

Louvain School of Management

The impact of investment strategies in the financial market: empirical evidence on hedge funds.

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Foreword

This thesis was written for my Master's Degree in Management with specialization in CEMS International Management at the Louvain School of Management.

The research topic at hand was both difficult and stimulating as it involved a combination of financial and economic disciplines. The completion of this thesis was made possible through the assistance of several individuals, including supportive family members and other helpful people who aided in the entire process. I would like to extend my gratitude to Leonardo Iania, Associate Professor of Finance at the Louvain School of Management, for his valuable advice, guidance, and patience, as well as to my family for its unwavering support. The completion of this thesis would not have been possible without them.

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Abstract

This master thesis examines the level of dependency of hedge fund strategies on the S&P500. It also determines which type of relationship hedge fund strategies, and the S&P500 have. Lastly, it analyzes the correlations during 3 different crisis periods between the respective monthly return of hedge fund indices and the returns of the market. Based on the observations it can therefore be concluded that 10 hedge fund indices out of 13 are significantly dependent on the S&P500, all 10 coefficients are positive, indicating a positive relationship. Lastly, correlations strongly differ from one crisis period to another.

1. Introduction

Capital Market Theory states that the Market Portfolio, consisting of all assets in the market, is the most efficient portfolio in terms of mean variance. Investors can customize their portfolios according to their risk appetite by investing more or less in the Market Portfolio, with borrowing or lending, resulting in a passive investment style. However, real markets are not efficient due to various imperfections such as taxes, dealing charges, non-uniform expectations, and unequal scrutiny of assets. Investment strategies that take advantage of these imperfections and the associated opportunities through mispriced assets are known as active, in contrast to passive investment styles (Jensen, 1972).

Hedge funds have grown quickly as investment options for active strategies and are highly desired by investors. Created in 1949, they offer an alternative asset class that is similar to mutual funds but have some significant distinctions. Hedge funds are subject to less regulation than mutual funds, which allows them to invest in conventional as well as non-traditional and riskier securities and derivatives. Additionally, hedge funds can engage in short-selling and leverage (Lei, 2022).

Hedge funds are also different from mutual funds in that they typically invest in assets that are less easily converted to cash. To achieve this, they might impose restrictions on when investors can withdraw their money, known as "lockup periods." Hedge funds also require a high minimum investment, typically ranging from \$500,000 to \$1 million, which means they are only accessible to sophisticated investors like institutions and wealthy individuals. In addition to traditional assets like stocks and bonds, hedge funds can also invest in alternative assets like art, antiques, and other unique items (Barclay Hedge, 2012).

The hedge fund industry has experienced significant growth, going from a market value of only \$118 billion in 1997 to \$4.87 trillion in 2022 (Barclay Hedge, 2022). The global financial crisis, triggered by the sub-prime mortgage market crash, led to a decline of 25% in hedge fund assets between 2007 and 2008, resulting in the closure of many funds (Statista, 2022). Given the meaning of hedging as a strategy to mitigate risk, it is important to assess the performance of hedge funds and see to what extent these specific funds behave dependently from the market.

This study aims to provide a comprehensive analysis of the most common hedge fund strategies that currently exist and to determine which relationship they have with the market performance. Research is conducted on testing the level of dependency of hedge fund strategies on the market represented by the S&P500 index. It focuses on the correlations during 3 different crisis periods between the respective monthly return of hedge fund indices and the monthly returns of the S&P500. Such study has been partially covered by Metzger and Shenai (2019). However, they focused specifically on the period during and after the financial crisis (June 2007–January 2017). Also, Asness et al. (2001) have conducted similar research but with data from January 1994 to September 2000. Moreover, they only analyzed 10 hedge fund strategies with 9 being relevant for this study.

To accomplish the research goal, a review of the literature is presented in Section 2. The review includes an overview of the risks for hedge funds and their primary strategies. Section 3 discusses the approach, objective and hypotheses of this research. In Section 4, the methodology, the different variables and the models will be explained. In Section 5, the study analyses monthly performance data for 13 major hedge fund strategies from 1994 to 2023, using various perspectives and the S&P500 as the market benchmark. Also, the study examines the correlations between different strategies and the whole market. Statistical analysis is used to test performance dependency. Also, a discussion on the findings of the research conducted is covered. Section 6 concludes this master thesis. Finally, Section 7 states several limitations and suggests further research in this area.

2. Literature review

Uncertainties for companies is so complex to define that no single model has been sufficient to take into account all the relevant factors that could evaluate in the most precise way how investment funds should make a safe and profitable investment. Many theories have been developed throughout the last 50 years. In the following sections many factors and models will be evaluated. The next part will start by explaining how risk can be quantified and interpreted. After, it will discuss two of the most critical risks for hedge funds i.e the liquidity risk and the market risk which is partially measured by the beta. Finally, this section will summarize the different hedge fund strategies and the risks allocated to these strategies.

2.1 Volatility

Risk may be quantified in a variety of ways, and it should be. Volatility is a clear and typical risk indicator (that is, the standard deviation of returns). Contrary to popular belief, volatility does not exclusively apply to normal distributions. It is true that the risk of crashes for non-normal distributions is not properly captured by volatility. Although two-standard-deviation returns and five-standard-deviation occurrences are rare for normal distributions, this is not the case for real-world hedge fund returns since they are not normally distributed. Two-standard-deviation events and five-standard-deviation events are both possible for hedge fund strategies. Keeping this in mind, volatility can still serve as a helpful risk indicator as long as the return distribution is symmetrical and there is not an excessive crash risk. Volatility, however, is not a suitable risk indicator for strategies with a high crash risk. For instance, selling out-of-the-money options, a strategy with modest gains most days but infrequent significant falls, is not effectively captured by volatility (Pedersen, 2015, p. 57).

One solution to dampen the effect of the volatility is the use of market makers. As a result, the natural sellers and buyers do not enter the market at the same time and, even when they do, they occasionally move to separate exchanges, fragmenting the order flow. This trend indicates that the market price oscillates around the "equilibrium price," which is the price that would prevail if all buyers and sellers were present in the market at the same time. If it were not for the market makers, the price would oscillate much more. In other words, the price is pushed up when there are too many buyers in the market, and the price is pushed down when there are too many sellers. Market makers offer liquidity as a service. In other words, market makers are prepared to purchase the surplus supply when there are more sellers than buyers in the market. Market makers keep the securities in stock till the arrival of the natural purchasers, then discharge the stock to meet demand (Pedersen, 2015, p. 154).

2.2 Liquidity risk

The three types of liquidity risk include the risk of increased transaction costs (market liquidity risk), the risk of running out of money (funding liquidity risk), which is particularly dangerous for leveraged hedge funds, and the risk of accommodating demand pressure. An essential arbitrage restriction is liquidity risk. Liquidity risk places restrictions on traders' capacity to fix mispricing, just like the other arbitrage constraints do. However, liquidity risk has a direct

impact on market prices because it generates a liquidity risk premium. It is not only a barrier to arbitrage. Or to put it another way, the cost of liquidity risk is a normal part of an inefficiently efficient market (Pedersen, 2015, p. 42).

What should be done if a liquidity spiral has been identified? There are several possibilities: (a) partly liquidate the portfolio, which releases cash, lowers risk, but also causes negative price movements, adds to transaction costs, and forfeits some of the potential gains when the liquidity spiral flips; (b) shift the portfolio in favor of the more eccentric elements that were unaffected by the unwinding, which would likewise incur transaction costs, forfeit upside, but not release any cash; (c) increase the stake in the anticipation of a reversal; or (d) make a substantial wager that the unwinding would last for a long time, paying high transaction costs in a gamble that goes against all the elements that the market typically believe in and liquidate the portfolio as well as turn it around. (Pedersen, 2015, p. 148)

2.3 Market risk

Market risk is considered the most important risk for hedge funds because it encompasses the potential for losses resulting from adverse movements in financial markets. Since hedge funds typically engage in significant trading activities and maintain diverse portfolios, they are susceptible to fluctuations in market conditions. Market risk captures the volatility and uncertainty inherent in financial markets. These market movements can impact the value of the assets held by hedge funds and consequently affect their performance and profitability (Canepa, González, & Skinner, 2020).

Unlike risks specific to individual companies or industries, market risk affects a broad range of financial instruments and can have a widespread impact on various sectors and asset classes. It is a systematic risk that cannot be diversified away through portfolio diversification alone. Even well-managed hedge funds with skilled investment strategies can experience losses if markets move against their positions. Managing market risk is crucial for hedge funds to protect capital and generate consistent returns. Hedge fund managers employ various techniques to mitigate this risk, such as employing hedging strategies, using derivatives for risk management, employing active trading strategies to take advantage of market trends, and maintaining a diversified portfolio. Additionally, monitoring and analyzing market trends and developments are essential for hedge fund managers to make informed investment decisions

and adjust their positions accordingly. Given the significance of market risk in determining hedge fund performance, understanding and effectively managing this risk is vital for hedge fund managers and investors. It requires continuous monitoring, analysis, and adaptation to changing market conditions to navigate potential market downturns and capitalize on opportunities for generating returns (Fung & Hsieh, 2004).

For funds, including hedge funds, market risk refers to the potential losses that can occur due to changes in market prices or factors that affect the overall market. By calculating Value at Risk (VaR), fund managers can estimate the maximum potential loss within a specified confidence level over a given time horizon. VaR helps them understand the downside risk associated with their investments and assess their exposure to market fluctuations. For example, a hedge fund manager can calculate the VaR of their portfolio to determine the potential losses that may occur with a certain level of confidence (e.g., 95% confidence level) over a specific time period (e.g., one day, one week, or one month). This information can be used to evaluate the risk-reward profile of the fund and make informed decisions regarding risk management, portfolio diversification, or the implementation of hedging strategies. It's important to note that VaR is just one of several measures used to assess market risk, and it has its limitations. VaR provides an estimate of potential losses up to a certain confidence level, but it does not capture extreme events or tail risk beyond that level. Additionally, VaR calculations rely on historical data and assumptions, which may not always accurately reflect future market conditions (Lhabitant, 2001).

2.4 Fixed income risk

Some risks exist such as fixed income risk. However, many solutions exist to reduce the uncertainties and hedge the potential drawbacks. Bond futures, interest-rate swaps, credit default swaps, options, and swaptions, which provide the opportunity to engage into an interest-rate swap, are some of the major derivative's markets. (Pedersen, 2015, p. 241)

A future yield that can be secured today is another way to think of the forward rate. In theory, the forward rate may be fixed by purchasing the bond that matures at time T and selling a similar dollar amount of the bond that matures at time S short. Forward rates are used in two ways by fixed-income traders: they begin by computing the entire forward yield curve at a future date, for instance one year from now. They examine this yield curve to determine

whether it agrees with their predictions of future yields and trade on any disparities that may exist. For instance, if a trader believes that the 1-year forward yield of a 9-year bond looks to be excessively high, he may buy a 10-year bond today (Pedersen, 2015, pp. 247-248).

Fixed income investments and fixed income arbitrage hedge funds are subject to various risks that investors should be aware of. One of the most significant risks is interest rate risk, which occurs when there are changes in interest rates that affect the value of fixed income securities, leading to losses for fixed income investors. This risk is particularly relevant for longer-term fixed income securities, which are more sensitive to changes in interest rates. Credit risk is another important risk to consider when investing in fixed income securities. Fixed income securities are subject to the risk of default by the issuer, which can result in a significant decline in the value of the security. This risk is especially relevant for securities issued by companies or countries with weaker credit ratings. Moreover, liquidity risk is also a concern for fixed income investors, as these securities can be less liquid than other investments, making it difficult to sell them at a reasonable price, particularly during times of market stress. Additionally, market risk is another factor to consider when investing in fixed income securities. These investments are subject to market risks, including fluctuations in the overall economy, changes in currency exchange rates, and geopolitical events. Lastly, fixed income arbitrage hedge funds, like all hedge funds, are also exposed to operational risks. These include fraud, errors, and system failures, which can lead to significant losses. It is important for investors to consider these risks when deciding whether to invest in fixed income securities or fixed income arbitrage hedge funds, and to diversify their portfolios to manage these risks effectively (Duarte, Longstaff, & Yu, 2006).

Fixed Income Arbitrage Managers seek to produce profits by recognizing pricing inconsistencies in fixed income securities. They establish a long position in an underpriced security and simultaneously take a short position in a related overpriced one. To minimize total volatility, they may establish a market-neutral or interest rate-neutral position. The strategy of Fixed Income Volatility arbitrage has been widely utilized by major financial market participants, including Wall Street firms and fixed income hedge funds. It has a long-standing history and is a popular strategy. Long-Term Capital Management's loss of over \$1.3 billion in volatility arbitrage positions before its downfall in 1998 is an example of the significant role that volatility arbitrage plays in the fixed income market. (Metzger & Shenai, 2019). Currently,

no study found significant results that proves a certain relationship between fixed income arbitrage hedge fund strategies and the S&P500.

2.5 Convertible Arbitrage risk

Convertible arbitrage is a popular strategy used by hedge funds to take advantage of pricing inefficiencies between a company's stock and its convertible bond. However, like any investment strategy, convertible arbitrage carries certain risks. Some of the main risks associated with convertible arbitrage include credit and market risks. Convertible arbitrage takes credit risk into consideration as it involves investing in a company's convertible bond, which is essentially a debt instrument. If the company defaults on its debt obligations, the bondholders may lose their investment. Additionally, convertible arbitrage takes into account market risk as it involves taking both long and short positions in the market, which exposes the hedge fund to general market risk. If the market experiences a downturn, the hedge fund may experience losses. Agarwal et al. (2010) conducted a study where they examined the important factors driving the success of convertible arbitrage as an investment strategy and their effects on the performance of hedge funds that employ this strategy. They found that a significant portion of these funds' returns can be explained by a buy-and-hedge approach, which involves taking a long position in convertible bonds while only hedging the equity risk. Hedge funds specializing in convertible arbitrage can manage the equity risk in convertible bonds by shorting stocks. The increased issuance of equity-linked debt securities can be partially attributed to the growing availability of capital provided by hedging strategies (Choi et al., 2009). Currently, no study found significant results that proves a certain relationship between convertible arbitrage hedge fund strategies and the S&P500

2.6 Emerging Market risk

Emerging market risk is another type of risk that hedge funds may face when investing in securities of companies located in developing economies. Some of the key risks associated with emerging markets include the economic and liquidity risks. Emerging market economies may be less stable and may be subject to inflation, currency fluctuations, and other economic risks that can impact investment returns. Additionally emerging market securities may be less liquid than those in developed markets, which can make it difficult for hedge funds to sell their

positions quickly in case of market downturns or other unexpected events (Abugri & Dutta, 2009). According to a study conducted by Asness et al. (2001), they concluded that the performance of the Emerging Market strategy in hedge funds is significantly influenced by the S&P500. Their findings revealed a coefficient of 0.74 and an R^2 value of 0.242, indicating a moderate positive relationship. Additionally, they observed a correlation of 0.50 between the S&P500 and the Emerging Market strategy in hedge funds. This correlation remains consistent regardless of the volatility levels and can be directly compared across funds with varying levels of volatility.

On the other hand, the beta coefficient is not consistent across different levels of volatility. Beta increases with higher volatility of an asset, given the same correlation. In the context of a simple regression model, the relationship between beta and correlation can be expressed as follows:

$$\beta_m^i = \rho_m^i * \left(\frac{\sigma_i}{\sigma_m} \right)$$

Therefore, the beta of an index is equal to its correlation with the S&P500 multiplied by the ratio of the hedge fund's volatility to the volatility of the S&P500.

2.7 Equity Market Neutral

Hedge funds are often praised for their low correlation with market returns, which is a desirable characteristic (Agarwal & Naik, 2004; Brown, Goetzmann, & Ibbotson, 1999; Fung & Hsieh, 2001). The term "hedge fund" was coined to describe a strategy of investing in undervalued securities using the proceeds from short-selling related securities, creating a "market neutral" approach (Caldwell, 1995). However, it is difficult to determine how much the short portfolio offsets the market exposure of the long portfolio since it depends on unobservable risk factors.

Patton (2009) studied the correlation between market neutral hedge funds and the S&P500, using standard linear correlation. They found that the average correlation between the 171 funds studied and the market index was low at 0.025. However, there was substantial variation in the degree of correlation across the sample. Despite being marketed as market neutral, over one-quarter of the funds had significant correlations with the market. This suggests that these funds are influenced by more factors than just the single market index.

According to a study conducted by Asness et al. (2001), they concluded that the performance of the Equity Market Neutral strategy in hedge funds is significantly influenced by the S&P 500 between January 1994 to September 2000. Their findings revealed a coefficient of 0.12 and an R^2 value of 0.222, indicating a small positive relationship. Additionally, they observed a correlation of 0.48 between the S&P 500 and the Equity Market Neutral strategy in hedge funds. This correlation remains consistent regardless of the volatility levels and can be directly compared across funds with varying levels of volatility.

2.8 Event Driven risks

Event-driven risks are those that arise from specific events, such as mergers, acquisitions, bankruptcies, and other corporate actions. Hedge funds that specialize in event-driven strategies can face several risks related to these events, including execution risk, regulatory risk, and market risk (Patton, 2009).

Execution risk is the risk that an event does not unfold as planned, or that the anticipated benefits are not realized due to unexpected complications. For example, if a merger or acquisition falls through, it could result in significant losses for a hedge fund that was betting on the deal. Regulatory risk refers to the risk that government agencies may not approve a particular event or that regulatory changes could affect the outcome of the event. Market risk is the risk that market movements could have an adverse impact on the event and the hedge fund's position (Fung & Hsieh, 1999).

Despite these risks, event-driven strategies offer several opportunities for hedge funds. For instance, hedge funds can profit from mispricings that arise from the market's failure to fully reflect the value of an event or from the divergence between the market's expectation of an event and the actual outcome. Additionally, event-driven strategies allow hedge funds to take advantage of situations where traditional investment strategies may not be as effective, such as in distressed debt or special situations where unique opportunities arise. Hedge funds can also use event-driven strategies to generate returns that are uncorrelated with market movements, which can be particularly beneficial in times of market turbulence. Overall, event-driven strategies provide hedge funds with a way to diversify their portfolios and generate

alpha, but they require specialized expertise and risk management to be successful (Lhabitant, 2001).

This table below displays statistics describing the monthly returns of the S&P500, the MSCI World and hedge funds specializing in event-driven strategies during the period of April 1993 to April 2003. The first column indicates the medians of the different statistics presented in the rows for event-driven funds with at least twelve observations. The last row of the table shows the number of monthly observations available for analysis. In addition, the Jarque-Bera test of normality (Jarque & Bera, 1980) and its corresponding p-values are also presented. The data reveals that event-driven hedge fund returns are not normally distributed, which supports the findings of previous studies by Gupta and Liang (2005) and Chan et al. (2005). Moreover, the Jarque-Bera tests indicate low median p-values.

	Event driven hedge funds	S&P 500	MSCI World
Mean	0.86	0.85	0.55
Standard deviation	2.52	4.52	4.25
Skewness	-0.17	-0.54	-0.54
Kurtosis	4.56	3.26	3.28
Minimum	-5.88	-14.44	-13.35
Maximum	7.71	9.78	9.02
Jarque-Bera statistic	11.73	5.99	6.04
Jarque-Bera p-value	0	0.05	0.05
Number of obs.	58	121	121

Table 1: Summary statistics of event driven hedge fund and market indices

Source: Patton (2009)

According to a study conducted by Asness et al. (2001), they concluded that the performance of the Event Driven strategy in hedge funds is significantly influenced by the S&P500 between January 1994 to September 2000. Their findings revealed a coefficient of 0.28 and an R^2 value of 0.34, indicating a small positive relationship. Additionally, they observed a correlation of 0.60 between the S&P 500 and the Event Driven in hedge funds. This correlation remains

consistent regardless of the volatility levels and can be directly compared across funds with varying levels of volatility.

2.9 Global macroeconomic risks

It is widely acknowledged that unexpected changes in macroeconomic variables can have global impacts on firm fundamentals, which include cash flows, risk-adjusted discount factors, and investment opportunities. There are various channels through which macroeconomic fundamentals like inflation, short-term and long-term interest rates, unemployment, and economic growth can affect the prices of risky assets like stocks, bonds, currencies, and derivatives. As hedge funds actively seek opportunities arising from changing economic conditions, it is expected that their performance from investments in these financial securities will be influenced by the degree to which they adjust their exposure to leading economic indicators. Bali et al. (2014) discovered that the resulting uncertainty betas can account for a significant portion of the differences in hedge fund returns across the sector. Even after controlling for numerous fund characteristics and risk factors, the positive connection between uncertainty betas and future hedge fund returns remains economically and statistically significant. As a result, Bali et al. (2014) contend that macroeconomic risk is a major driver of differences in hedge fund returns across the industry.

According to a study conducted by Asness et al. (2001), they concluded that the performance of the Global Macro strategy in hedge funds is significantly influenced by the S&P 500 between January 1994 to September 2000. Their findings revealed a coefficient of 0.37 and an R^2 value of 0.118, indicating a small positive relationship. Additionally, they observed a correlation of 0.36 between the S&P 500 and the Global Macro strategy in hedge funds. This correlation remains consistent regardless of the volatility levels and can be directly compared across funds with varying levels of volatility.

2.10 Long/Short Equity

Long/Short (L/S) equity hedge funds, as their name suggests, are hedge funds that benefit from shorting. In a study conducted by Fung and Hsieh (2011), it was found that among over 3,000 hedge fund, between 1994 and 2007, with similar style classification, less than 20% of

long/short equity hedge funds were able to achieve significant, persistent, stable positive non-factor related returns. As for risk characteristics, L/S equity hedge funds generally have lower market exposure than their counterparts in the long-only world, which are equity mutual funds. For example, in the Lipper-TASS database, the average L/S equity hedge fund (excluding funds-of-hedge funds) has a beta of 0.50 with respect to the S&P 500 index, while the average equity mutual fund in the Morningstar database has a beta of 0.96 (Fung & Hsieh, 2011)

According to Kat and Pallario (2008), Long/Short Equity risks for hedge funds are not entirely independent of market indices such as the S&P 500. Long/Short Equity strategies usually involve taking long positions in stocks that are expected to outperform the market while shorting stocks that are expected to underperform. As a result, they may still be exposed to broad market risk factors such as changes in interest rates, geopolitical events, and economic trends, which can affect the performance of the S&P 500. However, the objective of the Long/Short Equity strategy is to generate alpha, which is the excess return above the market, by exploiting inefficiencies in individual securities rather than simply relying on the direction of the broader market.

Hence, the main risks incurred in the L/S equity risk is the short selling risk and the market risk: the risk that the price of the security being shorted will rise, causing losses for the fund, and the risk that overall market conditions, such as a recession or a bear market, will adversely affect the value of the fund's long and short positions (Jegadeesh & Titman, 1993).

According to a study conducted by Asness et al. (2001), they concluded that the performance of the Long / Short Equity strategy in hedge funds is significantly influenced by the S&P 500 between January 1994 to September 2000. Their findings revealed a coefficient of 0.55 and an R^2 value of 0.374, indicating a small positive relationship. Additionally, they observed a correlation of 0.62 between the S&P 500 and the Long / Short Equity strategy in hedge funds. This correlation remains consistent regardless of the volatility levels and can be directly compared across funds with varying levels of volatility.

2.11 Managed Futures

The research conducted by Till and Eagleeye (2011) aims to provide investors with a comprehensive understanding of managed futures strategies and their potential benefits and

risks. Managed futures strategies refer to investments in futures contracts across various asset classes, including commodities, currencies, and equities, with the aim of generating returns through market trends. On one hand, some potential benefits of managed futures strategies include their ability to generate returns that are uncorrelated with traditional asset classes such as stocks and bonds, and their potential to provide downside protection during periods of market stress. On the other hand, some of the challenges and risks associated with investing in managed futures include high fees, limited liquidity, and the potential for significant drawdowns.

When analyzing all declines in the S&P500 that were greater than 6% since 1980, Till and Eagleeye (2011) found that managed futures programs have, on average, outperformed the S&P500 by 17% during each period of major equity loss. In each period of equity loss, the average decline of the S&P500 was around -12% while the average return of managed futures increased by +5%, according to data from Horwitz (2002). Figure 3 depicts the comparative performance history of managed futures and hedge funds during these periods, revealing that since 1990, hedge funds have typically declined during significant equity losses. The CISDM Trading Advisor Qualified Index represents the managed futures funds, while the HFR Fund Weighted Composite Index represents the hedge fund column.

		S&P 500	Managed Futures	Hedge Funds
1	Sep-Nov 1987	-30%	8.50%	
2	Apr-Jul 2002	-20%	10.6%	-4.4%
3	Jun-Sep 2001	-17%	1.9%	-3.8%
4	Jul-Aug 1998	-15%	5.8%	-9.4%
5	Feb-Mar 2001	-15%	4.0%	-3.8%
6	Jun-Oct 1990	-15%	19.4%	-1.9%
7	Sep-Nov 2000	-13%	2.7%	-6.4%
8	Sep 2002	-11%	1.9%	-1.5%
9	Dec 2002 to Feb 2003	-10%	12.1%	0.5%
10	Aug-Sep 1981	-10%	0.1%	
11	Feb-Mar 1980	-10%	10.3%	

12	Dec 1981-Mar 1982	-10%	7.9%	
13	Sep 1986	-8%	-4.2%	
14	Dec 1980-Jan 1981	-7%	9.5%	
15	Feb-Mar 1994	-7%	0.3%	-2.1%
16	Jan-Feb 2000	-7%	0.9%	6.8%
17	Jan 1990	-7%	3.2%	-2.1%
18	May-July 1982	-7%	1.4%	
19	Jul-Sep 1999	-6%	-0.5%	0.7%
	Average	-12%	5%	-2%

Table 2: Performance of the S&P500, Managed Futures Fund index, and Hedge Funds during periods of major decline in the equity market.

Source: Horwitz (2002)

2.12 Multi Strategy

Multi-strategy hedge funds are investment funds that invest in various asset classes and use different investment strategies simultaneously to generate returns for investors. These funds typically invest in equities, bonds, currencies, commodities, and derivatives, among other assets, and use a variety of strategies, including long/short, event-driven, and arbitrage, among others. Multi-strategy hedge funds are also known for their ability to adjust their investment strategies depending on market conditions, which allows them to respond to changes in the market more effectively (Credit Suisse, 2023).

The risks allocated to multi-strategy hedge funds vary depending on the strategies used and the assets invested in. These funds may face market risk, which arises from changes in market conditions that can affect the value of the assets in which the fund is invested. They may also face liquidity risk, which arises when a fund's investments cannot be sold quickly enough to meet redemptions. Additionally, multi-strategy hedge funds may face credit risk, which arises when the counterparty in a transaction fails to meet its obligations, as well as operational risk, which arises from factors such as errors in trading or compliance, among others (Metzger & Shenai, 2019).

Moreover, multi-strategy hedge funds are exposed to risks related to the use of leverage. The use of leverage can amplify gains, but it can also increase losses, which can be substantial. In addition, multi-strategy hedge funds may also face risks related to the use of derivatives, which can be complex financial instruments that are subject to changes in market conditions and can magnify losses. Finally, multi-strategy hedge funds may also face risks related to regulatory changes, as regulations can impact the way in which the fund operates and invests (Metzger & Shenai, 2019).

2.14 MSCI World

There are many academic papers that discuss the relationship between hedge fund indices and the MSCI World Index. These papers often examine the correlation between these indices, the impact of hedge funds on the global stock market, and the performance of hedge funds relative to the MSCI World Index.

The study of Kosowski et al. (2007) and Beltratti and Morana (2006) found that nearly all hedge fund strategies outperformed the MSCI World Index benchmark return and were better in terms of risk/return measures. To investigate the abnormal performance of hedge funds, the researchers used a seven-factor model developed by Fung and Hsieh in 2004 and regressed the net-of-fee monthly excess return of a hedge fund on the excess returns earned by traditional buy-and-hold and primitive trend following strategies. The intercept alpha in the regression represented the hedge fund manager's abnormal performance after controlling for their risk exposures.

To assess the performance of the hedge funds, Kosowski et al. (2007) built a model:

$$r_t^i = \alpha^i + \sum_{k=1}^k \beta_k^i * F_{k,t} + \varepsilon_t^i$$

r_t^i = net-of-fees excess return on an individual hedge fund "i" for month "t"

α^i = alpha performance measure or the abnormal performance of hedge fund "i" over the regression time period.

β_k^i = factor loading of hedge fund "i" on factor "k" during the regression period

$F_{k,t}$ = return for factor "k" for month "t"

ε_t^i = error term

The results showed that the average alpha across all funds was positive and around 0.42% per month and 5.04% per year, but the average alpha t-statistic was low, indicating that on average, the alphas were not statistically different from zero at the 10% level of significance. However, the researchers did not rule out the possibility of finding statistically significant performance persistence. They also found that fund returns were often serially correlated, with directional traders' fund returns being the most serially correlated and Long/Short Equity fund residuals being the most prone to heteroskedasticity, which was not surprising given the nature of their strategies.

3. Approach, objectives, and hypotheses

The literature reviews stated before is focusing on 2 different aspects. First, it points out two major risks that are allocated to the hedge fund. Second, it suggests different approaches on how to mitigate those market risks by stating 13 different strategies.

This study will primarily focus on the dependency of hedge fund Indices related to the market i.e the S&P500. My objectives for this research are the following:

- a) To test the level of dependency of hedge fund strategies on the market represented by the S&P 500 index.
- b) To determine which type of relationship hedge fund strategies and the S&P500 have.
- c) To analyze the correlations during 3 different crisis periods between the respective monthly return of hedge fund indices and the returns of the S&P500.

Descriptive research will be conducted. It will use secondary data. Secondary data will come from MarketWatch and Credit Suisse bank and will be used to have a more quantitative approach on the subject. Statistical methods will be used to analyze data. Quantitative methods are suitable to measure and categorize results for a better and more precise understanding of the situation. Quantitative approaches depend on testing theoretical propositions, such as hypotheses in this case (Antonakis, et al., 2004). Data are coming from public companies and industries and can be found on MarketWatch and Credit Suisse Lab. After discussing about the approach and the objectives, some hypotheses can be generated.

Hypothesis 1:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 2:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Convertible Arbitrage Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Convertible Arbitrage Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 3:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Emerging Markets Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Emerging Markets Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 4:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Equity Market Neutral Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Equity Market Neutral Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 5:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Event Driven Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Event Driven Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 6:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Event Driven Distressed Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Event Driven Distressed Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 7:

Null hypothesis: $\beta_1 = 0$

Event Driven Credit Suisse Event Driven Multi-Strategy Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Event Driven Credit Suisse Event Driven Multi-Strategy Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 8:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 9:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Fixed Income Arbitrage Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Fixed Income Arbitrage Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 10:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Global Macro Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Global Macro Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 11:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Long/Short Equity Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Long/Short Equity Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 12:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Managed Futures Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Managed Futures Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

Hypothesis 13:

Null hypothesis: $\beta_1 = 0$

Credit Suisse Multi-Strategy Hedge Fund Index rate of return is behaving independently from the S&P500 index rate of return.

Alternative hypothesis: $\beta_1 \neq 0$

Credit Suisse Multi-Strategy Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return.

4. Methodology and data

The goal of this part is to demonstrate which data has been used to conduct the research and the procedures that have been used to evaluate the relationship between the dependent and independent variables.

4.1 Data

In order to evaluate the chosen independent and dependent variables, the empirical phase of the research project utilized information obtained from various sources. These sources were carefully selected to ensure that the information obtained was accurate, reliable, and relevant to the research questions being investigated. Furthermore, the methodology employed in the empirical phase was designed to provide a systematic and rigorous analysis of the data collected, thereby enhancing the validity and reliability of the research findings.

- a) Performance of the S&P500 from January 31, 1994 until February 28 2023 retrieved from the historical data on www.marketwatch.com, focusing especially on opening price.
- b) Performance of 13 hedge fund indices from January 31, 1994 until February 28 2023 retrieved from the historical data on <https://lab.credit-suisse.com>, focusing on the monthly return.

4.2 Variables in the study

After gathering all the relevant information, the variables that would be used for the statistical analysis were identified. This involved a careful consideration of the data collected to ensure that the variables chosen were appropriate and meaningful for the research question being investigated. The process of selecting variables was based on a systematic and objective approach that took into account the research objectives, the research design, and the data analysis plan. Furthermore, the variables were chosen based on their potential to provide insights into the research problem and their ability to help test the hypotheses. The variables identified were then subjected to further scrutiny to ensure that they were measurable, reliable, and valid, and that they adequately captured the essence of the research question.

The careful selection of variables is a crucial step in any statistical study, as it ensures that the analysis is robust, accurate, and relevant to the research question.

4.2.1 Independent variable

This research used only one independent variables: the rate of return of the S&P500. The S&P 500, short for Standard and Poor's 500, is a stock market index in the United States that monitors the performance of 500 publicly traded domestic companies. It encompasses a wide range of industries and includes companies listed on U.S. exchanges. Considered as a comprehensive gauge of the American stock market's overall performance, it is highly regarded by many investors.

Standard & Poor's, the entity behind various other market indexes, can trace its origins back to an investment information service established in 1860 by Henry Varnum Poor. Unlike the Dow Jones average, the S&P 500 calculates a weighted average based on the constituent stocks of the index. Consequently, stocks with a higher market value exert a more significant influence on the overall index.

The companies listed on the S&P 500 are renowned players in various sectors of the U.S. industry. Changes in the list, including additions and removals, often indicate market trends. Notable companies with considerable weight in the index include General Electric Company, Microsoft Corporation, Citigroup Inc., and Exxon Mobil Corporation. Holding companies and real estate stocks do not qualify for inclusion in this index (Britannica, 2023).

4.2.1 Dependent variables

This research used 13 different dependent variables. Each of them represents an index that demonstrates the performance of multiple hedge funds put together.

Credit Suisse Hedge Fund Index

The Credit Suisse Hedge Fund Index is created by Credit Suisse Hedge Index LLC and is an asset-weighted index of hedge funds. The index comprises only of funds, not individual accounts,

and uses the Credit Suisse Hedge Fund Database, which monitors about 9,000 funds. The Credit Suisse Hedge Fund Index is considered the industry's primary asset-weighted hedge fund index, and it continues to lead the way in this category. Asset-weighting is deemed more accurate than equal-weighting, as it provides a more precise representation of an investment in the asset class.

The Credit Suisse Hedge Fund Index is the key index in the Credit Suisse Hedge Fund Index family, which also includes individual strategy indices referred to as the Credit Suisse Hedge Fund Strategy Indices. The Credit Suisse Hedge Fund Index's methodology begins with defining the investment universe it intends to measure. The index universe is made up of funds that have at least \$50 million in assets under management, a minimum one-year track record, and audited financial statements.

The index is recalculated and rebalanced on a monthly basis. Funds are reselected every quarter as required. The index uses a rules-based construction methodology, which identifies the constituent funds and minimizes subjectivity in the selection process as a result. The index aims to have a maximum representation of the index universe. To avoid survivorship bias, funds are only removed from the index after they are fully liquidated or no longer meet financial reporting requirements.

Credit Suisse Convertible Arbitrage Hedge Fund Index

The Credit Suisse Convertible Arbitrage Hedge Fund Index is a segment of the Credit Suisse Hedge Fund Index, which gauges the overall performance of convertible arbitrage funds. These types of funds aim to generate profits by buying convertible securities and shorting the corresponding stock when there is a pricing error made in the conversion factor of the security. The managers of such funds usually acquire long positions in convertible and other equity hybrid securities, and then hedge the equity component of the long securities positions by shorting the underlying stock or options. Typically, the number of shares sold short reflects a delta neutral or market-neutral ratio. Consequently, in ordinary market conditions, the arbitrageur anticipates that the combined position will be unaffected by fluctuations in the price of the underlying stock.

Credit Suisse Emerging Markets Hedge Fund Index

The Credit Suisse Emerging Markets Hedge Fund Index is a subdivision of the Credit Suisse Hedge Fund Index, which tracks the combined performance of emerging markets funds. Emerging markets funds generally invest in currencies, debt instruments, equities, and other securities of countries with developing or emerging markets, usually measured by their GDP per capita. These countries are deemed to be in a transitional phase between developing and developed status. Examples of such markets are China, India, Latin America, a significant portion of Southeast Asia, some parts of Eastern Europe, and some parts of Africa. The index comprises various subsectors, including arbitrage, credit, and event-driven, fixed income bias, and equity bias.

Credit Suisse Equity Market Neutral Hedge Fund Index

The Credit Suisse Equity Market Neutral Hedge Fund Index is a segment of the Credit Suisse Hedge Fund Index, which evaluates the combined performance of equity market neutral funds. Equity market neutral funds usually acquire both long and short positions in stocks, while striving to diminish exposure to the systematic risk of the market, meaning a beta of zero is preferred. Equity market neutral funds typically try to capitalize on investment opportunities specific to a particular group of stocks, while maintaining a neutral exposure to broad groups of stocks, which can be categorized by sector, industry, market capitalization, country, or region. The index encompasses several subsectors, such as statistical arbitrage, quantitative long/short, fundamental long/short, and index arbitrage. Managers often apply leverage to amplify returns.

Credit Suisse Event Driven Hedge Fund Index

The Credit Suisse Event Driven Hedge Fund Index is a component of the Credit Suisse Hedge Fund Index, which measures the combined performance of event driven funds. Event driven funds usually invest in different asset classes and attempt to profit from potential mispricing of securities related to a particular corporate or market event. Such events may include mergers, bankruptcies, financial or operational distress, restructurings, asset sales, recapitalizations, spin-offs, litigation, regulatory and legislative changes, as well as other types

of corporate events. Event driven funds may invest in equities, fixed income instruments (including investment grade, high yield, bank debt, convertible debt, and distressed securities), options, and various other derivatives. Many event driven fund managers utilize a blend of strategies and adjust exposures depending on the opportunity sets in each subsector.

Credit Suisse Event Driven Distressed Hedge Fund Index

The Credit Suisse Event Driven Distressed Hedge Fund Index is a component of the Credit Suisse Hedge Fund Index that calculates the overall performance of event-driven funds that concentrate on distressed situations. These funds usually invest in all levels of a company's capital structure when the company is undergoing financial or operational difficulties or bankruptcy proceedings. These securities usually trade at discounted prices to their intrinsic value due to their uncertain worth, lack of research coverage, or traditional investors' inability to hold them. Typically, the strategy is biased towards long positions, but managers may also take hedged or outright short positions. Distressed managers aim to profit from the issuer's ability to improve its operation or the success of the bankruptcy process that eventually leads to an exit strategy.

Credit Suisse Event Driven Multi-Strategy Hedge Fund Index

The Credit Suisse Event Driven Multi-Strategy Hedge Fund Index is a division of the Credit Suisse Hedge Fund Index that gauges the collective performance of multi-strategy event driven funds. These types of managers typically invest in a blend of event driven equities and credit. Within the equity realm, sub-strategies might include holding company arbitrage, risk arbitrage, equity special situations, and value equities with a hard or soft catalyst. Within the credit-oriented part, sub-strategies might include long/short high yield credit, leveraged loans, capital structure arbitrage, and distressed debt. This may include workout situations or bankruptcies and even post-reorganization equity. Multi-strategy event driven managers have the ability to pursue event investing across different asset classes and take advantage of shifts in economic cycles.

Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index

The Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index is a part of the Credit Suisse Hedge Fund Index which assesses the combined performance of risk arbitrage funds. These funds specialize in seizing the spreads in merger or acquisition transactions concerning publicly traded companies, after the announcement of the transaction terms. The difference between the transaction bid and the trading price is called the spread, and the target stock usually trades at a lower price than the bid to factor in the risk of the deal failing to close. In the case of a cash deal, the manager will usually buy the stock of the target and offer it at the closing price. In a fixed exchange ratio stock merger, the manager will go long on the target stock and short on the acquirer's stock based on the merger ratio, to isolate the spread and hedge out market risk. The main risk is the deal risk, in case the deal fails to close.

Credit Suisse Fixed Income Arbitrage Hedge Fund Index

The Credit Suisse Fixed Income Arbitrage Hedge Fund Index is a component of the Credit Suisse Hedge Fund Index that gauges the overall performance of fixed income arbitrage funds. These funds aim to generate profits by capitalizing on price inefficiencies and anomalies between correlated fixed income securities. To minimize market and interest rate risks, they often limit volatility by hedging their exposure. Typically, they employ various strategies such as leveraging both long and short positions in similar fixed income securities that are either mathematically or economically linked. The fixed income arbitrage sector includes credit yield curve relative value trading that involves government securities, futures, and interest rate swaps. Moreover, it includes options-based volatility trading, as well as arbitrage in mortgage-backed securities, primarily in the U.S. and over-the-counter market.

Credit Suisse Global Macro Hedge Fund Index

The Credit Suisse Global Macro Hedge Fund Index is a part of the Credit Suisse Hedge Fund Index which evaluates the overall performance of global macro funds. Global macro funds mainly concentrate on identifying extreme price valuations and frequently use leverage to capitalize on the predicted price movements in equity, currency, interest rate and commodity markets. The fund managers typically apply a global top-down approach to forecast how political trends and macroeconomic events worldwide influence the valuation of financial instruments. They may earn profits by accurately predicting the price movements in global

markets and having the flexibility to use a wide investment mandate, including holding positions in practically any market with any instrument. These approaches can be either systematic trend-following models or discretionary.

Credit Suisse Long/Short Equity Hedge Fund Index

The Credit Suisse Long/Short Equity Hedge Fund Index is a part of the Credit Suisse Hedge Fund Index that assesses the overall performance of long/short equity funds. These funds invest in both long and short sides of equity markets and tend to focus on diversifying or hedging across specific sectors, regions, or market capitalizations. Managers have the flexibility to shift from value to growth, small to medium to large capitalization stocks, and net long to net short. They can also trade equity futures and options, as well as equity-related securities and debt, or construct portfolios that are more concentrated than traditional long-only equity funds.

Credit Suisse Managed Futures Hedge Fund Index

The Credit Suisse Managed Futures Hedge Fund Index is a component of the Credit Suisse Hedge Fund Index that evaluates the collective performance of managed futures funds. These funds, also known as CTAs or Commodity Trading Advisors, usually invest in global listed futures markets for bonds, equities, commodities, and currencies. The managers of these funds employ systematic trading programs that rely on historical price data and market trends. Due to the use of futures contracts, significant leverage may be utilized. These managers typically do not have a preference for being net long or short in any particular market.

Credit Suisse Multi-Strategy Hedge Fund Index

The Credit Suisse Multi-Strategy Hedge Fund Index is a part of the Credit Suisse Hedge Fund Index that gauges the overall performance of multi-strategy funds. These funds are generally known for their capability to allocate investments based on perceived opportunities among several hedge fund strategies. By diversifying capital, managers aim to deliver consistently positive returns irrespective of the direction of equity, interest rate, or currency markets. This

diversification offers added benefits, such as reducing risk and smoothing returns, volatility, and asset-class and single-strategy risks. The strategies employed in a multi-strategy fund may involve a range of approaches, including but not limited to, convertible bond arbitrage, equity long/short, statistical arbitrage, and merger arbitrage.

4.3 The models

$$ROR\ HEDG = \beta_0 + \beta_1 * ROR\ US\ SPX \quad (1)$$

ROR HEDG= Credit Suisse Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$ROR\ HEDG_CVARB = \beta_0 + \beta_1 * ROR\ US\ SPX \quad (2)$$

ROR HEDG_CVARB= Credit Suisse Convertible Arbitrage Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$ROR\ HEDG_EMMKT = \beta_0 + \beta_1 * ROR\ US\ SPX \quad (3)$$

ROR HEDG_EMMKT= Credit Suisse Emerging Markets Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$ROR\ HEDG_EQNTR = \beta_0 + \beta_1 * ROR\ US\ SPX \quad (4)$$

ROR HEDG_EQNTR= Credit Suisse Equity Market Neutral Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$ROR\ HEDG_EVDRV = \beta_0 + \beta_1 * ROR\ US\ SPX \quad (5)$$

ROR HEDG_EVDRV= Credit Suisse Event Driven Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$ROR\ HEDG_DISTR = \beta_0 + \beta_1 * ROR\ US\ SPX \quad (6)$$

ROR HEDG_DISTR= Credit Suisse Event Driven Distressed Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$\mathbf{ROR\ HEDG_MSEVD = \beta_0 + \beta_1 * ROR\ US\ SPX} \quad (7)$$

ROR HEDG_MSEVD= Credit Suisse Event Driven Multi-Strategy Hedge Fund Index

ROR US SPX= S&P500 rate of return

$$\mathbf{ROR\ HEDG_MRARB = \beta_0 + \beta_1 * ROR\ US\ SPX} \quad (8)$$

ROR HEDG_MRARB= Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$\mathbf{ROR\ HEDG_FIARB = \beta_0 + \beta_1 * ROR\ US\ SPX} \quad (9)$$

ROR HEDG_FIARB= Credit Suisse Fixed Income Arbitrage Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$\mathbf{ROR\ HEDG_GLMAC = \beta_0 + \beta_1 * ROR\ US\ SPX} \quad (10)$$

ROR HEDG_GLMAC= Credit Suisse Global Macro Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$\mathbf{ROR\ HEDG_LOSHO = \beta_0 + \beta_1 * ROR\ US\ SPX} \quad (11)$$

ROR HEDG_LOSHO= Credit Suisse Long/Short Equity Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$\mathbf{ROR\ HEDG_MGFUT = \beta_0 + \beta_1 * ROR\ US\ SPX} \quad (12)$$

ROR HEDG_MGFUT= Credit Suisse Managed Futures Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

$$\mathbf{ROR\ HEDG_MULTI = \beta_0 + \beta_1 * ROR\ US\ SPX} \quad (13)$$

ROR HEDG_MULTI= Credit Suisse Multi-Strategy Hedge Fund Index rate of return

ROR US SPX= S&P500 rate of return

5. Results

Before digging into the results, it is important to mention that all 13 regressions have been run via Excel. By default, Excel performs a two-sample t-test to test the null hypothesis that the slope of the regression line is zero (that is, there is no significant relationship between the variables or in other words that $\beta_1 = 0$) against the alternative hypothesis that there is a significant relationship ($\beta_1 \neq 0$). Also, it is worth mentioning that all null hypotheses will be rejected if the p-value of the linear regression is below α i.e., 5%. This model represents a simple regression i.e., a single independent variable is used to predict a dependent variable. The relationship between the two variables is represented by a straight line, and the aim is to find the equation of this line that best fits the data.

In a simple regression where the dependent variable is a hedge fund index and the independent variable is the S&P500, having a positive intercept means that the hedge fund index has a positive value when the S&P500 index is zero. Typically, the intercept term (denoted as β_0) represents the value of the dependent variable (hedge fund index) when the independent variable (S&P500 index) is equal to zero. However, in the case of financial data like hedge fund indices, it is unlikely for the S&P500 index to be exactly zero. Therefore, the interpretation of the intercept in this context should be made with caution. To estimate alpha in the context of hedge fund indices, researchers and investors employ various techniques such as factor models, benchmarking against appropriate indices, or analyzing risk-adjusted returns. Simply relying on the intercept term in a regression is unlikely to provide an accurate enough measure of alpha in this complex investment context. In this section, the intercept will be considered as the alpha of each strategy but it does not represent the primary goal of this master thesis. Additionally, it is worth mentioning that the regression takes into account 279 observations which represents a sufficient number of observations.

When looking at the monthly correlations, it is interesting to test whether the rate of return of hedge fund indices are correlated with the negative returns of the S&P500. To compare the

13 different hedge fund indices, 3 periods have been scrutinized. Period 1 is from February 2000 to October 2001. It represents the Dot.com crisis. This period represents the time when the S&P500 crashed. It went down by an average of -1.44% per month for 21 months in a row. Period 2 is from July 2007 to July 2009. It represents the Great Financial crisis. This period represents the time when the S&P500 crashed with an average monthly performance of -1.78% for 24 months in a row. Lastly, Period 3 is from February 2020 to April 2020. It represents the Covid-19 crisis. This period represents the time when the S&P500 crashed with an average monthly performance of -8.12% for 3 months in a row.

Credit Suisse Hedge Fund Index rate of return

The analysis starts with the Credit Suisse Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

<i>Regression Statistics</i>						
Multiple R	0.1958					
R Square	0.0383					
Adjusted R Square	0.0349					
Standard Error	0.0161					
Observations	279					

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.0029	0.0029	11.0393	0.0010
Residual	277	0.0719	0.0003		
Total	278	0.0748			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.0044	0.0010	4.5710	0.0000	0.0025	0.0063
ROR US SPX	0.0701	0.0211	3.3225	0.0010	0.0286	0.1116

Table 3: Regression summary output Credit Suisse Hedge Fund Index

Because the p-value is equal to 0.0010, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0383, and hence, the model can only explain a 3.83% of the effect observed in the dependent variable, i.e., the rate of return of the Credit Suisse Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.0806 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Hedge Fund Index rate of return is estimated to increase by 0.0806%. This coefficient is positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse Hedge Fund Index also tends to perform well. This result strengthens the idea that the Credit Suisse Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.0701, it only explains 3.83% of the relation between the Credit Suisse Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.0000, there is a significant result concerning the alpha for the Credit Suisse Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has an monthly alpha of 0.44% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Hedge Fund Index.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Hedge Fund Index. The results are shown in the table below.

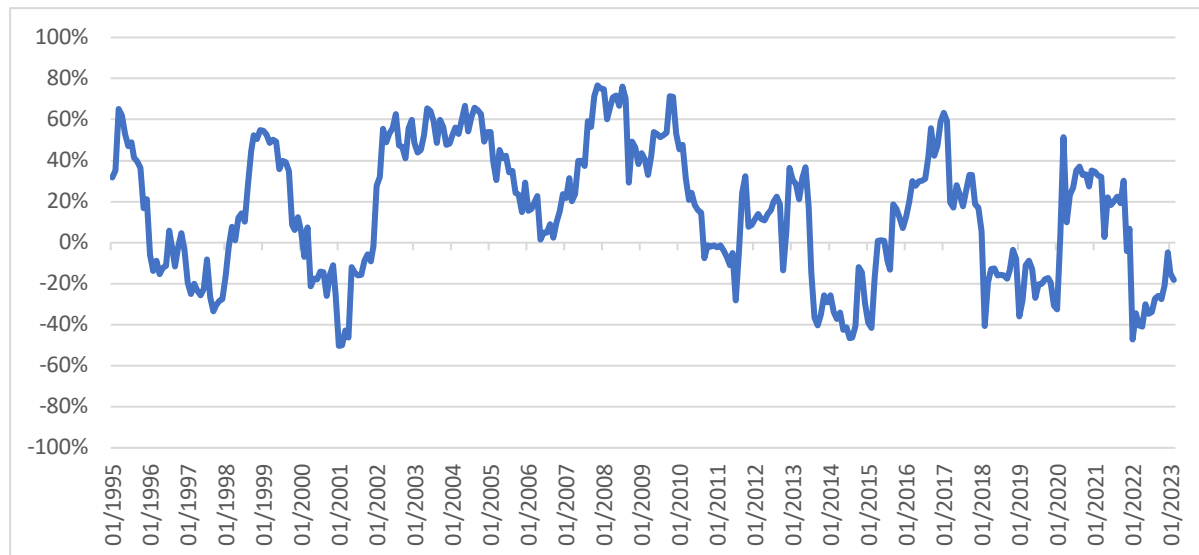


Figure 1: Monthly correlation between the S&P500 and the Credit Suisse Hedge Fund Index

For Period 1, the average monthly correlation is -20.27%. It means that the Credit Suisse Hedge Fund Index has an inverse relationship. In other words, when the S&P500 crashes, the Credit Suisse Hedge Fund Index is outperforming it during the Dot.com crisis. For Period 2, the average monthly correlation is 56.55%. It means that the Credit Suisse Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. During Period 3, the average monthly correlation is 21.51%. It means that the Credit Suisse Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

Credit Suisse Convertible Arbitrage Hedge Fund Index rate of return

Next, the Credit Suisse Convertible Arbitrage Hedge Fund Index is under the loop. The dependent variable is the rate of return of the Credit Suisse Convertible Arbitrage Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

<i>Regression Statistics</i>	
Multiple R	0.2615
R Square	0.0684
Adjusted R Square	0.0650

Standard Error	0.0175					
Observations	279					
ANOVA						
					Significance	
	df	SS	MS	F	F	
Regression	1	0.0063	0.0063	20.3362	0.0000	
Residual	277	0.0852	0.0003			
Total	278	0.0915				
						Upper
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	95%
Intercept	0.0042	0.0011	3.9465	0.0001	0.0021	0.0062
ROR US SPX	0.1036	0.0230	4.5096	0.0000	0.0584	0.1488

Table 4: Regression summary output Credit Suisse Convertible Arbitrage Hedge Fund

Because the p-value is equal to 0.0000, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Convertible Arbitrage Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0684, and hence, the model can only explain a 6.84% of the effect observed in the dependent variable, that is, the rate of return Credit Suisse Convertible Arbitrage Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.1036 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Convertible Arbitrage Hedge Fund Index rate of return is estimated to increase by 0.1036%. This coefficient is positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse Convertible Arbitrage Hedge Fund Index also tends to perform well. This result strengthens the idea that the Credit Suisse Convertible Arbitrage Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.1036, it only explains 6.84% of the relation between the Credit Suisse Convertible Arbitrage

Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Convertible Arbitrage Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.0001, there is a significant result concerning the alpha for the Credit Suisse Convertible Arbitrage Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.42% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Convertible Arbitrage Hedge Fund Index. Metzger and Shenai (2019) conducted research on the alpha for the same hedge fund strategy. They obtained an alpha of 0.42% between April 2009 and January 2017 with a significance at the 1% level. They used the Carhart's Four Factor Model to end up with a more accurate alpha. Asness et al. (2001) also found similar result. They used the intercept of the simple regression as the alpha of the Convertible Arbitrage Hedge Fund Index. They used data between January 1994 to September 2000 and obtained a monthly alpha of 0.40%.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Convertible Arbitrage Hedge Fund Index. The results are shown in the table below.

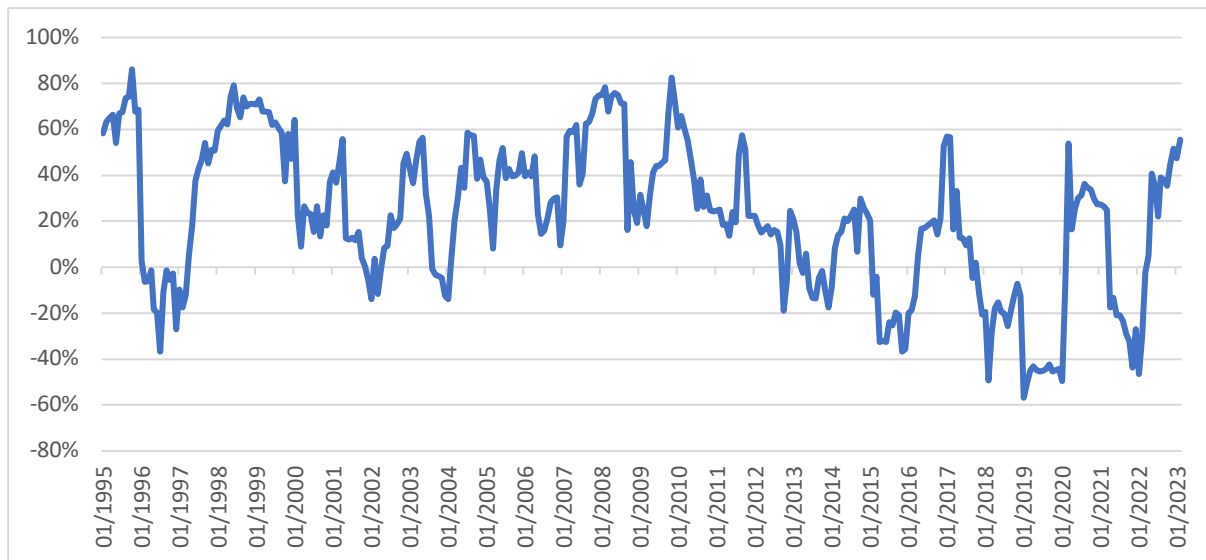


Figure 2: Monthly correlations between the S&P500 and the Credit Suisse Convertible Arbitrage Hedge Fund Index

For Period 1, the average monthly correlation is 23.14%. It means that the Credit Suisse Convertible Arbitrage Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Convertible Arbitrage Hedge Fund Index is also crashing but in a smoother way during the Dot.com crisis. For Period 2, the average monthly correlation is 52.43%. It means that the Credit Suisse Convertible Arbitrage Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Convertible Arbitrage Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. Hence, it validates the findings from Metzger and Shenai (2019) which identified a correlation of 55% at the same period of time. During Period 3, the average monthly correlation is 21.02%. It means that the Credit Suisse Convertible Arbitrage Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Convertible Arbitrage Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

Credit Suisse Emerging Markets Hedge Fund Index rate of return

Then, the analysis scrutinizes the Credit Suisse Emerging Markets Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Emerging Markets Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

<i>Regression Statistics</i>	
Multiple R	0.1737
R Square	0.0302
Adjusted R Square	0.0267
Standard Error	0.0283
Observations	279

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.0069	0.0069	8.6151	0.0036
Residual	277	0.2216	0.0008		
Total	278	0.2285			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.0056	0.0017	3.2717	0.0012	0.0022	0.0089
ROR US SPX	0.1087	0.0370	2.9351	0.0036	0.0358	0.1817

Table 5: Regression summary output Credit Suisse Emerging Markets Hedge Fund Index

Because the p-value is equal to 0.0036, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Emerging Markets Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0302, and hence, the model can only explain a 3.02% of the effect observed in the dependent variable, that is, the rate of return Credit Suisse Emerging Markets Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.1087 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Emerging Markets Hedge Fund Index rate of return is estimated to increase by 0.1087%. This coefficient is positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse

Emerging Markets Hedge Fund Index also tends to perform well. This result strengthens the idea that the Credit Suisse Emerging Markets Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.1087, it only explains 3.02% of the relation between the Credit Suisse Emerging Markets Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Emerging Markets Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.0012, there is a significant result concerning the alpha for the Credit Suisse Emerging Markets Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.56% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Emerging Markets Hedge Fund Index. Metzger and Shenai (2019) conducted research on the alpha for the same hedge fund strategy but no significant results were found. Asness et al. (2001) found lower result. They used the intercept of the simple regression as the alpha of the Emerging Markets Hedge Fund strategy. They used data between January 1994 to September 2000 and obtained a monthly alpha of -0.70%.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Emerging Markets Hedge Fund Index. The results are shown in the table below.

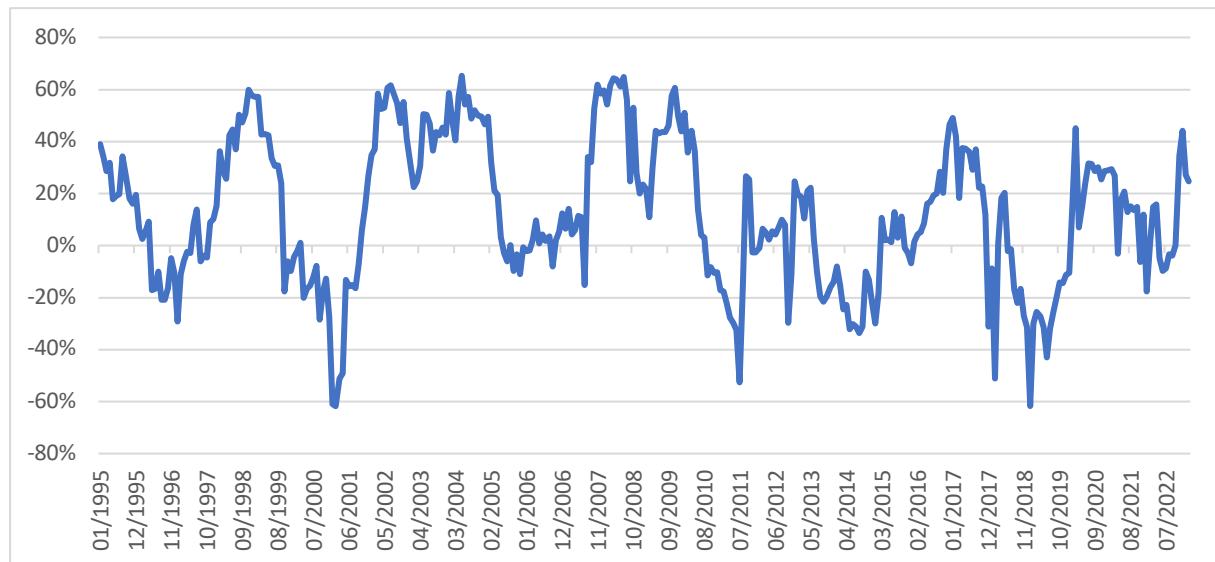


Figure 3: Monthly correlations between the S&P500 and the Credit Suisse Emerging Markets Hedge Fund Index

For Period 1, the average monthly correlation is -21.20%. It means that the Credit Suisse Emerging Markets Hedge Fund Index has an inverse relationship. In other words, when the S&P500 crashes, the Credit Suisse Emerging Markets Hedge Fund Index is outperforming it during the Dot.com crisis. For Period 2, the average monthly correlation is 42.09%. It means that the Credit Suisse Emerging Markets Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Emerging Markets Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. Other finding from Metzger and Shenai (2019) identified a higher correlation of 71% at the same period of time. During Period 3, the average monthly correlation is 22.65%. It means that the Credit Suisse Emerging Markets Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Emerging Markets Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

Comparing with Asness et al. (2001) study, the above results are different. Between January 1994 to September 2000, the past findings revealed a coefficient of 0.74 and an R^2 value of 0.242, indicating a moderate positive relationship. Additionally, they observed a correlation of 0.50 while this study revealed lower correlation of 0.1818 for the same period.

Credit Suisse Equity Market Neutral Hedge Fund Index rate of return

Afterwards, the analysis of the Credit Suisse Equity Market Neutral Hedge Fund Index is conducted. The dependent variable is the rate of return of the Credit Suisse Equity Market Neutral Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

<i>Regression Statistics</i>	
Multiple R	0.2331
R Square	0.0543
Adjusted R Square	0.0509
Standard Error	0.0266
Observations	279

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.0113	0.0113	15.9145	0.0001
Residual	277	0.1959	0.0007		
Total	278	0.2071			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.0014	0.0016	0.8811	0.3790	-0.0017	0.0046
ROR US SPX	0.1389	0.0348	3.9893	0.0001	0.0704	0.2075

Table 6: Regression summary output Credit Suisse Equity Market Neutral Hedge Fund Index

Because the p-value is equal to 0.0001, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Equity Market Neutral Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0543, and hence, the model can only explain a 5.43% of the effect observed in the dependent variable, that is, the rate of return Credit Suisse Equity Market Neutral Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.1389 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Equity Market Neutral Hedge Fund Index of return is estimated to increase by 0.1389%. This coefficient is positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse Equity Market Neutral Hedge Fund Index also tends to perform well. This result strengthens the idea that the Credit Suisse Equity Market Neutral Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.1389, it only explains 5.43% of the relation between the Credit Suisse Equity Market Neutral Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Equity Market Neutral Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.379, there is no significant result concerning the alpha for the Credit Suisse Equity Market Neutral Hedge Fund Index. Metzger and Shenai (2019) conducted research on the alpha for the same hedge fund strategy. They also obtained no significant result. Asness et al. (2001) found significant result. They used the intercept of the simple regression as the alpha of the Equity Market Neutral Hedge Fund Index. They used data between January 1994 to September 2000 and obtained a monthly alpha of 0.39%.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Equity Market Neutral Hedge Fund Index. The results are shown in the table below.

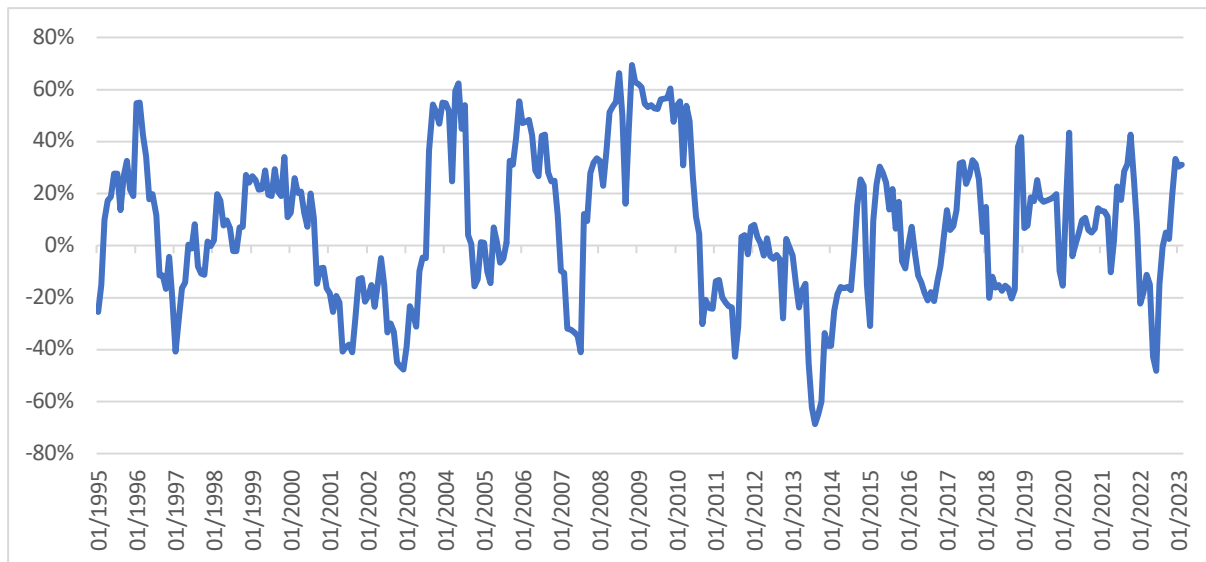


Figure 4: Monthly correlations between the S&P500 and the Credit Suisse Equity Market Neutral Hedge Fund Index

For Period 1, the average monthly correlation is -10.29%. It means that the Credit Suisse Equity Market Neutral Hedge Fund Index has an inverse relationship. In other words, when the S&P500 crashes, the Credit Suisse Equity Market Neutral Hedge Fund Index is outperforming it during the Dot.com crisis. For Period 2, the average monthly correlation is 40.95%. It means that the Credit Suisse Equity Market Neutral Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Emerging Markets Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. This represents a higher correlation than the study from Metzger and Shenai (2019) which identified a correlation of 30% at the same period of time. During Period 3, the average monthly correlation is 18.31%. It means that the Credit Suisse Emerging Markets Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Equity Market Neutral Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

Comparing with Asness et al. (2001) study, the above results are similar. Between January 1994 to September 2000, the past findings revealed a coefficient of 0.12 and an R^2 value of 0.222, indicating a moderate positive relationship. Additionally, they observed a correlation of 0.50. However, Patton (2009) found out a lower correlation of only 0.025 April 1993 to April 2003. To compare, this study revealed a correlaton of 0.0984 between January 1994 to September 2000.

Credit Suisse Event Driven Hedge Fund Index rate of return

Subsequently, this study looks at the Credit Suisse Event Driven Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Event Driven Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

<i>Regression Statistics</i>	
Multiple R	0.2590
R Square	0.0671
Adjusted R Square	0.0637
Standard Error	0.0180
Observations	279

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.0065	0.0065	19.9254	0.0000
Residual	277	0.0901	0.0003		
Total	278	0.0966			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.0045	0.0011	4.1635	0.0000	0.0024	0.0067
ROR US SPX	0.1055	0.0236	4.4638	0.0000	0.0590	0.1520

Table 7: Regression summary output Credit Suisse Event Driven Hedge Fund Index

Because the p-value is equal to 0.0000, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Event Driven Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0671, and hence, the model can only explain 6.71% of the effect observed in the dependent variable, that is, the rate of return Credit Suisse Event Driven Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.1055 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Event Driven Hedge Fund Index rate of return is estimated to increase by 0.1055%. This coefficient is positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse Event Driven Hedge Fund Index also tends to perform well. This result strengthens the idea that the Credit Suisse Event Driven Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.1055, it only explains 6.71% of the relation between the Credit Suisse Event Driven Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Event Driven Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.0000, there is a significant result concerning the alpha for the Credit Suisse Event Driven Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.45% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Event Driven Hedge Fund Index. Metzger and Shenai (2019) conducted research on the alpha for the same hedge fund strategy. However, they obtained no significant results. Asness et al. (2001) found lower results. They used the intercept of the simple regression as the alpha of the Event Driven Hedge Fund Index. They used data between January 1994 to September 2000 and obtained a monthly alpha of 0.17%.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Event Driven Hedge Fund Index. The results are shown in the table below.

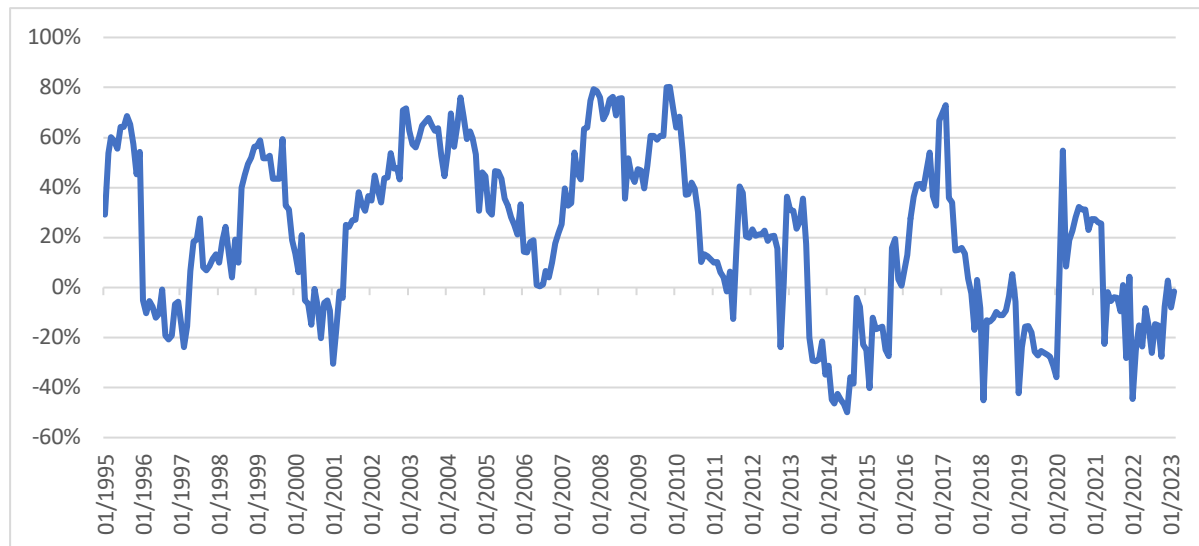


Figure 5: Monthly correlations between the S&P500 and the Credit Suisse Event Driven Hedge Fund Index

For Period 1, the average monthly correlation is 3.49%. It means that the Credit Suisse Event Driven Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Hedge Fund Index is also crashing but in a smoother way during the Dot.com crisis. For Period 2, the average monthly correlation is 61.02%. It means that the Credit Suisse Event Driven Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. Hence, it validates the findings from Metzger and Shenai (2019) which identified a correlation of 65% at the same period of time. During Period 3, the average monthly correlation is 23.79%. It means that the Credit Suisse Event Driven Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

Gupta and Liang (2005) and Chan et al. (2005) found out that the event driven strategy coefficient compared to the S&P500 was 0.85 between April 1993 to April 2003. However, Asness et al. (2001) resulted to a lower coefficient of 0.28 and a correlation of 0.60 between January 1994 to September 2000. This study revealed a correlation of 0.2286 between January 1994 to July 2000.

Credit Suisse Event Driven Distressed Hedge Fund Index rate of return

The following part analyzes the Credit Suisse Event Driven Distressed Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Event Driven Distressed Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

<i>Regression Statistics</i>	
Multiple R	0.3019
R Square	0.0911
Adjusted R Square	0.0878
Standard Error	0.0157
Observations	279

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>Significance</i>	
				<i>F</i>	<i>F</i>
Regression	1	0.0068	0.0068	27.7688	0.0000
Residual	277	0.0681	0.0002		
Total	278	0.0749			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Upper</i>	
					<i>Lower 95%</i>	<i>95%</i>
Intercept	0.0047	0.0009	4.9732	0.0000	0.0028	0.0066
ROR US SPX	0.1082	0.0205	5.2696	0.0000	0.0678	0.1487

Table 8: Regression summary output Event Driven Distressed Hedge Fund Index

Because the p-value is equal to 0.0000, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Event Driven Distressed Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0911, and hence, the model can only explain a 9.11% of the effect observed in the dependent variable, that is, the rate of return Credit Suisse Event Driven Distressed Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.1082 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Event Driven Distressed Hedge Fund Index rate of return is estimated to increase by 0.1082%. This coefficient is positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse Event Driven Distressed Hedge Fund Index also tends to perform well. This result strengthens the idea that the Credit Suisse Event Driven Distressed Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.1082, it only explains 9.11% of the relation between the Credit Suisse Event Driven Distressed Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Event Driven Distressed Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.0000, there is a significant result concerning the alpha for the Credit Suisse Event Driven Distressed Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.47% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Event Driven Distressed Hedge Fund Index. As this index is specific to Credit Suisse, there is no research to compare with.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Event Driven Distressed Hedge Fund Index. The results are shown in the table below.

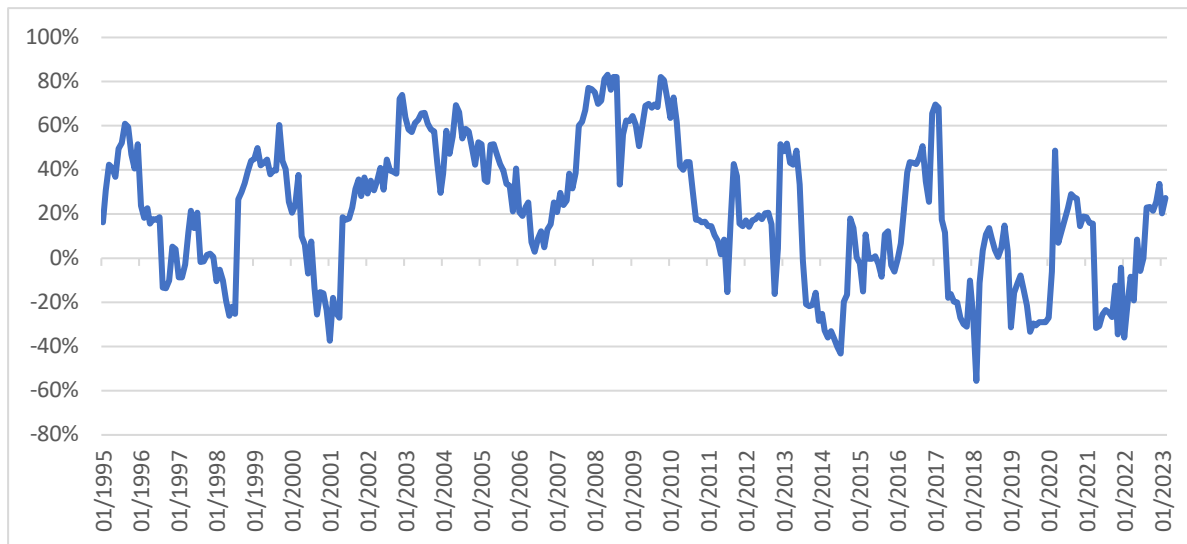


Figure 6: Monthly correlations between the S&P500 and the Credit Suisse Event Driven Distressed Hedge Fund Index

For Period 1, the average monthly correlation is 1.06%. It means that the Credit Suisse Event Driven Distressed Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Distressed Hedge Fund Index is also crashing but in a smoother way during the Dot.com crisis. For Period 2, the average monthly correlation is 66.38%. It means that the Credit Suisse Event Driven Distressed Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Distressed Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. During Period 3, the average monthly correlation is 16.64%. It means that the Credit Suisse Event Driven Distressed Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Distressed Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

Credit Suisse Event Driven Multi-Strategy Hedge Fund Index

Then, the analysis scrutinizes the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

Multiple R	0.2230
R Square	0.0497
Adjusted R Square	0.0463
Standard Error	0.0204
Observations	278

ANOVA

				Significance	
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>F</i>
Regression	1	0.0060	0.0060	14.4422	0.0002
Residual	276	0.1152	0.0004		
Total	277	0.1213			

		Standard			Upper	
	<i>Coefficients</i>	<i>Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>95%</i>
Intercept	0.0044	0.0012	3.5998	0.0004	0.0020	0.0069
ROR US SPX	0.1018	0.0268	3.8003	0.0002	0.0491	0.1545

Table 9: Regression summary output Credit Suisse Event Driven Multi-Strategy Hedge Fund Index

Because the p-value is equal to 0.0002, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Event Driven Multi-Strategy Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0497, and hence, the model can only explain a 4.97% of the effect observed in the dependent variable, that is, the rate of return Credit Suisse Event Driven Multi-Strategy Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.1018 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index of return is estimated to increase by 0.1018%. This coefficient is positive, indicating a positive relationship

between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index also tends to perform well. This result strengthens the idea that the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.1018, it only explains 4.97% of the relation between the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.0004, there is a significant result concerning the alpha for the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.44% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index. As this index is specific to Credit Suisse, there is no research to compare with.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index. The results are shown in the table below.

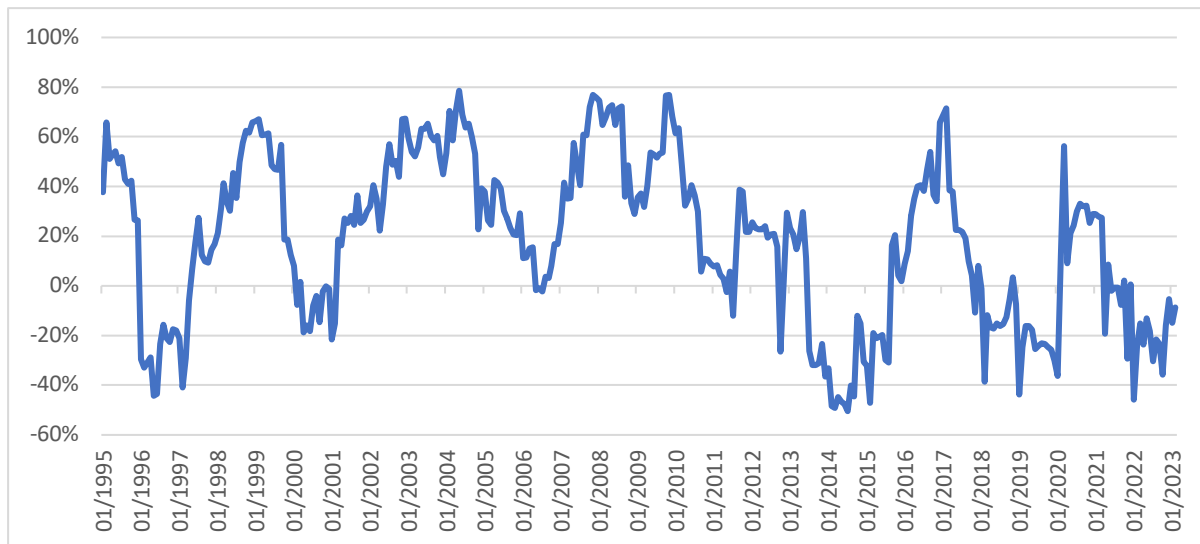


Figure 7: Monthly correlations between the S&P500 and the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index

For Period 1, the average monthly correlation is 3.65%. It means that the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index is also crashing but in a smoother way during the Dot.com crisis. For Period 2, the average monthly correlation is 55.87%. It means that the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. During Period 3, the average monthly correlation is 25.85%. It means that the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Multi-Strategy Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index rate of return

Afterwards, this study looks at the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

Regression Statistics

Multiple R	0.1389
R Square	0.0193
Adjusted R Square	0.0157
Standard Error	0.0123
Observations	278

ANOVA

				<i>Significance</i>	
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>F</i>
Regression	1	0.0008	0.0008	5.4264	0.0206
Residual	276	0.0418	0.0002		
Total	277	0.0426			

					<i>Upper</i>	
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>95%</i>
Intercept	0.0036	0.0007	4.8391	0.0000	0.0021	0.0051
ROR US SPX	0.0376	0.0161	2.3295	0.0206	0.0058	0.0693

Table 10: Regression summary output Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index

Because the p-value is equal to 0.0206, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0193, and hence, the model can only explain a 1.93% of the effect observed in the dependent variable, that is, the rate of return Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.0376 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index of return is estimated to increase by 0.0376%. This coefficient is positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index also tends to perform well. This result strengthens the idea that the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.0376, it only explains 1.93% of the relation between the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.0000, there is a significant result concerning the alpha for the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.36% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index. As this index is specific to Credit Suisse, there is no research to compare with.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index. The results are shown in the table below.

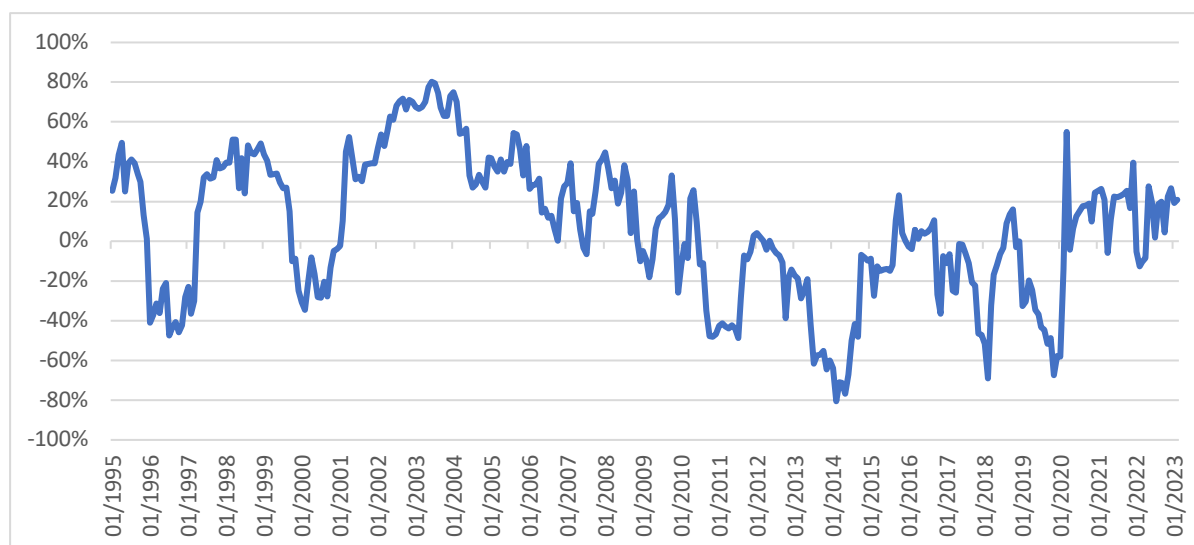


Figure 8: Monthly correlations between the S&P500 and the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index

For Period 1, the average monthly correlation is 5.29%. It means that the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index is also crashing but in a smoother way during the Dot.com crisis. For Period 2, the average monthly correlation is 15.45%. It means that the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. During Period 3, the average monthly correlation is 12.14%. It means that the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Event Driven Risk Arbitrage Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

Credit Suisse Fixed Income Arbitrage Hedge Fund Index rate of return

The following part is about the Credit Suisse Fixed Income Arbitrage Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Fixed Income Arbitrage Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

Multiple R	0.3171
R Square	0.1006
Adjusted R Square	0.0973
Standard Error	0.0137
Observations	278

ANOVA

				Significance	
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>F</i>
Regression	1	0.0058	0.0058	30.8622	0.0000
Residual	276	0.0518	0.0002		
Total	277	0.0576			

					Upper	
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>95%</i>
Intercept	0.0032	0.0008	3.8616	0.0001	0.0016	0.0048
ROR US SPX	0.0998	0.0180	5.5554	0.0000	0.0644	0.1351

Table 11: Regression summary output Credit Suisse Fixed Income Arbitrage Hedge Fund Index

Because the p-value is equal to 0.0000, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Fixed Income Arbitrage Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.1006, and hence, the model can only explain a 10.06% of the effect observed in the dependent variable, that is, the rate of return Credit Suisse Fixed Income Arbitrage Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.0998 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Fixed Income Arbitrage Hedge Fund Index of return is estimated to increase by 0.0998%. This coefficient is positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse Fixed

Income Arbitrage Hedge Fund Index also tends to perform well. This result strengthens the idea that the Credit Suisse Fixed Income Arbitrage Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.0998, it only explains 10.06% of the relation between the Credit Suisse Fixed Income Arbitrage Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Fixed Income Arbitrage Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.0001, there is a significant result concerning the alpha for the Credit Suisse Fixed Income Arbitrage Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.32% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Fixed Income Arbitrage Hedge Fund Index. Metzger and Shenai (2019) conducted research on the alpha for the same hedge fund strategy. They obtained an alpha of 0.54% between April 2009 and January 2017 with a significance at the 1% level. They used the Carhart's Four Factor Model to end up with a more accurate alpha. Asness et al. (2001) found lower results. They used the intercept of the simple regression as the alpha of the Fixed Income Arbitrage Hedge Fund Index. They used data between January 1994 to September 2000 and obtained a monthly alpha of 0.10%.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Fixed Income Arbitrage Hedge Fund Index. The results are shown in the table below.

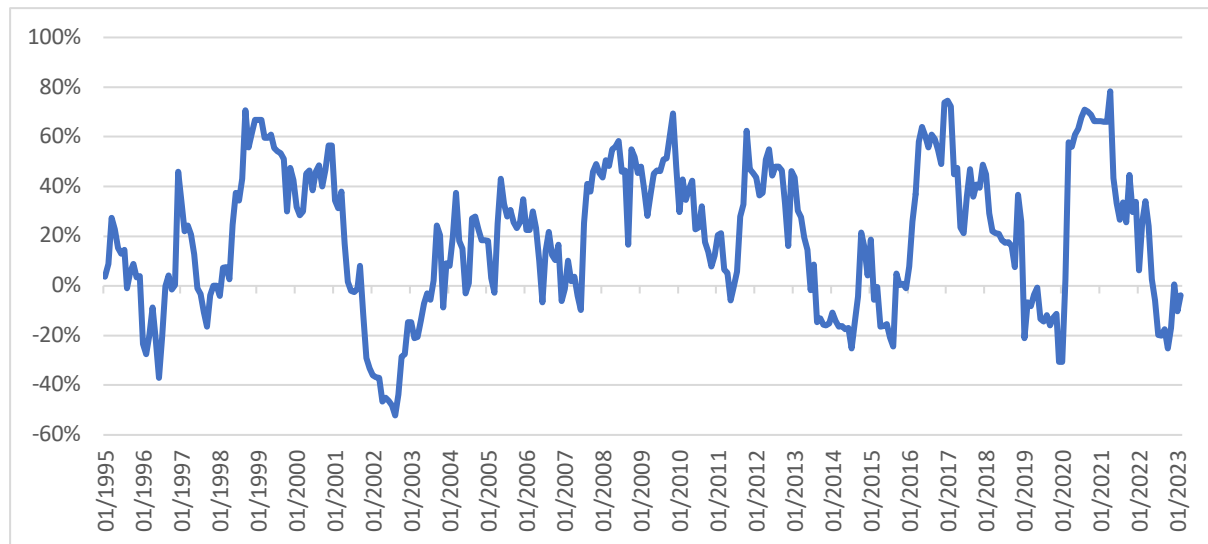


Figure 9: Monthly correlations between the S&P500 and the Credit Suisse Fixed Income Arbitrage Hedge Fund Index

For Period 1, the average monthly correlation is 28.42%. It means that the Credit Suisse Fixed Income Arbitrage Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Fixed Income Arbitrage Hedge Fund Index is also crashing but in a smoother way during the Dot.com crisis. For Period 2, the average monthly correlation is 44.27%. It means that the Credit Suisse Fixed Income Arbitrage Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Fixed Income Arbitrage Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. This represents a lower correlation than the study from Metzger and Shenai (2019) which identified a correlation of 66% at the same period of time. During Period 3, the average monthly correlation is 38.73%. It means that the Credit Suisse Fixed Income Arbitrage Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Fixed Income Arbitrage Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

Credit Suisse Global Macro Hedge Fund Index rate of return

Then, the analysis investigates the Credit Suisse Global Macro Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Global Macro Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

<i>Regression Statistics</i>	
Multiple R	0.0529
R Square	0.0028
Adjusted R Square	-0.0008
Standard Error	0.0178
Observations	278

ANOVA

				<i>Significance</i>	
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>F</i>
Regression	1	0.0002	0.0002	0.7742	0.3797
Residual	276	0.0878	0.0003		
Total	277	0.0880			

					<i>Upper</i>	
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>95%</i>
Intercept	0.0069	0.0011	6.4208	0.0000	0.0048	0.0090
ROR US SPX	-0.0206	0.0234	-0.8799	0.3797	-0.0666	0.0254

Table 12: Regression summary output Credit Suisse Global Macro Hedge Fund Index

Because the p-value is equal to 0.3797, the null hypothesis cannot be rejected meaning that the alternative hypothesis doesn't hold. Therefore, it cannot be proved that the Credit Suisse Global Macro Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0028, and hence, the model explains almost any effect observed in the dependent variable, that is, the rate of return Credit Suisse Global Macro Hedge Fund Index variation. Consequently, this model has no accuracy. No further analysis on the correlation could be stated due to a lack of statistical significance.

Comparing with Asness et al. (2001) study, the above results are different. Between January 1994 to September 2000, the past findings revealed a significant coefficient of 0.37 and an R^2 value of 0.242, indicating a moderate positive relationship. Additionally, they observed a correlation of 0.36.

Because the p-value of the intercept is equal to 0.0000, there is a significant result concerning the alpha for the Credit Suisse Global Macro Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.69% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Global Macro Hedge Fund Index. Metzger and Shenai (2019) conducted research on the alpha for the same hedge fund strategy. They obtained an alpha of 0.29% between April 2009 and January 2017 with a significance at the 5% level. They used the Carhart's Four Factor Model to end up with a more accurate alpha. Asness et al. (2001) also found similar result. They used the intercept of the simple regression as the alpha of the Global Macro Hedge Fund Index. They used data between January 1994 to September 2000 and obtained a monthly alpha of 0.20%.

Credit Suisse Long/Short Equity Hedge Fund Index rate of return

Next, the analysis covers the Credit Suisse Long/Short Equity Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Long/Short Equity Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

<i>Regression Statistics</i>	
Multiple R	0.0946
R Square	0.0090
Adjusted R Square	0.0054
Standard Error	0.0227
Observations	278

ANOVA

					Significance	
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>F</i>	
Regression	1	0.0013	0.0013	2.4930	0.1155	
Residual	276	0.1421	0.0005			
Total	277	0.1434				

						Upper
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>95%</i>
Intercept	0.0042	0.0014	3.1033	0.0021	0.0016	0.0069
ROR US SPX	0.0470	0.0297	1.5789	0.1155	-0.0116	0.1055

Table 13: Regression summary output Credit Suisse Long/Short Equity Hedge Fund Index

Because the p-value is equal to 0.1155, the null hypothesis cannot be rejected meaning that the alternative hypothesis doesn't hold. Therefore, it cannot be proved that the Credit Suisse Long/Short Equity Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0090, and hence, the model explain almost any effect observed in the dependent variable, that is, the rate of return Credit Suisse Long/Short Equity Hedge Fund Index variation. Consequently, this model has no accuracy. No further analysis on the correlation could be stated due to a lack of statistical significance.

Comparing with Fung and Hsieh (2011), the above results are different. The past findings revealed a coefficient of 0.50 between 1994 and 2007. Moreover, the study from Asness et al. (2001) announced a coefficient of 0.55 and an R^2 value of 0.374, indicating a small positive relationship between January 1994 to September 2000. Additionally, they observed a correlation of 0.62. In comparison, this study revealed a correlation of 0.0975 for the same period.

Because the p-value of the intercept is equal to 0.0021, there is a significant result concerning the alpha for the Credit Suisse Long/Short Equity Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.42% compared to the S&P500.

It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Long/Short Equity Hedge Fund Index. Metzger and Shenai (2019) conducted research on the alpha for the same hedge fund strategy. However, they didn't obtain significant results. Asness et al. (2001) found significant results. They used the intercept of the simple regression as the alpha of the Long/Short Equity Hedge Fund Index. They used data between January 1994 to September 2000 and obtained a monthly alpha of 0.32%.

Credit Suisse Managed Futures Hedge Fund Index rate of return

Then, this study discusses the result of the Credit Suisse Managed Futures Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Managed Futures Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

<i>Regression Statistics</i>	
Multiple R	0.0576
R Square	0.0033
Adjusted R Square	-0.0003
Standard Error	0.0317
Observations	278

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>Significance</i>	
				<i>F</i>	<i>F</i>
Regression	1	0.0009	0.0009	0.9174	0.3390
Residual	276	0.2779	0.0010		
Total	277	0.2788			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Upper</i>	
					<i>Lower 95%</i>	<i>95%</i>
Intercept	0.0046	0.0019	2.3825	0.0179	0.0008	0.0083

ROR US SPX	-0.0398	0.0416	0.9578	0.3390	-0.1217	0.0420
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Table 14: Regression summary output Credit Suisse Managed Futures Hedge Fund Index

Because the p-value is equal to 0.3390, the null hypothesis cannot be rejected meaning that the alternative hypothesis doesn't hold. Therefore, it cannot be proved that the Credit Suisse Managed Futures Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.0033, and hence, the model almost does not explain any effect observed in the dependent variable, that is, the rate of return Credit Suisse Managed Futures Hedge Fund Index variation. Consequently, this model has no accuracy. No further analysis on the correlation could be stated due to a lack of statistical significance.

Because the p-value of the intercept is equal to 0.0179, there is a significant result concerning the alpha for the Credit Suisse Managed Futures Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.46% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the Credit Suisse Managed Futures Hedge Fund Index. Metzger and Shenai (2019) conducted research on the alpha for the same hedge fund strategy. However, they didn't obtain significant results. Asness et al. (2001) found different results. They used the intercept of the simple regression as the alpha of the Managed Futures Hedge Fund Index. They used data between January 1994 to September 2000 and obtained a monthly alpha of -0.11%.

Credit Suisse Multi-Strategy Hedge Fund Index rate of return

Lastly, this research covers the Credit Suisse Multi-Strategy Hedge Fund Index. The dependent variable is the rate of return of the Credit Suisse Multi-Strategy Hedge Fund Index and the independent variable is the rate of return of the S&P500. Results are presented in the table below.

Multiple R	0.3207
R Square	0.1028
Adjusted R Square	0.0996
Standard Error	0.0133
Observations	278

ANOVA					
				Significance	
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>F</i>
Regression	1	0.0056	0.0056	31.6341	0.0000
Residual	276	0.0485	0.0002		
Total	277	0.0540			

					Upper	
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>95%</i>
Intercept	0.0047	0.0008	5.9073	0.0000	0.0031	0.0063
ROR US SPX	0.0977	0.0174	5.6244	0.0000	0.0635	0.1319

Table 15: Regression summary output Credit Suisse Multi-Strategy Hedge Fund Index

Because the p-value is equal to 0.0000, the null hypothesis can be rejected meaning that the alternative hypothesis is true. Therefore, Credit Suisse Multi-Strategy Hedge Fund Index rate of return is behaving dependently from the S&P500 index rate of return. Moreover, R^2 has a value of 0.1028, and hence, the model can only explain a 10.28% of the effect observed in the dependent variable, that is, the rate of return Credit Suisse Multi-Strategy Hedge Fund Index variation. Consequently, this model has a low accuracy and lack of statistical significance.

Also, a coefficient of 0.0977 suggests that for each 1% increase in the rate of return of the S&P500, the Credit Suisse Long/Short Equity Hedge Fund Index of return is estimated to increase by 0.0977%. This coefficient is positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, the Credit Suisse Multi-Strategy Hedge Fund Index also tends to perform well. This result strengthens the idea that

the Credit Suisse Multi-Strategy Hedge Fund Index is almost not influenced by the S&P500. The R^2 is very low which means that, even if the coefficient is 0.0977, it only explains 10.28% of the relation between the Credit Suisse Multi-Strategy Hedge Fund Index and the S&P500. Hence, many other factors play more significant roles in the performance of the Credit Suisse Multi-Strategy Hedge Fund Index. Having a low coefficient in a regression means that there is a weak or negligible relationship between the independent variable and the dependent variable. This may suggest that the independent variable is not a good predictor of the dependent variable.

Because the p-value of the intercept is equal to 0.0000, there is a significant result concerning the alpha for the Credit Suisse Multi-Strategy Hedge Fund Index. Between January 31, 1994 until February 28 2023, this strategy has a monthly alpha of 0.47% compared to the S&P500. It represents the skill or value added by the hedge fund strategy beyond what can be explained by market factors. It is the component of return that is unique to the C Credit Suisse Multi-Strategy Hedge Fund Index. Metzger and Shenai (2019) conducted research on the alpha for the same hedge fund strategy. They obtained an alpha of 0.42% between April 2009 and January 2017 with a significance at the 1% level. They used the Carhart's Four Factor Model to end up with a more accurate alpha. Asness et al. (2001) did not use such type of index in their research.

In addition to a regression, it is also interesting to make a monthly correlation between the return of the S&P500 and the Credit Suisse Multi-Strategy Hedge Fund Index. The results are shown in the table below.

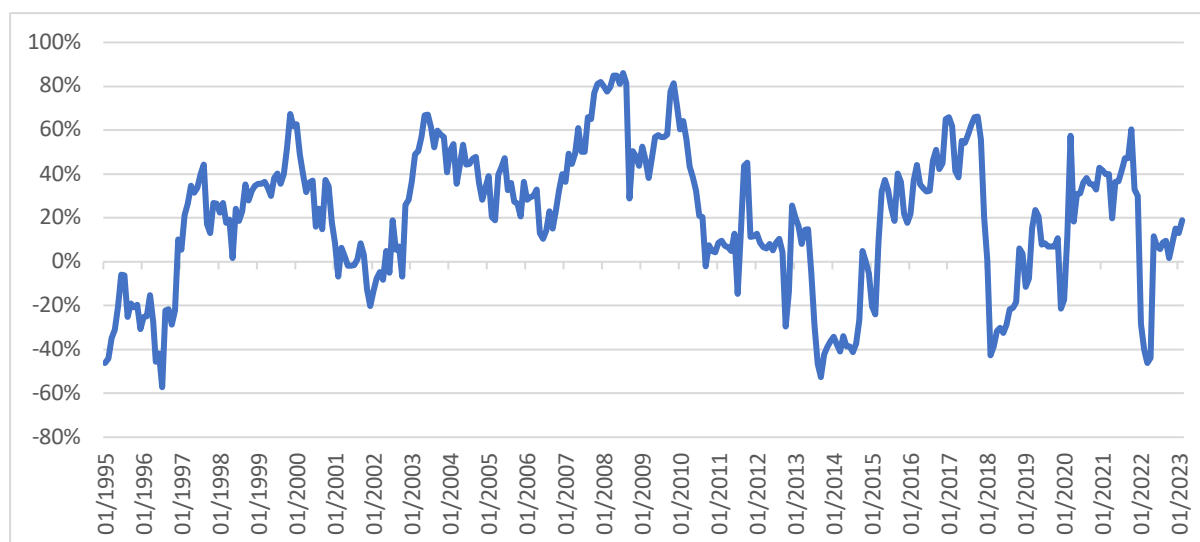


Figure 10: Monthly correlations between the S&P500 and the Credit Suisse Multi-Strategy Hedge Fund Index

For Period 1, the average monthly correlation is 16.99%. It means that the Credit Suisse Multi-Strategy Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Multi-Strategy Hedge Fund Index is also crashing but in a smoother way during the Dot.com crisis. For Period 2, the average monthly correlation is 64.14%. It means that the Credit Suisse Multi-Strategy Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Multi-Strategy Hedge Fund Index is also crashing but in a smoother way during the Great Financial crisis. This result almost matches the one from Metzger and Shenai (2019) which identified a correlation of 60% at the same period of time. During Period 3, the average monthly correlation is 29.36%. It means that the Credit Suisse Multi-Strategy Hedge Fund Index has a positive relationship. In other words, when the S&P500 crashes, the Credit Suisse Multi-Strategy Hedge Fund Index is also crashing but in a smoother way during the Covid-19 crisis.

6. Conclusion

This study analyzed the performance of 13 primary hedge fund strategies by utilizing a substantial database of 9,000 hedge funds accessible through the Credit Suisse lab. These hedge fund indices were scrutinized for three main reasons: to test their level of dependency on the market represented by the S&P500 index, to determine which type of relationship they

have with the S&P500 and, to analyze the correlations during 3 different crisis periods between the respective monthly return of hedge fund indices and the returns of the S&P500.

Analyses done by running regressions demonstrate that 10 hedge fund indices out of 13 are significantly dependent on the S&P500. The strategies are the following: the combined strategy gathering all the indices, Convertible Arbitrage, Emerging Markets, Equity Market Neutral, Event Driven, Event Driven Distressed, Event Driven Multi-Strategy, Event Driven Risk Arbitrage, Fixed Income Arbitrage, and Multi-Strategy. They all have a coefficient between 0.0461 and 0.1423 with an average of 0.1071. Moreover, all 10 coefficients are positive, indicating a positive relationship between the two variables, which suggests that when the S&P500 performs well, each index also tends to perform well. However, when a crisis occurs, these indices will be negatively affected. It is worth mentioning that having a very low coefficient strengthens the idea that hedge fund indices are almost not influenced by the S&P500. A low coefficient in a regression implies that there exists a weak or negligible association between the independent and dependent variables. This could indicate that the S&P500 is not an effective predictor of the hedge fund indices.

When analyzing the correlations of the 10 different indices that have statistical significance, 3 periods have been scrutinized: the dot.com crisis, the Great financial crisis, and the Covid-19 crisis. It has been proven that during the dot.com crisis, 3 hedge fund strategies had a negative correlation with the S&P500: the combined strategy, Emerging Markets, and Equity Market Neutral. The average correlation for all 10 strategies during the dot.com is 3.03%. Looking at the Great financial crisis of 2008, correlations are way stronger, with an average of 49.92% throughout the 10 strategies. The strongest correlation is from the Event Driven Distressed strategy with 66.38% and the weakest correlation is from the Event Driven Risk Arbitrage strategy with 15.45%. Consequently, hedge funds were significantly affected by the Great financial crisis. Lastly, the Covid-19 crisis had a mitigated effect on the hedge fund strategies with the lowest correlation for the Event Driven Risk Arbitrage strategy and the highest correlation for the Fixed Income Arbitrage strategy with 12.14% and 38.73%, respectively. The average correlation was 23%.

In summary, the comparison of the present study with the findings from other related research reveals notable variations and similarities across different hedge fund strategies.

Regarding the Emerging Market strategy, this study demonstrates different results compared to Asness et al. (2001). The prior research indicated a coefficient of 0.74 and a correlation of 0.50, while this study obtained a lower coefficient of 0.1087. The Equity Market Neutral strategy, in contrast, demonstrates comparable results in both this study and Asness et al. (2001). Asness et al. (2001) obtained a coefficient of 0.12, while this study yielded to a coefficient of 0.1389. The observed correlation in Asness et al. (2001) was 0.50. Nevertheless, Patton (2009) reported a lower correlation of merely 0.025. To compare, this study revealed a correlaton of 0.0984. Analyzing the Event-Driven strategy, Gupta and Liang (2005) and Chan et al. (2005) identified a coefficient of 0.85 compared to the S&P500, whereas Asness et al. (2001) reported a lower coefficient of 0.28 and a correlation of 0.60. In comparison, this study obtained a coefficient of 0.1055 and a correlation of 0.2286, which is lower than both previous studies. For the Global Macro strategy, this study demonstrates different results compared to Asness et al. (2001). The prior research revealed a coefficient of 0.37, and a correlation of 0.36, while this study did not find significant results. Regarding the Long/Short Equity strategy, this study did not find significant results like the ones from Fung and Hsieh (2011). The prior research identified a coefficient of 0.50, and a correlation of 0.62. Consequently, the comparison of the present study with previous research indicates variations and similarities across different hedge fund strategies, highlighting the importance of considering multiple studies for a comprehensive understanding of their characteristics.

To conclude, this research helped to confirm that hedge funds behave almost independently from the market (proxied by the S&P500). However, it is important to mention that a crisis could happen and negatively influence the performance of hedge funds. Furthermore, significant correlations do exist between returns of hedge funds and S&P500.

7. Limitations and further research

This study used data from the hedge fund indices, which contains information on 9000 hedge funds categorized by strategy. However, caution should be taken in generalizing the results as there may be variation in performance within each strategy. Since this study focuses solely on the overall performance of hedge fund indices, these outcomes may or may not be applicable to individual hedge funds. However, a meticulously selected portfolio of hedge funds can still offer investors the desired returns and diversification advantages. Additionally, with

increasing globalization, correlations between markets are expected to increase. Therefore, analyzing individual hedge fund performance in different crisis scenarios, such as the 1929 crisis or the 1997 Asian crisis, could provide more insights into their particular performance. Comparing results in each crisis could reveal patterns and identify strategies that offer superior performance in specific crisis scenarios. Moreover, R^2 in the different models are low, which does not offer the possibility to explain with strong accuracy the results given. Furthermore, simulating potential future crisis scenarios can help investigate how these strategies might perform. It is important to note that past performance may not necessarily indicate future performance, particularly in turbulent crisis scenarios.

8. Reference

- Abugri, B. A., & Dutta, S. (2009). Emerging market hedge funds: Do they perform like regular hedge funds? *Journal of International Financial Markets, Institutions & Money*, 19, 834–849.
- Agarwal, V., Fung, W. H., Loon, Y. C., & Naik, N. Y. (2011). Risk and return in convertible arbitrage: Evidence from the convertible bond market. *Journal of Empirical Finance*, 18, 175-194.
- Agarwal, V., & Naik, N. Y. (2004). Risks and Portfolio Decisions Involving Hedge Funds. *Review of Financial Studies*, 17, 63–98.
- Antonakis, J., Schriesheim, C. A., Donovan, J. A., Gopalakishna-Pillai, K., Pellegrini, E. K., & Rossomme, J. L. (2004). Methods for studying leadership. *The nature of leadership*, 48-70.
- Asness, C. A., Frazzini, L. H., & Pedersen, L. H. (2013). Quality Minus Junk. *Capital Management*.
- Asness, C., Krail, R., & Liew, J. (2001). *Journal of Portfolio Management*, 28(1), 6-19.
- Bali, T. G., Brown, S. J., & Caglayan, M. O. (2014). Macroeconomic risk and hedge fund returns. *Journal of Financial Economics*, 114, 1-19.
- Barclay Hedge. (2012). *What is a hedge fund?* Retrieved from Barclay Hedge: <https://www.barclayhedge.com/insider/what-is-a-hedge-fund>
- Barclay Hedge. (2022). *Hedge Fund Industry Assets Under Management*. Retrieved from Barclay Hedge: <https://www.barclayhedge.com/solutions/assets-under-management/hedge-fund-assets-under-management/>
- Beltratti, A., & Morana, C. (2006). Net inflows and time-varying alphas: the case of hedge funds. *International centre for economic research*.
- Britannica. (2023). *S&P500*. Retrieved from Britannica Money: <https://www.britannica.com/money/SandP-500>
- Brooks, C. (2019). *Introductory econometrics for finance*. Cambridge university press.
- Brown, S. J., Goetzmann, W. N., & Ibbotson, R. G. (1999). Offshore Hedge Funds: Survival and Performance 1989–1995. *Journal of Business*, 72, 91–117.
- Caldwell, E. (1995). *Introduction: The Model for Superior Performance*. New York, New York, USA: J. Lederman and R. A. Klein (eds.).
- Canepa, A., González, M. d., & Skinner, F. S. (2020). Hedge fund strategies: A non-parametric analysis. *International Review of Financial Analysis*, 101436.

- Chan, N., Getmansky, M., Haas, S. M., & Lo, A. W. (2005). *The Risks of Financial Institutions: Systemic Risk and Hedge Funds*. Chicago, USA: University of Chicago Press.
- Choi, D., Getmansky, M., & Tookes, H. (2009). Convertible bond arbitrage, liquidity externalities, and stock prices. *Journal of Financial Economics*, 91(2), 227-251.
- Credit Suisse. (2023). *LAB and HF Indices*. Retrieved April 2023, from Credit Suisse: https://lab.credit-suisse.com/#/en/index/HEDG/HEDG_MULTI/overview
- Duarte, J., Longstaff, F. A., & Yu, F. (2006). Risk and Return in Fixed-Income Arbitrage: Nickels in Front of a Steamroller? *Review of Financial Studies*, 20(3), 769–811.
- Fung, W., & Hsieh, D. A. (1999). A primer on hedge funds. *Journal of Empirical Finance*, 6, 309–331.
- Fung, W., & Hsieh, D. A. (2004). Hedge Fund Benchmarks: A Risk-Based Approach. *Financial Analysts Journal*, 60(5), 65-80.
- Fung, W., & Hsieh, D. A. (2011). The risk in hedge fund strategies: Theory and evidence from long/short equity hedge funds. *Journal of Empirical Finance*, 18, 547-569.
- Fung, W., & Hsieh, D. A. (2001). The Risk in Hedge Fund Strategies: Theory and Evidence from Trend Followers. *Review of Financial Studies*, 14, 313-341.
- Gupta, A., & Liang, B. (2005). Do Hedge Funds Have Enough Capital? A Value-at-Risk Approach. *Journal of Financial Economics*, 77, 219–253.
- Horwitz, R. (2002). Constructing a 'Risk-Efficient' Portfolio of Hedge Funds. *RiskInvest 2002 Conference Presentation* (p. 8). Boston: Kenmar Global Investment.
- Jarque, C. M., & Bera, A. K. (1980). Efficient Tests for Normality, Heteroskedasticity, and Serial Independence of Regression Residuals. *Economics Letters*, 6, 255–259.
- Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. *The Journal of finance*, 48(1), 65-91.
- Jensen, M. C. (1972). Capital markets: theory and evidence. *The Bell Journal of Economics and Management Science*, 3(2), 357-398.
- Kat, H. M., & Palaro, H. P. (2008). Risk and Return Characteristics of the Morningstar Hedge Fund Indexes. *The Journal of Alternative Investments*.
- Kosowski, R., Naik, N. Y., & Teo, M. (2007). Do hedge funds deliver alpha? A Bayesian and bootstrap analysis. *Journal of Financial Economics*, 229–264.
- Lei, T. (2022). Hedge Fund Strategy Performances during Corona Virus Disease 2019. *International Conference on mathematical statistics and economic analysis* (pp. pp. 292-300). Atlantis Press.

- Lhabitant, F. S. (2001). Assessing Market Risk for Hedge Funds and Hedge Fund Portfolios. *The Journal of Risk Finance*, 2(4), 16-32.
- 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(1), 1-31.
- Patton, A. J. (2009). Are “Market Neutral” Hedge Funds Really Market Neutral? *The Review of Financial Studies*, 22(7), 2495–2530.
- Pedersen, L. H. (2015). *Efficiently efficient: How Smart Money Invests and Market Price Are Determined*. Princeton and Oxford, New Jersey and Oxfordshire, United State of America and United Kingdom: Princeton University Press.
- Till, H., & Eagleeye, J. (2011). *A hedge fund investor’s guide to understanding managed futures*. Nice: EDHEC-Risk Institute.
- Statista. (2022). *Value of assets managed by hedge funds worldwide from 1997 to Q1 2022*. Retrieved from Statista: <https://www.statista.com/statistics/271771/assets-of-the-hedge-funds-worldwide/>

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