Asset Management Area

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I.   Portfolio Overview – Recap

Our Portfolio is composed of two components:

a) <u>Active Component:</u> This part of the portfolio is based on a zero-net investment (i.e., the sum of the weights of the long and the short component of the portfolios is equal to zero) factor investing strategy. We focused on the US and the European Stock Markets, picking a total of 78 stocks for both the sector neutral and the non-sector neutral portfolio. The factors and the steps used to build the active component will be listed and explained more in detail in the following sections. We decided to adopt an equal weighting scheme in order to preserve the factors identity. In this way we avoided the possible drawbacks that optimization techniques, such as the ones based on the mean-variance approach, could have caused to our portfolio.

b) <u>Passive Component:</u> This part of the portfolio is a well-diversified component across different asset classes and markets. We picked many indexes able to represent a good portion of the investable universe. Since nowadays most indexes are well replicated by Exchange-Traded-Funds (ETF), we chose an ETF for each index, focusing on their cost structure and trying to choose the ETF with the lowest Total Expense Ratio (TER). However, it is worth to mention that, although a high TER is not, in any way, a signal of a good asset manager, and it is by the way the main cause of bad total performances for expensive funds, it seems that in some cases we must accept a higher TER to have a longer history of performance. In fact, many cheap ETFs are relatively young and do not provide us with enough data to perform an historical analysis on expected returns and standard deviations, which are fundamental in a mean-variance context.

II.   Factor research

The last multi-factor portfolio includes the ESG factor. Here are some insights about this new factor.

What is ESG:

"ESG investing is the consideration of environmental, social and governance factors alongside financial factors in the investment decision–making process"
(Remy Briand, Managing Director of MSCI ESG Research, 2018).

Environmental criteria examine a company's pollution, treatment of animals, energy use and natural resource conservation in order to assess any environmental risk and to show how the firm is managing those risks. Social criteria observe the firm's management of the relationships with stakeholders such as suppliers, customers, employees and the communities where the company operates. Governance criteria may include a company's executive pay, shareholder rights, leadership and internal controls.

Why is ESG growing:

In years past, SRI (Socially Responsible Investments) restricted the investor's potential profit due to the limitation of the universe of firms eligible for investment. Thus, the investor had to face a trade-off since, at least in terms of stock price, "bad" firms sometimes had good performance.

Warning

This is an academic paper related to an academic project. This paper is not an investment suggestion and it does not in any way represent an invitation to purchase the securities we virtually invest in.

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More recently, asset managers have started investing in alignment with an individual's moral beliefs and values, with the intention to improve long-term risk-adjusted returns and to support positive environmental and social benefits. For instance, Volkswagen's emissions scandal and BP's 2010 oil spill rocked the firms' stock prices.

The most important drivers of the growth of ESG investments are:
- New risk factors have been introduced by global sustainability challenges such as data security, privacy, flood risk and sea level rise.
- Change of the investors - the millennial generation, that can increase the ESG investments because they are more sensitive to this issue, would strongly increase the size of the equity market.
- Improvement of data and analytics - more financially relevant and systematic approaches to ESG investments can be developed due to enhanced ESG researches and analytics capabilities.

ESG & Performance:

High ESG-rated companies have demonstrated greater profitability, better operational performance and the generation of abnormal returns, leading to greater dividend payments and profitability with respect to low ESG-rated firms. In addition, high ESG-rated firms have shown lower tail risk and experienced a lower frequency of idiosyncratic risk incidents such as major drawdowns. Furthermore, high ESG-rated companies have shown lower systematic risk exposure, less volatile earnings, less systematic volatility, lower costs of capital and lower betas compared to low ESG-rated firms.

The issuers improve their ability to raise new capital to finance sustainable projects and can also reduce the cost of capital. There exists a consistent correlation between operational metrics and ESG ratings. For example, high ESG-rated firms have lower net debt/EBITDA and higher ROCE and ROE than the market. Share prices, margins and returns are also more stable for the companies with higher ESG scores. Therefore, high ESG-rated firms are valued at a premium.

Even if there will be more sophisticated methods in the future, the most common screening technique is based on exclusions. ESG captures future risk reduction that could avoid quality deterioration. In fact, ESG showed downside protection in times of crisis. Overall, ESG can be used as a timing indicator.
Several studies have demonstrated that ESG strategies have generated significant alphas and solid returns everywhere, especially in Europe, since 2012. The ESG focus is greater in Europe and, therefore, Europe has outperformed North America.

If investors combine ESG ratings with quality metrics, they can create a portfolio of quality firms that are less susceptible to future deterioration and add alpha to a pure quality strategy. For example, the investment in emerging markets is very risky. However, if an emerging markets portfolio has limited exposure to ESG risks, the risk of unlikely events causing catastrophic damage may be reduced.

ESG Ratings:

In order to assign an ESG score to each company of our multi-factor portfolio, two different Thomson Reuters ESG Scores have been compared and analyzed.

These scores aim to objectively and transparently measure a firm's relative ESG commitment effectiveness and performance across 10 main themes (human rights, emissions, shareholders,

environmental product innovation etc.) based on company-reported information. Thomson Reuters ESG Scores are available going back to the fiscal year 2002 for approximately 1,000 companies (mainly U.S. and European).

1) Thomson Reuters ESG Score (ESG Score): it measures a company's ESG performance based on reported data in the public domain. It captures and calculates over 400 company level ESG measures, of which a subset of 178 most comparable and relevant fields have been selected to power the overall company assessment and scoring process. The underlying measures are based on considerations around industry relevance, comparability and data availability. They are grouped into 10 categories. A combination of the 10 categories, weighted proportionately to the count of measures within each category, formulates the three pillar scores and the final ESG Score.

2) Thomson Reuters ESG Combined Score (ESGC Score): it overlays the Thomson Reuters ESG Score with ESG controversies to provide a comprehensive evaluation of the company's sustainability impact and conduct. The ESG Combined Scores provide a rounded and comprehensive scoring of a company's ESG performance based on the reported information in the ESG pillars with ESG controversies overlay captured from global media sources. The main objective of this score is to discount the ESG performance score based on negative media stories. It does this by incorporating the impact of significant, material ESG controversies in the overall ESG Combined Score.

Thus, Thomson Reuters ESG Combined Score has been chosen as the factor in the multi-factor portfolio since it discounts the ESG Score for news controversies which materially impact the corporations. In fact, when companies were involved in ESG controversies, the ESG Combined Score is calculated as the weighted average of the ESG Scores and ESG Controversies Score per fiscal period, with recent controversies reflected in the latest complete period. When companies were not involved in ESG controversies, the ESG Combined Score is equal to the ESG Score. During the year, if a scandal occurs, the company involved is penalized and this affects its overall ESG Combined Score and grading. The impact of the event may still be seen in the following year if there are new developments related to the negative event, for example, lawsuits, ongoing legislation disputes or fines. All new media materials are captured as the controversy progresses.

What is BAB:

BAB stands for "Betting Against Beta" and represents an investment strategy that consists of buying low-beta stocks and shorting high-beta ones.

The ratio behind this is that investors who have restrictions from using leverage tend to over-weigh risky stocks for achieving higher returns which makes these stocks more expensive. This behavior suggests that high-beta (risky) stocks should deliver lower risk-adjusted returns than low-beta stocks. Investors not limited in leverage (arbitrageurs) could exploit this inefficiency by "betting against beta", i.e. by going long on a portfolio of low-beta stocks, leveraged to a beta of 1, and short on a portfolio of high-beta stocks, de-leveraged to a beta of 1. This long-short portfolio delivers substantial risk-adjusted returns and works well for US and Global equities, but nevertheless, caution is needed in implementing this strategy (costs, slippage, etc.) as research also suggests that this effect is the strongest in small-cap stocks.

BAB vs Volatility factor:

It has been analyzed how the introduction of a BAB factor, replacing the pre-existing Volatility factor of our investment strategy, would impact on the overall performance of our portfolios.

Therefore, it has been implemented a new sector neutral portfolio including a BAB score, calculated using the betas registered by the stocks on the 3rd December 2018. Its performance has been compared with the performance of Minerva's sector neutral portfolio adopting the Volatility factor, as reported in our last report of February 2019.
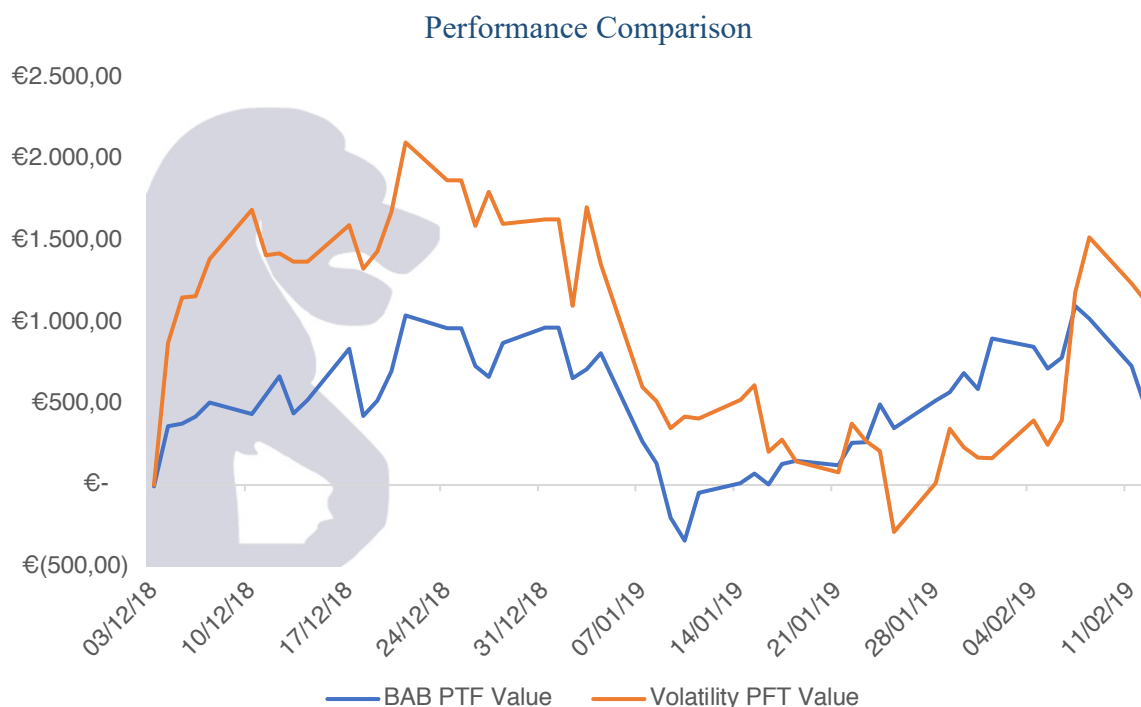

Figure 1 – Performance of the portfolio adopting the BAB factor vs Performance of the portfolio adopting the Volatility factor

As the graph shows, Minerva's portfolio adopting the Volatility factor has registered in the time period considered a better performance overall, closing at +1133,17€ against the +480,71€ value of the BAB portfolio.
Hence, with these specific market conditions leaving the Volatility among the factors of Minerva sector neutral portfolio proves to be more profitable.

Indeed, the Volatility factor makes us exploit at best the current bullish trend of the financial markets, while the BAB doesn't since the mispricing between high-beta and low-beta stocks appears to be not sufficient for reaching higher levels of profits in a bullish market. That is why, considering the current market conditions, we decided to keep the Volatility factor within Minerva's portfolios investment strategy.

Style Analysis

Style Analysis is a process used to determine what type of investment behaviour a money manager or an investor employs when he has to make investment decisions.

In our Style Model we decided to consider four factors according to Fama & French Theory: Rm-Rf, SMB, HML and Momentum.
Minimizing the volatility of the errors between our portfolio daily returns and the style returns, we obtained the "factors' optimal weights" as shown in the graph below.
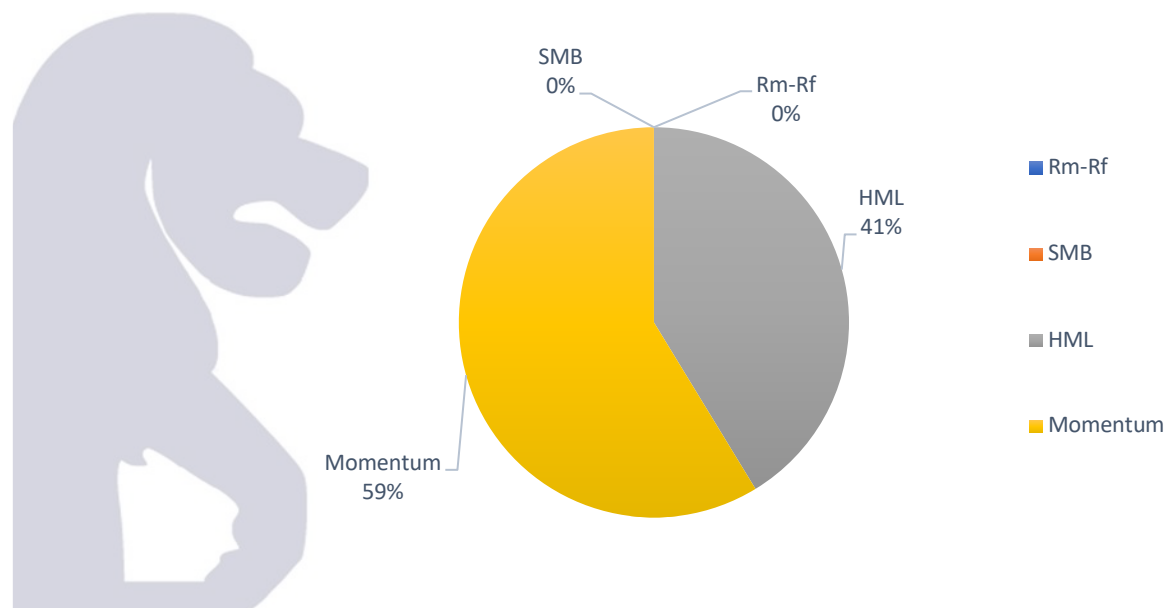
Figure 2 – Factors' weights (minimizing TEVariance)

The other output obtained are:
Tracking Error Variance = 8.64969E-05
Tracking Error Volatility = 0.009300373
Portfolio returns Variance = 0.000113198
R2 = 0.235879358
This R2 value is acceptable: it is inside the (0;1) range and it shows that about the 23.5% of our portfolio return is explained by the factors considered in the analysis (R2=0.235879).

The relatively low R2 value might be caused by many drivers such as:
- shortage in the data series;
- use of daily returns;
- use of other factors in our active portfolio that are not implemented/considered in the F&F model;
- the specific Factor Investing strategy that we use, which is based on weighted scores rather than on factors' portfolios aggregation.

III.   Active Component

Factors selection:

In rebalancing the previous portfolio and building the new one, we decided to add two new factors in order to help in the asset allocation process: Dividend Yield and ESG. Their final scores have been equally weighted with the scores of the old seven factors, after the Winsorization process.

a. *Value Factors (Buy cheap, Sell expensive)*

-Price-to-Book Value (P/BV): following the broad evidence provided by existing literature (e.g., Fama-French (1993)), we regard a high P/BV as a signal of relative overvaluation. We thus consider it as a selling indicator, since it shows that the company's equity is very expensive if compared with its underlying book value.
-EV/EBITDA: we regard a high EV/EBITDA as a selling signal, because it shows that the company is not able to generate a satisfactory level of profits if compared to the value of the assets used to generate such profits.

b. *Momentum Factor (Buy recently best performing stocks, Sell worst performing stocks)*

+MOM: following the evidence provided by Jegadeesh and Titman (1993) and Asness (1994), we consider momentum, defined as the compounded monthly return over the previous 13 months, excluding the last one, as a buy signal. In practice, we assume that the market will not invert its trend soon.

c. *Quality Factors (Buy high quality stocks, sell low quality stocks)*

+(FW 12m EPS−Trailing EPS): a higher value of this metric represents a buy a signal. Although not widespread, we introduced this factor in order to capture analysts' views (analysts' revisions). It is indeed built as the difference between the 12 month forecast EPS made by analysts and the trailing EPS recorded (last 12 months EPS). For companies with a high positive value of this indicator, we thus assume an increase in the stock price in the future that will mirror the earnings behaviour.

+ROE: we consider a high ROE, normalized for industry influence, as a signal of high profitability, and, thus, a buy signal. Specifically, we are assuming that investors' profitability will maintain its trend in the future and will be a reliable driver of future increases in stock prices.

d. *Volatility Factor (Buy low volatility, Sell high volatility)*

-Standard deviation: we deem a higher standard deviation to be a selling signal, since it reveals a riskier situation where returns are less stable, and, consequently, less predictable.

e. *Size Factor (Buy small cap, Sell large cap)*

-Market capitalization: a lower market cap is assumed to be a buy signal, since small cap stocks have historically shown relatively better performances than large cap stocks (see Banz (1981), Reinganum (1981) for empirical evidence in the academic literature).

f. *ESG Factor*

We assume a higher ESG score to be a positive signal, since it reveals more attention for the sustainability of a firm. Although this factor has still few data recorded, market evidence suggests that, in the long run, a higher ESG score allows "sustainable" investments to perform equally or even better than traditional ones, showing an improvement in the long-term risk-adjusted returns. Due to the lack of data, we use the ESG data from Reuters as of 2017. We have mainly introduced this factor to better understand actual market trends and to reduce the exposure to critical events in the market.

g. *Dividend Yield Factor*

+Dividend Yield: we consider a high Dividend Yield as a buy signal. Distributing dividends is a positive indicator of the soundness of a firm. Moreover, a high value of this factor is desirable on average, especially during very low interest rate periods, as the one we are experiencing nowadays.

Portfolio Construction:

Please find below the **revised portfolio**, after having applied the Winsorization technique and the data normalization procedure. In particular, we signal that, for both the S&P 500 and the EUROSTOXX 600, two long stocks and two short stocks for each sector, still following the score's sort, have been selected. The only exception is for the "Telecommunication" sector that has just one long and one short stock selected in the S&P component. After completing the list of sectors, the procedure was eventually repeated until we reached the desired number of stocks in the portfolio.

The rebalancing of the previous portfolio concerns both the sector and non-sector neutral one in which we just took the highest and lowest stocks in the rankings to buy and sell.

The rebalancing procedure led us to replace the majority of the stocks of our old portfolio. In detail, all the stocks in the US stock market component have been changed except for three: we are still long on Air Prds. & Chemsand and on Nextera Energy as in the old portfolio; we are now short on AT&T, on which we were long in the previous portfolio. All the stocks in the European constituent have been replaced except for two: now we are long on Cellnex, on which we had a short position before; we are still short on William Hill.

The best performing components are Edwards Lifesciences and Boskalis Westminister respectively in the S&P500 and in the EUROSTOXX 600 Index, both new investments for us. On the other hand, we are decisively bearish on Huntington Bcsh and Adyen, that proved to be the worst performers in terms of scores in our investment opportunity set.

An explanation to provide for justifying such a great change in the composition is that the first quarter of the year has just passed and so, new balance sheets have been approved. Thus, new data is available and has influenced the portfolio rebalancing.

Furthermore, two new factors have been added, which clearly alter the asset selection process.

Regarding the sector neutral portfolio, we present the composition of the **new portfolio:**

		NEW PORTFOLIO							
		S&P 500					**STOXX 600**		
	#	Name	Industry	Score	Weight	#	Name	Industry	Score	Weight
	1	EDWARDS LIFESCIENCES	Health Care	0,797324304	1/n	1	BOSKALIS WESTMINSTER	Industrials	0,84961138	1/n
	2	ULTA BEAUTY	Consumer Services	0,766282559	1/n	2	WIENERBERGER	Industrials	0,634770147	1/n
	3	KEYCORP	Financials	0,764116179	1/n	3	UNITED UTILITIES GROUP	Utilities	0,699014164	1/n
	4	AUTOMATIC DATA PROC.	Industrials	0,735095996	1/n	4	RUBIS	Utilities	0,572567802	1/n
	5	MGM RESORTS INTL.	Consumer Services	0,722024763	1/n	5	SIEMENS GAMESA RENEWABLE ENERGY	Oil & Gas	0,684850181	1/n
	6	COCA COLA	Consumer Goods	0,712576804	1/n	6	ENI	Oil & Gas	0,598321988	1/n
	7	CINTAS	Industrials	0,707149709	1/n	7	RTL GROUP (XET)	Consumer Services	0,668810222	1/n
	8	CORNING	Technology	0,68019306	1/n	8	RELX	Consumer Services	0,658020909	1/n
	9	IHS MARKIT	Financials	0,638682132	1/n	9	PERSIMMON	Consumer Goods	0,588615613	1/n
	10	HOLOGIC	Health Care	0,555455748	1/n	10	BERKELEY GROUP HDG.	Consumer Goods	0,586632482	1/n
	11	KELLOGG	Consumer Goods	0,510524731	1/n	11	ZURICH INSURANCE GROUP	Financials	0,553099272	1/n
	12	COGNIZANT TECH.SLTN.'A'	Technology	0,489359477	1/n	12	SWISS LIFE HOLDING	Financials	0,532380393	1/n
	13	NEWMONT MINING	Basic Materials	0,472084518	1/n	13	CELLNEX TELECOM	Telecommunications	0,540426116	1/n
	14	AIR PRDS.& CHEMS.	Basic Materials	0,46234373	1/n	14	BT GROUP	Telecommunications	0,481965848	1/n
	15	NEXTERA ENERGY	Utilities	0,416878434	1/n	15	AKZO NOBEL	Basic Materials	0,531395117	1/n
	16	AES	Utilities	0,405275784	1/n	16	LANXESS (XET)	Basic Materials	0,479758963	1/n
	17	BAKER HUGHES A	Oil & Gas	0,382440578	1/n	17	NOKIA	Technology	0,442106628	1/n
	18	CIMAREX EN.	Oil & Gas	0,329351422	1/n	18	SCOUT24 (XET)	Technology	0,441725311	1/n
	19	VERIZON COMMUNICATIONS	Telecommunications	0,108125555	1/n	19	SANOFI	Health Care	0,409107031	1/n
						20	TECAN 'R'	Health Care	0,374219189	1/n
	20	AT&T	Telecommunications	-0,120505771	1/n	21	REPSOL YPF	Oil & Gas	-0,438911361	1/n
	21	ENTERGY	Utilities	-0,356773675	1/n	22	SOPRA STERIA GROUP	Technology	-0,476450262	1/n
	22	SEMPRA EN.	Utilities	-0,357491635	1/n	23	NATURGY ENERGY	Utilities	-0,48648008	1/n
	23	CF INDUSTRIES HDG.	Basic Materials	-0,397204987	1/n	24	YARA INTERNATIONAL	Basic Materials	-0,489252557	1/n
	24	ECOLAB	Basic Materials	-0,419144836	1/n	25	DASSAULT SYSTEMES	Technology	-0,517101843	1/n
	25	PIONEER NTRL.RES.	Oil & Gas	-0,591976346	1/n	26	TELEFONICA DTL. (XET) HLDG.	Telecommunications	-0,545071447	1/n
	26	ADVANCED MICRO DEVICES	Technology	-0,609778299	1/n	27	ANTOFAGASTA	Basic Materials	-0,56780878	1/n
	27	PACCAR	Industrials	-0,6642542	1/n	28	VERBUND	Utilities	-0,584203181	1/n
	28	PROCTER & GAMBLE	Consumer Goods	-0,693244166	1/n	29	DEUTSCHE TELEKOM (XET)	Telecommunications	-0,623875807	1/n
	29	BALL	Industrials	-0,718458545	1/n	30	UCB	Health Care	-0,674840021	1/n
	30	ARISTA NETWORKS	Technology	-0,75558646	1/n	31	ZALANDO (XET)	Consumer Services	-0,685452593	1/n
	31	ALLERGAN	Health Care	-0,778412654	1/n	32	OMV	Oil & Gas	-0,755030134	1/n
	32	GOODYEAR TIRE & RUB.	Consumer Goods	-0,820290798	1/n	33	WILLIAM HILL	Consumer Services	-0,81089852	1/n
	33	MARSH & MCLENNAN	Financials	-0,838028117	1/n	34	UNILEVER (UK)	Consumer Goods	-0,818591671	1/n
	34	TWENTY-FIRST CENTURY FOX CL.B	Consumer Services	-0,908917302	1/n	35	CARL ZEISS MEDITEC (XET)	Health Care	-0,946050943	1/n
	35	CVS HEALTH	Consumer Services	-0,940878025	1/n	36	AMUNDI (WI)	Financials	-1,085279962	1/n
	36	CHEVRON	Oil & Gas	-0,981917595	1/n	37	BANK OF IRELAND GROUP	Financials	-1,200922324	1/n
	37	ABIOMED	Health Care	-1,003851405	1/n	38	AMER SPORTS	Consumer Goods	-1,257659988	1/n
	38	HUNTINGTON BCSH.	Financials	-1,051436137	1/n	39	WIRECARD (XET)	Industrials	-1,301961921	1/n
						40	ADYEN	Industrials	-1,332402043	1/n

ACTIVE COMPONENT

Figure 3 – Composition of the new active portfolio (sector-neutral)

See below for **the composition of the old portfolio:**

OLD PORTFOLIO									
S&P 500					**STOXX 600**				
#	Name	Industry	Score	Weight	#	Name	Industry	Score	Weight
1	LOCKHEED MARTIN	Industrials	1,308179381	1/n	1	PZU GROUP	Financials	1,084610258	1/n
2	LAMB WESTON HOLDINGS	Consumer Goods	0,995860558	1/n	2	NATIONAL GRID	Utilities	0,943833259	1/n
3	MCDONALDS	Consumer Services	0,971202732	1/n	3	KPN KON	Telecommunications	0,927980847	1/n
4	BANK OF NEW YORK MELLON	Financials	0,962454567	1/n	4	BTG	Health Care	0,905899644	1/n
5	AUTODESK	Technology	0,9577118	1/n	5	VOLVO B	Industrials	0,887968162	1/n
6	BOEING	Industrials	0,936026836	1/n	6	LUNDBERGFORETAGEN B	Financials	0,873564175	1/n
7	COMERICA	Financials	0,84469917	1/n	7	SECURITAS B	Industrials	0,859292597	1/n
8	HUMANA	Health Care	0,774826935	1/n	8	BRITISH AMERICAN TOBACCO	Consumer Goods	0,849955196	1/n
9	MOTOROLA SOLUTIONS	Technology	0,740229524	1/n	9	LOGITECH 'R'	Technology	0,790899053	1/n
10	CBS 'B'	Consumer Services	0,739482532	1/n	10	SHIRE	Health Care	0,790296847	1/n
11	LYONDELLBASELL INDS.CL.A	Basic Materials	0,631921264	1/n	11	BARRATT DEVELOPMENTS	Consumer Goods	0,744436745	1/n
12	D R HORTON	Consumer Goods	0,607926655	1/n	12	PEARSON	Consumer Services	0,73268641	1/n
13	NEXTERA ENERGY	Utilities	0,593897941	1/n	13	BP	Oil & Gas	0,648377134	1/n
14	AT&T	Telecommunications	0,565877731	1/n	14	SSE	Utilities	0,605495848	1/n
15	HOLLYFRONTIER	Oil & Gas	0,516842123	1/n	15	BHP GROUP	Basic Materials	0,534271216	1/n
16	ZIMMER BIOMET HDG.	Health Care	0,459936756	1/n	16	ORANGE	Telecommunications	0,513855298	1/n
17	AIR PRDS.& CHEMS.	Basic Materials	0,451171713	1/n	17	TELENET GROUP HOLDING	Consumer Services	0,449705949	1/n
18	ONEOK	Oil & Gas	0,449213443	1/n	18	HEXPOL B	Basic Materials	0,411535855	1/n
19	PINNACLE WEST CAP.	Utilities	0,448996323	1/n	19	VESTAS WINDSYSTEMS	Oil & Gas	0,397236529	1/n
					20	ALTEN	Technology	0,306961205	1/n
20	NUCOR	Basic Materials	-0,485240075	1/n	21	RANDGOLD RESOURCES	Basic Materials	-0,37572803	1/n
21	CENTURYLINK	Telecommunications	-0,512085324	1/n	22	ENEL	Utilities	-0,399122224	1/n
22	APACHE	Oil & Gas	-0,547319216	1/n	23	SAIPEM	Oil & Gas	-0,402938932	1/n
23	WEYERHAEUSER	Financials	-0,621547484	1/n	24	1&1 DRILLISCH	Telecommunications	-0,426734941	1/n
24	DOWDUPONT	Basic Materials	-0,639603621	1/n	25	GLENCORE	Basic Materials	-0,42853283	1/n
25	MARATHON OIL	Oil & Gas	-0,641554194	1/n	26	WOOD GROUP (JOHN)	Oil & Gas	-0,506131337	1/n
26	UNDER ARMOUR A	Consumer Goods	-0,6649231	1/n	27	DIAGEO	Consumer Goods	-0,53310728	1/n
27	AVALONBAY COMMNS.	Financials	-0,689483301	1/n	28	AMBU B	Health Care	-0,586493985	1/n
28	NEWS 'B'	Consumer Services	-0,692175507	1/n	29	WILLIAM HILL	Consumer Services	-0,656144838	1/n
29	RED HAT	Technology	-0,736526027	1/n	30	AMS	Technology	-0,666453415	1/n
30	QUALCOMM	Technology	-0,738486789	1/n	31	OCADO GROUP	Consumer Services	-0,700036267	1/n
31	UNDER ARMOUR 'C'	Consumer Goods	-0,765202349	1/n	32	EVOTEC (XET)	Health Care	-0,750388524	1/n
32	NRG ENERGY	Utilities	-0,808822642	1/n	33	AIB GROUP	Financials	-0,798362575	1/n
33	GENERAL ELECTRIC	Industrials	-0,858052537	1/n	34	CD PROJECT RED	Consumer Goods	-0,837387208	1/n
34	VERTEX PHARMS.	Health Care	-0,894160534	1/n	35	TEMENOS N	Technology	-0,846418229	1/n
35	WATERS	Industrials	-0,930597116	1/n	36	LAND SECURITIES GROUP	Financials	-0,867631502	1/n
36	NISOURCE	Utilities	-0,940608054	1/n	37	CELLNEX TELECOM	Telecommunications	-0,909822499	1/n
37	MCKESSON	Consumer Services	-0,961529042	1/n	38	MELROSE INDUSTRIES	Industrials	-0,938602466	1/n
38	NEKTAR THERAPEUTICS	Health Care	-1,247660065	1/n	39	SARTORIUS PREF. (XET)	Industrials	-1,025668301	1/n
					40	UNIPER SE (XET)	Utilities	-1,322986104	1/n

Figure 4 – Composition of the old active portfolio (sector-neutral)

Please find below the **composition of the new non-sector-neutral portfolio**:

NEW PORTFOLIO NO SECTOR NEUTRAL									
S&P 500					**STOXX 600**				
#	Name	Industry	Score	Weight	#	Name	Industry	Score	Weight
1	EDWARDS LIFESCIENCES	Health Care	0,797324304	1/n	1	BOSKALIS WESTMINSTER	Industrials	0,84961138	1/n
2	ULTA BEAUTY	Consumer Services	0,766282559	1/n	2	UNITED UTILITIES GROUP	Utilities	0,699014164	1/n
3	KEYCORP	Financials	0,764116179	1/n	3	SIEMENS GAMESA RENEWABLE ENER	Oil & Gas	0,684850181	1/n
4	AUTOMATIC DATA PROC.	Industrials	0,735095996	1/n	4	RTL GROUP (XET)	Consumer Services	0,668810222	1/n
5	MGM RESORTS INTL.	Consumer Services	0,722024763	1/n	5	RELX	Consumer Services	0,658020909	1/n
6	COCA COLA	Consumer Goods	0,712576804	1/n	6	WIENERBERGER	Industrials	0,634770147	1/n
7	CINTAS	Industrials	0,707149709	1/n	7	SODEXO	Consumer Services	0,611844553	1/n
8	CORNING	Technology	0,68019306	1/n	8	ENI	Oil & Gas	0,598321988	1/n
9	KEYSIGHT TECHNOLOGIES	Industrials	0,665658538	1/n	9	PERSIMMON	Consumer Goods	0,588615613	1/n
10	IHS MARKIT	Financials	0,638682132	1/n	10	BERKELEY GROUP HDG.	Consumer Goods	0,586632482	1/n
11	HOLOGIC	Health Care	0,555455748	1/n	11	RUBIS	Utilities	0,572567802	1/n
12	CARMAX	Consumer Services	0,532316139	1/n	12	REMY COINTREAU	Consumer Goods	0,56965402	1/n
13	KELLOGG	Consumer Goods	0,510524731	1/n	13	REXEL	Industrials	0,565717502	1/n
14	INGERSOLL-RAND	Industrials	0,504602664	1/n	14	SPIRAX-SARCO ENGR.	Industrials	0,561064647	1/n
15	IRON MOUNTAIN	Financials	0,492031087	1/n	15	FERGUSON	Industrials	0,557706105	1/n
16	COGNIZANT TECH.SLTN.'A'	Technology	0,489359477	1/n	16	ZURICH INSURANCE GROUP	Financials	0,553099272	1/n
17	TAKE TWO INTACT.SFTW.	Consumer Services	0,478445073	1/n	17	ASHTEAD GROUP	Industrials	0,549516639	1/n
18	NEWMONT MINING	Basic Materials	0,472084518	1/n	18	CELLNEX TELECOM	Telecommunications	0,540426116	1/n
19	SYMANTEC	Technology	0,464816446	1/n	19	LEGRAND	Industrials	0,537284119	1/n
					20	SWISS LIFE HOLDING	Financials	0,532380393	1/n
20	MONSTER BEVERAGE	Consumer Goods	-0,609814043	1/n	21	INDITEX	Consumer Services	-0,588062629	1/n
21	MYLAN	Health Care	-0,620189664	1/n	22	MERLIN ENTERTAINMENTS	Consumer Services	-0,622286841	1/n
22	MATTEL	Consumer Goods	-0,658567204	1/n	23	DEUTSCHE TELEKOM (XET)	Telecommunications	-0,623875807	1/n
23	UNIVERSAL HEALTH SVS.'B'	Health Care	-0,661268237	1/n	24	KERRY GROUP 'A'	Consumer Goods	-0,627899625	1/n
24	PERKINELMER	Industrials	-0,663034276	1/n	25	GETINGE B	Health Care	-0,628825644	1/n
25	PACCAR	Industrials	-0,6642542	1/n	26	RICHEMONT N	Consumer Goods	-0,674019763	1/n
26	FRANKLIN RESOURCES	Financials	-0,686301802	1/n	27	UCB	Health Care	-0,674840021	1/n
27	PROCTER & GAMBLE	Consumer Goods	-0,693244166	1/n	28	ZALANDO (XET)	Consumer Services	-0,685452593	1/n
28	BALL	Industrials	-0,718458545	1/n	29	HOMESERVE	Industrials	-0,68660255	1/n
29	ARISTA NETWORKS	Technology	-0,75558646	1/n	30	SAAB B	Industrials	-0,71707334	1/n
30	IQVIA HOLDINGS	Health Care	-0,770040401	1/n	31	OMV	Oil & Gas	-0,755030134	1/n
31	ALLERGAN	Health Care	-0,778412654	1/n	32	BANCO SANTANDER	Financials	-0,768483328	1/n
32	GOODYEAR TIRE & RUB.	Consumer Goods	-0,820290798	1/n	33	WILLIAM HILL	Consumer Services	-0,81089852	1/n
33	MARSH & MCLENNAN	Financials	-0,838028117	1/n	34	UNILEVER (UK)	Consumer Goods	-0,818591671	1/n
34	TWENTY-FIRST CENTURY FOX CL.B	Consumer Services	-0,908917302	1/n	35	CARL ZEISS MEDITEC (XET)	Health Care	-0,946050943	1/n
35	CVS HEALTH	Consumer Services	-0,940878025	1/n	36	AMUNDI (WI)	Financials	-1,085279962	1/n
36	CHEVRON	Oil & Gas	-0,981917595	1/n	37	BANK OF IRELAND GROUP	Financials	-1,200922324	1/n
37	ABIOMED	Health Care	-1,003851405	1/n	38	AMER SPORTS	Consumer Goods	-1,257659988	1/n
38	HUNTINGTON BCSH.	Financials	-1,051436137	1/n	39	WIRECARD (XET)	Industrials	-1,301961921	1/n
					40	ADYEN	Industrials	-1,332402043	1/n

Figure 5– Composition of the new active portfolio (non-sector-neutral)

We also display the ***old non-sector-neutral portfolio*** constructed and shown for the first time in the previous report:

	S&P 500					STOXX 600			
OLD PORTFOLIO NO SECTOR NEUTRAL									
#	Name	Industry	Score	Weight	#	Name	Industry	Score	Weight
1	LOCKHEED MARTIN	Industrials	1,308179	1/n	1	PZU GROUP	Financials	1,08461	1/n
2	LAMB WESTON HOLDINGS	Consumer Goods	0,995861	1/n	2	NATIONAL GRID	Utilities	0,943833	1/n
3	MCDONALDS	Consumer Services	0,971203	1/n	3	KPN KON	Telecommunications	0,927981	1/n
4	BANK OF NEW YORK MELLON	Financials	0,962455	1/n	4	BTG	Health Care	0,9059	1/n
5	AUTODESK	Technology	0,957712	1/n	5	VOLVO B	Industrials	0,887968	1/n
6	BOEING	Industrials	0,936027	1/n	6	LUNDBERGFORETAGEN B	Financials	0,873564	1/n
7	KEYSIGHT TECHNOLOGIES	Industrials	0,850198	1/n	7	SECURITAS B	Industrials	0,859293	1/n
8	COMERICA	Financials	0,844699	1/n	8	BRITISH AMERICAN TOBACCO	Consumer Goods	0,849955	1/n
9	HUMANA	Health Care	0,774827	1/n	9	ADP	Industrials	0,841128	1/n
10	ASSURANT	Financials	0,751454	1/n	10	LOGITECH 'R'	Technology	0,790899	1/n
11	MOTOROLA SOLUTIONS	Technology	0,74023	1/n	11	SHIRE	Health Care	0,790297	1/n
12	CBS 'B'	Consumer Services	0,739483	1/n	12	3I GROUP	Financials	0,763921	1/n
13	PRINCIPAL FINL.GP.	Financials	0,700875	1/n	13	DASSAULT AVIATION	Industrials	0,747742	1/n
14	AUTOZONE	Consumer Services	0,679709	1/n	14	BARRATT DEVELOPMENTS	Consumer Goods	0,744437	1/n
15	SYMANTEC	Technology	0,659738	1/n	15	BALFOUR BEATTY	Industrials	0,743773	1/n
16	LYONDELLBASELL INDS.CL.A	Basic Materials	0,631921	1/n	16	PEARSON	Consumer Services	0,732686	1/n
17	T ROWE PRICE GROUP	Financials	0,620342	1/n	17	SWEDISH MATCH	Consumer Goods	0,649918	1/n
18	D R HORTON	Consumer Goods	0,607927	1/n	18	BP	Oil & Gas	0,648377	1/n
19	PHILIP MORRIS INTL.	Consumer Goods	0,604756	1/n	19	KION GROUP (XET)	Industrials	0,631204	1/n
					20	BAYER (XET)	Health Care	0,613925	1/n
20	WEYERHAEUSER	Financials	-0,62155	1/n	21	WILLIAM HILL	Consumer Services	-0,65614	1/n
21	DOWDUPONT	Basic Materials	-0,6396	1/n	22	INVESTEC	Financials	-0,66066	1/n
22	MARATHON OIL	Oil & Gas	-0,64155	1/n	23	AMS	Technology	-0,66645	1/n
23	UNDER ARMOUR A	Consumer Goods	-0,66492	1/n	24	OCADO GROUP	Consumer Services	-0,70004	1/n
24	DARDEN RESTAURANTS	Consumer Services	-0,66853	1/n	25	PHOENIX GROUP HDG.	Financials	-0,71418	1/n
25	AVALONBAY COMMNS.	Financials	-0,68948	1/n	26	BANCO DE SABADELL	Financials	-0,74502	1/n
26	NEWS 'B'	Consumer Services	-0,69218	1/n	27	EVOTEC (XET)	Health Care	-0,75039	1/n
27	FIRSTENERGY	Utilities	-0,71684	1/n	28	BANKIA	Financials	-0,77706	1/n
28	RED HAT	Technology	-0,73653	1/n	29	NATIXIS	Financials	-0,79601	1/n
29	QUALCOMM	Technology	-0,73849	1/n	30	AIB GROUP	Financials	-0,79836	1/n
30	UNDER ARMOUR 'C'	Consumer Goods	-0,7652	1/n	31	LAFARGEHOLCIM	Industrials	-0,81677	1/n
31	NRG ENERGY	Utilities	-0,80882	1/n	32	CD PROJECT RED	Consumer Goods	-0,83739	1/n
32	PERKINELMER	Industrials	-0,8483	1/n	33	TEMENOS N	Technology	-0,84642	1/n
33	GENERAL ELECTRIC	Industrials	-0,85805	1/n	34	LAND SECURITIES GROUP	Financials	-0,86763	1/n
34	VERTEX PHARMS.	Health Care	-0,89416	1/n	35	WIRECARD (XET)	Industrials	-0,88504	1/n
35	WATERS	Industrials	-0,9306	1/n	36	CELLNEX TELECOM	Telecommunications	-0,90982	1/n
36	NISOURCE	Utilities	-0,94061	1/n	37	OSRAM LICHT (XET)	Industrials	-0,91623	1/n
37	MCKESSON	Consumer Services	-0,96153	1/n	38	MELROSE INDUSTRIES	Industrials	-0,9386	1/n
38	NEKTAR THERAPEUTICS	Health Care	-1,24766	1/n	39	SARTORIUS PREF. (XET)	Industrials	-1,02567	1/n
					40	UNIPER SE (XET)	Utilities	-1,32299	1/n

Figure 6 – Composition of the old active portfolio (non-sector-neutral)

Regarding the non-sector-neutral portfolio, as for the sector neutral one, we rebalanced it and most of the stocks of the previous portfolio have changed. Regarding the S&P 500, the long position on Keysight Technologies and the short position on PerkinElmer are the only two unchanged. In the EUROSTOXX 600 component, we turned the previous short position on Cellnex Telecom in a long one, whereas the short position on William Hill was the only one unchanged. Furthermore, while in the previous portfolio we were more exposed to the financial sector (5 long position vs 1 short) and each sector was covered with at least one stock as a long or as a short position, in the new one we do not have any stock to cover the Utilities sector and "Health Care" and "Technologies" are the sectors we are most exposed to.

Portfolio Performance:

In order to calculate the performance of the active part of the portfolio we used two different methods.

The classic tool, used in the previous reports, takes into account the daily return of the portfolio and is multiplied by €100,000, so that we find the daily gain and loss starting from daily prices. The main problem of this procedure is the approximation made to the number of stocks bought. Due to the fact that we could not buy fractions of stocks and that we would remain neutral in the investment, with the initial method we always rounded down and, consequently, the initial investment was not 0 but a lower number next to 0, and the weights were not actually the same. In order to avoid that problem, the number of stocks to have in the real initial portfolio and the value in the following days were computed with the right approximations. This way we found the time series value**.**

The graphs in the following pages show the value that a potential shareholder would have obtained daily by holding a long position for € 100,000 and a short position for € 100,000 in our strategy.

The following graph shows the portfolio's cumulative daily value from the inception date (25/01/2019) to 12/04/2019.
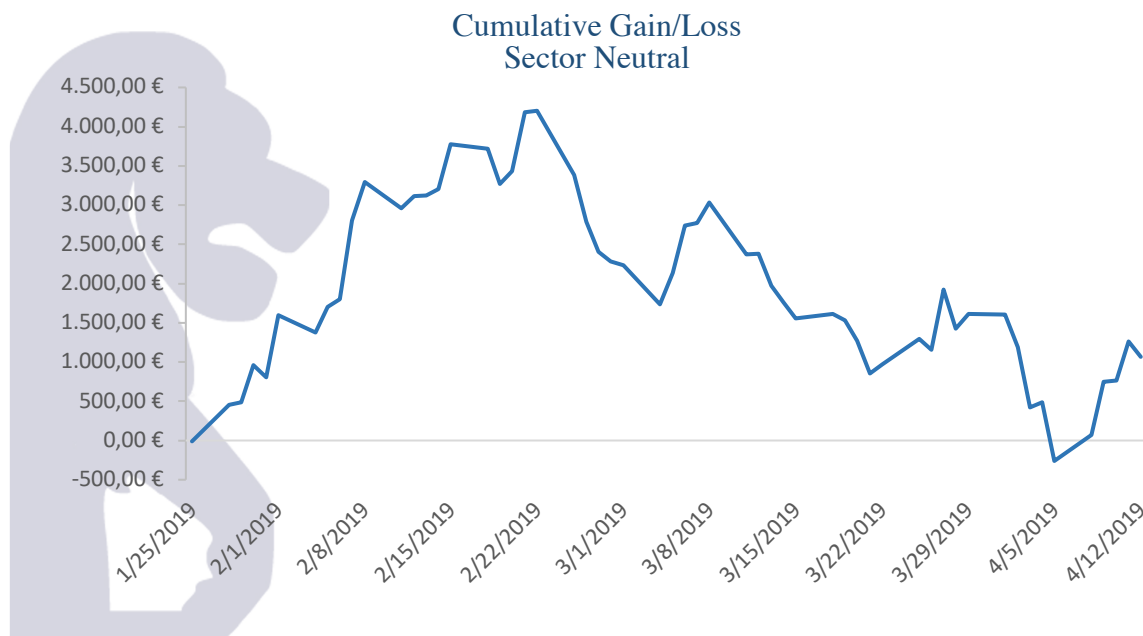

Figure 7 – Cumulative gain/loss (sector-neutral)

For reasons explained above, it does not start from 0, but from -13.31. The final cumulative gain is about 1,067.13. So, remembering that we did not start from 0, the sector neutral portfolio performed **+1,0804%** up to 12/04/2019. The portfolio registered a lower cumulative return than the previous **sector neutral portfolio**.

Here, instead, the graph represents the cumulative gain/loss for the **non-sector-neutral portfolio** over the same period and with regard to the previous considerations.
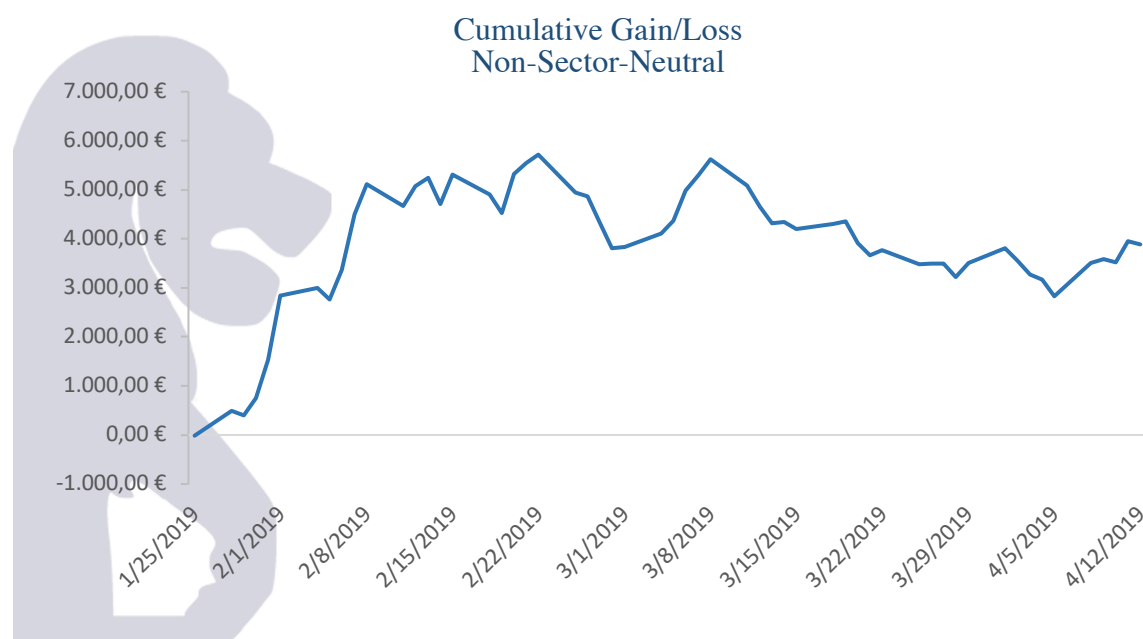
Figure 8– Cumulative gain/loss (non-sector-neutral)

It starts from -14.64 and reach a cumulative final gain of 3,886.09 that amounts to **+3.901%** for the non-sector-neutral portfolio performance.

Finally, we plotted the graph for **daily returns** computed as the sum of returns on long and short positions of our 78 stocks.
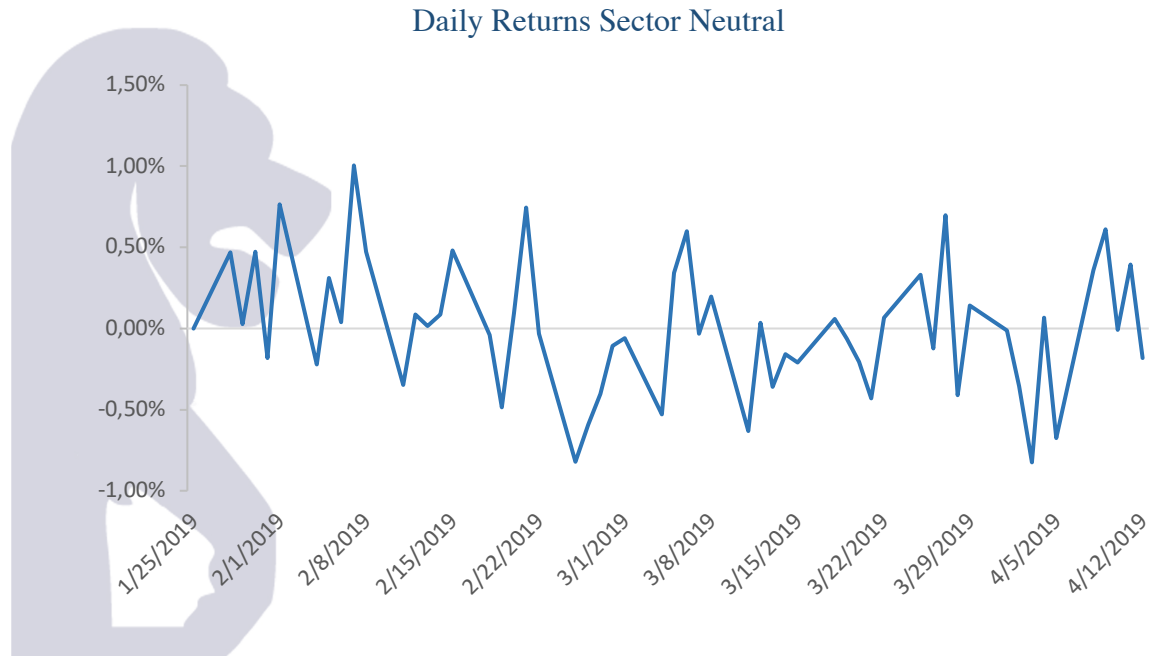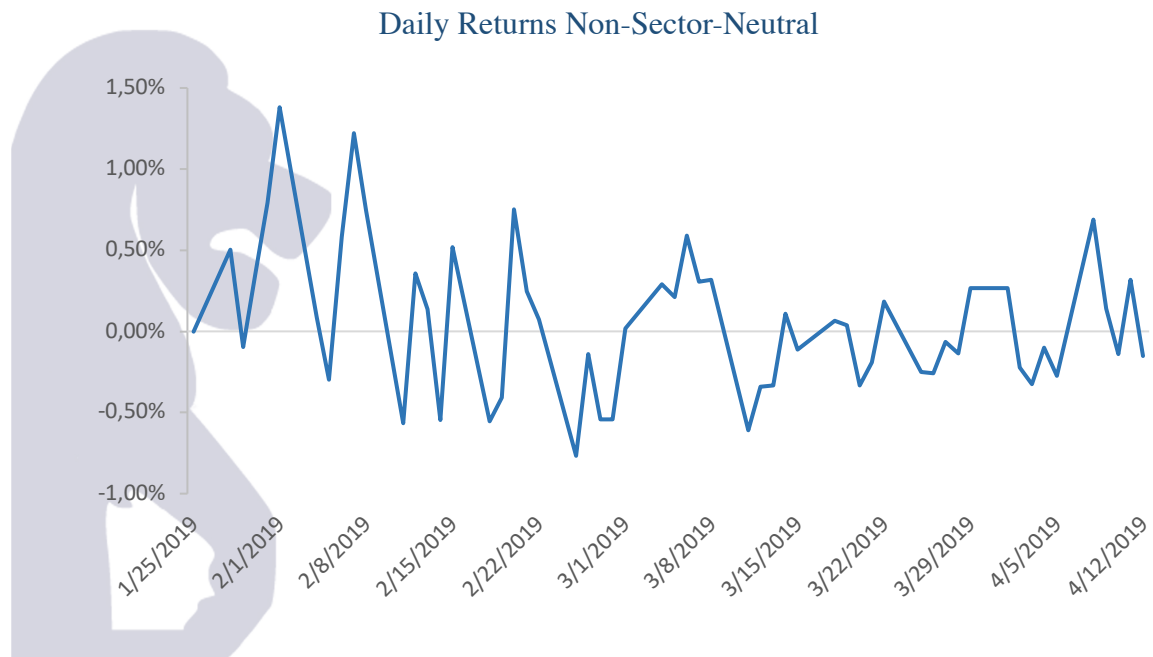

Figure 9 – Daily returns sector-neutral

Figure 10 – Daily returns non-sector-neutral

News – Portfolio Monitoring

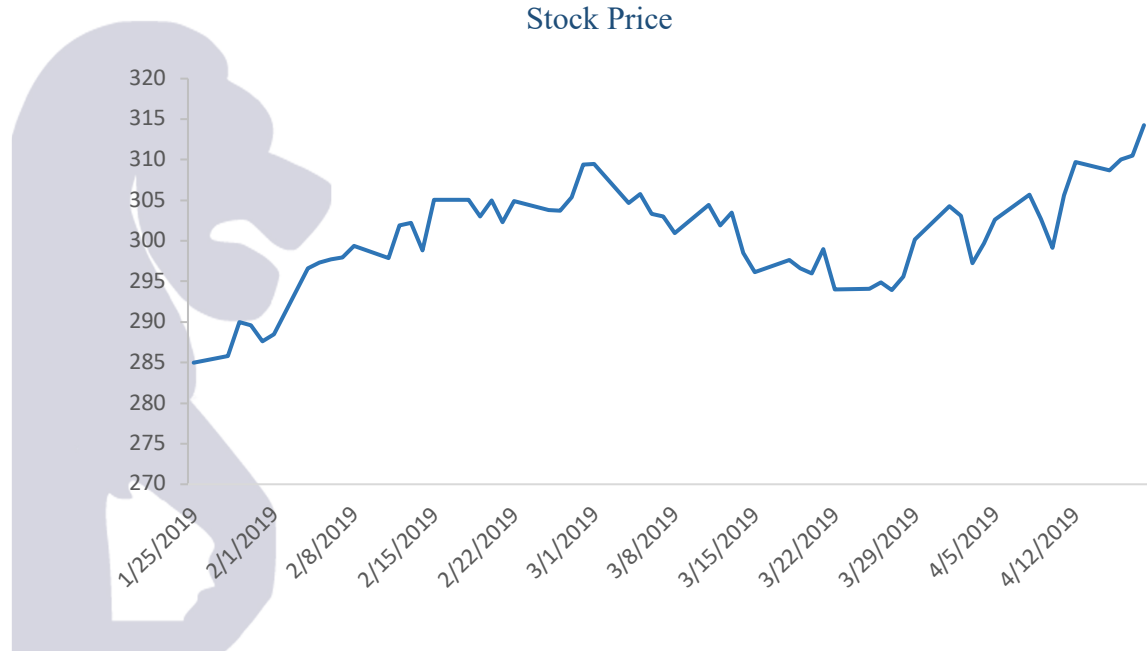Monitoring Period: Jan 25, 2019 to Apr 19, 2019.

Lockheed Martin

Figure 11 – Stock price of Lockheed Martin

On the 31st of January the German defence ministry has announced that Germany will not buy the US-made F-35 stealth fighter from **Lockheed Martin**. The decision marks a big setback for **Lockheed**, the top U.S. arms maker, which had hoped to add to recent F-35 sales to other European countries, including Belgium.

Despite the relevance of the news, as we can see from the graph, this event lightly impacted the stock price of the company that is currently trading at a higher price than the beginning of February.
Source: MarketWatch
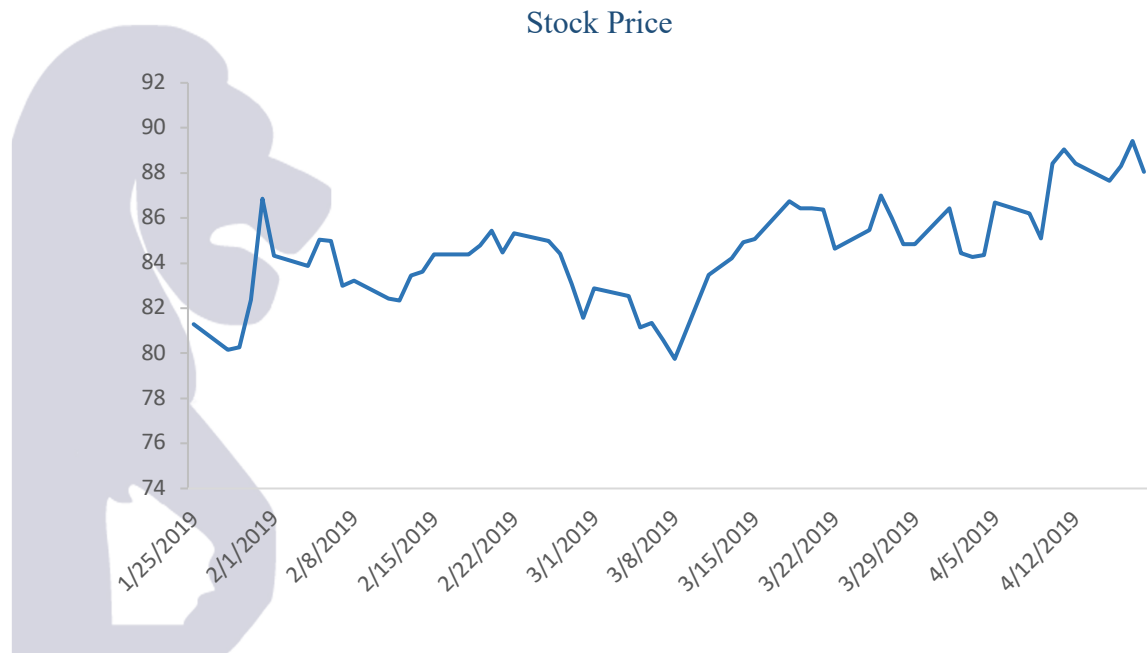
Valero Energy

Figure 12 – Stock price of Valero Energy

The Venezuelan political situation could not but impact oil industry in the United States. In fact, the prospect of further falls in Venezuela's oil output after the US and Canada embraced its opposition leader as interim president caused tremors in energy markets. Shares of **Valero Energy** fall on news from Caracas. Venezuela's crude oil output has plunged in recent years as the economic and political crisis in the country has all but paralysed its energy industry. Shares of **Valero** declined amid a rally in broader US stocks, registering a loss of 2.7%.

The Venezuelan situation is still critical; however, the stock price of **Valero Energy** registered a positive performance in the last two months, eagerly awaiting a state of calmness in Venezuelan politics.

Source: MarketWatch
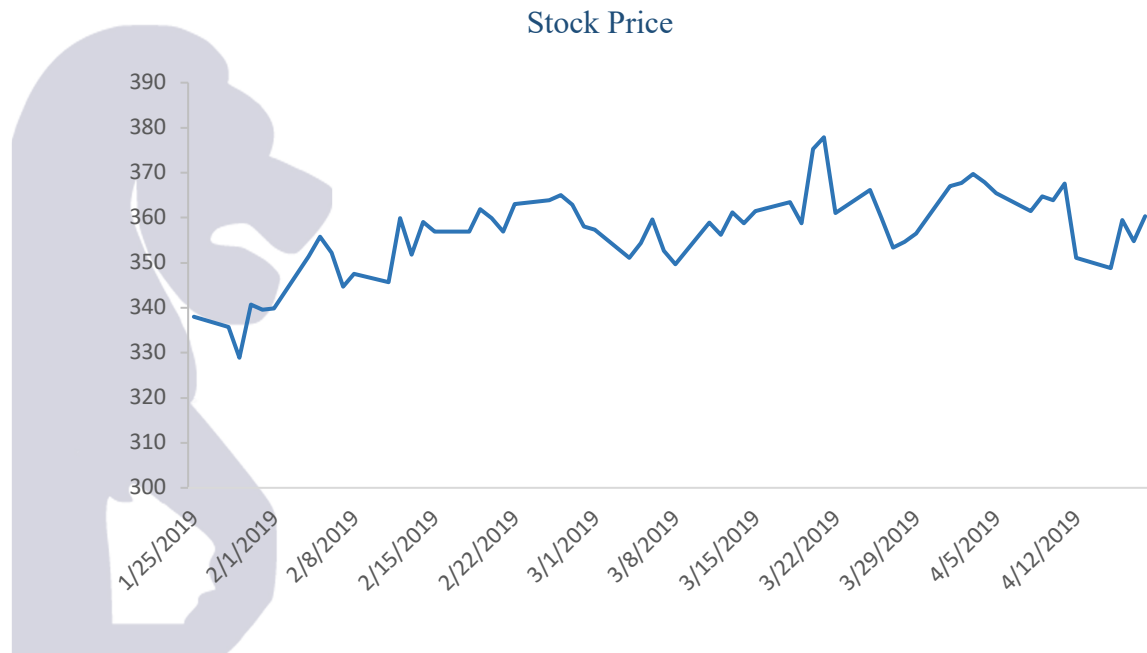
Netflix

Stock Price

Figure 13 – Stock price of Netflix

A new competitor is entering the TV streaming market.

A survey finds that **Netflix** is at risk of losing 8.7 million subscribers due to **Disney+**, the streaming service offered by Disney Co coming at $6.99 per month.

The survey shows that about 14% of **Netflix Inc.** subscribers, equal to 8.7 million people, are considering dropping the streaming service in favour of the newcomer costing **Netflix** about $117 million in lost revenue a month.

Netflix shares were down 1.1% Wednesday, but have gained 41% in 2019 to date, thus registering an extremely positive performance.
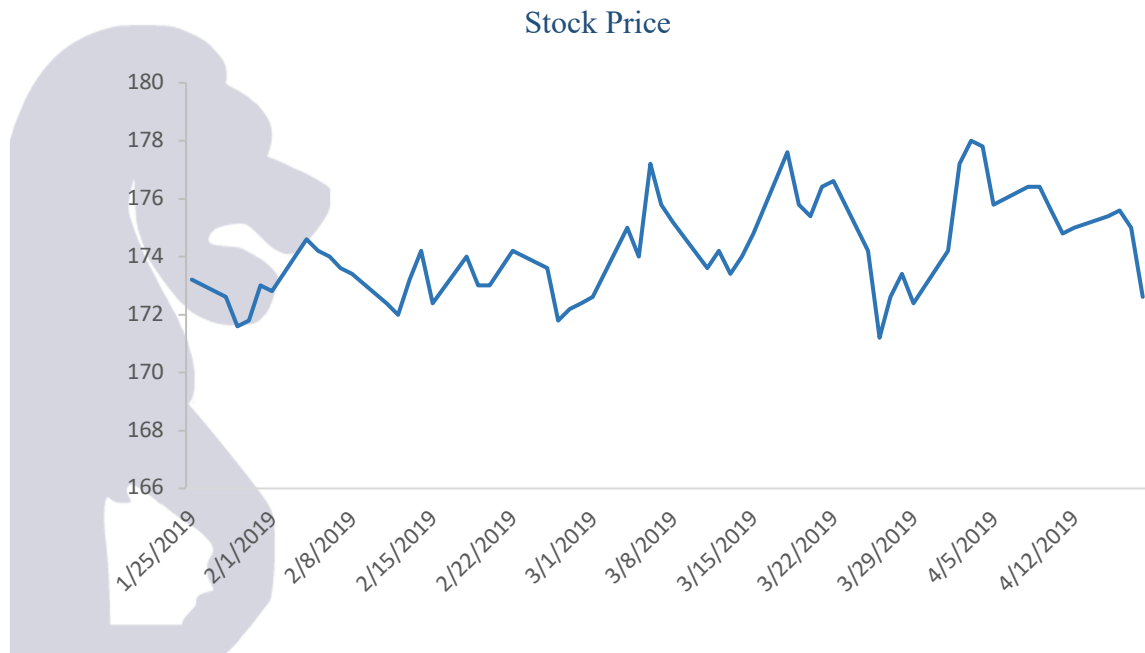
Source: MarketWatch

Sofina

Stock Price

Figure 14 – Stock price of Sofina

Sofina, a family-run investment company has taken a 20 percent stake in an investment deal in private schools' operator **Cognita**. The deal comes together with another 20 percent stake investment in **Cognita** from **BDT Capital**, a fund run by one of Wall Street's most influential bankers Byron Trott, who is former Goldman Sachs dealmaker and part of a secretive powerful group of rainmakers with strong connections to some of the largest families in the U.S., including Warren Buffet, Walmart, Mars and Pritzker families.

Affected by the news, the share price of **Sofina** rose 10% at the end of January and it has remained stable since.
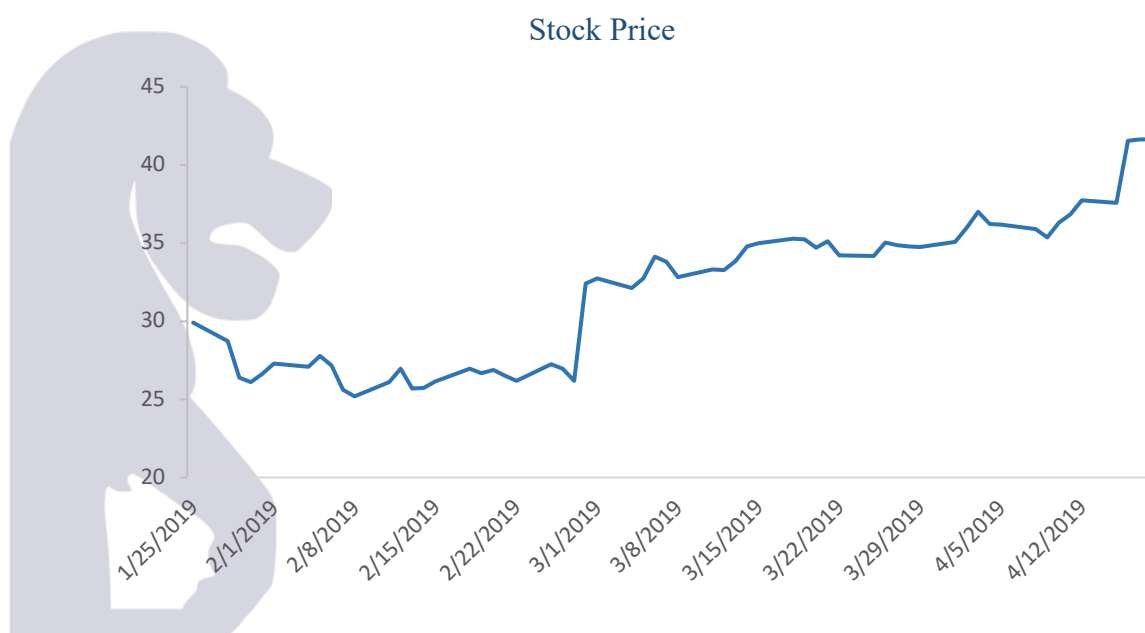
Source: MarketWatch

Zalando

Stock Price

Figure 15 – Stock price of Zalando

March 12: **Citigroup** downgraded **Zalando**, the German online fashion retailer, to "neutral" from "overweight" with an unchanged €36 price target. The downgrade follows **Zalando**'s capital markets day, where management set out a plan to win market share by growing sales both directly and through its commission-based marketplace business. Analyst believe that **Zalando** is sacrificing significant margin to drive long-term growth, which should drive higher shareholder value in the long term.

April 9: **Zalando** upgraded to "buy" at **Liberum**.

April 16: **Zalando** shares climb after unexpected first-quarter profit signal.

The German group said on Monday that it expected adjusted EBIT to be in "single-digit millions" for the first three months of the year, beating analyst expectations of a €10m loss. **Zalando** is due to report full first-quarter results on May 2.

Source: MarketWatch

Passive Component

Performance Review

Let's first look at the performance of the **previously constructed passive** portfolio, which was based on the **equally weighted risk contributions weights approach**. Daily returns in the period between Jan 25, 2019 and Apr 12, 2019 have been computed using the Total Return Index of ETFs. The daily returns were then, afterwards, applied to the 100,000€ initial capital through a daily compounding.

The weights used to do so are reported in the table below.

ETF	Weights
iShares Core s&P 500 UCITS ETF	2%
iShares € Gov Bond 1-3yr UCITS ETF	38%
iShares € Gov Bond 7-10yr UCITS ETF	4%
iShares $ High Yield Corp Bond UCITS ETF	9%
iShares Core MSCI Europe UCITS ETF	2%
iShares $ Treasury Bond 1-3yr UCITS ETF	34%
iShares IG Corp Bond UCITS ETF	4%
iShares $ Treasury Bond 7-10yr UCITS ETF	5%
Invesco Optimum Yield Diversified	2%

Figure 16 – Previous portfolio weights passive component

The following graphs show a more detailed performance of the passive component.

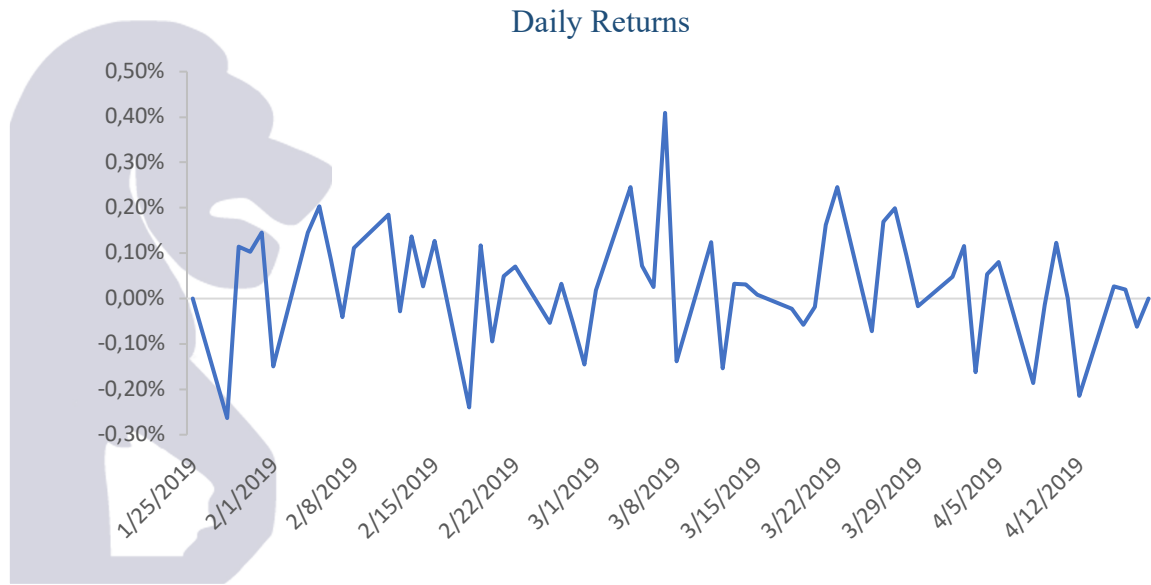The first graph displays the daily performance of the passive component.

Daily Returns

Figure 17 – Daily returns passive component

Whilst the second graph reports the cumulative investment, for which a **1.81%** return has been registered over the period considered.
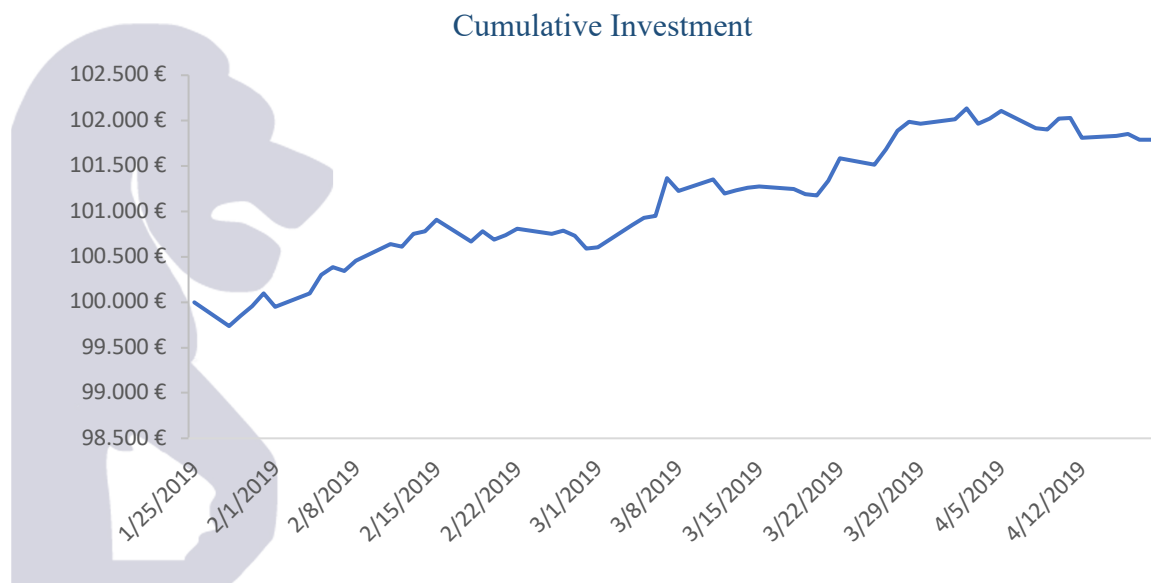

Cumulative Investment

Figure 18 – Cumulative value passive component

Overall returns

As a final illustration, we report the overall performance of our portfolio. It is given by the sum of the performances of the active and of the passive component. The cumulative return has been **2.89%** for the sector neutral portfolio and **5.71%** for the non-sector-neutral one.
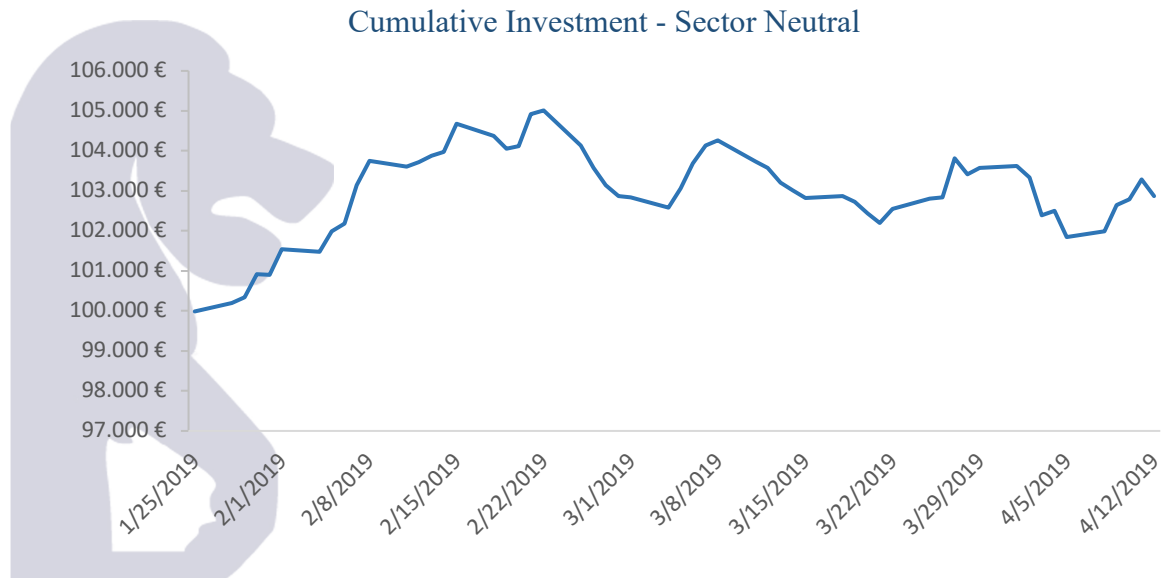
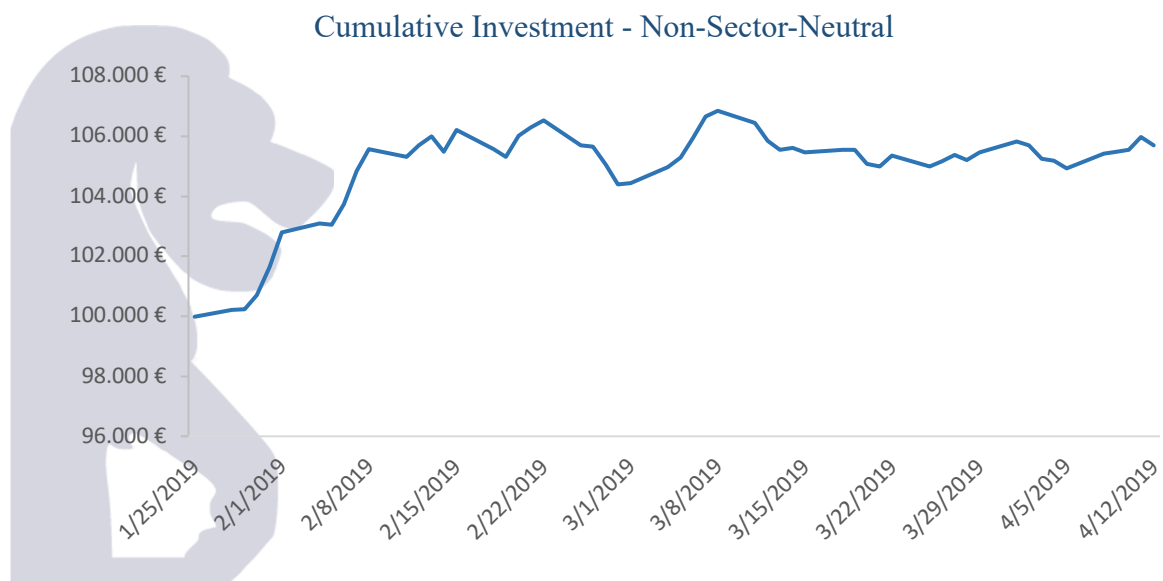Figure 19 – Overall cumulative value (sector-neutral)

Figure 20 – Overall cumulative value (non-sector-neutral)

For the sake of completeness, we also report the overall performance of the **previous portfolio.** The cumulative return of our previous portfolio, both for the active and passive component, was **7.10%** in the two months considered, as shown below.
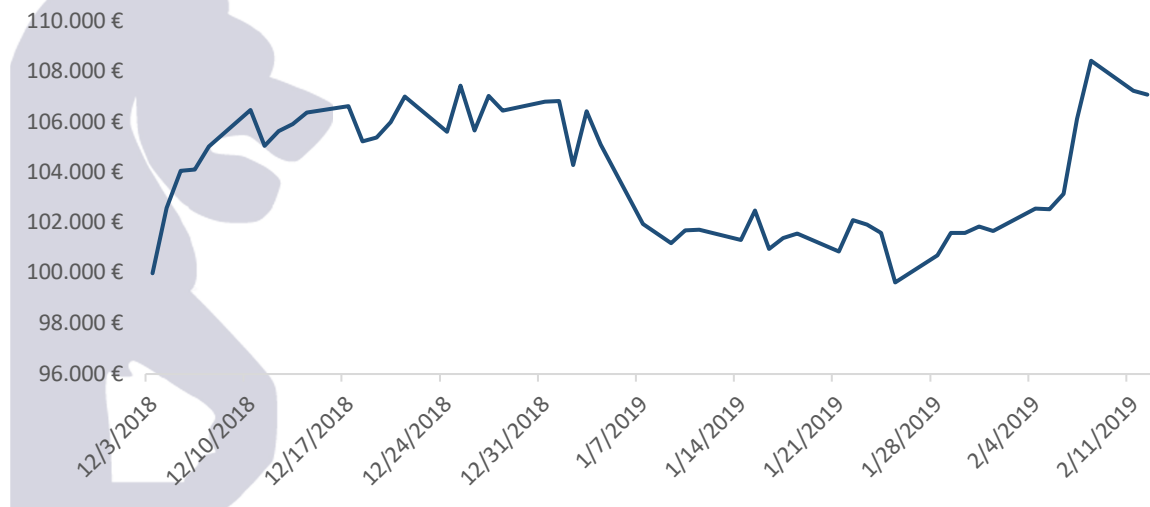
Overall Cumulative Investment

Figure 21 – Overall cumulative value previous portfolio

New passive component

Here below is our new passive component with the **Most Diversified Portfolio** theory:

ETF	Weights
iShares Core S&P 500 UCITS ETF	2%
iShares € Govt Bond 1-3yr UCITS ETF	36%
iShares € Govt Bond 7-10yr UCITS ETF	7%
iShares $ High Yield Corp Bond UCITS ETF	9%
iShares Core MSCI Europe UCITS ETF	2%
iShares $ Treasury Bond 1-3yr UCITS ETF	30%
iShares IG Corp Bond UCITS ETF	6%
iShares $ Treasury Bond 7-10yr UCITS ETF	6%
Invesco Optimum Yield Diversified	2%

Figure 22 – New passive component portfolio weights

For the iShares Core MSCI Europe UCITS ETF, the iShares Core S&P 500 UCITS ETF and the Invesco Optimum Yields Diversified the returns have been calculated through the percentage growth of the NAV from December 2014 to January 2019. Regarding the iShares IG Corp Bond UCITS ETF, the iShares € Govt Bond 1-3yr UCITS ETF, iShares $ Treasury Bond 7-10y, iShares € Govt Bond 7-10yr UCITS ETF, iShares $ High Yield Corp Bond UCITS ETF and iShares $ Treasury Bond 1-3yr UCITS ETF returns have been calculated as the percentage growth of the fund return, considering the ex-dividends of the period between 12/2014 and 01/2019, for example the iShares IG Corp Bond UCITS ETF return, in addition to the previous ones, has been calculated considering the ex-dividends of 1.03 at 13/12/2018.

From the equally-weighted risk contributions approach to the Most Diversified Portfolio

In the last portfolio implementation, we used the equally-weighted risk contributions approach; the peculiar goal of this portfolio implementation was to compute weights in order to reach an equal contribution of each asset class to the total portfolio's risk. To check the effective equal risk contribution of the asset classes, we started from the computation of the marginal risk, which was used to check the variation caused in the portfolio risk by an infinitesimal change in the asset class weight, and we arrived to an equal contribution to risk of 11.11% of each asset class, calculated as the product of the specific weight and the marginal risk. The results, in terms of weights and risk contributions, were the following:

ETF (EW Risk Contributions)	Weights	Marginal Risk	Risk Contribution (%)
iShares Core S&P 500 UCITS ETF	2.2%	0.015%	11%
iShares € Govt Bond 1-3yr UCITS	38.3%	0.001%	11%
iShares € Govt Bond 7-10yr UCITS	4.5%	0.007%	11%
iShares $ High Yield Corp Bond UCITS	8.8%	0.004%	11%
iShares Core MSCI Europe UCITS	1.7%	0.019%	11%
iShares $ Treasury Bond 1-3yr UCITS	33.9%	0.001%	11%
iShares IG Corp Bond UCITS ETF	3.6%	0.009%	11%
iShares $ Treasury Bond 7-10yr UCITS	5.0%	0.006%	11%
Invesco Optimum Yield Diversified	2.1%	0.015%	11%

Figure 23 – New passive component risk contributions

This time we decided to implement the Most Diversified Portfolio theory; introduced and analyzed in 2008 by Yves Choueifaty and Yves Coignard in the article "Toward Maximum Diversification", the theory aims to maximize the portfolio diversification potential.
The authors present in their papers a ratio, the diversification ratio (DR), whose maximization leads to the optimal portfolio, the Most Diversified Portfolio.

The Diversification Ratio represents the index that can be obtained by dividing the average, weighted for the w_i weights, of the standard deviations of the individual asset classes to the total volatility of the portfolio.
Let w be the initial weights' vector, in our case it will consist in a 11.11% for each of our nine ETFs, and σ the vector of standard deviations with w_i and σ_i the weight and the standard deviation of the i-th asset class and Σ the variance-covariance matrix, given N asset class:

$$w = \begin{bmatrix} w_1 \\ w_2 \\ ... \\ w_i \\ ... \\ w_N \end{bmatrix} \quad \Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{1N} \\ \sigma_{21} & \cdots & \sigma_{2N} \\ \vdots & \ddots & \vdots \\ \sigma_{N1} & \cdots & \sigma_{NN} \end{bmatrix} \quad \sigma = \begin{bmatrix} \sigma_1 \\ \sigma_2 \\ ... \\ \sigma_i \\ ... \\ \sigma_N \end{bmatrix}$$

The Diversification Ratio, given the constraints $\sum_i^N w_i = 1$ and the impossibility to short selling $| w_i \geq 0 \ with \ i = 1, ..., N$, will be equal to:

$$DR_p = \frac{w'\sigma}{\sqrt{w'\Sigma w}}$$

The index thus identified will be strictly greater than 1 except for the mono asset portfolios, in this case the DR will be equal to 1; considering this aspect, we can deduce that any portfolio with a Diversification Ratio close to the unit will be characterized by a low risk diversification.

The formalization of the Most Diversified Portfolio is presented as an optimization problem in which the Diversification Ratio is included in a maximization function

$$Max_{w^*}\left(\frac{w'\sigma}{\sqrt{w'\Sigma w}}\right)$$
$$s.t.$$
$$w'e = 1 \; with \; e = \begin{bmatrix} 1 & 1 & ... & N \end{bmatrix}$$
$$[w] \geq 0$$

The output of the optimization problem will be a portfolio which by construction represents the one with the greatest possible diversification and, consequently, also definable as an in-diversifiable portfolio; with our data we arrived to a DR of 2.99 starting from an initial DR of 1.735 (that referring to an equal balanced portfolio in terms of weights).

An interesting thing to notice is that the Diversification Ratio could be also seen as the result of the following decomposition:

$$DR_p = \frac{1}{\sqrt{\rho(w)[1 - CR(w)] + CR(w)}}$$

where ρ(w) is the average of correlation weighted for the volatility of the assets in the portfolio:

$$\rho(w) = \frac{\sum_{i\neq j}^{N}\left(w_i\sigma_i w_j\sigma_j\right)\rho_{ij}}{\sum_{i\neq j}^{N}\left(w_i\sigma_i w_j\sigma_j\right)}$$

while CR(w) represents the Concentration Ratio:

$$CR(w) = \frac{\sum_{i=1}^{N}(w_i\sigma_i)^2}{(\sum_{i=1}^{N}w_i\sigma_i)^2}$$

The breakdown presented shows how the Diversification Ratio increases when the average correlation and / or CR (w) decreases.

Our DR implementation and consequent maximization brought us to the following weights and risk values, as presented before and summed in the following table for clearness:

ETF (MDP)	Weights	Marginal Risk	Risk Contribution (%)	DR
iShares Core S&P 500 UCITS ETF	2.19%	0.014%	8.92%	
iShares € Govt Bond 1-3yr UCITS ETF	35.76%	0.001%	9.22%	
iShares € Govt Bond 7-10yr UCITS ETF	6.67%	0.008%	15.62%	
iShares $ High Yield Corp Bond UCITS ETF	9.28%	0.004%	9.75%	
iShares Core MSCI Europe UCITS ETF	2.04%	0.019%	11.44%	2.99
iShares $ Treasury Bond 1-3yr UCITS ETF	30.43%	0.001%	10.34%	
iShares IG Corp Bond UCITS ETF	6.35%	0.009%	17.58%	
iShares $ Treasury Bond 7-10yr UCITS ETF	5.67%	0.007%	12.60%	
Invesco Optimum Yield Diversified	1.60%	0.009%	4.53%	

Figure 24 – DR implementation risk contributions

To conclude, the implemented portfolio is the most diversified one; the increase in diversification could be measured by the growth of the Diversification Ratio which rose 72.33% from 1.735 (equal weights hypothesis) to 2.99.

Compared to the old portfolio implementation, we clearly see an improvement in diversification also in this case; in fact, if we calculate the Diversification Ratio also for the Equally Weighted Risk Contributions theory with the updated data for February and March, we will have a DR of 2.12, as indicated in the next table, which is 29.10% lower than the one found using the MDP theory (2.99).

ETF (EW Risk Contributions)	Weights	Marginal Risk	Risk Contribution (%)	DR
iShares Core S&P 500 UCITS ETF	2.2%	0.015%	11.1%	
iShares € Govt Bond 1-3yr UCITS ETF	40.0%	0.001%	11.1%	
iShares € Govt Bond 7-10yr UCITS ETF	4.6%	0.007%	11.1%	
iShares $ High Yield Corp Bond UCITS ETF	8.8%	0.004%	11.1%	
iShares Core MSCI Europe UCITS ETF	1.7%	0.019%	11.1%	2.12
iShares $ Treasury Bond 1-3yr UCITS ETF	31.5%	0.001%	11.1%	
iShares IG Corp Bond UCITS ETF	3.8%	0.009%	11.1%	
iShares $ Treasury Bond 7-10yr UCITS ETF	5.1%	0.006%	11.1%	
Invesco Optimum Yield Diversified	2.2%	0.015%	11.11%	

Figure 25 – DR implementation equal risk contributions

IV.   Conclusions

As a result of our analysis, we are now invested in two different portfolios. The first one is divided into an active component, implementing two new factors with respect to those used in the previous investment period, along with a passive one constructed following the most diversified portfolio theory. The second one is similar to the first, except for the sector neutrality strategy that has not been implemented. The reasons driving this strategy have been explained in the previous report. The Fixed and Alternative division will provide the latter with a hedging component covering for some sectors exposure and macro potentially adverse trends, we refer you to their report that will be published soon. During the investment period considered, we obtained a positive performance on the overall portfolio, thanks to different factors, though not all of them were under our control.

However, as for the passive component, this time, ETFs registered a lower performance, though still in line with forecasts of the Fixed and Alternatives Division and mainly because it is more risk-balanced than the previous implementation.

		NEW PORTFOLIO SECTOR NEUTRAL							
		S&P 500					**STOXX 600**		
	#	Name	Industry	Score	Weight	#	Name	Industry	Score	Weight
ACTIVE COMPONENT	1	EDWARDS LIFESCIENCES	Health Care	0,797324304	1/n	1	BOSKALIS WESTMINSTER	Industrials	0,84961138	1/n
	2	ULTA BEAUTY	Consumer Services	0,766282559	1/n	2	WIENERBERGER	Industrials	0,634770147	1/n
	3	KEYCORP	Financials	0,764116179	1/n	3	UNITED UTILITIES GROUP	Utilities	0,699014164	1/n
	4	AUTOMATIC DATA PROC.	Industrials	0,735095996	1/n	4	RUBIS	Utilities	0,572567802	1/n
	5	MGM RESORTS INTL.	Consumer Services	0,722024763	1/n	5	SIEMENS GAMESA RENEWABLE ENERGY	Oil & Gas	0,684850181	1/n
	6	COCA COLA	Consumer Goods	0,712576804	1/n	6	ENI	Oil & Gas	0,598321988	1/n
	7	CINTAS	Industrials	0,707149709	1/n	7	RTL GROUP (XET)	Consumer Services	0,668810222	1/n
	8	CORNING	Technology	0,68019306	1/n	8	RELX	Consumer Services	0,658020909	1/n
	9	IHS MARKIT	Financials	0,638682132	1/n	9	PERSIMMON	Consumer Goods	0,588615613	1/n
	10	HOLOGIC	Health Care	0,555455748	1/n	10	BERKELEY GROUP HDG.	Consumer Goods	0,586632482	1/n
	11	KELLOGG	Consumer Goods	0,510524731	1/n	11	ZURICH INSURANCE GROUP	Financials	0,553099272	1/n
	12	COGNIZANT TECH.SLTN.'A'	Technology	0,489359477	1/n	12	SWISS LIFE HOLDING	Financials	0,532380393	1/n
	13	NEWMONT MINING	Basic Materials	0,472084518	1/n	13	CELLNEX TELECOM	Telecommunications	0,540426116	1/n
	14	AIR PRDS.& CHEMS.	Basic Materials	0,46234373	1/n	14	BT GROUP	Telecommunications	0,481965848	1/n
	15	NEXTERA ENERGY	Utilities	0,416878434	1/n	15	AKZO NOBEL	Basic Materials	0,531395117	1/n
	16	AES	Utilities	0,405275784	1/n	16	LANXESS (XET)	Basic Materials	0,479758963	1/n
	17	BAKER HUGHES A	Oil & Gas	0,382440578	1/n	17	NOKIA	Technology	0,442106628	1/n
	18	CIMAREX EN.	Oil & Gas	0,329351422	1/n	18	SCOUT24 (XET)	Technology	0,441725311	1/n
	19	VERIZON COMMUNICATIONS	Telecommunications	0,108125555	1/n	19	SANOFI	Health Care	0,409107031	1/n
						20	TECAN 'R'	Health Care	0,374219189	1/n
	20	AT&T	Telecommunications	-0,120505771	1/n	21	REPSOL YPF	Oil & Gas	-0,438911361	1/n
	21	ENTERGY	Utilities	-0,356773675	1/n	22	SOPRA STERIA GROUP	Technology	-0,476450262	1/n
	22	SEMPRA EN.	Utilities	-0,357491635	1/n	23	NATURGY ENERGY	Utilities	-0,48648008	1/n
	23	CF INDUSTRIES HDG.	Basic Materials	-0,397204987	1/n	24	YARA INTERNATIONAL	Basic Materials	-0,489252557	1/n
	24	ECOLAB	Basic Materials	-0,419144836	1/n	25	DASSAULT SYSTEMES	Technology	-0,517101843	1/n
	25	PIONEER NTRL.RES.	Oil & Gas	-0,591967346	1/n	26	TELEFONICA DTL. (XET) HLDG.	Telecommunications	-0,545071447	1/n
	26	ADVANCED MICRO DEVICES	Technology	-0,609778299	1/n	27	ANTOFAGASTA	Basic Materials	-0,56780878	1/n
	27	PACCAR	Industrials	-0,6642542	1/n	28	VERBUND	Utilities	-0,584203181	1/n
	28	PROCTER & GAMBLE	Consumer Goods	-0,693244166	1/n	29	DEUTSCHE TELEKOM (XET)	Telecommunications	-0,623875807	1/n
	29	BALL	Industrials	-0,718458545	1/n	30	UCB	Health Care	-0,674840021	1/n
	30	ARISTA NETWORKS	Technology	-0,75558646	1/n	31	ZALANDO (XET)	Consumer Services	-0,685452593	1/n
	31	ALLERGAN	Health Care	-0,778412654	1/n	32	OMV	Oil & Gas	-0,755030134	1/n
	32	GOODYEAR TIRE & RUB.	Consumer Goods	-0,820290798	1/n	33	WILLIAM HILL	Consumer Services	-0,81089852	1/n
	33	MARSH & MCLENNAN	Financials	-0,838028117	1/n	34	UNILEVER (UK)	Consumer Goods	-0,818591671	1/n
	34	TWENTY-FIRST CENTURY FOX CL.B	Consumer Services	-0,908917302	1/n	35	CARL ZEISS MEDITEC (XET)	Health Care	-0,946050943	1/n
	35	CVS HEALTH	Consumer Services	-0,940878025	1/n	36	AMUNDI (WI)	Financials	-1,085279962	1/n
	36	CHEVRON	Oil & Gas	-0,981917595	1/n	37	BANK OF IRELAND GROUP	Financials	-1,200922324	1/n
	37	ABIOMED	Health Care	-1,003851405	1/n	38	AMER SPORTS	Consumer Goods	-1,257659988	1/n
	38	HUNTINGTON BCSH.	Financials	-1,051436137	1/n	39	WIRECARD (XET)	Industrials	-1,301961921	1/n
						40	ADYEN	Industrials	-1,332402043	1/n
PASSIVE COMPONENT	1	iShares Core s&P 500 UCITS ETF			2%				
	2	iShares € Gov Bond 1-3yr UCITS ETF			36%		Invested Capital (Active Long)	€ 100'000	
	3	iShares € Gov Bond 7-10yr UCITS ETF			7%		Invested Capital (Active Short)	(€100'000)	
	4	iShares $ High Yield Corp Bond UCITS ETF			9%		# Stocks	78	
	5	iShares Core MSCI Europe UCITS ETF			2%		1/n	1.282,05 €	
	6	iShares $ Treasury Bond 1-3yr UCITS ETF			30%		Hedging strategy	NO	
	7	iShares IG Corp Bond UCITS ETF			6%				
	8	iShares $ Treasury Bond 7-10yr UCITS ETF			6%				
	9	Invesco Optimum Yield Diversified			2%				

Figure 26 – Overview overall portfolio (sector-neutral)

NEW PORTFOLIO NO SECTOR NEUTRAL								
S&P 500				**STOXX 600**				
#	Name	Industry	Score	Weight	#	Name	Industry	Score	Weight
1	EDWARDS LIFESCIENCES	Health Care	0,797324304	1/n	1	BOSKALIS WESTMINSTER	Industrials	0,84961138	1/n
2	ULTA BEAUTY	Consumer Services	0,766282559	1/n	2	UNITED UTILITIES GROUP	Utilities	0,69901416	1/n
3	KEYCORP	Financials	0,764116179	1/n	3	SIEMENS GAMESA RENEWABLE ENERGY	Oil & Gas	0,68485018	1/n
4	AUTOMATIC DATA PROC.	Industrials	0,735095996	1/n	4	RTL GROUP (XET)	Consumer Ser	0,66881022	1/n
5	MGM RESORTS INTL.	Consumer Services	0,722024763	1/n	5	RELX	Consumer Ser	0,65802091	1/n
6	COCA COLA	Consumer Goods	0,712576804	1/n	6	WIENERBERGER	Industrials	0,63477015	1/n
7	CINTAS	Industrials	0,707149709	1/n	7	SODEXO	Consumer Ser	0,61184455	1/n
8	CORNING	Technology	0,68019306	1/n	8	ENI	Oil & Gas	0,59832199	1/n
9	KEYSIGHT TECHNOLOGIES	Industrials	0,665658538	1/n	9	PERSIMMON	Consumer Go	0,58861561	1/n
10	IHS MARKIT	Financials	0,638682132	1/n	10	BERKELEY GROUP HDG.	Consumer Go	0,58663248	1/n
11	HOLOGIC	Health Care	0,555455748	1/n	11	RUBIS	Utilities	0,5725678	1/n
12	CARMAX	Consumer Services	0,532316139	1/n	12	REMY COINTREAU	Consumer Go	0,56965402	1/n
13	KELLOGG	Consumer Goods	0,510524731	1/n	13	REXEL	Industrials	0,5657175	1/n
14	INGERSOLL-RAND	Industrials	0,504602664	1/n	14	SPIRAX-SARCO ENGR.	Industrials	0,56106465	1/n
15	IRON MOUNTAIN	Financials	0,492031087	1/n	15	FERGUSON	Industrials	0,55770611	1/n
16	COGNIZANT TECH.SLTN.'A'	Technology	0,489359477	1/n	16	ZURICH INSURANCE GROUP	Financials	0,55309927	1/n
17	TAKE TWO INTACT.SFTW.	Consumer Goods	0,478445073	1/n	17	ASHTEAD GROUP	Industrials	0,54951664	1/n
18	NEWMONT MINING	Basic Materials	0,472084518	1/n	18	CELLNEX TELECOM	Telecommuni	0,54042612	1/n
19	SYMANTEC	Technology	0,464816446	1/n	19	LEGRAND	Industrials	0,53728412	1/n
					20	SWISS LIFE HOLDING	Financials	0,53238039	1/n
20	MONSTER BEVERAGE	Consumer Goods	-0,609814043	1/n	21	INDITEX	Consumer Ser	-0,5880626	1/n
21	MYLAN	Health Care	-0,620189664	1/n	22	MERLIN ENTERTAINMENTS	Consumer Ser	-0,6222868	1/n
22	MATTEL	Consumer Goods	-0,658567204	1/n	23	DEUTSCHE TELEKOM (XET)	Telecommuni	-0,6238758	1/n
23	UNIVERSAL HEALTH SVS.'B'	Health Care	-0,661268237	1/n	24	KERRY GROUP 'A'	Consumer Go	-0,6278996	1/n
24	PERKINELMER	Industrials	-0,663034276	1/n	25	GETINGE B	Health Care	-0,6288256	1/n
25	PACCAR	Industrials	-0,6642542	1/n	26	RICHEMONT N	Consumer Go	-0,6740198	1/n
26	FRANKLIN RESOURCES	Financials	-0,686301802	1/n	27	UCB	Health Care	-0,67484	1/n
27	PROCTER & GAMBLE	Consumer Goods	-0,693244166	1/n	28	ZALANDO (XET)	Consumer Ser	-0,6854526	1/n
28	BALL	Industrials	-0,718458545	1/n	29	HOMESERVE	Industrials	-0,6866026	1/n
29	ARISTA NETWORKS	Technology	-0,75558646	1/n	30	SAAB B	Industrials	-0,7170733	1/n
30	IQVIA HOLDINGS	Health Care	-0,770040401	1/n	31	OMV	Oil & Gas	-0,7550301	1/n
31	ALLERGAN	Health Care	-0,778412654	1/n	32	BANCO SANTANDER	Financials	-0,7684833	1/n
32	GOODYEAR TIRE & RUB.	Consumer Goods	-0,820290798	1/n	33	WILLIAM HILL	Consumer Ser	-0,8108985	1/n
33	MARSH & MCLENNAN	Financials	-0,838028117	1/n	34	UNILEVER (UK)	Consumer Go	-0,8185917	1/n
34	TWENTY-FIRST CENTURY FOX CL.B	Consumer Services	-0,908917302	1/n	35	CARL ZEISS MEDITEC (XET)	Health Care	-0,9460509	1/n
35	CVS HEALTH	Consumer Services	-0,940878025	1/n	36	AMUNDI (WI)	Financials	-1,08528	1/n
36	CHEVRON	Oil & Gas	-0,981917595	1/n	37	BANK OF IRELAND GROUP	Financials	-1,2009223	1/n
37	ABIOMED	Health Care	-1,003851405	1/n	38	AMER SPORTS	Consumer Go	-1,25766	1/n
38	HUNTINGTON BCSH.	Financials	-1,051436137	1/n	39	WIRECARD (XET)	Industrials	-1,3019619	1/n
					40	ADYEN	Industrials	-1,332402	1/n

ACTIVE COMPONENT

	PASSIVE COMPONENT					
1	iShares Core s&P 500 UCITS ETF	2%		Invested Capital (Active Long)	€ 100'000
2	iShares € Gov Bond 1-3yr UCITS ETF	36%		Invested Capital (Active Short)	(€100'000)
3	iShares € Gov Bond 7-10yr UCITS ETF	7%		# Stocks	78
4	iShares $ High Yield Corp Bond UCITS ETF	9%		1/n	1.282,05 €
5	iShares Core MSCI Europe UCITS ETF	2%		Hedging strategy	YES
6	iShares $ Treasury Bond 1-3yr UCITS ETF	30%			
7	iShares IG Corp Bond UCITS ETF	6%			
8	iShares $ Treasury Bond 7-10yr UCITS ETF	6%			
9	Invesco Optimum Yield Diversified	2%			

Figure 27 – Overview overall portfolio (non-sector-neutral)

Both portfolios have been implemented on Interactive Brokers, a popular trading platform which we recommend for academic purposes.

(Inception date: 25/04/2019)

V.   **Appendix:**

https://www.msci.com/esg-ratings

https://www.msci.com/esg-investing

https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/esg-scores-methodology.pdf

https://www.msci.com/documents/10199/123a2b2b-1395-4aa2-a121-ea14de6d708a

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