

# Portfolio Theory (LECGE 1218)



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EXCELLENCE & ETHICS IN BUSINESS

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## Preface:

The main goal is to **construct a portfolio** by picking securities from the Euro Stoxx 50 (SX5E) which is the benchmark target, **quantify its performance** and make a **performance attribution**. We must follow a set of regulations, which are reported as follows:

- a) We can invest only in the securities included in the **Euro Stoxx 50**.
- b) We must use all our capital (**no cash remaining**).
- c) Only **long position** are allowed.
- d) No **transaction costs**.
- e) We assume that our initial portfolio have been set up **52 weeks ago**.

There is a **trade off** in the achievement of the main objectives due to a **different time frame**. In fact, the construction of an optimal portfolio implies a long-term vision and (in our case) it is based on a weekly analysis of returns. In order to get good results, it is necessary to study **returns in a lower time frame**. Moreover, instead of using a passive strategy, as we are going to do at the end, it would be better to choose an **active strategy** in order to try to beat the market. However, a portfolio well made with a passive strategy may yield more than an active portfolio in the long-term. Therefore, in our work we are going to focus on the **former objective**.

During the course we had **4 opportunities to change the composition** of our portfolio, in order to get best performance according to our forecasts. We will describe these decisions and the logic behind each asset and security included in our portfolio. We will then analyze these decisions through **performance attribution** and **indexes of performance**.

## The benchmark:

The EURO STOXX 50 Index, Europe's leading blue-chip index for the Eurozone, provides a representation of leaders in the region. The index covers 50 stocks from 11 Eurozone countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.<sup>1</sup> It represents almost the 60% of the free-float market cap of the corresponding EURO STOXX TMI index. The data about the performance of the index are reported below:

### Risk and return figures<sup>1</sup>

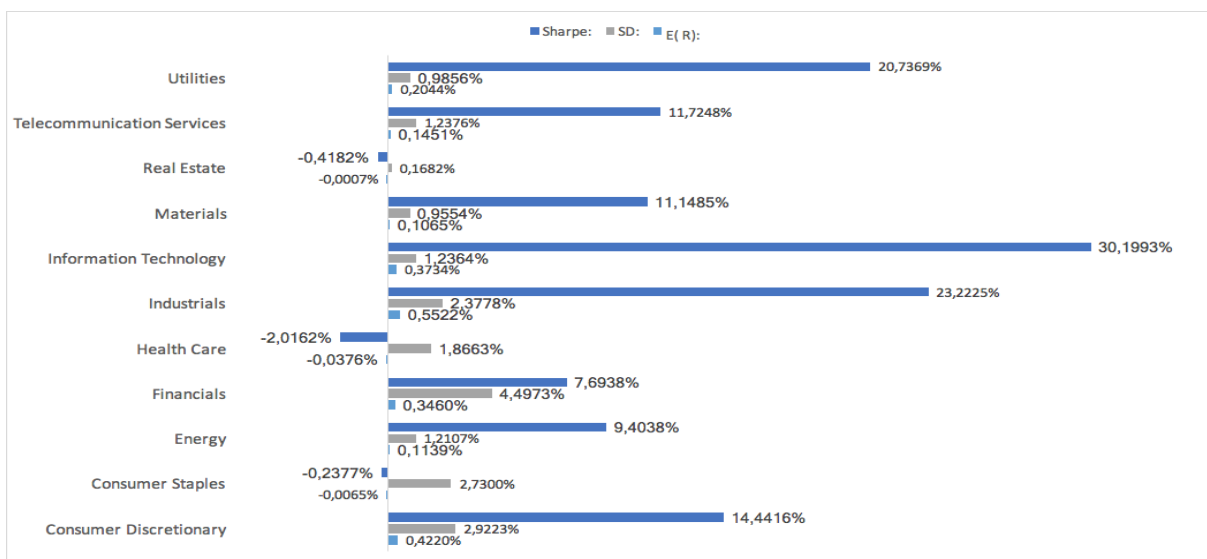
Index returns	Return (%)					Annualized return (%)				
	Last month	YTD	1Y	3Y	5Y	Last month	YTD	1Y	3Y	5Y
EURO STOXX 50 Index	6.0	2.0	2.9	8.9	55.8	N/A	N/A	2.9	2.9	9.4
EURO STOXX Index	5.1	2.3	5.6	15.5	67.9	N/A	N/A	5.7	5.0	11.1
Index volatility and risk	Annualized volatility (%)					Annualized Sharpe ratio <sup>2</sup>				
	Last month	YTD	1Y	3Y	5Y	Last month	YTD	1Y	3Y	5Y
EURO STOXX 50 Index	11.8	14.5	11.5	19.0	18.2	N/A	N/A	0.3	0.2	0.5
EURO STOXX Index	11.5	14.0	11.0	17.8	16.9	N/A	N/A	N/A	0.3	0.6
Index to benchmark	Correlation					Tracking error (%)				
	Last month	YTD	1Y	3Y	5Y	Last month	YTD	1Y	3Y	5Y
EURO STOXX 50 Index	1.0	1.0	1.0	1.0	1.0	1.6	2.0	1.7	2.3	2.4
Index to benchmark	Beta					Annualized information ratio				
	Last month	YTD	1Y	3Y	5Y	Last month	YTD	1Y	3Y	5Y
EURO STOXX 50 Index	1.0	1.0	1.0	1.1	1.1	6.8	-0.4	-1.6	-0.8	-0.6

<sup>1</sup> <https://www.stoxx.com/index-details?symbol=sx5E>

However, for our studies we are going to use *annual performance measures* based on our reference period (from 23/03/2017 to 24/04/2018), which are the following:

	SE5X
Expected return:	-3.42%
TWR:	-4.29%
Standard Deviation	13.47%
Sharpe Ratio:	-0.251

The average *sector expected return, Sharpe ratio and standard deviation* of the index, calculated from 2015 up to 2018 is the following:



As we can see, the largest component of this index is the *financial sector* accounting for 19% of the overall index, this is also *the most volatile sector* of the index and does not have the highest expected return. Upon calculating this, we decided not to include a large amount of financial securities due to the height of volatility in this sector. In order to have safer and more profitable investments, we made our decisions based on the composition of the benchmark index.

As we said at the beginning, SE5X *is going to be our Benchmark*. Therefore, our aim is to outperform it, that's why all constraints that we will use to choose the weights of our optimal portfolio and to pick securities will be referred to data about Euro Stoxx 50. We will also use it *as a means to compare our weekly progress*.

### First decision:

Our first decision is our most crucial decision as we are constructing the foundations of the portfolio. We approach the first portfolio with an *active strategy*, aiming to select undervalued securities. Without

forgetting the important *principle of diversification*, that pushes us to try to pick securities from almost every sector. When we were deciding our assets there were *four main attributes*:

1. We consider the *price-to-book ratio* (P/B) and the *price-earnings ratio* (P/E) of each asset. When we gather these figures for each asset we *compare them to the values of the sector it belongs*. The P/B ratio is used to compare a stock's market value to its book value. The lower P/B ratio of a security than the P/B ratio of the industry could mean that the stock is undervalued<sup>2</sup>. Therefore, we selected stocks which have a lower P/B ratio than the industry. However, we have to do further research to ensure that the low P/B ratio isn't caused by a fundamental problem with the company. The P/E ratio represents the company's stock price to the company's earnings per share. We chose assets with a *lower P/E ratio than the industry* as we are searching for undervalued stocks that aren't getting a lot of attention from investors. Also in this second situation, the growth of earnings along quarters and a low P/E may be a good sign because we must always keep in mind that a low P/E can mean that the firm has economic troubles too.
2. Furthermore, we consider other measures: the *return on assets* (ROA) and the *return on equity* (ROE). We use these methods as an indicator of *how profitable the company is relative to its total assets*. This tells us how efficient the company is and how good their management is, therefore if the security has a higher ROA than the industry we perceive it as more efficient than other securities in that industry. The ROE portrays how effectively a company uses investors' money. This ratio is very important when *evaluating the health and growth perspective of a company*. We decided to pick securities which have a higher ROE than its industry as a company which makes intelligent use of investor money has a high growth perspective. When selecting the securities we considered firms where their capital was greater than its growth.
3. We took into consideration *the beta figure* of each stock. It represents the securities movement with the market. The bigger the beta is, the more similar it is to the market. According to the opinions of some market experts and some indicators it seems that *the SE5X is bearish*. Therefore, we are going to select a high number of securities with a beta figure of less than one in order to set off the negative effect of the market<sup>3</sup>.
4. In order to attempt to get rid of some of the non-systematic risk of our portfolio, we decided to diversify our assets by sector. The sectors that we included are as follows: consumer non-cyclical (43%), consumer cyclical (20%), basic materials (4%), financial (8%), industrial (12%), utilities (12%), and communications (4%). By investing in various sectors, we expected to reduce the risk in our portfolio. Moreover, to make our decision less aggressive, we also include in the portfolio some securities that aren't undervalued and that have a high ROA and ROE.

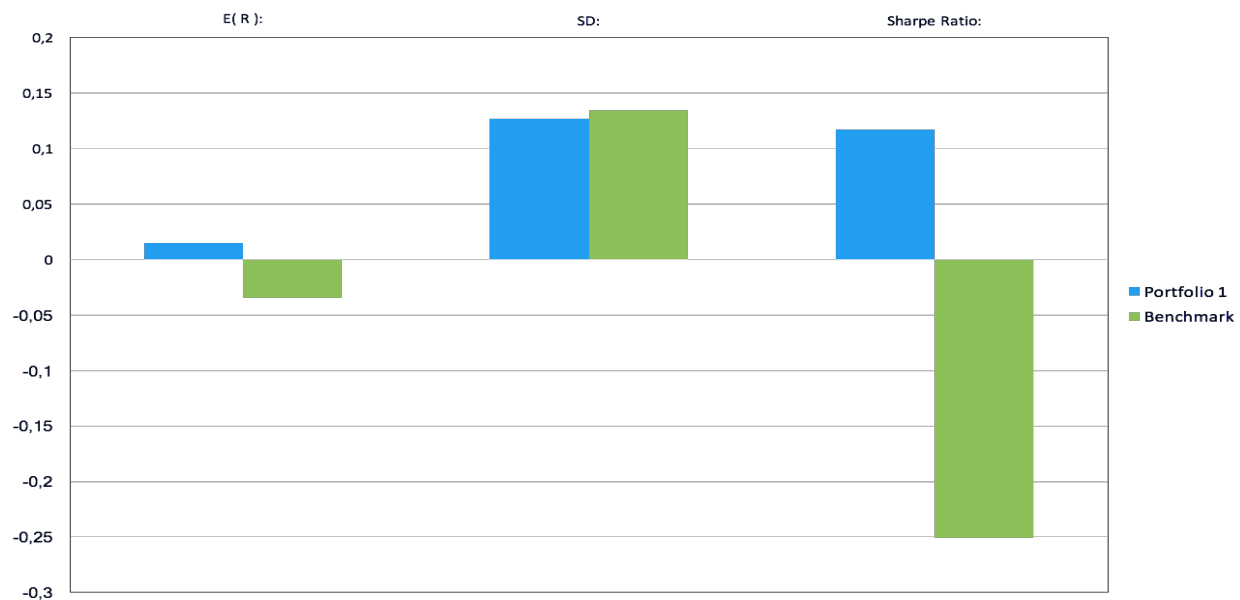
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<sup>2</sup> <https://www.investopedia.com/terms/p/price-to-bookratio.asp>

These criteria bring us to build the following portfolio:

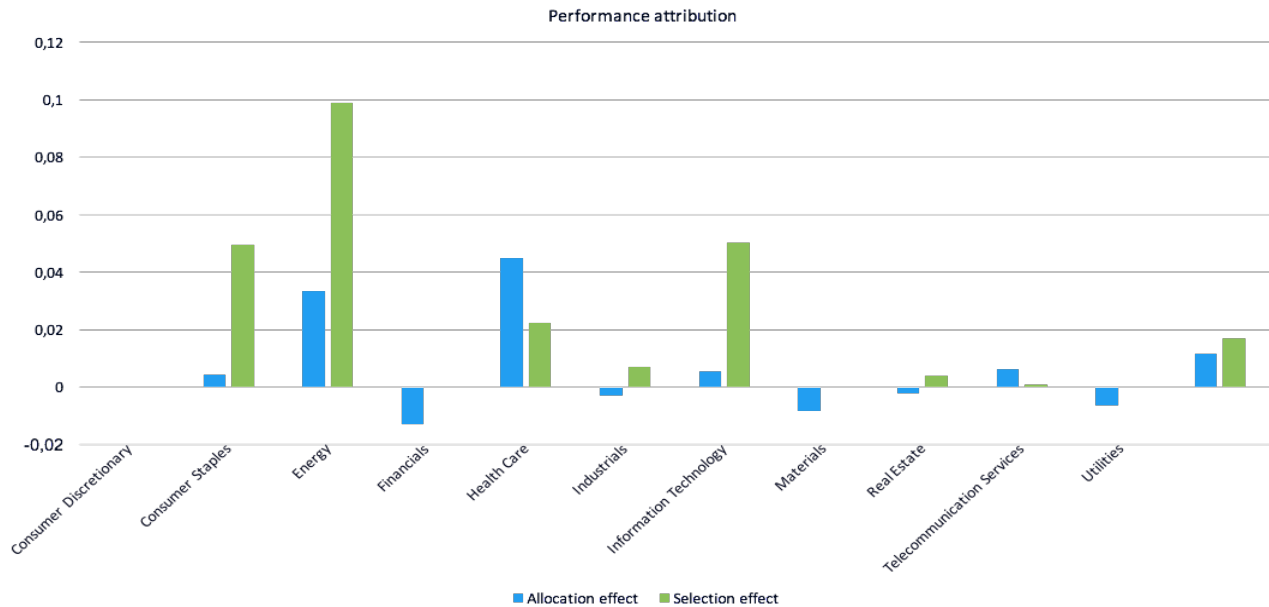
adidas AG	AD NA Equity	Consumer, Non-cyclical	15%
Vivendi SA	ADS GY Equity	Consumer, Cyclical	12%
L'Oreal SA	BAS GY Equity	Basic Materials	4%
Unilever NV	BN FP Equity	Consumer, Non-cyclical	4%
AXA SA	CS FP Equity	Financial	4%
Fresenius SE & Co KGaA	DPW GY Equity	Industrial	3%
Deutsche Post AG	ENGI FP Equity	Utilities	8%
Safran SA	EOAN GY Equity	Utilities	4%
Siemens AG	FRE GY Equity	Consumer, Non-cyclical	4%
BASF SE	ITX SQ Equity	Consumer, Cyclical	8%
Unibail-Rodamco SE	OR FP Equity	Consumer, Non-cyclical	15%
E.ON SE	SAF FP Equity	Industrial	4%
Engie SA	SIE GY Equity	Industrial	4%
Industria de Diseno Textil SA	UL NA Equity	Financial	4%
Koninklijke Ahold Delhaize NV	UNA NA Equity	Consumer, Non-cyclical	6%
Danone SA	VIV FP Equity	Communications	4%

Now we can calculate the expected return, the standard deviation and the Sharpe ratio of our portfolio and compare them with the benchmark. The annual expected returns was 1.489%, the volatility was 12.700% and the Sharpe Ratio was 0.1172. As you can see below, our portfolio performed better than the index.



Thanks to the performance attribution analysis, we can appreciate how different choices have had an impact on our performance. Our excess returns are 32.73% and of these 7.32% come from the '*sector allocation*' and 25.10% from the *security selection*. We can say that in this case the active strategy rewarded us<sup>4</sup>.

<sup>4</sup> Excel file for more details



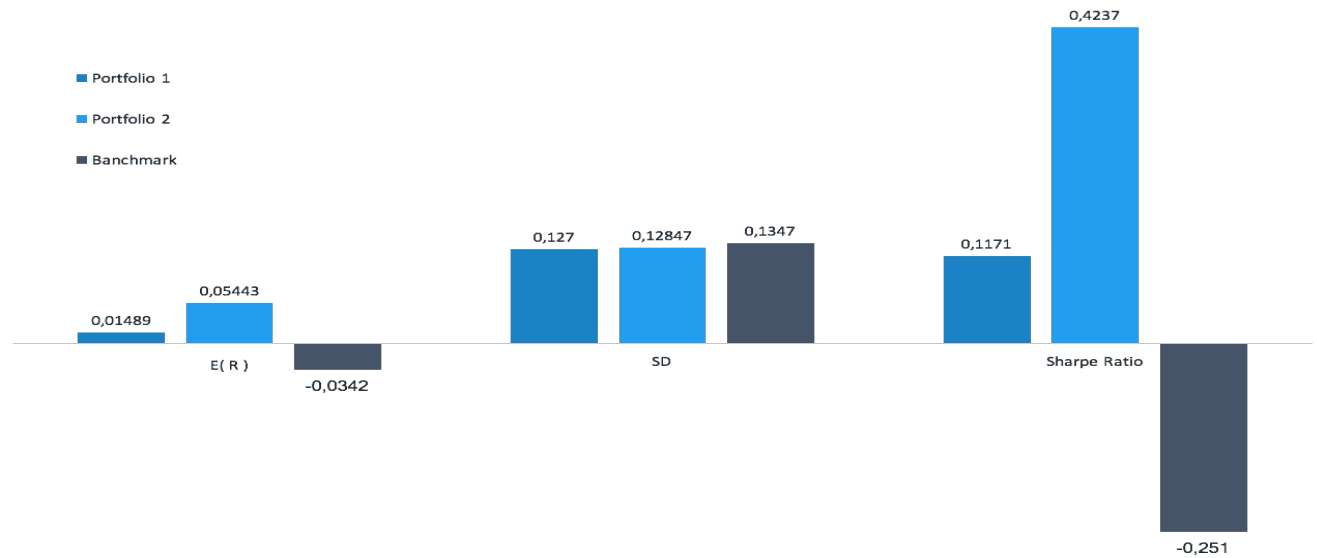
## Second decision:

For the second decision we decided to add more securities in order to reduce our non-systematic risk. We wished to **increase our risk-return characteristic** and add securities which increase our Sharpe ratio.

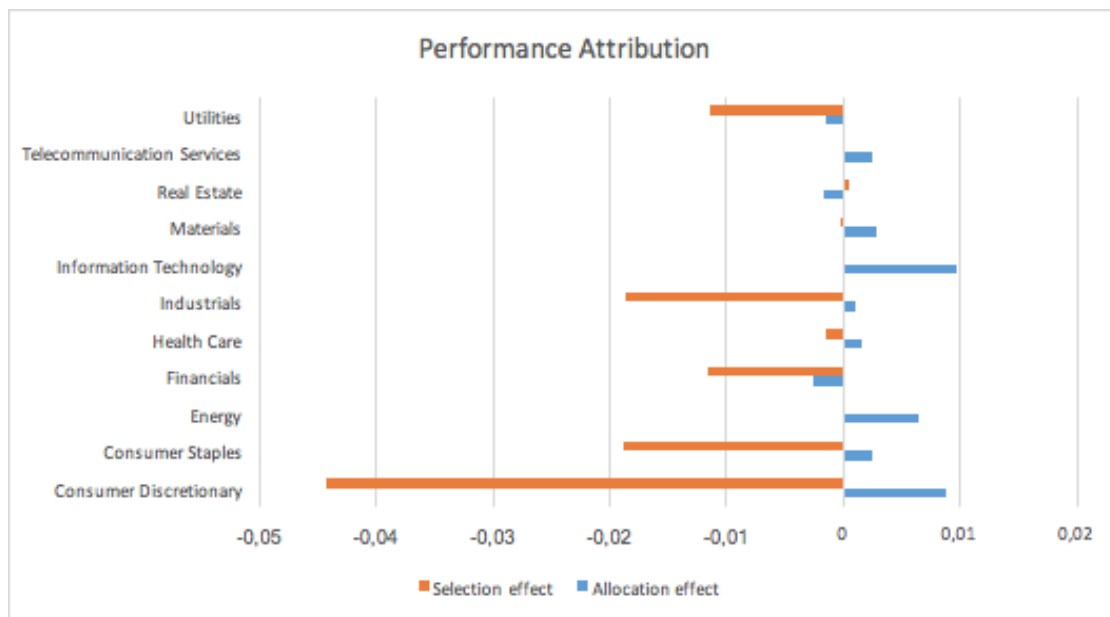
Since our previous strategy worked out for us, we decided to use the same criteria for stock selection. By following the same process, we decided to compare the P/B ratio from each company to P/B ratio of the industry that it belongs to and select those companies whose P/B ratio is lower than the industry. Then, we followed the same process with P/E ratio. Moreover, we calculate **beta for each company** in order to know how volatile was the stock in comparison to the market as a whole. We realize that on average beta was 0.9715 so our criterion was to pick all betas lower than 1. We try to had a more diversified portfolio with the aim of **facing the possible risks on the market in a more efficient way**.

Having analyzed all the companies which fulfilled the requirements mentioned before, we end up with twenty in an attempt to increase our Sharpe ratio and take advantage of diversification in order to minimize the volatility of our portfolio. Then, we had to analyze if we were diversified in terms of sectors. The sectors were taken as follows: Basic materials (2%), Communications (8%), Consumer discretionary (10%), Consumer Cyclical (10%), Consumer Non-cyclical (10%), Financial (12%), Health care (2%), Industrial (18%), Utilities (16%).

The annual expected return on portfolio was 5.443%, a standard deviation of 12.847% and a Sharpe ratio of 0.4237. Comparing these values with the ones of the previous portfolio and the benchmark, we can see that this second portfolio has a better Sharpe ratio, thanks to **higher expected returns**. By the contrast, the volatility **increased slightly**. Hence, we can say that this new portfolio is better than the previous one.



Unfortunately, in that week our portfolio underperformed the benchmark, our returns were equal to 4.54%, instead the ones of the index were 12.17%.

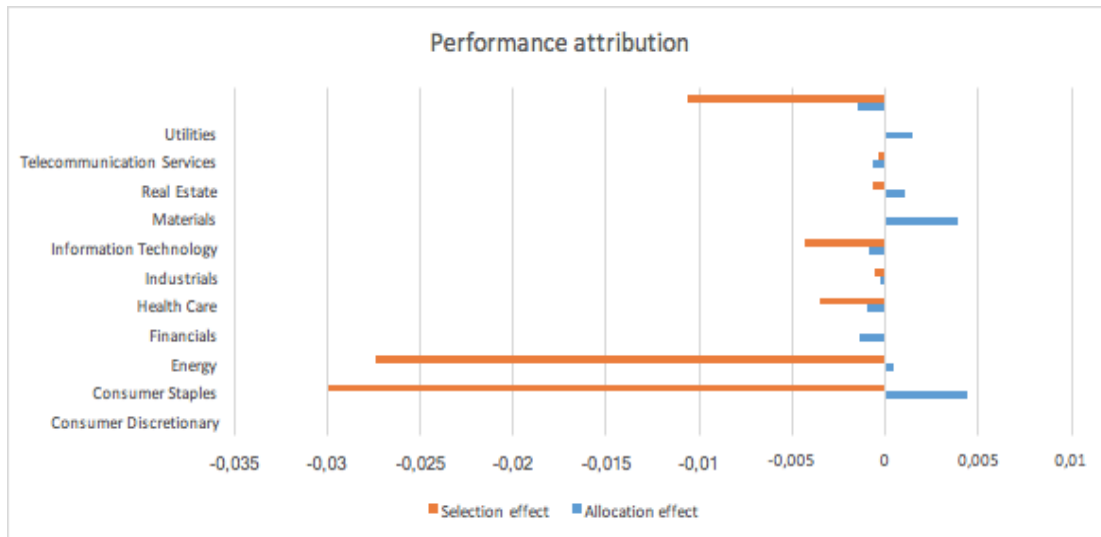


The *performance attribution procedure*<sup>5</sup> can help us to understand where the problem is: The allocation effect is still positive (but lower than in the first portfolio), and the selection effect is negative. Therefore, the problem was in the securities we had selected. Going deeper, we realized that *the problem was the beta* of securities: in that week, the trend of the index changed, but we hadn't changed our beta criterion, keeping many securities with a low beta. That's why our portfolio had lower returns than the index.

<sup>5</sup> Excel file for more details

### Third decision:

For the third decision we decide to keep the same securities as the second decision.



Finally, at the end of the week we realized that the results obtained were worse than the previous week. Thanks to performance attribution procedure<sup>6</sup> we realized that the problem was *in the selection of securities*. Moreover, we noticed that the allocation effect was almost zero. These outcomes push us towards the research of new ways. In particular, for our last decision we adopted a *passive strategy*, implementing the Markowitz portfolio method.

### Last decision:

The last decision was provided by 4 perspectives in order to earn the maximum profit, reducing the volatility and the risk and following the data criteria provided by Markowitz. The new decision included the *diversification tool with a passive strategy*, taking advantage from the differences inside the benchmark and estimating the performance in the economy.

Passive strategy has *lower cost in terms of time and research* of information. In fact, if we had checked with more accuracy the trend of the market and changed weights and securities in related with beta, we would probably have had better performance. Moreover, if we assume that markets are most of the time in balance, adopting a passive strategy, we can play as "*free rider*". In addition, data has shown that portfolios constructed with this strategy have achieved better results. Finally, with this approach we can fully benefit from diversification, reducing at minimum the non-systematic risk.

According to the Markowitz's criteria, we have to *maximize the slope of the Capital Allocation Line*, which is the Sharpe Ratio. In this way, we considered the investor's rational aversion to risk and compared the reference-free asset (in our case, a government bond) with the risk premium in terms of

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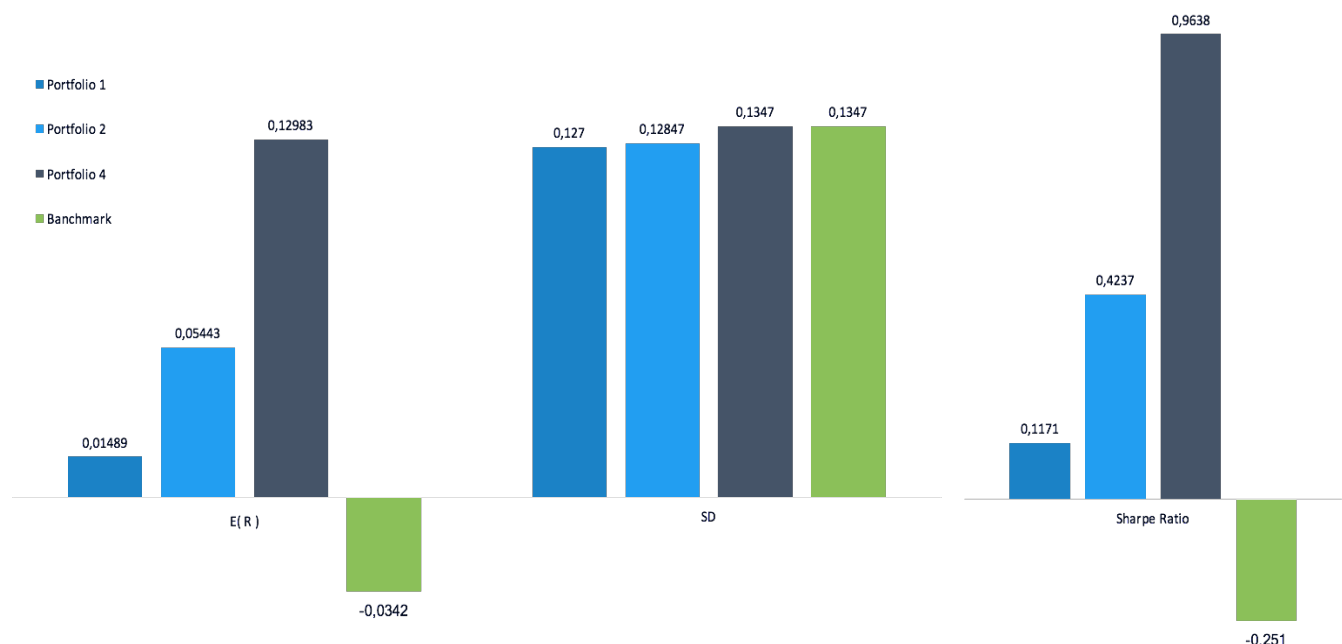
<sup>6</sup> Excel file for more details



expected return. After calculating expected returns, standard deviation and Sharpe ratio for a portfolio in which all securities have the same weight, we have to maximize the Sharpe of the portfolio by ‘Solver’ tool<sup>7</sup>. The put some constraints:

1. The sum of all weights must be 100%
2. In order to have a good diversification each security weight must be higher than 0.05% and lower than 7.00%.
3. The standard deviation of the portfolio must be equal or lower to Benchmark’s.
4. Returns of the portfolio must be positive.

We expected that the passive strategy works better than the active one. In fact, the measure that we obtain after the maximization were better than the ones of the other portfolios and the benchmark.



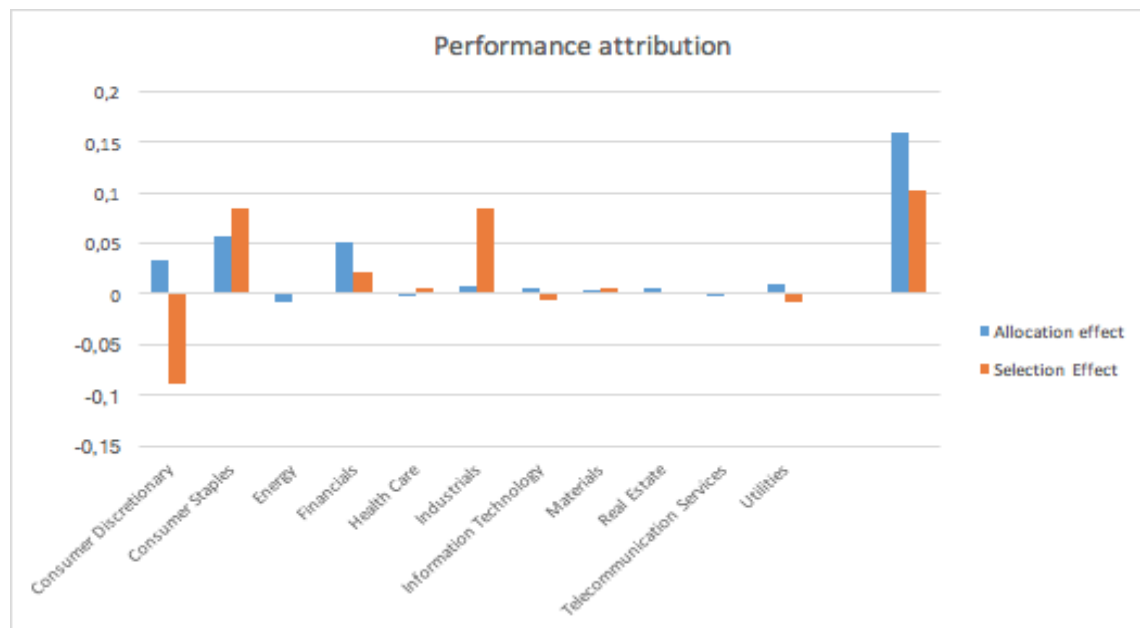
In the las week, our portfolio beat the market in terms of return. Furthermore, the excess of our performance was due to the allocation effect (2.04%) and to the selection effect (0.30%)<sup>8</sup>.

### Multi period analysis:

To complete our analysis we can do the attribution perform procedure in the overall period. After all, our portfolio has worked well. As we can see above, the excess returns of the portfolio against the benchmark for the whole period is equal to 25.91%. The 15.98% excess returns come from the allocation effects and 10.19% from the Selection effect.

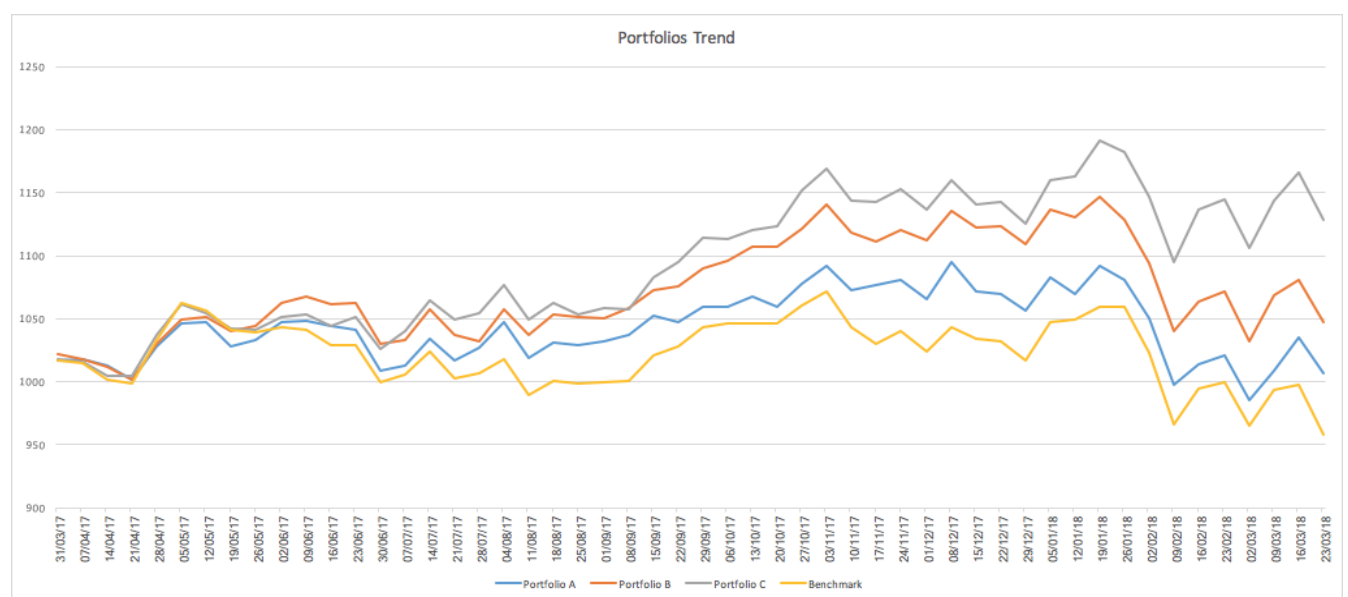
<sup>7</sup> Excel fail for more details

<sup>8</sup> Excel file for more details



### Performance measurements:

So far, we have studied each decision we have made separately. It can be interesting to compare all of them in order to understand, in a long-term view, which of the three portfolios was the best. We will split this section in two parts. As first thing, we supposed to have an initial wealth of 1000€ and we will see after one year which is the portfolio that would perform better. As we can see, the portfolio made by the passive strategy is the one which has the best performance.



Another method of evaluation is to compare our portfolios and benchmark thanks to the indexes of performance, as the Sharpe Ratio, the tracking error and so on. As we can appreciate from the table, the portfolio made by the passive strategy is the best. It is interesting to underline that in terms of volatility our passive portfolio is the worst, but if we take a look to the lower partial standard deviation (which is the standard deviation that measures only the variability of negative returns), once again it is the best.

### Performance statistics

	Portfolio A	Portfolio B	Portfolio C	Benchmark M
Average Return (Arithmetic)	1.489%	5.443%	12.983%	-3.42%
Average Return (Geometric)	0.679%	4.719%	12.817%	-4.241%
Standard Deviation	12.824%	12.973%	13.601%	13.598%
Lower Partial Standard Deviation	9.18%	9.38%	8.97%	10.82%
Sharpe Ratio	0.12	0.42	0.95	-0.25
M <sup>2</sup>	5.00%	9.12%	16.40%	
Alpha	0.00085	0.00164	0.00313	
Beta	0.86188	0.89952	0.96622	
Treynor	0.02	0.06	0.13	
Tracking Error	5.26%	4.36%	3.55%	
Information Ratio	0.0162	0.0375	0.0882	
R-SQR	83.525%	88.902%	93.311%	