AFRC=Average Factor Return Contribution. HEDG=Hedge fund index; CARB=Convertible arbitrage; EMMKT=Emerging markets; ENTR=Equity market neutral; EDRV=Event driven; EDDIST=Event Driven Distressed; EDMS=Event Driven Multi Strategy; EDRARB=Event Driven Risk Arbitrage; FIARB=Fixed Income Arbitrage; GLMAC=Global macro; LOSHO=Long/Short equity; MGFUT=Managed futures; MULTI=Multi -Strategy; MKT=Market Factor; SMB=Size Factor; HML=Value Factor; RMW=Profitability Factor; CMA=Investment Factor; MOM=Momentum Factor, RF=risk-free rate.

## 5. Concluding Remarks

In this paper we evaluate the contribution of several risk factors to hedge fund expected returns. The asset pricing models considered are the market factor model and the five factor Fama and French model augmented with the momentum factor. Using monthly returns for 13 hedge fund indices representing different investment styles from January 1994 to January 2024, our empirical results showed that major return contributions come from the market risk factor as well as the alpha factor. The effect of multi-factors, such as size, value, momentum, profitability, and investment, is minimal in terms of both their impact on the variance as well as the expected return of hedge fund indices. The market factor exhibit remarkable robustness in terms of its average contribution to hedge fund returns. The multi-factors manage to marginally reduce the average contribution of the alpha return factor, whereas the contribution of the market factor is unaffected by the inclusion of additional factors.

## References

- [1] Ackermann, C., McEnally, R. and Ravenscraft, D. (1999). The performance of hedge funds: risk, return, and incentives. *Journal of Finance*, 54(3), pp. 833–874.
- [2] Adrian, T. and Franzoni, F. (2009). Learning about beta: time-varying factor loadings, expected returns, and the conditional CAPM. *Journal of Empirical Finance*, 16, pp. 537–556.
- [3] Aghassi, M., Asness, C., Fattouche, C. and Moskowitz, T.J. (2023). Fact, fiction and factor investing. *Journal of Portfolio Management*, 49(2), pp. 57-94
- [4] Ammann, M., Huber, O. and Schmid, M. (2013). Hedge fund characteristics and performance persistence. *European Financial Management*, 19(2), pp. 209-250.
- [5] Amihud, Y. (2002). Illiquidity and stock returns: cross-section and time-series effects, *Journal of Financial Markets*, 5, pp. 31-56.
- [6] Ang, A. and Chen, J. (2007). CAPM over the long run: 1926-2001. *Journal of Empirical Finance*, 14, pp. 1-40.
- [7] Arnott, R. D., Harvey, C. R., Kalesnik, V., & Linnainmaa, J. T. (2019). Alice’s adventures in factorland: Three blunders that plague factor investing. *Journal of Portfolio Management*, 45(4), pp. 18-36.
- [8] Arshanapalli, B., Fabozzi, F.J. and Nelson, W. (2006) The value, size, and momentum spread during distressed economic periods. *Finance Research Letters*, 3, pp. 244-252.
- [9] Asness, C., Robert K. and Liew J. (2001) Do hedge funds hedge? *Journal of Portfolio Management*, Fall, pp. 6-19.
- [10] Avramov, D., Chordia, T., Jostova, G. and Philipov, A. (2007). Momentum and credit rating., *Journal of Finance*, 62, pp. 2503-2520.

- [11] Bali, T. G., Engle, R. F., & Murray, S. (2016). Empirical asset pricing: The cross section of stock returns. John Wiley & Sons.
- [12] Banz, R.W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics*, 9, pp. 3-18.
- [13] Basu, S. (1977). The investment performance of common stocks in relation to their price-earnings ratios: A test of the efficient market hypothesis. *Journal of Finance*, 32, pp. 663-682.
- [14] Bhandari, L.C. (1988). Debt/equity ratio and expected common stock returns: Empirical Evidence. *Journal of Finance*, 43, pp. 507-528.
- [15] Campbell, J. Y., Hilscher, J., & Szilagyi, J. (2008). In search of distress risk. *Journal of Finance*, 63(6), pp. 2899-2939.
- [16] Carhart, M. M. (1997). On persistence in mutual fund performance. *Journal of Finance*, 52, pp. 57-82.
- [17] Chan, K. C., Chen, N. F. and Hsieh, D. A. (1985). An exploratory investigation of the firm size effect. *Journal of Financial Economics*, 14(3), pp. 451-471.
- [18] Chen, N. F., Roll, R. and Ross, S. A. (1986). Economic forces and the stock market. *Journal of Business*, pp. 383-403.
- [19] Chordia, T. and Shivakumar, L. (2002). Momentum, business cycle, and time-varying expected returns. *Journal of Finance*, 57(2), pp. 985-1019.
- [20] Cochrane, J. (2011). Discount rates. *Journal of Finance*, 56(4) pp. 1047-1108.
- [21] Cooper, M. J., Gutierrez Jr, R. C. and Hameed, A. (2004). Market states and momentum. *Journal of Finance*, 59(3), pp. 1345-1365.
- [22] Fama, E.F. and French, K.R. (1992). The cross-section of expected stock returns. *Journal of Finance*, 47, pp. 427-465.
- [23] Fama, E.F. and French, K.R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33, pp. 3-56.
- [24] Fama, E.F. and French, K.R. (2015). A five-factor asset pricing model. *Journal of Financial Economics*, 116(1), pp. 1-22.
- [25] Fama, E.F. and French, K.R. (2016). Dissecting anomalies with a five factor model. *The Review of Financial Studies*, 29(1), pp. 69-103.
- [26] French, D., Wu, Y. and Li, Y. (2016). Identifying the relative importance of stock characteristics. *Journal of Multinational Financial Management*, 34, pp. 80-91.
- [27] Fung, W. and Hsieh, D.A. (2004). Hedge fund benchmarks: a risk-based approach. *Financial Analysts Journal*, 60(4), pp. 65-80.
- [28] Getmansky, M., Lo, A. W. and Makarov, I. (2004). An econometric model of serial correlation and illiquidity in hedge fund returns. *Journal of Financial Economics*, 74(3), pp. 529-609.
- [29] Grinblatt, M., and Moskowitz, T. (2004). Predicting stock price movements from past returns: the role of consistency and tax-loss selling. *Journal of Financial Economics*, 71, pp. 541-579.
- [30] Griffin, J., and Lemmon, M. (2002). Book-to-market equity, distress risk, and stock returns. *Journal of Finance*, 57, pp. 2317-2336.

- [31] Hou, K., Xue, C. and Zhang, L. (2015). Digesting anomalies: an investment approach. *Review of Financial Studies*, 28(3), pp. 650-705.
- [32] Ibbotson, R. G., Chen, P. and Zhu, K. X. (2011). The ABCs of hedge funds: Alphas, betas, and costs. *Financial Analysts Journal*, 67(1), pp. 15-25.
- [33] Jagadeesh, N., and Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. *Journal of Finance*, 48, pp. 65-92.
- [34] Knif, J., Kolari, J.W., Koutmos, G. and Pynnonen, S. (2019). Measuring the relative return contribution of risk factors. *Journal of Asset Management*, 20, pp. 263-272.
- [35] Rosenberg, B., Reid, K. and Lanstein, R. (1985) Persuasive evidence of market inefficiency, *Journal of Portfolio Management*, 11, pp. 9-17.
- [36] Simpson, M. W. and Ramchander, S. (2008). An inquiry into the economic fundamentals of the Fama and French equity factors. *Journal of Empirical Finance*, 15(5), pp. 801-815.
- [37] Stattman, D. (1980) Book values and stock returns, *The Chicago MBA: A Journal of Selected Papers*, 4, pp. 25-45.
- [38] Stulz, R. (2007). Hedge funds: past, present, and future. *Journal of Economic Perspectives*, 21(2), pp. 175–194.
- [39] Zhang, L. (2005). The value premium. *Journal of Finance*, 60, pp. 67-103.