

THE PERFORMANCE OF HEDGE FUND INDUSTRY DURING THE COVID-19 CRISIS – THEORETICAL CHARACTERISTICS AND EMPIRICAL ASPECTS²

The study reveals that the COVID-19 crisis has had a strong but one-off negative impact on the hedge fund industry. It also shows that during the new coronavirus pandemic, the main components of the hedge fund industry achieved only partially their main investment goal, i.e. they as a whole provided a hedge of the investment risk but did not produce higher than the market return in the conditions of a growing capital market. In this situation, due to the relatively stable M&A market, the Event-Driven Risk Arbitrage strategy was undoubtedly most successful, followed by the Emerging Markets, the Global Macro and the Long/Short Equity strategies. The worst performance was reported for the Fixed Income Arbitrage strategy due to the currently overvalued bond markets and to the expectations for higher inflation rates in the countries with developed capital markets.

Keywords: hedge funds; investment strategies of hedge funds; portfolio performance; COVID-19

JEL: G11; G15; G23

Introduction

Hedge funds are among the most popular collective investment schemes. This is largely due to the high levels of secrecy associated with their activities. Another reason is the great freedom of their investment operations, which makes them significantly different from the other types of investment funds. Hedge funds are also popular because they often are perceived as subjects whose investment activities produce turbulences on the global financial markets. The hedge fund industry also concentrates huge financial resources. According to BarclayHedge, by the end of the Q4 of 2020, hedge funds and the associated Commodity Trading Advisor funds were managing assets worth more than \$4.128 trillion (BarclayHedge, 2021). This means that the great economic power of these financial institutions should not be ignored.

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² This paper should be cited as: Ganchev, A. (2022). *The Performance of Hedge Fund Industry during the COVID-19 Crisis – Theoretical Characteristics and Empirical Aspects.* – *Economic Studies (Ikonomicheski Izsledvania)*, 31 (1), p. 18-37.

The COVID-19 crisis hit the world economy in an unprecedented way. According to the International Monetary Fund, in 2020, the world's gross domestic product is expected to shrink by 4.4% (IMF, 2021), and the GDP decrease of the world's leading economies to surpass even the decline after the global financial crisis of 2008. Under these conditions, of all major economies, only China reported annual growth of 6.5% (Reuters, 2021).

The dynamic processes in the global economy have inevitably caused strong turbulence on the global financial markets. During the second half of March 2020, some leading indices such as S&P500, FTSE 100 and NIKKEI 225 declined over 30% of their highest values recorded since the beginning of the year and for the European CAC40 and DAX30 the decline was over 38%. A rapid recovery followed, with capital markets in the United States and Japan growing by more than 75% by early March 2021. Even the SSE Composite index of China's capital market, which was affected less by the crisis, registered a decline of 10.97% from 03 January to 20 March 2020, followed by an increase of 30.57% by 25 February 2021. Moreover, on 20 April 2020, the crude oil futures hit negative values (Reuters, 2020) and then rose to over 60 USD per barrel by the end of February 2021. In August 2020, the price of gold reached a historic high of more than 2000 USD per ounce (BBC, 2020). At the beginning of 2021, however, gold registered its weakest start of the year for a period of 30 years (Telegraph, 2021). Such volatile markets are a challenge for every portfolio manager and every investor. However, they are an excellent opportunity to study how managers in the hedge fund industry have managed their portfolios under the described conditions, whether their management has been effective and whether it has achieved its main goals. Therefore, the object of the study is the portfolio management of hedge funds in the conditions of COVID-19, and its subject are the quantitative tools for portfolio performance evaluation. The aim of the study is to conduct a systematic analysis of hedge funds performance in the conditions of COVID-19 and to determine whether, in such conditions, they achieve their main investment goal.

1. The Hedge Fund Industry and the COVID-19 Crisis

Unlike the last crisis, which seriously affected the global financial markets and the world economy in the period 2008-2009, the current COVID-19 crisis occurred first as a health phenomenon caused by the SARS-CoV-2 coronavirus. The first cases of people infected with it were reported by the scientific community at the beginning of December 2019 in the town of Wuhan, China (Huang, et al., 2020). However, the health authorities in the Chinese city officially announced the new infection much later – on December 31 of the same year (Reuters, 2019). By then, the global economy and financial markets had not been affected by the negative processes associated with the infection. However, this date can be accepted as the official beginning of the global crisis caused by COVID-19.

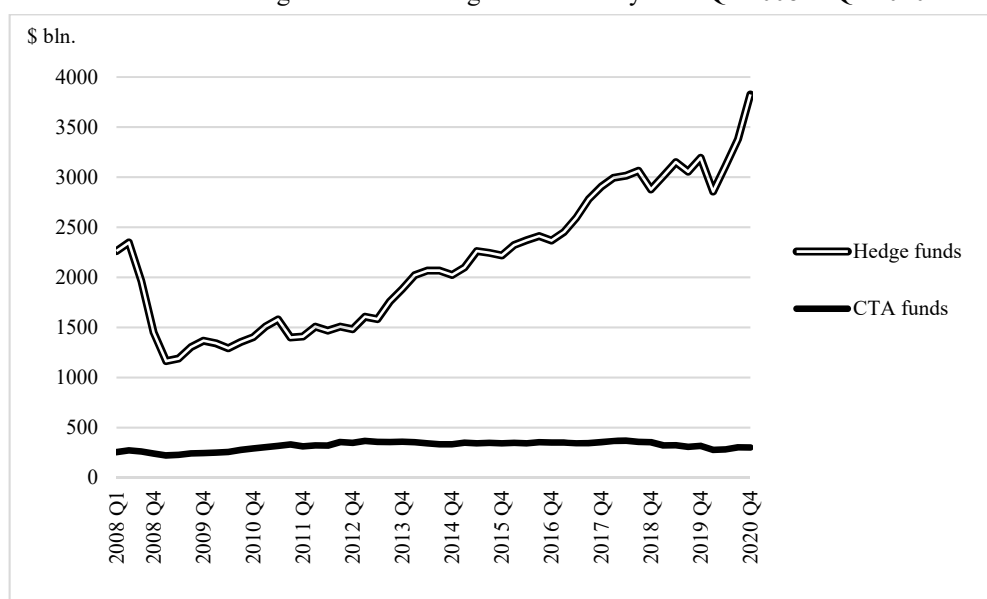
The official start of the crisis caused by the new coronavirus at the very end of the year means that it did not affect the performance of the hedge fund industry in 2019. Quite the reverse, according to the information shown in Figure 1 (BarclayHedge, 2021), the hedge fund industry has been growing throughout 2019. Together with the CTA funds, at the end of the first quarter of the year, they managed \$3.334 trillion of assets. This is an increase of 3.12%

compared to the end of 2018, which offsets the slight decline of the volume of assets they managed in the Q3 and the Q4 of that year. The hedge fund industry ended 2019 with \$3.512 trillion of assets, which is a growth of 8.64% compared to the beginning of the year and a total growth of 153.33% compared to the first quarter of 2009.

The impact of the new coronavirus on the financial markets was felt in the first quarter of 2020. At the end of February and the beginning of March, the global capital markets were registered their biggest declines since the global financial crisis from 2008. Consequently, at the end of March 2020, the assets managed by hedge funds and CTA funds fell by 10.74% to \$3.135 trillion. The unwinding of the healthcare aspects of the crisis, together with the measures undertaken by most governments and central banks to support their economies, are gradually soothing the financial markets and they, despite some minor exceptions in terms of commodity exchange shocks, reported growth by the end of 2020. The assets managed by the hedge fund industry skyrocketed to \$3.366 trillion in the Q2 and \$ 3.683 trillion in the Q3 of 2020. This means that at some time between July and September of the same year, the hedge funds completely offset the losses they had incurred due to the COVID-19 crisis. In the Q4 of 2020, the industry grew by a further 13.22% compared to the previous quarter, and the growth continued even in the first months of 2021 (Hedge Fund Research, 2021). This means that the COVID-19 crisis creates a one-off negative shock for the hedge funds from which they are recovering rapidly.

Figure 1

Assets under management in the hedge fund industry from Q1 2008 to Q4 2020



Source: BarclayHedge.com.

However, the dynamics of the assets under management provides only a general overview of hedge fund industry performance during the COVID-19 crisis. In fact, the analysis of how

hedge funds perform during the current crisis is more complex and much more detailed due to several reasons. First of all, the hedge fund industry is quite fragmented. It comprises many players that follow various investment strategies. This is why hedge funds are not analysed in terms of their risk profile, as is the case with traditional investment funds but are grouped and analysed in terms of their investment strategies. Secondly, regardless of their type and investment strategy, hedge funds have the common investment goal to achieve the highest possible return regardless of the conditions in the financial markets (Jaeger, 2003, pp. 3-4), i.e. the effectiveness of their portfolio management is a key factor for them. This problem is especially important in the conditions of financial market turmoil such as the one caused by COVID-19. Therefore, from the point of view of financial theory and investment practice, the analysis of the efficiency and quality of investment management in the different parts of the hedge funds industry during the COVID-19 crisis becomes even more interesting.

2. Characteristics of the Hedge Funds Strategies

Currently, there are many different and sometimes even contradictory classifications of the investment approaches applied by the hedge funds. Such classifications are proposed by authors such as Lhabitant (Lhabitant, 2006, pp. 159-399), Stefanini (Stefanini, 2006, pp. 21-277) and Anson (Anson, 2006, p. 139). Information companies such as BarclayHedge (BarclayHedge, 2021), Eurekahedge (Eurekahedge, 2021) and Hedge Fund Research (Hedge Fund Research, 2021) also use their own definitions of hedge fund investment strategies. However, the most common and frequently used classification is that proposed by Credit Suisse (Credit Suisse, 2021). Its main distinguishing feature and advantage are that it is not as detailed as the classifications of BarclayHedge and Hedge Fund Research and at the same time, it is not as concise as that of Eurekahedge. According to Credit Suisse, hedge funds are classified according to the following nine strategies:

First. Long/Short Equity is a strategy based on the principles formulated by Karl Karsten in 1931 (Karsten, 1931). It combines long positions in equity instruments, the value of which is expected to increase with short positions in those whose value will decrease. This multiplies the return and reduces investment risk due to the negative correlation between the different parts of the portfolio, which is artificially created through short sales.

Second. The Equity Market Neutral strategy was created and applied for the first time in the period 1979-1980 by Edward Thorp. Here the portfolio is created with zero net market or zero net beta exposure. This makes the portfolio neutral to the systematic risk factor, but retains its ability to extract high returns.

Third. Event-Driven is a set of investment strategies related to specific corporate or market events, such as mergers, acquisitions and financial distress, etc. With proper management of regulatory risks, the strategy provides an opportunity for very high and almost riskless returns.

Fourth. Fixed-Income Arbitrage is currently the strategy under which most of the assets in the hedge fund industry are managed (BarclayHedge, 2021). Here the hedge funds make arbitrage among different debt instruments, which allows the spread in their yield to be fully

hedged. The main drawback of the strategy is its highly leveraged nature which could lead to large losses or defaults like this of Long Term Capital Management L.P. in 1998.

Fifth. Convertible Arbitrage is a strategy that exploits the fact that convertible securities are often traded below their intrinsic value. The strategy is usually implemented with short positions in common stocks and long positions in convertible bonds of the same issuer. Due to its complexity, the strategy is not very popular.

Sixth. Global Macro was applied for the first time in 1980 by Julian Robertson in his Tiger Fund (Rohrer, 1986). Here the investment operations are global and they are motivated by the identified market or economic anomalies. The strategy is very attractive due to its global diversification of risk, high return and access to the cheapest possible sources of financing for its implementation.

Seventh. Emerging Markets is not a separate investment approach. Here hedge funds make their investments only in economies with financial markets identified as emerging. The strategy provides high returns, but at the same time, is characterised by high levels of investment, credit, and political risk that are typical for the emerging markets in Asia, South America and Eastern Europe.

Eighth. Managed Futures, also referred to as Commodity Trading Advisor by the legal definition of the funds that apply it (Electronic Code of Federal Regulations, 2021) is not a hedge fund strategy but is referred to as a strategy because of the fact that the CTA funds have all the functional and financial characteristics of hedge funds. Under this strategy, the CTA funds buy or sell futures contracts on different exchange-traded commodities. This allows them to diversify the risk among many assets whose value is affected by completely different fundamental factors.

Ninth. Multi-strategy is an investment approach where the hedge funds apply not one but several investment strategies. This increases the sources of return and allows a double reduction of investment risk.

3. Methodology and Data

As it was mentioned above, the main goal of hedge funds is to achieve a positive return regardless of whether markets are rising or falling, i.e. they must have zero sensitivity to the systematic risk factor. Another feature of the investment policy of hedge funds is related to the way they make their revenues. Unlike traditional investment funds, hedge funds generate most of their income from the fees they charge on the growth in their net asset value. Thus the hedge fund managers are motivated not only to achieve high returns but also to do it relatively quickly, i.e. their portfolio management is predominantly short-term and dynamic.

These characteristics severely constrain the possibilities to evaluate the portfolio performance of hedge funds using some traditional tools, such as the Treynor ratio (Treynor, 1965), the Jensen model (Jensen, 1967), its derivative appraisal ratio (Treynor & Black, 1973), the model of Treynor and Mazuy (Treynor & Mazuy, 1966) and the Fama model (Fama, 1972). They assess the portfolio performance using systematic risk, CAPM, and

related to them concepts. Therefore, when used to evaluate hedge funds, they would provide misleading results. In contrast, hedge funds performance can easily be evaluated using the Sharpe ratio (Sharpe, 1966), the arithmetic tracking error from equation 1 and Sharpe's information ratio (Jorion, 2007, p. 373):

$$TE_A = \frac{\sum_{t=1}^T (r_{p,t} - r_{b,t})}{T-1}, \quad (1)$$

$$I = \frac{r_p - r_b}{\sigma_{r_p - r_b}}, \quad (2)$$

where: TE_A is the arithmetic tracking error. $r_{p,t}$ is the portfolio return at time t ; $r_{b,t}$ is the return of the benchmark at time t ; I is the information ratio; $r_{p,t}$ is the portfolio return r_b is the return of the benchmark; $\sigma_{r_p - r_b}$ is the standard deviation of the portfolio's excess return.

Although the beta coefficient is not suitable to measure the systematic risk of hedge funds, it can be used to analyse the sensitivity of their performance to current market conditions. Such an analysis can be improved by adding the positive and negative betas proposed by Bacon (Bacon, 2008, pp. 72-73), which measure the sensitivity only to positive or negative benchmark returns.

From the point of view of the investment goals of hedge funds, the evaluation of their portfolio efficiency, which includes their negative investment results, would give a methodologically correct picture of their investment performance. Some of the measures that meet this requirement are those using downside risk. Most popular among them are the Sortino ratio (Sortino & Price, 1994) and the Kappa ratio proposed by Kaplan и Knowels (Kaplan & Knowels, 2004):

$$\text{SortinoR} = \frac{r_p - \text{MAR}}{\sigma_{\text{MAR}}}, \quad (3)$$

$$\text{Kappa} = \frac{r_p - \tau}{\sqrt{\alpha \text{LPM}_{\alpha,t}}}, \quad (4)$$

where: SortinoR is the Sortino and Price ratio; MAR is minimum acceptable return; σ_{MAR} is below MAR semi-standard deviation; Kappa is the ratio proposed by Kaplan and Knowels; $\text{LPM}_{\alpha,t}$ is the lower partial moment of order α and target return τ .

In 1999 Sortino, Meer and Plantinga (Sortino, et al., 1999) proposed the upside potential ratio. It shows the average positive return above the target return per unit of downside risk measured as a below target semi-standard deviation:

$$\text{UPR} = \frac{\frac{\sum_{t=1}^G \text{Max}[0, (\tau - r_t)]}{G}}{\sigma_{\tau}}, \quad (5)$$

where: UPR is the upside potential ratio; τ is target return; σ_{τ} is below τ semi-standard deviation.

A measure similar to the upside potential ratio is variability skewness, which was proposed by Bacon (Bacon, 2008, p. 98). It measures the magnitude of the deviation above the target return compared to the deviation below it over a certain period:

$$VS = \frac{\sqrt{\frac{\sum_{t=1}^T [\text{Max}(0, \tau - r_t)]^2}{T-1}}}{\sigma_{\tau}}, \quad (6)$$

where VS is variability skewness.

Another hedge fund performance measure was proposed by Bernardo and Ledoit in 1996 (Bernardo & Ledoit, 2000). Their gain to loss ratio is the ratio of the average gain to the average loss over a certain period. In 2002, Keating and Shadwick (Keating & Shadwick, 2002, p. 2) generalised the concept of Bernardo and Ledoit into their Omega ratio:

$$GLR = \frac{[\sum_{i=1}^G \text{Max}(r_i, 0)]/G}{[\sum_{i=1}^L \text{Min}(r_i, 0)]/L}, \quad (7)$$

$$\Omega = \frac{[\sum_{t=1}^T \text{Max}[0, (\tau - r_t)]]/T}{[\sum_{t=1}^T \text{Min}[0, (\tau - r_t)]]/T}, \quad (8)$$

where: GLR is the gain-to-loss ratio; Ω is the omega ratio; $\sum_{t=1}^T \text{Max}[0, (\tau - r_t)]/T$ is average gain above τ ; $\sum_{t=1}^T \text{Min}[0, (\tau - r_t)]/T$ is average loss below τ ; G is the number of gains; L is the number of losses.

The risk of collective investment schemes can also be determined using tools based on the drawdown concept. They are not based on sound scientific foundations, and their best-known forms are the average drawdown, the drawdown deviation, the maximum drawdown and the largest individual drawdown. Due to their simplicity, these tools are very popular and are at the core of a number of approaches for portfolio performance evaluation. One of them is the CALMAR ratio. It was developed by Young (Young, 1991) in 1991 on the base of Sharpe ratio, in which the standard deviation is replaced by the maximum drawdown:

$$CALMAR = \frac{r_p - r_f}{MDD}, \quad (9)$$

where: CALMAR is the ratio proposed by Young; MDD is the maximum drawdown.

In 2006, Zephyr Associates modified Young's methodology by substituting the denominator in equation 9 with the average absolute drawdown. They called this risk metric "pain index" and the related ratio – pain ratio (Odo, 2006):

$$P.R. = \frac{r_p - r_f}{P.I.}, \quad (10)$$

$$PI = \frac{\sum_{i=1}^d |D_i|}{d}, \quad (11)$$

where: P.R. is pain ratio; P.I. is pain index; D_i is the i^{th} drawdown; d is total number of drawdowns.

Ulcer Performance Index is a ratio that uses a risk metric developed in 1989 by Martin and McCann and known as ulcer index (Martin, 2012). The advantage of the ulcer index compared to the pain ratio is that it is very sensitive even to minute losses because it uses their quadratic values:

$$UPI = \frac{r_p - r_f}{U.I.}, \quad (12)$$

$$UI = \sqrt{\frac{\sum_{i=1}^d D_i^2}{d}}, \quad (13)$$

where: U.I. is ulcer index; UPI is ulcer performance index.

The last group of metrics that can be used successfully to evaluate the performance of hedge funds comprises ratios that are highly simplified, but can provide important information that many of the measures discussed above cannot. Morningstar (MorningStar, 2021) defines two of these tools as upside capture indicator and downside capture indicator. The upside capture is a ratio, which divides the average portfolio return during periods when the benchmark had a positive return and the average benchmark return during that same period. The downside capture is a ratio, which divides the average portfolio return during periods when the benchmark had a negative return and the average benchmark return during that same period. The up number ratio and down number ratio proposed by Bacon (Bacon, 2012, p. 34) compare the number of periods for which a portfolio has a positive or negative return to the number of periods in which the benchmark had the same positive or negative return. The up percentage ratio and the down percentage ratio (Bacon, 2008, p. 48) assess how many times the portfolio outperformed the benchmark when the benchmark was up or down, respectively. On the other hand, for a given period of time, the percentage gain ratio proposed by Lhabitant (Lhabitant, 2004, p. 58) and its counterpart per cent loss ratio measure whether a portfolio outperformed the benchmark in numbers of gains or losses.

The performance of the hedge fund industry during the COVID-19 crisis was evaluated using a database of U.S. dollar-denominated net asset value indices of the main hedge fund strategies published by Credit Suisse (Credit Suisse, 2021). The sub-indices of the Event-Driven strategy available in the database (Event-Driven Distressed, Event-Driven Multi-Strategy and Event-Driven Risk Arbitrage) were also analysed. They measure the performance of hedge funds that invest in companies in financial distress, hedge funds applying multiple event-driven strategies and those investing in companies involved in mergers and acquisitions.

The analysis covers the period between the end of October 2018 and the end of February 2021 divided into two equal sub-periods designated as pre-crisis and crisis periods, respectively. The first sub-period is from 31 January 2018 to 31 December 2019, and the second is from 31 December 2019 to 26 February 2021. The main purpose of this subdivision is to compare the performance of the hedge fund industry prior to and during the COVID-19 crisis in order to highlight its effects. Of course, when the analysis was completed, the healthcare aspects of the COVID-19 crisis were still in force. However, the recovery of industrial production and expectations for economic growth in 2021 show that the world economy has overcome or is about to overcome its negative effects. On the other

hand, the growth of the hedge fund industry and financial markets since the beginning of 2021 shows that, as far as the capital markets are concerned, the problems have also been overcome. Moreover, at the beginning of 2021, inflation expectations are already the main drive of the processes on the capital markets, and especially those in the United States. This shows that the financial markets are already entering a fundamentally new phase of their existence, which is not directly related to COVID-19. Therefore, the frame of the crisis period in the study is appropriate and correspond to its goal.

Due to the specific characteristics of the activity of hedge funds and their quasi-opened nature, the analysed data has a monthly frequency. For this reason, the database for the assumed benchmark MSCI ACWI All Cap Index, published by the financial company MSCI (MSCI, 2021), is again with monthly frequency. The index includes data for over 14,000 financial instruments issued on developed as well as emerging financial markets.

The risk-free yield used in the study is the yield of the 3-month U.S. Treasury Bills set by the U.S. Treasury Department (U. S. Department of Treasury, 2021). In order to facilitate the analysis, the same yield is assumed as a target return. For the purposes of the research, the annual risk-free rate is adjusted on a monthly basis and for both sub-periods.

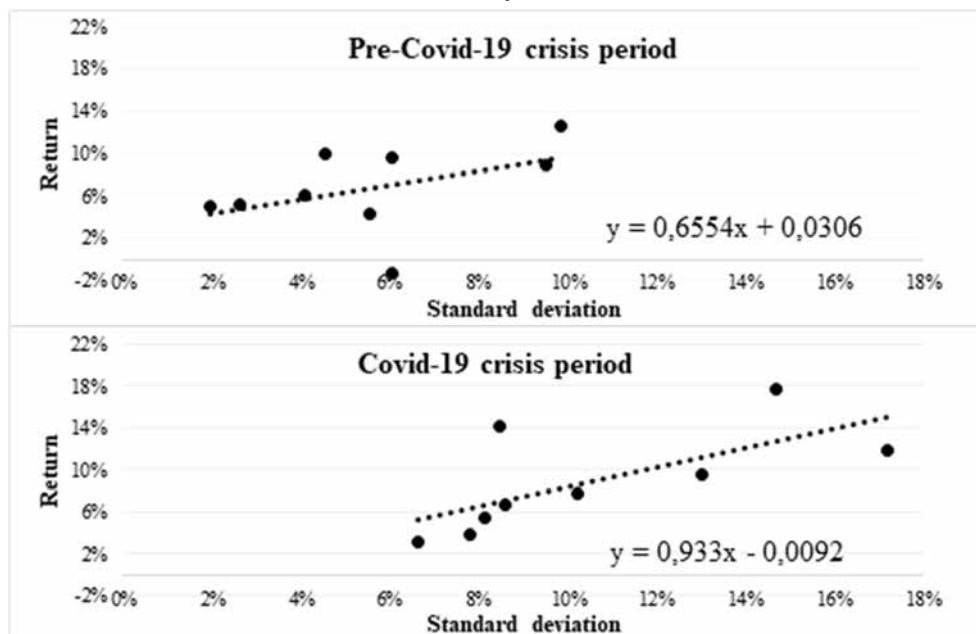
The returns of the benchmark index and the Credit Suisse indices are calculated using a simple growth rate, which is averaged by using a geometric mean. Equivalent to the study period is the value of its standard deviation and below target semi-standard deviation, calculated according to Markowitz (Markowitz, 1991, pp. 188-202). The LPM used in the calculations in the study is of the first order.

4. Empirical Results

The analysis of the dynamics in the hedge fund industry from Figure 1 shows that it was growing throughout the studied period but with wide negative and positive fluctuations of the assets under management. This is confirmed by the results shown in Figure 2, which presents the overall risk-return characteristics of the main hedge fund strategies before and during the crisis. It shows that in the pre-crisis period, the major hedge funds achieved lower overall returns compared to their performance during the crisis. From 31 October 2018 till 31 December 2019, the return of the different hedge fund strategies fluctuated between -1.29% for the Equity Market Neutral strategy and 12.57% for the Emerging Markets strategy. The same two strategies set the lower and upper hedge fund performance margins for the period 31 December 2019 – 26 February 2021 during which the minimum return was 3.08% for the former strategy and 17.78% for the latter.

The better overall return during the COVID-19 crisis period was achieved at the cost of higher risk exposure. Even at a quick glance, the information in Figure 2 shows that during the COVID-19 crisis, the industry took a significantly higher risk than the risk levels before its occurrence. However, the relationship between the standard deviation and the return for the two sub-periods shows that during the crisis period, the hedge fund industry managed to achieve an average return of 0.93% for each unit of investment risk, while in the pre-crisis period, the industry achieved only 0.66% per unit of risk.

Figure 2
Risk-return characteristics of the main hedge fund strategies from 31 October 2018 to 26 February 2021



Source: Author's own calculations.

Table 1 provides a more detailed picture of the overall performance of the main hedge fund strategies. The Sharpe ratio during the COVID-19 crisis was highest for the Convertible Arbitrage and the Emerging Markets strategies. Moreover, both strategies have Sharpe ratios that are greater than the benchmark's Sharpe ratio of 0.7282. The values of the Sharpe ratio of all other hedge fund strategies are lower than this of the benchmark. The worst performance here have Equity Market Neutral and Managed Futures strategies. Against this background, only the Event-Driven Risk Arbitrage sub-strategy has a Sharpe ratio above 2, which is more than three times higher than the Sharpe ratio of the Event-Driven strategy as a whole. All this shows that the seemingly better overall performance of the hedge fund industry during the crisis period is mainly due to the Convertible Arbitrage and the Emerging Markets and, to a certain extent, to the Event-Driven Risk Arbitrage strategy. The situation prior to the crisis was quite different. The strategies like Emerging Markets, Fixed Income Arbitrage, Global Macro, Long/Short Equity and Multi-Strategy had Sharpe ratios greater than 1. Here the Sharpe ratios of Fixed Income Arbitrage, Global Macro and Long/Short Equity strategies were greater than the Sharpe ratio of the benchmark that is 1.0707. It is also worth noting that in the pre-crisis period, the Event-Driven Risk Arbitrage sub-strategy also performed significantly better than the overall Event-Driven strategy and the benchmark index.

Table 1
Sharpe ratio, Information ratio and Tracking error of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period			Covid-19 crisis period		
	Sharpe ratio	Tracking error	Information ratio	Sharpe ratio	Tracking error	Information ratio
Convertible Arbitrage	0.8860	-0.0089	-1.0451	1.6146	-0.0054	-0.2597
Emerging Markets	1.0215	-0.0044	-0.5986	1.1791	-0.0026	-0.0940
Equity Market Neutral	-0.6336	-0.0140	-1.1682	0.3974	-0.0128	-0.7239
Event-Driven	0.3329	-0.0100	-1.3773	0.6638	-0.0060	-0.6148
Event-Driven Distressed	-0.7594	-0.0138	-1.6950	0.5453	-0.0091	-0.7433
Event-Driven Multi-Strategy	0.6296	-0.0084	-1.2253	0.5831	-0.0055	-0.6800
Event-Driven Risk Arbitrage	1.6301	-0.0093	-0.9592	2.0570	0.0000	0.1835
Fixed Income Arbitrage	1.2564	-0.0097	-0.9971	0.6090	-0.0111	-0.6178
Global Macro	1.6471	-0.0063	-0.6514	0.7233	-0.0093	-0.6505
Long/Short Equity	1.1683	-0.0065	-0.9561	0.7023	-0.0079	-0.6385
Managed Futures	0.6581	-0.0068	-0.5201	0.4269	-0.0123	-0.6087
Multi-Strategy	1.0277	-0.0095	-0.9596	0.7163	-0.0103	-0.6412

Source: Author's own calculations.

The data show that only the Event-Driven Risk Arbitrage sub-strategy had a tracking error of 0 during the crisis, while the benchmark outperformed all other strategies in both analysed sub-periods. Therefore, it is no coincidence that all strategies but the Event-Driven Risk Arbitrage have negative information ratios for both sub-periods of the study.

Table 2
Beta, Positive beta, and Negative beta of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period			Covid-19 crisis period		
	Beta	Positive beta	Negative beta	Beta	Positive beta	Negative beta
Convertible Arbitrage	0.2181**	0.3087*	0.24690	0.2540**	0.0488	0.4505*
Emerging Markets	0.4764**	0.45620	-0.7769*	0.4657**	0.0973	0.7590*
Equity Market Neutral	-0.0621	0.30820	-0.46580	0.1578*	-0.1519	0.1718*
Event-Driven	0.3298**	0.3398**	0.31260	0.6109**	0.3537**	0.9705**
Event-Driven Distressed	0.2514**	0.2848*	0.05340	0.4560**	0.3706	0.6917**
Event-Driven Multi-Strategy	0.3781**	0.3782**	0.43890	0.7022**	0.3611**	1.1197**
Event-Driven Risk Arbitrage	0.0953**	0.1391*	-0.05330	0.3380**	0.2443	0.5846*
Fixed Income Arbitrage	0.0917**	0.1285*	-0.02160	0.1715*	-0.2081	0.4952*
Global Macro	0.1495	0.26630	0.07590	0.3464**	0.1405	0.4146**
Long/Short Equity	0.3789**	0.3857**	0.44310	0.4546**	0.1229	0.4122*
Managed Futures	-0.1024	-0.24380	0.86280	0.0597	-0.1637	-0.0224
Multi-Strategy	0.0825	0.14410	0.25770	0.2634**	-0.0511	0.4196**

* statistical significance at 95% confidence interval

** statistical significance at 99% confidence interval

Source: Author's own calculations.

By definition, the sensitivity of hedge fund returns to benchmark returns should be zero. The empirical results in Table 2 show that, with the exception of the Managed Futures strategy in the crisis period, the beta coefficients of all strategies are higher than and statistically significantly different from zero. In the pre-crisis period, the situation for the Equity Market

Neutral, Fixed Income Arbitrage, Managed Futures, Multi-Strategy and Event-Driven Risk Arbitrage sub-strategy was similar, although slightly better. The absence of positive beta ratios greater than 1 in both sub-periods shows that the hedge fund industry, in general, did not have a tendency to make higher than the benchmark return when the global capital markets grow. Moreover, the positive beta coefficients of the Managed Futures strategy in the pre-crisis period and of the Equity Market Neutral, Fixed Income Arbitrage, Managed Futures, Multi-Strategy strategies during the crisis have negative values, which means that in the conditions of growing capital markets, they tended to make negative returns.

The values of the negative beta show that during the crisis, only the Managed Futures strategy had a weak and, in fact, insignificant tendency to achieve positive returns in a declining global capital market. The values of the negative beta of the other hedge fund strategies in this period are positive and statistically significant, which means that during the crisis period, they tended to have a negative performance in a declining capital market. In contrast to the crisis period, in the pre-crisis period, the negative betas of all but three of the strategies and one of the sub-strategies have positive values. However, these values are lower than those in the crisis period, which means that in the pre-crisis period, the hedge funds were less sensitive to the negative side of the systematic risk factor. In contrast to the pre-crisis period, the value of the negative betas of the Emerging Markets, Equity Market Neutral, and Fixed Income Arbitrage strategies and the Event-Driven Risk Arbitrage sub-strategy are negative (and even statistically significant for the Emerging Markets strategy). This means that these hedge fund strategies managed to generate positive returns in the face of a global market downturn.

The data in Table 3 show that during the crisis, the strategies Emerging Markets, Global Macro, Long/Short Equity, Managed Futures and Multi-Strategy have the highest Sortino ratios and with a few exceptions, the highest Kappa ratios. The Fixed Income Arbitrage has the worst performance according to both ratios, which is due to the low return of this strategy throughout the whole period and its relatively high downside risk. It is also worth noting that due to its high return in the period from 31 October 2018 to 31 December 2019, the Event-Driven Risk Arbitrage sub-strategy had the best relative performance considering its asymmetric risk.

Table 3

Sortino&Price ratio and Kappa ratio of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period		Covid-19 crisis period	
	Sortino	Kappa	Sortino	Kappa
Convertible Arbitrage	1.1768	1.7064	0.5637	0.1506
Emerging Markets	0.9874	1.2842	0.8782	0.3584
Equity Market Neutral	-0.4942	-0.6920	0.5496	0.2062
Event-Driven	0.3281	0.4432	0.4413	0.1920
Event-Driven Distressed	-0.6778	-0.7988	0.4273	0.2051
Event-Driven Multi-Strategy	0.5920	0.8089	0.4273	0.2041
Event-Driven Risk Arbitrage	2.1008	2.3828	1.3046	0.4446
Fixed Income Arbitrage	1.1992	1.4889	0.2738	0.0832
Global Macro	2.7064	3.0071	0.7032	0.2725
Long/Short Equity	1.1124	1.4916	0.6779	0.2356
Managed Futures	0.6354	0.7257	0.6545	0.1944
Multi-Strategy	0.8896	1.1316	0.5869	0.2463

Source: Author's own calculations

Despite the lower returns of the main hedge fund strategies in the pre-crisis period, the values of their Sortino and Kappa ratios are significantly higher in general. This is due to their lower downside risk, as the Fixed Income Arbitrage strategy ranks among the leaders in terms of its return per unit of asymmetric risk. The same holds for the Convertible Arbitrage strategy. The Event-Driven Risk Arbitrage sub-strategy also has a very good performance in this respect. In contrast, the strategies with poorer performance during the crisis, such as the Equity Market Neutral and the Event-Driven (together with its Event-Driven Multi-Strategy and Event-Driven Distressed sub-strategies) had low return-to-downside risk ratios in the pre-crisis period as well. Only the Multi-Strategy strategy retained its ranking in both sub-periods.

Table 4

Upside potential, Variability skewness, Gain to loss ratio and Omega ratio of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period				Covid-19 crisis period			
	Upside Potential	Variability Skewness	Gain to Loss	Omega	Upside Potential	Variability Skewness	Gain to Loss	Omega
Convertible Arbitrage	0.0410	1.6361	1.7830	1.7917	0.0173	0.2772	0.2398	0.2326
Emerging Markets	0.0649	0.9969	0.9244	1.0583	0.0636	0.6717	0.9147	0.8937
Equity Market Neutral	0.0099	0.5054	0.6575	0.6096	0.0618	1.9027	2.5469	2.3991
Event-Driven	0.0269	0.9763	1.7025	1.1957	0.0445	0.4912	0.7048	0.6895
Event-Driven Distressed	0.0136	0.7845	1.1855	0.7941	0.0467	0.6505	0.9289	0.9002
Event-Driven Multi-Strategy	0.0329	0.9130	1.0913	1.0938	0.0528	0.5527	0.9297	0.9115
Event-Driven Risk Arbitrage	0.0219	1.5386	2.2401	1.3791	0.0620	0.6519	0.6663	0.6486
Fixed Income Arbitrage	0.0126	0.9822	1.1852	1.0522	0.0117	0.2752	0.2778	0.2664
Global Macro	0.0763	2.0755	2.0972	1.6843	0.0582	0.9845	0.9504	1.2385
Long/Short Equity	0.0395	0.9847	1.0881	1.1221	0.0727	0.9710	1.2095	1.1793
Managed Futures	0.0593	0.9674	1.0276	0.8438	0.0920	2.0568	1.8986	1.8085
Multi-Strategy	0.0131	0.8183	1.3245	0.9428	0.0357	0.7269	0.9873	0.9452

Source: Author's own calculations.

The data in Table 4 show that the Managed Futures, the Long/Short Equity, and the Emerging Markets strategies had the highest growth potential during the COVID-19 crisis. For each additional unit of downside risk, they had an excess return above the benchmark of 0.092%, 0.073%, and 0.064%, respectively. The Event-Driven, the Multi-Strategy, the Convertible Arbitrage and the Fixed Income Arbitrage had the worst upside potential ratios during the crisis, the main reason for this being their large below target semi-standard deviation, which in some cases is between four and five times higher compared to the strategies with the highest upside potential. This is the reason why the Managed Futures and the Equity Market Neutral have a very strong variation of their positive return above the target return compared to this below it. During the COVID-19 crisis, the deviation below the target return of all other strategies is deeper and/or longer than that above it. The gain-to-loss ratios show that the average positive return of the Equity Market Neutral, the Managed Futures and the Long/Short Equity strategies throughout the period was higher than their average negative return, something that is not valid for the other analysed strategies. A comparison of the data in Table 4 shows that prior to the COVID-19 crisis, most of the strategies had lower upside potential than during the crisis. However, a great number of them had bigger positive deviations from the target return than negative deviations from it. Their average gain-to-loss

ratio was also better, as in ten of the strategies, it was greater than one. This means that, prior to the crisis, the hedge funds that applied these strategies on average gained more than they lost. This particularly holds for the Global Macro strategy and the Event-Driven Risk sub-strategy and does not apply only to the Emerging Markets and the Equity Market Neutral strategies.

Table 5

CALMAR, Pain ratio and Ulcer Performance Index of the main hedge fund strategies
before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period			Covid-19 crisis period		
	CALMAR	Pain ratio	UPI	CALMAR	Pain ratio	UPI
Convertible Arbitrage	1.9379	14.3231	0.4557	2.1215	13.7081	0.4146
Emerging Markets	1.7502	7.6832	0.2923	1.6090	9.5410	0.3153
Equity Market Neutral	-0.8904	-2.2704	-0.1263	0.4989	1.6097	0.0774
Event-Driven	0.5224	2.3040	0.0987	0.7161	2.6583	0.1168
Event-Driven Distressed	-0.8565	-1.9529	-0.0991	0.6481	1.8852	0.0902
Event-Driven Multi-Strategy	0.9508	5.3454	0.2044	0.6119	2.2953	0.1003
Event-Driven Risk Arbitrage	7.8119	55.4173	1.4544	3.1659	24.2536	0.6928
Fixed Income Arbitrage	2.3015	17.9354	0.4947	0.5967	2.5608	0.0966
Global Macro	8.6018	34.9096	1.2973	0.9126	4.0420	0.1636
Long/Short Equity	2.8625	16.2171	0.5128	0.8194	3.7401	0.1559
Managed Futures	0.9048	3.1817	0.1279	0.6472	1.5863	0.0804
Multi-Strategy	1.4397	8.7949	0.2789	0.8280	3.6356	0.1418

Source: Author's own calculations.

Table 5 presents the performance of the different hedge fund strategies according to their drawdown risk. Obviously, during the COVID-19 crisis, the Convertible Arbitrage, the Emerging Markets, and the Global Macro strategies had an outstanding performance in terms of their CALMAR, Pain ratio, and Ulcer Performance Index. However, they and all other strategies in the analysis were outperformed by the Event-Driven Risk Arbitrage sub-strategy. What is more, the other event-driven strategies included in the analysis, as well as the Managed Futures, the Fixed Income Arbitrage and the Equity Market Neutral strategies had the worst performance in this sub-period according to the same criteria. Here the strategies with poor performance tend to maintain their low rank across the three assessment criteria. This means that the magnitude of their drawdowns is relatively the same, regardless of the computational approaches used. The only more significant discrepancy in the assessments of the Fixed Income Arbitrage and the Managed Futures strategies shows that during the crisis, they had a higher maximum but relatively lower average and squared drawdown and a lower maximum but higher average and a squared drawdown, respectively.

The data in Table 5 show that during the pre-crisis period, all strategies had better indicators compared to the crisis period, which, considering their lower return in the period 31 October 2018 – 31 December 2019, means that they had achieved lower drawdowns. The second important conclusion is that the strategies with poor performance in the crisis period had poor performance in the pre-crisis period as well. The only significant exception is the Fixed Income Arbitrage strategy, which means that prior to the crisis, most debt markets were growing. Another observation for the pre-crisis period is the poor performance of the

Convertible Arbitrage strategy, which means that there weren't appropriate arbitrage opportunities between the debt and the equity markets.

Table 6

Upside capture, Downside capture, Up number ratio and Down number ratio of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period				Covid-19 crisis period			
	Upside capture	Downside capture	Up number	Down number	Upside capture	Downside capture	Up number	Down number
Convertible Arbitrage	0.2466	0.1514	0.8182	1	0.3291	0.1023	1	0.1667
Emerging Markets	0.6144	0.5490	0.9091	1	0.5359	0.3235	1	0.6667
Equity Market Neutral	-0.1134	-0.1758	0.5455	0.3333	0.2033	0.2391	0.6250	1
Event-Driven	0.2911	0.3496	0.6364	1	0.5572	0.5223	1	0.6667
Event-Driven Distressed	0.1273	0.3305	0.5455	1	0.3946	0.3911	0.8750	0.6667
Event-Driven Multi-Strategy	0.3678	0.3772	0.8182	1	0.6317	0.6304	1	0.8333
Event-Driven Risk Arbitrage	0.1780	0.0408	0.9091	0.6667	0.4471	0.0486	1	0.3333
Fixed Income Arbitrage	0.1628	0.0437	0.9091	0.6667	0.1706	0.1024	0.8750	0.1667
Global Macro	0.2892	0.0151	0.7273	0.3333	0.3706	0.3618	0.8750	0.6667
Long/Short Equity	0.4296	0.3381	0.9091	1	0.5243	0.5597	1	1
Managed Futures	0.1319	-0.2793	0.6364	0.3333	0.1485	0.1189	0.5000	0.6667
Multi-Strategy	0.1471	-0.0075	0.8182	0.6667	0.2872	0.2626	1	0.8333

Source: Author's own calculations.

The information in Table 6 shows that during the COVID-19 crisis, most hedge fund strategies have managed to achieve positive returns in periods when the benchmark grows. Only the Fixed Income Arbitrage, the Global Macro, the Equity Market Neutral, the Managed Futures strategies and the Event-Driven Distressed sub-strategy fail to do so in all periods where MSCI ACWI All Cap Index is up. On the other hand, the values of the down number ratio show that, with the exception of the Equity Market Neutral and the Long/Short Equity strategies, most parts of the hedge fund industry has managed to hedge itself against market downturns. However, both findings should not lead to over-optimism, because throughout the specified period, no hedge fund strategy managed to achieve a higher return than the benchmark when it was up. Moreover, no hedge fund strategy achieved a return that exceeds 63.17% of the positive return of the MSCI ACWI All Cap Index and only the Event-Driven, the Emerging Markets, the Long/Short Equity and the Event-Driven Multi-Strategy achieved returns exceeding 52.43% of its return. The same strategies in the conditions of a declining capital market and especially the Event-Driven, the Long/Short Equity, and the Event-Driven Multi-Strategy had the highest average negative returns. Here the strategy Event-Driven Risk Arbitrage is again the best performer. The situation is even worse considering the pre-crisis data. During this period, the industry failed to keep pace with the benchmark when it was growing. Almost half of the strategies had negative returns during market decline and as a whole, the values of the up capture indicator are worse than those during the crisis period. Only the Emerging Markets strategy had an average performance close to its performance during the COVID-19 crisis sub-period. On the other hand, only the strategies like Managed Futures, Equity Market Neutral and Multi-Strategy managed to achieve a positive average return in conditions of market decline.

The final aspects of the performance of the analysed hedge fund strategies are shown in Table 7. The values of the up per cent ratio indicate that during the crisis, about half of the analysed strategies did not outperform the MSCI ACWI All Cap Index during market growth. The index was defeated only twice by the Managed Futures strategy and only once by the other strategies with similar performance. In conditions of market decline, the hedge funds had better results than MSCI ACWI All Cap Index. Eight of the hedge fund strategies had better returns than the index return, and four of them failed to make this only once. During the crisis, nine strategies had a greater number of positive returns than the benchmark, one strategy (the Long/Short Equity) had equal positive returns like the benchmark, and only the Equity Market Neutral and the Managed Futures strategies scored fewer positive returns than the benchmark. The values of the percent loss ratio confirm again the conclusion that the hedge fund industry performs well during a market decline, with the Equity Market Neutral and the Managed Futures again score more losses than the MSCI ACWI All Cap Index.

Table 7

Up per cent ratio, Down per cent ratio, Percent gain ratio and Percent loss ratio of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period				Covid-19 crisis period			
	Up %	Down %	Per cent gain	Per cent loss	Up %	Down %	Per cent gain	Per cent loss
Convertible Arbitrage	0	1	0.8182	1.6667	0	1	1.6250	0.1667
Emerging Markets	0.3636	0.6667	0.9091	1.3333	0.1250	1	1.2500	0.6667
Equity Market Neutral	0	1	0.7273	2	0	1	0.6250	1.5000
Event-Driven	0	1	0.6364	2.3333	0.1250	1	1.2500	0.6667
Event-Driven Distressed	0	1	0.5455	2.6667	0.1250	1	1.1250	0.8333
Event-Driven Multi-Strategy	0.1818	1	0.8182	1.6667	0.1250	0.8333	1.1250	0.8333
Event-Driven Risk Arbitrage	0	1	1	1	0.1250	1	1.5000	0.3333
Fixed Income Arbitrage	0	1	1	1	0	1	1.5000	0.3333
Global Macro	0.1818	1	0.9091	1.3333	0	1	1.1250	0.8333
Long/Short Equity	0.0909	1	0.9091	1.3333	0.1250	0.8333	1	1
Managed Futures	0.1818	1	0.8182	1.6667	0.2500	0.8333	0.7500	1.3333
Multi-Strategy	0.0909	1	0.9091	1.3333	0	0.8333	1.1250	0.8333

Source: Author's own calculations

During the pre-crisis period, the situation was different because all strategies underperformed in more cases compared to the benchmark index. During this period, only the Fixed Income Arbitrage and the Event-Driven Risk Arbitrage strategies had more positive returns than the MSCI ACWI All Cap Index. However, in the pre-crisis period, the industry as a whole had better performance in terms of risk hedging and protection of investors' wealth. Only the Emerging Markets strategy failed to beat the benchmark in conditions of market decline. Moreover, before the beginning of 2020, most hedge fund strategies had never been able to outperform the benchmark in conditions of market growth. The only significant exception is the Emerging Markets strategy, which outperformed the market four times, and some of the other strategies had better performance only once for the entire period.

Conclusion

The study presents an analysis of the impact of the COVID-19 crisis on the performance of different hedge fund strategies by the end of 2019 and in the first months of 2021. The analysis covers nine strategies and three sub-strategies and its main empirical results lead to the following conclusions:

First. The empirical results imply that during the COVID-19 crisis, all components of the hedge funds industry partially achieved their main investment goal. In general, the various strategies applied in the hedge fund industry provide good hedging of the investment risk in a declining market. However, they do not outperform the benchmark in an upside market. An interesting fact is that this conclusion is valid for the pre-crisis period as well.

Second. During the crisis, the different hedge fund strategies have higher Sharpe ratios than during the pre-crisis period. However, before the COVID-19 crisis, most of the hedge funds had Sharpe ratios that approximated or exceeded the Sharpe ratio of the benchmark. Moreover, most of the analysed hedge fund strategies had lower returns than the market in both sub-periods, which indirectly supports the opinion that they did not achieve their main investment goal in full.

Third. The analysed hedge fund strategies and sub-strategies have almost twice as high average return in the period 31 December 2019 – 26 February 2021 compared to the pre-crisis period. However, this was achieved at the cost of taking almost double the investment risk measured in terms of standard deviation.

Fourth. The downside risk taken by the hedge fund industry during the crisis period is significantly higher compared to the pre-crisis period. With a below and above target semi-standard deviation, the asymmetrical risk is respectively almost two and three times higher. On the other hand, the average LPM for the industry during the COVID-19 crisis is more than ten times higher than prior to the crisis. A detailed analysis of the negative shocks of the return in the hedge fund industry during the crisis shows that they are relatively few but with significant size and impact. In contrast, in the pre-crisis period, their number is greater, but they have lower size and impact.

Fifth. The most effective strategy during the COVID-19 crisis is undoubtedly the Event-Driven Risk Arbitrage. Its performance is significantly better than that of all other analysed strategies. Moreover, it is much better than the overall performance of all Event-Driven strategies combined, as well as the Event-Driven Multi-Strategy and the Event-Driven Distressed strategy. This performance is largely due to the very good condition and rapid recovery of the global M&A market, especially in the second half of 2020, as well as the growing popularity in the United States of investment strategies based on SPAC structures. This allowed the hedge funds to benefit from the strengths of the Risk Arbitrage strategy, in which the only source of risk are legal M&A procedures that are not directly related to capital market processes. Provided that the volume of the mergers and acquisitions market in the corporate world remains unchanged, we may expect that hedge funds that follow the Event-Driven Risk Arbitrage strategy will continue to have a very good performance in the near future.

Sixth. Other hedge fund strategies with very good performance during the COVID-19 crisis period are the Emerging Markets, the Global Macro and the Long/Short Equity. Obviously, these are the strategies in which the hedge funds have managed to diversify globally the sources of return and risk or have made an effective portfolio selection. The slower expected recovery of the emerging markets in 2021 compared to the developed economies may lead to poorer performance of the hedge funds that apply the Emerging Markets strategy and better performance of those applying the Global Macro and the Long/Short Equity strategies.

Seventh. Strategies such as Convertible Arbitrage, Multi-Strategy and Managed Futures had a mediocre performance during the crisis, as the market conditions between 31 December 2019 and 26 February 2021 did not allow effective implementation of investment approaches intended to mitigate the systematic risk. Therefore, the performance of the Equity Market Neutral strategy can be described as unsatisfactory. The same assessment can be given for all Event-Driven strategies except for the strategy based on the arbitrage of companies engaged in mergers and acquisitions.

Eighth. Despite its relatively high ranking according to some of the criteria, the investment strategy with the poorest performance during the COVID-19 crisis is the Fixed Income Arbitrage. This is largely due to the loose monetary policy of central banks in countries with developed capital markets, which is why their bond markets are overvalued and without significant growth potential at the onset of the COVID-19 crisis. Another factor for the poor performance of the Fixed Income Arbitrage is the upward trend in U.S. government bond yields after mid-2020. The rising inflation expectations at the beginning of 2021 indicate that this strategy is likely to perform poorly in the foreseeable future.

Ninth. The performance of the different hedge fund strategies between 31 October 2018 and 31 December 2019 does not differ significantly from their performance during the crisis. The only differences are in terms of the ranking of some of the strategies and the slightly better performance of others. For example, the best overall performance in the pre-crisis period is observed for the Global Macro strategy, followed closely by Event-Driven Risk Arbitrage. Also impressive is the much better performance of the Fixed Income Arbitrage strategy and the slightly better performance of the Convertible Arbitrage strategy.

Tenth. The use of metrics such as upside and downside capture, up number and down number, up percentage and down percentage, per cent gain and percentage loss ratio can lead to conflicting assessments of the effectiveness of the hedge fund strategies against other metrics used in the study. Therefore, in the case of portfolio performance analysis of hedge funds, they should be used in combinations rather than independently.

These findings present some important characteristics of the hedge fund industry during the COVID-19 crisis. Of course, the study is far from comprehensive and covers only the different components of the hedge fund industry. That is why the main directions for further work are related to investigating the individual performance of different hedge funds and the trends in their development.

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