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### Hedge Fund Return Correlation under Extreme Market Condition

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# Newsletter of the BNP Paribas Hedge Fund Centre at SMU

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## Mission of the BNP Paribas Hedge Fund Centre

The mission of the BNP Paribas Hedge Fund Centre is to facilitate, encourage, and sponsor high-level academic research on hedge funds. The Centre also provides outstanding education to students, executives, and investors, and publishes objective and independent information on hedge funds, while promoting understanding and awareness of alternative investment strategies. Through excellence in research on alternative investments, the Centre is recognized for its capacity to foster stimulating exchange of opinions, and to develop a knowledgeable and objective information base regarding hedge funds.

Specifically, the primary objectives of the BNP Paribas Hedge Fund Centre at the Singapore Management University are to

1. conduct and disseminate high quality academic hedge fund research
2. educate finance practitioners and the investor public on hedge funds, and
3. raise the profile of the hedge fund industry in Asia and Singapore

To achieve these goals, the Centre will collaborate closely with academics at the London Business School. Moreover at all times, the Centre is absolutely committed to the highest ethical conduct and will actively avoid any conflicts of interest with outside parties.

# Hedge Fund Return Correlation under Extreme Market Conditions

Melvyn Teo<sup>1</sup>

## Executive summary

How dependent are returns across hedge fund investment strategies? We estimate the probability that each investment strategy performs poorly when other investment strategies are delivering extreme negative returns. Under extreme market conditions, we find that event driven, distressed debt, and equity long/short funds exhibit the highest correlation with other styles while commodity trading advisors, macro, and equity market neutral funds exhibit the lowest correlation. In addition, we show that Asia-focused event driven and equity market neutral funds provide diversification for investors holding US- and Europe-focused funds.

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How correlated are hedge fund returns in difficult market conditions? Which investment strategies confer diversification benefits to investors holding on to other hedge funds? Do Asia-focused hedge funds add value to a portfolio of US- and Europe-focused funds? These are some of the questions that fund investors and fund of funds managers often grapple with. A common critique of hedge funds is that correlations between different strategies converge to one during difficult market conditions. In this newsletter, we ask just how do correlations behave under those extreme situations, and if there are any differences across investment styles. Specifically, we employ methodology of Boyson, Stahel and Stulz (2010) to understand the probability that each investment strategy performs poorly when other investment strategies are also performing poorly.

To generate style return indices, we first merge Barclayhedge, HFR, and Lipper Tass databases. The sample period extends from January 1994 to December 2010. In total, the combined database consists of 22,031 funds of which 13,778 funds stopped reporting returns at the end of our sample period. We then classify hedge funds into convertible arbitrage, distressed debt, event driven, equity long/short, commodity trading advisors, fixed income, macro, and equity market neutral, and form equal-weighted return portfolios for each investment style. We believe that these 8 investment styles capture the majority of hedge fund strategies featured in our merged global database.

As a prelude to the main analysis, we compute the correlations between investment styles for both raw returns and risk-adjusted returns. The correlation coefficients are reported in Table 1. The coefficients presented in bold are statistically significant at the five percent level. Panel A of Table 1 indicates that hedge fund returns are strongly correlated across investment styles.

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## Newsletter, March 2012

However, commodity trading advisors, macro, and to a lesser extent, equity market neutral funds are able to escape this trend.

As some of the correlation in raw returns may stem from economic fundamentals or funds loading up on the same underlying risk factors (such as the equity market or the default spread), we strip away the effects of risk by regressing strategy returns on the Fung and Hsieh (2004) seven factors and examining the residuals from the regression or the risk-adjusted returns.<sup>2</sup> We find in Panel B of Table 1 that some of the high correlations are driven by the fact that returns across different strategies are often dependent on the same underlying risk factors. For example, exposure to similar risk factors accounts for about 23 percent of the correlation in raw returns between event driven and equity long/short.

**Table 1: Return correlation between investment styles**

	convertible arbitrage	distressed debt	event driven	equity long/short	commodity trading advisors	fixed income	macro	equity market neutral
<i>Panel A: Raw returns</i>								
convertible arbitrage	1.00	<b>0.73</b>	<b>0.79</b>	<b>0.69</b>	-0.05	<b>0.81</b>	<b>0.19</b>	<b>0.49</b>
distressed debt		1.00	<b>0.89</b>	<b>0.77</b>	-0.06	<b>0.80</b>	<b>0.16</b>	<b>0.47</b>
event driven			1.00	<b>0.89</b>	-0.01	<b>0.75</b>	<b>0.23</b>	<b>0.51</b>
equity long/short				1.00	0.05	<b>0.63</b>	<b>0.32</b>	<b>0.45</b>
commodity trading advisors					1.00	-0.05	<b>0.92</b>	0.10
fixed income						1.00	<b>0.17</b>	<b>0.41</b>
macro							1.00	<b>0.20</b>
equity market neutral								1.00
<i>Panel B: Risk-adjusted returns</i>								
convertible arbitrage	1.00	<b>0.42</b>	<b>0.59</b>	<b>0.49</b>	<b>0.15</b>	<b>0.54</b>	<b>0.27</b>	<b>0.39</b>
distressed debt		1.00	<b>0.72</b>	<b>0.48</b>	0.11	<b>0.65</b>	<b>0.19</b>	<b>0.35</b>
event driven			1.00	<b>0.68</b>	<b>0.20</b>	<b>0.54</b>	<b>0.29</b>	<b>0.41</b>
equity long/short				1.00	<b>0.21</b>	<b>0.39</b>	<b>0.37</b>	<b>0.34</b>
commodity trading advisors					1.00	<b>0.14</b>	<b>0.93</b>	0.10
fixed income						1.00	<b>0.24</b>	<b>0.24</b>
macro							1.00	0.11
equity market neutral								1.00

Note: Estimates in bold are statistically significant at the 5 percent level.

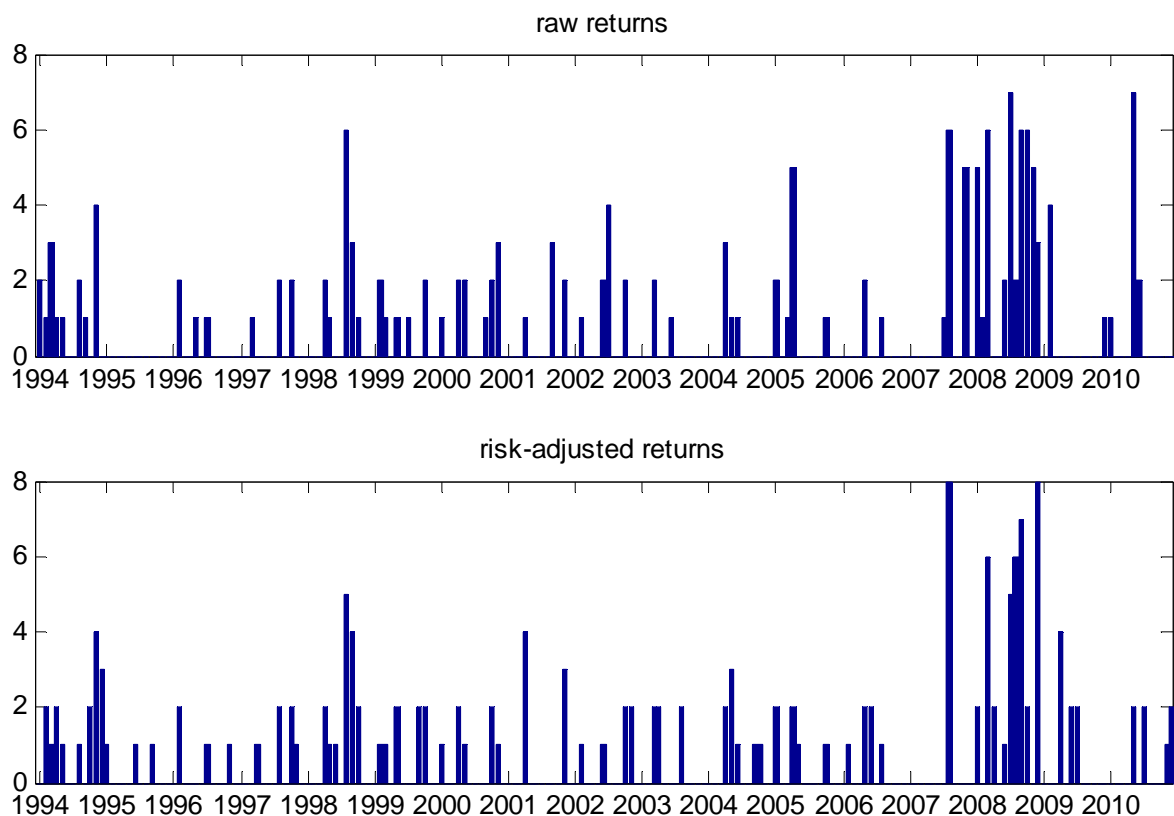
On balance, these findings suggest that the diversification benefits from adding more funds to a portfolio of hedge funds, even if those funds belong to an investment strategy not represented in the portfolio, may be quite modest. Of course, these findings mask the possibility that fund returns are heterogeneous within each investment strategy.

Since investors are likely to worry more about correlations in extreme conditions, we graph the number of hedge fund investment strategies with extreme negative returns, where extreme

<sup>2</sup> The risk adjustment is done over the full sample. That is we assume that for each investment strategy the factor loadings are constant over the 1994-2010 period.

negative returns are returns below the 10<sup>th</sup> percentile over the entire 1994-2010 period. The sample period covers 204 months, therefore returns fall below the 10<sup>th</sup> percentile for 20 months for each investment strategy. The pattern depicted in Figure 1 is consistent with anecdotal evidence. Hedge funds performed poorly across the board in the fall of 1998 when LTCM collapsed, in the fall of 2007 at the start of the subprime financial crisis, and in 2008. This is true whether we examine raw returns or risk-adjusted returns.

**Figure 1: Number of hedge fund investment strategies with extreme negative returns**



To understand correlations under extreme conditions better, we compute the probability that an investment style experiences extreme negative returns when other strategies are also experiencing extreme negative performance.<sup>3</sup> We do so by estimating a logistic regression for each strategy where the dependent variable is an indicator variable that is set to one if the hedge fund strategy delivers a return in the bottom decile of all returns for that strategy. The independent variable is  $N$  or the number of other strategies with returns in the bottom decile. The independent variable  $N$  therefore takes values between 0 and 7. A positive and statistically significant coefficient on the independent variable indicates that extreme negative returns for a style cluster with extreme negative returns for other styles. It is also straightforward to back out

<sup>3</sup> Henceforth, for the rest of the analysis, we take as style returns the residuals after stripping away the impact of risk or economic fundamentals.

the probability that a style delivers poor performance from the coefficient estimates on the constant and  $N$ , i.e.,  $\beta_{constant}$  and  $\beta_N$ , respectively. Namely,

$$Probability = 1/(1 + e^{-(\beta_{constant} + \beta_N * N)})$$

**Table 2: Testing for contagion with Logistic regressions**

	convertible arbitrage	distressed debt	event driven	equity long/short	commodity trading advisors	fixed income	macro	equity market neutral
constant	<b>-2.89</b> (-8.84)	<b>-3.53</b> (-8.16)	<b>-3.78</b> (-7.82)	<b>-3.38</b> (-8.41)	<b>-2.68</b> (-8.89)	<b>-2.86</b> (-8.84)	<b>-3.03</b> (-8.80)	<b>-3.17</b> (-8.58)
$N$ , number of other strategies with extreme negative returns	<b>0.60</b> (4.20)	<b>1.08</b> (4.84)	<b>1.23</b> (5.03)	<b>0.95</b> (4.94)	<b>0.44</b> (3.41)	<b>0.58</b> (4.10)	<b>0.70</b> (4.58)	<b>0.80</b> (4.70)

*Note: The t-statistics are in parentheses. Estimates in bold are statistically significant at the 5 percent level.*

The coefficient estimates reported in Table 2 indicate that extreme negative event driven returns cluster the most, while extreme negative commodity trading advisor returns cluster the least, with those of other styles. Other notable styles that exhibit poor performance clustering are distressed debt and equity long/short. Conversely, styles that do not exhibit as much poor performance clustering are fixed income, convertible arbitrage, and macro. The coefficient estimates in Table 2 imply that when 4 other styles are experiencing an extreme bad month, the probability that event driven, equity long/short, macro, and commodity trading advisors are also experiencing a bad month is 0.75, 0.61, 0.44, and 0.29, respectively. Clearly significant differences in the propensity to cluster exist between styles.

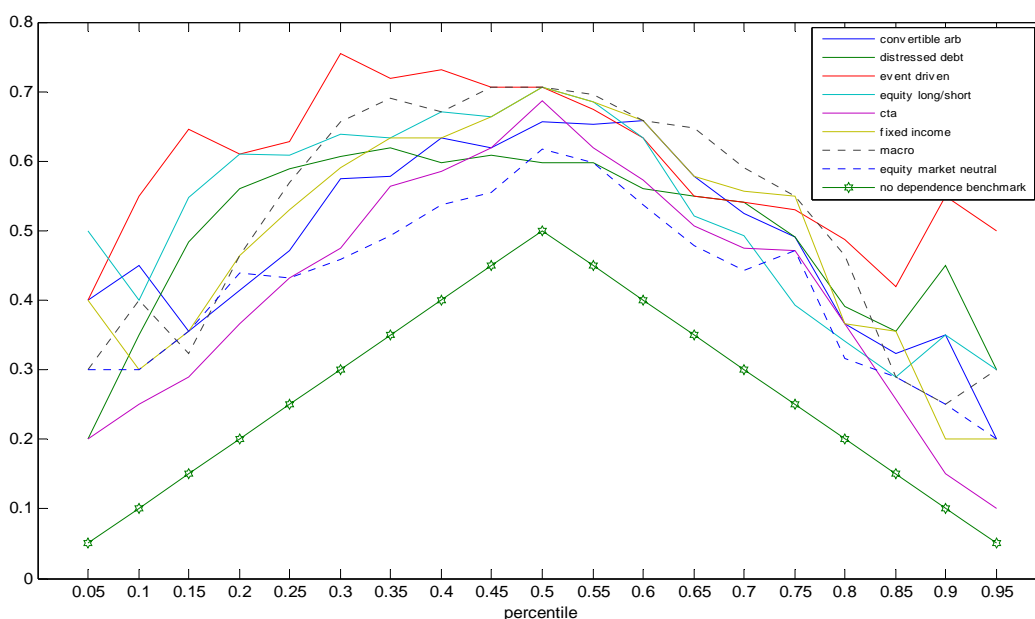
Investors may not be solely interested in the clustering of extreme negative style returns that fall below the 10<sup>th</sup> percentile. There may be concerns about the clustering of returns that fall below the  $x^{\text{th}}$  percentile for a variety of  $x$ . Therefore, we plot in Figure 2 a co-movement box which illustrates the broad relationship between individual strategy returns and the average strategy return. To populate the box, we calculate for a large spectrum of left and right tails the probability that an individual style return falls within the tail conditional on the average style return also falling within the tail. We plot these conditional probabilities against the benchmark case where no co-dependence exists (see the 45 degree line marked by hexagons in Figure 2). For example, if there is no co-dependence, the probability that event driven returns fall below the 20<sup>th</sup> percentile conditional on the average style return also falling below its 20<sup>th</sup> percentile is simply 0.2.

The results depicted in Figure 2 reveal positive dependence in the left tail of the return distribution and also, to a lesser extent, in the right tail.<sup>4</sup> Visually, clustering in the left tail

<sup>4</sup> Note that our right tail results appear inconsistent with those of Boyson, Stahel, and Stulz (2010). The divergence in findings may be linked to the different methods we employ to control for fundamentals in the co-movement tests.

appears to be strongest for event driven, equity long/short and distressed debt for a wide variety of left tails (where returns fall below the 10<sup>th</sup> percentile to where returns fall below the 25<sup>th</sup> percentile). Left tail clustering seems less serious for commodity trading advisors, macro, and equity market neutral. For the extreme left tail, where returns fall below the 5<sup>th</sup> percentile, clustering appears particularly problematic for convertible arbitrage and fixed income funds (in addition to the usual suspects event driven and equity long/short). The sensitivity of convertible arbitrage and fixed income returns to liquidity shocks may explain these findings.

**Figure 2: Co-movement box - the relationship between individual strategy returns and the average strategy return**



An often cited reason for adding Asia-focused hedge funds to a portfolio of hedge funds is that the Asia-focused managers add diversification to a US- and Europe-focused fund portfolio. We can test this assertion using the methodology employed in this newsletter. Specifically, we estimate logistic regressions on each Asia-focused strategy with sufficient return observations (namely event driven, equity long/short, fixed income, macro, and equity market neutral). We confine the analysis to the January 2002 to December 2010 period again to ensure that there are enough funds per style so that portfolio returns are meaningful. As in the analysis in Table 2, the dependent variable is an indicator variable that is set to one if the hedge fund strategy delivers a return in the bottom decile of all returns for that strategy. The independent variables are now  $N1$ , the number of US- and Europe-focused strategies with extreme negative returns, and  $N2$ , the number of other Asia-focused strategies with extreme negative returns. Table 3 which reports the coefficient estimates from the logistic regressions also includes results for US- and Europe-focused strategies for completeness.

We are primarily interested in the impact of  $N1$  on the probability of an extreme negative return for Asia-focused strategies. The estimates in Panel B of Table 3 indicate that Asia-focused event driven and equity market neutral do not cluster with US- and Europe-focused strategy

returns, but Asia-focused fixed income and macro returns do. These results suggest that, on a relative basis, there is greater decoupling between Asia and the developed world in the equity market than in the fixed income and currency markets. In line with our previous findings, the extreme negative returns of Asia-focused event driven and equity long/short funds are most likely to cluster with those of other Asia-focused hedge funds. Conversely, Asia-focused fixed income, equity market neutral and macro funds are least likely to be affected by contagion from other Asia-focused styles.

**Table 3: Testing for contagion between US/Europe-focused strategies and Asia-focused strategies**

	convertible arbitrage	distressed debt	event driven	equity long/short	commodity trading advisors	fixed income	macro	equity market neutral
<i>Panel A: US/EU/Global-focused strategies</i>								
constant	<b>-3.40</b> (-5.46)	<b>-4.10</b> (-5.55)	<b>-3.70</b> (-5.9)	<b>-5.55</b> (-4.58)	<b>-2.79</b> (-6.31)	<b>-2.89</b> (-6.27)	<b>-3.98</b> (-5.69)	<b>-3.59</b> (-5.99)
N1 ( number of other US/EU/Global-focused strategies with extreme negative returns)	<b>1.68</b> (3.91)	<b>1.08</b> (3.57)	<b>1.01</b> (3.64)	<b>1.15</b> (3.24)	0.35 (1.92)	<b>0.56</b> (2.76)	<b>0.77</b> (3.26)	<b>0.61</b> (2.89)
N2 (number of other Asia- focused strategies with extreme negative returns)	<b>-2.02</b> (-2.76)	0.38 (1.04)	0.11 (0.27)	<b>1.47</b> (3.15)	0.29 (0.92)	0.03 (0.08)	<b>0.78</b> (2.26)	<b>0.68</b> (2.01)
<i>Panel B: Asia-focused strategies</i>								
constant			<b>-3.01</b> (-6.18)	<b>-5.83</b> (-4.37)		<b>-2.96</b> (-6.31)	<b>-3.18</b> (-6.2)	<b>-2.44</b> (-6.23)
N1 (number of other US/EU/Global-focused strategies with extreme negative returns)			-0.06 (-0.27)	0.41 (1.92)		<b>0.51</b> (3.02)	<b>0.38</b> (2.24)	0.02 (0.08)
N2 (number of other Asia- focused strategies with extreme negative returns)			<b>1.28</b> (2.93)	<b>3.39</b> (3.19)		0.11 (0.32)	0.71 (1.93)	0.45 (1.25)

*Note: The t-statistics are in parentheses. Estimates in bold are statistically significant at the 5 percent level.*

## Conclusion

The critique that all hedge fund correlations converge to one in a down market is a broad generalization that ignores important cross-sectional diversity amongst funds operating in different investment styles and regions. We present a more nuanced view of the propensity of hedge funds to cluster under extreme market conditions. We find that commodity trading advisors, macro, fixed income, and equity market neutral funds tend to display a significantly lower propensity to cluster in the left tail relative to event driven, distressed debt, and equity long/short funds, where the left tail is defined as returns below the 10<sup>th</sup> percentile. Moreover, event driven and equity market neutral Asia-focused funds can add useful diversification to a portfolio of hedge funds as their returns cluster less with those of US- and Europe-focused



funds. Hedge fund investors who are mindful of the aforementioned critique and concerned with the tendency of hedge funds to cluster under extreme conditions will find these results helpful.

## References

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## Update on the Centre's Activities

### Education

The centre will host a seminar by Aje Saigal on 27 April 2012. Aje is the Director of Economics and Investment Strategy at the Government of Singapore Investment Corporation. For more information on our upcoming events, please visit our events website:

<http://www.smu.edu.sg/centres/hfc/events.asp>

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For more information regarding the BNP Paribas Hedge Fund Centre at SMU and our upcoming activities, please contact Ms Karyn Tai, centre coordinator (Tel: +65-6828-0933, E-mail: [hfc@smu.edu.sg](mailto:hfc@smu.edu.sg)) or visit our webpage at <http://www.smu.edu.sg/centres/hfc/index.asp>. We look forward to receiving your suggestions and comments.