Financial Market Analytics

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INTRODUCTION

In this project, our goal is to understand the main structural characteristic of the risk in the real investment portfolio. To achieve our target, we need to build real portfolios based on historical data of some assets found within a market index.

In order to do so, after obtaining the logarithmic returns and performing the weekly rolling regression on them, we selected weekly the best sixty stocks to be included within these portfolios based on high values of several parameters, like: R2 or 2. So, we will have a different portfolio each week.

Once obtained the portfolios we compare the performance they record, in order to understand which of them can overperform the overall market.

DATASET

As a first phase of the project, an analysis was carried out to better understand our historical data.

The index selected to conduct the project is the STOXX 600. It is a stock index composed by 600 of the major European market capitalizations.

This index has a fixed number of components and includes large capitalized companies in 17 European countries, covering about the 90% of the market capitalization of the European stock market.

The total number of stocks in the dataset is 1256; that's because the composition and the set of stocks included in the index changes continuously and there may be stocks that are included in it for a short period of time or in different time intervals.

Given the index, we consider a span of 5 years, from 2013 to the end of 2018

Dates	BP PLC	Vodafone Group PLC	Glaxo SmithKline PLC	HSBC Holdings PLC	TOTAL SA	Novartis AG	Royal Dutch Petroleum Co	Nestle SA	Nokia OYJ	Shell Transport & Trading Co Ltd/The	...	LPP SA	AAK AB	Valmet OYJ	Nemetschek SE
2013-01-01	5.22816	2.36829	16.43030	7.96162	39.010	47.59070	51.6	49.37173	2.926	7.63325	...	1116.66752	5.34031	NaN	8.300
2013-01-02	5.31584	2.41779	16.74373	8.20486	39.975	47.59070	51.6	49.37173	3.124	7.63325	...	1082.97281	5.37426	NaN	8.300
2013-01-03	5.44284	2.41650	16.80170	8.16364	39.855	48.55392	51.6	50.16687	3.200	7.63325	...	1102.01717	5.39679	NaN	8.545

PREPROCESSING AND DATA PREPARATION

Log returns have been calculated for of each title in the dataset and also for the index's returns.

The log return are computed by calculating the logarithm of a given price minus the logarithm of closing price of the previous day.

Dates	BP PLC	Vodafone Group PLC	Glaxo SmithKline PLC	HSBC Holdings PLC	TOTAL SA	Novartis AG	Royal Dutch Petroleum Co	Nestle SA	Nokia OYJ	Shell Transport & Trading Co Ltd/The	...	LPP SA	AAK AB	Valmet OYJ
2013-01-02	0.016632	0.020686	0.018897	0.030094	0.024436	0.000000	0.0	0.000000	0.065478	0.0	...	-0.030639	0.006337	NaN
2013-01-03	0.023610	-0.000534	0.003456	-0.005037	-0.003006	0.020038	0.0	0.015977	0.024037	0.0	...	0.017432	0.004183	NaN
2013-01-04	0.024210	0.014539	0.010961	0.005514	-0.000879	0.012050	0.0	0.005950	0.007472	0.0	...	0.019130	0.004024	NaN

ROLLING REGRESSION

In this part of the project, we explain the rolling regression and the parameters used to create the ranking of the assets.

After obtaining the log returns, a rolling model was built considering the first 180 days as the sample. On the 180th day we obtain the regression's parameters related to the previous 180 days, for each asset.

After this, the model, consider a range of seven days. So at the 187th day we derive the parameters of the regression model related to each asset calculated on the previous 180 days.

At this point, through regression of the residuals we obtain the selectors used to build the portfolios:

STOCK RANKING

The Single-Index-Model equation, proposed by Sharpe, can be used to derive the returns of a stock:

As can be seen, the returns are obtained through a linear regression, which includes several parameters:

- r_i: expected return on security

- α: is the intercept of the straight line or alpha coefficient

- β_i: the slope of the straight line or beta coefficient, it measures the volatility or systematic risk

- RM : the return of the market

- e_i: the error term

By considering the characteristics and values that these parameters take, it is possible to create different portfolios that allow us to understand how they affect the returns obtained. To produce the tilted portfolios, it is necessary to rank the values obtained from individual parameters or from a combination of them. The selectors that we choose to build portfolios are the following:

- Highest level of R^2: The R-squared measures how close the price of a stock, on a given date, is to the value assumed by the benchmark. R-squared takes values between 0 and 1, if a stock price assumes a value of R-squared closed to 0 than its correlations with the movements of the benchmark is low, instead if R-squared's value is 1 then the stock perfectly follows the trend of the index.
- Highest level of specific risk (σ_{ei}): the specific risk is the risk applies only to the considered stock. The values of the specific risk is related to events that affect the company or the sector of the company. If the specific risk takes high value that could affect the total risk of the stock, and when a stock presents high level of total risk than it would potentially produce high returns.
- Highest absolute return (r_i): the absolute return is the value of return that an asset achieves over a specific period of time. According to Momentum strategy if a stock produces high returns in the past month it can continue to produce a high level of returns through the time.
- Highest and lowest level of beta (β_i): beta shows the relationship between the volatility of the stock and the volatility of the benchmark. A stock can be a defensive stock or a aggressive one. If the value of the beta is less than 1 the stock is a defensive one and its volatility is lower than the volatility of the benchmark. This type of stock is useful to obtain stable returns during the period of crisis. Quite the opposite, if the asset shows a level of beta greater than 1 then it is a aggressive one and its volatility is higher than the volatility of the benchmark. For this reason, the aggressive stocks are used to gain higher results, accepting a higher level of risk.
- Highest level of alpha (α): alpha denotes if an asset produces excess of return compared to the return of the benchmark index. The overperformance is considered stable if alpha is significantly higher than 0, so we choose to analyse the portfolio that produces the highest level of alpha. Normally the alpha value has to be zero, according to CAPM, but in the real market usually the titles can present a deviation from zero, so the investors can exploit this temporary situation to speculate on the title.

- <u>Highest level of systematic risk ($\beta^2_i\ \sigma^2_M$)</u>: the systematic risk refers to the risk inherent to the entire market. An asset is affected by this risk due to the participation to a specific market.

After deciding which parameter to use, the titles are ranked. In order to create a portfolio that was partially diversified, we chose to introduce the first sixty stocks that had the best values with respect to the parameter. The first ranking is done by a linear regression over a 180-day window, while thereafter returns are calculated weekly by averaging returns of the titles including in the portfolio, starting from the 180th day moving from week to week. In this way, the stocks in the portfolios are updated every 7 days and look ahead bias is avoided. This bias is caused by the influence of information that would not have been known or available during the period being analyzed. For this reason, portfolios are updated weekly, avoiding the influence of past data.

Finally, the output obtained are three csv files for each parameter:

- portfolio: a dataset containing the stocks that make up the portfolio and their total returns week by week

- portfolio_history: a dataframe containing the ranking of the top 60 titles for the analyzed parameter, for each week

- portfolio_returns: an array containing the values of the weekly returns

PORTFOLIOS THAT OUTPERFORM THE INDEX

These portfolios show a trend at the beginning similar to the benchmark one but after 2016 they grow higher than the index. The first one is the portfolio that contains titles with a high level of alpha. This portfolio archives an annual return of +6.26% and a volatility of 19%. As mentioned earlier, a high alpha value implies that the stocks in the portfolio are those that overperform over the benchmark. The second portfolio includes titles that present a high level of absolute return. The portfolio gains an annual return of 6.5 % (which is the higher percentage produced by a portfolio), and achieves a volatility of 18,93%. The results meet expectations, because in this portfolio are considered the top 60 stocks with the highest value of weekly returns.
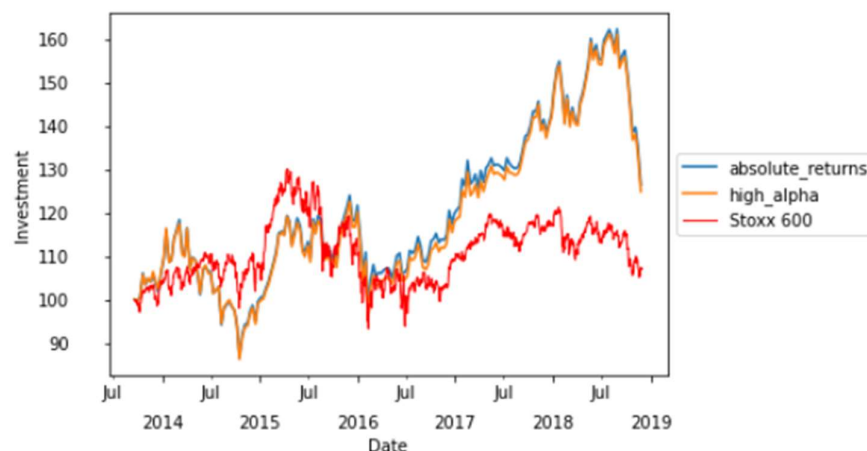
# PORTFOLIOS SIMILAR TO THE INDEX

During our period of analysis two portfolios have a similar trend of our index. The first one is the one that contained stocks with an high R^2; as expected it had an high goodness of fit to our index, so it didn't deviate much from it.

The second one was the portfolio with a low beta; by definition the stocks with low beta tend to have a low volatility and more stable returns, in fact in this case we have an annual volatility of 11.7 which is the lowest of all the calculated portfolios.
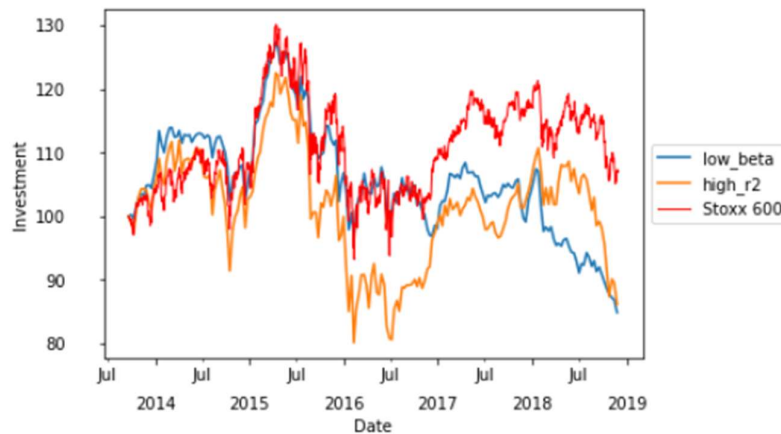
UNDERPERFORMING PORTFOLIOS

These portfolios show a trend that from 2015 reached a really low level of expected return compared to the benchmark index. The worst portfolio in terms of results is the one which includes the securities with the highest level of specific risk: as a matter of facts its annual return is -32,2 %. This can be acceptable because a stock with a high specific risk could produce higher returns than the others, but also worse if the company goes through a period of crisis. Another problem connected with a portfolio containing assets with a high level of specific risk is the absence of diversification. This could also happen for the portfolio that contains titles with an aggressive beta (in our case its annual return is equal to -15.92 %).
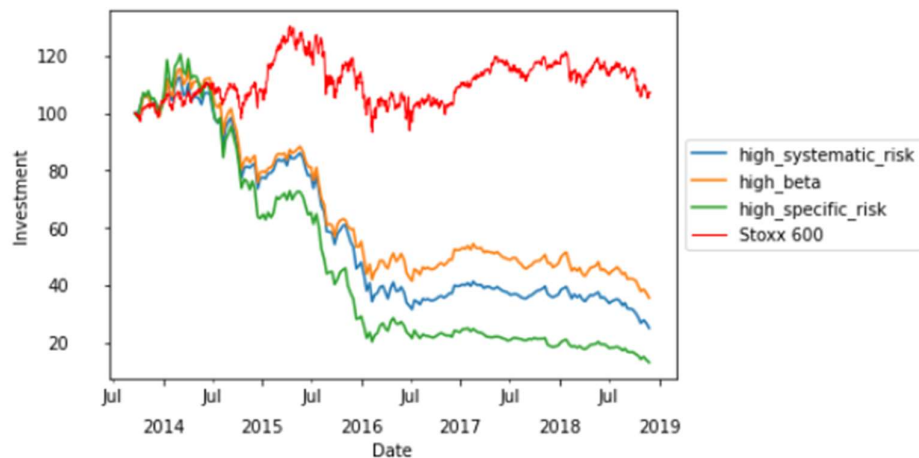
OVERALL RESULTS

Considering all the tilted portfolios, the one that guaranteed the better performance was the one that was composed by low beta stocks, which had an overall performance of 2.13; the one that performed the poorest instead was the high specific risk one, with a return-volatility ratio of – 1,04.

	Annual volatility	Annual returns	Performance
high_systematic_risk	24.95	-21.82	-0.87
high_beta	22.87	-15.92	-0.7
low_beta	11.68	-2.12	-0.18
absolute_returns	18.93	6.5	0.34
high_alpha	19.0	6.26	0.33
high_r2	17.92	-0.87	-0.05
high_specific_risk	30.91	-32.2	-1.04
Stoxx 600	5.55	0.57	0.1

CONCLUSIONS

Thanks to our study we discovered the various trends and behaviours of stocks with characteristics; this analysis tough could not be implemented in the real world as it doesn't consider taxes and commission fees, which decrease the eventual return. A strategy that could be implemented to this work is the momentum one, which takes into account the most recent returns of stocks while investing, because the titles that have performed well in the past tend to continue the trend in the future.