



*Department of Economics and Finance
Chair in Fixed Income, Credit and
Commodities Markets*

Hedge Fund Activism: Mimicking Elliott Management Portfolio.

Supervisor
Prof. Alberto Adolfo
Cybo-Ottone

Co-Supervisor
Prof. Marshall Langer

Candidate
Gianmarco Vitiello
696651

Academic Year 2018/2019

Table of Contents

<i>Introduction</i>	3
<i>Data Scraping from Web and Data Sources</i>	6
<i>Index Construction</i>	9
<i>Event Study</i>	18
<i>Factor Analysis</i>	25
<i>Conclusion</i>	35
<i>Bibliography</i>	37
<i>Appendix A: Web Scraping Script in Visual Basic for Applications</i>	40
<i>Appendix B: Data Analysis Scripts in MatLab</i>	54

Introduction

In a world of zero-interest rate, investment funds and fund of funds struggle to achieve sustainable returns that give a sense to invest in them. A popular trend since the dot.com bubble has been the activism investing. It consists in having an active role in the management of the company acquired by the investment fund in order to unlock the hidden value of the investment. Sometimes, “the investment funds decide to operate in such a way after a long period of underperformance of the passive approach. These investors may eventually conclude that such change of fate will not materialize and that their investment will not reap any benefits unless they take a pro-active stance.” (Vitale, 2015-2016)

The most relevant reason because of the underperformance of securities is the mismanagement of the board. The explanations include overconfidence in their ability, the desire to build up a large corporate empire without profiting, misjudgement, short-termism and of course bad management decisions in stressed business periods.

Activist investors try to replace the management across two ways: proxy contests or hostile take-over bids. “The proxy contest refers to a situation in which a group of shareholders in a company joins forces in an attempt to oppose and vote out the current management or board of directors. In other words, a proxy fight is a battle between shareholders and senior management for control of the company.”¹

The hostile takeover bid refers to the launch of a bid to the public by the offeror (the investment fund) in order to purchase the shares of the target company, often at a price higher than the current trading price. The takeover bid is hostile if the management directors do not approve the bid.

Once the activist investor gathers the voting right to exercise its influence, it replaces the management and appoints a new friendly board that has the competence and the properness to unlock the hidden value of the undervalued company. The performance is not only achieved thanks to better decisions concerning the business operations of the company under evaluation, but also thanks to a new business strategy, a different capital structure that allows to obtain more tax benefits, deployment of unprofitable assets, sale

¹ <https://corporatefinanceinstitute.com/resources/knowledge/finance/proxy-fight/>

of unrelated branches, acquisitions of synergic companies, and mergers to other business players. The liquidation of company is a solutions, too. Most of the time, the investment funds do not cash the operations only with debt but they employ a large amount of debt to execute the buyout.

One of the most famous and the largest activist investor is Elliott Management Corp.. it is an American investment firm, based in New York, founded by Paul Singer, the current CEO of the company. Its notoriety is nurtured by investment in distressed securities in debt of bankrupt or near-bankrupt companies.

The following research tries to analyse deeply the performance of this hedge fund in US stock market, by mimicking the strategic allocation with the delay of 45 days from the actual portfolio operation. In particular, the research answers whether it is possible to profit from the disclosure of the 13F filings of Elliott Management by aping the portfolio positions or, on the other hand, the market reflects the information on the security prices correctly without leaving unlocked hidden value after the delay. With a broad economic view, this research attempts to test the efficiency of the market.

In addition to the economic reasons, the research requires the author to write an algorithm to scrape and to wrangle data from the SEC webpage. The algorithm is written in Visual Basic for Applications

The research addresses the profitability of a strategy easy to execute by the retail investor. The first paragraph introduces the reader to automated steps that the algorithm executes to download and to wangle data. Moreover, the paragraph identifies the sources from which the data are download to perform the following analysis.

After obtaining the data, the second paragraph reports the total invested amount in the US market and the performance of the portfolio in comparison to the buy-and-hold strategy of investing in the S&P 500 index. In particular, the reader will have descriptive statistics of the index and S&P500, with the further check of few statistical tests. In addition, the paragraph concludes with an untheoretical time series analysis in order to check the autocorrelation and the stationarity of the index portfolio returns.

Further, the analysis is enhanced by an event study analysis of the single positions. The event is the disclosure of the 13F filings. The estimation window includes all the returns a year before the disclosure and the event window involves the entire investment period held by the portfolio in a security.

In addition, the research makes an effort to find the factors that drive the performance of the index portfolio by testing different economic models. The factors that are included in the analysis are the excess market returns, the Fama, French's Small-Minus-Big factor and the High-Minus-Low factor, the Carhart's Momentum factor, the Fama, French's Conservative-Minus-Aggressive factor and the Robust-Minus-Weak factor, the Frazzini Pedersen's Betting Against Beta factor and the Asness, Frazzini, Pedersen's Quality Minus Junk factor.

Finally, the last paragraph sums up all the information and concludes the research.

At the bottom, there are two appendices that contain the script of the web scraping in Visual Basic for Applications and the econometric scripts written in MatLab.

Data Scraping from Web and Data Sources

The most expensive activities of this work are spent in the data gathering process and in the data wrangling process: the data gathering process is the process of collect and measuring data on pointed variables in an established system, which then enables one to answer relevant questions and evaluate outcomes, and data wrangling refers to the process of cleaning, restructuring and enriching the raw data available into a more usable format. Part of the data are collected by the implementation of a proprietary algorithm of data scraping from web. The script is written in Visual Basic for Applications and it is reported in Appendix A at the bottom of the following work.

The algorithm lets to download all mandatory Form 13F filings, disclosed by Elliott Management corp. between November 15, 1999 and November 14, 2019.

The Form 13F filings with the Securities and Exchange Commission reports the holdings of an institutional investment manager, that satisfies the following conditions: he uses the U.S. mail in the course of its business and he exercises investment discretion over \$100 million or more in Section 13F securities. The Securities and Exchange Commission redeems an institutional investment manager either as an entity that invests in, or buys and sells, securities for its own account; or a natural person or an entity that exercises investment discretion over the account of any other natural person or entity.

Form 13F is required to be filed within 45 days of the end of a calendar quarter. The Form 13F report requires disclosure of the name of the institutional investment manager that files the report, and, with respect to each section 13(f) security over which it exercises investment discretion, the name and class, the CUSIP number, the number of shares as of the end of the calendar quarter for which the report is filed, and the total market value.²

The starting point of the algorithm is the EDGAR Database³, in particular the web page referred to Elliott Management Corp: <https://www.sec.gov/cgi-bin/browse-edgar?company=elliott+management&owner=exclude&action=getcompany>.

The filings are gathered together in three web pages and each filing occupies a line in table provided at each page. The algorithm clicks on the link of the filing on the column

² <https://www.sec.gov/fast-answers/answers-form13fhtm.html>

³ The EDGAR Database is the database where SEC stores all the companies filings for each discloser.

“Format” and then downloads the file of the table of the holdings written in HTML⁴. So, in this case, table is fully reported in the Excel workbook.

Not all the filings are written in HTML language, especially the older ones that are in the .txt (text) format. In this case, the algorithm downloads all the texts files and then it copies the tables in a sheet of the main Excel workbook. The entries are not perfect because the .txt files do not follow a precise format demanded by the SEC, so the clearing process is manual.

The following steps consists of the data wrangling of all the raw data. First, the work aims at analysing an investment strategy in equity; so, the first screening consists of deleting all the entries in bonds, calls and puts.

Second, the entries of interest are all the ones traded at New York Stock Exchange and at NASDAQ, that is in US market. This choice is the result of the greater transparency obligation required by the SEC, not only to investment managers, but also to the management boards of the traded companies. In other words, all the entries that related to stocks traded outside the NYSE and the NASDAQ are removed by the analysis.

Third, the current workbook has as many worksheets as fillings downloaded by the algorithm; in order to have an historic view of the portfolio, the data are restructured in a list of all the different historical positions. The following columns contain the value of the security at the date times in which the stock appears in the filings for the first time.

In other words, the first column includes the company names indicating the shareholding, while the following columns represent a regulatory filings date. Each matrix entry has the value of the position that Elliott Management allocates in a stock at the particular filling date.

Each line can have some consecutive cells with values, because the position is held for more than a quarter: technically, it appears for more consecutive fillings. Further, there are lines in which the cells with values are non-consecutives because the fund enters and shorts the position multiple times during the years.

Finally, for each investment, the initial and the final date of the investment periods is reported in a different worksheet. The format is transposed with respect to the initial

⁴ Hyper Text Mark-up Language (**HTML**) is the standard markup language for documents designed to be displayed in a web browser.

matrix because this time each column represent an investment and the further two line are the final date and the entry date, respectively.

Having the entry dates and the exit dates of the portfolio allocation, the prices of each stock is obtained from Datastream, and the returns of the S&P 500 Index is taken by Yahoo Finance⁵. Not all the prices of the all the securities were available during the investment periods. One explanation is that, being Elliott Management an activism investment fund, most companies were merged to other companies or were bought-out during the 45 days delay. Another explanation is that some positions are in private companies. The stock prices and the index price are not dividend adjusted.

In addition to the prices of the all the companies during the investment window, the research employs the Fama French's factors SMB (Small-Minus-Big), HML (High-Minus-Low), RMW (Robust Minus Weak) and CMA (Conservative Minus Aggressive), the Carhart's momentum factor, the Frazzini, Pedersen's factor BAB (Betting-Against-Alpha) and Asness, Frazzini, Pedersen's QMJ (Quality-Minus-Junk). The Fama French's factors and the momentum factor are downloaded from Ken French's website⁶, whereas the Frazzini-Pedersen's and the Asness, Frazzini, Pedersen's factors are downloaded from the AQR website⁷. The returns are computed at daily frequency.

⁵ <https://finance.yahoo.com/quote/%5EGSPC?p=%5EGSPC>

⁶ https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

⁷ <https://www.aqr.com/Insights/Datasets/Betting-Against-Beta-Equity-Factors-Daily>
<https://www.aqr.com/Insights/Datasets/Quality-Minus-Junk-Factors-Daily>

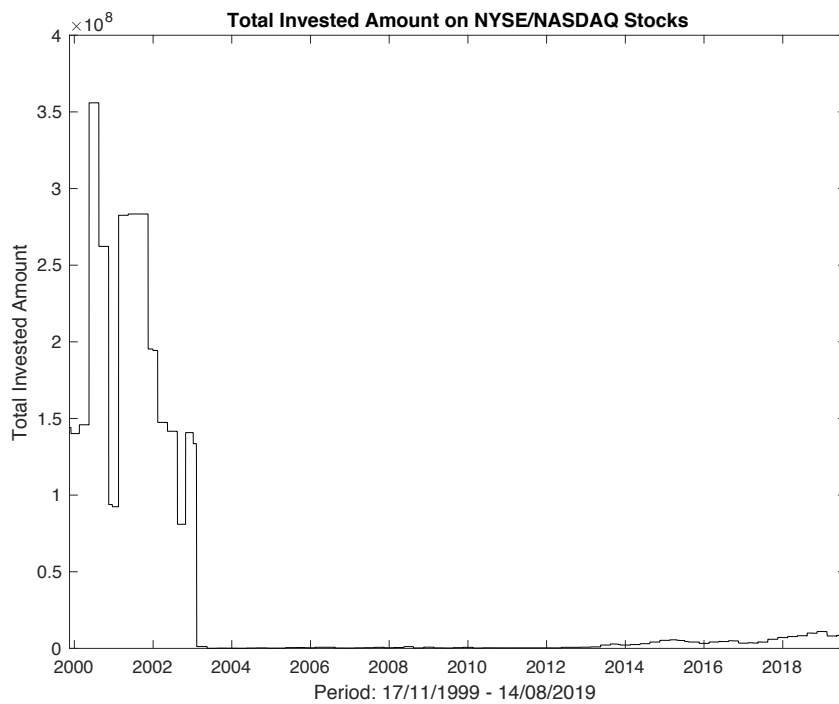
Index Construction

Thanks to the data scraping algorithm it is possible to know not only when Elliott Management Corp enters into a position, with the delay of 45 days, but also, the amount it invests in each stock. Moreover, whenever the position table shows a blank cell in the row after a full cell, it is possible to deduct that the fund exits the position 45 days before. In addition, the time series of some companies are not fully available for the considered period window, because of major changes such as delisting, merger and other circumstances.

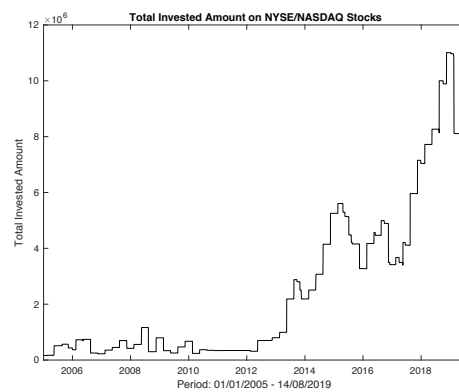
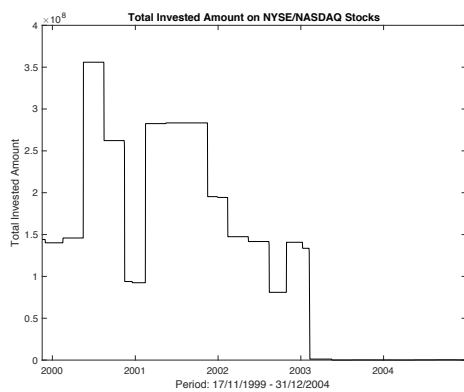
The algorithm identifies 721 positions in the period between November 17, 1999 and August 14, 2019. The number of positions is not the number of different stocks in which Elliott invested: it also comprises multiple positions held in one single stock opened on different times. For example, Elliott discloses the first position in Microsoft in the report on February 15, 2000 that lasts up to February 13, 2001. Then, a new position in Microsoft is disclosed on November 14, 2001 up to the end of the quarter and 5 further positions, whose durations last a quarter of year, are disclosed on August 14, 2003, on May 14, 2004, on February 15 2005, on August 15, 2006 and on May 15, 2013.

The sample of daily returns consists of 5151 observations. The majority of the positions are held for one quarter, but there are investment durations longer than one year, such as the first investment window in Microsoft.

The first meaningful data that can be analysed is the total investment value. The total investment value is the sum of all the screened values reported on Form-13F filings. The figure below shows the time series of the total amount of dollars invested in stock traded on NYSE and on NASDAQ by Elliott Management Corp in the period from November 17, 1999 to August 14, 2019. The frequency of the chart is daily to take into account any delisting of company stock.



It is clear that before 2003, the investments in NYSE and in NASDAQ stocks is significant higher than later. Two explanations of the duality of the graph are the dot-com bubble and the global diversification phenomenon, that is the process of investing all around the world to capture a better degree of diversification in the portfolio allocation. Moreover, in the period between the starting date and almost the start of 2004, the graph has a negative trend: the trend is the first signal of the losses suffered by Elliott Management during the dot-com crash, lasted from March 11, 2000, to October 9, 2002.



By splitting the graph in two sub-periods: the first from November 17,1999 to December 31, 2004 and the second from January 1, 2005 to August 14,2019; it is possible to add further conclusions to the post crisis investment period. The total investment value remain almost constant for 7 years since 2005. The invested amount goes up steeply since 2012, but it suffers a break in the period between the 2015 and 2017. The 2012 turning point can be a signal of any change in the investment allocation strategy.

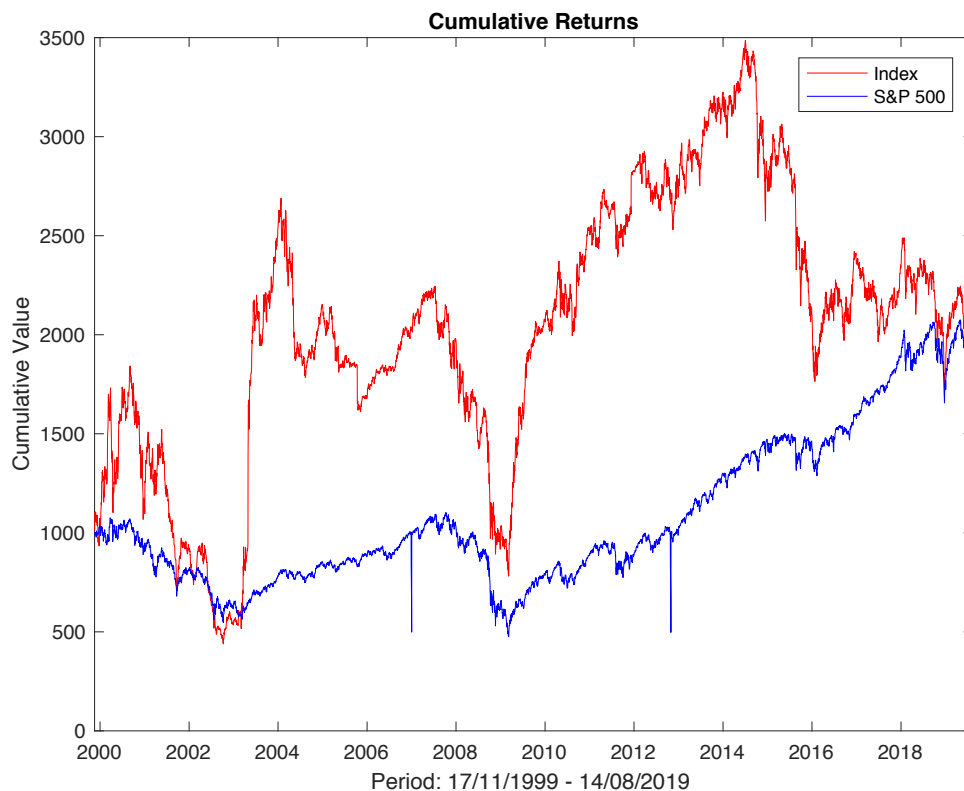
In order to aggregate all the investment windows and to building an investment strategy, the next step consists of the construction of an index or portfolio.

The rules of the strategies are the following:

- If a stock appears for the first time on the reports, it is bought the third day after the disclosure;
- If a stock disappears from the most recent reports after it is bought, then the position is sold the third day after the disclosure;
- If the stock is delisted, the portfolio is rebalanced with the open positions at the time of the delisting.

The weights to balance the different positions are the ratios between the amount allocated by Elliott Management Corp on the stock and the total invested amount of the screened positions. The choice of entering and exiting on the third day after the disclosure does not affect the results from any change in returns due to pre-market and after-market trading. The aim of the this research is to analyse a possible investment strategy that can be executed by any retail investors, and not only by institutional investors.

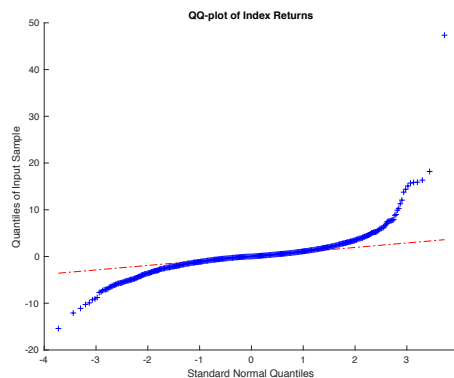
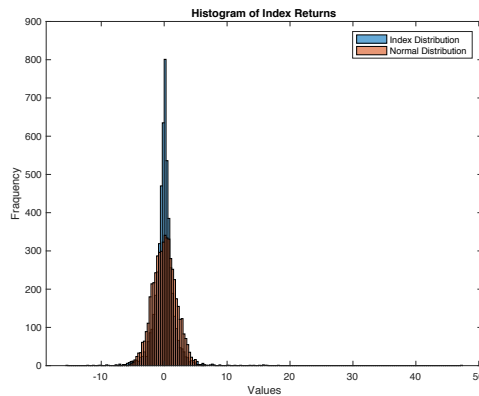
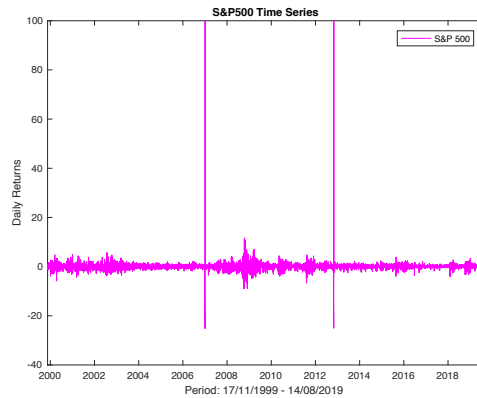
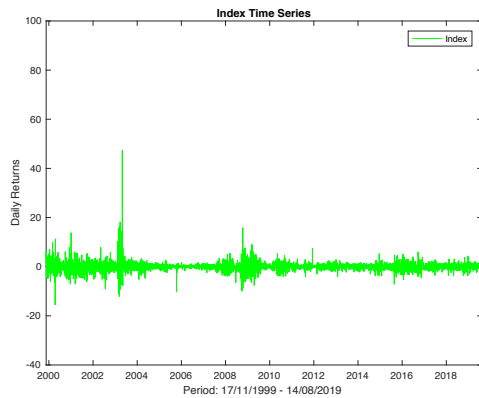
After constructing the index, the strategy shows the following cumulative performance during the period under investigation:



The reference benchmark is S&P 500 index, in particular the index strategy performance is compared to the buy-and-hold strategy of S&P 500.

The comparison shows a positive correlation between the two strategies. The index performance magnitude is higher than the buy-and-hold strategy: when the S&P 500 goes up, the index goes up more than proportionally; on the other hand, if the when the S&P 500 goes down, the index goes down steeply. The reason is that the index portfolio is less diversified than a broad index.

The index suffers three major breaks: the first related to the dot-com crash between the 2000 and 2003, the second breaks corresponds to the period of the great financial crisis in 2008/2009 and the third happens between the 2014 and 2016. The first drawdown is the only one that makes the cumulative value of the portfolio to be lower than cumulative value of the buy-and-hold strategy. The first and the second breaks are recovered in about one year. The third break has not been recovered: actually, the index has an horizontal trend up to the end of the sample. Another relevant element is that during the period of the third break (2014-2016), the buy-and-hold strategy declines slightly or it has an almost horizontal movement.



By analysing deeply the track record of the index portfolio, the arithmetic average return of the index is 0.0304% lower than 0.03510% of the buy-and-hold strategy. Surprisingly, the daily realized volatility of the index is 1.8451%, lower than the S&P 500 (2.3952%).

	Mean	Volatility	Skewness	Kurtosis
Index	0.03040%	1.84510%	4.03820%	98.99310%
S&P 500	0.03510%	2.39520%	27.41680%	1186.80000%

Both the sample returns skewness are positive and the distributions of the returns are both leptokurtic: the value of S&P500 are much higher than the index values. In order to have a further theoretical basis to reject the normality assumptions of the returns, it is performed the Jarque-Bera test to the both sample. “The test follows a chi-square distribution with two degrees of freedom.

$$JBTest = \frac{T}{6} * [Skewness^2 + \frac{Kurtosis^2}{4}]$$

Under the null hypothesis, the test states that a series of returns is normal distributed even without knowing the mean and the variance; on the other hand the alternative hypothesis affirms that the series of returns do not have a normal distribution.” (Lhabitant, 2006) Even the QQ-plot confirms this conclusion.

Further, the Sharpe ratio of the index strategy is a bit higher than the S&P500 one. The effect of greater realized volatility does overcome the higher average of returns. Consequently, the Information Ratio is negative.

	Sharpe Ratio	Treynor ratio	Information Ratio	5% VaR
Index	0.0129	0.1099	-0.0018	-2.4345
S&P 500	0.0119	0.0286	0	-1.8476

Even the Treynor Ratio indicates a slight superiority of the Index strategy against the buy-and-hold one. A confirmation of the graphical magnitude of the index strategy is the Value at Risk at 5% of -2.4345% of the index against of – 1.8476% of the buy-and-hold. To statistically check the slightly superiority of the index strategy and have a more theoretical ground thereon to make assumptions, the Jobson-Korkie test and Gibbons, Ross and Shanken test are performed. The first test evaluates under the null assumption, if the two portfolios have the same sharpe ratio.

“The Jobson-Korkie statistic is:

$$Z = (\mu_2\sigma_1 - \mu_1\sigma_2)/\sqrt{\theta}$$

$$\theta = \frac{1}{T} * [2\sigma_1^2\sigma_2^2 - 2\sigma_1\sigma_2\sigma_{1,2} + \frac{1}{2}(\mu_1\sigma_2)^2 + \frac{1}{2}(\mu_2\sigma_1)^2 - \frac{\mu_1\mu_2}{\sigma_1\sigma_2}\sigma_{1,2}^2]$$

The Z statistic is approximately standard normal distributed where the μ are the excess returns, the σ are the standard deviations and the covariance of the returns.” (Lhabitant, 2006) The p-value of 0.5496 indicates that the two sharpe ratio are not different.

“The Gibbons, Ross and Shanken test is a test of efficiency that tests if the index portfolio is statistically more efficient than the market portfolio.

$$F = \frac{T(T - N - 1)}{N(T - 2)} \left(\left[\frac{\sqrt{1 + SR_2^2}}{\sqrt{1 + SR_1^2}} \right]^2 - 1 \right)$$

The test follows a F-distribution with (N, T-N-1) degrees of freedom, where T is the number of the observation, N is the number of assets in the market portfolio, SR_2 and SR_1 refer to the index and buy-and-hold Sharpe ratio, respectively. The first product is the finite-sample adjustment of the statistic.” (Lhabitant, 2006) Even the GBS test rejects any improvement of the index strategy.

Jarque-Bera Test	Jobson-Korkie test	GRS test
1	0.5496	1

To further have a basic understanding of the index constructed by the strategy, it is performed a time series analysis to the sample of returns. Time series analysis is an untheoretical approach that checks any autocorrelation or any data pattern in the data.

The raw data on which the analysis is performed are the excess returns over the risk-free rate.

The first performed test is the Ljung-Box test, a statistic that is based on the residuals of autocorrelation functions. The statistics has the following expression:

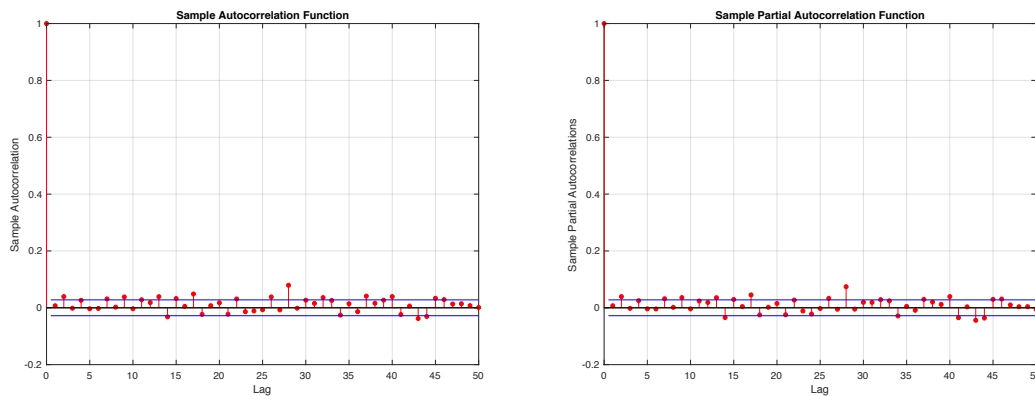
$$Q = T(T + 2) \sum_{j=1}^m \frac{\rho_j^2}{T - j}$$

where the m is the order of the correlation, T is the number of observations and the first factor is the finite sample correction in order to improve the power of the test. The statistic is chi-squared distributed with $m - p - q$ degree of freedom.” (Santucci De Magistris, s.d.) The null hypothesis of a white noise is reject; so, the data are not independently distributed and they exhibit serial correlation.

The second step is to check if the data are stationary or non-stationary. To check this assumption, three tests are performed: the Augmented Dickey Fuller test, Phillip-Perron test and the KPSS test. The first two test null hypothesis is that the data are white noise, and hence, non-stationary against the alternative hypothesis of stationary data. The null and the alternative hypothesis of the KPSS test are inverted. The three test are executed together because they set different assumptions to check stationarity; so, multiple assessments increase the reliability of the conclusion.

The three tests conclude that the data are stationary.

The third step consists in representing the autocorrelation function and the partial autocorrelation function. Both the graphs are reported below.



Both the representations give no initial guess for the initial values of the p order of autoregressive model and q order of the moving average model.

In order to identify the best order of the possible ARMA model it is applied the Bayesian Information Criterion:

$$BIC = \ln \frac{SSR}{N} + \frac{k \ln N}{N}$$

Where SSR is the sum of the squared residuals, N is the sample size and K is the number of independent variables included into the model.

It is performed a matrix computation of the Bayesian Information Criterion with different possible orders of autoregression process (p) and of moving average process (q): the maximum values for p and q is 6; so, the BIC matrix is a squared 6x6 one. The choice of

the Bayesian Information criterion over the Akaike Information Criterion is that any additional order is penalized heavier: the rigidity provides a small shield against the data snooping bias.

The matrix points out that the minimum information criterion value is the one of the ARMA model of order (p,q) equal to (1,1).

ARIMA(1,0,1) Model:

 Conditional Probability Distribution: Gaussian

Parameter	Value	Standard Error	t Statistic
Constant	0.000337629	0.000951072	0.354998
AR{1}	0.979778	0.00745269	131.466
MA{1}	-0.967347	0.0087367	-110.722
Variance	3.38908	0.0121456	279.037

The intercept is almost zero and the t statistic does not reject the null hypothesis of equalling to zero. Both the AR(1) and the MA(1) coefficients are statistically significant different from zero and approach in absolute value the unity, but the signs are contrary. The AR(1) coefficient is positive and the MA(1) is negative. The F test of the significant of the model is statistically significant, hence the model under this concept may be robust. The element that undermine all the previous facts is that the goodness of fit is almost zero, that is 0.4%. The conclusion is that the model is not reliable to explain the data behaviour.

Event Study

After the descriptive and time series analyses of the index portfolio, the research carries out a micro-analysis on the performance of the single position after the disclosure of Form 13F by Elliott Management Corp..

The event of interest in this study is the event of disclosure of the opening position by Elliott Management Corp.: this analysis answer the question of whether the disclosure of the acquisition of shares by Elliott is a significant event that modifies the normal trend of the share price of the stock under consideration.

The event window that is taken into account is the entire holding period of the position held by the mimicking portfolio. The holding period of the positions starts the third day from the disclosure day in which that stock appears in the 13F and ends the third day after the stock disappears from the most recent 13F.

The event window is unusually long for the analysis because of two reasons: activism strategies usually take time to show their effects on the share prices and the scope of the analysis has an ex-post approach to the assessment of the portfolio.

The event windows under consideration are not equal to all the positions because of the heterogeneity of the holding periods.

The data wrangling process was executed with the help of Visual Basic for Applications scripts that are not reported in the appendix because the scripts have not a linear consequent structure in executing their tasks. There are a multitude of scripts that solve tasks without be assembled in an unit and compact script.

The necessary data for the analysis are: the daily share price of the stock between the holding period and the data of the market index price reported at the same time, that is the performance of S&P 500 between the opening date and exit date of the holding period. In addition, for each couple of share and of market index, the daily returns are also downloaded such as estimation sample. The estimation period consists of all the previous daily returns a year early.

Each share price of the stocks is obtained from Datastream whereas the S&P 500 is obtained from Yahoo Finance.

First, the algorithms compute the opening date and exit date from the matrix of the positions. Then, it is calculated the return of each share between a year before the

disclosure of the position and the end of the position and all the returns are pasted on a new worksheet whose columns represent different events.

Second, the algorithms insert a new column at the right of the event column and paste the corresponding returns of the market index.

Third, for each column it is identified the first date of the event window and thus the all pair of returns within the event window is cut and pasted on a new worksheet.

So, the result consists of two worksheets that include the matrix of the estimation sample returns of the event and the matrix of the event window. The odd-numbered columns comprise the dependent variables of the analysis and the even-numbered columns comprise the independent variable. Both the tables are imported into MatLab to perform the econometric analysis.

To appraise the event's impact it is required to measure the abnormal return. "The abnormal return is the actual ex-post return of the security over the event window minus the normal return of the firm over the event window. The normal return is defined as the return that would be expected if the event did not take place, that is

$$\epsilon_{it}^* = R_{it} - E[R_{it}|X_t]$$

Where ϵ_{it}^* is the abnormal return, R_{it} is the actual return and $E[R_{it}|X_t]$ is the normal return, for the event i at the time t ." (Campbell, et al., 1997)

As the construction of the two matrix suggests, in order to compute the normal returns the research models the normal returns across the market model.

"The market model is a statistical model which relates the returns of a given security to the return of the market portfolio. It assumes a linear relationship between the return under investigation and the market return that is the S&P 500 and it assumes joint normality of the assets returns.

Therefore, the model is:

$$\begin{aligned} R_{it} &= \alpha_i + \beta_i R_{mt} + \epsilon_{it} \\ E[\epsilon_{it}] &= 0 \\ Var[\epsilon_{it}] &= \sigma_i^2 \end{aligned}$$

Where R_{it} is the estimation sample return, α_i is the coefficient parameter estimator, β_i is the parameter estimator of the market returns, R_{mt} is the market return and ϵ_{it} is the error term of the regression.” (Campbell, et al., 1997)

“In matrix form, the system is:

$$R_i = X_i\theta_i + \epsilon_i$$

Where R_i is the vector $[R_{i1} \dots R_{iT}]$ of estimation sample returns, X_i is the matrix whose first column is the vector of one and whose second column is the vector of R_{mt} , θ_i is the vector of parameter α_i and β_i .

The parameter estimator are

$$\hat{\theta}_i = (X_i'X_i)^{-1}X_i'R_i$$

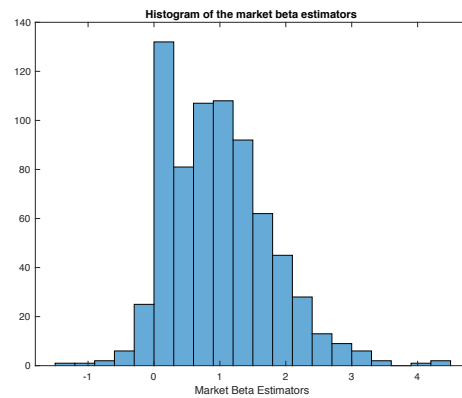
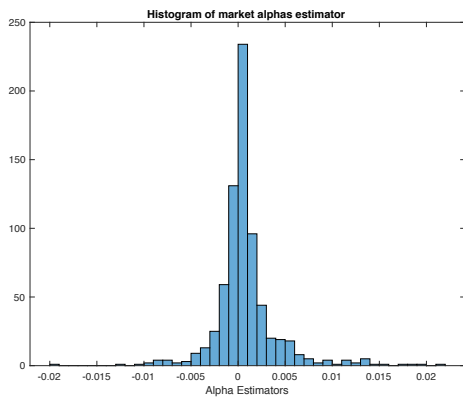
$$\widehat{\sigma}_\epsilon^2 = \frac{1}{N_1 - 2} \hat{\epsilon}_i' \hat{\epsilon}_i$$

$$\hat{\epsilon}_i = R_i - X_i\hat{\theta}_i$$

$$Var[\hat{\theta}_i] = \widehat{\sigma}_\epsilon^2 (X_i'X_i)^{-1}$$

where N_1 is the number of observation of the return sample.” (Campbell, et al., 1997)

The 723 couples of parameters estimators that come out from the regression are reported below in the histograms.



the alpha estimators for the majority of the events is zero or in the range between -0.005 and +0.005. the fact that the alphas are not statistically significant different from zero suggests that the model captures the variability of the single positions.

The histogram of the beta estimators is more interesting. First, there are betas less than zero; so, those securities are negative correlated to the market and have an hedging effect. Second, the histogram is positive skewed on the mean near to 1. So, the securities under the consideration are almost correlated to the market with the tendency of been less affected by the market movements, but there are significant outliers, even greater than 4. Given the parameter estimators $\widehat{\theta}_t$, it is possible to measure and analyse the abnormal returns. By using the parameter estimators from the market model, the systems of abnormal returns is:

$$\begin{aligned}\widehat{\epsilon}_t^* &= \mathbf{R}_t^* - \mathbf{X}_t^* \widehat{\theta}_t = \mathbf{R}_t^* - \widehat{\alpha}_t - \widehat{\beta}_t \mathbf{R}_m^* \\ E[\widehat{\epsilon}_t^*] &= \mathbf{0} \\ Var[\widehat{\epsilon}_t^*] &= \sigma_\epsilon^2 + \frac{1}{N_1} \left(1 + \frac{(R_{mt} - \widehat{\mu}_m)^2}{\widehat{\sigma}_m^2} \right)\end{aligned}$$

Where $\widehat{\epsilon}_t^*$ is the vector of abnormal returns, \mathbf{R}_t^* is the vector of the returns of the stock position in the event window, \mathbf{R}_m^* is the vector of the market returns in the event window. Moreover, $\widehat{\mu}_m$ is the estimator of the average of market returns, $\widehat{\sigma}_m^2$ is the estimator of the variance of the market returns.

“Given that the abnormal return is unbiased and that the returns are independent and identically distributed, for large values of N_1 , it is possible to apply the central limit theorem, and thus to draw inferences because

$$\widehat{\epsilon}_t^* \sim \mathbf{N}(\mathbf{0}, Var[\widehat{\epsilon}_t^*])$$

that is the abnormal returns are normal distributed with mean zero and positive variance.” (Campbell, et al., 1997)

The abnormal returns that are obtained are aggregated in order to draw inferences for the event. “At this point, it is defined the Cumulative Abnormal Return within the event

window: the cumulative abnormal return for a security from time 0 and the last observation: “

$$\widehat{CAR} = \gamma' \widehat{\epsilon}_t^*$$

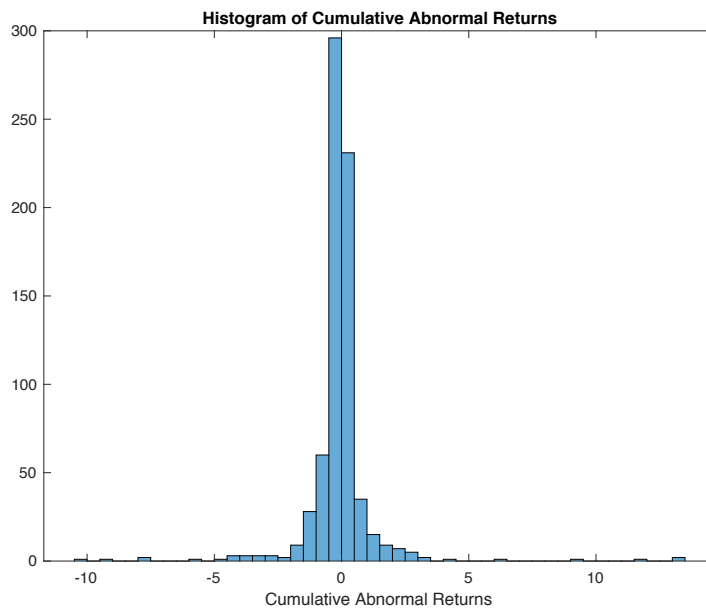
$$Var[\widehat{CAR}] = \gamma' Var[\widehat{\epsilon}_t^*] \gamma$$

(Campbell, et al., 1997)

It follows from the Central Limit Theorem that

$$\widehat{CAR} \sim N(\mathbf{0}, Var[\widehat{CAR}])$$

The cumulative abnormal returns for each security is reported in the histogram below.



The results are not outstanding on the investment side because the mean of the cumulative abnormal returns is -0.0611%. Moreover, the histogram is strongly centred on the mean with few high outliers both on the positive side and on the negative side. An important element to take into account is the fact that the cumulative abnormal returns is a simple addition of the daily abnormal returns, hence, it does not represent the return of the investment period.

On the theoretical side, it is possible to draw inference on the cumulative abnormal returns for each security. “In particular it is possible to compute the standardized cumulative abnormal return

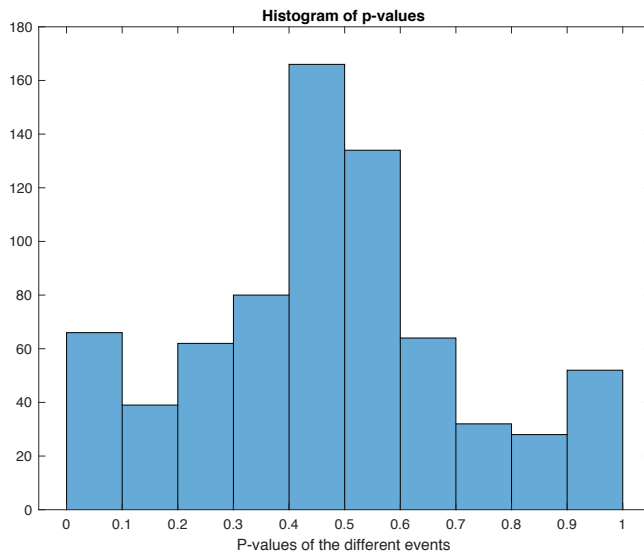
$$\widehat{SCAR} = \frac{\widehat{CAR}}{\sqrt{Var[\widehat{CAR}]}}$$

\widehat{SCAR} has a t-Student distribution with $N_1 - 2$ degree of freedom under the null hypothesis. The expectation of \widehat{SCAR} is zero and the variance is $\frac{N_1-2}{N_1-4}$.” (Campbell, et al., 1997) The following method is a parametric inference test whose results are strongly dependent of the assumption of the normality of the standardized cumulative abnormal returns.

The parametric inference testing is performed in order to have rigorous statistical results at the end of the analysis, even if the histogram of cumulative abnormal returns is particularly conclusive.

The results of the statistical inferences confirm that only for few events the null hypothesis of cumulative abnormal returns different from zero is rejected.

The p-values are reported in the following histogram:



The events with statistically significant cumulative abnormal returns at 10% of critical value are less than 70, that is less than the 10% of the events guarantees statistically significant returns.

In addition to the parametric inference, the analysis is concluded by the non-parametric inference. “The test is the sign test and it is called in such a way because it is based on the sign of the abnormal return. The assumptions are that the cumulative abnormal returns are independent across securities and that the expected proportion of positive abnormal returns under the null hypothesis is 0.5. The latter assumption means that the null hypothesis is that the probability of having positive cumulative abnormal returns and negative ones is equal, against of having disproportionate positive cumulative abnormal returns under the alternative hypothesis.

The test statistic is:

$$ST = \left[\frac{N^+}{N} - 0.5 \right] \frac{N^{\frac{1}{2}}}{0.5} \sim N(0, 1)$$

Where N is the number of observations, N^+ is the number of positive cumulative abnormal returns. The sign test does not reject the null hypothesis of the consistency of positive cumulative abnormal returns.” (Campbell, et al., 1997)

The non-parametric inference is a tool really useful in case of data that do not fit well the assumptions of the parametric inference. In fact, few securities have cumulative abnormal returns data normal distributed. The following conclusion can be checked through the Jarque-Bera test: only one fourth of the time series of CAR do not reject the null hypothesis of normality.

In conclusion, the event analysis points out that trading on information reported on the 13F of Elliott Management Corp. does not produce significant abnormal results.

In comparison to the conclusion of the previous paragraph, the large profits and the large losses of the index can be explained by the fact that Elliott Management Corp. invests in high-beta stocks that guarantee an amplified performance related to the market benchmark.

Factor Analysis

The final analysis performed on the index returns is the factor decomposition. The factor decomposition shows some possible exposures of the strategy to some risk factors. In the following paragraph, the index is confronted to the following models: Capital asset pricing model, Fama-French's 3 factors model, Fama-French's 5 factors model, Carhart's 4 factors model, the model that includes the Frazzini-Pedersen Betting Against Beta factor and the Asness-Frazzini-Pedersen Quality-Minus-Junk factor, and finally a model that includes all the factors under consideration. All the models parameter estimators are obtained by the Ordinary Least Squared estimation and the RESET test is performed for a consistency analysis.

“The RESET test is a general specification test for the linear regression model. It tests whether nonlinear combinations of the fitted values help explain the response variable.

The test consists of estimating the parameter of the following polynomial:

$$y = \alpha + \beta_1 x_1 + \dots + \beta_n x_n + \gamma_1 y^2 + \gamma_2 y^3$$

Then, it is tested if γ_1 and γ_2 are statistically different from zero through the F-test. If the null hypothesis is rejected, then the model is mis-specified.” (Santucci De Magistris, s.d.)

The analysis starts with the exposure to the market: how the index performed against the market, how it is tied to the market portfolio. In the following analysis, the S&P 500 index is considered as a the market index. So, the model is:

$$R_i - r = \alpha_i + \beta(R_M - r)$$

The results of the estimation points out a beta coefficient of 0.2171 and an alpha of 0.0176%. The alpha estimation is not statistical significant: the p-value of 0.4744 does not reject the null hypothesis of alpha equals to zero. On the other hand, the p-value of the beta is statistical significant.

OLS estimation

```

*****
Number of observations:    5151.0000
Number of parameters      2.0000
*****
      parameter      beta      stderr      t-student      p-value
      1             0.0176      0.0247       0.7154         0.4744
      2             0.2171      0.0103      21.0756         0.0000

```

The beta estimation is lower than one, it implies that the strategy has a low, but positive correlation to the market index. It is contrary to the conclusion of the event analysis and the graphical deductions.

The model is statistical significant, but the goodness of fit statistic, the R squared is 0.0794: not a result that guarantees on the consistency of the model. Further, the RESET test p-value is 0: it means that the parameter estimations of the square of the independent variable and of the cube of the independent variable are consistently different from zero. The goodness of fit statistic and the RESET test conclude that the model suffers of misspecification.

The second model that is applied to the data is the Fama, French's 3 factors model. The two factors are Small-Minus-Big factor and the High-Minus-Low factor.

“The Fama, French factors are constructed using the 6 value-weight portfolios formed on size and book-to-market. The portfolios are rebalanced at the end of the last day of June: in other word, the initial day of the rebalanced portfolios are is the first of July. SMB (Small Minus Big) is the average return on the three small portfolios minus the average return on the three big portfolios,

$$SMB = \frac{1}{3}(Small\ Value + Small\ Neutral + Small\ Growth) - \frac{1}{3}(Big\ Value + Big\ Neutral + Big\ Growth)$$

HML (High Minus Low) is the average return on the two value portfolios minus the average return on the two growth portfolios,

$$HML = \frac{1}{2}(Small\ Value + Big\ Value) - \frac{1}{2}(Small\ Growth + Big\ Growth)"^8$$

So, the equation model is:

$$R_i - r = \alpha_i + \beta_1(R_M - r) + \beta_2SMB_i + \beta_3HML_i$$

In this model, the low positive beta value of the excess market return is confirmed, the p-value is consistent. Also, the Fama, French factors are statistically significant: the p-value of the SMB coefficient is 0, whereas the one of the HML is 0.0013.

OLS estimation

```

*****
Number of observations:    5151.0000
Number of parameters      4.0000
*****
      parameter      beta      stderr      t-student      p-value
      1      0.0105      0.0242      0.4332      0.6649
      2      0.2129      0.0101     21.0299      0.0000
      3      0.5798      0.0414     14.0115      0.0000
      4      0.1237      0.0384      3.2215      0.0013

```

The values of the SMB parameter estimator is equal to 0.5798 and the HML one is 0.1237. it means that the strategy is positive correlated to the SMB and HML portfolios. The positive SMB parameter estimator reflects the tendency of the strategy to keep open position in stock whose size is small. The positive HML parameter estimator reflects the tendency of the strategy to keep open positions in stocks whose book-to-market is high. In conclusion, the performance of the Elliott mimicking portfolio invests in small and value stock. Unfortunately, the model suffers of the same problems of the previous one: the RESET test states that the model is mis-specified and the adjusted R squared is only 0.1128: the model explain only one tenth of the portfolio performance.

⁸ https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

The third model estimated is the Carhart's 4 factors model. It includes to the Momentum factors to the Fama French's model.

"To compute the momentum factor, six value-weight portfolios formed on size and prior returns are used. The portfolios, which are formed daily, are the intersections of 2 portfolios formed on size (market equity, ME) and 3 portfolios formed on prior return. Mom is the average return on the two high prior return portfolios minus the average return on the two low prior return portfolios,

$$MOM = \frac{1}{2}(Small\ High + Big\ High) - \frac{1}{2}(Small\ Low + Big\ Low)^{9}$$

So the model equation is:

$$R_i - r = \alpha_i + \beta_1(R_M - r) + \beta_2SMB_i + \beta_3HML_i + \beta_4MOM_i$$

The Carhart's 4 factors model performs slightly better than the Fama French 3 factors model: the adjusted R squared gains 5 percentile points to 0.1650. The RESET test still points out mis-specification. By analysing the data with have, the model improves but the parameter estimation of the HML factor changes sign: by adding the momentum factor, the HML strategy is negative correlated to the index one.

OLS estimation

```

*****
Number of observations:    5151.0000
Number of parameters      5.0000
*****

```

parameter	beta	stderr	t-student	p-value
1	0.0210	0.0235	0.8938	0.3715
2	0.1858	0.0099	18.6955	0.0000
3	0.6318	0.0402	15.6982	0.0000
4	-0.1023	0.0393	-2.6012	0.0093
5	-0.4766	0.0265	-17.9652	0.0000

⁹ https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_mom_factor_daily.html

The momentum factor parameter estimation is negative and statistically significant. The momentum strategy corresponds to buying stocks that have been “up” in the sense of outperforming the market, while shorting the stocks that are relatively “down”. The negative weight means that the index stocks performed bad after outperforming the market and performed good after underperforming the market.

At this point, the model that is taken into consideration is the recent Fama French’s 5 factors models. In addition to the SMB and HML factors, the Fama French’s 5 factors model defines two more factors, that is the Robust Minus Weak factor and the Conservative Minus Aggressive factor.

$$R_i - r = \alpha_i + \beta_1(R_M - r) + \beta_2SMB_i + \beta_3HML_i + \beta_4RMW_i + \beta_5CMA_i$$

To include these two additional factors, the model change also the construction of the historical Fama French factors.

“The Fama/French 5 factors are constructed using the 6 value-weight portfolios formed on size and book-to-market, the 6 value-weight portfolios formed on size and operating profitability, and the 6 value-weight portfolios formed on size and investment.

SMB (Small Minus Big) is the average return on the nine small stock portfolios minus the average return on the nine big stock portfolios,

$$SMB_{\left(\frac{B}{M}\right)} = \frac{1}{3}(Small\ Value + Small\ Neutral + Small\ Growth) \\ - \frac{1}{3}(Big\ Value + Big\ Neutral + Big\ Growth)$$

$$SMB_{(OP)} = \frac{1}{3}(Small\ Robust + Small\ Neutral + Small\ Weak) \\ - \frac{1}{3}(Big\ Robust + Big\ Neutral + Big\ Weak)$$

$$SMB_{(INV)} = \frac{1}{3}(Small\ Conservative + Small\ Neutral + Small\ Aggressive) \\ - \frac{1}{3}(Big\ Conservative + Big\ Neutral + Big\ Aggressive)$$

$$SMB = \frac{1}{3}(SMB_{\left(\frac{B}{M}\right)} + SMB_{(OP)} + SMB_{(INV)})$$

HML (High Minus Low) is the average return on the two value portfolios minus the average return on the two growth portfolios,

$$HML = \frac{1}{2}(Small\ Value + Big\ Value) - \frac{1}{2}(Small\ Growth + Big\ Growth)$$

RMW (Robust Minus Weak) is the average return on the two robust operating profitability portfolios minus the average return on the two weak operating profitability portfolios,

$$RMW = \frac{1}{2}(Small\ Robust + Big\ Robust) - \frac{1}{2}(Small\ Weak + Big\ Weak)$$

CMA (Conservative Minus Aggressive) is the average return on the two conservative investment portfolios minus the average return on the two aggressive investment portfolios,

$$CMA = \frac{1}{2}(Small\ Conservative + Big\ Conservatove) - \frac{1}{2}(Small\ Aggressive + Big\ Aggressive)^{10}$$

The estimator parameters are reported in the table below:

¹⁰ https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_5_factors_2x3.html

OLS estimation

```

*****
Number of observations:    5151.0000
Number of parameters      6.0000
*****
      parameter      beta      stderr      t-student      p-value
      1      0.0392      0.0229      1.7085      0.0876
      2      0.1606      0.0098     16.3881      0.0000
      3      0.3253      0.0420      7.7369      0.0000
      4      0.3610      0.0412      8.7628      0.0000
      5     -0.9382      0.0517     -18.1493     0.0000
      6     -0.7600      0.0656     -11.5824     0.0000

```

All the estimators are statistically significant. The two new factor estimators are negative and in value near to the unity. The portfolio index has the tendency to reflect the position in aggressive and operationally weak portfolios. Further, the estimator of the SMB factor suffers a marginal decrement in this model: it is possible to deduct that the loading on small stocks is partly explained by an aggressive and financial weak situation of the position held on the index portfolio, nevertheless the estimator remains positive.

The adjusted R squared of the model shows a significant improvement to 0.2075, so, one fifth of the variability of the index is explained by the following model.

The model suffer of mis-specification: the factors do not capture the main factor that drives the index performance.

The last theoretical model that is applied is the one that includes the Frazzini Pedersen's Betting Against Beta factor and the Asness, Frazzini, Pedersen' Quality Minus Junk factor to the Carhart's 4 factors model.

“A BAB factor is a portfolio that holds low-beta assets, leveraged to a beta of 1, and that shorts high-beta assets, de-leveraged to a beta of 1. For instance, the BAB factor for U.S. stocks achieves a zero beta by holding \$1.4 of low-beta stocks and short-selling \$0.7 of high-beta stocks, with offsetting positions in the risk-free asset to make it self-financing” (Frazzini & Pedersen, 2014)

The model equation is:

$$R_i - r = \alpha_i + \beta_1(R_M - r) + \beta_2SMB_i + \beta_3HML_i + \beta_4MOM_i + \beta_5BAB_i + \beta_6QMJ_i$$

A loading on the BAB factor reflects a tendency to buy safe (low-beta) stocks while shying away from risky (high-beta) stocks. Similarly, a loading on the quality QMJ factor reflects a tendency to buy high-quality companies, that is, companies that are profitable, growing, safe and have high payout.

The results of the econometric estimation are reported below:

OLS estimation

```

*****
Number of observations:    5151.0000
Number of parameters      7.0000
*****
parameter      beta      stderr      t-student      p-value
1              0.0590      0.0220       2.6769          0.0075
2              0.1219      0.0096      12.7066         0.0000
3              0.1999      0.0410       4.8714          0.0000
4             -0.2534      0.0390      -6.4936         0.0000
5             -0.1206      0.0290      -4.1569         0.0000
6             -0.4339      0.0404     -10.7326         0.0000
7             -0.9246      0.0523     -17.6915         0.0000

```

The parameter estimators of the BAB and QMJ are both negative and statistically significant. The QMJ estimation is almost one in absolute value, so, there is consistent negative correlation.

According the construction of the new parameter estimators, the index portfolio has positions in stock whose beta is high and whose financial situation is not so strong. Moreover, as in the Fama, French's 5 factors model, the value of the SMB estimator decreases: as in this case, the small stock positions are characterised by bad performance. The two additional factors confirm the previous Fama, French's factors loadings.

Consistent to the previous Carhart's 4 factors model is the Momentum weight and even in this case the HML switch from positive to negative when the momentum factors is takes into account.

The adjusted R squared achieves the value of 0.2695: this interesting results let to explain one fourth of the variability of the index performance.

The model is mis-specified according to the RESET test.

Finally, the last model that is applied to the index tries to gather all the results above mentioned in one model. The estimation procedure follows a two steps procedure, therein the first steps consists in computing the residuals of the ARMA(1,1) model and therein the second step include the regression of all the factors taken into consideration earlier. So, the model equation is:

$$\begin{aligned} (R - r)_t - \gamma(R - r)_{t-1} - \theta\varepsilon_{t-1} \\ = \alpha_t + \beta_1(R_M - r) + \beta_2SMB_t + \beta_3HML_t + \beta_4MOM_t + \beta_5BAB_t \\ + \beta_6QMJ_t + \beta_7RMW_t + \beta_8CMA_t \end{aligned}$$

The second stage adjusted R squared is 0.2734 and The model is still misspecified. A slight improvement in the explanation of the variability of index portfolio. This final parameter estimations points out for two statistically insignificant factors, that is the HML and the RMW factors. Moreover, the negative value estimations of the HML, MOM, BAB, QMJ, RMW and CMA are confirmed. The highest estimation in absolute value are the BAB (-0.4097), QMJ (-0.8159) and CMA (-0.4359), so, the index portfolio has the tendency in investing in stock with high beta, negative financial situation according to Asness, Frazzini and Pedersen and which are regarded as an aggressive allocation by Fama French. The positive SMB estimation says that those stocks are small in size.

OLS estimation

```
*****
Number of observations:    5151.0000
Number of parameters      9.0000
*****
      parameter      beta      stderr      t-student      p-value
      1          0.0355      0.0219         1.6200         0.1053
      2          0.1186      0.0096        12.3963         0.0000
      3          0.2101      0.0417         5.0383         0.0000
      4         -0.0720      0.0464        -1.5506         0.1211
      5         -0.0859      0.0293        -2.9266         0.0034
      6         -0.4097      0.0411        -9.9613         0.0000
      7         -0.8159      0.0642       -12.7089         0.0000
      8         -0.0704      0.0662        -1.0644         0.2872
      9         -0.4359      0.0653        -6.6750         0.0000
```

If it is remembered the building construction process of the index portfolio, the results are not so outstanding. The allocation of the portfolio consists in opening the positions held by Elliott Management Corp with a delay of a quarter of year.

The fund under consideration is an activist investor that characterised himself for doing risky investment; so, a positive loadings in small, aggressive, high beta and low-quality stocks is the confirmation of the risk that a person has to face if he decides to invest in activist investors.

An unexplained fact is why the excess market return parameter estimator is so small in value, although the beta estimators of event analysis are in average near to 1 and although the BAB estimator concludes that the portfolio has positions in high beta stocks: it seems that the whenever the portfolio opens positions in high beta stocks, the stocks reduce their exposures to the market index by reducing the beta in the investment period.

Conclusion

The research points out the analysis of the Elliott mimicking portfolio, comparing it to the performance of the S&P 500 index, performing the event analysis at the disclosure of the 13F and studying the factor exposures. The research reports the following results.

First, the portfolio performance is affected by the market exposure: the three breaks suffered by the portfolio are parallel to the dot.com, financial crisis and the slowdown in 2014. The portfolio easily recovered the first drawdown whereas it never recovered the third one. Moreover, since then, the performance of the portfolio seems to have better degree of correlation to S&P 500 index. Two explanations are that the strategy has been exploited by other market participants or that Elliott management corp changes its investment strategy, by switching to more relevant stocks. The daily volatility of the index is lower than the S&P 500 one.

The performance of the index at the end of the entire investment period is not statistically different from the market portfolio. The analysis does not include the transaction costs of the opened and closed positions. So, it is possible to conclude that the actual performance is negative in comparison to the buy-and-hold strategy.

Second, the event analysis of the disclosure the 13F filings does not confirm any significant effect on the stock prices included in the portfolio. Only less than one tenth of the position shows significant cumulative abnormal returns in comparison to the market and there are negative cumulative abnormal returns.

Third, the factors individualized in the research are not satisfactory to explain the variability of the portfolio: all the models suffer of mis-specification.

The model that includes all the factors explains almost one fourth of the variability of the portfolio. By this model it is possible to deduct that Elliott invests in stock with the following features:

- Little market exposure to the index;
- Small;
- That have a negative loading to the momentum factor;
- That have a positive loading to the portfolio of high beta stocks according to Frazzini and Pedersen;
- Junk quality according to Asness, Frazzini and Pedersen;

- That are considered aggressive by Fama and French.

The identifies stock are in line with the reputation of Elliott management's strategies.

The research arises a beta puzzle, that is the contrasting results of the event analysis, the parameter estimator of the excess market returns and the parameter estimator of the Betting-Against-Beta factor. The average of the betas of the estimation period for each securities is almost one, but the excess market return loading is significant and near to zero, and the loading of the BAB factor suggests that the portfolio is correlated to a portfolio of high-valued-beta stocks.

One explanation of the puzzle is that after the disclosure of the activist investor's position, all the actions taken by Elliott have an effect on the sensitivity of the stock price on the market: that explains the huge difference between the average beta estimators and the beta estimator in the factor analysis. Moreover, it explains in part the negative results of the event analysis because the normal returns are biased upward in case of positive market returns and downward in case of negative market returns. Finally, it confirms the loading in BAB factor because Elliott buys high-beta stocks.

In conclusion, the research analyses the behaviour of only one market participant. Statistically, it is not correct to assess the profitability of the mimicking-only-one-player allocation strategy because the results are strongly biased by non-representativeness. In other word, the research is non-exhaustive in assessing the strategy because it is not taken into account the majority of the 13F filings disclosed by other investment firms.

This may be a starting point for future researches on unlocking value from the disclosure of 13F.

In addition, the portfolio includes only position in US stocks and not the broad Elliott's portfolio, it can be really interesting the entire performance of the mimicking strategy across investing in all the securities Elliott allocates its funds.

Bibliography

- Asness, C., Frazzini, A. & Pedersen, L. H., 2013. Quality Minus Junk. *working paper*.
- Bebchuk, L. A., Brav, A. & Jiang, W., 2014. The long-term effects of hedge fund activism. *Columbia Law Review*, Volume 114, p. 13–66.
- Bebchuk, L. A., Brav, A., Jiang, W. & Keusch, T., 2019. Dancing with Activists. *Working Paper 26171*, August.
- Becht, M., Franks, J. & Grant, J., 2014. Hedge fund activism in Europe: Does privacy matter?. *In Handbook in shareholder power*.
- Becht, M., Franks, J., Grant, J. & Wagner, H., 2019. The Early Returns to International Hedge Fund Activism: 2000-2010. *Journal of Applied Corporate Finance*, 31(1), pp. 62-80.
- Becht, M., Franks, J., Grant, J. & Wagner, H. F., 2017. Returns to Hedge Fund Activism: An International Study.. *The Review of Financial Studies*, 30(9), pp. 2933-2971.
- Becht, M., Franks, J., Mayer, C. & Rossi, S., 2009. Returns to shareholder activism: Evidence from a clinical study of the Hermes UK Focus Fund.. *The Review of Financial Studies*, 22(8), pp. 3093-3129.
- Boyson, N. M. & Mooradian, R. M., 2011. Corporate governance and hedge fund activism. *Review of Derivatives Research*, April, Volume 14, p. 169–204.
- Bratton, W. W., 2010. Hedge Funds and Governance Targets: Long-Term Results. *Research Paper 10-17*, September.
- Brav, A., Dasgupta, A. & Mathews, R. D., 2016. Wolf Pack Activism. *Robert H. Smith School Research Paper*.
- Brav, A., Jiang, W. & Kim, H., 2009. Hedge Fund Activism: A Review. *Foundations and Trends in Finance*, Volume 4, pp. 185-246.
- Brav, A., Jiang, W. & Kim, H., 2015. Recent advances in research on hedge fund activism: Value creation and identification. *Annual Review of Financial Economics*, December, Volume 7, pp. 579-595.
- Brav, A., Jiang, W. & Kim, H., 2015. The Real Effects of Hedge Fund Activism: Productivity, Asset Allocation, and Labor Outcomes. *The Review of Financial Studies*, October, 28(10), p. 2723–2769.
- Brav, A., Jiang, W., Ma, S. & Tian, X., 2018. How does hedge fund activism reshape corporate innovation?. *Journal of Financial Economics*, 130(2), pp. 237-264.

Brav, A., Jiang, W., Partnoy, F. & Thomas, R., 2008. Hedge Fund Activism, Corporate Governance, and Firm Performance. *The Journal of Finance*, August, 63(4), pp. 1729-1775.

Campbell, J. Y., Lo, A. W. & MacKinlay, A. C., 1997. The Econometrics of Financial Markets.

Carhart, M. M., 1997. On Persistence in Mutual Fund Performance. *Journal of Finance*, 52(1), pp. 57-82.

Denes, M. R., Karpoff, J. M. & McWilliams, V. B., 2017. Thirty years of shareholder activism: A survey of empirical research. *Journal of Corporate Finance*, June, Volume 44, pp. 405-424.

Fama, E. F. & French, K. R., 1996. Multifactor Explanations of Asset Pricing Anomalies. *Journal of Finance*, Mar, 51(1), pp. 55-84.

Fama, E. F. & French, K. R., 2015. A Five-Factor Asset Pricing Model. *Journal of Financial Economics*, April, 116(1), pp. 1-22.

Frazzini, A., Kabiller, D. & Pedersen, L. H., 2018. Buffett's Alpha. *Financial Analyst Journal*, 74(4), pp. 35-55.

Frazzini, A. & Pedersen, L. H., 2014. Betting Against Beta. *Journal of Financial Economics*, 111(1), pp. 1-25.

Gantchev, N., 2013. The Costs of Shareholder Activism: Evidence from A Sequential Decision Model. *Journal of Financial Economics*, Volume 107, pp. 610-631.

Greene, W. H., 2012. *Econometric Analysis*.

Greenwood, R. & Schor, M., 2009. Investor activism and takeovers.. *Journal of Financial Economics*, Volume 92, p. 362–75.

Klein, A. & Zur, E., 2006. Hedge Fund Activism. *Working Paper*, October.

Klein, A. & Zur, E., 2009. Entrepreneurial Shareholder Activism: Hedge Funds and Other Private Investors. *The Journal of Finance*, 23 January, 64(1), pp. 187-229.

Klein, A. & Zur, E., 2011. The Impact of Hedge Fund Activism on the Target Firm's Existing Bondholders. *The Review of Financial Studies*, 24(5), pp. 1735-1771.

Lhabitant, F. S., 2006. *Handbook of Hedge Funds*.

Santucci De Magistris, P., 2018-2019. *Lecture Notes in Econometric Analysis*.

Santucci De Magistris, P., s.d. *Parts of MatLab Scripts of the course in Econometric Theory*.

Santucci De Magistris, P., s.d. Parts of MatLab Scripts of the course in Empirical Finance.
Vitale, P., 2015-2016. Value and Growth Investing. *Lecture Notes of Equity Markets and Alternatives Investments*.

Appendix A: Web Scraping Script in Visual Basic for Applications

Option Explicit

Const SECWebSite As String = "https://www.sec.gov"

#If VBA7 Then

Private Declare PtrSafe Function URLDownloadToFile Lib "urlmon" Alias

"URLDownloadToFileA" (_

ByVal pCaller As LongPtr, _

ByVal szURL As String, _

ByVal szFileName As String, _

ByVal dwReserved As LongPtr, _

ByVal lpfnCB As Long) As LongPtr

#Else

Private Declare Function URLDownloadToFile Lib "urlmon" Alias

"URLDownloadToFileA" (_

ByVal pCaller As Long, _

ByVal szURL As String, _

ByVal szFileName As String, _

ByVal dwReserved As Long, _

ByVal lpfnCB As Long) As Long

#End If

Sub MultipleWebScraping()

Application.ScreenUpdating = False

Dim EdgarURL As String

Dim XMLReq As New MSXML2.XMLHTTP60

Dim HTMLDoc As New MSHTML.HTMLDocument

Dim PagesArray(1 To 3) As Variant

Dim counter As Long

PagesArray(1) = 0

PagesArray(2) = 40


```
PagesArray(3) = 80
For counter = 1 To 3
    EdgarURL = SECWebSite & _
        "/cgi-bin/browse-
edgar?action=getcompany&CIK=0001048445&type=&dateb=&owner=exclude&start=
" & PagesArray(counter) & "&count=40"
    XMLReq.Open "GET", EdgarURL, False
    XMLReq.send
    HTMLDoc.body.innerHTML = XMLReq.responseText
    Set XMLReq = Nothing
    ScrapeWebTable HTMLDoc, PagesArray(counter)
Next counter
Application.ScreenUpdating = True
End Sub
```

```

Sub ScrapeWebTable(HTMLPage As MSHTML.HTMLDocument, ByVal RowCounter
As Long)
    Application.ScreenUpdating = False
    Dim FTables As MSHTML.IHTMLCollection
    Dim FTable As MSHTML.IHTMLTable
    Dim TRows As MSHTML.IHTMLTableRow
    Dim TCols As MSHTML.IHTMLTableCell
    Dim RowN As Long
    Dim ColN As Long
    Dim Link As MSHTML.IHTMLAnchorElement
    Dim LinkPart As String
    Dim URL As String
    Set FTables = HTMLPage.getElementsByTagName("table")
    For Each FTable In FTables
        If LCase(FTable.className) = "tablefile2" Then
            RowN = 1 + RowCounter
            For Each TRows In FTable.getElementsByTagName("tr")
                ColN = 1
                For Each TCols In TRows.getElementsByTagName("td")
                    For Each Link In TCols.getElementsByTagName("a")
                        If LCase(Link.ID) = "documentsbutton" Then
                            LinkPart = Link.getAttribute("href")
                            URL = SECWebSite & Mid(LinkPart, InStr(LinkPart, ":") + 1)
                            With
                                Worksheets("ElliottThesis").Worksheets("ListOfDocs").Cells(RowN, ColN)
                                    .Value = TCols.innerText
                                    .Hyperlinks.Add
                                End With
                            Worksheets("ElliottThesis").Worksheets("ListOfDocs").Cells(RowN, ColN), URL
                                ScrapeIntermediate URL
                            End With
                        End If
                    Next Link
                Next TRows
            Next FTable
        End If
    Next FTable
End Sub

```

```
        Workbooks("ElliottThesis").Worksheets("ListOfDocs").Cells(RowN,  
ColN).Value = TCols.innerText  
        ColN = ColN + 1  
        'Debug.Print TCols.innerText  
    Next TCols  
    RowN = RowN + 1  
    'Debug.Print TRows.tagName  
Next TRows  
End If  
Next FTable  
Range("A2").CurrentRegion.EntireColumn.AutoFit  
Application.ScreenUpdating = True  
End Sub
```

```

Sub ScrapeIntermediate(URLPage As String)
    Application.ScreenUpdating = False
    'Dim URLPage As String
    Dim XMLReq As New MSXML2.XMLHTTP60
    Dim HTMLDoc2 As New MSHTML.HTMLDocument
    Dim Tables2 As MSHTML.IHTMLCollection
    Dim Table2 As MSHTML.IHTMLCollection
    Dim Rows2 As MSHTML.IHTMLCollection
    Dim LinkData As String
    Dim URLTable As String
    Dim FillingDates As MSHTML.IHTMLCollection
    Dim FillingDate As MSHTML.IHTMLCollection
    Dim ATT As MSHTML.IHTMLCollection
    Dim NameOfFile As String
    'URLPage =
    "https://www.sec.gov/Archives/edgar/data/1048445/000156761919016981/0001567619
-19-016981-index.htm"
    XMLReq.Open "GET", URLPage, False
    XMLReq.send
    HTMLDoc2.body.innerHTML = XMLReq.responseText
    Set XMLReq = Nothing
    Set Tables2 = HTMLDoc2.getElementsByTagName("table")
    Set FillingDates = HTMLDoc2.getElementsByClassName("info")
    'Debug.Print FillingDates(0).innerText
    On Error GoTo RenameSheet
        NameOfFile = FillingDates(0).innerText
        Workbooks("ElliottThesis").Worksheets.Add.Name = NameOfFile
        Workbooks("ElliottThesis").Worksheets(NameOfFile).Select
    On Error GoTo 0
    For Each Table2 In Tables2
        If LCase(Table2.getAttribute("summary")) = "document format files" Then
            Set Rows2 = Table2.getElementsByTagName("a")

```

```

If Rows2.Length = 1 Then
    LinkData = Rows2(1).getAttribute("href")
    URLTable = SECWebSite & Mid(LinkData, InStr(LinkData, ":") + 1)
    GetFillingFromTextFile URLTable, NameOfFile & ".txt"
ElseIf Rows2.Length = 2 Then
    LinkData = Rows2(1).getAttribute("href")
    URLTable = SECWebSite & Mid(LinkData, InStr(LinkData, ":") + 1)
    GetFillingFromTextFile URLTable, NameOfFile & ".txt"
Else
    LinkData = Rows2(2).getAttribute("href")
    URLTable = SECWebSite & Mid(LinkData, InStr(LinkData, ":") + 1)
    'Debug.Print URLTable
    GetSECFilling URLTable
End If
End If
Next Table2
Application.ScreenUpdating = True
Exit Sub
'*****
'ERROR HANDLING
'*****
RenameSheet:
    NameOfFile = FillingDates(0).innerText & " (1)"
    Workbooks("ElliottThesis").Worksheets.Add.Name = NameOfFile
    Workbooks("ElliottThesis").Worksheets(NameOfFile).Select
    Resume Next
End Sub

```

```
Sub GetSECFilling(URLFilling As String)
    Application.ScreenUpdating = False
    'Dim URLFilling As String
    Dim XMLFilling As New MSXML2.XMLHTTP60
    Dim HTMLDoc3 As New MSHTML.HTMLDocument
    'URLFilling =
    "https://www.sec.gov/Archives/edgar/data/1048445/000114036113032984/xslForm13F
    _X01/form13fInfoTable.xml"
    XMLFilling.Open "GET", URLFilling, False
    XMLFilling.send
    HTMLDoc3.body.innerHTML = XMLFilling.responseText
    Set XMLFilling = Nothing
    ProcessHTMLTable HTMLDoc3
    Range("A1").CurrentRegion.EntireColumn.AutoFit
    Application.ScreenUpdating = True
End Sub
```

```

Sub ProcessHTMLTable(HTMLPage As MSHTML.HTMLDocument)
    Application.ScreenUpdating = False
    Dim HTMLTables As MSHTML.IHTMLCollection
    Dim HTMLTable As MSHTML.IHTMLTable
    Dim HTMLRow As MSHTML.IHTMLRow
    Dim HTMLCell As MSHTML.IHTMLCell
    Dim RowNum As Long, ColNum As Long
    Set HTMLTables = HTMLPage.getElementsByTagName("table")
    For Each HTMLTable In HTMLTables
        If LCase(HTMLTable.getAttribute("summary")) = "form 13f-nt header
information" Then
            'Workbooks("ElliottThesis").Activate
            'Worksheets.Add
            RowNum = 1
            For Each HTMLRow In HTMLTable.getElementsByTagName("tr")
                ColNum = 1
                For Each HTMLCell In HTMLRow.getElementsByTagName("td")
                    Cells(RowNum, ColNum).Value = HTMLCell.innerText
                    ColNum = ColNum + 1
                Next HTMLCell
                RowNum = RowNum + 1
            Next HTMLRow
        End If
    Next HTMLTable
    Application.ScreenUpdating = True
End Sub

```

```

Sub GetFillingFromTextFile(FileURL As String, FileName As String)
    Application.ScreenUpdating = False
    Dim DestinationFile As String
    DestinationFile = "C:\Users\Francesco\Desktop\Gianmarco\TXT Fillings\" &
    FileName
    URLDownloadToFile 0, FileURL, DestinationFile, 0, 0
'   With ActiveSheet.QueryTables.Add( _
'       Connection:="TEXT;" & DestinationFile, _
'       Destination:=Range("$A$1"))
'       .CommandType = 0
'       .Name = FileName
'       .FieldNames = True
'       .RowNumbers = False
'       .FillAdjacentFormulas = False
'       .PreserveFormatting = True
'       .RefreshOnFileOpen = False
'       .RefreshStyle = xlInsertDeleteCells
'       .SavePassword = False
'       .SaveData = True
'       .AdjustColumnWidth = True
'       .RefreshPeriod = 0
'       .TextFilePromptOnRefresh = False
'       .TextFilePlatform = 850
'       .TextFileStartRow = 140
'       .TextFileParseType = xlFixedWidth
'       .TextFileTextQualifier = xlTextQualifierDoubleQuote
'       .TextFileConsecutiveDelimiter = False
'       .TextFileTabDelimiter = True
'       .TextFileSemicolonDelimiter = False
'       .TextFileCommaDelimiter = False
'       .TextFileSpaceDelimiter = False
'       .TextFileColumnDataTypes = Array(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1)

```



```
' .TextFileFixedColumnWidths = Array(30, 23, 9, 9, 12, 5, 5, 9, 9, 7, 10)
' .TextFileTrailingMinusNumbers = True
' .Refresh BackgroundQuery:=False
' End With
' FormattingTxtTables
Application.ScreenUpdating = True
End Sub
```

```

Sub FormattingTxtTables()
    Application.ScreenUpdating = False
    Dim SearchRange As Range
    Dim Column1Cell As Range
    Dim NameIssuer As Range
    Dim TableN As Range
    Dim Caption As Range
    Dim PageN As Range
    Dim DocumentN As Range
    Dim TextN As Range
    Set SearchRange = Range("A1").EntireColumn
    Set Column1Cell = SearchRange.Find(what:="COLUMN 1", MatchCase:=False,
lookat:=xlPart)
    Do
        Set Column1Cell = SearchRange.FindNext '(Column1Cell)
        If Column1Cell Is Nothing Then
            Exit Do
        Else
            Column1Cell.Offset(2, 0).EntireRow.Delete shift:=xlUp
            Column1Cell.Offset(1, 0).EntireRow.Delete shift:=xlUp
            Column1Cell.EntireRow.Delete shift:=xlUp
        End If
    Loop
    Set NameIssuer = SearchRange.Find(what:="Name of Issuer", MatchCase:=False,
lookat:=xlPart)
    Do
        Set NameIssuer = SearchRange.FindNext '(NameIssuer)
        If NameIssuer Is Nothing Then
            Exit Do
        Else
            NameIssuer.Offset(2, 0).EntireRow.Delete shift:=xlUp
            NameIssuer.Offset(1, 0).EntireRow.Delete shift:=xlUp
        End If
    Loop
End Sub

```

```

        NameIssuer.EntireRow.Delete shift:=xlUp
    End If
Loop
Set Caption = SearchRange.Find(what:="caption>", MatchCase:=False,
lookat:=xlPart)
Do
    Set Caption = SearchRange.FindNext '(Caption)
    If Caption Is Nothing Then
        Exit Do
    Else
        Caption.Offset(2, 0).EntireRow.Delete shift:=xlUp
        Caption.Offset(1, 0).EntireRow.Delete shift:=xlUp
        Caption.EntireRow.Delete shift:=xlUp
    End If
Loop
Set PageN = SearchRange.Find(what:="page>", MatchCase:=False, lookat:=xlPart)
Do
    Set PageN = SearchRange.FindNext '(PageN)
    If PageN Is Nothing Then
        Exit Do
    Else
        PageN.Offset(-2, 0).Select
        ActiveCell.Offset(2, 0).EntireRow.Delete shift:=xlUp
        ActiveCell.Offset(1, 0).EntireRow.Delete shift:=xlUp
        ActiveCell.EntireRow.Delete shift:=xlUp
    End If
Loop
Set TableN = SearchRange.Find(what:="table>", MatchCase:=False, lookat:=xlPart)
Do
    Set TableN = SearchRange.FindNext '(TableN)
    If TableN Is Nothing Then
        Exit Do

```

```

Else
    TableN.EntireRow.Delete shift:=xlUp
End If
Loop
Set DocumentN = SearchRange.Find(what:="document>", MatchCase:=False,
lookat:=xlPart)
Do
    Set DocumentN = SearchRange.FindNext '(DocumentN)
    If DocumentN Is Nothing Then
        Exit Do
    Else
        DocumentN.EntireRow.Delete shift:=xlUp
    End If
Loop
Set TextN = SearchRange.Find(what:"text>", MatchCase:=False, lookat:=xlPart)
Do
    Set TextN = SearchRange.FindNext '(TextN)
    If TextN Is Nothing Then
        Exit Do
    Else
        TextN.EntireRow.Delete shift:=xlUp
    End If
Loop
Rows("1:1").Select
Selection.Insert shift:=xlDown, CopyOrigin:=xlFormatFromLeftOrAbove
With Range("A1")
    .Value = "NAME OF ISSUER"
    .Offset(0, 1).Value = "TITLE OF CLASS"
    .Offset(0, 2).Value = "CUSIP"
    .Offset(0, 3).Value = "VALUE (X1000)"
    .Offset(0, 4).Value = "SHRS OR PRN AMT"
    .Offset(0, 5).Value = "SH/PRN"

```

```
.Offset(0, 6).Value = "PUT/CALL"  
.Offset(0, 7).Value = "INV DISCR"  
.Offset(0, 8).Value = "OTHER MANAGER"  
.Offset(0, 9).Value = "SOLE"  
.Offset(0, 10).Value = "SHARED"  
.Offset(0, 11).Value = "NONE"  
End With  
Application.ScreenUpdating = True  
End Sub
```

Appendix B: Data Analysis Scripts in MatLab

```
% Analysis of the Index Returns
clear all
clc

[R] = xlsread('RiskFreeRate.xlsx');
[C] = xlsread('Index Returns.xlsx');

ExDates = C(:,1);
Date9919 = x2mdate(ExDates, 0, 'datetime');
%% Introductory Statistics
% Descriptive Statistics
Mean_I = mean(C(:,2))
Std_I = std(C(:,2))
Skew_I = skewness(C(:,2))
Kurt_I = kurtosis(C(:,2))
JBTest_I = jbtest(C(:,2))

Mean_M = mean(C(:,3))
Std_M = std(C(:,3))
Skew_M = skewness(C(:,3))
Kurt_M = kurtosis(C(:,3))
JBTest_M = jbtest(C(:,3))

Z = normrnd(Mean_I, Std_I, length(C(:,2)),1);
figure(1)
histogram(C(:,2))
hold on
histogram(Z)
legend('Index Distribution','Normal Distribution')
title('Histogram of Index Returns')
xlabel('Values')
ylabel('Frequency')
hold off
figure(2)
qqplot(C(:,2))
title('QQ-plot of Index Returns')

% Sharpe Ratio
SR_I = (Mean_I - mean(R))/(Std_I)
SR_M = (mean(C(:,3)) - mean(R))/Std_M

% Treynor Ratio
X = [ones(length(C(:,3)),1), C(:,3)- R];
beta_I = inv(X' * X) * X' * (C(:,2)-R);
TreynorR_I = (Mean_I - mean(R))/(beta_I(2))
TreynorR_M = (mean(C(:,3)) - mean(R))

% Information Ratio
TrackError = std(C(:,2) - C(:,3));
IR_I = (Mean_I - Mean_M)/ TrackError

%Value at Risk
VaR_I = prctile(C(:,2),5)
VaR_M = prctile(C(:,3),5)

%Jobson-Korkie test
```

```

T = length(C(:,2));
EMean_I = Mean_I - mean(R)
EMean_M = Mean_M - mean(R)
Cov = cov(C(:,2), C(:,3));
theta = (1/T)*(2 * Std_I^2 * Std_M^2 - 2 * Std_I * Std_M * Cov(2,1)...
        + (1/2)* (EMean_I*Std_M)^2 + (1/2) * (EMean_M*Std_I)^2 ...
        - (EMean_I * EMean_M * Cov(2,1)^2))/(Std_M * Std_I);

Y = (Std_I * EMean_M - Std_M * EMean_I)/(theta^(1/2));
JKtest = 1 - cdf('Normal', Y,0,1)

%Gibbons, Ross and Shanken test
N = 500;
F =T *(T-N-1)/(N*(T-2))*((sqrt(1+SR_I^2)/sqrt(1+SR_M^2))^2-1);
GRStest = 1- fcdf(F,N, T-N-1)

%% Cummulative Returns
Index = C(:,2)./100 + ones(T,1);
SP500 = C(:,3)./100 + ones(T,1);
CumIndex = cumprod(Index)*1000;
CumSP500 = cumprod(SP500)*1000;

figure(3)
plot(Date9919, CumIndex, 'r-')
hold on
plot(Date9919, CumSP500, 'b-')
title('Cumulative Returns')
xlabel('Period: 17/11/1999 - 14/08/2019')
ylabel('Cumulative Value')
legend('Index', 'S&P 500')
hold off

figure(4)
plot(Date9919, C(:,2), '-g')
ylim([-40, 100])
title('Index Time Series')
xlabel('Period: 17/11/1999 - 14/08/2019')
ylabel('Daily Returns')
legend('Index')

figure(5)
plot(Date9919, C(:,3), '-m')
title('S&P500 Time Series')
xlabel('Period: 17/11/1999 - 14/08/2019')
ylabel('Daily Returns')
legend('S&P 500')

```

```

%% Time Series Analysis of the Index Return
clear all
clc

%Import Data to MatLab
[C] = xlsread('Index Returns.xlsx');
[R] = xlsread('RiskFreeRate.xlsx');
ExDates = C(:,1);
IndexER = C(:,2)-R;
SP500ER = C(:,3)-R;
Date9919 = x2mdate(ExDates, 0, 'datetime');

% Import of all the factors
[X] = xlsread('Factors.xlsx');

ExRet = X(:,1);
EMR = X(:,2);
SMB = X(:,3);
HML = X(:,4);
MOM = X(:,5);
BAB = X(:,6);
QMJ = X(:,7);
RMW = X(:,8);
CMA = X(:,9);

h = lbqtest(IndexER)
%Autocorrelation and Partial-Autocorrelation Functions
figure(1)
autocorr(IndexER,50)
figure(2)
parcorr(IndexER, 50)

% Unit Root Tests
[h1,pValue_ADF_no_det] = adftest(IndexER,'lags',0:2,'model','AR');
[h2,pValue_PP_no_det] = pptest(IndexER,'model','AR');
[h3,pValue_KPSS_no_det,stats] = kpsstest(IndexER,'trend',false);

%% Define parameters of the model

options= ...
    optimset('Diagnostics','off','Display',...
        'iter','Algorithm','interior-point');

max_p=5;
max_q=5;
T=length(IndexER);

logl=zeros(max_p+1,max_q+1);
BIC=zeros(max_p+1,max_q+1);
AIC=zeros(max_p+1,max_q+1);

for p = 0:max_p; % Autoregressive part
    for q = 0:max_q; % Moving average part
        Mdl= arima(p,0,q);
        [~,~,logl(p+1,q+1)] = estimate(Mdl,IndexER);
        [AIC(p+1,q+1),BIC(p+1,q+1)] = aicbic(logl(p+1,q+1), [p+q+2],T);
    end
end
end

```



```

min_BIC = min(min(BIC));
[p_star,q_star]=find(BIC==min_BIC);
p_star=p_star-1; % first elements ar p=0, q=0;
q_star=q_star-1; % first elements ar p=0, q=0;

%ARMA(1,1)
Mdl_star= arima(p_star,0,q_star);
[EstMdl,~,logl(p+1,q+1)] = estimate(Mdl_star,IndexER,
'Display',{'params','diagnostics'});
[resid] = infer(EstMdl,IndexER);

N = length(X(:,1));
iota = ones(N,1);
A = [iota, EMR, SMB, HML, MOM, BAB, QMJ, RMW, CMA];
TSALL = ols(resid, A,3);

```

```

% Event Study of Elliott Management

clear
clc

[D] = xlsread('ElliottEventEstimationSample.xlsx');
[C] = xlsread('ElliottCAREventSample.xlsx');

for i = 1:2:1446

    X1 = D(:,i+1);
    X1 = X1(~isnan(X1));
    X1 = [ones(length(X1),1), X1];
    Y = D(:,i);
    Y = Y(~isnan(Y));
    beta(:,(i+1)/2) = inv(X1'*X1) * X1' * Y;
    EPS = Y - X1 * beta(:,(i+1)/2);
    sigmaEPS(:,(i+1)/2) = EPS'*EPS/(length(EPS)-1);

    X2 = C(:,i+1);
    X2 = X2(~isnan(X2));
    X2 = [ones(length(X2),1), X2];
    Y1 = C(:,i);
    Y1 = Y1(~isnan(Y1));
    Epsilon = Y1 - X2 * beta(:,(i+1)/2);

    JB(:,(i+1)/2) = jbtest(Epsilon);
    CAR(:,(i+1)/2) = ones(1,length(Epsilon))*Epsilon;
    sigmaCAR(:,(i+1)/2) = (sigmaEPS(:,(i+1)/2) + (1 + ((X2(:,2) ...
        - mean(X1(:,2)))'*(X2(:,2) - mean(X1(:,2))))/var(X1(:,2))) ...
        /length(X1(:,1)))^(1/2);

    SCAR = CAR ./ sigmaCAR;
    pvalues = 1 - tcdf(SCAR, length(X1(:,1)) - 2, 'upper');

end

% Sign test
PositiveCAR = CAR(CAR>0);
posN = length(PositiveCAR);
SignStat = (posN/723-0.5)*sqrt(723)/0.5;
pvalue = 1-normcdf(SignStat);

beta = beta';
figure(1)
histogram(beta(:,1))
title('Histogram of market alphas estimator')
xlabel('Alpha Estimators')

figure(2)
histogram(beta(:,2))
title('Histogram of the market beta estimators')
xlabel('Market Beta Estimators')

figure(3)
histogram(CAR)
title('Histogram of Cumulative Abnormal Returns')
xlabel('Cumulative Abnormal Returns')

```

```
figure(4)
histogram(pvalues)
title('Histogram of p-values')
xlabel('P-values of the different events')
```

```

% Regression Analysis of the Portfolio performance
clear all
clc
% Import of all the factors
[X] = xlsread('Factors.xlsx');

ExRet = X(:,1);
EMR = X(:,2);
SMB = X(:,3);
HML = X(:,4);
MOM = X(:,5);
BAB = X(:,6);
QMJ = X(:,7);
RMW = X(:,8);
CMA = X(:,9);

% Capital Asset Pricing Model
N = length(X(:,1));
iota = ones(N,1);
CapmX = [iota, EMR];
CAPMresults = ols(ExRet, CapmX, 3);

% Fama-French 3-Factors Model
FF3X = [iota, EMR, SMB, HML];
FF3results = ols(ExRet, FF3X, 3);

% Carhart's 4-Factors Model
C4FX = [iota, EMR, SMB, HML, MOM];
C4Fresults = ols(ExRet, C4FX, 3);

% Fama-French 5-Factors Model
FF5X = [iota, EMR, SMB, HML, RMW, CMA];
FF5results = ols(ExRet, FF5X, 3);

% Frazzini-Pedersen 6-Factors Model
FP6results = ols(ExRet, [iota, EMR, SMB, HML, MOM, BAB, QMJ] , 3);

% All-In
A = [iota, EMR, SMB, HML, MOM, BAB, QMJ, RMW, CMA];
Aresults = ols(ExRet, A,3);

```

```

function results=ols(y,x,p)
% PURPOSE: least-squares regression
%-----
% USAGE: results = ols(y,x)
% where: y = dependent variable vector      (nobs x 1)
%        x = independent variables matrix (nobs x nvar)
%-----
% RETURNS: a structure
%         results.meth = 'ols'
%         results.beta = bhat      (nvar x 1)
%         results.tstat = t-stats  (nvar x 1)
%         results.bstd  = std deviations for bhat (nvar x 1)
%         results.yhat  = yhat     (nobs x 1)
%         results.resid = residuals (nobs x 1)
%         results.sige  = e'*e/(n-k) scalar
%         results.rsqr  = rsquared  scalar
%         results.rbar  = rbar-squared scalar
%         results.dw    = Durbin-Watson Statistic
%         results.nobs  = nobs
%         results.nvar  = nvars
%         results.y     = y data vector (nobs x 1)
%         results.bint  = (nvar x2 ) vector with 95% confidence
intervals on beta
%-----
% SEE ALSO: prt(results), plt(results)
%-----

% written by:
% James P. LeSage, Dept of Economics
% University of Toledo
% 2801 W. Bancroft St,
% Toledo, OH 43606
% jlesage@spatial-econometrics.com
%
% Barry Dillon (CICG Equity)
% added the 95% confidence intervals on bhat

if (nargin > 3); error('Wrong # of arguments to ols');
else
    [nobs nvar] = size(x); [nobs2 junk] = size(y);
    if (nobs ~= nobs2); error('x and y must have same # obs in ols');
    end;
end;

results.meth = 'ols';
results.y = y;
results.nobs = nobs;
results.nvar = nvar;

xpxi = (x'*x)\eye(nvar);

T=size(x,1);
results.beta = xpxi*(x'*y);
results.yhat = x*results.beta;
results.resid = y - results.yhat;
sigu = results.resid'*results.resid;
results.sige = sigu/(nobs-nvar);
tmp = (results.sige)*(diag(xpxi));

```

```

results.cov=(results.sige)*(xpxi);
sigb=sqrt(tmp);
results.bstd = sigb;
results.tstat = results.beta./(sqrt(tmp));
results.pvalue = 2*(1-tcdf( abs(results.tstat), T-
size(results.beta,1) ));
ym = y - mean(y);
rsqr1 = sigu;
rsqr2 = ym'*ym;
results.rsqr = 1.0 - rsqr1/rsqr2; % r-squared
rsqr1 = rsqr1/(nobs-nvar);
rsqr2 = rsqr2/(nobs-1.0);
if rsqr2 ~= 0
    results.rbar = 1 - (rsqr1/rsqr2); % rbar-squared
else
    results.rbar = results.rsqr;
end;
ediff = results.resid(2:nobs) - results.resid(1:nobs-1);
results.dw = (ediff'*ediff)/sigu; % durbin-watson

%% RESET TEST
% Default, powers 2 and 3.
if nargin==2;
    p=3;
end;
pw=[2:p];

Z=results.yhat.^pw;

W=[x,Z]; % extended set of regressors

K=size(x,2); % number of original regressors

L=size(W,2)-K; % number of powers of y_hat

R=[zeros(L,K), eye(L)]; % generate the selection matrix of
restrictions

c=zeros(L,1); % vector of constants

gamma_hat=inv(W'*W)*W'*y; % estimates on the auxiliary extended
regression

resid_aux=y-W*gamma_hat; % residuals auxiliary component

s2_aux=resid_aux'*resid_aux/(T-K-L);

results.RESET_test=(R*gamma_hat-c)'*inv(R*inv(W'*W)*R')*(R*gamma_hat-
c)/(L*s2_aux); % RESET test-statistic

results.pvalue_RESET_test=1-fcdf(results.RESET_test,L,T-K-L); % p-
value (all probability of the F on the right tail) - pvalue>0.05 : the
linear specification is ok
%% Print on screen

```

```

parno    = (1:size(results.beta,1))';

Res      = [ parno results.beta results.bstd results.tstat
results.pvalue];

disp('OLS estimation');

fprintf('\n\n\n
*****
\n');
if T-size(results.beta,1)<=0;
    fprintf('\nWarning\n')
    fprintf('Model contains more parameters than observations \n')

fprintf('!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!! \n')
end
fprintf('Number of observations: %12.4f\n',T);
fprintf('Number of parameters      %12.4f\n',size(results.beta,1));
fprintf('
*****
\n');
fprintf('          parameter      beta      stderr      t-student
p-value\n');
fprintf(' %12.0f %12.4f %12.4f %12.4f %12.4f\n', Res' );

```

Summary

In a world of zero-interest rate, investment funds and fund of funds struggle to achieve sustainable returns that give a sense to invest in them. A popular trend since the dot.com bubble has been the activism investing. It consists in having an active role in the management of the company acquired by the investment fund in order to unlock the hidden value of the investment. Sometimes, “the investment funds decide to operate in such a way after a long period of underperformance of the passive approach. These investors may eventually conclude that such change of fate will not materialize and that their investment will not reap any benefits unless they take a pro-active stance.” (Vitale, 2015-2016)

The most relevant reason because of the underperformance of securities is the mismanagement of the board. The explanations include overconfidence in their ability, the desire to build up a large corporate empire without profiting, misjudgement, short-terminism and of course bad management decisions in stressed business periods.

Activist investors try to replace the management across two ways: proxy contests or hostile take-over bids. “The proxy contest refers to a situation in which a group of shareholders in a company joins forces in an attempt to oppose and vote out the current management or board of directors. In other words, a proxy fight is a battle between shareholders and senior management for control of the company”¹¹.

The hostile takeover bid refers to the launch of a bid to the public by the offeror (the investment fund) in order to purchase the shares of the target company, often at a price higher than the current trading price. The takeover bid is hostile if the management directors do not approve the bid.

Once the activist investor gathers the voting right to exercise its influence, it replaces the management and appoints a new friendly board that has the competence and the properness to unlock the hidden value of the undervalued company. The performance is not only achieved thanks to better decisions concerning the business operations of the company under evaluation, but also thanks to a new business strategy, a different capital structure that allows to obtain more tax benefits, deployment of unprofitable assets, sale of unrelated branches, acquisitions of synergic companies, and mergers to other business

¹¹ <https://corporatefinanceinstitute.com/resources/knowledge/finance/proxy-fight/>

players. The liquidation of company is a solutions, too. Most of the time, the investment funds do not fund the operations only with debt but they employ a large amount of debt to execute the buyout.

The most famous and one of the largest activist investor is Elliott Management Corp.. It is an American investment firm, based in New York, founded by Paul Singer, the current CEO of the company. Its notoriety is nurtured by investment in distressed securities in debt of bankrupt or- near-bankrupt companies.

The following research tries to analyse deeply the performance of this hedge fund in US stock market, by mimicking the strategic allocation with the delay of 45 days from the actual portfolio operation. In particular, the research answers whether it is possible to profit from the disclosure of the 13F filings of Elliott Management by aping the portfolio positions or, on the other hand, the market reflects the information on the security prices correctly without leaving unlocked hidden value after the delay. With a broad economic view, this research attempts to test the efficiency of the market.

In addition to the economic reasons, the research requires the author to write an algorithm to scrape and to wrangle data from the SEC webpage. The algorithm is written in Visual Basic for Applications

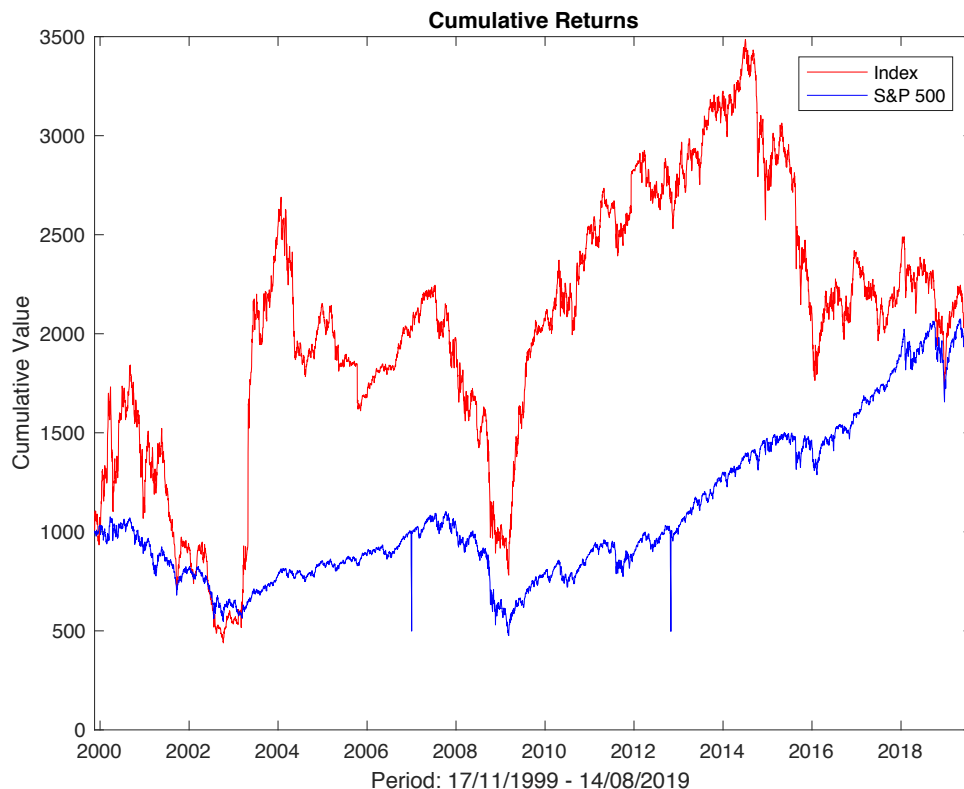
The research addresses the profitability of a strategy easy to execute by the retail investor. The first paragraph introduces the reader to automated steps that the algorithm executes to download and to wangle data. Moreover, the paragraph identifies the sources from which the data are download to perform the following analysis. The stock prices are downloaded from Datastream, the S&P 500 index value is downloaded form Yahoo finance, as well as the Fama, French’s factors and the Carhart’s momentum factor are downloaded from the Franch’s website. The Betting-Against-Beta factor and Quality-Minus-Junk factor are downloaded from the AQR website.

After obtaining the data, the second paragraph reports the total invested amount in the US market and the performance of the portfolio in comparison to the buy-and-hold strategy of investing in the S&P 500 index. In particular, the reader will have descriptive statistics of the index and S&P500, with the further check of few statistical tests.

	Mean	Volatility	Skewness	Kurtosis
Index	0.03040%	1.84510%	4.03820%	98.99310%
S&P 500	0.03510%	2.39520%	27.41680%	1186.80000%

	Sharpe Ratio	Treynor ratio	Information Ratio	5% VaR
Index	0.0129	0.1099	-0.0018	-2.4345
S&P 500	0.0119	0.0286	0	-1.8476

The graph of the portfolio and S&P 500 performances is reported below.



The comparison shows a positive correlation between the two strategies. The index performance magnitude is higher than the buy-and-hold strategy: when the S&P 500 goes up, the index goes up more than proportionally; on the other hand, if the when the S&P 500 goes down, the index goes down steeply. The reason is that the index portfolio is less diversified than a broad index.

The third paragraph concludes with an untheoretical time series analysis in order to check the autocorrelation and the stationarity of the index portfolio returns. The statistical tests confirm a sort of autocorrelation and the stationarity of the portfolio performance.

The best model according to the Bayesian Information Criterium is the ARMA(1,1).

The model is reported below.

ARIMA(1,0,1) Model:

Conditional Probability Distribution: Gaussian

Parameter	Value	Standard Error	t Statistic
Constant	0.000337629	0.000951072	0.354998
AR{1}	0.979778	0.00745269	131.466
MA{1}	-0.967347	0.0087367	-110.722
Variance	3.38908	0.0121456	279.037

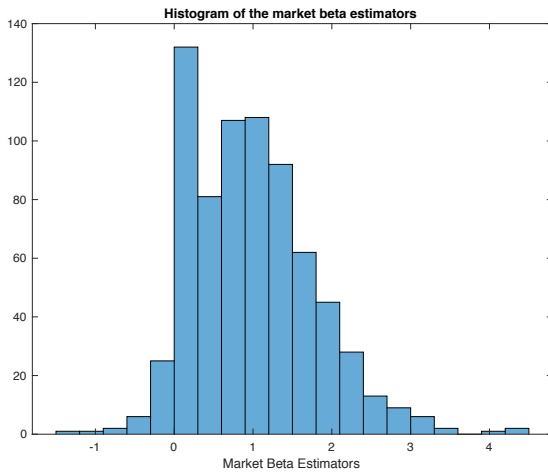
The intercept is almost zero and the t statistic does not reject the null hypothesis of equalling to zero. Both the AR(1) and the MA(1) coefficients are statistically significant different from zero and approach in absolute value the unity, but the signs are contrary.

The AR(1) coefficient is positive and the MA(1) is negative. The F test of the significant of the model is statistically significant, hence the model under this concept may be robust.

The element that undermine all the previous facts is that the goodness of fit is almost zero, that is 0.4%. The conclusion is that the model is not reliable to explain the data behaviour.

Further, the analysis is enhanced by an event study analysis of the single positions in the fourth paragraph. The event is the disclosure of the 13F filings. The estimation window includes all the returns a year before the disclosure and the event window involves the entire investment period held by the portfolio in a security.

The event analysis consists of two steps: first, it is estimated a market model in order to have the parameter estimators; second, the parameter estimators are used to compute the normal returns. The first-step beta estimator of all the positions are reported in the following histogram.

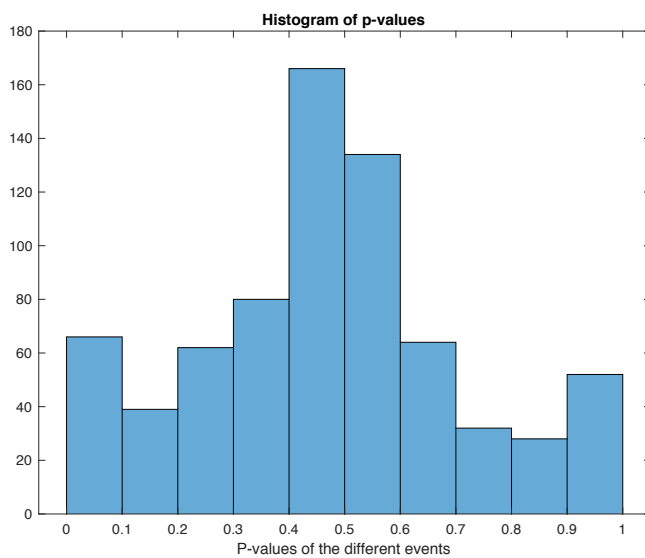


The normal returns are compared to the actual returns and the differences are gathered together to compute the cumulative abnormal returns.

In order to have a statistical significant event, the cumulative abnormal returns must be different from zero.

The results of the statistical inferences confirm that only for few events the null hypothesis of cumulative abnormal returns different from zero is rejected.

The p-values are reported in the following histogram:



The events with statistically significant cumulative abnormal returns at 10% of critical value are less than 70, that is less than the 10% of the events guarantees statistically

significant returns. In addition to the parametric inference, it is performed the sign test, non-parametric test employed to check whether the chance of cumulative abnormal returns is casual or there is consistency in positive cumulative abnormal returns. The test confirms the parametric results.

Finally, the research makes an effort to find the factors that drive the performance of the index portfolio by testing different economic models. The factors that are included in the analysis are the excess market returns, the Fama, French's Small-Minus-Big factor and the High-Minus-Low factor, the Carhart's Momentum factor, the Fama, French's Conservative-Minus-Aggressive factor and the Robust-Minus-Weak factor, the Frazzini Pedersen's Betting Against Beta factor and the Asness, Frazzini, Pedersen's Quality Minus Junk factor.

The estimated model are the Capital Asset Pricing Model, the Fama, French's 3 factors model, the Fama, French's 5 factors model, the Carhart's 4 factors model, the model including the Frazzini Pedersen's Betting-Against-Beta factor and the Asness, Frazzini, Pedersen's Quality-Minus-Junk factor and finally, the model that includes all the factors expressed above. The models are statistically significant and have statistically significant estimators different from zero, but they suffer of little goodness of fit reference and of mis-specification. The most significant model is the that includes all the factors, according to the adjusted-R-squared. The equation is reported below

$$\begin{aligned} (R - r)_t - \gamma(R - r)_{t-1} - \theta\varepsilon_{t-1} \\ = \alpha_t + \beta_1(R_M - r) + \beta_2SMB_t + \beta_3HML_t + \beta_4MOM_t + \beta_5BAB_t \\ + \beta_6QMJ_t + \beta_7RMW_t + \beta_8CMA_t \end{aligned}$$

The estimation for this model consists of two stages: the first stage computes the ARMA(1,1) errors and the second one estimate the parameters by considering those such as independent variable.

The second stage adjusted R squared is 0.2734 and the model is still mis-specified. A slight improvement in the explanation of the variability of index portfolio with respect to all the previous models. This final parameter estimations point out for two statistically insignificant factors, that is the HML and the RMW factors. Moreover, the negative value estimations of the HML, MOM, BAB, QMJ, RMW and CMA are confirmed. The highest

estimation in absolute value are the BAB (-0.4097), QMJ (-0.8159) and CMA (-0.4359), so, the index portfolio has the tendency in investing in stock with high beta, negative financial situation according to Asness, Frazzini and Pedersen and which are regarded as an aggressive allocation by Fama French. The positive SMB estimation says that those stocks are small in size.

The estimators table is reported below.

OLS estimation

```

*****
Number of observations:    5151.0000
Number of parameters      9.0000
*****

```

parameter	beta	stderr	t-student	p-value
1	0.0355	0.0219	1.6200	0.1053
2	0.1186	0.0096	12.3963	0.0000
3	0.2101	0.0417	5.0383	0.0000
4	-0.0720	0.0464	-1.5506	0.1211
5	-0.0859	0.0293	-2.9266	0.0034
6	-0.4097	0.0411	-9.9613	0.0000
7	-0.8159	0.0642	-12.7089	0.0000
8	-0.0704	0.0662	-1.0644	0.2872
9	-0.4359	0.0653	-6.6750	0.0000

The results of the model that includes all the factors are confirmed by the previous models. Hence, the research points out the analysis of the Elliott mimicking portfolio, comparing it to the performance of the S&P 500 index, performing the event analysis at the disclosure of the 13F and studying the factor exposures. The research reports the following results.

First, the portfolio performance is affected by the market exposure: the three breaks suffered by the portfolio are parallel to the dot.com, financial crisis and the slowdown in 2014. The portfolio easily recovered the first drawdown, whereas it never recovered the third one. Moreover, since then, the performance of the portfolio seems to have better degree of correlation to S&P 500 index. Two explanations are that the strategy has been exploited by other market participants or that Elliott management Corp. changes its investment strategy, by switching to more relevant stocks. The daily volatility of the index is lower than the S&P 500 one.

The performance of the index at the end of the entire investment period is not statistically different from the market portfolio. The analysis does not include the transaction costs of the opened and closed positions. So, it is possible to conclude that the actual performance is negative in comparison to the buy-and-hold strategy.

Second, the event analysis of the disclosure the 13F filings does not confirm any significant effect on the stock prices included in the portfolio. Only less than one tenth of the position shows significant cumulative abnormal returns in comparison to the market and there are negative cumulative abnormal returns.

Third, the factors individualized in the research are not satisfactory to explain the variability of the portfolio: all the models suffer of mis-specification.

The model that includes all the factors explains almost one fourth of the variability of the portfolio. By this model it is possible to deduct that Elliott invests in stock with the following features:

- Little market exposure to the index;
- Small;
- That have a negative loading to the momentum factor;
- That have a positive loading to the portfolio of high beta stocks according to Frazzini and Pedersen;
- Junk quality according to Asness, Frazzini and Pedersen;
- That are considered aggressive by Fama and French.

The identifies stock are in line with the reputation of Elliott management's strategies.

The research arises a beta puzzle, that is the contrasting results of the event analysis, the parameter estimator of the excess market returns and the parameter estimator of the Betting-Against-Beta factor. The average of the betas of the estimation period for each securities is almost one, but the excess market return loading is significant and near to zero, and the loading of the BAB factor suggests that the portfolio is correlated to a portfolio of high-valued-beta stocks.

One explanation of the puzzle is that after the disclosure of the activist investor's position, all the actions taken by Elliott have an effect on the sensitivity of the stock price on the market: that explains the huge difference between the average beta estimators and the beta estimator in the factor analysis. Moreover, it explains in part the negative results of the event analysis because the normal returns are biased upward in case of positive market

returns and downward in case of negative market returns. Finally, it confirms the loading in BAB factor because Elliott buys high-beta stocks.

In conclusion, the research analyses the behaviour of only one market participant. Statistically, it is not correct to assess the profitability of the mimicking-only-one-player allocation strategy because the results are strongly biased by non-representativeness. In other word, the research is non-exhaustive in assessing the strategy because it is not taken into account the majority of the 13F filings disclosed by other investment firms.

This may be a starting point for future researches on unlocking value from the disclosure of 13F.

In addition, the portfolio includes only position in US stocks and not the broad Elliott's portfolio, it can be really interesting the entire performance of the mimicking strategy across investing in all the securities Elliott allocates its funds.