

## Box 3

## MEASURING THE CROWDING OF HEDGE FUND TRADES

In the June 2005 FSR, two indicators were proposed as possible measures of the crowding of hedge fund trades: the dispersion of monthly hedge funds' returns and the median pairwise correlation coefficient of monthly hedge funds' returns within a strategy. In the June 2006 FSR, a weighted average correlation coefficient across hedge fund strategies was used to complement the analysis of the similarity of hedge funds' investment positions. This box provides an update and reassessment of various measurement approaches and presents some results on new alternative measures.

In times of stress, hedge funds are unlikely or simply cannot afford to wait when their leveraged positions become loss-making and it is likely, therefore, that they would be among the first to attempt to exit such investments. The more similar or "crowded" such positions are with those of other hedge funds and other market participants, the higher the risk of market liquidity drying up in the affected markets. However, comparable information on the investment portfolios of a sufficiently large number of hedge funds is unavailable and gauging the degree of similarity of hedge funds' positioning must therefore be based on an indirect approach: analysis of hedge funds' returns. An important shortcoming of such returns-based analysis is that it requires information on gross returns, whereas hedge funds only report returns that are net of all fees and transaction costs.

Recently, researchers have been devoting a lot of effort to explaining the sources of hedge funds' returns using multi-factor models. Although this work is still ongoing, several financial institutions have launched products that aim at replicating the returns of broad hedge fund indices more cheaply by investing in liquid traditional assets. The emergence of such products and the investor demand for them can be attributed to growing evidence that a significant part of average hedge funds' returns can be explained by time-varying exposures to traditional betas (e.g. stock and bond indices) and alternative betas, such as volatility or rule-based trading strategies.

Comparing and aggregating the coefficients (factor loadings) obtained from regressions of individual hedge funds' returns on various risk factors could give an indication of the similarity of hedge funds' exposures to selected risk factors and the size of such exposures relative to the size of the markets associated with chosen risk factors. However, to date, only the returns of broadly diversified hedge fund indices have been replicated with some success owing to the fact that such broad indices average out idiosyncratic differences, leaving only exposures to a set of systematic risk factors. By contrast, the mimicking of returns of specific hedge fund investment strategies has not been as fruitful. Replicating the returns of a particular hedge fund is even more difficult, not least because of the non-linearity of returns, hedge funds' ability to invest in illiquid assets and derivatives and to take short positions in a wide range of markets. As noted by Fung and Hsieh (1997), the return of any fund is a function of where it trades (asset class), how it trades (strategy), and the size of its trades (leverage).<sup>1</sup> Furthermore, the returns of hedge funds may exhibit high co-movement during times of stress not only because they follow similar strategies and invest in the same assets, but also because they have the same type of liabilities towards a limited number of major prime brokers whose actions may force hedge fund managers to deleverage at the same time. As a result, any conclusion on the similarity of hedge funds' exposures based on a regression analysis of returns will only be as good as the model used to estimate them.

To avoid model risk, another solution could be to compare hedge fund returns directly.<sup>2</sup> The more similar and correlated the returns of hedge funds, the more likely their trades are crowded. However, for this kind of analysis it is important to select only relatively homogenous hedge funds, particularly in terms of investment strategy and leverage. Otherwise, a measure would also be capturing the correlations of the returns on different assets in which hedge funds invest. This is the main reason why average correlations across hedge fund strategies or across all hedge funds irrespective of their strategy are not appropriate indicators for the crowding of hedge funds' trades. Nevertheless, they might be useful indicators for funds of hedge funds and other investors who seek to build diversified portfolios of investments into single-manager hedge funds.

Regime-switching models applied to the indices of hedge fund strategies' returns have also been proposed as measures of systemic risk in the hedge fund sector.<sup>3</sup> When applied to the returns of individual hedge funds, the results of a regime-switching model would indicate when the selected hedge funds were in distress based on individually or jointly-specified regime-switching processes. However, when two hedge funds are both in high-volatility and typically

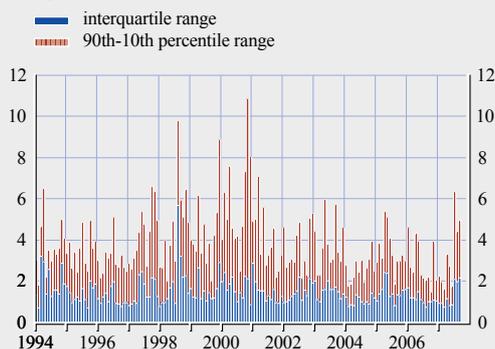
1 See W. Fung and D. A. Hsieh (1997), "Empirical characteristics of dynamic trading strategies: the case of hedge funds", *Review of Financial Studies*, No. 2, pp. 275-302.

2 See also T. Garbaravicius and F. Dierick (2005), "Hedge funds and their implications for financial stability", *ECB Occasional Paper*, No. 34, August.

3 See N. Chan, M. Getmansky, S. M. Haas and A. W. Lo (2006), "Do Hedge Funds Increase Systemic Risk?", Federal Reserve Bank of Atlanta, *Economic Review*, Vol. 91, No. 4, pp. 49-80.

**Chart A Convertible arbitrage hedge funds: dispersion of returns**

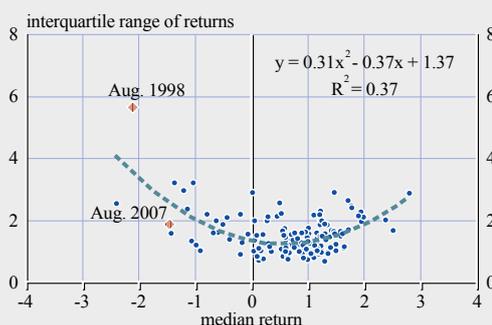
(Jan. 1994 - Sep. 2007; %; monthly returns net of all fees in USD)



Sources: Lipper TASS database and ECB calculations.  
Note: Most recent data are subject to incomplete reporting.

**Chart B Convertible arbitrage hedge funds: link between median returns and the dispersion of returns**

(Jan. 1994 - Sep. 2007; %; monthly returns net of all fees in USD)



Sources: Lipper TASS database and ECB calculations.  
Note: Most recent data are subject to incomplete reporting.

low-return states based on their individually or jointly-specified regime-switching processes, that would not necessarily mean that their investment exposures were similar, even if they both pursued the same broadly defined investment strategy.

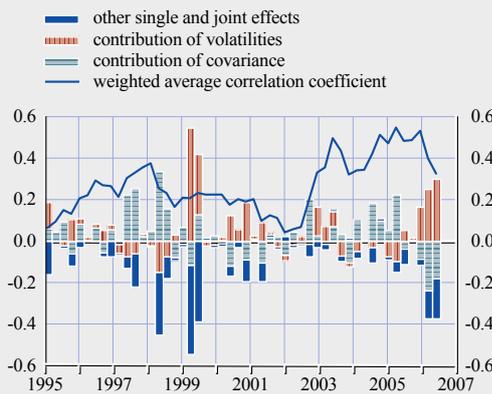
Perhaps the simplest way to gauge the similarity of hedge funds' positioning would be to look at the dispersion of hedge funds' returns within a certain hedge fund strategy at any given point in time (see Chart A). However, the degree of dispersion of hedge funds' returns seems to depend on the magnitude of the median return, as shown in Chart B for convertible arbitrage hedge funds. The similarly-shaped rather strong link is also valid for most other hedge fund strategies and is most likely related to the varying degree of leverage across hedge funds. Correlation analysis could be less affected by varying degrees of leverage across hedge funds and, therefore, could be a more appropriate way of measuring the possible crowding of hedge fund trades.

The Pearson's pairwise correlation coefficient could be used for gauging hedge fund return comovement but it is probably not the best indicator because it assumes a normal distribution and a linear relationship between returns, whereas hedge funds' returns are typically not distributed normally. Hence, outliers can have a very large marginal impact on the resulting correlation coefficient. In addition, by construction, the Pearson's correlation coefficient is driven by the covariance of returns (numerator) and the product of returns' volatilities (denominator). As a result, the correlation coefficient can increase solely as a result of lower volatilities of returns, rather than because of their higher covariance.<sup>4</sup> For example, during the last five quarters to June 2007, the contribution of lower volatilities to the moving 12-month weighted average pairwise correlation coefficient across hedge fund strategies was always positive, whereas the contribution of covariances was always negative or close to zero (see Chart C). Moreover, the weighted average covariance across hedge fund strategies has been rather low since 2001 (see Chart D). This varying effect of volatilities would favour the use of covariance rather than the Pearson's correlation coefficient (the standardised version of covariance).

<sup>4</sup> See also T. Adrian (2007), "Measuring Risk in the Hedge Fund Sector", Federal Reserve Bank of New York, *Current Issues in Economics and Finance*, Vol. 13, No. 3, March/April.

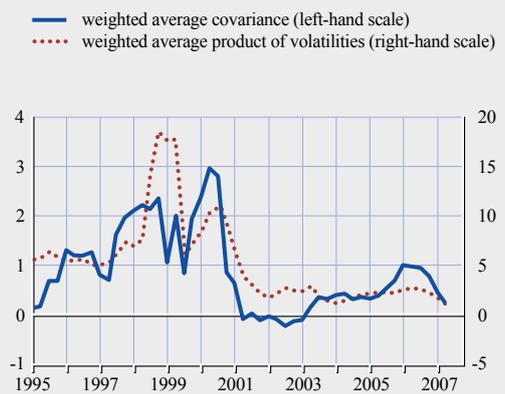
**Chart C Correlation across hedge fund strategies and decomposition of its changes**

(Q1 1995 - Q2 2007; 12-month moving window, average pairwise correlation coefficient among ten CS/Tremont hedge fund indices)



**Chart D Covariance and the product of volatilities of hedge fund investment strategies' returns**

(Q1 1995 - Q2 2007; 12-month moving window, weighted average pairwise covariance and the product of volatilities of ten CS/Tremont hedge fund indices)



Sources: Credit Suisse Tremont Index, Lipper TASS and ECB calculations.

Notes: The ten CS/Tremont indices comprise Multi-Strategy, Equity Market Neutral, Convertible Arbitrage, Fixed Income Arbitrage, Event Driven, Managed Futures, Emerging Markets, Global Macro, Dedicated Short Bias, Long/Short Equity Hedge indices. Weighted average is calculated according to the formula:

$$\text{weighted average} = \frac{\sum_{i < j} c_{ij} \times (w_i + w_j)}{\sum_{i < j} (w_i + w_j)}, \text{ where } c_{ij} \text{ is a pairwise covariance, product of volatilities or correlation coefficient between}$$

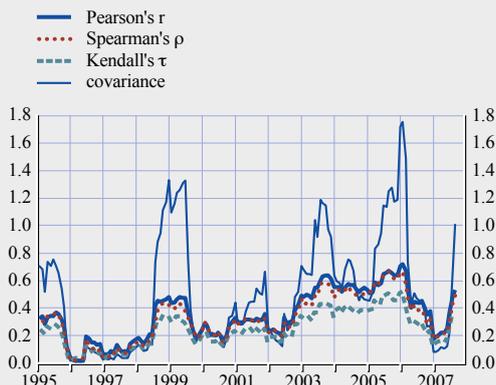
12 monthly returns of strategies  $i$  and  $j$ . Weights  $w_i$  and  $w_j$  refer to the shares of capital under management of strategies  $i$  and  $j$  at the end of the 12-month window. During each quarter, individual contributions to changes in the moving weighted average correlation coefficient were calculated by holding the values of all other variables in the correlation coefficient formula fixed, i.e. the same as in the previous 12-month window.

Since hedge funds' returns are typically not distributed normally, non-parametric correlation measures should provide an even more robust comparison of the returns of hedge funds belonging to the same investment category than the covariance coefficient. Nonetheless, all variants of median pairwise correlation coefficients, including Pearson's correlation coefficient, generally move in tandem and tend to exhibit contemporaneous increases and falls, as exemplified by the medians calculated for convertible arbitrage hedge funds (see Chart E). Kendall's  $\tau$  correlation coefficient makes no assumption about the distances between variables or their distribution, and thus could be used as the most conservative estimate of the possible crowding of hedge fund trades.

An advantage of moving median pairwise correlation coefficients is that if their values are on an upward trend, it indicates that positions are becoming increasingly similar. Moreover, high values could signal capacity constraints within a selected strategy, as they seemed to indicate in the case of the convertible arbitrage strategy before 2004 and for some time thereafter (see Chart F). In times of stress, if trades are crowded, median correlation coefficients can surge, thereby also revealing points in time when hedge funds were in distress (e.g. August 1998). The use of a moving window means that the impact of a stressful period will disappear only after this particular period drops out of the moving window. At the same time, choosing the length of a moving window represents a trade-off between the usefulness of analysing longer-term trends and the ability to highlight the most recent developments using a shorter window, albeit at the cost of lower statistical significance of calculated correlation coefficients.

**Chart E Convertible arbitrage hedge funds: medians of pairwise covariance and correlation coefficients of monthly hedge fund returns**

(Jan. 1995 - Sep. 2007; monthly returns net of all fees in USD; moving 12-month window)

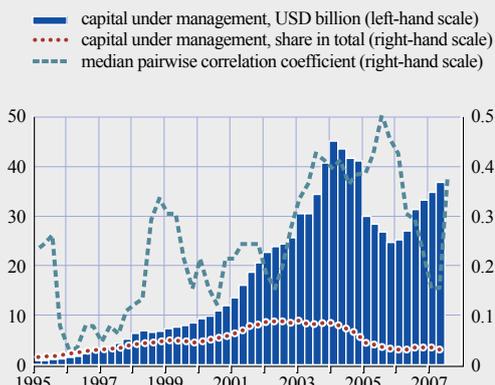


Sources: Lipper TASS database and ECB calculations.

Note: Medians are probably slightly biased, since time series of hedge fund returns in the database were not adjusted for sub-fund structures, which represent onshore and offshore versions or different classes of shares with different fee structures, lock-up periods and other "technical" differences, which basically correspond to the same pool of money managed in a highly correlated or nearly identical way.

**Chart F Convertible arbitrage hedge funds: crowded trades and capital under management**

(Q1 1995 - Q3 2007)



Sources: Lipper TASS, Lipper TASS database and ECB calculations.

Note: Moving 12-month median Kendall's  $\tau$ , pairwise correlation coefficient. For each 12-month moving window, only hedge funds with 12 monthly observations were included. Medians are probably slightly biased, since time series of hedge fund returns in the database were not adjusted for sub-fund structures, which represent onshore and offshore versions or different classes of shares with different fee structures, lock-up periods and other "technical" differences, which basically correspond to the same pool of money managed in a highly correlated or nearly identical way.

To sum up, given the lack of publicly or commercially available information on hedge funds' investment portfolios, various indirect methods need to be employed for the detection of the possible crowding of hedge funds' trades. In such an analysis, it is important to compare individual hedge funds and to select only relatively homogenous hedge funds, which in practice would mean selecting hedge funds that pursue the same broadly-defined investment strategy. Since hedge funds' returns are typically not distributed normally, non-parametric correlation measures are preferred to the standard Pearson's correlation coefficient, and these might provide various insights regarding the developments in a certain strategy. Further improvements in multi-factor regressions of hedge funds' returns could yield additional useful information for the detection of possible crowding of hedge funds' investment positions.