

Louvain School of Management

Which hedge fund strategies are the most effective in the long term, in bull markets and in bear markets?

Author: Nicolas De Becker
Supervisor: Leonardo Iania
Academic year 2022-2023
Dissertation for the master of Business Engineering
Master subject and focus: Financial Engineering
Daytime schedule

The purpose of this study was to analyze the performance of hedge fund strategies in the long term (1994-2021) and during periods of bull and bear markets. We wanted to investigate which strategies perform better in the long term as well as whether some strategies perform always better or worse than others during periods of bull and bear markets. After having defined our different sub-periods of crisis, we used performance measures involving the risk and the return.

We found that multi-strategy, event driven distressed and global macro are the most effective strategies in the long term while dedicated short bias, equity market neutral, managed futures and emerging markets are the least effective strategies. For periods of bear market, our computations show that dedicated short bias, managed futures and global macro are the best performing strategies while long/short equity, emerging markets and event driven strategies (except event driven risk arbitrage) are the worst performers. As for periods of bull market, we found that event driven distressed, event driven, multi-strategy and event driven multi-strategy are the best performing strategies while dedicated short bias, managed futures and equity market neutral perform the worst.

Finally, we also found that the hedge fund sector, represented by the CSHFI, outperforms the overall market (represented by the S&P 500) in the long term, but also during crises and during periods of bull market.

Before I get to the heart of the matter, I would like to thank all the people who have helped and supported me throughout the realization of my master thesis.

First and foremost, I would like to thank my master thesis supervisor, Professor Leonardo Iania, for his valuable advice and guidance, which put me on the right track to complete this master thesis.

I also thank my parents who have always supported me along the long and winding road of writing a master thesis.

Finally, I would also like to thank the other students with whom I was able to exchange about the master thesis and glean valuable advice.

Table of Contents

Introduction.....	1
Description of hedge funds and their strategies	3
1. Historic and evolution.....	3
2. Definition	4
3. Hedge Fund Strategies	4
Literature Review.....	6
4. Performance of hedge funds compared to the overall market.....	6
4.1. In the long term.....	6
4.2. Global financial crisis	7
5. Performance of hedge fund strategies in the long term	8
5.1. Return	8
5.2. Risk.....	9
5.3. Risk-reward ratios	9
6. Performance of hedge fund strategies during the dotcom crisis	10
7. Performance of hedge fund strategies during the global financial crisis	11
7.1. Return	11
7.2. Risk.....	11
7.3. Risk-reward ratios	12
8. Summary	12
Empirical Analysis.....	13
9. Description of databases	13
9.1. Database for Hedge Fund performance	13
9.2. Database for stock market performance.....	15
9.3. Database for risk-free asset performance	15
10. Definition of the periods of crisis and without crisis.....	16
11. Analysis of the performance of hedge funds and their strategies	18
11.1. Measures of the return	18
11.2. Measures of risk	27
11.3. Risk-reward ratios	38
12. Conclusion about the performance analysis	52
12.1. In the long term.....	52
12.2. During periods of bear market	53
12.3. During periods of bull market	55
General Conclusion	57
References	59
Appendix 1: Description of hedge fund strategies.....	62

Introduction

Hedge funds are private investment vehicles pursuing a variety of strategies, taking both long and short positions on various markets and, using leverage to try to generate a higher return. Often unknown to the general public since their apparition over 70 years ago until recently, they experienced a growing interest from investors and researchers in finance. Indeed, the increasing number of existing hedge funds and the fast-growing assets under management imply that they have become an important player in the financial markets. Consequently to the increasing importance of hedge funds in the financial place, authors have become increasingly interested in the study of their performance and characteristics to better understand their behavior. More precisely, researchers have often analyzed the performance of hedge funds and their different strategies in the long term and during sub-periods such as before, during and after the global financial crisis. The global financial crisis is indeed the most studied crisis which is logical since it was one of the most important crises.

On the contrary, the performance of hedge funds had been much less studied during the dotcom crisis, the other major crisis in recent history. As for the impact of big crises in the second half of the 20th century on hedge funds, it has not been and will not be studied since the first hedge fund indexes and databases appeared in the 1990s. However, although there is data available, it appears that researchers did not study the performance of hedge funds during smaller crises that the world experienced since the end of the 1990s. Moreover, authors did not analyze the performance of hedge funds and their different investment strategies during several crises at the same time. Indeed, they did not attempt to generalize their results to determine which strategies are the most effective under different market conditions. There is a gap in the literature.

Therefore, in this study, we would like to investigate which hedge fund strategies are the most effective in the long term, when the market is going up (bull market) and when the market is falling (bear market). The goal of this study is to determine whether we can generalize the results and say, for example, “the strategy X performs in general better than the other ones in bull markets, but the strategy Y performs better in bear markets”. We are also looking for general rules regarding hedge fund strategies performance such as, for example, being able to determine that a strategy performs always better than others under certain conditions.

Consequently, we formulate our research question for this study as follows:

“Which hedge fund strategies are the most effective in the long term, in bull markets and in bear markets?”

To address this research question, we will analyze the performance of hedge fund strategies in the long term (1994-2021) and during sub-periods. These sub-periods will be the different crises that we will define and the periods between these crises. There will be the two biggest crises that occurred since the creation of hedge fund indexes in 1994 (the dotcom and global financial crises) as well as smaller crises such as crises the covid-19 crisis but also those that occurred in 1998, 2010, 2011, 2015 and 2018. Although, these crises are different regarding their nature and their causes, we argue that it is interesting to try to generalize the performance of hedge fund strategies in bull and bear markets.

To answer our research question, we will structure our study as follows. We will start by describing the universe of hedge funds: we will define hedge funds as well as the different investment strategies they use, and we will talk about their evolution. Then, we will review the literature about the performance of hedge funds and their investment strategies, both in the long term and during particular events such as crises. This will allow us to have a first idea of the effectiveness of hedge fund strategies and it will be useful to have these results in mind when we will analyze our results. In the second part of this study, the empirical part, we will start by describing our database for hedge fund past performance as well as databases for the market benchmark and the risk-free asset. Then, we will define the different sub-periods of our analysis (periods of bull and bear market) and present some summary statistics for these periods. Afterwards, we will evaluate the performance of hedge fund strategies both in the long term and during these sub-periods. To do so, we will compute the return and the excess return as well as the risk associated to the different investment strategies. We will also use risk-reward ratios, which combine different measures of risk and return. Finally, we will present the weighted average of each performance measure, both in bull and bear markets, in order to generalize our results. Based on that, we will be able to draw conclusions about the most effective hedge fund strategies in the long term, in bull market and in bear market.

Description of hedge funds and their strategies

1. Historic and evolution

Hedge funds have been existing for more than 70 years. More precisely, the first hedge fund was created by Alfred Winslow Jones in 1949. The idea of Jones was to balance long and short positions to relatively protect himself from overall market moves while profiting from the relative outperformance of his long positions compared to his short positions (Pedersen, 2015). Since then, the number of hedge funds has increased, reaching 140 in 1968 according to the SEC, and representing about \$2 trillion under management before the global financial crisis. After falling during the crisis, the total amount of assets under management has recovered and is even higher than before this crisis, showing the important interest for hedge funds (Pedersen, 2015). At the end of 2021, it is estimated that there exist more than 9,000 hedge funds, representing about \$4 trillion of assets under management. The graph below shows the evolution of the number of hedge funds and of the total assets under management from 2004 until 2021.

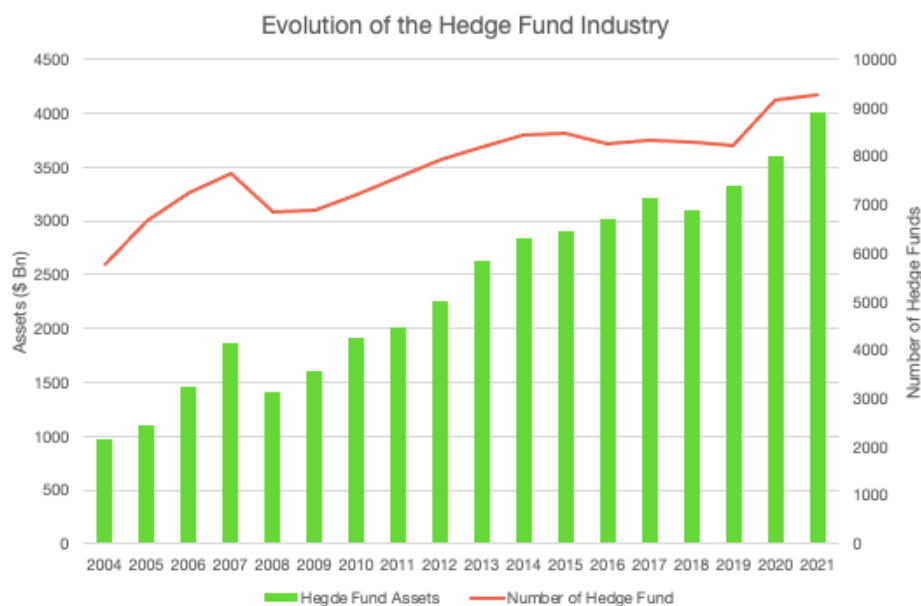


Figure 1: Evolution of the Hedge Fund industry from 2004 until 2021. Green sticks represent the assets under management (in billions of USD) while the red line represents the number of hedge funds¹.

Source: ETFGI and Hedge Fund Research

¹ Note that this is an estimation. Nobody knows the exact number of existing hedge funds and therefore the exact amount of assets under management in the industry.

2. Definition

According to Pedersen (2015), hedge funds are difficult to define. This is due to their non-regulation and therefore to the diversity of their characteristics. Nevertheless, Pedersen (2015) provided a simple definition, considering hedge funds as “investment vehicles pursuing a variety of complex trading strategies to make money”. He added that “the word *hedge* refers to reducing market risk by investing in both long and short positions, and the word *fund* refers to a pool of money contributed by the manager and investors”. The term of “pool of money” also comes back in the definition provided by the Securities and Exchange Commission (SEC), which adds that this money is invested “in an effort to make a positive return”. This seems logical but words are important here as hedge funds seek to provide the best possible return and not a return comparatively higher than a benchmark. They are interested in absolute returns. Other characteristics of hedge funds pointed out by Pedersen (2015) and the SEC are the use of leverage, short-selling and derivatives. Metzger (2019) defined them as investment vehicles for active strategies which are closely related to mutual funds but with some differences. Hedge funds are indeed less regulated than mutual funds which allows them to invest in traditional, as well as, in alternative and more risky securities and derivatives. He also pointed the use of short-selling and leverage as important characteristics of hedge funds.

3. Hedge Fund Strategies

The number of strategies that hedge funds can use for their investments is very large. In his study about the effectiveness of hedge funds, Falkowski mentioned a past study of 2003 from the Alternative Investment Management Association (AIMA) about investment styles of hedge funds. This study concluded that half of the studied entities said that they use their own investment strategy classification, 47% said that they use one or more strategies described in the literature, and the remaining entities said that their strategy could not be strictly defined. Following what we said, it appears that it is not always easy to define and classify the strategies used by hedge funds. However, some investment banks and researchers have classified hedge funds in different categories to build indices. In this study, we will use the classification made by the Credit Suisse since we will use their database for the quantitative analysis. There are thirteen investment strategies identified by the Credit Suisse. Note that we can group these thirteen strategies in four groups: directional, non-directional, event-driven and hybrid strategies (Stefanini, 2006).

Directional strategies include long/short equity, dedicated short bias, managed futures, global macro, and emerging markets while non-directional strategies are convertible arbitrage, fixed income arbitrage, and equity market neutral. As for the event driven index, it is further decomposed in three subcategories: distressed, multi-strategy and risk arbitrage. Finally, hybrid strategies contain multi-strategy. See Appendix 1 for more details about the different hedge fund strategies.

.

Literature Review

As a reminder, our study aims at analyzing the performance of hedge fund strategies in the long term, during periods of crisis (bear market) and during periods between crisis when the market is going well (bull market). We would like to determine whether hedge funds perform better than the global stock market and more importantly, we would like to determine if some strategies perform better than others in the long term, during crises and between crises. To have a first idea of the performance of hedge fund strategies over time, we review below past academic studies about the topic.

4. Performance of hedge funds compared to the overall market

4.1. In the long term

In the first stage of their study about the effectiveness of hedge fund strategies, Falkowski et al. (2020) showed that both the BHFI² and the CSHFI³ had a total rate of return more than twice as high as that of the MSCI⁴ World Index over the period 1994-2015 (398% for BHFI and 450% for CSHFI vs 191% for MSCI). Moreover, the annual rate of return of the BHFI was negative only twice: in 2008 during the global financial crisis and in 2011 during the global economic slowdown while the global stock market incurred losses in 1994, 2000-2002, 2007-2008, 2011 and 2015. In addition, the risk measured by the standard deviation of the rate of return was lower for both hedge fund indices compared to the global stock market (2.08% for BHFI and 2.03% for CSHFI vs 4.32% for MSCI). The downside risk or “bad risk” was also lower for hedge funds (1.65% for BHFI and 1.52% for CSHFI vs 3.34% for MSCI).

This result is consistent with Aspadarec (2014) who analyzed the performance of hedge funds over the period 1997-2012 and found that hedge funds outperformed the global stock market. Indeed, over the 1997-2012 period, the total rate of return of the Barclay Hedge Fund Index (BHFI) reached 301.8% while the S&P 500 had a total rate of return of 75.4%. Even though the studied period is slightly different and shorter, we can still associate results of this study to the long-term performance of hedge funds.

² Barclay Hedge Fund Index

³ Credit Suisse Hedge Fund Index

⁴ Morgan Stanley Capital International

Metzger and Sheila (2019) analyzed hedge funds performance over the period 2007-2017. They did not provide a comparison between a general hedge fund index such as the CSHFI or the BHFI and the global stock market. However, they found that seven out of the ten hedge fund strategies performed better than the S&P 500, which might be a signal that the hedge fund sector outperformed the global stock market in the long term. Nevertheless, they also found that the S&P 500 outperformed all the hedge fund strategies over the period 2009-2017 (the period after the global financial crisis). The financial crisis of 2007-2009 might be a turning point as mentioned by Vonèche (2017) in her master thesis.

4.2. Global financial crisis

According to Falkowski et al. (2020), the hedge fund sector continued to outperform the global stock market during the global financial crisis (2007-2009) as it encountered much lower losses (-1.44% for CSHFI and -2.64% for BHFI vs -50.41% for MSCI). Only the risk-free investment had a positive return during that period (4.13%). Moreover, the risk was lower for hedge funds compared to the global stock market (2.96% for BHFI and 2.25% for CSHFI vs 5.37% for MSCI). Results for the “bad risk” were a bit different since the risk was higher for the BHFI than for the global stock market and the CSHFI (2.52% for BHFI, 2.07% for MSCI and 0.73% for CSHFI). Metzger and Shenai (2019) also found that hedge funds clearly outperformed the global stock market (measured by the S&P 500) during the global financial crisis, both in terms of return and risk. Indeed, all the hedge fund strategies performed better than the S&P 500.

After the first stage of their study, Falkowski et al. (2020) were able to confirm “the hypothesis that hedge funds achieve significantly higher profitability regardless of current market conditions, and their investments carry less risk than direct allocation of capital in stocks”. The conclusion of Metzger and Sheila (2019) is similar as they say that hedge fund strategies can generate higher returns than passive investments in the Market Portfolio (i.e. a portfolio made of S&P 500 stocks), especially during a period of crisis.

5. Performance of hedge fund strategies in the long term

5.1. Return

In the second stage of their analysis about the effectiveness of hedge fund strategies, Falkowski et al. (2020) analyzed the performance of hedge fund strategies in the long term (1994-2015). They found that all the strategies are effective in the long term (positive total rate of return), except one strategy (dedicated short bias). Moreover, the total rate of return of all the strategies, except dedicated short bias and equity market neutral, exceeds the return on risk-free assets and on the global stock portfolio. Regarding mean annual and monthly rate of return, the results are less optimistic for hedge funds, especially for non-directional strategies, as some strategies have lower values than those of the MSCI. If we consider only the return, the most effective strategy in the long term was the global macro strategy, followed by another directional strategy, the long/short equity strategy. Event-driven, hybrid and directional strategy groups may be considered effective on a par while the non-directional strategy group is the least effective.

Metzger and Shenai (2019) studied the performance of hedge fund strategies over the period 2007-2017. They found that global macro achieved the highest return, followed by multi-strategy, convertible arbitrage, and long/short equity. They also found that two strategies were not effective (negative rate of return) over that period: dedicated short bias and equity market neutral, dedicated short bias being the least performing strategy.

Aspadarec (2014) compared the different hedge fund strategies using, between others, the average annual rate of return. He obtained values not very different from Falkowski et al. (between 1 and 71 basis points) except for global macro (101 basis points) and more importantly for dedicated short bias (718 basis points). The little difference (in general) of values is reflected in a quite similar ranking of hedge fund strategies regarding performance measured by the annual rate of return. Values are quite different from those of Metzger and Shenai (2019), but the long-term period is also very different. However, Aspadarec (2014) had results close to those of the two other studies, especially the one of Falkowski et al. (2020). Global macro was also the strategy with the highest annual rate of return, followed by event driven distressed (and event driven in general) and long/short equity. Regarding the least effective strategies in terms of annual rate of return, Aspadarec (2014) has dedicated short bias, equity market neutral and fixed income arbitrage, dedicated short bias being the least effective and the only one having a

negative annual rate of return. In general, the ranking of strategies regarding their annual rate of return is quite similar in these three studies.

Ibbotson et al. (2011) studied the performance of hedge funds over the period 1995-2009. They computed the average annual compound return and found that long/short equity was the strategy with the highest annual compound return, followed by emerging markets, event driven and global macro. The strategy with the lowest annual compound return was dedicated short bias, followed by managed futures, and fixed income arbitrage. Results of Ibbotson et al. (2011) are therefore slightly different from those of the three other studies, but with similarities such as the poor performance of dedicated short bias and the good performance of global macro.

5.2. Risk

However, to better assess the performance of hedge funds, Falkowski et al. (2020) needed to consider also the risk measured by the standard deviation and the downside deviation. In the long term, event-driven and hybrid strategies seem to be the least risky, followed by non-directional strategies (except equity market neutral). Directional strategies, especially dedicated short bias and emerging markets, are the strategies carrying the higher risk in the long term. In their analysis of the risk over the period 2007-2017, Metzger and Shenai (2019) had slightly different results as they found that global macro had the lowest risk. However, like Falkowski et al. (2020), they found that hybrid (multi-strategy) and event driven strategies had a low risk compared to non-directional and directional strategies. Dedicated short bias and equity market neutral were clearly the strategies carrying the higher risk, followed by managed futures.

5.3. Risk-reward ratios

Finally, after having discussed the return and the risk separately, we can combine them in performance measures such as risk-reward ratios (Sharpe, Sortino and Treynor ratios) and the Jensen's alpha. Falkowski et al. (2020) concluded that, in the long term, the most effective strategy was global macro, followed by event-driven distressed securities. The least effective strategies were dedicated short bias, equity market neutral and managed futures. In general, directional, event-driven and hybrid strategies are the most effective for hedge funds in the long and they all performed better than the overall hedge fund sector and investments in the global stock market.

Metzger and Shenai (2019) had similar results for risk-reward ratios such as the Sharpe and Sortino ratios. Indeed, global macro was the most effective strategy, followed by multi-strategy and event driven. Dedicated short bias was clearly the least effective strategy, followed by equity market neutral and managed futures. Following their results, we can also state that hybrid and event driven strategies are the most effective. However, we cannot state that directional strategies are more effective than non-directional strategies over the period 2007-2017.

Aspadarec (2014) also compared hedge fund strategies using the Sharpe ratio. The first observation is that Sharpe ratios of his study are very different from those of Falkowski et al. (2020) and Metzger and Shenai (2019). Indeed, Sharpe ratios in the study of Aspadarec (2014) are on average three to four times higher. However, except the fact that Sharpe ratios are quite different, the ranking of hedge fund strategies regarding their performance measured by the Sharpe ratio is quite similar. We find the three same strategies at the three first places but in a different order. Event driven is the most effective strategy, followed by global macro and multi-strategy. Dedicated short bias is again the least performing strategy (with a negative Sharpe ratio), followed by equity market neutral and managed futures.

Ibbotson et al. (2011) used the Sharpe ratio as performance measure and found that equity market neutral was the best performing strategy, followed by fixed income arbitrage, event driven and global macro. At the bottom of the ranking, they have dedicated short bias, managed futures, and emerging markets. The ranking of the strategies is not that different when they use the information ratio. Equity market neutral is first, followed by event driven and long/short equity. The least effective strategies regarding this performance measure are managed futures, dedicated short bias and emerging markets. Results of Ibbotson et al. (2011) are quite different from those of the three other studies given that equity market neutral was one of the least performing strategies. However, there are some similarities such as the poor performance of dedicated short bias and managed futures in the long term. Another similarity is the good performance of event driven.

6. Performance of hedge fund strategies during the dotcom crisis

Ibbotson et al. (2011) did not analyze specifically the dotcom crisis. However, since they analyzed hedge funds over the period 1995-2009, they computed the annual post-fee return, the alpha and the beta of hedge funds. They found that the post-fee return was not negative in 2000-

2002 during the dotcom crisis. Even though hedge funds produced negative systematic beta returns in 2000, 2001 and 2002, hedge funds had positive returns in 2000-2002 thanks to the high alphas that could compensate the negative betas.

7. Performance of hedge fund strategies during the global financial crisis

7.1.Return

Falkowski et al. (2020) had very different results for the global financial crisis than for the long-term period. Indeed, the strategy that achieved the highest return during that period was dedicated short bias which had the lowest return in the long-term. It is followed by managed futures (which performs also poorly in the long-term) and global macro. Equity market neutral was the strategy incurring the largest loss during the financial crisis, followed by fixed income arbitrage and convertible arbitrage. In general, non-directional strategies were the least effective strategies in terms of return during the financial crisis.

Metzger and Shenai (2019) also analyzed the performance of hedge fund strategies during the global financial crisis. Their results are similar to those of Falkowski et al. (2020). Dedicated short bias had the highest rate of return, followed by managed futures and global macro. Equity market neutral was the least effective strategy in terms of return during the financial crisis, followed by fixed income arbitrage and convertible arbitrage.

7.2.Risk

Regarding the risk carried out by hedge fund strategies, Falkowski et al. (2020) found that equity market neutral was the riskiest strategy during the financial crisis both with the risk measured by the standard deviation and by the downside deviation. It is followed by dedicated short bias, emerging markets, and convertible arbitrage. Event driven, hybrid and global macro strategies were clearly the least risky strategies.

Metzger and Sheila (2019) used only the standard deviation of the return as a measure of risk. They also found that equity market neutral was the riskiest strategy during the financial crisis, followed by dedicated short bias and emerging markets. Like Falkowski et al. (2020), Metzger and Sheila (2019) found that event driven, hybrid and global macro strategies were the least risky strategies.

7.3. Risk-reward ratios

To assess the performance of hedge fund strategies during the global financial crisis, Falkowski et al. (2020) also used risk-reward ratios such as the Sharpe, Sortino and Treynor ratios. Global macro was clearly the most effective strategy since it had the highest Sharpe and Sortino ratios and the second highest Treynor ratio. Then, there are dedicated short bias and managed futures. Non-directional strategies (equity market neutral, convertible arbitrage and fixed income arbitrage) had the worst values for risk-reward ratios.

Metzger and Sheila (2019) used the Sharpe, Sortino and Upside potential ratios to compare hedge fund strategies. For the period of the global financial crisis, their results are slightly different than those of Falkowski et al. (2020), though they remain close. Dedicated short bias and managed futures are the most effective strategies since they have the highest values for these ratios. Global macro is this time the third most effective strategy. At the bottom of the ranking, results are different than those of Falkowski et al. (2020) since there are fixed income arbitrage, event driven and multi-strategy.

8. Summary

This literature review allowed us to have a first idea of the performance of hedge funds and their different investment strategies, both in the long term and during times of crisis. We can summarize these findings below:

- It seems that hedge funds tend to outperform the global stock market, especially in times of crisis. However, the financial crisis of 2007-2009 might be a turning point.
- In the long-term: global macro, event driven, and multi-strategy seem more efficient while dedicated short bias, managed futures and equity market neutral are less efficient.
- During the global financial crisis: dedicated short bias, managed futures and global macro seem to be the most efficient strategies while equity market neutral, fixed income arbitrage and convertible arbitrage seem to be the least efficient.
- During the dotcom crisis: hedge funds managed to generate positive returns in 2000-2002 and therefore outperformed the global stock market thanks to the high alphas that could compensate the negative betas. We did not find studies that focus on the analysis of the performance of hedge fund strategies during that period.

Empirical Analysis

The literature review allowed us to have a first idea of the performance of hedge fund strategies in the long term and during crises such as the global financial crisis and to a lesser extent the dotcom crisis. In this part, we will deepen our analysis by computing performance measures about risk and return. As a reminder, our goal is to answer the following research question:

“Which hedge fund strategies are the most effective in the long term, in bull markets and in bear markets?”.

To do so, we will start by describing our database and define our different periods of crisis and without crisis. Then, we will describe the performance measures that will be used to answer our question and we will present the result of our computations as well as our analysis of these results.

9. Description of databases

For our study, we need data about the past performance of hedge funds and their different strategies. We also need data for the past performance of the global stock market and for a risk-free asset as we will need them to define the periods of crisis, to compare them with hedge funds values and to compute some performance measures. As a reminder, the studied period goes from January 1994 until December 2021 since the Credit Suisse Hedge Fund Index did not exist before January 1994. Given that we will work with monthly data, it means that we have 336 observations per index⁵. We detail our three databases below.

9.1. Database for Hedge Fund performance

The database used for the past performance of hedge funds comes from the Credit Suisse. It includes the past performance of the Credit Suisse Hedge Fund Index (CSHFI) as well as the past performance of the thirteen sub-indexes, also called Credit Suisse Hedge Fund Strategy Indexes, representing the thirteen strategies used by hedge funds⁶.

⁵ There are two exceptions: January 2017 is the last observation for dedicated short bias meaning that there are only 277 observations for this strategy; April 1994 is the first observation for multi-strategy meaning that there are 333 observations for this strategy.

⁶ As it has been said before, there are much more than thirteen investment strategies used by hedge funds. Indeed, there are as many strategies as there are hedge funds. However, they can be grouped in thirteen categories to ease comparisons and analyzes.

The Credit Suisse Hedge Fund Index is the industry's leading asset-weighted hedge fund index. The advantage of an asset-weighted index, as opposed to an equal-weighted index, is that it is less biased. Indeed, Ibbotson et al. (2011) showed that the backfill bias is much lower in an asset-weighted index than in an equal-weighted index. Moreover, the Credit Suisse indicates that it aims to minimize the survivorship bias. To do so, it does not remove funds from the index until they are fully liquidated or fail to meet the financial reporting requirements. This is important given that Ibbotson et al. (2011) estimated that the survivorship bias can be as high as 3 to 5%.

Some precisions about the index universe are necessary. First, this index includes only funds and does not include separate accounts. Second, the CSHFI uses the Credit Suisse Hedge Fund Database, which tracks about 9,000 funds that meet the following criteria:

- Having a minimum of U.S. \$50 million assets under management ("AUM")
- Having a minimum one-year track record
- Having current audited financial statements

Funds within the Credit Suisse Hedge Fund Index are split into ten⁷ subcategories based on their investment strategy. The CSHFI always represents at least 85% of the AUM in each respective category of the index universe. The methodology analyzes the percentage of assets invested in each subcategory and selects funds for the index based on those percentages, matching the shape of the index to the shape of the universe. It is also mentioned that fund weights may be constrained to improve diversification and limit concentration risk. A graph showing the evolution of the weights of the different hedge fund strategies in the Credit Suisse Hedge Fund Index can be found below.

⁷ The event-driven subcategory is further decomposed in three categories (distressed securities, risk arbitrage and multistrategy). It implies that there are 10+3 hedge fund strategies indices.

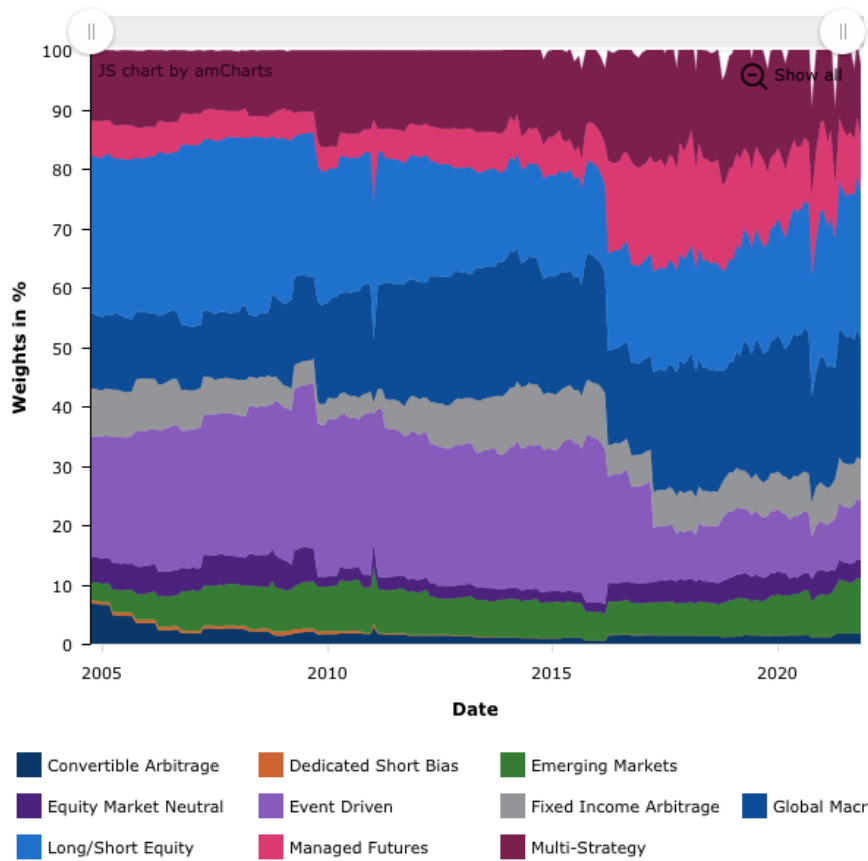


Figure 2: Evolution of the weights of the different hedge fund strategies in the Credit Suisse Hedge Fund Index

Note that the indexes are computed and rebalanced on a monthly basis and reflect the performance net of all performance fees and expenses.

9.2. Database for stock market performance

To compare the performance of hedge funds with an investment in the global stock market, we need a benchmark for this stock market. We will use the S&P 500, which is an index aggregating the 500 biggest US companies in terms of market capitalization. We could also use the MSCI World Index, but we were not able to download data back to 1994. We downloaded historical data for the S&P 500 from the website Investing and we compared them with other sources to make sure that these historical data are correct.

9.3. Database for risk-free asset performance

Finally, we also need a database for a risk-free asset. In this study, we decided to use the US 3-month Treasury Bill as risk-free rate. We took data from the Federal Reserve Economic Data (FRED).

10. Definition of the periods of crisis and without crisis

Since our analysis aims at trying to generalize the performance of hedge fund strategies during periods of crisis (bear market) and during periods without crisis (bull market), we first need to define all these periods. To do so, we analyzed the returns of the S&P 500 between January 1994 and December 2021. We have set some rules for defining these periods:

- A period of crisis must last at least three months if the maximum drawdown between the beginning of the crisis and the lower point is greater than -10% and six months if the maximum drawdown is lower than -10%.
- Periods between crises must last at least six months.

As shown by Table 1, our period of analysis contains two big crises (dotcom and global financial crises), which lasted two to three years and saw a very important fall of the S&P 500 (around -50%). Besides these two crises, there are six smaller crises which lasted between three and nine months and for which the S&P 500 lost between 8.89% and 20%.

All the sub-periods of our analysis are presented below with some summary statistics:

Name of the period	Period	Length of the period (months)	Number of months of losses	Number of months of gains	Max consecutive months of losses (of gains for non-crisis periods)	Drawdown beginning of the crisis to lower point	Mean return	Maximum loss	Maximum return	Standard deviation of the return
	01/1994 – 04/1998	52	12	40	8		1.74%	-5.75%	7.81%	3.31%
Crisis 1998	05/1998 – 08/1998	4	3	1	2	-13.89%	-3.42%	-14.58%	3.94%	7.88%
	09/1998 – 03/2000	19	7	12	5		2.48%	-5.09%	9.67%	4.50%
Dotcom crisis	04/2000 – 02/2003	35	22	13	4	-45.60%	-1.51%	-11.00%	8.64%	5.13%
	03/2003 – 05/2007	51	13	38	8		1.21%	-3.43%	8.10%	2.35%
Financial crisis	06/2007 – 02/2009	21	14	7	5	-51.97%	-3.28%	-16.94%	4.75%	5.45%
	03/2009 – 04/2010	14	2	10	7		3.55%	-3.70%	9.39%	3.83%
Crisis of 2010	05/2010 – 08/2010	4	3	1	2	-13.14%	-2.86%	-8.20%	6.88%	6.67%
	09/2010 – 04/2011	8	2	6	3		3.37%	-0.23%	8.76%	3.06%
Crisis of 2011	05/2011 – 09/2011	5	5	0	5	-17.03%	-3.64%	-7.18%	-1.35%	2.62%
	10/2011 – 05/2015	44	12	32	7		1.47%	-6.27%	10.77%	2.97%
Crisis of 2015	06/2015 – 02/2016	9	6	3	3	-8.89%	-0.88%	-6.26%	8.30%	4.26%
	03/2016 – 09/2018	31	6	25	10		1.36%	-3.89%	6.60%	2.18%
Crisis fall 2018	10/2018 – 12/2018	3	2	1	1	-13.97%	-4.78%	-9.18%	1.79%	5.80%
	01/2019 – 12/2019	12	2	10	4		2.20%	-6.58%	7.87%	3.74%
Covid-19 crisis	01/2020 – 03/2020	3	3	0	3	-20.00%	-7.03%	-12.51%	-0.16%	6.29%
	04/2020 – 12/2021	21	5	16	7		3.04%	-4.76%	12.68%	4.38%

Table 1: Sub-periods of our analysis with some summary statistics. Periods of crisis are in red while non-crisis periods are in white.

11. Analysis of the performance of hedge funds and their strategies

In this part, we will analyze the performance of the hedge fund sector in general (CSHFI) and of the different investment strategies, both in the long term and during sub-periods of crisis (bear market) and without crisis (bull market) that we defined previously. We will start by analyzing the return of hedge funds using two measures: the average monthly rate of return and the alpha of Jensen. Then, we will analyze the performance of hedge funds in terms of risk by employing three measures: the standard deviation of the return, the downside deviation, and the beta. Finally, we will combine these measures of risk and return in risk-reward ratios such as the Sharpe, Sortino and Information ratios to better assess the performance of hedge funds.

11.1. Measures of the return

11.1.1. Monthly rate of return

Logically, we start our study of hedge fund effectiveness by analyzing the return and more precisely the monthly rate of return. The result of our computations can be found in Table 2.

Hedge Fund Sector

First, one can observe that the hedge fund sector represented by the CSHFI incurred losses during all the crises, except during the dotcom crisis. However, these losses were smaller than those incurred by the S&P 500 for each crisis. One can also observe that the CSHFI suffered its largest losses in terms of average monthly rate of return during the Covid-19 crisis, followed by the crises of October-December 2018, May-September 2011, and May-August 1998. This is because these crisis periods were relatively limited in time (three to five months) but intense. Regarding the performance of the hedge fund sector during the two biggest crises (dotcom and global financial crises), we obtained very different results: the CSHFI had a positive return during the dotcom crisis, though lower than during periods between crises, while it incurred losses during the global financial crisis.

As for the performance of the hedge fund sector during periods between crises, we can observe that it always had a positive return. However, it performed always worse than the S&P 500 given that it always had a lower monthly rate of return. We can also see in the results that the three non-crisis periods where hedge funds performed the worst are: March 2016 to September 2018, October 2011 to May 2015 and January to December 2019. On the other hand, March 2009 to April 2010, September 2010 to April 2011 and January 1994 to April 1998 were the three non-crisis periods with the best performance of the hedge fund sector.

Individual Hedge Fund Strategies

Let's analyze now the performance of individual hedge fund strategies. The first observation is that dedicated short bias always had a negative return during periods of bull market and a positive return during periods of crisis. Losses incurred by this strategy were even the largest when the overall hedge fund sector (CSHFI) performed the best: during the periods from September 2010 to April 2011 and from March 2009 to April 2010. On the other hand, this strategy had a quite high return during the crises of May-August 1998 and May-September 2011 when the CSHFI experienced large losses.

Excluding dedicated short bias, all the strategies had positive returns during the periods without crisis, except global macro between September 1998 and March 2000 and, managed futures from March 2009 to April 2010 and from March 2016 to September 2018. Note that these losses were quite limited. We can also see that event driven risk arbitrage seems to underperform the other event driven strategies while long/short equity and emerging markets seem to outperform the other directional strategies during periods between crises.

As for the performance in times of crisis, we found that long/short equity sustained losses during every crisis. Emerging markets and event driven strategies, except event driven risk arbitrage, also incurred losses during every crisis except during the dotcom crisis. In addition to its positive monthly rate of return during the dotcom crisis, multi-strategy also had a positive monthly return during the crisis from May to August 1998. As for the global macro strategy, it managed to generate a positive monthly rate of return during the first five crises and then sustained losses during the three last ones. Non-directional strategies (equity market neutral, fixed income arbitrage and convertible arbitrage) also incurred losses during most of the crises, but we cannot see a general rule given that they sometimes generated positive returns. Finally, we can also see that, in general, event driven strategies (except event driven risk arbitrage) had more problems than non-directional strategies in bear market, except during the global financial crisis.

	01/1994 – 04/1998	Crisis 05/1998 – 08/1998	09/1998 – 03/2000	Dotcom crisis	03/2003 – 05/2007	Global financial crisis	03/2009 – 04/2010	Crisis 05/2010 – 08/2010	09/2010 – 04/2011	Crisis 05/2011 – 09/2011	10/2011 – 05/2015	Crisis 06/2015 – 02/2016	03/2016 – 09/2018	Crisis 10/2018 – 12/2018	01/2019 – 12/2019	Covid crisis 01/2020 – 03/2020	04/2020 – 12/2021
CSHFI	1.31%	-1.20%	1.23%	0.29%	0.98%	-0.76%	1.53%	-0.45%	1.51%	-1.43%	0.57%	-0.72%	0.38%	-1.45%	0.75%	-3.04%	1.14%
Global macro	1.72%	0.90%	-0.50%	1.34%	0.97%	0.39%	0.91%	0.52%	1.20%	0.53%	0.38%	-0.69%	0.31%	-0.58%	0.83%	-2.74%	1.17%
Long/short equity	1.15%	-2.28%	3.34%	-0.27%	1.17%	-0.88%	1.62%	-1.20%	1.87%	-2.65%	0.82%	-0.55%	0.52%	-2.26%	0.97%	-3.83%	1.34%
Emerging markets	1.02%	-9.35%	2.21%	0.06%	1.56%	-1.19%	2.34%	-0.17%	1.51%	-2.14%	0.58%	-1.05%	0.56%	-1.09%	1.09%	-3.51%	1.36%
Dedicated short bias	-0.08%	8.50%	-2.72%	1.13%	-0.67%	1.56%	-3.40%	3.23%	-3.97%	4.36%	-1.64%	2.08%	-2.42%				
Managed futures	0.36%	3.25%	0.06%	1.18%	0.42%	0.91%	-0.11%	-0.06%	1.60%	-0.80%	0.25%	0.55%	-0.42%	-1.22%	0.76%	0.02%	0.48%
Equity market neutral	0.83%	0.21%	1.35%	0.74%	0.67%	-1.92%	0.60%	-1.04%	1.33%	-0.92%	0.21%	0.20%	0.18%	-1.62%	0.14%	-1.78%	0.63%
Fixed income arbitrage	0.73%	-0.57%	0.27%	0.60%	0.48%	-1.45%	2.02%	0.64%	0.90%	0.07%	0.47%	-0.24%	0.48%	-0.43%	0.50%	-1.90%	0.70%
Convertible arbitrage	0.82%	-0.96%	0.99%	1.03%	0.50%	-1.39%	2.74%	0.27%	1.10%	-0.90%	0.38%	-0.55%	0.47%	-1.08%	0.66%	-1.74%	1.03%
Event driven	1.24%	-3.43%	1.36%	0.51%	1.22%	-0.78%	1.84%	-0.87%	1.65%	-2.80%	0.69%	-1.61%	0.52%	-2.09%	0.67%	-5.40%	1.75%
Event driven distressed	1.44%	-3.29%	1.34%	0.66%	1.31%	-1.11%	1.94%	-0.79%	1.28%	-1.73%	0.70%	-1.01%	0.57%	-1.07%	0.12%	-3.62%	1.31%
Event driven risk arbitrage	0.89%	-1.71%	1.14%	0.32%	0.61%	0.08%	0.83%	0.13%	0.68%	-0.88%	0.23%	-0.14%	0.38%	-0.28%	0.40%	-2.28%	1.32%
Event driven multi-strategy	1.14%	-3.73%	1.42%	0.45%	1.18%	-0.59%	1.77%	-0.96%	1.93%	-3.45%	0.69%	-1.85%	0.51%	-2.62%	0.91%	-6.46%	1.97%
Multi-strategy	0.90%	0.83%	0.74%	0.51%	0.95%	-1.00%	1.61%	-0.33%	1.48%	-0.88%	0.73%	-0.13%	0.49%	-1.26%	0.59%	-2.16%	0.91%
S&P 500	1.74%	-3.42%	2.48%	-1.51%	1.21%	-3.28%	3.55%	-2.86%	3.37%	-3.64%	1.47%	-0.88%	1.36%	-4.78%	2.20%	-7.03%	3.04%

Table 2: Average monthly rate of return for all the periods and all the strategies. Periods of crisis are in red while periods between crises are in white.

Generalization

To have a clearer idea of the performance of the hedge fund sector and of the different investment strategies, we computed the average monthly rate of return in the long term, during periods of bear market and during bull market periods. Values for bull and bear market periods are simply the weighted average of all the periods of bull and bear market, the weight of each period being its length. Results are presented in Table 3.

In the long term, dedicated short bias is the only strategy which has a negative average monthly rate of return and is consequently the least efficient strategy. Equity market neutral, managed futures and fixed income arbitrage are the other three least effective strategies with an average monthly rate of return comprised between 0.36% and 0.42%. As it shown in Table 3, global macro has the highest monthly rate of return, followed by long/short equity and event driven distressed. Event driven, emerging markets, event driven multi-strategy and multi-strategy are not far behind. Note also that the S&P 500 has a higher monthly rate of return than all the hedge fund strategies in the long term.

Results are very different during periods of crisis. This time, only three strategies have a positive monthly rate of return: dedicated short bias, managed futures, and global macro. Dedicated short bias which was the only strategy with a negative monthly rate of return in the long term is now the most efficient strategy by far. The second most efficient strategy in times of crisis is managed futures, which was the third least effective strategy in the long term. It is followed by global macro. Event driven risk arbitrage, the least performing of the event driven strategies in the long term, is ranked at the fourth place during crises with only a very limited loss (-0.08%). On the other hand, emerging markets and long/short equity which were performing well in the long term (respectively 5th and 2nd) are the two strategies incurring the largest losses during periods of crisis. Event driven strategies, except event driven risk arbitrage, were also among the most impacted strategies during crises. Note that, contrary to the long-term period, all the hedge fund strategies performed better than the S&P 500 (or at least less poorly).

During bull market periods, results are very different than during crises but not very different than for the long-term period in terms of ranking. As it was the case in the long term, dedicated short bias is the only strategy having a negative average monthly rate of return. The second least performing strategy is managed futures, followed by equity market neutral and fixed

income arbitrage. On the other hand, long/short equity and emerging markets achieved the highest rates of return during periods between crises. They are followed by event driven strategies, except event driven risk arbitrage which is the least effective of the event driven strategies (like in the long term). Global macro which was on the top of the ranking in the long term and third during crises, is ranked only at the 7th place in growing markets with a performance relatively similar to the multi-strategy (which is always in the middle of the ranking). Contrary to the crisis periods, the S&P 500 is largely outperforming all the hedge fund strategies during periods between crises.

	In the long term	During periods of bear market	During periods of bull market
CSHFI	0.61%	-0.47%	0.97%
Global macro	0.77%	0.56%	0.84%
Long/short equity	0.70%	-0.93%	1.24%
Emerging markets	0.62%	-1.13%	1.21%
Dedicated short bias	-0.39%	2.05%	-1.35%
Managed futures	0.42%	0.84%	0.28%
Equity market neutral	0.36%	-0.36%	0.60%
Fixed income arbitrage	0.42%	-0.22%	0.63%
Convertible arbitrage	0.54%	-0.17%	0.77%
Event driven	0.64%	-0.79%	1.12%
Event driven distressed	0.69%	-0.58%	1.12%
Event driven risk arbitrage	0.49%	-0.08%	0.68%
Event driven multi-strategy	0.62%	-0.91%	1.13%
Multi-strategy	0.59%	-0.20%	0.86%
S&P 500	0.79%	-2.48%	1.88%

	In the long term	During periods of bear market	During periods of bull market
CSHFI			
Global macro	1	3	7
Long/short equity	2	12	1
Emerging markets	5	13	2
Dedicated short bias	13	1	13
Managed futures	11	2	12
Equity market neutral	12	8	11
Fixed income arbitrage	10	7	10
Convertible arbitrage	8	5	8
Event driven	4	10	4
Event driven distressed	3	9	5
Event driven risk arbitrage	9	4	9
Event driven multi-strategy	6	11	3
Multi-strategy	7	6	6
S&P 500			

Table 3: Left: Average monthly rate of return in the long term, during bear market and during bull market. Right: Ranking of each hedge fund strategy based on the monthly rate of return.

11.1.2. Jensen's alpha

The Jensen's alpha, also simply referred to as alpha, is the component of the return which represents the excess return due to hedge fund manager skills, adjusted for the market risk. This measure allows to assess the difference between the real excess return and the theoretical return for the level of risk considered. If the alpha is positive, it means that the investor gets a higher return compared to the return he would have obtained by investing in the market portfolio. A negative alpha means that the excess return is not sufficient considering the higher risk implied by this investment. Concretely, as shown by the formula below, the alpha is the difference between the excess return of the investment over the risk-free rate and the excess return of the market over the risk-free rate having considered the systematic risk represented by the Beta.

$$\text{Jensen's alpha} = (R - R_f) - \beta * (R_B - R_f)$$

Where “R” is the return of the analyzed investment, “R_f” is the risk-free rate, “R_B” is the return of the benchmark (S&P 500) and “β” is the systematic risk.

Hedge Fund Sector

As shown by Table 4, CSHFI provided most of the time a positive alpha, except during the crises of June 2015-February 2016 and of October-December 2018. This alpha seems to be higher during bull market periods, but this is not a general rule as it is sometimes the opposite.

Individual Hedge Fund Strategies

We can see in the table that long/short equity, fixed income arbitrage, convertible arbitrage, event driven multi-strategy and multi-strategy always generated a positive alpha during periods between crises. It was almost the case for event driven and event driven distressed as they generated a positive alpha during all the non-crisis periods, except the one from January to December 2019. As for dedicated short bias and managed futures, they had a negative alpha during most of the periods between crises, especially before October 2011 for managed futures. However, during periods of crisis, all the strategies returned both positive and negative alphas, depending on the crisis. One can observe that most of the hedge fund strategies managed to generate a positive alpha during the dotcom and Covid-19 crises. On the other hand, only event driven risk arbitrage had a positive alpha during the crisis from October to December 2018. Even though it is difficult to find patterns in Table 4, it seems that event driven strategies were the strategies with the lowest alphas during the crises from October to December 1998 and from June 2015 to February 2016.

	01/1994 – 04/1998	Crisis 05/1998 – 08/1998	09/1998 – 03/2000	Dotcom crisis	03/2003 – 05/2007	Global financial crisis	03/2009 – 04/2010	Crisis 05/2010 – 08/2010	09/2010 – 04/2011	Crisis 05/2011 – 09/2011	10/2011 – 05/2015	Crisis 06/2015 – 02/2016	03/2016 – 09/2018	Crisis 10/2018 – 12/2018	01/2019 – 12/2019	Covid crisis 01/2020 – 03/2020	04/2020 – 12/2021
CSHFI	0.20%	0.41%	0.86%	0.24%	0.45%	0.06%	0.93%	0.23%	0.14%	0.22%	0.26%	-0.55%	0.02%	-1.13%	0.15%	0.81%	0.39%
Global macro	0.38%	2.29%	-0.82%	1.06%	0.58%	0.74%	0.68%	0.62%	-0.05%	0.08%	0.29%	-0.46%	-0.01%	-0.97%	0.23%	0.47%	0.38%
Long/short equity	0.00%	0.43%	2.54%	-0.16%	0.47%	0.27%	0.33%	-0.04%	0.08%	0.06%	0.15%	-0.29%	0.04%	-0.85%	0.04%	-0.35%	0.07%
Emerging markets	-0.15%	-5.49%	1.25%	0.52%	0.87%	0.45%	0.97%	1.05%	0.25%	2.06%	0.09%	-0.73%	0.10%	-0.16%	-0.18%	1.72%	0.53%
Dedicated short bias	0.64%	2.98%	-1.76%	-0.61%	0.28%	-0.60%	-0.86%	1.30%	-0.76%	0.25%	-0.36%	1.22%	-0.95%				
Managed futures	-0.26%	0.74%	-0.58%	0.13%	-0.61%	0.17%	-0.90%	-0.14%	-1.25%	-1.79%	0.29%	0.52%	-1.17%	-1.60%	0.67%	0.75%	0.11%
Equity market neutral	0.19%	0.10%	0.83%	0.52%	0.41%	-0.60%	0.02%	-0.21%	-0.06%	-0.06%	-0.15%	0.13%	-0.08%	-4.07%	0.04%	-0.92%	0.29%
Fixed income arbitrage	0.17%	-0.79%	0.17%	0.28%	0.20%	-0.12%	1.80%	0.87%	0.56%	0.42%	0.40%	-0.23%	0.37%	-0.71%	0.18%	1.58%	0.78%
Convertible arbitrage	0.28%	-0.32%	0.92%	0.79%	0.13%	-0.25%	2.17%	0.96%	0.61%	0.17%	0.24%	-0.45%	0.18%	-0.54%	0.12%	1.28%	0.65%
Event driven	0.51%	-1.29%	0.95%	0.44%	0.73%	-0.12%	1.60%	-0.10%	0.22%	0.18%	0.28%	-1.40%	0.21%	-1.02%	-0.07%	1.56%	0.77%
Event driven distressed	0.61%	-0.82%	0.94%	0.62%	0.87%	-0.45%	1.82%	-0.19%	0.43%	0.79%	0.36%	-0.94%	0.35%	-0.64%	-0.56%	1.81%	0.56%
Event driven risk arbitrage	0.35%	-0.80%	0.73%	0.19%	0.18%	0.45%	0.52%	0.61%	-0.20%	-0.35%	-0.02%	-0.16%	0.08%	0.04%	0.00%	0.99%	0.75%
Event driven multi-strategy	0.49%	-1.84%	1.00%	0.37%	0.66%	0.08%	1.43%	-0.05%	0.08%	-0.19%	0.24%	-1.58%	0.15%	-1.25%	0.13%	1.52%	0.86%
Multi-strategy	0.50%	0.26%	0.55%	0.33%	0.52%	-0.28%	1.25%	0.30%	0.73%	0.71%	0.50%	-0.08%	0.19%	-1.62%	0.28%	1.54%	0.44%

Table 4: Jensen' s alpha for all the periods and all the strategies. Periods of crisis are in red while periods between crises are in white.

Generalization

As we did for the monthly rate of return, we aggregated the results to have a clearer view of which strategies generated higher alphas in the long term, during periods of crisis and during periods between crises (Table 5). We can confirm that the hedge fund sector generated a positive alpha in the long term and that this alpha is higher during bull market periods but remains positive during periods of crisis.

Regarding individual investment strategies, global macro had a clear advantage in the long term and during periods of crisis but not during periods between crises. In the long term, global macro is followed by event driven distressed, multi-strategy and event driven. Four other strategies (long/short equity, convertible arbitrage, event driven multi-strategy and managed futures) are very close behind event driven. At the bottom of the ranking, we find dedicated short bias which is the only strategy with a negative alpha in the long term. The second least effective strategy in the long term is equity market neutral with a barely positive alpha.

During periods of crisis, global macro is the most effective strategy by far, followed by convertible arbitrage, emerging markets and event driven risk arbitrage. The latter two strategies were among the least efficient in the long term. On the other hand, equity market neutral is the last strategy and has a negative alpha. Four other strategies have a negative alpha during crisis periods (event driven multi-strategy, dedicated short bias, long/short equity and event driven), meaning that the excess return is not sufficient considering the higher risk implied by this investment.

During bull market periods, event driven strategies, except event driven risk arbitrage, are the strategies generating the highest alphas, followed by multi-strategy. Behind these strategies, four strategies have relatively similar alphas: convertible and fixed income arbitrage, emerging markets, and long/short equity. Global macro, which had the highest alpha by far in times of crisis and in the long term, is only ranked 9th but has still a significantly positive alpha. Two strategies have a negative alpha during periods between crises: managed futures and dedicated short bias, managed futures having the worst alpha.

Note that all the strategies, except global macro and managed futures, generated a higher alpha during periods between crises.

	In the long term	During periods of bear market	During periods of bull market
CSHFI	0.26%	0.09%	0.34%
Global macro	0.49%	0.70%	0.26%
Long/short equity	0.26%	-0.05%	0.35%
Emerging markets	0.15%	0.22%	0.37%
Dedicated short bias	-0.21%	-0.06%	-0.15%
Managed futures	0.25%	0.04%	-0.36%
Equity market neutral	0.07%	-0.11%	0.17%
Fixed income arbitrage	0.16%	0.12%	0.39%
Convertible arbitrage	0.25%	0.29%	0.42%
Event driven	0.28%	-0.03%	0.56%
Event driven distressed	0.35%	0.09%	0.61%
Event driven risk arbitrage	0.21%	0.18%	0.25%
Event driven multi-strategy	0.25%	-0.09%	0.53%
Multi-strategy	0.32%	0.13%	0.50%

	In the long term	During periods of bear market	During periods of bull market
CSHFI			
Global macro	1	1	9
Long/short equity	5	10	8
Emerging markets	11	3	7
Dedicated short bias	13	11	12
Managed futures	8	8	13
Equity market neutral	12	13	11
Fixed income arbitrage	10	6	6
Convertible arbitrage	6	2	5
Event driven	4	9	2
Event driven distressed	2	7	1
Event driven risk arbitrage	9	4	10
Event driven multi-strategy	7	12	3
Multi-strategy	3	5	4

Table 5: Left: Average Jensen's alpha in the long term, during bear market and during bull market. Right: Ranking of each hedge fund strategy based on the Jensen's alpha.

11.2. Measures of risk

As we said previously, looking at the return alone is not sufficient to evaluate the performance of hedge funds and their strategies, we also need to consider the risk. To do so, we will analyze three risk measures: the standard deviation of the return, the downside deviation, and the beta.

11.2.1. Standard deviation of the return

Hedge fund sector

First, we can observe that, logically, the standard deviation of the CSHFI increased when there were crises, especially during three crises: the crisis of May-August 1998, the global financial crisis and the Covid-19 crisis. However, results for the Covid-19 crisis and for the crisis from May to August 1998 may be exaggerated by the fact that these two crises were very short (three months).

We can also observe that the CSHFI always had a lower standard deviation than the global stock market (represented by the S&P 500), both in times of crisis and during periods between crises. The difference is even often bigger in times of crisis. Moreover, most of the strategies, except dedicated short bias and sometimes emerging markets have a lower standard deviation than the S&P 500.

Individual HF strategies

Regarding individual hedge fund strategies, we can see that dedicated short bias, emerging markets and managed futures seem to be the riskiest strategies, both during crises and during periods between crises. On the other hand, fixed income arbitrage is often the least risky strategy or one of the least risky strategies, except during three periods: during the global financial and covid-19 crises and, from September 1998 to March 2000. Event driven risk arbitrage and multi-strategy are also two low risk strategies, with a standard deviation often around 1%, except during the crisis of 1998 and since the covid-19 crisis for event driven risk arbitrage, and during the global financial and covid-19 crises for multi-strategy.

In general, directional strategies seem to be riskier, both in times of crisis and during periods between crises. On the other hand, non-directional, event driven, and hybrid strategies seem to carry a similar amount of risk. However, this general rule has some exceptions: event driven strategies are riskier than non-directional and hybrid strategies during the crisis of 1998 and they are riskier than the three other strategy groups during the covid-19 crisis; as for non-directional strategies, they are the riskiest during the global financial crisis.

	01/1994 – 04/1998	Crisis 05/1998 – 08/1998	09/1998 – 03/2000	Dotcom crisis	03/2003 – 05/2007	Global financial crisis	03/2009 – 04/2010	Crisis 05/2010 – 08/2010	09/2010 – 04/2011	Crisis 05/2011 – 09/2011	10/2011 – 05/2015	Crisis 06/2015 – 02/2016	03/2016 – 09/2018	Crisis 10/2018 – 12/2018	01/2019 – 12/2019	Covid crisis 01/2020 – 03/2020	04/2020 – 12/2021
CSHFI	2.65%	4.27%	3.17%	1.45%	1.05%	2.59%	1.16%	1.84%	1.27%	1.47%	0.93%	1.00%	0.77%	1.02%	0.91%	3.83%	1.52%
Global macro	4.16%	3.90%	4.43%	1.64%	1.02%	2.86%	1.32%	0.87%	1.42%	1.60%	0.96%	1.60%	0.95%	0.84%	1.29%	3.15%	2.15%
Long/short equity	2.51%	6.45%	4.36%	2.38%	1.57%	3.06%	1.81%	2.78%	1.69%	2.07%	1.65%	1.52%	1.11%	2.33%	1.52%	3.34%	2.36%
Emerging markets	5.26%	9.97%	5.41%	3.31%	1.98%	4.30%	2.28%	3.19%	1.77%	3.44%	1.66%	1.88%	1.58%	1.58%	2.88%	5.87%	2.62%
Dedicated short bias	4.13%	10.93%	4.62%	5.27%	3.69%	5.13%	3.57%	4.51%	3.30%	2.99%	3.31%	5.30%	3.30%				
Managed futures	3.28%	4.81%	2.72%	4.01%	3.26%	3.43%	3.10%	3.76%	3.71%	3.27%	2.99%	3.83%	2.78%	2.15%	2.82%	1.38%	2.19%
Equity market neutral	1.11%	0.91%	0.61%	0.61%	0.54%	8.96%	1.24%	2.06%	1.91%	0.81%	1.13%	1.09%	1.28%	2.95%	1.19%	1.16%	1.38%
Fixed income arbitrage	0.86%	0.87%	2.14%	0.77%	0.68%	3.81%	1.06%	0.97%	0.61%	0.33%	0.49%	0.44%	0.53%	0.17%	0.42%	4.00%	0.99%
Convertible arbitrage	1.09%	2.49%	1.98%	1.23%	1.06%	4.27%	1.78%	2.06%	1.21%	0.85%	0.91%	0.79%	0.74%	0.85%	0.99%	4.09%	1.13%
Event driven	1.22%	5.58%	1.47%	1.27%	0.95%	2.22%	1.12%	1.96%	1.41%	2.29%	1.24%	1.30%	0.77%	1.47%	1.24%	7.14%	1.92%
Event driven distressed	1.65%	6.16%	1.28%	1.72%	0.80%	2.10%	1.10%	1.48%	0.93%	1.99%	1.11%	0.39%	0.63%	0.84%	1.24%	5.69%	1.76%
Event driven risk arbitrage	0.97%	2.98%	1.47%	1.13%	0.80%	1.54%	0.59%	1.28%	1.21%	0.57%	0.87%	0.79%	0.67%	1.08%	0.55%	3.56%	2.18%
Event driven multi-strategy	1.34%	5.25%	2.06%	1.16%	1.20%	2.43%	1.19%	2.33%	1.78%	2.53%	1.34%	1.67%	0.90%	1.84%	1.36%	8.11%	2.14%
Multi-strategy	1.54%	0.45%	1.74%	0.78%	0.91%	2.73%	1.11%	1.61%	0.81%	1.25%	0.80%	0.56%	0.85%	0.68%	0.49%	3.55%	1.35%
S&P 500	3.31%	7.88%	4.50%	5.13%	2.35%	5.45%	3.83%	6.67%	3.06%	2.62%	2.97%	4.26%	2.18%	5.80%	3.74%	6.29%	4.38%

Table 6: Standard deviation of the monthly rate of return for all the periods and all the strategies. Periods of crisis are in red while periods between crises are in white.

Generalization

To have a clearer idea of the risk carried out by the hedge fund strategies, the hedge fund sector in general and the S&P 500, we aggregated the results for periods of bull and bear market, and we present them together with values for the long-term period (1994-2021) in Table 7. As it was the case for the average monthly rate of return and the Jensen's alpha, we computed the weighted average of the standard deviations to obtain one value per index for bull market periods and one value per index for bear market periods.

Our computations show that in the long term, event driven risk arbitrage is the least risky strategy, followed by multi-strategy and fixed income arbitrage. Behind this trio, we have convertible arbitrage, event driven distressed, and event driven, which have a standard deviation below 2%. On the other hand, dedicated short bias is by far the riskiest strategy in the long term, followed by emerging markets and managed futures. Between these two extremes, there are four strategies with a standard deviation comprised between 2.11% and 2.57%: event driven multi-strategy, global macro, equity market neutral and long/short equity.

During periods of crisis, the ranking is not very different than in the long term. The three least risky strategies are again event driven risk arbitrage, multi-strategy, and fixed income arbitrage. Like in the long term, dedicated short bias is by far the riskiest strategy, followed by emerging markets and managed futures. In the middle of the ranking, convertible arbitrage lost three places which implies that some other strategies gained one place. As in the long term, directional strategies are riskier than the other strategy groups.

During bull market periods, hedge fund strategies logically have a lower standard deviation than during crisis periods, except global macro which has the same standard deviation. Dedicated short bias is again the riskiest strategy. This time, managed futures comes next and emerging markets is the third riskiest strategy as these two strategies inverted their positions. Fixed income arbitrage is the least risky strategy, followed by event driven risk arbitrage (which was 1st in the long term and during crises) and equity market neutral (which was among the riskiest strategies in the long term and during crises). In general, standard deviations for non-directional, event driven, and hybrid strategies are quite similar during non-crisis periods. Like in the long term and during periods of crisis, directional strategies are riskier than the other three strategy groups.

Finally, note that all the hedge fund strategies, except dedicated short bias, have a lower standard deviation than the S&P 500 in the long term, during periods of crisis and during periods between crises, meaning that they carry less risk.

	In the long term	During periods of bear market	During periods of bull market
CSHFI	1.94%	1.91%	1.53%
Global macro	2.46%	2.04%	2.04%
Long/short equity	2.57%	2.69%	2.01%
Emerging markets	3.72%	3.75%	2.92%
Dedicated short bias	4.69%	5.34%	3.77%
Managed futures	3.19%	3.67%	3.01%
Equity market neutral	2.54%	2.95%	1.04%
Fixed income arbitrage	1.44%	1.58%	0.81%
Convertible arbitrage	1.76%	2.11%	1.12%
Event driven	1.91%	2.03%	1.19%
Event driven distressed	1.82%	2.00%	1.17%
Event driven risk arbitrage	1.26%	1.34%	0.99%
Event driven multi-strategy	2.11%	2.14%	1.39%
Multi-strategy	1.42%	1.39%	1.10%
S&P 500	4.28%	5.24%	3.14%

	In the long term	During periods of bear market	During periods of bull market
CSHFI			
Global macro	8	6	10
Long/short equity	10	9	9
Emerging markets	12	12	11
Dedicated short bias	13	13	13
Managed futures	11	11	12
Equity market neutral	9	10	3
Fixed income arbitrage	3	3	1
Convertible arbitrage	4	7	5
Event driven	6	5	7
Event driven distressed	5	4	6
Event driven risk arbitrage	1	1	2
Event driven multi-strategy	7	8	8
Multi-strategy	2	2	4
S&P 500			

Table 7: Left: Average standard deviation in the long term, during bear market and during bull market. Right: Ranking of each hedge fund strategy based on the standard deviation.

11.2.2. Downside deviation

The downside deviation, also called downside risk, is a measure of risk or volatility that focuses on deviation below the average, contrary to the standard deviation which focuses on deviation both above and below the average. This risk measure is therefore useful as investors are more

concerned by returns that fall under the average than by those that are above the average. It is used to compare investments and determine which one is safer and which one is more likely to suffer from losses, even if they have similar returns. At equal returns, investors will prefer the investment with the lower downside deviation. The downside deviation can be computed with the following formula:

$$\sigma_{downside} = \sqrt{\frac{\sum_{i=1}^N (\min(R_i - MAR; 0))^2}{N}}$$

Where " R_i " is the return of the analyzed investment for the observation i (in our case, each hedge fund strategy and the CSHFI), "MAR" is the minimum acceptable rate of return (we took the risk-free rate as MAR) and N is the number of observations of the analyzed period.

Hedge fund sector

The first observation we can make is that the downside deviation of the CSHFI is lower than that of the S&P 500, both in times of crisis and during periods between crises, meaning that the hedge fund sector carries less "bad risk" than the S&P 500. The difference between the downside deviations of the CSHFI and of the S&P 500 is even bigger during periods of crisis.

A second observation is that the downside deviation of the CSHFI always increases during periods of crisis, except for the dotcom crisis. Like for the standard deviation, this is especially true for three crises: the crisis of May-August 1998, the global financial crisis and the Covid-19 crisis.

Individual HF strategies

At first sight, dedicated short bias, emerging markets and managed futures seem to be the strategies with the higher downside deviation compared to the other strategies, especially during bull market periods. However, this is not always the case. Indeed, event driven strategies (except event driven risk arbitrage) were riskier during the crisis from May to August 1998 and non-directional strategies were riskier during the global financial crisis. Among event driven strategies, event driven multi-strategy seems to be the one with the highest risk, especially in times of crisis since the crisis from May to August 2010 until the covid-19 crisis.

We can also observe that half of the strategies (fixed income and convertible arbitrage as well as event driven strategies) had a downside deviation equal to 0.00% between March 2009 and April 2010 since their returns were higher than the minimum acceptable rate of return.

	01/1994 – 04/1998	Crisis 05/1998 – 08/1998	09/1998 – 03/2000	Dotcom crisis	03/2003 – 05/2007	Global financial crisis	03/2009 – 04/2010	Crisis 05/2010 – 08/2010	09/2010 – 04/2011	Crisis 05/2011 – 09/2011	10/2011 – 05/2015	Crisis 06/2015 – 02/2016	03/2016 – 09/2018	Crisis 10/2018 – 12/2018	01/2019 – 12/2019	Covid crisis 01/2020 – 03/2020	04/2020 – 12/2021
CSHFI	1.38%	3.98%	1.51%	1.11%	0.42%	2.46%	0.00%	1.45%	0.07%	1.91%	0.39%	1.14%	0.43%	1.84%	0.38%	4.39%	0.56%
Global macro	2.07%	2.62%	3.55%	1.02%	0.34%	2.06%	0.45%	0.32%	0.33%	0.57%	0.53%	1.48%	0.49%	1.03%	0.38%	3.80%	1.01%
Long/short equity	1.34%	6.01%	1.34%	2.02%	0.77%	2.84%	0.52%	2.39%	0.00%	3.23%	0.81%	1.34%	0.59%	3.10%	0.77%	4.76%	1.03%
Emerging markets	3.32%	13.03%	2.40%	2.61%	1.08%	4.01%	0.24%	2.15%	0.20%	3.67%	0.94%	1.85%	1.02%	1.80%	1.68%	5.96%	1.21%
Dedicated short bias	3.09%	1.38%	5.19%	3.12%	3.02%	2.73%	4.68%	1.77%	5.04%	0.00%	3.23%	2.39%	3.80%				
Managed futures	2.43%	0.77%	1.93%	2.32%	2.17%	2.01%	2.16%	2.16%	1.78%	2.44%	1.98%	2.41%	2.20%	2.23%	1.64%	0.92%	1.15%
Equity market neutral	0.52%	0.68%	0.04%	0.14%	0.13%	8.93%	0.45%	1.90%	0.89%	1.18%	0.70%	0.62%	0.78%	2.91%	0.88%	2.08%	0.41%
Fixed income arbitrage	0.57%	1.24%	1.94%	0.49%	0.38%	3.97%	0.00%	0.40%	0.11%	0.15%	0.21%	0.48%	0.30%	0.64%	0.16%	3.77%	0.44%
Convertible arbitrage	0.71%	2.55%	1.42%	0.65%	0.70%	4.20%	0.00%	1.26%	0.22%	1.17%	0.39%	0.88%	0.31%	1.45%	0.24%	3.73%	0.26%
Event driven	0.44%	6.17%	0.78%	0.88%	0.33%	2.19%	0.00%	1.75%	0.09%	3.47%	0.56%	2.03%	0.36%	2.58%	0.58%	7.98%	0.43%
Event driven distressed	0.68%	6.49%	0.46%	1.13%	0.10%	2.33%	0.00%	1.41%	0.04%	2.48%	0.48%	1.08%	0.22%	1.44%	0.89%	5.90%	0.31%
Event driven risk arbitrage	0.43%	3.34%	0.65%	0.83%	0.37%	1.15%	0.03%	0.77%	0.56%	1.02%	0.58%	0.58%	0.36%	0.97%	0.23%	3.71%	0.84%
Event driven multi-strategy	0.52%	6.14%	1.19%	0.81%	0.53%	2.20%	0.00%	2.03%	0.13%	4.13%	0.62%	2.43%	0.46%	3.19%	0.54%	9.28%	0.53%
Multi-strategy	1.03%	0.09%	1.30%	0.50%	0.33%	2.68%	0.00%	1.18%	0.00%	1.40%	0.27%	0.42%	0.45%	1.55%	0.15%	3.60%	0.40%
S&P 500	1.86%	7.62%	2.08%	4.59%	1.11%	6.16%	1.12%	5.46%	0.09%	4.33%	1.40%	2.98%	0.95%	6.80%	2.04%	8.76%	1.51%

Table 8: Downside deviation for all the periods and all the strategies. Periods of crisis are in red while periods between crises are in white.

Generalization

As we did for the standard deviation, we also computed the weighted average downside deviation for each strategy for periods of crisis and between crises. Results are shown in Table 9.

First, we have the confirmation that the overall hedge fund sector has a lower downside risk than the S&P 500 in the long term, during periods of crisis and during periods between crises. Table 9 also shows that only dedicated short bias has a higher downside deviation than the S&P 500 in the long term. During periods of crisis, no strategies have a higher downside risk than the S&P 500 while only dedicated short bias, managed futures and emerging markets are riskier than the S&P 500 during non-crisis periods.

In the long term, dedicated short bias is by far the strategy with the highest downside risk. It is followed by emerging markets, equity market neutral and managed futures. All the other strategies have a downside risk below 2% and sometimes below 1%. This is the case for event driven risk arbitrage which is the strategy with the lowest “bad risk”. The second place is occupied by the multi-strategy which has also a downside risk below 1%. Fixed income arbitrage, event driven distressed and convertible arbitrage come next with downside deviations comprised between 1.22% and 1.31%. In the long term, directional strategies are clearly riskier while the three other strategy groups can be considered as equivalent in terms of risk (if we exclude equity market neutral).

The ranking of hedge fund strategies is not very different during periods of crisis. Emerging markets has this time the highest downside deviation by far (2nd highest in the long term), followed by equity market neutral (third highest downside deviation in the long term). Then, there are dedicated short bias and long/short equity which have the same downside risk. On the other hand, the safer strategy is again event driven risk arbitrage with multi-strategy remaining the second safer strategy. Global macro which was only 7th in the long term is now occupying the third place. No notable changes can be noticed for the other strategies.

During bull market periods, all the strategies, except dedicated short bias, have a lower downside risk than during crises. Event driven distressed is now the strategy with the lower downside deviation, followed by event driven and event driven risk arbitrage (which was 1st during crises). However, we can notice that the first eight strategies have relatively similar downside deviations. As shown by the Table 9, directional strategies are clearly the riskiest

strategies during periods between crises since they occupy by far the last five places of the ranking.

	In the long term	During periods of bear market	During periods of bull market
CSHFI	1.23%	1.79%	0.67%
Global macro	1.48%	1.44%	1.06%
Long/short equity	1.61%	2.57%	0.90%
Emerging markets	2.66%	3.51%	1.58%
Dedicated short bias	3.38%	2.57%	3.53%
Managed futures	2.10%	2.12%	2.05%
Equity market neutral	2.33%	2.73%	0.48%
Fixed income arbitrage	1.22%	1.49%	0.46%
Convertible arbitrage	1.31%	1.85%	0.54%
Event driven	1.39%	2.09%	0.42%
Event driven distressed	1.27%	1.96%	0.38%
Event driven risk arbitrage	0.80%	1.12%	0.46%
Event driven multi-strategy	1.55%	2.23%	0.54%
Multi-strategy	0.99%	1.25%	0.52%
S&P 500	2.98%	5.21%	1.42%

	In the long term	During periods of bear market	During periods of bull market
CSHFI			
Global macro	7	3	10
Long/short equity	9	10	9
Emerging markets	12	13	11
Dedicated short bias	13	11	13
Managed futures	10	8	12
Equity market neutral	11	12	5
Fixed income arbitrage	3	4	4
Convertible arbitrage	5	5	7
Event driven	6	7	2
Event driven distressed	4	6	1
Event driven risk arbitrage	1	1	3
Event driven multi-strategy	8	9	8
Multi-strategy	2	2	6
S&P 500			

Table 9: Left: Average downside deviation in the long term, during bear market and during bull market. Right: Ranking of each hedge fund strategy based on the downside deviation.

11.2.3. Beta

The beta of an investment measures the volatility of its return relative to the overall market. It is therefore a measure of the systematic risk. A beta equal to 1 means that the investment is as volatile as the market. When the beta is greater than 1, the investment is more volatile than

the market while the investment is less volatile than the market if the beta is between 0 et 1. An investment is negatively correlated to the market when the beta is negative and uncorrelated to the market when the beta is equal to 0. Beta can be computed with the following formula:

$$\beta = \frac{cov(R; R_B)}{var(R_B)}$$

Where “R” is the return of the analyzed investment and “ R_B ” is the return of the benchmark (S&P 500).

Hedge Fund Sector

As shown by Table 10, the hedge fund sector always has a beta below 1 and even below 0.55, meaning that the hedge fund sector is much less volatile than the S&P 500. The beta was higher during three periods: during the covid-19 and May-August 1998 crises and from January 1994 to April 1998. In contrast, the CSHFI was much less volatile during three periods in particular: from September 1998 to March 2000, during the dotcom crisis and during the crisis from October to December 2018. However, we do not see a general rule for the beta during periods of crises of and bull market

Individual Hedge Fund Strategies

First, we see that dedicated short bias is negatively correlated with the overall market benchmark during all the periods. As for managed futures, it is negatively correlated with the S&P 500 during all the crises, except the covid-19 crisis but it is always less negatively correlated than dedicated short bias. We can also notice that event driven strategies as well as long/short equity and emerging markets always have a positive beta, and this beta is comprised between 0 and 1 during the vast majority of periods. It means that these strategies almost always less volatile than the S&P 500. For the other strategies, it can happen that they have a negative beta, but this is rare.

By looking at Table 10, it seems difficult to find patterns for the beta. However, we can observe that event driven strategies (especially event driven, event driven distressed, and event driven multi-strategy) had a higher beta than usual during three crises: from May to August 1998, from May to September 2011, and during the covid-19 crisis. As for non-directional strategies, they had a higher beta than usual during the global financial crisis.

	01/1994 – 04/1998	Crisis 05/1998 – 08/1998	09/1998 – 03/2000	Dotcom crisis	03/2003 – 05/2007	Global financial crisis	03/2009 – 04/2010	Crisis 05/2010 – 08/2010	09/2010 – 04/2011	Crisis 05/2011 – 09/2011	10/2011 – 05/2015	Crisis 06/2015 – 02/2016	03/2016 – 09/2018	Crisis 10/2018 – 12/2018	01/2019 – 12/2019	Covid crisis 01/2020 – 03/2020	04/2020 – 12/2021
CSHFI	0.52	0.53	-0.01	0.12	0.30	0.29	0.17	0.24	0.40	0.45	0.21	0.20	0.22	0.10	0.21	0.55	0.24
Global macro	0.70	0.47	-0.03	0.00	0.16	0.15	0.06	0.04	0.37	-0.12	0.06	0.27	0.18	-0.04	0.21	0.46	0.26
Long/short equity	0.56	0.81	0.19	0.22	0.48	0.38	0.36	0.41	0.53	0.74	0.46	0.30	0.31	0.32	0.38	0.50	0.42
Emerging markets	0.57	1.12	0.27	0.41	0.47	0.53	0.38	0.43	0.37	1.15	0.34	0.37	0.29	0.22	0.54	0.75	0.27
Dedicated short bias	-0.86	-1.33	-0.65	-0.82	-1.22	-0.57	-0.72	-0.67	-0.96	-1.13	-0.88	-0.96	-0.99				
Managed futures	0.15	-0.55	0.12	-0.44	0.82	-0.16	0.22	-0.02	0.84	-0.27	-0.03	-0.02	0.52	-0.04	-0.04	0.12	0.12
Equity market neutral	0.17	0.08	0.06	0.03	0.02	0.43	0.16	0.29	0.41	0.24	0.24	-0.07	0.14	-0.45	-0.04	0.13	0.11
Fixed income arbitrage	0.11	0.05	-0.14	-0.02	0.04	0.44	0.06	0.08	0.10	0.10	0.04	0.02	0.02	-0.02	0.07	0.50	-0.03
Convertible arbitrage	0.09	0.28	-0.15	0.02	0.14	0.38	0.16	0.24	0.14	0.29	0.09	0.11	0.16	0.15	0.18	0.44	0.12
Event driven	0.24	0.66	0.01	0.11	0.26	0.24	0.07	0.27	0.42	0.82	0.28	0.25	0.18	0.25	0.28	0.99	0.32
Event driven distressed	0.32	0.75	0.00	0.13	0.22	0.24	0.03	0.21	0.25	0.69	0.23	0.08	0.11	0.13	0.25	0.78	0.24
Event driven risk arbitrage	0.10	0.35	0.01	0.08	0.19	0.16	0.08	0.17	0.26	0.15	0.17	0.00	0.17	0.10	0.11	0.47	0.19
Event driven multi-strategy	0.18	0.60	0.02	0.11	0.30	0.25	0.10	0.32	0.55	0.90	0.30	0.32	0.21	0.32	0.30	1.13	0.36
Multi-strategy	-0.01	-0.04	-0.10	0.06	0.21	0.26	0.10	0.22	0.22	0.44	0.15	0.06	0.17	-0.03	0.07	0.53	0.15

Table 10: Beta for all the periods and all the strategies. Periods of crisis are in red while periods between crises are in white.

Generalization

First, we see that the CSHFI and all the hedge fund strategies have a beta lower than one, meaning that they have a lower volatility than the S&P 500. These betas are even relatively low for most of the strategies in the long term, during crises and during bull market periods.

We can also see that, except managed futures and to a lesser extent global macro, all the strategies as well as the CSHFI, have relatively similar betas during crises and during periods between crises (and consequently in the long term).

The Table 11 shows that event driven risk arbitrage, non-directional and hybrid strategies are the strategies with the smallest systematic risk in the long term, during periods of crisis and during periods between crises given that their betas have the lowest absolute values. Note that global macro has the lowest systematic risk during crises, but not in bull market and in the long term. The three other event driven strategies come after non-directional and hybrid strategies, but they still less exposed to the systematic risk than directional strategies. The negative betas for dedicated short bias and managed futures show that these strategies go always (or often for managed futures) in the opposition direction to the market, which is consistent with what we observed with the other performances measures.

Table 11: Beta in bull/bear market and in the LT

	In the long term	During periods of bear market	During periods of bull market
CSHFI	0.27	0.23	0.28
Global macro	0.17	0.10	0.25
Long/short equity	0.42	0.35	0.43
Emerging markets	0.48	0.52	0.41
Dedicated short bias	-0.84	-0.81	-0.94
Managed futures	-0.02	-0.27	0.31
Equity market neutral	0.17	0.13	0.13
Fixed income arbitrage	0.12	0.13	0.04
Convertible arbitrage	0.17	0.18	0.10
Event driven	0.30	0.27	0.23
Event driven distressed	0.27	0.24	0.20
Event driven risk arbitrage	0.15	0.13	0.14
Event driven multi-strategy	0.31	0.29	0.24
Multi-strategy	0.15	0.15	0.11

11.3. Risk-reward ratios

After analyzing the return and the risk separately, we will now combine different measures of risk and return through the computation of risk-reward ratios such as the Sharpe, Sortino and information ratios.

11.3.1. Sharpe Ratio

The Sharpe ratio is a measure of the risk adjusted return. Indeed, it allows investors to compare the excess return with the risk. Said differently, this ratio measures the reward per unit of risk where the reward is the excess return over the risk-free rate and the risk is measured by the standard deviation of this excess return. Logically, investors will prefer a higher Sharpe ratio since it means a higher return for a lower risk. A negative Sharpe ratio means that it would have been preferable to invest in the risk-free asset. The Sharpe ratio is computed as follows:

$$\text{Sharpe ratio} = \frac{R - R_f}{\sigma(R - R_f)}$$

Where “R” is the return of the analyzed investment (in our case, each hedge fund strategy and the CSHFI), “Rf” is the risk-free rate and “ $\sigma(R - R_f)$ ” is the standard deviation of the excess return.

Hedge Fund Sector

The first observation is that the hedge fund sector (CSHFI) always had a positive Sharpe ratio during periods between crises and a negative Sharpe ratio during crises, except for the dotcom crisis during which the Sharpe ratio was barely positive. We can also see in Table 12 that the CSHFI outperformed the S&P 500 during most of the crises (except those from June 2015 to February 2016 and from October to December 2018) and during most of the non-crisis periods (except three periods: January 1994-April 1998, September 1998-March 2000 and March 2016-September 2018).

Individual Hedge Fund Strategies

Logically, the Sharpe ratio is negative for the periods during which the average monthly rate of return is negative. Moreover, the Sharpe ratio will be negative for periods with a barely positive return smaller than the return of the risk-free asset.

Since long/short equity and emerging markets have negative returns during all the crises, they have a negative Sharpe ratio for all the crises. Applying the same reasoning, we have that event driven strategies have a negative Sharpe ratio during all the crises, except the dotcom crisis (and the crisis from May to August 2010 for event driven risk arbitrage). Non-directional strategies have a positive Sharpe ratio during the dotcom crisis but also sometimes during other crises, which prevents us to find a general rule for this group of strategies. As for global macro and managed futures, they have a positive Sharpe ratio during the first five and the first two crises respectively.

Another observation is that dedicated short bias always had the worst Sharpe ratio during bull market periods, often followed by managed futures. However, dedicated short bias was often the strategy with the highest Sharpe ratio during crises, except during the dotcom (9th) and May-August 1998 (2nd) crises. Equity market neutral which was among the best strategies from January 1994 until the end of the global financial crisis, was then among the least effective strategies during periods between crises.

	01/1994 – 04/1998	Crisis 05/1998 – 08/1998	09/1998 – 03/2000	Dotcom crisis	03/2003 – 05/2007	Global financial crisis	03/2009 – 04/2010	Crisis 05/2010 – 08/2010	09/2010 – 04/2011	Crisis 05/2011 – 09/2011	10/2011 – 05/2015	Crisis 06/2015 – 02/2016	03/2016 – 09/2018	Crisis 10/2018 – 12/2018	01/2019 – 12/2019	Covid crisis 01/2020 – 03/2020	04/2020 – 12/2021
CSHFI	0.34	-0.38	0.27	0.01	0.71	-0.37	1.30	-0.25	1.18	-0.97	0.61	-0.72	0.38	-1.62	0.63	-0.83	0.74
Global macro	0.32	0.13	-0.20	0.65	0.71	0.08	0.68	0.58	0.84	0.33	0.40	-0.43	0.24	-0.92	0.52	-0.92	0.54
Long/short equity	0.30	-0.42	0.68	-0.23	0.60	-0.35	0.89	-0.43	1.10	-1.28	0.50	-0.36	0.39	-1.05	0.53	-1.19	0.57
Emerging markets	0.11	-0.98	0.34	-0.06	0.67	-0.32	1.03	-0.06	0.85	-0.62	0.35	-0.56	0.30	-0.81	0.32	-0.62	0.52
Dedicated short bias	-0.12	0.74	-0.67	0.16	-0.25	0.27	-0.96	0.71	-1.20	1.45	-0.50	0.39	-0.74				
Managed futures	-0.02	0.59	-0.12	0.23	0.06	0.21	-0.04	-0.02	0.43	-0.25	0.08	0.14	-0.18	-0.66	0.21	-0.05	0.22
Equity market neutral	0.38	-0.23	1.54	0.84	0.81	-0.23	0.48	-0.51	0.69	-1.14	0.18	0.17	0.07	-0.61	-0.03	-1.70	0.45
Fixed income arbitrage	0.37	-1.13	-0.06	0.41	0.36	-0.43	1.89	0.65	1.45	0.21	0.96	-0.56	0.72	-3.50	0.76	-0.51	0.71
Convertible arbitrage	0.38	-0.55	0.31	0.63	0.25	-0.37	1.53	0.12	0.90	-1.06	0.41	-0.70	0.50	-1.50	0.49	-0.46	0.91
Event driven	0.69	-0.69	0.66	0.19	1.03	-0.44	1.64	-0.45	1.17	-1.22	0.56	-1.24	0.56	-1.55	0.40	-0.78	0.91
Event driven distressed	0.63	-0.60	0.73	0.22	1.31	-0.63	1.75	-0.54	1.36	-0.87	0.63	-2.57	0.74	-1.51	-0.04	-0.66	0.74
Event driven risk arbitrage	0.49	-0.71	0.51	0.04	0.46	-0.07	1.41	0.09	0.55	-1.55	0.26	-0.20	0.43	-0.44	0.41	-0.68	0.60
Event driven multi-strategy	0.54	-0.79	0.50	0.15	0.79	-0.32	1.48	-0.42	1.08	-1.37	0.51	-1.11	0.47	-1.53	0.55	-0.81	0.92
Multi-strategy	0.31	0.91	0.21	0.29	0.80	-0.44	1.44	-0.21	1.82	-0.70	0.92	-0.25	0.47	-2.16	0.87	-0.64	0.67
S&P 500	0.40	-0.49	0.46	-0.35	0.41	-0.64	0.92	-0.43	1.10	-1.39	0.49	-0.21	0.58	-0.86	0.54	-1.14	0.69

Table 12: Sharpe ratio for all the periods and all the strategies. Periods of crisis are in red while periods between crises are in white.

Generalization

The first observation is that the hedge fund sector has a higher Sharpe ratio than the S&P 500 in the long term, during periods of crisis and during bull market periods. It shows that the much lower risk of hedge funds more than compensate their lower return in the long term and during bull market periods compared to the S&P 500.

In the long term, dedicated short bias is the only strategy having a negative Sharpe ratio and is consequently the least effective strategy. Equity market neutral, managed futures and emerging markets come next. They have a positive Sharpe ratio, but which is lower than the one of the S&P 500. On the other hand, multi-strategy has the highest Sharpe ratio and is very closely followed by event driven distressed. Then, there are three strategies not far behind which have the same Sharpe ratio: event driven, event driven risk arbitrage and global macro. In general, hybrid and event driven strategies performed the best in the long term in terms of Sharpe ratio while directional (except dedicated short bias) and non-directional strategies perform quite similarly.

During crises, results are very different. Nine strategies have a negative Sharpe ratio, but which is less bad than the one of the S&P 500, except for event driven distressed. Long/short equity, event driven, event driven multi-strategy and emerging markets have a Sharpe ratio less bad than event driven distressed, but which is still significantly negative. In contrast, dedicated short bias and managed futures, which were two of the three strategies with the worst ratio in the long term, are now ranked respectively 1st and 3rd while global macro is at the second place. Non-directional and hybrid strategies occupy the middle of the ranking, with equity market neutral being the only of these strategies to have a positive Sharpe ratio. Directional strategies seem to be more efficient than other strategy groups in times of crisis while event driven strategies are clearly the least efficient during crises.

During bull market periods, we are not far from inverting the ranking compared to periods of crisis. Dedicated short bias which was the most effective strategy during crises is now the only strategy having a negative Sharpe ratio. Managed futures which was ranked 3rd in times of crisis is the penultimate strategy during non-crisis periods with a barely positive Sharpe ratio. The second most efficient strategy in times of crisis, global macro, is only tenth during periods between crises but it does not have a bad Sharpe ratio. On the other hand, event driven are the most effective strategies during periods between crises (together with hybrid strategies) while

they were the least effective during crises. Like during crises, non-directional strategies are in the middle of the ranking.

	In the long term	During periods of bear market	During periods of bull market
CSHFI	0.22	-0.34	0.59
Global macro	0.24	0.23	0.43
Long/short equity	0.20	-0.42	0.52
Emerging markets	0.12	-0.31	0.42
Dedicated short bias	-0.13	0.36	-0.42
Managed futures	0.07	0.15	0.03
Equity market neutral	0.07	0.12	0.48
Fixed income arbitrage	0.16	-0.15	0.65
Convertible arbitrage	0.20	-0.06	0.50
Event driven	0.24	-0.38	0.79
Event driven distressed	0.28	-0.53	0.85
Event driven risk arbitrage	0.24	-0.18	0.50
Event driven multi-strategy	0.21	-0.36	0.68
Multi-strategy	0.29	-0.12	0.69
S&P 500	0.14	-0.52	0.53

	In the long term	During periods of bear market	During periods of bull market
CSHFI			
Global macro	5	2	10
Long/short equity	8	12	6
Emerging markets	10	9	11
Dedicated short bias	13	1	13
Managed futures	11	3	12
Equity market neutral	12	4	9
Fixed income arbitrage	9	7	5
Convertible arbitrage	7	5	7
Event driven	3	11	2
Event driven distressed	2	13	1
Event driven risk arbitrage	4	8	8
Event driven multi-strategy	6	10	4
Multi-strategy	1	6	3
S&P 500			

Table 13: Left: Average Sharpe ratio in the long term, during bear market and during bull market. Right: Ranking of each hedge fund strategy based on the Sharpe ratio.

11.3.2. Sortino Ratio

The Sortino ratio is a variation from the Sharpe ratio which uses the downside deviation instead of the standard deviation as denominator. Thus, it is a measure of the excess return over the risk-free rate per unit of “bad risk” since it considers only the downside risk. The formula is the following:

$$\text{Sortino ratio} = \frac{R - R_f}{\sigma_{\text{downside}}}$$

Where “R” is the return of the analyzed investment (in our case, each hedge fund strategy and the CSHFI), “R_f” is the risk-free rate and “ σ_{downside} ” is the downside deviation.

Hedge Fund Sector

Like the Sharpe ratio, the Sortino ratio is negative during periods for which the average monthly rate of return is negative and during periods where this monthly rate of return is lower than the return of the risk-free asset. Therefore, like the Sharpe ratio, the Sortino ratio of the CSHFI is positive during all the periods between crises and negative during all the crises, except the dotcom crisis. Note that for the period running from March 2009 to April 2010, “#DIV/0!” is due to the fact that the downside deviation is equal to 0.00% for that period. Thus, it corresponds to an infinite Sortino ratio.

Compared to the S&P 500, the CSHFI has a higher Sortino ratio during all the crises, except those from June 2015 to February 2016 and from October to December 2018. For bull market periods, results are less clear as it is sometimes the CSHFI which has a higher Sortino ratio and sometimes the S&P 500.

Individual Hedge Fund Strategies

Since they have a negative monthly rate of return during all the crises, long/short equity and emerging markets have a negative Sortino ratio during each of them. Similarly, event driven strategies have a negative Sortino ratio during all the crises, except the dotcom crisis (and during the crisis from May to August 2010 for event driven risk arbitrage). Global macro and multi-strategy managed to produce a positive Sortino ratio during the first five and first two crises respectively. Like for the Sharpe ratio, positive Sortino ratios in times of crisis are less predictable for non-directional strategies.

We also found that dedicated short bias has always a negative Sortino ratio during periods between crises and is always the least effective strategy during these periods. However, except during the dotcom crisis, this strategy is always ranked first with a positive Sortino ratio during crises. Managed futures seems also to perform relatively well in times of crisis compared to other strategies. However, this is not the case for event driven strategies which clearly struggle during crises. Nevertheless, these strategies seem to be among the most efficient during periods between crises.

Finally, note that we have some “#DIV/0!” in Table 14, especially for the period from March 2009 to April 2010 which was characterized by a huge growth after the global financial crisis. Some strategies, except directional strategies, did not incur any loss during that period which implies that the downside deviation is equal to 0.00%. Consequently, we have an infinite Sortino ratio for these strategies. Sometimes also, the downside deviation is very close to 0% which gives a very high Sortino ratio when we use the formula.

	01/1994 – 04/1998	Crisis 05/1998 – 08/1998	09/1998 – 03/2000	Dotcom crisis	03/2003 – 05/2007	Global financial crisis	03/2009 – 04/2010	Crisis 05/2010 – 08/2010	09/2010 – 04/2011	Crisis 05/2011 – 09/2011	10/2011 – 05/2015	Crisis 06/2015 – 02/2016	03/2016 – 09/2018	Crisis 10/2018 – 12/2018	01/2019 – 12/2019	Covid crisis 01/2020 – 03/2020	04/2020 – 12/2021
CSHFI	0.65	-0.41	0.56	0.02	1.76	-0.38		-0.32	22.09	-0.75	1.43	-0.64	0.70	-0.89	1.51	-0.71	2.03
Global macro	0.63	0.19	-0.25	1.05	2.14	0.10	2.01	1.56	3.56	0.91	0.72	-0.47	0.46	-0.75	1.73	-0.75	1.15
Long/short equity	0.55	-0.45	2.20	-0.27	1.21	-0.37	3.12	-0.51		-0.82	1.01	-0.41	0.74	-0.79	1.04	-0.83	1.30
Emerging markets	0.18	-0.75	0.76	-0.08	1.23	-0.34	9.78	-0.08	7.48	-0.58	0.62	-0.57	0.47	-0.71	0.55	-0.60	1.12
Dedicated short bias	-0.16	5.87	-0.60	0.27	-0.30	0.51	-0.73	1.82	-0.79		-0.51	0.86					
Managed futures	-0.02	3.70	-0.17	0.39	0.08	0.36	-0.06	-0.03	0.89	-0.33	0.12	0.22	-0.23	-0.64	0.36	-0.08	0.41
Equity market neutral	0.80	-0.30	24.45	3.42	3.33	-0.23	1.33	-0.56	1.48	-0.79	0.29	0.30	0.12	-0.62	-0.04	-0.90	1.52
Fixed income arbitrage	0.55	-0.79	-0.07	0.66	0.64	-0.41		1.57	7.93	0.47	2.18	-0.53	1.32	-0.97	1.99	-0.53	1.59
Convertible arbitrage	0.57	-0.54	0.42	1.15	0.38	-0.37		0.20	4.98	-0.76	0.96	-0.63	1.25	-0.88	2.07	-0.49	3.85
Event driven	1.87	-0.62	1.25	0.27	2.94	-0.44		-0.51	17.28	-0.81	1.24	-0.80	1.23	-0.89	0.86	-0.69	4.08
Event driven distressed	1.50	-0.57	2.06	0.34	10.43	-0.55		-0.56	33.18	-0.70	1.46	-0.94	2.15	-0.88	-0.06	-0.63	4.16
Event driven risk arbitrage	1.10	-0.63	1.16	0.05	1.01	-0.09	27.09	0.15	1.19	-0.87	0.39	-0.27	0.81	-0.49	1.00	-0.64	1.56
Event driven multi-strategy	1.40	-0.67	0.87	0.22	1.77	-0.35		-0.48	14.31	-0.84	1.10	-0.76	0.93	-0.88	1.39	-0.71	3.67
Multi-strategy	0.47	4.73	0.27	0.48	2.15	-0.44		-0.29		-0.63	2.69	-0.33	0.89	-0.94	2.73	-0.63	2.26
S&P 500	0.71	-0.50	1.00	-0.39	0.87	-0.56	3.15	-0.53	35.88	-0.84	1.04	-0.30	1.34	-0.73	1.00	-0.81	2.01

Table 14: Sortino ratio for all the periods and all the strategies. Periods of crisis are in red while periods between crises are in white

Generalization

To be able to generalize our results and compute weighted average Sortino ratios, we had to make some corrections to solve the issue raised above. First, we decided not to take into account the period from March 2009 to April 2010 since half the strategies have “#DIV/0!” instead of a value. The second correction we made is that we replaced downside deviations equal to 0.00% by 0.10% (0.01% was not a good solution since it gave us Sortino ratios reaching 450). Finally, we decided to limit the value of Sortino ratios at 20 so that one period cannot influence the average too much.

As far as results are concerned, we found that the hedge fund sector (CSHFI) has a superior Sortino ratio than that of the S&P 500 in the long term but also during periods with and without crisis. In the long term, dedicated short bias is again the least performing strategy and the only one having a negative Sortino ratio. Equity market neutral, managed futures, emerging markets and fixed income arbitrage are not very effective, but they still manage to produce positive Sortino ratios. On the other side, multi-strategy has the highest Sortino ratio in the long term, closely followed by event driven distressed, global macro and event driven risk arbitrage. In general, hybrid and event driven strategies seem more effective than directional (except global macro) and non-directional strategies in the long term.

However, during crises, event driven strategies are among the least performing strategies as they all have a negative Sortino ratio. Only long/short equity and emerging markets perform worse. On the other hand, dedicated short bias, which has the worst performance in the long term, produces the highest Sortino ratio during periods of crisis. It is followed by equity market neutral (second worst performer in the long term) and global macro (already 3rd in the long term). Non-directional and hybrid strategies are in the middle of the ranking and have positive Sortino ratios.

During periods between crises, event driven distressed occupies the first place by far, followed by equity market neutral. Note, however, that the weighted average Sortino ratios of these two strategies are influenced by two and one extreme values respectively. Event driven and multi-strategy come next, but their ratios are also influenced by one extreme value. On the other hand, the most effective strategy during crises, dedicated short bias, is the only one having a negative Sortino ratio during bull market periods. Managed futures which was also performing well in times of crisis is now the second least effective strategy with a barely positive Sortino ratio. Contrary to the periods of crisis, event driven strategies (except event driven risk arbitrage)

seem to be the most effective strategies alongside with multi-strategy. Directional strategies are clearly the least effective during periods without crisis.

	In the long term	During periods of bear market	During periods of bull market
CSHFI	0.34	-0.29	1.85
Global macro	0.40	0.50	1.08
Long/short equity	0.32	-0.40	1.63
Emerging markets	0.16	-0.30	0.92
Dedicated short bias	-0.18	2.03	-0.41
Managed futures	0.11	0.41	0.08
Equity market neutral	0.07	1.26	2.74
Fixed income arbitrage	0.19	0.13	1.33
Convertible arbitrage	0.27	0.21	1.19
Event driven	0.33	-0.24	2.51
Event driven distressed	0.40	-0.25	4.31
Event driven risk arbitrage	0.38	-0.14	0.96
Event driven multi-strategy	0.28	-0.24	1.96
Multi-strategy	0.42	0.17	2.03
S&P 500	0.20	-0.49	1.69

	In the long term	During periods of bear market	During periods of bull market
CSHFI			
Global macro	3	3	9
Long/short equity	6	13	6
Emerging markets	10	12	11
Dedicated short bias	13	1	13
Managed futures	11	4	12
Equity market neutral	12	2	2
Fixed income arbitrage	9	7	7
Convertible arbitrage	8	5	8
Event driven	5	10	3
Event driven distressed	2	11	1
Event driven risk arbitrage	4	8	10
Event driven multi-strategy	7	9	5
Multi-strategy	1	6	4
S&P 500			

Table 15: Left: Average Sortino ratio in the long term, during bear market and during bull market. Right: Ranking of each hedge fund strategy based on the Sortino ratio.

11.3.3. Information Ratio

The Information ratio is a risk-reward ratio that measures the excess return of an investment over a benchmark and compares it with the volatility or risk of this excess return. The principle is the same as for the Sharpe ratio, except that instead of measuring the excess return over the risk-free rate, we will measure the excess return over the market benchmark (S&P 500). In addition to have a better idea of the performance of hedge fund strategies compared to the overall stock market (S&P 500), this ratio will also help us to identify the most effective strategies during periods of crisis and between crises. A positive ratio means that the strategy outperforms the benchmark while a negative value indicates that the strategy underperforms the benchmark. The formula of the information ratio is the following:

$$\text{Information Ratio} = \frac{R - R_B}{\sigma(R - R_B)}$$

Where “R” is the return of the analyzed investment, “ R_B ” is the return of the benchmark (S&P 500) and “ σ ” is the standard deviation.

Hedge Fund Sector

The information ratio of the CSHFI is always positive during crises, indicating that the hedge fund sector outperforms the S&P 500 during crises. However, it is the exact opposite during non-crisis periods, which means that the S&P 500 outperforms the hedge fund sector.

Individual Hedge Fund Strategies

First, we can see in Table 16 that all the hedge fund strategies outperformed the S&P 500 during most of the crises, except some strategies during the crises from May to August 1998 (emerging markets and event driven multi-strategy) and from June 2015 to February 2016 (emerging markets, event driven, event driven distressed, and event driven multi-strategy). However, during bull market periods, all the strategies underperformed the S&P 500, except long/short equity (09/1998-03/2000) and emerging markets, event driven, and event driven distressed (03/2003-05/2007).

We can also see that dedicated short bias has the lowest information ratio during all the periods between crises, except from January 1994 to April 1998. As for non-directional strategies, they seem to perform slightly above the average of the other strategies during crises, except the global financial crisis. For the other strategies, however, it is difficult to find patterns with Table 16.

	01/1994 – 04/1998	Crisis 05/1998 – 08/1998	09/1998 – 03/2000	Dotcom crisis	03/2003 – 05/2007	Global financial crisis	03/2009 – 04/2010	Crisis 05/2010 – 08/2010	09/2010 – 04/2011	Crisis 05/2011 – 09/2011	10/2011 – 05/2015	Crisis 06/2015 – 02/2016	03/2016 – 09/2018	Crisis 10/2018 – 12/2018	01/2019 – 12/2019	Covid crisis 01/2020 – 03/2020	04/2020 – 12/2021
CSHFI	-0.17	0.58	-0.23	0.38	-0.13	0.57	-0.60	0.47	-1.01	1.32	-0.37	0.05	-0.54	0.63	-0.49	1.23	-0.55
Global macro	0.00	0.99	-0.46	0.53	-0.11	0.68	-0.69	0.52	-1.03	1.25	-0.37	0.06	-0.53	0.69	-0.44	1.20	-0.50
Long/short equity	-0.26	0.69	0.15	0.27	-0.02	0.59	-0.71	0.41	-0.99	1.03	-0.35	0.11	-0.48	0.60	-0.51	0.96	-0.58
Emerging markets	-0.14	-1.24	-0.04	0.40	0.17	0.51	-0.41	0.66	-0.79	0.89	-0.37	-0.06	-0.38	0.81	-0.42	0.91	-0.43
Dedicated short bias	-0.27	0.64	-0.63	0.27	-0.33	0.51	-1.00	0.55	-1.19	1.43	-0.52	0.33	-0.76				
Managed futures	-0.32	0.54	-0.51	0.33	-0.30	0.59	-0.87	0.36	-0.66	0.61	-0.28	0.25	-0.65	0.56	-0.30	1.24	-0.58
Equity market neutral	-0.31	0.50	-0.27	0.45	-0.23	0.15	-0.87	0.38	-0.88	1.32	-0.52	0.23	-0.53	0.37	-0.51	0.95	-0.59
Fixed income arbitrage	-0.33	0.38	-0.40	0.40	-0.31	0.43	-0.41	0.57	-0.88	1.56	-0.35	0.15	-0.40	0.74	-0.49	1.29	-0.51
Convertible arbitrage	-0.29	0.42	-0.27	0.49	-0.31	0.38	-0.22	0.60	-0.79	1.46	-0.38	0.09	-0.46	0.75	-0.49	1.14	-0.51
Event driven	-0.18	0.00	-0.24	0.43	0.01	0.56	-0.46	0.41	-0.93	0.89	-0.33	-0.22	-0.44	0.62	-0.55	0.47	-0.40
Event driven distressed	-0.11	0.05	-0.24	0.46	0.05	0.49	-0.41	0.39	-0.89	1.66	-0.31	-0.03	-0.39	0.73	-0.71	1.05	-0.48
Event driven risk arbitrage	-0.27	0.32	-0.29	0.38	-0.30	0.71	-0.77	0.54	-1.10	1.21	-0.48	0.17	-0.52	0.85	-0.54	1.23	-0.42
Event driven multi-strategy	-0.20	-0.08	-0.22	0.42	-0.01	0.59	-0.49	0.41	-0.95	0.19	-0.34	-0.31	-0.45	0.54	-0.47	0.14	-0.34
Multi-strategy	-0.29	0.52	-0.33	0.41	-0.13	0.49	-0.54	0.49	-0.78	1.77	-0.28	0.19	-0.44	0.58	-0.46	1.54	-0.55

Table 16: Information ratio for all the periods and all the strategies. Periods of crisis are in red while periods between crises are in white.

Generalization

In the long term and during periods between crises, the CSHFI has a negative information ratio which means that it underperforms the S&P 500 both in the long term and during bull market periods. In the long term, all the strategies, except global macro, underperformed the S&P 500 given that they have a negative information ratio. Note that the ranking for the long term shown in Table 17 is for information only. Indeed, the ranking does not have a lot of value given the similarity of the values.

During crises, we have bigger differences between the information ratios, which means that our ranking has more value than previously. Global macro is clearly the most effective strategy and is followed by multi-strategy and event driven risk arbitrage. Three strategies are not far behind: convertible arbitrage, fixed income arbitrage and event driven distressed. Event driven multi-strategy and emerging markets are the two least effective strategies. Dedicated short bias which was always well ranked during crises is only 8th while managed futures, another strategy performing often well during crises, is only 7th. Nevertheless, note that their information ratios are not far behind the most effective strategies.

In bull markets, all the strategies underperform the S&P 500 given that they all have negative information ratios. Dedicated short bias, equity market neutral and managed futures are the strategies that underperform the most the S&P 500, with event driven risk arbitrage, fixed income, and convertible arbitrage very close behind. On the other hand, the first four places of the ranking are occupied by strategies that were badly ranked during crises: emerging markets, event driven distressed, event driven, and event driven multi-strategy.

	In the long term	During periods of bear market	During periods of bull market
CSHFI	-0.05	0.50	-0.34
Global macro	0.00	0.61	-0.32
Long/short equity	-0.03	0.44	-0.31
Emerging markets	-0.04	0.37	-0.21
Dedicated short bias	-0.07	0.45	-0.49
Managed futures	-0.07	0.45	-0.43
Equity market neutral	-0.10	0.42	-0.44
Fixed income arbitrage	-0.09	0.50	-0.39
Convertible arbitrage	-0.06	0.51	-0.37
Event driven	-0.04	0.41	-0.28
Event driven distressed	-0.03	0.49	-0.26
Event driven risk arbitrage	-0.08	0.54	-0.42
Event driven multi-strategy	-0.05	0.34	-0.28
Multi-strategy	-0.05	0.54	-0.34

	In the long term	During periods of bear market	During periods of bull market
CSHFI			
Global macro	1	1	6
Long/short equity	3	9	5
Emerging markets	4	12	1
Dedicated short bias	10	8	13
Managed futures	9	7	11
Equity market neutral	13	10	12
Fixed income arbitrage	12	5	9
Convertible arbitrage	8	4	8
Event driven	5	11	3
Event driven distressed	2	6	2
Event driven risk arbitrage	11	3	10
Event driven multi-strategy	6	13	4
Multi-strategy	7	2	7

Table 17: Left: Average information ratio in the long term, during bear market and during bull market. Right: Ranking of each hedge fund strategy based on the information ratio.

11.3.4. Treynor Ratio

Our first idea was to analyze also the Treynor ratio to complete our analysis about the performance of hedge funds. However, when we computed the Treynor ratio, we obtained very similar values for all the strategies and all the periods. These values were all close to 0, which implies that it does not help us in our analysis. Moreover, these values seem strange compared to some studies in the past. Therefore, we decided not to present the Treynor ratio in this research.

12. Conclusion about the performance analysis

In the previous section, we computed different performance measures for all the hedge fund strategies as well as for the CSHFI (hedge fund benchmark) and the S&P 500 (overall market benchmark). We started by computing two measures of the return: the average monthly rate of return and the alpha of Jensen. Then, we introduced the notion of risk with three measures: the standard deviation of the monthly rate of return, the downside risk which is a measure of the “bad” risk, and the beta which measures the systematic risk. Logically, we continued our analysis by combining these different measures of risk and return in risk-reward ratios.

In addition to computing these performance measures for each sub-period, we also computed a weighted average of each performance measure during periods of bull and bear markets. Based on that, we defined, for each performance measure, a ranking of hedge fund strategies in the long term as well as during periods of bull and bear markets. Since we want to know which hedge fund strategies perform best in the long term, during periods of crisis and during periods of bull market, the goal of this section will be to investigate if the different performance measures give similar rankings. If this is the case, we will be able to answer our research question.

12.1. In the long term

When we start by looking at measures of the return, we find that one strategy, global macro, arrives at the first place of the ranking for both the average monthly rate of return and the Jensen’s alpha. At first sight, this might indicate a superior performance of the global macro strategy in the long term. Two other strategies, event driven distressed and event driven, are also well ranked with both measures (2nd and 4th). Long/short equity which is 2nd in terms of monthly rate of return is 5th regarding the alpha, but not far behind the three first strategies. On the other hand, regarding the least effective strategies, the two measures agree on the fact that dedicated short bias is by far the least effective strategy in the long term since it is the only strategy having a negative monthly rate of return and a negative alpha. Both measures also agree on the fact that equity market neutral and fixed income arbitrage are respectively the second and the fourth least effective strategies in the long term. Another similarity is that event driven risk arbitrage is the least efficient of the event driven strategies in the long term in terms of return. However, there is a notable difference regarding the ranking of emerging markets which is 5th with the monthly rate of return, but only 11th with the Jensen’s alpha.

When we look at risk measures (standard deviation and downside deviation), we see that the ranking is different than with return measures. Event driven risk arbitrage, which was the least effective of the event driven strategies in terms of return, has a lower risk than the other event driven strategies and even than all the strategies. Both measures also agree on the fact that multi-strategy and fixed income arbitrage are the strategies with the second and third lowest risk in the long term respectively. With both measures, dedicated short bias and emerging markets are the most and second most risky strategies, followed by equity market neutral, managed futures and long/short equity. However, these two risk measures diverge regarding convertible arbitrage which is among the riskiest strategies when we use the downside deviation and among the safest when we use the standard deviation.

Finally, we have a clearer idea of the most effective strategies when we combine risk and return measures in risk-reward ratios. Note that, as we said previously, the information ratio will not help us for the long-term period. However, the Sharpe and Sortino ratios give us clear results. Multi-strategy is the most effective strategy with both ratios since its low risk compensates its medium return. Event driven distressed comes at the second place, followed by global macro and event driven (the general index). On the other hand, dedicated short bias is logically the least efficient strategy since it has the highest risk and the lowest return (a loss actually). Equity market neutral is the second most inefficient strategy in the long term, followed by managed futures and emerging markets. In general, event driven and hybrid strategies are the most effective strategies in the long term, while directional and non-directional strategy groups seem to perform worse. These results for the long-term period are comparable to those of past studies examined in the literature review.

As for the performance of the hedge fund sector (CSHFI) compared to the S&P 500, we can see that the hedge fund sector had a lower return but also a much lower risk, resulting in better risk-reward ratios for the hedge fund sector. This result is also in line with past studies.

12.2. During periods of bear market

During periods of crisis, results are quite different than in the long term. Conducting the same reasoning as for the long-term period, we start by looking at measures of the return. We can see that our two measures (monthly rate of return and Jensen's alpha) do not always agree on the ranking of hedge fund strategies. Indeed, dedicated short bias which has the highest monthly rate of return is only 11th regarding the alpha (with even a slightly negative alpha). Same

observation for managed futures which produces the second highest monthly return, but only the 8th alpha (which is barely positive). Another notable difference can be observed for emerging markets, which is the strategy incurring the highest average monthly loss, but which has the third highest alpha. However, both measures agree that global macro performs well in terms of return in bear markets. Indeed, this strategy is one of the three strategies with a positive return in bear markets and it has the highest alpha. As for event driven risk arbitrage, it is ranked 4th with both measures and is therefore among the best performing strategies during crises. They also agree that long/short equity and event driven multi-strategy are among the least effective strategies regarding the return.

When analyzing the risk, we see that both the standard and downside deviations agree that event driven risk arbitrage and multi-strategy are the strategies carrying the lowest risk during crises, followed by fixed income arbitrage. Global macro and event driven distressed seem to be also among the safest strategies, but the two risk measures do not agree on their ranking. On the other hand, dedicated short bias, emerging markets and equity market neutral are the riskiest strategies with both risk measures.

Again, we have a clearer view on the performance of hedge fund strategies when we combine these measures of risk and return in risk-reward ratios. These ratios, except the information ratio, show that dedicated short bias is strategy performing the best during crises. Indeed, its much higher average monthly rate of return largely compensates its higher risk. The Sharpe and Sortino ratios also agree on the fact that global macro, managed futures, and equity market neutral are performing well in times of crisis. Note that dedicated short bias, global macro, and managed futures are the only strategies that generate positive monthly return during periods of crisis. Risk-reward ratios also show that long/short equity and emerging markets are among the worst performing strategies due to a negative return and a high risk. Our computations also indicate that event driven strategies are badly ranked during crises since they incur substantial losses which are not compensated by a much lower risk. Note that, contrary to the long-term period, event driven risk arbitrage is the event driven strategy that performs the least badly during crises.

In past studies, authors found that dedicated short bias, managed futures and global macro performed better than the other strategies during the global financial crisis. Our study shows that we can generalize this result to other periods of crisis, on average. However, in our study,

equity market neutral is among the best performing strategies during crises, which was not the case in the past study during the global financial crisis. We also do not agree that convertible and fixed income arbitrage are among the least effective strategies in bear markets.

Finally, we also have to mention that the hedge funds do not always behave in the same way during all the crises (with some exceptions). Indeed, we have to keep in mind that the crises are different by nature and have different causes. Therefore, some crises may have a bigger effect on some strategies than on others. We must also mention the case of the dotcom crisis during which hedge funds were able to generate profits while the global stock market was falling. This crisis was definitively different regarding its impact on hedge funds.

Regarding the performance of the CSHFI compared to the S&P 500, it is clear that the CSHFI performed better during crises. Indeed, the CSHFI had a lower risk and incurred a smaller loss. The better performance of the hedge fund index was mentioned in past studies as we said in the literature review.

12.3. During periods of bull market

During periods of bull market, our two return measures clearly indicate that dedicated short bias, managed futures, and equity market neutral are the least effective strategies. However, for periods between crises, our two return measures do not agree regarding the best performing strategies. Indeed, except for event driven multi-strategy, which is ranked third with both measures, there are differences: long/short equity has the highest monthly rate of return, followed by emerging markets while event driven distressed has the highest alpha, with event driven (the general index) coming next. Nevertheless, both measures agree that event driven multi-strategy is among the most effective strategies (3rd).

Regarding the risk, the standard deviation and the downside deviation clearly indicate that dedicated short bias is the riskiest strategy in bull markets, followed by managed futures, emerging markets, and global macro. However, there is no consensus for the safest strategies. Both measures agree that fixed income arbitrage and event driven risk arbitrage are among the safest strategies, but they have different rankings with these two measures. Moreover, different strategies are considered as among the safest: equity market neutral and multi-strategy for the standard deviation, and event driven distressed as well as event driven in general for the downside deviation.

As for the long-term and for periods of crisis, we combine the previous risk and return measures. During periods of bull market, dedicated short bias and managed futures are the least effective strategies as indicated by the three risk-reward ratios. Dedicated short bias incurs losses during periods between crises and carries the highest risk. Managed futures has a positive return (though relatively low), but its high risk implies that values for the risk-reward ratios are low.

On the other hand, according to the risk-reward ratios, event driven distressed is the most effective strategy in growing markets, followed by the general event driven index. These strategies have a low risk and a rather good return. Multi-strategy and event driven multi-strategy come next.

In general, directional strategies are the least effective in growing markets. Even global macro which was performing well in the long term and during crises is now among the least effective strategies. The bad ranking of directional strategies is explained by the higher risk implied by these strategies. We can add that, contrary to the other event driven strategies, event driven risk arbitrage is not well ranked during bull market periods because of its lower return.

Finally, regarding the performance of the hedge fund sector compared to the global stock market, it seems that the hedge fund sector slightly outperforms the global stock market. The CSHFI has a lower return than the S&P 500, but it has also a much lower risk.

General Conclusion

In this study, we wanted to investigate which hedge fund strategies are the most effective in the long term, in bull markets and in bear markets. Our goal was to determine whether we can generalize the results and have a ranking of the best and worst performing hedge fund strategies in the long term, in bull markets and in bear markets.

To do so, we started by defining the universe of hedge funds to have a clearer view on how they operate. Then, we reviewed the literature to have a first idea of what could be the answer to our research question. Afterwards, we defined our different sub-periods, which are periods of bull and bear markets, based on historical returns of the S&P 500. Finally, we computed performance measures about the risk and the return as well as risk-reward ratios which combine measures of risk and return.

To the question *“Which hedge fund strategies are the most effective in the long term, in bull markets and in bear markets?”*, our answer is the following:

- In the long term: multi-strategy, event driven distressed and global macro are the most effective strategies while dedicated short bias, equity market neutral, managed futures and emerging markets are the least effective strategies.
- During periods of bear market (crises): dedicated short bias, managed futures and global macro are the best performing strategies while long/short equity, emerging markets and event driven strategies (except event driven risk arbitrage) are the worst performers.
- During periods of bull market: event driven distressed, event driven, multi-strategy and event driven multi-strategy are the best performing strategies while dedicated short bias, managed futures, equity market neutral, and emerging markets perform the worst.

Compared to the S&P 500, the hedge fund sector (represented by the CSHFI) performs better in terms of risk-reward ratios in the long term, but also in bull and in bear markets. Indeed, in the long term and during periods of bull market, the CSHFI has a lower return but also a much lower risk. During crises, the CSHFI incurs smaller losses and has a lower risk.

Finally, our computations showed that the results were clearly different for the dotcom crisis than for the other crises. Indeed, the dotcom crisis was not associated with a poor performance of hedge funds given that only few strategies sustained losses during that period.

As you can see, our study allowed us to answer our research question. However, we see some limitations to our analysis.

First of all, we based our conclusion about the effectiveness of hedge fund strategies under various market conditions on weighted average performance measures. Therefore, we were able to determine that some strategies perform, **in general**, better than others in the long term, in bear markets and bull markets. However, this does not mean that it is a general rule and that it will be the case during each crisis or during each period of bull market. Indeed, it is important to add that the different crises have different causes and are different by nature. The principle is the same for periods between crises, which have different characteristics between them. This study is purely mathematical and does not try to generalize the results together with a deep analysis of the overall economy to explain the characteristics of the different sub-periods, which can be the subject of an entire book.

A second limitation we see is that all the performance measures do not always provide the same results in terms of ranking. We can indeed have contradictory results, especially between the Sharpe/Sortino ratios and the information ratio. Results are not always straightforward.

Another limitation or weakness lies in the definition of the different sub-periods of bull and bear markets. We can say that what is the strength of this research, the goal of generalization, may also be a weakness. Indeed, some may argue that there are too many sub-periods and that too short periods have an impact on the computations. Moreover, even if we have set some rules for defining the different periods of our analysis, there is always a part of subjectivity when defining these sub-periods to determine when they start and when they end.

Finally, we can evoke the potential biases in our database about past performance of hedge funds since they are not obliged to report their performance. Even though we chose a database known to be reliable, it can still be subject to biases such as backfill and survivorship biases.

References

Scientific papers and books

- Aspadarec, W. (2014). Investment Performance of Hedge Funds. *Folia Oeconomica Stetinensia*. Doi: 10.2478/fofi-2013-0001
- Brown, S. (2016). Why Hedge Funds? *Financial Analyst Journal*, (), Editor's Corner.
- Falkowski, M., Sierpiska-Sawicz, A. & Szczepankowski, P. (2020). The Effectiveness of Hedge Fund Investment Strategies under Various Market Conditions. *Contemporary Economics*, 14(2), 127-143. doi: 10.5709/ce.1897-9254.336
- Ibbotson, R., Chen, P., CFA. & Zhu, K. (2011). The ABCs of Hedge Funds: Alphas, Betas, and Costs. *Financial Analyst Journal*, 67(1). Online <https://www.proquest.com/openview/59ec6cbd24bbd01180e4f4f85577f144/1?pq-origsite=gscholar&cbl=34871>
- Kaiser, D. & Haberfelner, F. (2012). Hedge fund biases after the financial crisis. *Managerial Finance*, 38(1), 27-43. doi: 10.1108/03074351211188349
- Metzger, N. & Shenai, V. (2019). Hedge Fund Performance during and after the Crisis: A Comparative Analysis of Strategies 2007-2017. *International Journal of Financial Studies*, 7(15), 1-31. doi:10.3390/ijfs7010015
- Pedersen, L.H. (2015). *Efficiently Inefficient: How Smart Money Invests and Market Prices Are Determined*. Princeton: Princeton University Press.
- Stulz, R. (2007). Hedge Funds: Past, Present, and Future. *Journal of Economic Perspectives*, 21(2), 175-194. Online <https://files.fisher.osu.edu/departement-finance/public/2007-03.pdf>
- Vonèche, I. (2017). *La gestion alternative de portefeuille dite « hedge funds » permet-elle de surperformer le marché à long terme ?*. Mémoire de master, Université catholique de Louvain, Louvain-la-Neuve. Online https://dial.uclouvain.be/memoire/ucl/en/object/thesis%3A10510/datastream/PDF_01/view

Databases

Credit Suisse. *Download Indices*. <https://lab.credit-suisse.com/#/en/index-nav>, accessed on September 09/20/22.

FRED (2022). 3-Month Treasury Bill Secondary Market Rate, Discount Basis. Online <https://fred.stlouisfed.org/series/TB3MS>, accessed on 09/20/22.

Investing. *S&P 500 – Données Historiques*. <https://fr.investing.com/indices/us-spx-500-historical-data>, accessed on 09/20/22.

Web sources

Barclay Hedge. (2022). Hedge Fund Industry Assets Under Management. Online <https://www.barclayhedge.com/solutions/assets-under-management/hedge-fund-assets-under-management/>, accessed on 11/30/22.

CME Group. What are Managed Futures? Online <https://www.cmegroup.com/education/courses/managed-futures/what-are-managed-futures.html>, accessed on 10/01/22.

Corporate Finance Institute. (2022). What is the Sharpe Ratio?. Online <https://corporatefinanceinstitute.com/resources/risk-management/sharpe-ratio-definition-formula/>, accessed on 09/20/22.

Corporate Finance Institute. (2022). Treynor Ratio. Online <https://corporatefinanceinstitute.com/resources/wealth-management/treynor-ratio/>, accessed on 09/22/22

Corporate Finance Institute. (2022). *Sortino Ratio*. Online <https://corporatefinanceinstitute.com/resources/wealth-management/sortino-ratio-2/>, accessed on 09/22/22.

Corporate Finance Institute. (2022). Information Ratio. Online <https://corporatefinanceinstitute.com/resources/wealth-management/information-ratio/>, accessed on 09/23/22.

Corporate Finance Institute. (2022). Global Macro Strategy. Online <https://corporatefinanceinstitute.com/resources/wealth-management/global-macro-strategy/>, accessed on 09/29/22.

Credit Suisse. *Credit Suisse Hedge Fund Index: Methodology*. Online <https://lab.credit-suisse.com/#/en/index/HEDG/HEDG/methodology>, accessed on 09/20/22.

Credit Suisse. *Broad Hedge Fund Indices: Overview*. https://lab.credit-suisse.com/#/en/index/HEDG/HEDG_CVARB/overview, accessed on September 09/20/22.

ETFGLI. (2021). ETFGLI reports assets invested in the global ETFs industry increase the lead over global hedge fund industry to US\$4.39 trillion at the end of 2020. Online <https://etfghi.com/news/press-releases/2021/03/etfghi-reports-assets-invested-global-etfs-industry-increase-lead-over>, accessed on 11/30/22.

Investopedia. (2022). Sharpe Ratio Formula and Definition with Examples. Online <https://www.investopedia.com/terms/s/sharperatio.asp>, accessed on 09/20/22.

Investopedia. (2020). *Sortino Ratio: Definition, Formula, Calculation, and Example*. Online <https://www.investopedia.com/terms/s/sortinoratio.asp>, accessed on 09/22/22.

Investopedia. (2020). What Is Jensen's Measure (Alpha), and How Is It Calculated?. Online <https://www.investopedia.com/terms/j/jensensmeasure.asp>, accessed on 09/22/22.

Investopedia. (2020). *Information Ratio (IR). Definition, Formula, vs. Sharpe Ratio*. Online <https://www.investopedia.com/terms/i/informationratio.asp>, accessed on 09/23/22.

Investopedia (2022). Equity Market Neutral. Online <https://www.investopedia.com/terms/e/equitymarketneutral.asp>, accessed on 09/28/22.

Investopedia (2022). Short Selling: Definition, Pros, Cons, and Examples. Online <https://www.investopedia.com/terms/s/shortselling.asp>, accessed on 09/28/22.

Investopedia. (2022). Fixed-Income Arbitrage. Online <https://www.investopedia.com/terms/f/fixedincomearbitrage.asp>, accessed on 09/28/22.

Investopedia. (2020). Global Macro Strategy: Definition, How It Works, Types of Funds. Online <https://www.investopedia.com/terms/g/globalmacro.asp>, accessed on 09/29/22.

Investopedia. (2020). Long-Short Equity: What It Is, How It Works in Investing Strategy. Online <https://www.investopedia.com/terms/l/long-shortequity.asp>, accessed on 09/29/22.

Investopedia. (2022). Managed Futures. Online <https://www.investopedia.com/terms/m/managed-futures.asp>, accessed on 10/01/22.

Investopedia. (2022). Dedicated Short Bias. Online <https://www.investopedia.com/terms/d/dedicatedshortbias.asp>, accessed on 10/01/22.

Pace University. (2022). Financial Crisis and Recovery: Financial Crisis Timeline. Online <https://libraryguides.law.pace.edu/financialcrisis>, accessed on 11/16/22.

Securities and Exchange Commission. Hedge Funds. https://www.sec.gov/files/ib_hedgefunds.pdf, accessed on 11/29/22.

Appendix 1: Description of hedge fund strategies

Directional strategies

Hedge funds using strategies within this group combine long and short positions for various assets whose prices move in the same direction as changes in the market. The return on investment depends on the direction of these changes. Stefanini adds that directional strategies have high variations in performance, especially in the short term.

- **Long/short equity**

As the name suggests, funds using this strategy go both long and short on equity markets. Long/short equity hedge funds try to go long on excellent stocks that trade at a discount and go short on bad stocks that are overvalued. Note that funds using this strategy usually have more long than short positions. The strategy is similar to the equity market neutral strategy except that in this case, funds do not need to be market neutral. Long/short equity funds can specialize in a particular sector, in value or growth investing, etc. The Credit Suisse precises that funds using this strategy can also trade equity futures and options as well as equity related securities and debt.

- **Dedicated short bias**

Dedicated short bias hedge funds are funds focusing on short selling. Even if these funds have both long and short positions, they have a net short exposure to the market. Like other equity investors, they will also rely on fundamental analysis. However, since they focus on short selling, these funds will look for potential problems that firms may encounter such as materially overstated earnings, aggressive accounting methods, but also problems linked to the business model itself.

- **Managed futures**

Managed futures hedge funds (often called Commodity Trading Advisors/CTAs) typically invest in bond, equity, and commodity futures as well as in currency forwards. This strategy is often considered as a trend-following strategy since fund managers use systematic trading programs that analyze market trends and historical price data. Two remarks can be noted: a lot of leverage may be used since this strategy is about futures contracts; this strategy is not particularly long or short biased meaning that hedge funds using this strategy take both long and short positions to a similar extent.

- **Global macro**

Global macro hedge funds base their investment decisions on their analysis of the impact of large macroeconomic events and political trends on the valuation of financial instruments. These factors are interest rates, currency exchange rates, levels of international trade, political events, and international relations. Thus, these funds make profits when they correctly anticipate all these trends and events. Funds using this strategy are the least restricted funds and can invest in all asset classes (equities, bonds, currencies, commodities, etc).

- **Emerging markets**

Funds using the emerging markets strategy typically invest in equities, debt instruments, currencies, and other instruments of countries with developing or “emerging” markets. An emerging market can be described as “countries experiencing rapid growth and progressing into developed economies” (Basu & Huang-Jones, 2015). To define emerging countries or markets, one usually uses the GDP per capita as a measure. Some examples of emerging markets are China, India, Latin America, some parts of Africa and Eastern Europe, and the majority of Southeast Asia.

Non-directional strategies

Non-directional or relative value strategies are strategies where investments are made based on the identification of differences in valuation of related instruments. Investors open opposite positions to neutralize the risk. As opposed to directional strategies, investments are made independently of any market trend.

- **Convertible arbitrage**

Convertible arbitrage consists in buying convertible securities, which are usually bonds or preferred shares that can be converted into common stock and taking a short position in the underlying stock. By doing that, funds aim at benefiting from pricing inefficiencies between the stock and the convertible.

- **Fixed income arbitrage**

Funds using this strategy try to profit from inefficiencies and pricing differences that may occur between related fixed income securities (bonds or other interest-rate securities). Funds will take

a short position on the security that is overpriced and a long position on the security that is underpriced. Going long and short on related securities (mathematically or economically) allows to hedge a lot of the risk. The Credit Suisse adds that fixed income arbitrage includes “credit yield curve relative value trading involving interest rate swaps, government securities and futures; volatility trading involving options; and mortgage-backed securities arbitrage”. Note that fixed income arbitrage funds often use a lot of leverage, which may lead to moderate earnings when the relative price differences converge, but also to important losses when many arbitrageurs are forced to simultaneously deleverage their positions in a fire sale.

- **Equity market neutral**

Hedge funds using this strategy aim at profiting from differences in stock prices by taking both long and short positions in closely related stocks. Funds will indeed try to buy undervalued stocks and short overvalued stocks. At the same time, these funds seek to reduce exposure to the systematic risk (or beta risk) of the market, they want to be market neutral. Concretely, this means that a beta of zero is desired. “Closely related stocks” written in the definition above refers to the fact that funds using the equity market neutral strategy usually “seek to exploit investment opportunities unique to a specific group of stocks, while maintaining a neutral exposure to broad groups of stocks defined for example by sector, industry, market capitalization, country, or region” (Credit Suisse).

Event-driven strategies

Strategies within this category try to profit from exceptional situations or events occurring at the issuers’ that affect asset values. The uncertainty resulting from these events creates opportunities for investors.

- **Event driven**

Event driven funds seek to benefit from temporary mispricing of securities due to a specific corporate or market event. Such events are for example: mergers, restructurings, bankruptcies, financial or operational stress, asset sales, recapitalizations, spin-offs, litigation, regulatory and legislative changes, etc. Note that these funds can invest in various securities such as equities, fixed income instruments (investment grade, high yield, bank debt, convertible debt and distressed), options and other derivatives.

The Credit Suisse further decomposes the event driven category in three subcategories: distressed, multi-strategy and risk arbitrage.

- **Event driven distressed**

Funds using this strategy focus on companies subject to financial or operational distress or bankruptcy proceedings and invest across their capital structure. Distressed securities often trade below the intrinsic value because of difficulties in assessing their right value, lack of research coverage, or because traditional investors are unable to continue holding them. This strategy is generally long-biased since fund managers aim at profiting from the issuer's ability to improve its situation or from the success of the bankruptcy process that leads to an exit strategy. Nevertheless, as mentioned by the Credit Suisse, managers may take long-only, hedged, or short-only positions.

- **Event driven multi-strategy**

Event driven multi-strategy hedge funds are defined by the Credit Suisse as funds usually combining investments in event driven equities and credit. Following the Credit Suisse definition, the equity space includes sub-strategies such as risk arbitrage, holding company arbitrage, equity special situations, and value equities with a hard or soft catalyst. As for the credit part, it includes sub-strategies such as long/short high yield credit, leveraged loans, capital structure arbitrage (debt vs. debt or debt vs. equity), and distressed debt including post-reorganization equity. To sum up, event driven multi-strategy funds try to profit from events by investing across different asset classes and benefit from shifts in economic cycles.

- **Event driven risk arbitrage**

Event driven risk arbitrage, also called merger arbitrage, consists in funds attempting to profit from price moves when merger or acquisition transactions involving public companies have been announced. These funds will indeed try to capture the spread, which is the difference between the transaction bid and the trading price (the bid is typically higher than the trading price to incentivize the owner to sell). To do so, funds will purchase the stock of the target at the trading price and then sell it at the bid price if the deal is concluded. Another possibility for hedge funds using this strategy is to go long the target stock and short the acquirer's stock to create a hedge. Note that the main risk of this strategy is that the deal might fail (deal risk).

Hybrid strategies

As the name suggests, these strategies combine the advantages of the strategies discussed previously.

- **Multi-strategy**

Multi-strategy funds will attempt to benefit from opportunities among several hedge fund strategies such as, for example, convertible bond arbitrage, equity long/short, statistical arbitrage, and merger arbitrage. With this diversification of strategies, fund managers seek to deliver consistently positive returns regardless of the directional movement in equity, currency markets or interest rates. This greater diversification will help to reduce the risk profile of funds, lower volatility, smooth returns and reduce asset-class and single strategy risks.