

Neutrality of market neutral funds

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Neutrality of market neutral funds

Abstract

Using an original database of 634 market neutral hedge funds, this study formally analyses the market neutrality of market neutral funds which are particular in the hedge fund universe since the only objective of these funds is to provide positive returns completely independent of the market conditions. We start by analysing this neutrality using various market neutral indices before focusing on individual fund returns. Finally, an analysis based on ex-post beta helps us explaining and confirming our previous results. We perform this analysis over the global January 1993- December 2002 period as well as on bull and bear market periods.

JEL Classification codes: G2, G11, G15

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I. Introduction

Hedge funds considered as a whole have been studied since 1997. The precursors of the academic world were Fung and Hsieh (1997) in their *Review of Financial Studies* paper and Ackermann, McEnally and Ravenscraft (1999) in their *Journal of Finance* article. Since then, the literature on the subject has expanded strongly and more and more researchers are focusing on these investment products.

Hedge fund studies can be classified in four global categories. In the first one, we report studies that are focused on hedge fund performance. This includes mainly studies that compare the performance of hedge funds with equity and other indices (see for example Ackermann, McEnally and Ravenscraft, 1999; Brown, Goetzmann and Ibbotson, 1999; Liang, 1999; Amin and Kat, 2001; Liang, 2001; Barès, Gibson and Gyger, 2002; Liang, 2003; Agarwal and Naik, 2004; Capocci and Hübner, 2004). Results of such studies are mitigated. The second field of hedge fund performance analysis compares the performance of hedge funds with the one of mutual funds. In this context, Ackermann, McEnally and Ravenscraft (1999) and Liang (1999) find that hedge funds constantly obtain better performance than mutual funds, although lower and more volatile than the reference market indices considered. Finally, performance analysis includes the study of the persistence of hedge fund returns. Persistence is particularly important in the case of hedge funds because, as suggested by Brown, Goetzmann and Ibbotson (1999) and Liang (2000, 2001), the hedge fund industry has an attrition rate higher than mutual funds. Brown, Goetzmann and Ibbotson (1999) are in this category. They prove that offshore hedge funds have positive risk adjusted returns, but they input this result to style effect and conclude that there is no proof of particular capacity of some fund managers. Agarwal and Naik (2000) analyse the presence of persistence in hedge fund returns using a one-year moving average period. They prove that there is proof of persistence in hedge fund's performance, particularly for bad performing funds that continue to underperform. Capocci and Hübner (2004) and Capocci, Corhay and Hübner (2004) use the decile analysis developed in Carhart (1997) in order to determine if persistence is present in hedge fund returns. The first concluded that some low-risk managers have been able to consistently create alpha over the period studied (1/94-6/00). The second focused on the period starting 1/94 but ending 12/02 and concluded that over this global period that included

a bear market, excess return creation was present in most of the cases and there was a clear proof of persistency in hedge fund returns.

It is important to stress that few authors have attempted to estimate the behaviour of hedge funds in bear markets. The periods under study do not favour this exercise, as periods of downward trends on the stock market were rare and discontinuous before March 2000. For the period 1990-1998, Edwards and Caglayan (2001) found that only three hedge fund strategies (Market Neutral, Event Driven and Macro) provide protection to investors when stock markets head south. More recently, Ennis and Sebastian (2003) contend that in general, hedge funds did not provide investor protection after the market downturn of March 2000; rather, their superior performance is mostly due to the good market timing of their managers.

On the other hand, the second global category includes authors that both try to analyse and describe hedge funds investment style and to explain these features with style models (see for example Fung and Hsieh, 1997; Brown, Goetzmann and Park, 1998; Brealy and Kaplanis, 2001, Brown and Goetzmann, 2001, Liang 2001; Liang 2003). In this context, Fung and Hsieh (1997) applied Sharpe's style analysis (see Sharpe, 1992) to a large sample of hedge funds and CTA. They assumed that fund returns are linearly related to the returns on a number of factors and measured the factor by 8 mimicking portfolios, found that the regressions have little explanatory power and suggested that the low R^2_{adj} is due to the fund's trading strategy. Brown, Goetzmann and Park (1998) used the same methodology to analyse hedge fund returns during the 1997-98 Asian crisis.

A third part of the literature finally focuses on the correlation of hedge funds with other investment products and analyses the power of diversification of hedge funds. Fung and Hsieh (1997) and Schneeweis and Spurgin (1997) proved that the insertion of hedge funds in a portfolio could significantly improve its risk-return profile thanks to their weak correlation with other financial securities. This low correlation is also emphasized by Liang (1999), Agarwal and Naik (1999) and Capocci and Hübner (2004). Amin and Kat (2001) found that stand-alone investment hedge funds do not offer a superior risk-return profile, but that a great majority of funds classified as inefficient on a stand-alone basis are able to produce an efficient payoff profile when mixed with the S&P500. They obtain the best results when 10-20% of the portfolio value is invested in hedge funds. Taking all these results into account, hedge funds seem to be a good investment tool. Amenc and Martellini (2002) proved on the

basis of ex-post estimations that the inclusion of hedge funds in a portfolio can lead to a significant decrease in the volatility of a portfolio without leading to a significant change in the returns. This means that a stronger risk control does not correspond with a decrease in return.

Finally other authors have analysed various other aspect of the hedge fund industry. This category includes the "*other studies*". Schneeweis and Spurgin (1999), Amenc, Curtis and Martellini (2002), Amenc, Martellini and Vaissié (2002) and Berényi (2002) have studied the risks involved in hedge fund investing. Schneeweis and Spurgin and Amenc, Martellini and Vaissié (2002) proved that hedge fund returns are not only exposed to the market risk, but that other risks like volatility risk, default risk or liquidity risk have to be considered. Liang (2000) analysed the presence of survivorship bias in hedge fund data and Fung and Hsieh (2000) included other biases in their analysis. Ackermann and Ravenscraft (1998) emphasized that the stronger legal limitations for mutual funds than for hedge funds hinder their performance. Various authors study hedge fund indices. There are many different hedge funds' indices providers like EACM, HFR, CSFB/Tremont, Zurich Capital, Van Hedge, Hennessee Group, Hedgefund.net, LJH Global Investment, Mar, Altvest and Magnum¹. Brooks and Kat (2001) Amenc and Martellini (2002) studied this aspect in detail.

CTAs are a particular category in the hedge fund world. Some authors consider them as part of the hedge fund world (Fung and Hsieh, 1997; Schneeweis and Spurgin, 2000), whereas others study them by separating them from hedge funds (Liang, 2003) or study them on a stand-alone basis (Fung and Hsieh, 2000a; Gregoriou and Rouah, 2003; Capocci, 2004b). In this study, we only study market neutral funds and do not include CTAs.

II. Interest of the study

This study aims at analysing the exposure to the equity market for market neutral funds. At first sight, it can seem quite reductive to focus on a particular strategy since the bulk of the literature considers hedge funds as a whole. Three independent reasons justify this choice. Firstly, market neutral funds are particular since their objective is to create alpha while completely hedging the exposure to the market. Other hedge fund strategies are

¹ See Amenc and Martellini (2002) for a complete description of these hedge fund indices providers.

generally at least partially exposed to the market and results particular to market neutral funds may not be true for other hedge fund strategies. Recently, in their study based on a very large database of a total of 2894 individual funds, Capocci, Corhay and Hübner (2004) concluded that equity market neutral funds present interesting characteristics that need further investigation. This is exactly the objective of the present study. Secondly, as suggested in several studies, market neutral funds represent a high percentage of the hedge fund industry. According to our database described hereafter, as much as 28.3% of the global MAR/CISDM individual funds in the database are market neutral funds. Other authors also report high numbers of market neutral funds in their database (see for example Capocci and Hübner, 2004 and Capocci, Corhay and Hübner, 2004). A high number of market neutral funds allow to analyse them in more detail and to obtain global results. Thirdly, more and more authors however consider individual strategies to better understand their particularities. Mitchell and Pulvino (2002) only focused on risk arbitrage, Fung and Hsieh (2002) on fixed income arbitrage funds; Capocci (2004a) has analysed the inclusion of convertible arbitrage funds in a classical portfolio. Gatev, Goetzmann and Rouwenhorst (1999) study relative value funds on a stand-alone basis. Market neutral funds should also be studied on a stand-alone basis to understand their particularities. Navone's (2001) look at the diversification benefits from adding market neutral funds to a portfolio of mutual funds could significantly help the risk return trade-off but he did not look at their neutrality.

Market neutral funds are defined as funds that take long and short positions in various securities while trying to avoid exposure to the equity market. Sub-strategies are arbitrage market neutral funds, which are managers that apply market neutral arbitrage strategies. This category includes, among other things, convertible arbitrage funds that buy undervalued convertibles, while hedging all intrinsic value and fixed income arbitrage funds that exploit pricing anomalies in the global fixed income. Another sub-strategy is long/short market neutral funds also named equity market neutral funds. These funds simultaneously take long and short positions of the same size within the same market. Managers take advantage of relative price discrepancies. Typically the strategy is based on quantitative models for selecting specific stocks with equal dollar amounts comprising the long and short sides of the portfolio. In theory, market risk is greatly reduced but it is very difficult to make a profit on a large diversified portfolio, so stock picking is critical. The final sub-strategy is mortgage-backed funds that invest in mortgage-backed securities but also in futures and options. Usually they focus on AAA-rated mortgage bonds.

Market neutrality implies dollar neutral, beta neutral or both. Dollar neutral strategies have zero net investment, i.e. equal dollar amount in long and short positions. Beta neutral strategies target a zero total portfolio beta (i.e. beta of the long positions equals the beta on the short side). While dollar neutrality has the virtue of neutrality, beta neutrality better defines a strategy uncorrelated with the market return. Many managers of such strategies balance their long and shorts in the same sector or industry. By being sector neutral, they avoid the risk of market movements affecting some sectors or industries differently than others.

The study is organized as followed. Section III describes that database. In section IV we report the descriptive statistics and analyse the attrition rate present in our database. In section V we report the bias analysis before describing our methodology in section VI. We report the global results in section VII and the results obtained for individual funds in section VIII. We perform a sub-period analysis in section IX. Section XX concludes the paper.

III. Database

Four main hedge fund databases are available for empirical studies, the Managed Account Reports, Inc/Center for International Securities Derivatives Markets, Hedge Fund Research, Inc, Tass Management and the Barclays database. The first three ones are the most used in academic studies. The Barclay database is currently under investigation by various authors but it has not yet been used in published studies. The data provider collects various information on the funds included. For a majority of funds, they record other useful information such as company name, start and ending date, strategy followed, assets under management, management and incentive fees, manager's name, manager's address, etc. There is no consensus on the definition of the strategy followed but there are similarities. MAR/CISDM defines 9 strategies with a total of 16 sub-strategies. HFR defines 16 different strategies in 2 categories, 11 non-directional and 5 directional strategies, plus the Funds of Funds and the Sector categories. TASS defines 15 strategies. Finally, Barclays defines 20 individual strategies.

We use hedge fund data from MAR/CISDM, as in Fung and Hsieh (1997), Schneeweis and Spurgin (1998), Amin and Kat (2001), and Capocci, Corhay and Hübner (2004). The database gives monthly net-of-fee individual returns and other information on

individual funds and groups them in indices. The whole database consists of 634 individuals market neutral funds including 398 surviving funds (62.8%) and 236 (37.2%) dissolved funds. We use 120 monthly returns between January 1993 and December 2002.

IV. Descriptive statistics and attrition rates

Before analyzing the presence of bias in hedge fund data, we present the descriptive statistics, the correlation analysis and the attrition rates in this section.

3.1 Descriptive statistics

In Panel A of Table 1 contains descriptive statistics of the funds, whether alive or dead, in our database. We report the statistics for the whole market neutral database and we divide this database in arbitrage funds, long/short funds, mortgage backed securities funds and non-classified funds². These hedge fund data are contrasted with the descriptive statistics of the S&P500 that represent the equity market. Panel B of Table 1 reports the same descriptive statistics when funds were classified in decile based on the average performance of the funds over the whole period.

INSERT TABLE 1 APPROXIMATELY HERE

Panel A of Table 1 indicates that market neutral funds offered an average monthly return of 1.08% over the period studied with a monthly standard deviation of 0.94%. Arbitrage funds offered almost the same return with the same volatility whereas long/short funds offered 1.16% with a monthly volatility of 1.16%. Mortgage fund returns are more volatile than the other market neutral funds. All average returns are significantly positive. Median returns indicate the same pattern except that mortgage-backed funds have an impressively high median return compared with the other funds studied. This result can be explained but the low skewness and extremely large kurtosis of mortgage-backed securities funds. Minimum monthly returns are relatively high with a total of -2.54% for market neutral funds except for mortgage backed funds (-8.74%). On the other side, the maximum is also relatively low for all strategies, particularly for arbitrage funds (2.93%) and mortgage backed funds (2.84%). Mortgage backed securities have largely negatively skewed returns'

² There are 3 funds with no sub-strategy. The data regarding these funds ended in January 2001.

distribution (skewness of -4.11) with fat tails (kurtosis of 26.45). All other sub-strategies except long/short funds and the strategy considered as a whole all have significantly negative skewness, which leads to negatively skewed return distribution. All classifications also have significantly positive kurtosis which leads to the presence of fat tails (at least to some extent). Long/short funds have positively skewed return distribution.

The Sharpe score (it is defined as the ratio of average return over the standard deviation) indicates that arbitrage funds offer a better trade-off than long/short funds, which, in turn offer a better trade-off as mortgage-backed securities funds.

By comparison, the equity index has a low average monthly return of 0.69% , which is in line with the long-term return of the equity market of around 8% . This return is weakly and significantly positive with a relatively high volatility of 4.47% . The median return is however as high as the median return of market neutral funds considered as a whole and higher than all the sub-strategies except the mortgage-backed index. The minimum and maximum for the index are more extreme than those obtained for the hedge funds and the return distribution of the index is neither skewed, nor has fat tails. This is in line with previous results indicating normality of returns for the stocks indices (see for example Fung and Hsieh, 1999).

Panel B reports the same descriptive statistics when we classify all these funds in decile on the basis of their average performance over the whole period studied. Decile 1 contains the worst performing funds over the period and decile 10 the best performing ones. The dead fund column indicates that bad performing funds have more chance to be dissolved. On the average, 52% of the funds in the worst 3 deciles are dissolved against 31% on the average for the top 3 deciles. Moreover 62% of the funds in decile 1 are dissolved. Interestingly, fewer funds from deciles 5 to 9 have been dissolved compared to decile 10 and middle decile fund returns are more stable than worst and top performing decile (see standard deviation). These results are in line with the one obtained by Capocci and Hübner (2004) in their dissolution frequencies analysis but their deciles were constructed on the basis of previous year's performance. The minimum and maximum columns indicate that very low minimum will lead to lower decile (decile 1 minimum is extremely low compared to other minimums), but that high maximum does not necessarily lead to higher decile (decile 1 maximum is the second highest maximum over the 10 deciles). Skewness and kurtosis results do not lead to particular remarks. We can however note that some skewness are significantly

positive (deciles 2, 7 and 9) whereas others are significantly negative (deciles 1, 4, 5 and 6) and that all kurtosis that are significant are positive. There is only one insignificant negative kurtosis.

3.2 Correlation analysis

As suggested in the introduction, the traditional hedge funds literature contends that, thanks to the weak correlation between hedge funds and other securities, hedge funds are likely to improve the risk-return trade-off when added to a traditional portfolio (see Fung and Hsieh, 1997; Schneeweis and Spurgin, 1997; Liang, 1999; Amin and Kat, 2001). The first step of the analysis of the neutrality of equity market neutral funds is to check the correlation of these funds with the equity index as approximate by the S&P 500 index. The correlation coefficients are reported in the Table 2.

INSERT TABLE 2 APPROXIMATELY HERE

Table 2 indicates that the correlation between the market neutral index and its main components, arbitrage and long/short funds is higher than 90%. This result is logical since these 2 sub-strategies represent a total of more than 90% of the funds in the database. The correlation between the market neutral index and the mortgage funds is significantly lower at 0.49. The correlation between the market neutral sub-strategies ranges from 0.37 (between mortgage-backed funds and no sub-strategy funds) to 0.7 (between arbitrage funds and long/short funds). These figures are reasonably high and suggest that the sub-classification has a sense since no sub-strategies are completely correlated. The correlation between market neutral funds (considered as a whole or per sub-strategies) ranges from 0.19 (between no sub-strategy funds and the index) to 0.54 (between market neutral funds and the index). These figures are reasonable but relatively high for the index. These results are in line with previous results obtained by Schneeweis and Spurgin, 1997; Liang, 1999; Amin and Kat, 2001 and Capocci and Hübner, 2004).

INSERT FIGURE 1 APPROXIMATELY HERE

Figure 1 reports the average, median, minimum and maximum individual correlation between market neutral fund index and its sub-strategies and the equity index³. We describe this figure using market neutral funds as an example. The bottom line of the block represents the minimum individual correlation between market neutral funds and the equity index, -0.29 in the first case. The upper part of the grey block ended at the average correlation between market neutral funds and the index, 0.15 for market neutral funds. The median is reported below the white part of the block at 0.3 for market neutral funds. Finally, the top of the box is the maximum individual correlation between a single market neutral fund and the equity index.

Figure 1 indicates that the individual correlation between individual hedge funds and the equity index vary strongly for the strategy and the sub-strategies considered and that the individual correlation between hedge funds and the index are much lower than the correlation between hedge funds indices and the equity index. This result indicates that even if individual market funds are not correlated with the equity index, it is important to consider individual funds because index aggregation can increase the correlation and the exposure to the equity market. This point is particularly important for the beta analysis. The sub-strategy correlation analysis also reported in Figure 1 confirms this topic since the correlation between the sub-indices and the equity market is lower than the correlation of the global market neutral index that contains all these sub-strategies.

3.3 Birth and attrition rates

Attrition rates of hedge funds are largely publicized in academic studies (see for example Fung and Hsieh, 1997; Liang, 2000; Liang 2003). This rate can be defined as the percentage of funds in the database that are dissolved each year. Table 3 reports the birth rate and the attrition rate of the fund in our database for each year under study.

INSERT TABLE 3 APPROXIMATELY HERE

Table 3 indicates that birth rates are much higher than attrition rate but that this rate diminished over time from more than 50% in 1994 to 11% in 2002. On the other side, the

³ We removed 3 funds with few data to perform the correlation analysis at the individual fund level. We do not report the result of the no sub-strategy index because it includes only 3 individual funds.

attrition rate is very low for the first 2 years under investigation and is almost stable between 1995 and 2002 ranging from 8% to 13.7%. The high level of dissolution in 1998 should probably be due to the Russian, the Asian crisis and the bailout of Long Term Capital Management, LTCM. The average birth rate is around 30% and the average attrition rate is 8.7% indicating that each year, on average around 8.7% of the fund in the industry are dissolved. Table 3 also indicates that the total number of funds has increased linearly over the period. These results are in line with the results obtained by Liang (2000) for the TASS database but lower than the 14% obtained by Brown, Goetzmann and Ibbotson (1999).

V. Survivorship bias analysis

Survivorship bias is particularly important in the case of hedge funds (see Fung and Hsieh, 1997; Fung and Hsieh, 2000; Ackermann, McEnally and Ravenscraft, 2001; Capocci and Hübner, 2004). Usually this bias is studied on a global basis for full databases including a variety of different strategies. In this study, since we focus on market neutral funds, we will analyse the presence of survivorship bias for the funds in our database.

Survivorship bias can be defined in 2 ways: the performance difference between surviving and dissolved funds (e.g. Ackermann et al., 1999) and the performance difference between living and all funds (e.g. Fung and Hsieh, 2000). We report the bias using both definitions.

INSERT TABLE 4 APPROXIMATELY HERE

Panel A of Table 4 indicates that the returns have been less interesting in recent years compared to the past. The most difficult years for market neutral funds have been 1994 (bond market crisis), 1998 (Russian, Asian crisis and the LTCM bailout) and 2002 (3rd year of bearish market). The average return for the funds that survived over the whole period is 1.22%, higher than the whole funds in the database average return of 1.08% and higher than the returns of funds that have been dissolved during the period studied with a performance of 0.77%. Standard deviation is interesting because it indicates that in recent years the volatility of the dissolved funds has increased dramatically compared to surviving funds. This indicates that volatile funds have been more exposed to dissolution in 2001 and 2002.

Panel B reports the difference of performance between living and dead funds (left side) and living and all funds (right side). The table indicates that the difference in performance between living funds and dead funds has increased dramatically compared to the difference between living funds and all funds in recent years to almost 1% in 2000 and 2002. The total bias is 5.4% using the first formula and 1.68% using the general one. The latest figure is the generally used one in hedge fund studies and can be compared to past results.

This latter value is much higher than the very low value obtained by Ackermann et al. for the period 1988-1995. It is similar to the percentage of 1.5% from Fung and Hsieh (1998), lower than the 0.30% monthly bias found by Fung and Hsieh (2000) and slightly higher than the percentage of 1.2% found by Capocci and Hübner (2004) for the 1994-2000 period. It is however lower than the 3% bias found by Liang (2001), which is also the industry consensus as stressed by Amin and Kat (2001)⁴.

VI. Methodology

The objective of this study is to determine if market neutral funds are exposed to the equity market or if they are really market neutral. The methodology used in this study is two-fold. The first part of this analysis has the objective to analyse the exposure of market neutral funds to the equity market. We perform this analysis in three steps. First, we analyse market neutral funds grouped per sub-strategy. Secondly, we classify them in decile on the basis on the global performance over the period studied in order to determine which funds were the most exposed to the market. Thirdly, we classify them using Carhart's (1997) methodology in order to determine if there is a pattern to detect portfolio's constructed on the basis of previous year's performance. Each year, we classify funds on the basis of their previous year performance and we create return series. Then, we estimate the exposure to the market for all these deciles in order to determine if best or worst performing funds are more or less exposed to the market.

In the second part of the analysis we perform the same analysis for individual funds and by extracting a bull and a bear market period. For individual funds, we also perform an

⁴ This consensus value is quite high when compared to the 0.8-1.5 bias reported by Malkiel (1995) and Brown and Goetzmann (1995) for US mutual funds.

ex-post beta analysis. This methodology uses the same results as previously but differently. We classify the funds in decile on the basis of their ex-post betas and analyse their descriptive statistics. This part of the analysis has the objective to determine if it is the same funds that performed well in bear/bull market and in the whole period. Does the beta exposure explain better or worst returns?

The model used is a single index model based on the classical CAPM developed by Sharpe (1964) and Lintner (1965). Its equation to estimate is the following:

$$R_{P_t F_t} = \alpha_P + \beta_P * R_{M_t} + \varepsilon_{P_t} \quad t = 1, 2, \dots, T \quad (1)$$

Where R_{P_t} = return of fund P in month t ; R_{M_t} = return of the equity market portfolio, in our case the S&P500 on month t ; ε_{P_t} = error term; α_P and β_P are the intercept and the slope of the regression, respectively. The intercept of this equation, α_P commonly called Jensen's alpha (1968) is usually interpreted as a measure of out- or under-performance relative to the market proxy used. The beta is interpreted as a measure of the dependence of a fund's return to the index. It is a relative measure. We compute all estimations by using Newey-West (1987) standard errors to adjust for any autocorrelation in the returns

VII. Strategy and decile analysis

This section reports the results of the exposure analysis obtained using strategy and sub-strategy indices and on the basis of the decile classification. Panel A of Table 5 reports the results for the market neutral strategy and various market neutral sub-strategies.

INSERT TABLE 5 APPROXIMATELY HERE

Panel A reports the average return and standard deviation of returns over the period studied as well as the results of the regression analysis. A comparison between the average return and the alpha indicates that they are relatively close to each other, which indicates that only a small part of market neutral returns can be explained by the market. The R^2_{adj} are relatively low, most market neutral indices indicating that the market cannot explain a big proportion of the average return of the indices even if the 29% R^2_{adj} obtained for market neutral funds is relatively high for this kind of model. The betas indicate however that all

indices except mortgage-backed securities funds are significantly exposed to the equity market at the 1% significance level. On an absolute term however, the beta obtained is low between 0.06 for mortgage backed securities and 0.14 for long/short funds.

Panel B reports the results obtained using the decile classification. These results are based on decile constructed on the basis of the performance over the period studied. As previously, top performing funds are reported in Decile 10 and worst performing funds are reported in Decile 1. Panel B indicates the same pattern as Panel A, the difference between the alpha and the average return is relatively low, the R^2_{adj} are relatively low, but all market betas are significantly positive even if they are all low in absolute term. Top and worst performing funds have however the highest market exposure.

In a second step, we perform the same analysis on the basis of Carhart (1997) methodology. The objective of this analysis is to determine if last year best or bad performers are more exposed to the market. Each year, we classify the funds on the basis of their previous year performance and we create return series. Then, we estimate the exposure to the market for all these deciles in order to determine if best or worst performing funds are more or less exposed to the market.

INSERT FIGURE 2 APPROXIMATELY HERE

Before analysing the results of this analysis, we report the number of funds in each decile in Figure 2. It reports the number of funds in the analysis each year (left axis) and the number of funds per decile each year (right axis) as well as the average number of funds per year over the whole period and the average number of funds per decile. This figure indicates that the average number of funds per year is 264 with decile of 28 funds on average. Over the whole period, decile 1 (worst performing funds) would have offered 0.72% per month against 1.26% for decile 10 (best performing funds) and 0.69% for the index.

INSERT TABLE 6 APPROXIMATELY HERE

A comparison between the average return and the alpha obtained in Table 6 indicates that the market exposure cannot explain the performance of market neutral funds since the alphas obtained before and after the regression are very close. Moreover, the R^2_{adj} obtained is

very low, which confirms the results. On the other hand however, the market column indicates that 6 out of 10 deciles are significantly exposed to the market. These deciles are spread but the 3 top performing deciles are all significantly exposed to the market. The spreads reported on the bottom of Table 6 indicate that the spread between decile 1 and decile 10 is significantly positive but that the spreads between decile 1 and decile 2 and between decile 9 and decile 10 are not significantly different from zero.

These results suggest that the exposure of market neutral funds to the equity market is not clear. Even if the 6 out of 10 deciles's exposure are significantly positive, in absolute term, the market factor does not explain a large part of the alpha created by market neutral funds and the low R^2_{ADJ} obtained suggest that the exposure does not describe market neutral fund returns well. In absolute term, the market factors are another time very low.

VIII. Individual fund analysis

In this section, we base our analysis on the individual fund return series in order to determine if the results previously obtained using strategy and sub-strategy indices are still valid. In the first sub-section, we analyse the market exposure. In the second one, we look at the ex-post beta exposure.

8.1 Market exposure

As we suggested in the correlation analysis, it is important to check if the results obtained on a strategy or sub-strategy basis are still valid on an individual fund basis. To check this, we perform the same analysis using the returns of individual funds⁵. Results are reported in Table 7. This Table reports the average return, the return distribution which is the percentage of average monthly returns that are significantly positive (+), significantly negative (-) and not significant (0) on the one side, and the results of the regression of the other. Like average return, individual alpha and beta are classified as significantly positive at the 5% significance level, significantly negative or not significant.

⁵ We require all funds to have at least 24 months of data to perform this analysis. This lead us to remove 172 funds (74 arbitrage funds, 92 long/short funds, 5 mortgage backed funds and 1 no sub-strategy fund) from the database and leave us with a total of 462 funds (207 arbitrage funds, 214 long/short funds, 39 mortgage backed securities funds and 2 no sub-strategy funds).

INSERT TABLE 7 APPROXIMATELY HERE

The left-hand side of Table 7 indicates that the vast majority of individual average returns are significantly positive and that around 20% of them are not significantly different from 0. Very few average returns are significantly negative over the period studied. The average returns and alphas obtained for individual funds are higher compared to the ones obtained while studying funds agglomerated in indices. Alphas are always lower than the corresponding average return but the differences are relatively small. Nevertheless, much more alphas are concentrated around 0, being not significantly different from it. The percentage of market neutral funds average return not significantly different increases from 21% to 38% when the market impact is taken into account. Results are similar for the main sub-strategies, but they explain more precisely the ones previously obtained. The inclusion of the market index puts many significantly positive average return back to no significance even if the quantitative impact on alpha is small.

On an absolute term, the market exposure remains obviously the same here as it was in previous analysis. It is however particularly interesting to underline that the beta distribution for individual funds indicates that the majority of betas are not significantly different from zero. This result is not inline with the previous one and it indicates that almost two-third of the individual beta exposure for market neutral funds are not significantly different from zero and not exposed to the market. This result could be explained by 2 reasons. First, the aggregation of funds in indices leads to an increase in the exposure to the equity market. This first reason is in line with the results obtained in the correlation analysis and stresses the importance that it is of major importance to consider individual funds in empirical analysis because results based on indices could be biased. Secondly, since the bulk of the funds are not significantly exposed to the market but one third of the funds are and only five percent of the funds are negatively significantly exposed to the market, the funds significantly exposed could bias the results. These two remarks are of particular interest.

8.2 Ex-post beta analysis

In the second step of the analysis we use the results obtained in the first part of this section to study the link between the beta and the performance of the funds. We use the

individual results obtained in the previous section but we classify funds in Table 8 on the basis of the betas from the lowest to the highest one.

INSERT TABLE 8 APPROXIMATELY HERE

Table 8 indicates that there is no clear pattern in the average return column. The figure indicates that the highest average returns are spread between decile 8, decile 1, decile 10 and decile 6. The return distribution however indicates that more insignificant returns are offered by low beta funds (see decile 1) and by high beta funds (decile 9 and 10). This means that the best performing market neutral funds are those that are not exposed to the market. The standard deviation column indicates that the same decile 1, decile 9 and decile 10. These results also indicate an interesting pattern. Negatively exposed and strongly positive exposed funds are more volatile than market neutral funds. This result is in line with the objective of market neutral funds which is to offer low volatility positive returns over time.

A closer look at the regression results indicates that the highest alphas are offered by the same deciles that offered high average returns but with lower absolute values. Please note that the alpha for middle decile funds is weakly exposed to the market and very close to the values obtained for the average returns confirming the fact that these funds are unexposed to the market. The distribution of the alpha indicates the same pattern as the return distribution with higher figures for alpha's not significantly different from zero. This remark is particularly true, strongly exposed or negatively and significantly exposed deciles (decile 1, decile 9 and decile 10) indicating that these funds were not able to offer significantly positive returns when the market impact was taken into account or, in other words that the market can explain a major part of their returns. This could be explained by the fact that funds reported in decile 1 benefited mainly from bear market and funds in deciles 9 and 10 did so from bull market conditions. This result is also true for other deciles but less precise.

As we could expect, and by construction, the beta analysis indicates that the betas are increasing over the decile. More interestingly, the beta distribution columns indicate a clear pattern. No betas are significantly positive for the more weakly exposed deciles (deciles 1 to decile 3). This logical result confirms our previous suggestion that low decile funds profit from the bear market. Then, the number of significantly positive returns increase

monotonically and the percentage of significantly negatively exposed to the market funds go to zero after decile 4, indicating that there has been more positively market exposed funds than negatively exposed funds over the period studied. As before the R^2_{adj} are low except for decile 10. This result can be explained by the fact that funds reported in decile 10 are more exposed to the market. All over, this analysis suggests that most market neutral funds are not significantly exposed to the market.

IX. Sub-period analysis

Since our analysis period covers a bull and a bear period, we will perform the same analysis as in section VI in dividing the analysis period in 2 sub-periods. We chose the bull and a bear market as defined by Capocci, Corhay and Hübner (2004). The cutting point chosen for the identification of the up and down periods has been set at March 2000. This month corresponds to the maximum observed value of the Russel 3000 (that contains 95% of the capitalisation of the American equity market) 500 Index that reached a value of 858.48 during the session of March 24, 2000. During the up period, the monthly index return was positive in 70% of the months (52 out of 74) with an average yearly return of 19.4%. During the down period, the monthly index return was positive in **39%** of the months (12 out of 34) and the average yearly return was -16.9%. Those trends are sufficiently strong to allow us to consider the whole sub-periods as, respectively, bullish and bearish without having to use a complex rule to separate bullish, bearish and neutral months since these rules would obviously not match the ones used by fund managers for their market timing decisions.

9.1 Market exposure

INSERT TABLE 9 APPROXIMATIVELY HERE

Panel A of table 9 reports the result of the beta analysis for funds considered in indices and for funds classified on the basis of their performance over the period studied in order to determine if best or worst performing funds have been more or less exposed to the equity market over the bullish and bearish period studied.

The results obtained for the bullish period (see Table 9 Panel A) indicates that the alphas reported are higher than those obtained over the whole period. This result is quite astonishing because it seems to indicate that market neutral funds have been able to

outperform the market index over the period studied. The market and R^2_{adj} columns however indicate that this significant alpha was created totally independently of the market direction because all market factors are not significantly different from zero. Moreover, the R^2_{adj} are very low indicating that the market factor cannot explain the returns. More precisely, this result confirms the non-exposure to the market for market neutral funds but the ability to create absolute performance over the bullish period studied. Mortgage backed funds' results even indicate that the funds were negatively (but not significantly) exposed to the market and that they create absolute alpha.

The second part of Panel A of Table 9 reports the deciles' regression analysis for the bull period. It indicates the same pattern as over the whole period with higher absolute numbers with the same level of significance indicating that all but the worst performing funds were able to create significantly positive alpha over the period studied with no exposure to the market as indicated by the market and the R^2_{adj} columns. This means that these funds do not offer absolute⁶ significantly positive returns over this period. On the other side, the funds reported in the other deciles offered significantly positive absolute returns over the period studied.

Panel B of Table 10 shows that the average return for every strategy (the exception being the no sub-strategy category) was higher over the whole period than over the bear market period studied. This result is inverse from the one obtained for the bull market period and is logical since managers face more difficulties in finding investment opportunities when stocks' prices (good and bad one) were decreasing. Standard deviations are also in almost all cases higher. Alphas indicate the same pattern. Interestingly, the beta reported are significantly positive in all cases over this time period indicating that the funds were significantly exposed to the market over this period. The market exposure can explain a bigger part of the alphas generated since the R^2_{adj} are much higher than the one obtained over the bull market. On an absolute term however, the alphas generated by the market neutral funds are significantly positive. The reasons explaining this result are however completely different from the one explaining the alpha in the bull market. In the bull market period the market exposure could not explain the alpha created by the funds leading to significantly

⁶ We use the term absolute to underlie the fact that these funds were not significantly exposed to the market, which means that these figures have to be considered on a absolute basis rather than in comparison with the index considered;

positive alphas with extremely low R^2_{adj} . On the other side, in the second case, the bullish period, the funds significantly outperformed the market with a significant exposure to it and comparatively high R^2_{adj} . This result is particularly important.

The second part of Panel B indicates exactly the same pattern, lower alpha for most decile in absolute term significant (in statistical term but low in absolute term) exposure to the equity market for the same deciles and relatively high R^2_{adj} . An interesting point to stress here is that these results are not exact to performing funds that could create alpha with no exposure to the market. These funds create positive absolute returns (while remaining market neutral funds) whereas worst performing market neutral funds create alpha compared to the equity market (which was strongly negative over this period). This result interestingly stresses that most bad performing market neutral funds out-perform the equity market without offering significantly positive performance but that the best performing funds significantly outperformed the equity market and offered significantly positive returns over the bearish market after March 2000.

INSERT TABLE 10 APPROXIMATELY HERE

Table 10 reports the same results based on the decile classification from Carhart's (1997). The average return and standard deviation column indicates that the top and bottom decile funds, the most volatile one has not offered significantly positive return over the period covered. This result is confirmed by the regression results. No alpha is significantly positive when the market impact is taken into account. Interestingly, no deciles but decile 9 are exposed to the market. Most deciles are even negatively (but not significantly) exposed to the equity market. The R^2_{adj} are low. All these results suggest that low volatility market neutral funds create value on an absolute basis (without exposure to the equity market) but that almost none of them benefit from the market sharp increase. Moreover, this strong bull market has a negative (but not significant) impact on the performance.

Panel B of Table 10 indicates that even if the average return of the previous year top and worst performing funds are not significantly different from zero, the other deciles offer a significantly positive alpha. These results are stronger than before, confirming that volatile funds cannot create persistent value over time. In absolute term, top funds however offered better (but not significantly positive) alphas than bad ones. Bottom and particularly top

deciles had the highest volatility confirming our previous results. Over the bearish period, no decile but the one containing last year worst performing funds have been significantly exposed to the market. Interestingly, the alpha of this decile is significantly positive whereas its average return was not. This result can be explained by the fact that funds in this decile were significantly exposed to the market. In fact, the average return is lower than the alpha. Since the market went down over the period studied, the exposure of the fund to the market has unable the manager to offer significantly positive alpha compared to the index whereas its average return was not different from zero. The spread between decile 1 and decile 2 is significantly negative confirming this remark.

9.2 Individual funds

INSERT TABLE 11 APPROXIMATELY HERE

Table 11 reports the sub-period analysis obtained for individual funds⁷. As one could expect, the average return obtained for the bull market are higher than those obtained over the whole period (except for mortgage backed funds) and a higher proportion of these returns are significantly positive. The alpha column and distribution reports the same pattern. The market exposure however indicates differences. Whereas it was on the average positive over the whole period with one third of the beta being significantly positive, almost all betas are not significantly different from zero over the bull market. This result indicates that individual market neutral funds are not exposed to the market in bull markets. The R^2_{adj} obtained confirms this result.

Panel B's average returns are much lower but the average returns are spread in the same way as before for market neutral funds arbitrage funds and long/short funds. For mortgage backed funds, more average returns are significantly positive over the bear period.

⁷ We require all funds to have returns for the whole period between September 1998 and March 2000. This lead us to remove 200 funds (90 arbitrage funds, 96 long/short funds, 13 mortgage backed funds and 1 no sub-strategy fund) from the database and leave us with a total of 262 funds (146 arbitrage funds, 138 long/short funds, 29 mortgage backed securities funds and 2 no sub-strategy funds) for the 9/98-3/00 period analysis. This lead remove 125 funds (60 arbitrage funds, 52 long/short funds, 11 mortgage backed funds and 2 no sub-strategy fund) from the database and leave us with a total of 337 funds (147 arbitrage funds, 162 long/short funds and 14 mortgage backed securities funds) for the 4/00-12/02 period analysis.

The alpha's obtained are also lower and there are some differences in the proportion of significantly positive alphas and alphas not significantly different from zero for arbitrage funds (more alphas are not significantly different from zero over the bear period) and long/short funds (more alphas are significantly different from zero over the bear period). The market exposure over the bull market are more spread with up to 31% significantly positive alphas (arbitrage funds) and there are up to 18% of significantly negative alpha's for some strategy (mortgage backed funds for example) indicating that these funds did not short the market. These results indicate that Arbitrage funds and mortgaged backed funds seemed to perform better in bull market (with more significantly positive alpha) without being exposed to the market. On the other side when the market was down they were able to create positive alpha but are more exposed to the market. On the other side, regarding market exposure, in bear market, market neutral managers considered as a whole seemed more to be exposed to the market, on the long on or the short side. Interestingly, market neutral funds were significantly and negatively exposed to the market only during bear market.

9.3 Ex-post beta sub-period analysis

INSERT TABLE 12 APPROXIMATELY HERE

Table 12 reports the beta ex-post analysis over the 2 sub-periods considered. Panel A reports higher average returns for the bull market period compared to the whole period but fewer of these returns are significantly positive. The standard deviations of the returns are lower for the bull market compared to the global period. The regression results report higher alphas than previously for all deciles but fewer of them are significantly positive. As before and by construction the exposure to the market increases but the absolute level over the bull market are lower than before indicating that market neutral funds are less exposed to the market during bull market than during a whole investment cycle. Fewer individual betas are significantly positive over the bull market conditions compared to the whole period studied. The R^2_{adj} are close to zero for all deciles except the high beta decile. All in one these results indicate that market neutral funds could offer absolute alpha during the bull market without being exposed to the market.

Panel B of Table 12 indicates that over the bear market period covered, market neutral funds offered higher average returns compared to the whole period and to the bull market period but fewer returns are significantly positive compared to the whole period and less strict compared to the bull market. The standard deviation is close to those obtained over the whole period and higher than those obtained over the bull market period. Alphas are lower than over the whole period and fewer of them are significantly positive. The market exposure increases logically by construction with extreme's beta value higher (respectively lower) for high (respectively low) beta funds. This confirms our previous results that in the bear market period, market neutral fund's beta are higher in absolute term. The beta distribution confirms this result. The R^2_{adj} obtained are also relatively high for top and bottom deciles indicating that fund's market exposure help explaining returns for the highest negatively and positively exposed funds.

X. Conclusion

This study focuses on the neutrality of market neutral funds. It has the objective to determine if so-called market neutral funds are really not exposed to the equity market. We will analyse this topic over a complete market cycle going from January 1993 to December 2002 and over bull and bear market conditions covering respectively the September 1998 to March 2002 and the April 2000 to December 2002 periods.

In the first descriptive part of the analysis, we will focus on the literature, the interest of the study, on the descriptive statistics, attrition and birth rates and on the presence of survivorship bias in the data. The core of the study is based on a methodology that use classical exposure measures like the beta in an original way. We will perform the analysis using strategy and sub-strategy indices and using individual funds data in order to determine if we obtained the same results.

The results obtained using sub-strategy indices indicate the beta obtained are low on an absolute term but significantly positive. Decile analysis indicates that top and worst performing funds (over the whole period) have the highest market exposure. The analysis of the decile constructed in the previous year's performance as a tool of classification suggests that the exposure of market neutral funds to the equity market is not clear. In all cases, market

factors are significantly positive but they do not explain a major part of the alphas that are relatively the same as the average return and the calculations usually give low R^2_{adj} .

The individual fund analysis results indicate that on the average, one third of the individual funds were significantly positively exposed to the market while two third of the alphas are significantly positive (especially for worst and best performing funds that also offer the more volatile returns). Then, the ex-post beta analysis indicates that negatively exposed and strongly positive exposed funds are more volatile than market neutral funds. Middle decile funds returns are the only real market neutral funds. Some funds are strongly positively or negatively exposed to the market over the period studied, but most market neutral funds are not significantly exposed to the market.

We had to perform an analysis at the individual fund level to find out this result because market neutral index analysis lead to more controversial results. This paper stresses the importance of considering individual funds when performing market neutral empirical analysis. This result could be explained by 2 reasons. First, the aggregation of funds in indices leads to an increase in the exposure to the equity market. This first reason is in line with the results obtained in the correlation analysis and stresses the point that it is of major importance to consider individual funds in empirical analysis because results based on indices could be biased. Secondly, since the bulk of the funds are not significantly exposed to the market but one third of the funds are and only five percent of the funds are negatively significantly exposed to the market, the funds significantly exposed could bias the results.

The sub-period analysis also reports very interesting results. First, most bad performing market neutral funds out-perform the equity market without being significantly exposed to the market but best performing funds significantly out-performed the equity market and offered significantly positive returns over the bearish market after March 2000. Secondly, on a strategy and sub-strategy basis, over the bullish period no index or decile has been significantly exposed to the market. Over the bearish period, all but the best performing deciles have been significantly exposed to the market but they all, except the best performing funds create significant alpha. The decile classification based on previous year's performance interestingly add to these results that they were very few funds significantly positively exposed to the market during the bullish period and that there was no clear pattern in the bear period results for these calculations. Thirdly, arbitrage funds and mortgaged-backed funds

perform better in bull market without being exposed to the market. On the other side when the market is down they are able to create positive alpha but are exposed to the market. On the other side, regarding market exposure, in bear market, market neutral managers considered as a whole tend more to be exposed to the market, on the long or the short side. Interestingly, some market neutral funds are significantly negatively exposed to the market only during bear market.

Our analysis leads to the conclusion that most market neutral funds are not significantly exposed to the equity market, but that they tend to be more exposed during bear market than during bull market without being negatively impacted.

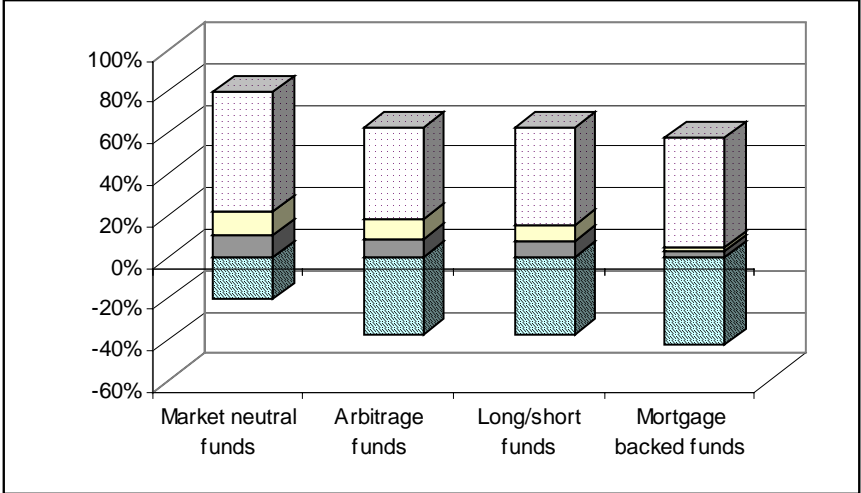
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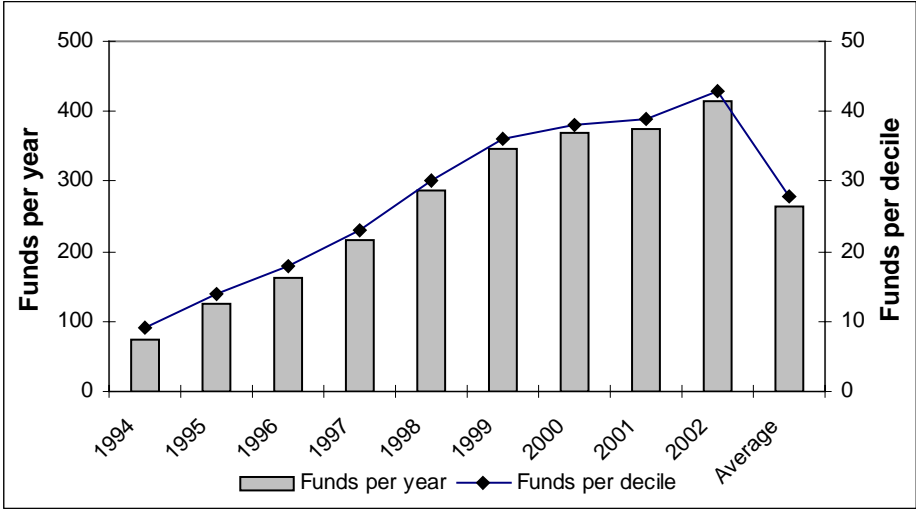
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Figure 1: Minimum, maximum, median and mean individual correlations between market neutral funds and the equity index



This figure reports the minimum, maximum, median and mean individual correlations between market neutral funds and the equity index between January 1993 and December 2002.

Figure 2: Lagged 12-month decile description



This figure reports the yearly lagged 12-month decile description. The left-hand axis reports the number of funds per year. The right-hand axis reports the number of funds per decile. The average is for the January 1994 to December 2002 period.

Table 1: Descriptive statistics and decile descriptive statistics

Panel A: Strategy, sub-strategies and index descriptive statistics

	Hedge		Funds strategies		Jan. 1993-Dec. 2002 (120 months)										
	No of Fds	% of the strategy	Living Funds	Dead Funds	Mean Return	S. D.	Median	Min	Max	Skewness	Kurtosis	Sharpe score			
<i>Individual Funds</i>															
Market neutral funds	634	100%	398	236	1,08%	***	0,94%	1,10%	-2,54%	3,96%	-0,31	***	1,26	***	1,15
- Arbitrage funds	281	44,3%	175	106	1,03%	***	0,92%	1,05%	-2,84%	2,93%	-0,80	***	1,83	***	1,13
- Long/short funds	306	48,3%	197	109	1,16%	***	1,16%	1,06%	-1,84%	5,53%	0,39	***	1,19	***	1,00
- Mortgage backed funds	44	6,9%	26	18	1,06%	***	1,32%	1,26%	-8,74%	2,84%	-4,11	***	26,45	***	0,80
- No sub-strategy	3	0,5%	0	3	0,73%	***	1,11%	0,79%	-2,76%	4,06%	-0,29	***	1,77	***	0,65
Index	NA	NA	NA	NA	0,69%	*	4,47%	1,10%	-14,58%	9,67%	-0,59		0,43		0,15

Panel B: Decile descriptive statistics

	Hedge		Funds deciles		Jan. 1993-Dec. 2002 (120 months)									
	No of Fds	Living Funds	Dead Funds	Mean Return	S. D.	Median	Min	Max	Skewness	Kurtosis	Sharpe score			
Decile 1	63	38%	62%	-0,34%	3,53%	-0,2%	-17,5%	8,5%	-1,28	***	5,02	***	-0,10	
Decile 2	63	43%	57%	0,28%	***	1,21%	0,3%	-2,3%	4,4%	0,51	***	0,78	***	0,23
Decile 3	63	62%	38%	0,55%	***	0,59%	0,6%	-1,0%	2,1%	0,01		-0,02		0,93
Decile 4	63	56%	44%	0,72%	***	0,95%	0,8%	-2,4%	2,4%	-1,11	***	1,94	***	0,76
Decile 5	64	80%	20%	0,89%	***	0,84%	1,0%	-4,2%	2,7%	-1,90	***	10,31	***	1,05
Decile 6	64	72%	28%	1,10%	***	1,04%	1,2%	-2,7%	4,2%	-0,27	***	1,24	***	1,07
Decile 7	63	71%	29%	1,21%	***	1,28%	1,2%	-2,7%	5,9%	0,36	***	2,05	***	0,95
Decile 8	63	71%	29%	1,40%	***	1,10%	1,4%	-2,5%	4,4%	0,01		1,02	***	1,27
Decile 9	63	81%	19%	1,75%	***	1,43%	1,7%	-2,4%	6,3%	0,30	**	0,72	***	1,23
Decile 10	63	56%	44%	2,70%	***	2,41%	2,5%	-4,1%	9,2%	0,11		0,31		1,12

This Table shows the number of funds (No of Fds), percentage of the strategy (% of the strategy), the number of living funds, the number of dead funds, the mean return, the standard deviation (S.D.), the median, the minimum (min), the maximum (max), the skewness, the kurtosis and the Sharpe score for the individual hedge funds in our MAR/CISDM database for the whole period 01:1993-12:2002. No sub-strategy ended in 01:12001. Sharpe score is the ratio of return and standard deviation. Panel A focus on strategy, sub-strategy and index descriptive statistics, Panel B on decile descriptive statistics. *** Significant at the 1% level, ** Significant at the 5% level and * Significant at the 10% level.

Table 2: Correlation between market neutral strategies and equity index

	Market neutral funds	Arbitrage funds	Long/short funds	Mortgage backed funds	No sub-strategy	Index
Market neutral funds	1					
- Arbitrage funds	0,91	1				
- Long/short funds	0,92	0,70	1			
- Mortgage backed funds	0,49	0,45	0,30	1		
- No sub-strategy	0,62	0,58	0,53	0,37	1	
Index	0,54	0,46	0,54	0,19	0,30	1

This Table reports the correlation coefficients among market neutral sub-strategies and between market neutral funds strategies and the index. The database consists of 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. The period covered is 01:1993-12/2002 period.

Table 3: Birth and attrition rates

	Year start	New	Dissolved	Year end	Birth rate	Attrition rate
1993	63	27	1	89	42,9%	1,6%
1994	89	50	2	137	56,2%	2,2%
1995	137	44	18	163	32,1%	13,1%
1996	163	74	13	224	45,4%	8,0%
1997	224	80	19	285	35,7%	8,5%
1998	285	78	39	324	27,4%	13,7%
1999	324	58	36	346	17,9%	11,1%
2000	346	47	32	361	13,6%	9,2%
2001	361	69	34	396	19,1%	9,4%
2002	396	44	42	398	11,1%	10,6%
Total		571	236	Average	30,1%	8,7%

This Table reports the number of funds at year start, the number of new funds, the number dissolved funds, the birth rate and the attrition rate for the market neutral funds in our database. Birth rate is defined as the ratio between the number of new funds and the number of funds at year start. The attrition rate is defined as the ratio of dissolved funds to number of funds at year start. The database consists of 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. The period covered is 01:1993-12/2002.

Table 4: Survivorship bias

Panel A: Annual performance (all funds, surviving funds and dissolved funds)

Year	All Funds		Surviving Funds		Dissolved Funds	
	Return	S.D.	Return	S. D.	Return	S. D.
1993	1,41%	0,43%	1,47%	0,47%	1,37%	0,47%
1994	0,25%	0,62%	0,45%	0,65%	0,10%	0,68%
1995	1,54%	0,55%	1,69%	0,58%	1,37%	0,75%
1996	1,56%	0,46%	1,88%	0,42%	1,16%	0,63%
1997	1,41%	0,92%	1,58%	0,94%	1,20%	1,02%
1998	0,58%	1,42%	0,64%	1,33%	0,48%	1,61%
1999	1,44%	0,80%	1,54%	0,78%	1,26%	0,91%
2000	1,41%	1,14%	1,64%	1,13%	0,70%	1,44%
2001	0,80%	0,74%	0,85%	0,65%	0,56%	1,39%
2002	0,36%	0,63%	0,43%	0,59%	-0,55%	2,96%
Average	1,08%	0,77%	1,22%	0,76%	0,77%	1,19%

Panel B:

Survivorship bias

Living - Dead Funds		Living - All Funds	
Year	Return	Year	Return
1993	0,10%	1993	0,06%
1994	0,35%	1994	0,20%
1995	0,32%	1995	0,15%
1996	0,73%	1996	0,32%
1997	0,38%	1997	0,17%
1998	0,16%	1998	0,07%
1999	0,28%	1999	0,09%
2000	0,94%	2000	0,23%
2001	0,29%	2001	0,05%
2002	0,97%	2002	0,06%
Bias 93-02	0,45%	per Month	0,14%
	5,40%	per Year	1,68%

This Table reports the survivorship bias of our database. Our MAR/CISDM database contains 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. In Panel B survivorship bias is calculated as the performance difference between surviving funds and dissolved funds (left-hand side) and as the performance difference between surviving funds and all funds (right-hand side). All returns are net of fees. Numbers in the table are yearly percentage unless otherwise indicated.

Table 5: Market exposure analysis

Panel A: Market exposure for market neutral funds

	Average return	S. D.	Alpha	Market	R ² adj
Market neutral funds	1,08% ***	0,94%	1,00% ***	0,11 ***	0,29
- Arbitrage funds	1,03% ***	0,92%	0,97% ***	0,10 ***	0,21
- Long/short funds	1,16% ***	1,16%	1,05% ***	0,14 ***	0,29
- Mortgage backed funds	1,06% ***	1,32%	1,02% ***	0,06 *	0,03
- No sub-strategy	0,73% ***	1,11%	0,62% ***	0,08 ***	0,08

Panel B: Decile market exposure

	Average return	S. D.	Alpha	Market	R ² adj
Decile 1	-0,34%	3,53%	-0,48%	0,21 ***	0,06
Decile 2	0,28%	1,21%	0,22% *	0,10 ***	0,12
Decile 3	0,55% ***	0,59%	0,51% ***	0,05 ***	0,12
Decile 4	0,72% ***	0,95%	0,64% ***	0,11 ***	0,29
Decile 5	0,89% ***	0,84%	0,85% ***	0,06 ***	0,08
Decile 6	1,10% ***	1,04%	1,01% ***	0,13 ***	0,31
Decile 7	1,21% ***	1,28%	1,15% ***	0,09 ***	0,08
Decile 8	1,40% ***	1,10%	1,32% ***	0,11 ***	0,19
Decile 9	1,75% ***	1,43%	1,66% ***	0,14 ***	0,19
Decile 10	2,70% ***	2,41%	2,56% ***	0,20 ***	0,13

The table reports the market exposure analysis. Panel A presents the average return, the standard deviation (S.D), the alpha, the market exposure (the beta) and the R²_{adj}. Panel B presents the same information when funds are classified in deciles on the basis of their performance over the period studied. Our MAR/CISDM database contains 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. *** Significant at the 1% level, ** Significant at the 5% level and * Significant at the 10% level.. t-stats are heteroskdasticity consistent. The period covered is 01:1993-12:2002.

Table 6: Lagged 12-month decile exposure

Portfolio	Average return		S. D.	Alpha		Market		R ² _{adj}
D1	0,72%	***	2,14%	0,70%	***	0,11	***	0,06
D2	0,62%	***	1,32%	0,63%	***	0,07	*	0,05
D3	0,60%	***	0,83%	0,65%	***	0,04	**	0,03
D4	0,48%	***	0,75%	0,49%	***	0,03	*	0,03
D5	0,61%	***	0,82%	0,61%	***	0,06	***	0,11
D6	0,67%	***	0,95%	0,67%	***	0,03		0,01
D7	0,79%	***	1,22%	0,80%	***	0,06	*	0,03
D8	0,89%	***	1,09%	0,88%	***	0,08	***	0,10
D9	1,11%	***	1,66%	1,04%	***	0,11	**	0,08
D10	1,26%	***	2,38%	1,33%	***	0,11	**	0,04
1-10 spread	0,54%	**	2,71%	0,63%	***	0,00		-0,01
1-2 spread	-0,10%		1,69%	-0,07%		-0,04		0,01
9-10 spread	0,15%		2,03%	0,29%		-0,01		-0,01

The table reports the market exposure using deciles constructed on the lagged-12 month performance (see Carhart 1997). It reports the average return, the standard deviation (S.D), the alpha, the market exposure (the beta) and the R²_{adj}. Our MAR/CISDM database contains 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. *** Significant at the 1% level, ** Significant at the 5% level and * Significant at the 10% level. t-stats are heteroskdasticity consistent. The period covered is 01:1993-12:2002.

Table 7: Individual fund market exposure

	Average return	Return distribution (5%)			S.D.	Alpha	Alpha distribution (5%)			Market	Beta distribution (5%)			R ² _{adj}
		+	0	-			+	0	-		+	0	-	
Market neutral funds	1,02%	78%	21%	1%	3,3%	0,95%	62%	38%	0%	0,13	32%	63%	5%	0,08
- Arbitrage funds	1,03%	84%	16%	0%	2,5%	0,94%	71%	29%	0%	0,09	33%	63%	3%	0,05
- Long/short funds	1,03%	71%	27%	2%	4,3%	1,00%	52%	47%	0%	0,16	36%	57%	7%	0,10
- Mortgage backed funds	0,89%	85%	13%	3%	3,0%	0,75%	67%	33%	0%	0,11	8%	92%	0%	0,03
- No sub-strategy	0,45%	50%	50%	0%	1,3%	0,36%	50%	50%	0%	0,18	50%	50%	0%	0,12

The table reports the individual fund market exposure. It reports the average return, the return distribution at the 5% level. (+ are significantly positive, 0 not significantly different from 0 and – significantly negative), the standard deviation (S.D), the alpha, alpha distribution at the 5% level (+ are significantly positive, 0 not significantly different from 0 and – significantly negative), the market exposure (the beta), the beta distribution (+ are significantly positive, 0 not significantly different from 0 and – significantly negative) and the R²_{adj}. Our MAR/CISDM database contains 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. t-stats are heteroskdasticity consistent. The period covered is 01:1993-12:2002.

Table 8: Ex-post beta analysis

	Average return	Return distribution (5%)			S.D.	alpha	Alpha distribution (5%)			Market	Beta distribution (5%)			R ² adj
		+	0	-			+	0	-		+	0	-	
Decile 1	1,14%	59%	39%	2%	4,9%	1,07%	39%	61%	0%	-0,27	0%	54%	46%	0,10
Decile 2	0,89%	85%	15%	0%	2,6%	0,90%	70%	30%	0%	-0,06	0%	96%	4%	0,01
Decile 3	0,96%	98%	2%	0%	1,6%	0,96%	83%	17%	0%	-0,01	0%	100%	0%	-0,01
Decile 4	0,81%	91%	9%	0%	1,2%	0,80%	83%	17%	0%	0,02	4%	96%	0%	0,00
Decile 5	1,00%	89%	9%	2%	1,9%	1,00%	81%	17%	2%	0,04	13%	87%	0%	0,00
Decile 6	1,07%	89%	9%	2%	2,0%	1,05%	83%	17%	0%	0,07	30%	70%	0%	0,03
Decile 7	0,96%	78%	20%	2%	2,8%	0,90%	59%	41%	0%	0,12	48%	52%	0%	0,07
Decile 8	1,24%	85%	13%	2%	3,9%	1,17%	67%	33%	0%	0,21	63%	37%	0%	0,10
Decile 9	1,00%	61%	39%	0%	4,7%	0,80%	26%	74%	0%	0,37	83%	17%	0%	0,16
Decile 10	1,11%	41%	57%	2%	8,0%	0,85%	26%	74%	0%	0,80	83%	17%	0%	0,31

The table reports the ex-post beta. Deciles are constructed on the basis of the market exposure of the individual funds. It reports the average return, the return distribution at the 5% level. (+ are significantly positive, 0 not significantly different from 0 and – significantly negative), the standard deviation (S.D), the alpha, alpha distribution at the 5% level (+ are significantly positive, 0 not significantly different from 0 and – significantly negative), the market exposure (the beta), the beta distribution (+ are significantly positive, 0 not significantly different from 0 and – significantly negative) and the R²_{adj}. Our MAR/CISDM database contains 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. t-stats are heteroskedasticity consistent. The period covered is 01:1993-12:2002.

Table 9: Indices and deciles sub-period analysis

<u>Panel A: 9/98-03/00</u>							
	Average return		S.D.	Alpha	Market		R ² adj
Market neutral funds	1,49%	***	1,11%	1,52%	***	-0,01	-0,06
- Arbitrage funds	1,40%	***	1,08%	1,48%	***	-0,03	-0,04
- Long/short funds	1,72%	***	1,34%	1,65%	***	0,03	-0,05
- Mortgage backed funds	0,73%		2,52%	1,04%	***	-0,12	-0,01
- No sub-strategy	0,64%	***	1,16%	0,74%	***	-0,04	-0,03
Decile 1	-0,36%		0,03	-0,07%		-0,12	-0,03
Decile 2	0,42%		1,87%	0,41%		0,00	-0,06
Decile 3	0,54%	***	0,60%	0,60%	***	-0,03	-0,02
Decile 4	0,85%	***	1,01%	0,94%	***	-0,03	-0,03
Decile 5	1,01%	***	1,41%	1,23%	***	-0,09	0,03
Decile 6	1,24%	***	0,96%	1,18%	***	0,02	-0,04
Decile 7	1,46%	***	1,39%	1,52%	***	-0,03	-0,05
Decile 8	1,62%	***	1,41%	1,58%	***	0,02	-0,06
Decile 9	2,60%	***	1,39%	2,53%	***	0,03	-0,05
Decile 10	4,27%	***	2,33%	4,04%	***	0,09	-0,03
<u>Panel B: 4/0-12/02</u>							
	Average return		S.D.	Alpha	Market		R ² adj
Market neutral funds	0,71%	***	0,77%	0,84%	***	0,09	0,35
- Arbitrage funds	0,75%	***	0,70%	0,85%	***	0,07	0,22
- Long/short funds	0,65%	***	1,08%	0,82%	***	0,11	0,29
- Mortgage backed funds	0,87%	***	0,88%	0,95%	***	0,06	0,10
- No sub-strategy	0,69%	***	1,31%	0,81%	*	0,14	0,11
Decile 1	-0,59%		3,37%	0,03%		0,43	0,43
Decile 2	-0,15%		0,99%	-0,03%		0,08	0,15
Decile 3	0,48%	***	0,67%	0,58%	***	0,07	0,27
Decile 4	0,40%	**	1,06%	0,65%	***	0,17	0,67
Decile 5	0,54%	***	0,52%	0,61%	***	0,05	0,21
Decile 6	0,61%	***	0,92%	0,78%	***	0,11	0,42
Decile 7	0,83%	***	0,67%	0,83%	***	0,00	-0,03
Decile 8	0,97%	***	0,80%	1,06%	***	0,06	**
Decile 9	1,17%	***	1,06%	1,26%	***	0,07	*
Decile 10	1,97%	***	1,42%	2,06%	***	0,06	0,02

This table reports the market exposure analysis over sub-periods. Each Panel presents the average return, the standard deviation (S.D), the alpha, the market exposure (the beta) and the R²_{adj}. Panel B presents the same information when funds are classified in deciles on the basis of their performance over the period studied. Our MAR/CISDM database contains 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. *** Significant at the 1% level, ** Significant at the 5% level and * Significant at the 10% level. t-stats are heteroskedasticity consistent. Panel A presents the bullish period (09:1998-03:2000), Panel B presents the bearish period (04:2000-12:2002).

Table 10: Lagged 12-month decile sub-period analysis

Panel A: 9/98-03/00						
	Average return	S.D.	alpha	Market	R ² _{adj}	
Decile 1	0,40%		0,17%	0,02		-0,05
Decile 2	0,56%	*	1,28%	0,15%	-0,01	-0,05
Decile 3	0,46%	**	0,88%	0,15%	-0,03	-0,03
Decile 4	0,28%	**	0,57%	0,12%	-0,03	-0,02
Decile 5	0,43%	***	0,70%	0,18%	0,04	0,00
Decile 6	0,35%	**	0,74%	0,15%	-0,05	-0,01
Decile 7	0,44%	*	1,12%	0,11%	-0,05	-0,05
Decile 8	0,59%	**	1,14%	0,26%	-0,01	-0,06
Decile 9	1,02%	**	1,86%	0,50%	0,11	** 0,11
Decile 10	1,40%	*	3,14%	0,57%	0,00	-0,06
1-10 spread	1,00%		2,93%	0,41%	-0,02	-0,06
1-2 spread	0,16%		1,02%	-0,02%	-0,03	-0,01
9-10 spread	0,38%		2,00%	0,07%	-0,11	0,10

Panel B: 4/0-12/02						
	Average return	S.D.	Alpha	Market	R ² _{adj}	
Decile 1	0,65%		2,71%	0,83%	*** 0,09	** 0,11
Decile 2	0,53%	**	1,32%	0,92%	*** 0,00	-0,03
Decile 3	0,37%	***	0,81%	0,76%	*** 0,02	-0,02
Decile 4	0,45%	***	0,79%	0,53%	*** 0,01	-0,03
Decile 5	0,56%	***	0,60%	0,67%	*** 0,01	-0,03
Decile 6	0,67%	***	0,62%	0,73%	*** 0,01	-0,02
Decile 7	0,72%	***	0,78%	0,93%	*** 0,04	0,00
Decile 8	0,82%	***	0,64%	0,96%	*** 0,03	-0,01
Decile 9	1,20%	***	0,83%	1,33%	*** 0,01	-0,03
Decile 10	0,53%		2,50%	1,77%	*** 0,13	0,01
1-10 spread	-0,13%		3,31%	0,94%	* 0,03	-0,03
1-2 spread	-0,12%		2,05%	0,09%	-0,09	** 0,12
9-10 spread	-0,67%		2,23%	0,44%	0,11	0,03

The table reports the market exposure using deciles constructed on the lagged-12 month performance (see Carhart 1997). It reports the average return, the standard deviation (S.D), the alpha, the market exposure (the beta) and the R²_{adj}. Our MAR/CISDM database contains 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. *** Significant at the 1% level, ** Significant at the 5% level and * Significant at the 10% level. t-stats are heteroskedasticity consistent. Panel A presents the bullish period (09:1998-03:2000), Panel B presents the bearish period (04:2000-12:2002).

Table 11: Sub-period individual funds results

Panel A: 9/98-03/00	Average return	Return distribution (5%)			S.D.	alpha	Alpha distribution (5%)			Market	Beta distribution (5%)			R ² adj
		+	0	-			+	0	-		+	0	-	
Market neutral funds	1,57%	58%	42%	0%	3,76%	1,65%	61%	38%	0%	-0,03	6%	92%	2%	0,01
- Arbitrage funds	1,52%	77%	23%	0%	2,38%	1,55%	84%	16%	0%	-0,01	3%	94%	3%	0,00
- Long/short funds	1,81%	23%	77%	0%	4,55%	1,87%	21%	79%	0%	-0,02	6%	94%	0%	0,02
- Mortgage backed funds	0,83%	38%	62%	0%	4,12%	1,10%	65%	35%	0%	-0,11	0%	100%	0%	0,02
- No sub-strategy	0,64%	100%	0%	0%	1,16%	0,74%	100%	0%	0%	-0,04	0%	100%	0%	-0,03

Panel B: 4/00-12/02	Average return	Return distribution (5%)			S.D.	alpha	Alpha distribution (5%)			Market	Beta distribution (5%)			R ² adj
		+	0	-			+	0	-		+	0	-	
Market neutral funds	0,71%	58%	41%	1%	2,84%	0,84%	58%	41%	1%	0,09	26%	64%	10%	0,09
- Arbitrage funds	0,80%	75%	24%	1%	1,80%	0,88%	72%	27%	1%	0,06	26%	72%	2%	0,05
- Long/short funds	0,59%	40%	59%	1%	3,91%	0,78%	42%	57%	1%	0,12	31%	53%	16%	0,14
- Mortgage backed funds	0,91%	79%	21%	0%	2,05%	1,02%	75%	25%	0%	0,07	4%	79%	18%	0,05
- No sub-strategy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

The table reports the individual fund market exposure. It reports the average return, the return distribution at the 5% level. (+ are significantly positive, 0 not significantly different from 0 and – significantly negative), the standard deviation (S.D), the alpha, alpha distribution at the 5% level (+ are significantly positive, 0 not significantly different from 0 and – significantly negative), the market exposure (the beta), the beta distribution (+ are significantly positive, 0 not significantly different from 0 and – significantly negative) and the R²_{adj}. Our MAR/CISDM database contains 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. t-stats are heteroskedasticity consistent. Panel A presents the bullish period (09:1998-03:2000), Panel B presents the bearish period (04:2000-12:2002).

Table 12: Ex-post beta sub-period analysis

Panel A: 9/98-03/00

	Average return	Return distribution (5%)			S.D	Alpha	Alpha distribution (5%)			Market	Beta distribution (5%)			R ² adj
		+	0	-			+	0	-		+	0	-	
Decile 1	1,69%	15%	85%	0%	9,1%	3,03%	19%	81%	0%	-0,54	0%	96%	4%	0,04
Decile 2	1,66%	27%	73%	0%	5,2%	2,24%	50%	50%	0%	-0,23	0%	100%	0%	0,02
Decile 3	1,66%	50%	50%	0%	3,5%	1,99%	81%	19%	0%	-0,13	0%	92%	8%	0,02
Decile 4	1,16%	62%	38%	0%	2,6%	1,36%	69%	31%	0%	-0,08	0%	96%	4%	0,00
Decile 5	1,32%	96%	4%	0%	1,4%	1,42%	100%	0%	0%	-0,04	0%	100%	0%	-0,02
Decile 6	1,37%	85%	15%	0%	1,6%	1,40%	81%	19%	0%	-0,01	0%	100%	0%	-0,05
Decile 7	1,01%	69%	31%	0%	2,3%	0,96%	69%	31%	0%	0,02	0%	100%	0%	-0,05
Decile 8	1,34%	69%	27%	4%	2,3%	1,20%	69%	27%	4%	0,06	4%	96%	0%	-0,01
Decile 9	1,89%	50%	50%	0%	3,9%	1,47%	50%	50%	0%	0,17	12%	88%	0%	0,01
Decile 10	2,68%	50%	50%	0%	5,8%	1,44%	23%	77%	0%	0,50	46%	54%	0%	0,16

Panel B: 04/00-12/02

	Average return	Return distribution (5%)			S.D	Alpha	Alpha distribution (5%)			Market	Beta distribution (5%)			R ² adj
		+	0	-			+	0	-		+	0	-	
Decile 1	1,50%	36%	64%	0%	5,1%	0,95%	27%	73%	0%	-0,37	0%	39%	61%	0,17
Decile 2	0,78%	61%	39%	0%	2,2%	0,63%	33%	67%	0%	-0,11	0%	76%	24%	0,06
Decile 3	1,04%	91%	9%	0%	1,4%	0,98%	85%	15%	0%	-0,04	0%	82%	18%	0,02
Decile 4	0,88%	91%	9%	0%	1,1%	0,87%	85%	15%	0%	0,00	0%	100%	0%	-0,03
Decile 5	0,70%	91%	9%	0%	1,0%	0,73%	91%	9%	0%	0,01	0%	100%	0%	-0,02
Decile 6	0,79%	76%	24%	0%	1,5%	0,84%	76%	24%	0%	0,03	9%	91%	0%	0,00
Decile 7	0,86%	76%	24%	0%	1,8%	0,96%	74%	26%	0%	0,07	50%	50%	0%	0,06
Decile 8	0,73%	53%	47%	0%	2,0%	0,93%	56%	44%	0%	0,14	71%	29%	0%	0,13
Decile 9	0,33%	3%	94%	3%	4,4%	0,75%	29%	68%	3%	0,28	47%	53%	0%	0,13
Decile 10	-0,55%	0%	94%	6%	8,1%	0,76%	24%	70%	6%	0,88	88%	12%	0%	0,36

The table reports the ex-post beta. Deciles are constructed on the basis of the market exposure of the individual funds. It reports the average return, the return distribution at the 5% level. (+ are significantly positive, 0 not significantly different from 0 and – significantly negative), the standard deviation (S.D), the alpha, alpha distribution at the 5% level (+ are significantly positive, 0 not significantly different from 0 and – significantly negative), the market exposure (the beta), the beta distribution (+ are significantly positive, 0 not significantly different from 0 and – significantly negative) and the R²_{adj}. Our MAR/CISDM database contains 634 individual market neutral funds, including 398 survived funds and 236 dissolved funds as of December 2002. t-stats are heteroskedasticity consistent. Panel A presents the bullish period (09:1998-03:2000), Panel B presents the bearish period (04:2000-12:2002).