

20248 - Asset Management cl. 31

Assignment part I and II - Group 01

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Introduction

The ESG Multi-Asset Fund class E2 – EUR (from now on “the fund”), aims to provide a return on investment through a combination of capital appreciation and income on the Fund's assets and to invest in a manner consistent with environmental, social and governance (ESG) investment principles (art. 8).

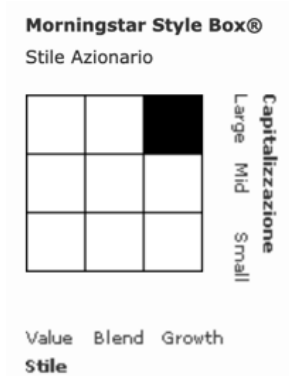
With net assets of €5’428.14 million (as of October 31, 2023), the fund invests in a range of asset classes, including those with low or unrated credit ratings. based on market conditions and guided by the investment advisor. For risk management, it refers to a composite benchmark, which is 50% MSCI World Index and 50% Bloomberg Global Aggregate Bond Index hedged to EUR.

The share class is denominated in euros, and the asset class is multi-asset. The fund does not have a performance fee but has an annual management fee of 1.20% and ongoing operational costs of 1.53%.

Moreover, as of October 31, 2023, the fund holds 761 securities in its portfolio and its risk-return characteristics, such as a three-year standard deviation of 8.69% and a three-year beta of .90, reflect an overall balanced approach to risk.

Currently, the Fund invests primarily in global equities (around 53.7% of AuM), followed by fixed income at 37.91%, alternative instruments at 9.54% and liquidity at -1.16%. Concerning equities, the image below illustrates the Morningstar Style Box, a classification tool for identifying the investment style of stock funds. The highlighted top-right quadrant signifies that Morningstar categorizes the fund as Large Cap Growth. In our conduction of the style analysis, it is then imperative to choose equity indices that mirror the characteristics of large-cap, growth-oriented companies, or markets. This ensures that the selected indices align with companies characterized by strong growth prospects, thereby minimizing the analysis error and accurately reflecting the fund's investment style.

For what concerns ESG factors, the fund is classified according to Article 8 of the SFDR regulation, which applies to financial products that promote environmental or social characteristics, or a combination of both, provided that the companies in which the investments are made adhere to good governance practices.



Part 1 – Style Analysis

The Sharpe style analysis of the Blackrock ESG Multi Asset Fund provided a comprehensive evaluation by examining its performance across different time periods and geographic sectors. This analysis was instrumental in determining the fund's position in terms of risk and return, revealing key insights into its investment strategy's effectiveness.

By comparing the fund's cumulative returns with specific benchmarks and the efficient frontier, the analysis offered a cohesive understanding of how the fund's strategy adapts and performs in varying market scenarios, highlighting its strategic and tactical asset allocation decisions and the goal to pursue ESG objectives.

Geographical Style Analysis

The primary objective of our style analysis, which concentrates on geographic regions, is to accurately assign weights to regional indices. Through a process of minimizing the variance error, these weights are intended to mirror the fund's performance over a specific period. We achieve this by selecting a limited number of factors based on in-sample data. In our methodology, we wanted to address two pivotal risks.

Firstly, to circumvent overfitting risk, we limited the number of variables used. Overfitting, characterized by modeling random noise rather than actual data trends, can significantly impair predictive accuracy. Therefore, using an excessive number of variables was deliberately avoided.

Secondly, considering the fund's concentration in a few asset classes, it was crucial to prevent selecting overly interrelated factors. This potential issue was managed by analyzing correlation matrices and excluding factors that showed more than 75% correlation with others, as a rule of thumb. The challenge thus laid in identifying distinct factors that substantially explained the fund's performance without being closely interlinked.

Simultaneously, we aimed at maximizing the portion of explained variance, R^2 , striving to ensure that our model was not only precise but also efficient in capturing the fund's performance dynamics.

In line with this approach, for what regards fixed income instruments, we selected the JPM Government Bond Global index and the Bloomberg Global Aggregate Corporate index. This choice was strategic and intended to avoid a mere comparison between European and American bonds. Instead, we wanted to offer a wider global perspective, encompassing a diverse range of bond markets, dividing by governative and corporate ones. This is also supported by the fact that, in the last months, corporate bonds attracted a larger number of yield-seeking investors than compared to 2020 and 2021.

The average maturities of our selected indices, 9.22 years for the JPM Government Bond Global Index and 8.31 years for the Bloomberg Global Aggregate Corporate Index, were carefully weighed against the fund's investment horizons, which are indeed medium-long. This alignment with the fund's overall target, strikes a balance between long-term growth potential and liquidity needs.

Regarding liquidity, both in geographical and sectoral terms, the US Treasury Short Bond 0-1 year was inserted as a money market instrument. This correctly aligns to the fund's goal to hold liquidity for redemptions and strategic allocations, as evidenced by its net liquidity exposure of 1.54%. Furthermore, it is always good practice to insert a money market index in style analyses.

Selection of equity

The fund's equity index selection was conducted aligning to the fund's objective of maximizing total return through diversified positions. In this regard, the MSCI US was preferred over the S&P 500 due to its broader market representation, encompassing both large and small enterprises. This choice not only aligns to the fund's aim but also to our constraint of factors' parsimony.

With the goal to ensure a comprehensive coverage of worldwide investment opportunities, we selected indices like MSCI Pacific excluded Japan (i.e. Australia, Hong Kong, Singapore, New Zealand), MSCI Japan and MSCI Europe excluded UK. Let's discover deeper why we preferred these indexes.

Index	Description	Composition (as of 31 Oct 2023)
MXEUG Index	With 245 constituents, covering 85% of the free float-adjusted market capitalization across European Developed Markets excl. the UK	France 24.2%, Switzerland 19.79%, Germany 16.59%, Netherlands 8.81%, Denmark 6.84%, Other 23.77%
MSCI Japan	With 236 constituents, covering approximately 85% of the free float-adjusted market capitalization in Japan.	Industrials 22.14%, Consumer Discretionary 19.26%, Information Technology 13.54%, Financials 13.21%, Health Care 8.28%, Communication Services 7.33%
MXUS Index	With 626 constituents, the index covering 85% of the free float-adjusted market capitalization in the US.	Information Technology 28.36%, Health Care 12.98%, Financials 12.42%, Consumer Discretionary 10.54%, Industrials 8.75%, Communication Services 8.69%
MSCI Pacific Ex Japan	With 119 constituents, covering 85% of the free float-adjusted market capitalization in each country.	Australia 64.27%, Hong Kong 21.03%, Singapore 13.01%, New Zealand 1.69%

The decision to include MSCI Pacific excl. Japan is supported by multiple factors: e.g. the different Japanese social and political landscape with respect to its Pacific peers, the unique reaction to the global pandemic shock, and the low correlation shown with MSCI Japan. This choice then allowed us to include both indexes without any collinearity issues.

We opted for an MSCI GB exclusion due to excessive correlation with both MSCI Pacific ex Japan and MSCI US. This high correlation is likely attributable to overlapping market sectors and multinational corporations operating in similar industries across these regions, so, to ensure a lower correlation between factors, we decided to remove this index from our set. The correlation table provided below shows the correlation factors. In addition, the fund does not invest heavily in UK so the exclusion of this index seemed a reasonable choice, indeed its inclusion systematically led to a reduction in the portion of variance explained by the model.

	MXEUG Index	MSCI GB	MXUS Index	MSCI Pacific Ex Japan	US Treasury Short Bond	JPM Government Bond Global	Bloomberg Global Aggr. Corporate
MXEUG Index	1	8.74%	2.67%	3.49%	5.75%	2.57%	12.36%
MSCI GB	8.74%	1	75.05%	81.85%	-21.38%	-3.83%	35.15%
MXUS Index	2.67%	75.05%	1	74.46%	-13.00%	19.80%	53.56%
MSCI Pacific Ex Japan	3.49%	81.85%	74.46%	1	-25.99%	9.37%	49.36%
US Treasury Short Bond 0-3	5.75%	-21.38%	-13.00%	-25.99%	1	-26.81%	24.67%
JPM Government Bond Global	2.57%	-3.83%	19.80%	9.37%	-26.81%	1	57.78%
Bloomberg Global Aggr. Corporate	12.36%	35.15%	53.56%	49.36%	24.67%	57.78%	1

Finally, the decision not to include MSCI North America was driven by its high correlation with MSCI US. Consequently, the sole inclusion of Canadian instruments would have offered limited to no value.

Findings

The methodology used to calculate the weights of various factors in the style analysis involves an optimization process that aims at minimizing error variance (where errors are calculated as the differences between the returns of the style portfolio and the returns of the fund) while adhering to a long-only constraint.

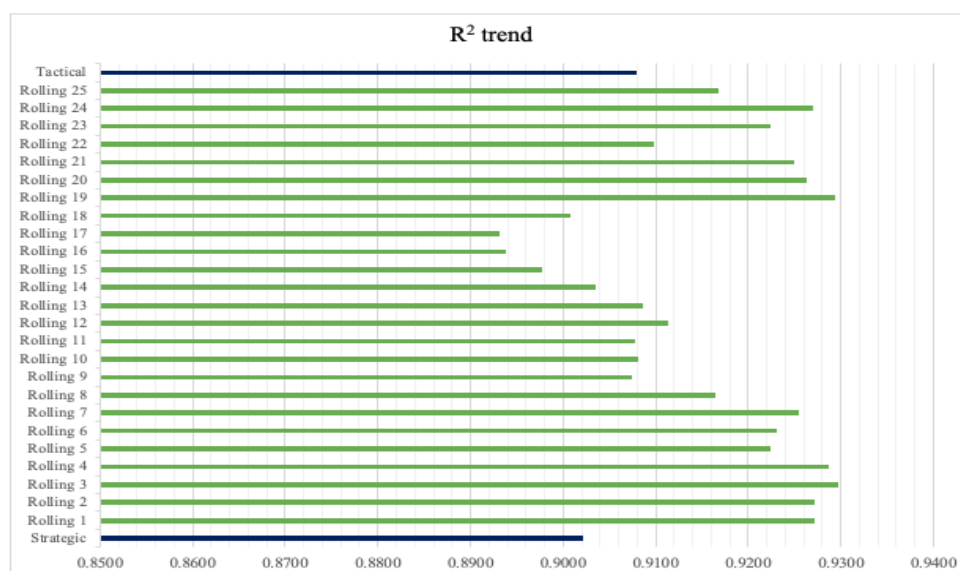
The variance is calculated over a 60-month period (from October 2018 to September 2023) for the strategic analysis, the most recent 24 months for the tactical, and on 25 spans of 36 months each for the rolling. This approach has enabled us to obtain an optimized data table for each type of analysis.

The following are some interesting insights:

The R^2 values for the Strategic-Tactical and Rolling Style Analyses are significantly high (90.22%, 91.56%, 90.79%), demonstrating that the replication portfolio was fairly able to explain a large portion of the fund's returns' variance. We can state that, for the strategic portfolio, the remaining 9.78% is the portion of variance that may be explained by factors other than the ones selected (e.g. manager's skills, specific security picking or other factors not directly addressed by the style analysis).

	MXEUG Index	MSCI Japan	MXUS Index	Pacific Ex Japan	US Treasury Short Bond 0-1y	JPM Government Bond Global	Bloomberg Global Aggr. Corporate	R^2
Strategic	1.287%	2.800%	38.952%	7.606%	7.843%	41.512%	0.000%	0.9022
Rolling 1	2.669%	6.507%	43.407%	1.051%	0.086%	46.281%	0.000%	0.9272
Rolling 2	2.855%	6.966%	42.700%	1.059%	0.086%	46.335%	0.000%	0.9272
Rolling 3	4.081%	6.587%	42.465%	1.191%	0.087%	45.589%	0.000%	0.9298
Rolling 4	4.156%	6.290%	41.964%	1.819%	0.848%	44.923%	0.000%	0.9287
Rolling 5	2.991%	7.043%	43.503%	0.951%	0.000%	45.512%	0.000%	0.9224
Rolling 6	1.596%	7.637%	42.805%	1.306%	0.000%	46.657%	0.000%	0.9231
Rolling 7	0.000%	6.811%	43.425%	2.161%	1.406%	46.197%	0.000%	0.9255
Rolling 8	2.280%	4.042%	41.307%	4.686%	7.197%	40.488%	0.000%	0.9164
Rolling 9	1.402%	2.844%	41.377%	5.183%	8.669%	40.525%	0.000%	0.9074
Rolling 10	1.310%	3.047%	41.732%	5.178%	7.010%	41.722%	0.000%	0.9081
Rolling 11	1.551%	2.948%	40.792%	5.808%	6.720%	42.181%	0.000%	0.9077
Rolling 12	1.191%	3.244%	40.912%	4.965%	6.308%	43.379%	0.000%	0.9113
Rolling 13	1.588%	4.158%	40.262%	5.421%	3.943%	44.629%	0.000%	0.9086
Rolling 14	2.362%	4.936%	36.920%	7.565%	2.646%	45.571%	0.000%	0.9035
Rolling 15	0.901%	3.612%	40.305%	5.209%	7.178%	42.795%	0.000%	0.8978
Rolling 16	1.094%	4.420%	38.087%	6.158%	6.226%	44.015%	0.000%	0.8938
Rolling 17	1.237%	4.386%	38.242%	5.989%	6.869%	43.277%	0.000%	0.8931
Rolling 18	0.701%	1.836%	37.603%	6.481%	6.961%	46.419%	0.000%	0.9008
Rolling 19	2.177%	0.000%	38.343%	13.278%	8.356%	34.275%	3.571%	0.9293
Rolling 20	2.113%	0.000%	37.663%	12.732%	8.649%	38.842%	0.000%	0.9263
Rolling 21	2.423%	0.000%	37.086%	13.216%	7.684%	39.591%	0.000%	0.9249
Rolling 22	1.044%	0.000%	34.916%	13.907%	7.430%	37.494%	5.210%	0.9098
Rolling 23	0.343%	0.127%	33.664%	16.192%	10.795%	28.089%	10.791%	0.9224
Rolling 24	0.000%	0.000%	32.457%	15.907%	9.732%	26.810%	15.094%	0.9271
Rolling 25	0.751%	0.000%	33.994%	15.248%	8.627%	31.672%	9.708%	0.9167
Tactical	0.576%	0.000%	33.279%	14.043%	10.568%	24.266%	17.268%	0.9079

The significant volatility of R^2 values, however never below 89.4%, may be attributed to various



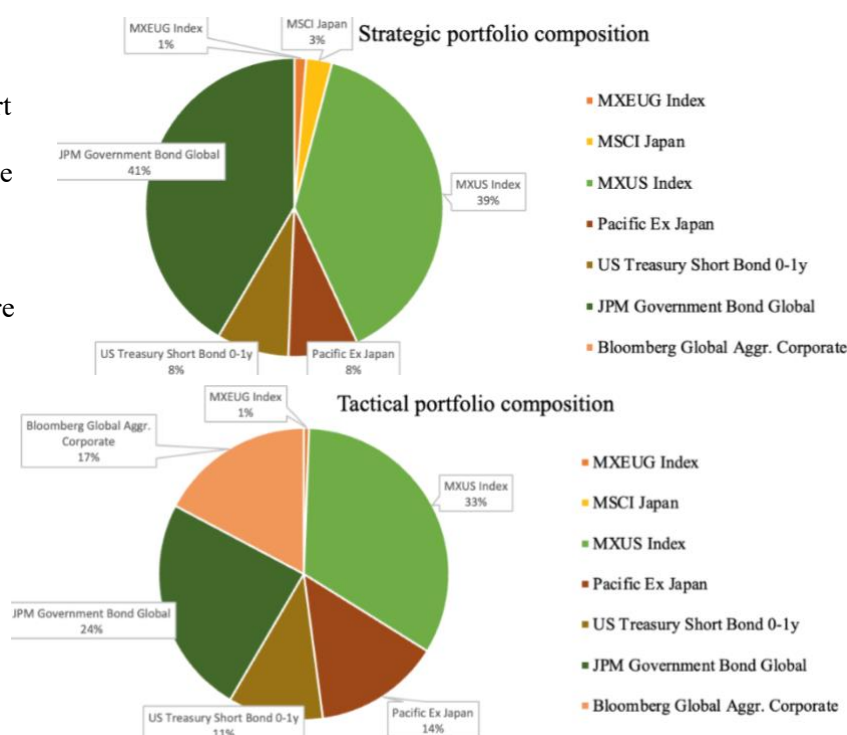
reasons: e.g., changes in the fund's investment strategy, evolving market dynamics and the varying relevance of chosen factors over different periods (e.g., in 17th rolling period). Thus, while the model may be robust in certain periods, its ability to explain the fund's performance can fluctuate potentially due to these evolving conditions.

The most meaningful difference between the strategic and tactical portfolio is in the increased value of the factor Global Aggregate Corporate Bond, that rises from zero to 17.3%. However, it is notable that the total weight of the fixed income component remained almost unchanged. This shift from government bonds to corporate bonds, starting from the 23rd rolling period (July 2023), is likely due to portfolio diversification, inflation outlooks and increased yield for corporate obligations.

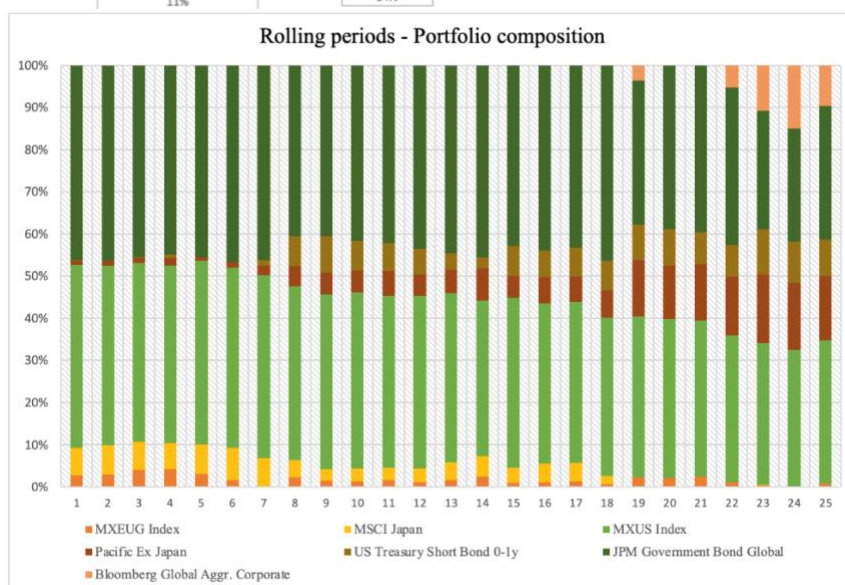
The presence of MSCI US oscillating between 33.2% and 43.5% incisively indicates a strong relevance placed on American stocks, consistent with the fund's focus on growth and large-cap stocks. As a matter of fact, US stocks on average have outperformed their Japanese and European counterparts since October 2018 and mostly, after pandemic.

The behavior of European and Japanese equities is interesting, decreasing from a total of 4.1% in the strategic portfolio to only .576% in the tactical one. The relatively minor role of European and Japanese stocks (1.29% strategic, .57% tactical, peaking at 4.2% in rolling) is likely due to a strategic shift away from these market in favor of fixed income instruments or US stocks, driven by sustained inflation and higher policy rates.

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Finally, US Treasury ultra-0-1y bonds maintained the weight, indicating manager's commitment to maintain a fair of liquidity.



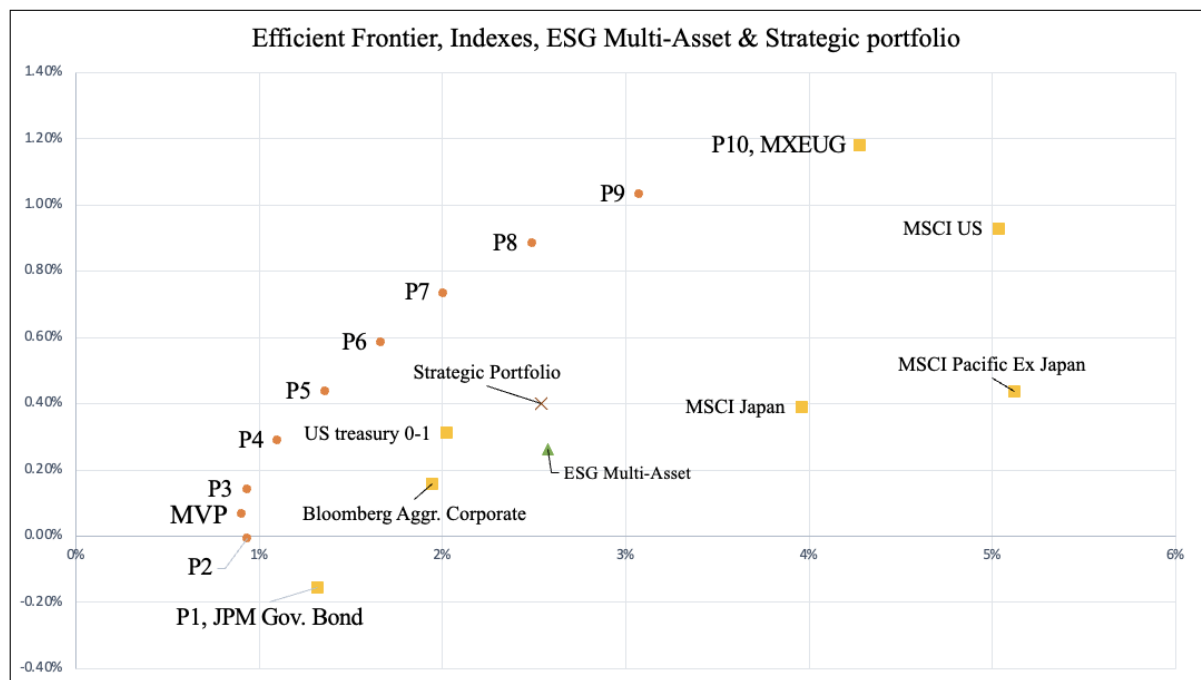
Efficient Frontier

The Efficient Frontier chart is given plotting the portfolio expected return on the y-axis and the portfolio standard deviation on the x-axis. In the expected return/standard deviation plan the Blackrock ESG Multi-Asset fund has positioned with an average return of .26% and a standard deviation of 2.57%, with values close to the ones of the strategic portfolio ($\sigma = .39\%$; $E(R) = 2.54\%$).

The Minimum Variance Portfolio shows an expected return of .069% and a standard deviation around .906%, which is aligned with other portfolios' combinations. Talking of indexes, while the MSCI Europe excl. GB lies on the efficient frontier ($\sigma = 4.28\%$; $E(R) = 1.18\%$), all others lie below it, with MSCI Japan and MSCI Pacific ex Japan sharing almost the same $E(R)$ at $\sim .4\%$ (however, MSCI Pacific ex Japan shows a higher profile of σ at 5.12%). MSCI US and MSCI EU, on the other side, share the highest σ and $E(R)$.

As predictable the fixed incomes show the lowest volatility and expected returns, with the JPM Government bond Aggr. that in the period considered plunged to negative returns area ($-.156\%$). In conclusion, the money market index is likely the factor that, stand alone, mostly behaved as the fund, with $\sigma = 2.02\%$ and $E(R) = .3\%$.

In the following comprehensive chart, can be observed the $\sigma/E(R)$ combinations for the MVP, the equity factors, the fixed incomes, the strategic portfolio and finally the fund.






Sectors Style analysis

Selection of equity indexes

The Blackrock ESG Multi Asset Fund invests in many different sectors and the main guidance in the selection of sector indexes has been to cover most of the areas in which the fund invests, also avoiding selecting more factors that are strongly correlated to each other in order to avoid overfitting.

The 5 top sectors in portfolio as of Oct. 31, 2023, are illustrated below. Since the index choice follows a goal to explain the most error variance possible, the equity indexes selected are MSCI IT, MSCI World Consumer Staples, MSCI World Health Care, MSCI World Financials.

The MSCI Consumer Staples has been preferred to the similar MSCI Consumer Discretionary mostly for two reasons. The first is that the fund invests more of its assets in Consumer Cyclical-related companies, than in discretionary-related ones. The second is that MSCI Consumer Cyclical shows a smaller beta, thus is less affected by economic downturns and better help in explaining the fund behavior over the period considered.

Top 5 Sectors	%
 Technology	23.16
 Industrials	19.98
 Financial Services	12.56
 Healthcare	12.00
 Consumer Cyclical	7.64

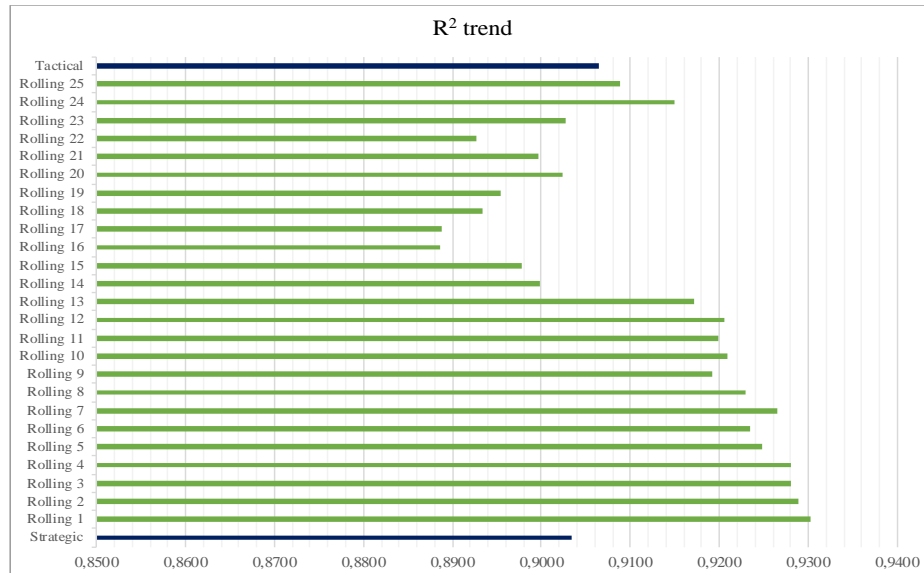
Here, the aim in choosing the indexes is the same as the geographical style analysis: minimizing error variance, addressing overfitting, and avoiding selecting overly correlated factors. As a matter of fact, regarding the issue of collinearity among factors, a correlation matrix reported for simplicity in the datasheets, shows the low correlations among all factors.

Findings

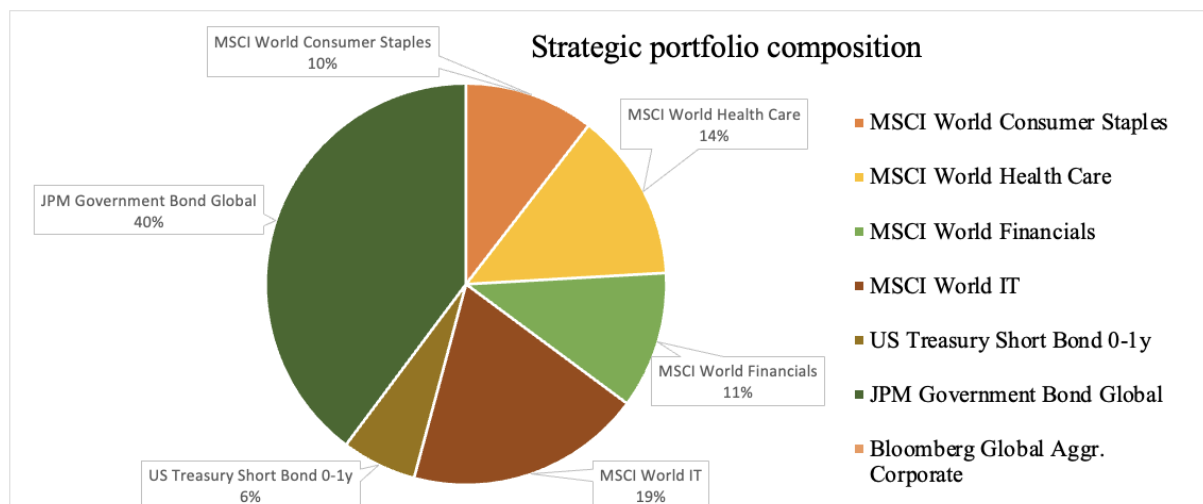
The weights of the style analysis by sectors have been computed with the same methodology explained for the style analysis by geography, leading to the following results:

	MSCI World Consumer Staples	MSCI World Health Care	MSCI World Financials	MSCI World IT	US Treasury Short Bond 0-3	JPM Government Aggr. Corporate	Bloomberg Global Aggr. Corporate	R ²
Strategic	10.480%	13.624%	11.032%	19.044%	6.048%	39.772%	0.000%	0.9034
Rolling 1	2.248%	15.607%	12.407%	22.372%	5.365%	42.001%	0.000%	0.9303
Rolling 2	3.098%	14.990%	12.339%	21.769%	6.063%	41.742%	0.000%	0.9288
Rolling 3	2.968%	14.867%	11.951%	22.184%	6.719%	41.312%	0.000%	0.9280
Rolling 4	3.300%	15.179%	11.886%	22.144%	6.817%	40.674%	0.000%	0.9281
Rolling 5	2.184%	16.544%	10.844%	23.456%	5.748%	41.225%	0.000%	0.9249
Rolling 6	2.276%	17.240%	10.967%	22.547%	5.813%	41.157%	0.000%	0.9234
Rolling 7	4.901%	16.659%	9.455%	23.514%	7.213%	38.258%	0.000%	0.9265
Rolling 8	8.022%	16.816%	8.666%	22.186%	9.717%	34.593%	0.000%	0.9229
Rolling 9	10.583%	15.221%	7.744%	22.979%	9.435%	34.038%	0.000%	0.9191
Rolling 10	10.814%	15.078%	7.918%	23.452%	7.054%	35.683%	0.000%	0.9209
Rolling 11	10.267%	16.011%	8.223%	22.400%	6.803%	36.295%	0.000%	0.9199
Rolling 12	12.626%	13.776%	7.806%	22.107%	6.886%	36.799%	0.000%	0.9205
Rolling 13	14.943%	11.729%	7.332%	22.981%	4.703%	38.312%	0.000%	0.9171
Rolling 14	14.240%	9.303%	6.481%	23.953%	6.020%	37.738%	2.265%	0.8999
Rolling 15	12.625%	9.853%	6.502%	25.200%	9.509%	35.986%	0.324%	0.8977
Rolling 16	11.926%	11.312%	6.785%	22.589%	6.734%	37.545%	3.109%	0.8887
Rolling 17	12.053%	11.120%	6.644%	22.672%	6.635%	37.384%	3.491%	0.8888
Rolling 18	9.599%	11.828%	5.933%	21.708%	4.282%	38.353%	8.297%	0.8934
Rolling 19	7.796%	12.505%	11.068%	17.957%	1.559%	24.610%	24.505%	0.8955
Rolling 20	10.032%	8.517%	11.845%	18.679%	6.389%	38.662%	5.876%	0.9024
Rolling 21	11.651%	9.414%	12.178%	16.792%	3.609%	40.602%	5.754%	0.8997
Rolling 22	11.751%	9.472%	11.671%	16.487%	2.731%	37.503%	10.385%	0.8926
Rolling 23	9.883%	10.721%	12.651%	16.406%	5.338%	29.984%	15.017%	0.9027
Rolling 24	9.180%	12.663%	12.572%	14.077%	2.493%	26.016%	22.999%	0.9149
Rolling 25	10.948%	11.582%	11.876%	14.734%	1.715%	29.946%	19.198%	0.9088
Tactical	18.981%	8.600%	6.956%	15.193%	1.453%	19.994%	28.823%	0.9064

The R^2 chart shows that the sector factors can explain most of the style of the fund, being comprised between 88.87% and 93.03%. The variability in the R^2 may stem from multiple factors. For example, it might be linked to shifts in the fund's investment strategy. This is particularly noticeable in the decrease of R^2 during the 16th rolling period, coinciding with the fund's transition from government to corporate bonds. Additionally, fluctuations in market conditions can influence the model's capacity to explain these changes.



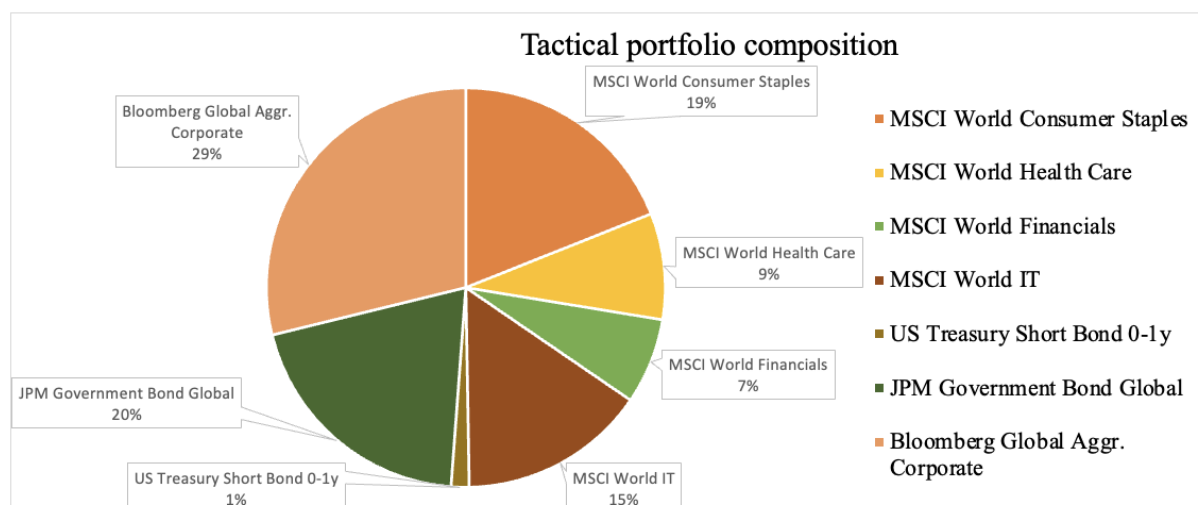
For what concerns the R^2 we can then affirm that the remaining portion of variance may be attributed to factors other than the ones selected. This could encompass elements such as the manager's expertise and their specific choices in security selection, or other factors that the style analysis does not cover.



By looking at the composition of the strategic portfolio we can notice that the most important weights are assigned to JPM Government Bond Global (39.78%) and MSCI World IT (19%), while the indexes characterized by lowest ones are Bloomberg Global Aggregate Corporate and the money market's US Treasury Short Bond 0-1y months.

The portfolio's allocation strategy appears to be tailored to the current macroeconomic landscape. The JPM Government Bond Global holds the most significant weight, which may be attributed to its reduced sensitivity to economic cycles through government bonds, thus potentially lowering risks in a period of economic uncertainty. This approach might explain why the Bloomberg Global Aggregate Corporate is not featured in the strategy portfolio.

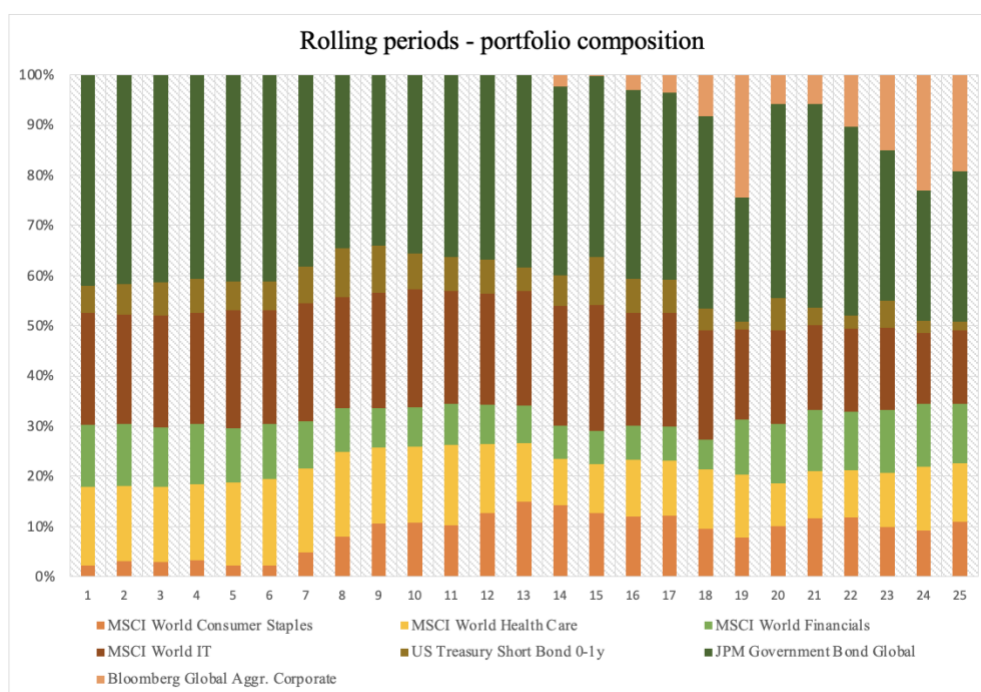
Meanwhile, the significant weight of the MSCI World IT could be due to its strong performance in the previous years and the high returns expected from technological advancements in the coming years. Additionally, the IT sector's keen focus on ESG factors, which aligns with the fund's view, may be a contributing reason for its prominence in all computed style analysis portfolios.



For what regards the tactical portfolio, the factors characterized by the highest weights are the Bloomberg Global Aggregate Corporate (28.82%) and, again, the JPM Government Bond Global (19.99%). Instead, the lowest weight is on the money market's US Treasury Short Bond 0-1y.

The key distinction between the strategic and tactical asset allocation of the portfolio is highlighted by the significant rise in the weight of the factor representing the Aggregate Global Corporate bond yield, which escalated from zero to 28.82%. Initiated in the 14th rolling period, this transition from government to corporate bonds could indicate a strategic shift in the fund's approach. During a period characterized by high yields and increased risks, the fund may have aimed to diversify its holdings by incorporating corporate bonds as well.

Considering the potential reasons for strategic shifts in fund allocation, the change in the weight of U.S. Treasury Short Bonds 0-1y in the portfolio stands out. Originally, these bonds comprised 6.04% of the strategic portfolio but were reduced to just 1.45% in the tactical allocation. This reduced emphasis on ultra-short bonds might be indicative of a strategic diversification towards longer-term investments with superior yield outlooks.

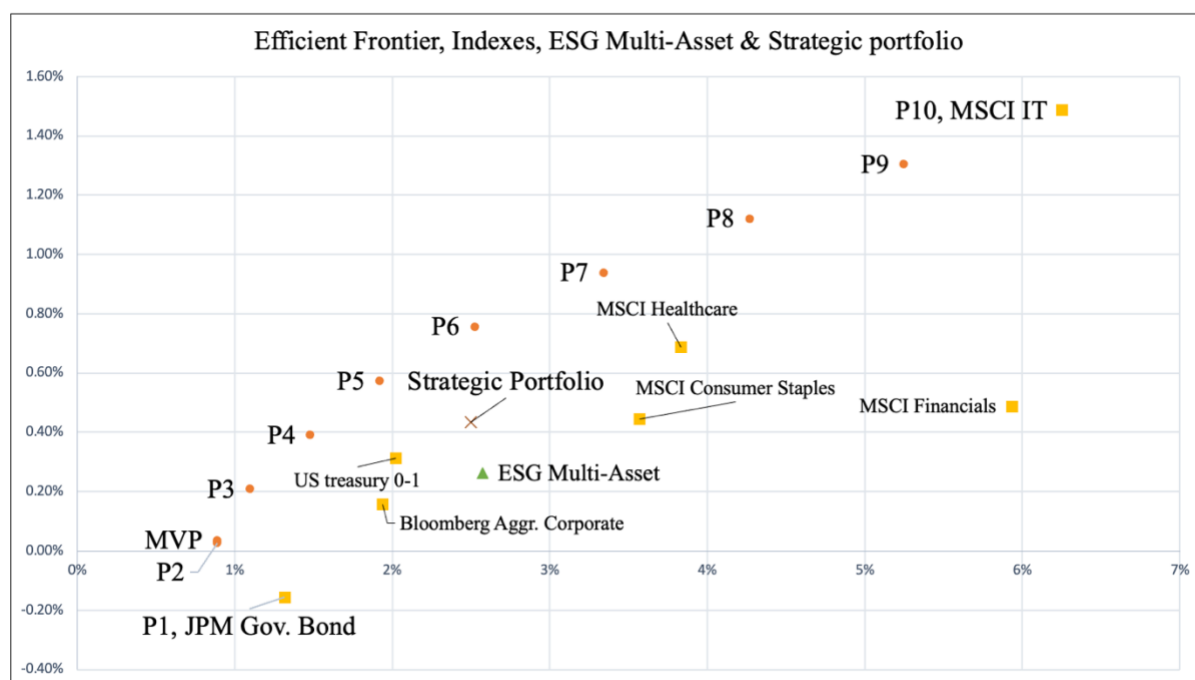


The rolling style analysis by sectors of the fund is computed using 25 period of 36 months each. Above it's possible to observe the results of the portfolio composition for each rolling period.

The reader can notice that the total weight assigned to the fixed income component (dark green and dark rose) are quite stable, with an average of 47.32%, varying from 42.74% (rolling 10th) to 51.51% (rolling 24th). As mentioned, there is only a change in share between government and corporate bonds that could be justified by desire of increasing in diversification, see from the 14th onwards, and in particular the 19th rolling, for example.

Efficient Frontier

Our group has drawn the efficient frontier by calculating 10 equally spaced portfolios from the minimum index return (JPM Government Bond Global, P1) to the maximum index return (MSCI World IT, P10).



Considering the expected risk/return plan, the Blackrock ESG Multi Asset Fund and the sector strategic portfolio are located very closely. However, a small preference could be given to the latter because the monthly volatility of the fund is 2.57% while that of the strategic portfolio is 2.5%. As well, taking into account the expected monthly return, it is equal to .26% for the former and .43% for the latter.

The Minimum Variance Portfolio shows an expected return of .04% and a standard deviation around .89%, which are both slightly lower than the other portfolio's combinations. Analyzing the indexes, the MSCI World IT lies on the efficient frontier ($\sigma = 6.25\%$; $E(R) = 1.49\%$) as the allocation with highest standard deviation and highest expected return. All other indexes, instead, stand below the efficient frontier, in particular MSCI Financials shows high variance without ensuring higher expected returns compared to same/lower risky indexes.

As predictable, and shown also by the geographic style analysis, the fixed income securities have the lowest volatility and expected returns, with the JPM Government bond that in the period considered plunged to negative returns area (-.156%).

In conclusion, the money market index, and the Bloomberg Aggr. Corporate are the factor that, stand alone, mostly behaved as the fund, with $\sigma = 2.02\%$ and $E(R) = .3\%$ and $\sigma = 1.94\%$ and $E(R) = .157\%$, respectively.

Part 2 – Risk Measurement

The objective of the second part of the assignment is to describe absolute and relative risk measures for the “Blackrock ESG Multi asset fund class E2 – EUR” fund, meaning, analysing the behaviour of the daily VaR and ReVaR indicators for the 2-year period ranging from 01/10/2021 to 30/09/2023, at both 95% and 99% level.

The output will allow us to assess the performance of the portfolio, its risk and the fluctuations of the measures during the period under scrutiny.

In order to do so, we first calculated the daily returns of the Benchmark. The Benchmark is built as follows:

- 50% MSCI World.
- 50% Bloomberg Global Aggregate Bond Index hedged to EUR.

After computing benchmark returns, we calculated absolute risk (VaR) and relative risk (ReVaR) measures for both the fund and the benchmark at 95% and 99% confidence level.

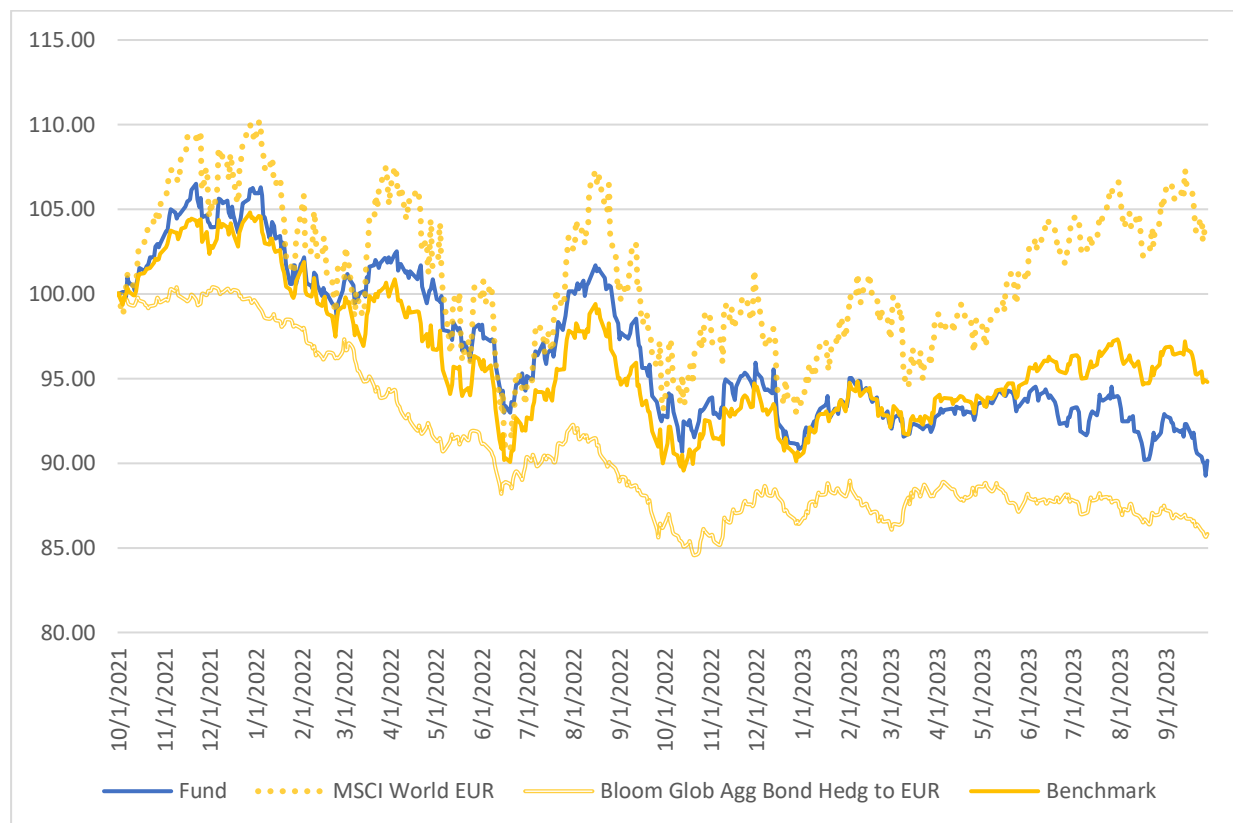


Figure 1 - Fund vs Benchmark (and its components) returns

The period taken in consideration comprehends the last months of 2021. Global stock markets continued to rally, with various indices hitting all-time highs. As inflation started to get higher during the last months of the year and during 2022, Central Banks had to raise interest rates. World stocks went down ~20% in their worst year since the financial crisis; bond markets followed as they were pressured by the interest rate hikes. The war in Ukraine was another driver of these effects.

In 2023, stocks experienced a positive performance, bouncing back primarily due to a quicker-than-anticipated decline in inflation. This was further supported by analysts' projections of central banks implementing interest rate cuts earlier in 2024, coupled with robust economic growth in the United States. A surge in enthusiasm for AI contributed to a surge in tech stocks, pushing the entire US stock market. Meanwhile, the bond market maintained lower levels, given that interest rates remained elevated

(October 2023).

We will analyse how the fund's absolute and relative risk measures reacted to these events later.

Value at Risk – Absolute Risk Measurement

The primary goal of VaR is to assess ex-ante the maximum potential loss a portfolio might generate within a specified time horizon and confidence level, given its current composition and current market conditions. Various methods can be employed to calculate VaR, and for this analysis, we explored:

- Parametric with 100-days Historical Volatility,
- Parametric with Exponentially Weighted Moving Average Volatility on 100 days,
- Historical Simulation with different observation periods (100 days and 500 days),
- Filtered Historical Simulation (100 days) with EWMA Volatility Estimates calculated for the parametric model.

Parametric with 100-days Historical Volatility

Parametric VaR (PAR in the spreadsheet file) is calculated considering the simple historical volatility of the previous 100 days. We assume conditional normality and zero-mean for this normal distribution. Results suffer from Echo-Effect, since all the volatility data from the sample is equally weighted.

Parametric with Exponentially Weighted Moving Average Volatility (100 days)

Parametric VaR with EWMA Volatility (EWVaR in the spreadsheet file) is calculated considering the exponentially weighted average of the squared returns, which solves the Echo-Effect through the decay factor (set at .94). The decay factor gives more importance to more recent data in comparison to older data that is weighted less. With a reduced Echo-Effect, EWVaR reacts quicker to volatility episodes.

Historical Simulation (100 days and 500 days)

Simple Historical Simulation VaR (HSVaR in the spreadsheet file) overcomes the assumption of normal distribution, while embracing the non-normality of market factor returns, but has the main problem of being unconditional with respect to current volatility, with possible Echo-Effect. HSVaR considers the tail of the distribution at a certain given level of confidence. The 500-days sample VaR is less reactive than the 100-days one.

Filtered Historical Simulation (100 days) with EWMA Volatility Estimates

In this model (FHSVAr in the spreadsheet file) daily returns are standardized dividing them by a EWMA volatility estimate. This generates a standardized empirical distribution. Given the desired percentile level, the simulation is cut, and the result is multiplied by the daily volatility estimate. This model is very reactive to volatility shocks, and because of that is the most prudent one.

VaR Dynamics

During the period in consideration there has not been any particular shock. After the 2021 stock market rally, 2022 has experienced one of its worst years, with a bear stock market and with bonds selling off as inflation and, as a consequence, interest rates hiked. Nevertheless, we haven't experienced any volatility peaks as harsh as the Covid-19 one.

2023 witnessed stocks rebound, with a renewed bull market, while bonds are staying at lower levels. The aggregate consequence is that we did not experience any strong movements in absolute risk measurements, but we can still comment on some characteristics of these measures, and on how they reacted on some minor increases in volatility during this period.

Parametric VaR at a 95% (99%) confidence level has stayed in the [-.60%; -1.20%] range ([-.80%; -1.60] range) for the whole timeframe, while Parametric EWMA VaR has been more responsive to peaks in volatility. This can be seen in Figure 2 and Figure 3. That is explained by the fact that EWMA VaR assigns more weight to latest data, giving more clear representation of the risk in a timelier manner. The lowest value it reached was -1.36%.

EWMA VaR is also quicker to get back to higher levels, by construction, for the same reasons. Parametric VaR performs well during periods characterized by minimal fluctuations in returns around an average value. However, in times of crisis, it exhibits a gradual adjustment to shocks. We can see this effect clearly during Q1 2022, Q3 2022, October 2022 and December 2022. These were the moments in which the bear trends were stronger.

As 2023 began, the fund returns got flattish, and we can see in Figure 1 that the Fund lateralized for the first part of the year, and in the last part of the year it started underperforming the Benchmark. As a consequence, VaR measures became way better at first, until Q3 2023, when they started to get a bit worse, but still on very “safe levels”. Parametric VaR with simple historical volatility could underestimate the fund risk, or at least, its response is not the timeliest.

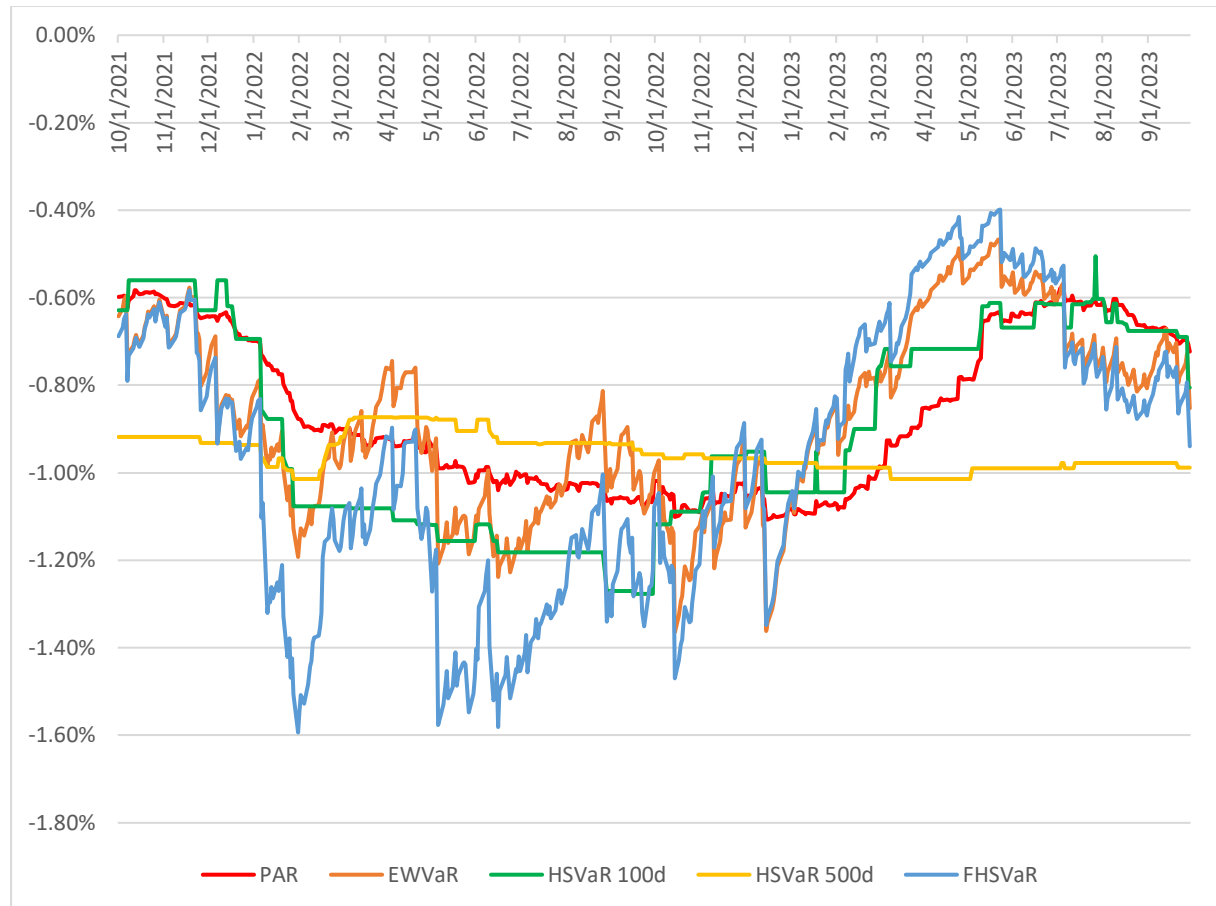


Figure 2 - Comparison of different VaR measures at 95% confidence level

Historical Simulation VaR tends to show more stable values, as it considers the tail of the distribution at the 95% (or 99%) level of confidence. Fluctuations appear when the fund suffers from greater losses that end up in that part of the distribution. Historical Simulation calculated on 100 days incorporates fewer negative returns, therefore it is more responsive to new losses, while Historical Simulation on 500 days is less reactive especially as, on the 01/10/2021, it still incorporates returns from the Covid-19 market crash. Because of that, we can see that the HS VaR measurement (500 days) was lower than the other VaR measures (-.92% at the 95% confidence level, -1.92% at the 99% confidence level) in the first period.

Negative returns stay in the tail of the distribution for longer in the 500 days HS VaR, which makes this kind of VaR more stable but also more significantly impacted by losses. As soon as these losses are surpassed in the model, the measure reacts by positioning itself on higher values. This explains why 500 days HS VaR sometimes moves in the opposite direction of other VaR measures. One of the main cons of HS VaR is its unconditionality with respect to current volatility. 100 days HS VaR behaves more

similarly to the other VaR measures, since the time frame it considers is shorter, it contains less distant losses and therefore is able to incorporate newer losses more easily.

The last VaR measure we analysed is Filtered Historical Simulation VaR. In this case daily returns are standardized dividing them by a EWMA volatility estimate. This generates a standardized empirical distribution. Given the desired percentile level, the simulation is cut, and the result is multiplied by the daily volatility estimate. This model appears to be the most reactive ones to losses, as it incorporates higher weights to more recent data and empirical standardized return distributions. Market trends and the riskiness of the fund are better contemplated with this last model. We can see that that FHS VaR is more responsive to peaks in volatility and is also faster than Parametric VaR at getting back to higher levels.

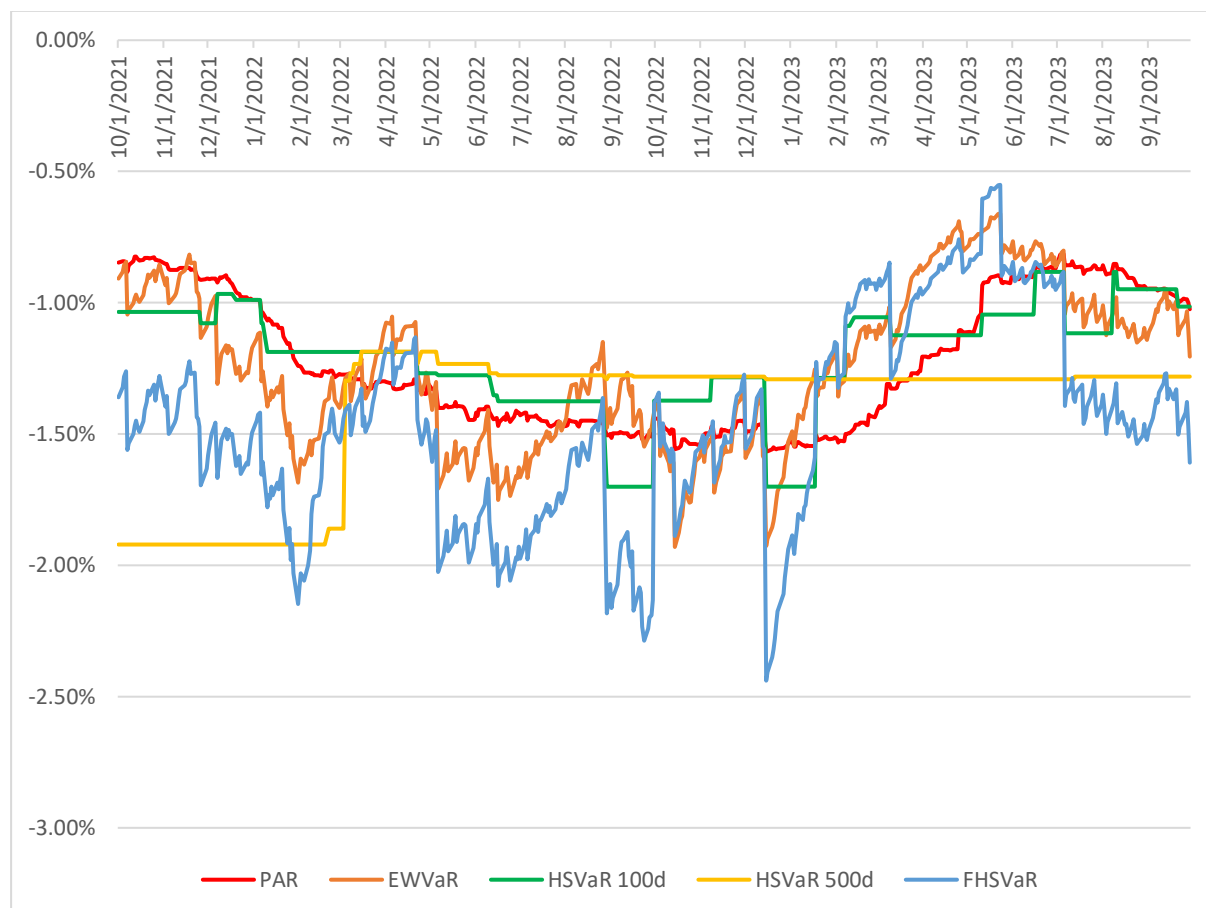


Figure 3 - Comparison of different VaR measures at 99% confidence level

VaR measures and P&L

Various VaR models exist because Value at Risk is not an observable value like returns. We can only determine if the loss falls below our prediction. The reliability of the model is determined by the frequency with which the loss is below the Value at Risk. We compared the fund's P&L to the various VaR measures (of the previous day) to assess how many times the fund had lower returns in comparison to the values predicted by the absolute risk measurement.

The underperformances that exceeded the VaR are:

- PARVaR at 5% confidence level: 6.99%
- PARVaR at 1% confidence level: 2.40%
- EWVaR at 5% confidence level: 6.59%
- EWVaR at 1% confidence level: 2.40%
- HSVaR (100 days) at 5% confidence level: 6.39%
- HSVaR (100 days) at 1% confidence level: 2.79%
- HSVaR (500 days) at 5% confidence level: 5.79%

- HSVaR (500 days) at 1% confidence level: 1.60%
- FHSVaR at 5% confidence level: 5.59%
- FHSVaR at 1% confidence level: 1.40%

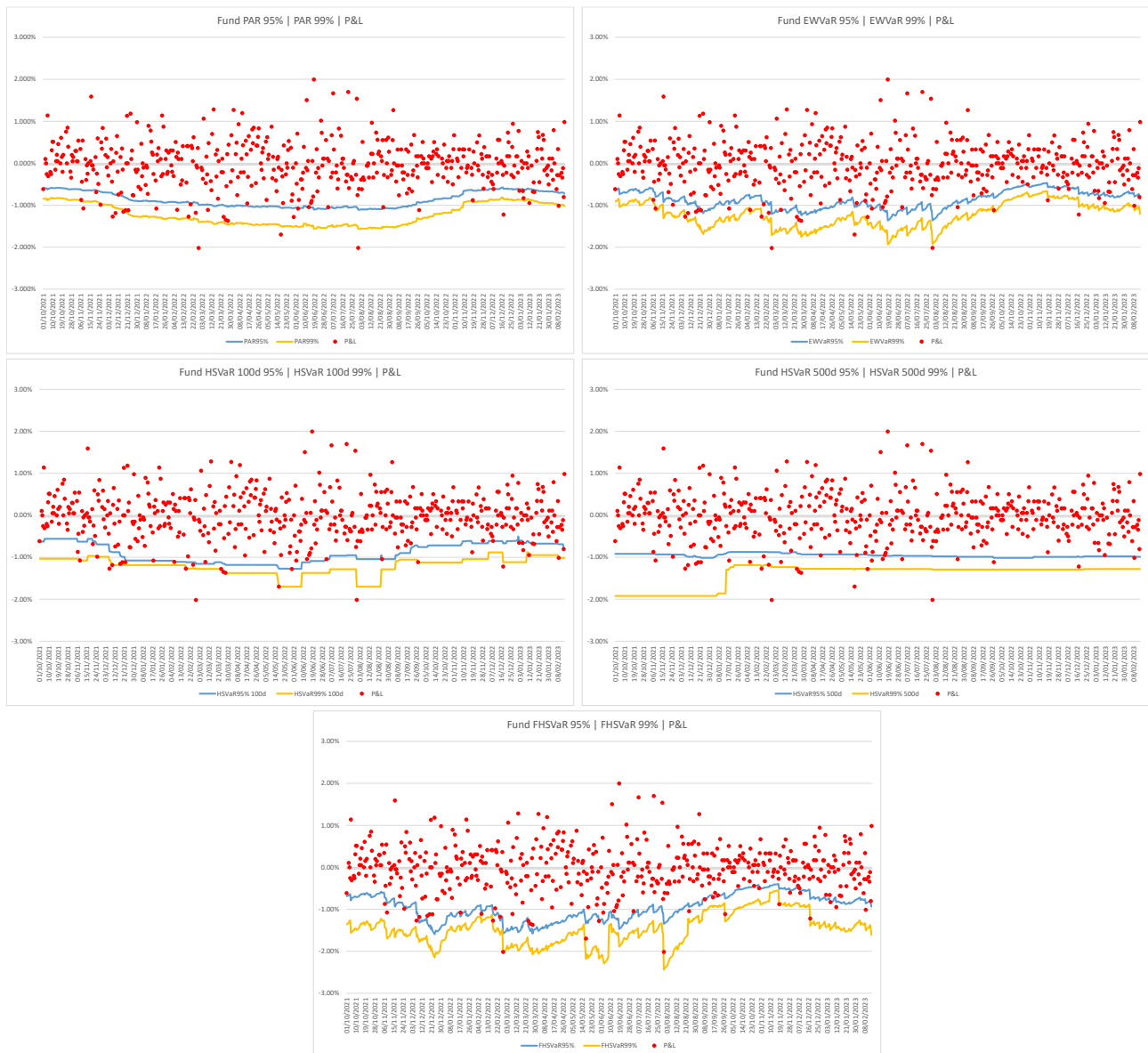


Figure 4 – VaR measures vs P&L

We can conclude that Filtered Historical Simulation VaR is the most robust and reliable measure, as it is very responsive and has demonstrated to be the most accurate one. At 5% and 1% confidence level, the times the P&L has surpassed the VaR threshold during the period of consideration have been only 5.59% and 1.40% respectively, while with other measures the frequency with which the loss is below the Value at Risk is worse.

In the figures above (Figure 4) we plotted the lines of different VaR measures (at 5% confidence level in blue, and at 1% confidence level in yellow) with the scatter of all fund's returns for the period of consideration (in red).

Fund VaR measures vs Benchmark VaR measures

Examining Figure 1, it is not possible to infer whether the fund follows a more or less aggressive strategy compared to the benchmark. This is because the volatility of the fund is neither higher nor lower than that of the benchmark during the specified period. If the Fund had a riskier or more aggressive strategy in comparison to the Fund, the Fund's VaR measures (the continuous lines in Figure 5) should be lower

than the Benchmark's VaR measures (the dotted lines in Figure 5). In reality we cannot clearly see a substantial difference, at both 95% and 99% level. Benchmark's Parametric VaR is lower than the Fund's one only in Q3 and Q4 2022; there are no substantial differences for EWMA Parametric VaR, Historical Simulation VaR (100 days), and Filtered Historical Simulation VaR, at both 95% and 99% level. Only for Historical Simulation VaR (500 days) we can address that at the 95% level Fund's VaR is always lower than Benchmark's VaR, while at the 99% level this is almost always the case except for when the Echo-Effect of the Covid-19 Crash runs out.

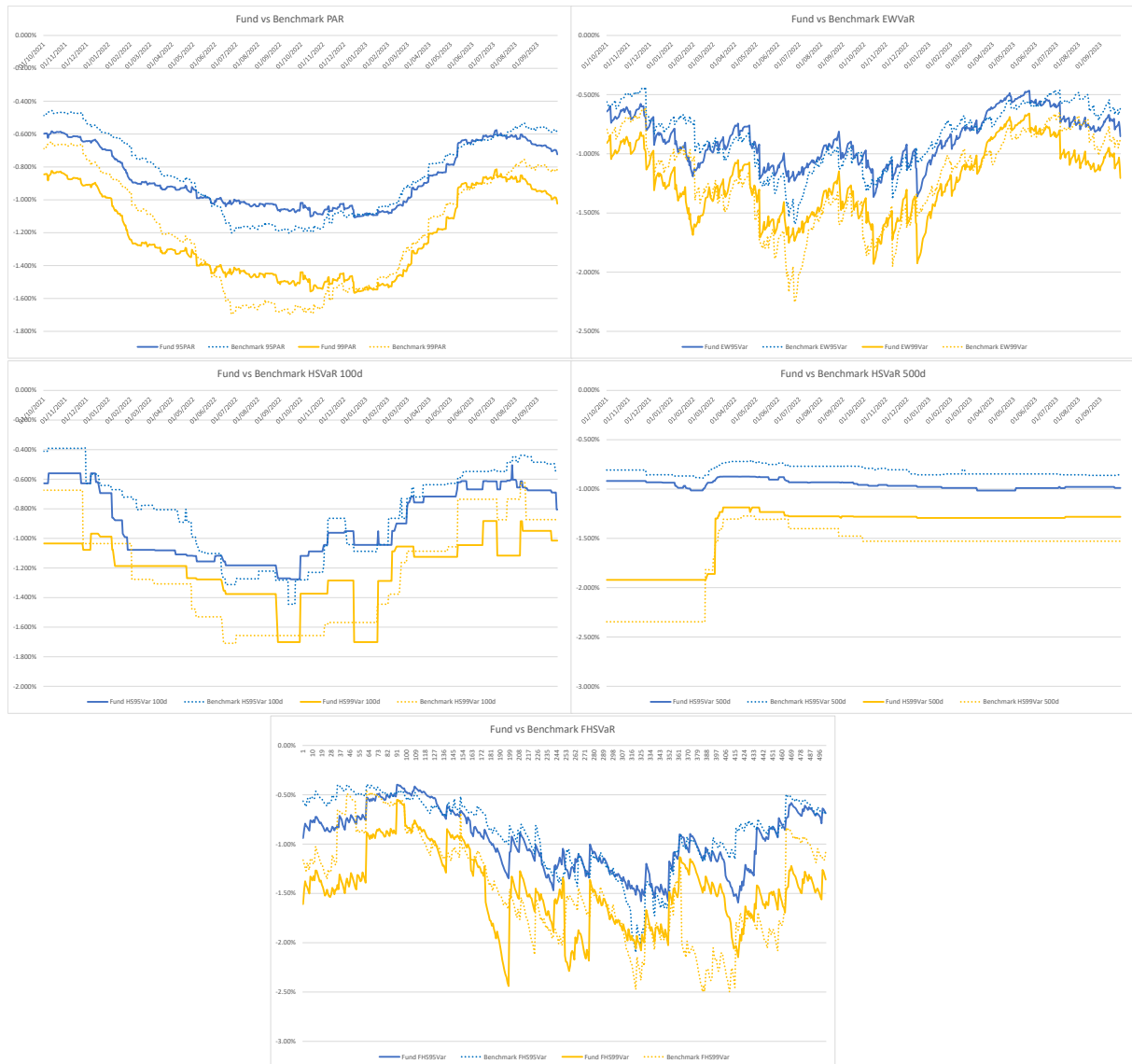


Figure 5 - Fund vs Benchmark VaR measures comparison

Relative Value at Risk – Relative Risk Measurement

ReVaR is calculated using the same methods as VaR, but instead of the fund's absolute returns, we consider the active returns, i.e. the differential return of the fund with respect to the benchmark return. ReVaR is the main ex-ante relative risk measure, which shows what is the maximum underperformance with respect to a benchmark that a portfolio can generate over a certain time period, with a given confidence level. ReVaR depends on current portfolio composition and on current market conditions. Various methods can be employed to calculate ReVaR, and for this analysis, we explored:

- Parametric with 100-days Historical Volatility,
- Parametric with Exponentially Weighted Moving Average Volatility on 100 days,
- Historical Simulation with different observation periods (100 days and 500 days),
- Filtered Historical Simulation (100 days) with EWMA Volatility Estimates calculated for the parametric model.

Parametric with 100-days Historical Volatility

Parametric ReVaR (RePAR in the spreadsheet file) is calculated considering the simple historical volatility of the previous 100 days. We assume conditional normality and zero-mean for this normal distribution. Results suffer from Echo-Effect, since all the volatility data from the sample is equally weighted.

We need to consider that the zero-mean assumption for active returns' distribution is *more robust* when it comes to ReVaR, differently from VaR.

Parametric with Exponentially Weighted Moving Average Volatility (100 days)

Parametric ReVaR with EWMA Volatility (EWReVaR in the spreadsheet file) is calculated considering the exponentially weighted average of the squared active returns, which solves the Echo-Effect through the decay factor (set at .94). The decay factor gives more importance to more recent data in comparison to older data than is weighted less. With a reduced Echo-Effect, EWReVaR reacts quicker to volatility episodes.

Historical Simulation (100 days and 500 days)

Simple Historical Simulation ReVaR (HSReVaR in the spreadsheet file) considers the tail of the distribution at a certain given level of confidence. The 500-days sample ReVaR is less reactive than the 100-days one. It has the main problem of being unconditional with respect to current volatility, with possible Echo-Effect.

Filtered Historical Simulation (100 days) with EWMA Volatility Estimates

In this model (FHSReVaR in the spreadsheet file) daily active returns are standardized by dividing them by an EWMA volatility estimate. This generates a standardized empirical distribution. Given the desired percentile level, the simulation is cut, and the result is multiplied by the daily volatility estimate. This model is very reactive to volatility shocks, and because of that is the most prudent one.

ReVaR Dynamics

It's possible to compare the different ReVaR measures looking at Figures 6 and 7. We can see how Parametric ReVaR and Historical Simulation ReVaR (100 days) tend to have very similar trends, while Parametric EWMA ReVaR is more similar to Filtered Historical Simulation ReVaR in the sense that they react in a quicker way to increased risk of underperformance. At both 95% and 99% confidence level Historical Simulation ReVaR (500 days) reacts very slowly to new data, as it incorporates older active returns. Because of that, it seems that it moves in an opposite direction in comparison to other ReVaR measures.

Parametric ReVaR and Historical Simulation ReVaR (100d) at a 95% (99%) confidence level have stayed in the [-.43%; -1.25%] range ([-.62%; -1.75%] range) for the whole timeframe, while Parametric EWMA ReVaR and Filtered Historical Simulation ReVaR have been more responsive to peaks in volatility. FHSReVaR reached a minimum on the 06/05/2022 at -2.28% at 5% confidence level and the

10/05/2022 at -2.73% at 1% confidence level. It is possible to see this in Figure 6 and 7. That is explained by the fact that EWMA assigns more weight to latest data, giving more clear representation of the risk in a timelier manner. EWMA ReVaR and FHSReVaR are also quicker to get back to higher levels, by construction, for the same reasons. Parametric ReVaR performs well during periods characterized by minimal fluctuations in active returns around an average value. However, in times of crisis, it exhibits a gradual adjustment to shocks. Parametric ReVaR with simple historical volatility could underestimate the fund relative risk, or at least, its response is not the timeliest.

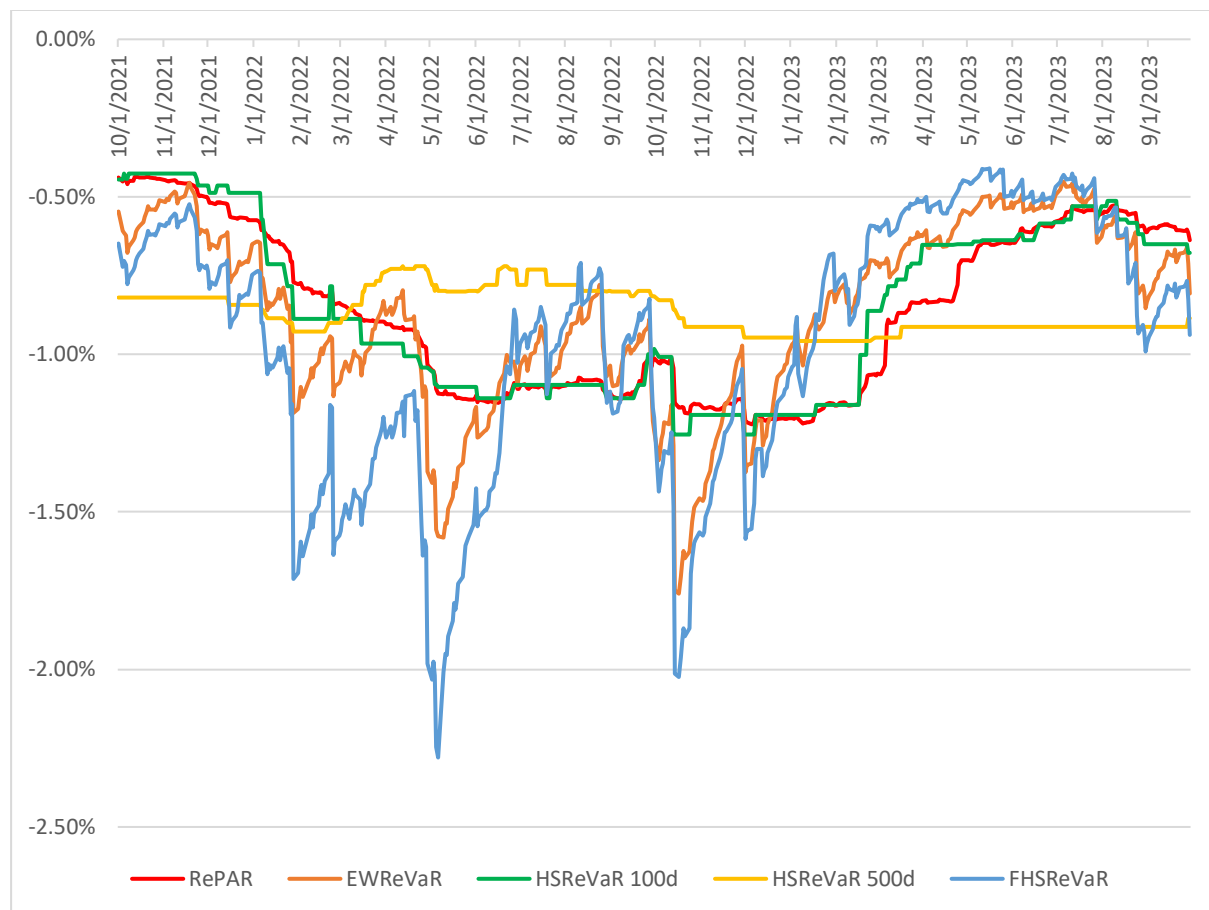


Figure 6 - Comparison of different ReVaR measures at 95% confidence level

Historical Simulation ReVaR tends to show more stable values, as it considers the tail of the distribution at the 95% (or 99%) level of confidence. Fluctuations appear when the fund suffers from greater underperformances that end up in that part of the distribution. Historical Simulation calculated on 100 days incorporates fewer negative active returns, therefore it's more responsive to new underperformances, while Historical Simulation on 500 days is less reactive especially as it still incorporated active returns from the Covid-19 market crash on the 01/10/2021. Because of that, we can see that the HS ReVaR measurement (500 days) was lower than the other ReVaR measures (-.82% at the 95% confidence level, -1.51% at the 99% confidence level) in the first period. Underperformances stay in the tail of the distribution for longer in the 500 days HS ReVaR, which makes this kind of ReVaR more stable but also more significantly impacted by big relative losses. As soon as these underperformances get surpassed in the model, the measure reacts by positioning itself on higher values. This explains why 500 days HS ReVaR sometimes moves in the opposite direction of other ReVaR measures.

The last ReVaR measure we analysed is Filtered Historical Simulation ReVaR. In this case daily active returns are standardized dividing them by a EWMA volatility estimate. This generates a standardized empirical distribution. Given the desired percentile level, the simulation is cut, and the result is multiplied by the daily volatility estimate. This model appears to be the most reactive ones to relative

losses, as it incorporates higher weights to more recent data and empirical standardized active return distributions. We can see that that FHS VaR is more responsive to peaks in volatility and is also faster than Parametric VaR at getting back to higher levels.

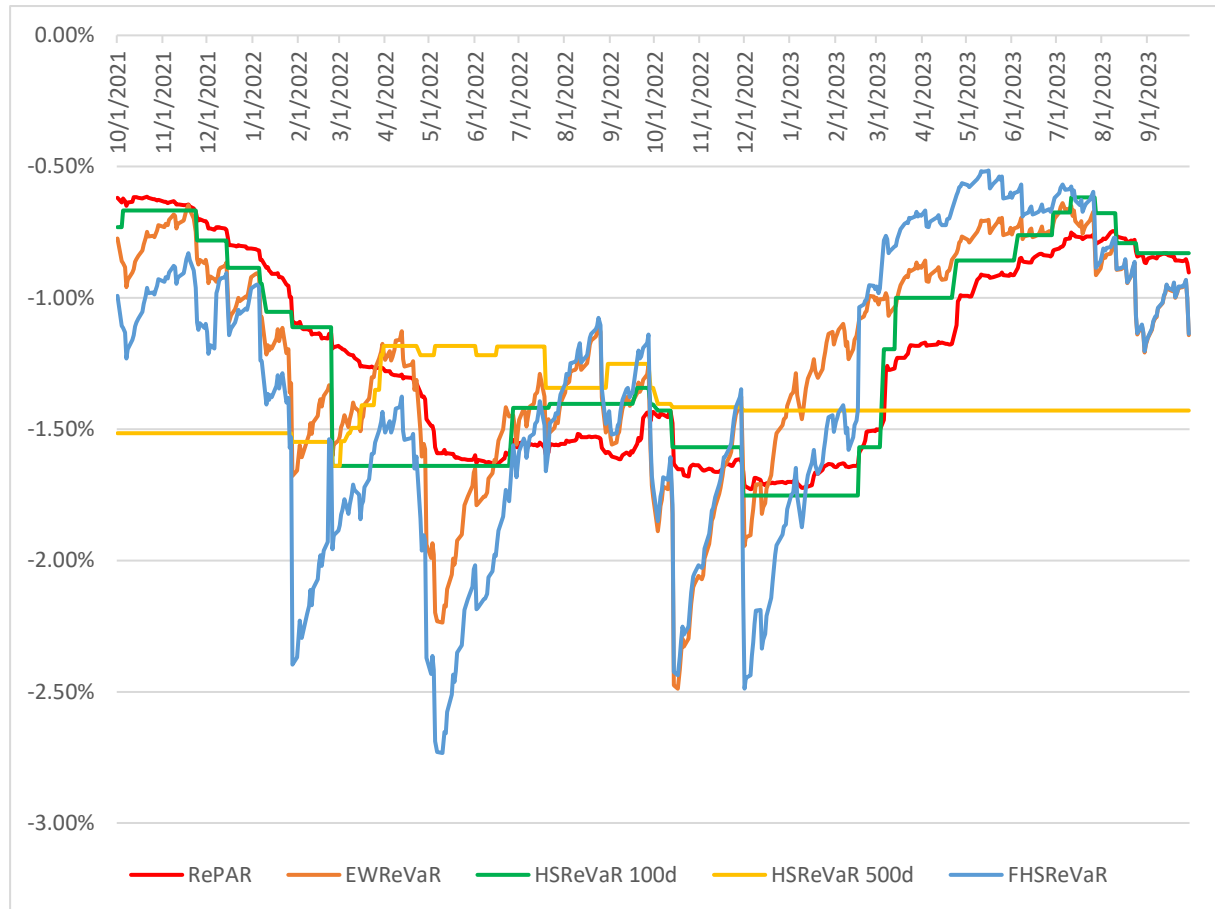


Figure 7 - Comparison of different ReVaR measures at 99% confidence level

ReVaR measure and Active Returns

Various ReVaR models exist because Relative Value at Risk is not an observable value like active returns. We can only determine if the active loss falls below our prediction. The reliability of the model is determined by the frequency with which the active loss is worse than the Relative Value at Risk. We compared the fund's active returns to the various ReVaR measures (of the previous day) to assess how many times the fund had lower active returns in comparison to the values predicted by the relative risk measurement.

The underperformances that exceeded the ReVaR are:

- PARReVaR at 5% confidence level: 6.39%
- PARReVaR at 1% confidence level: 2.99%
- EWReVaR at 5% confidence level: 5.99%
- EWReVaR at 1% confidence level: 2.00%
- HSReVaR (100 days) at 5% confidence level: 5.99%
- HSReVaR (100 days) at 1% confidence level: 2.59%
- HSReVaR (500 days) at 5% confidence level: 5.79%
- HSReVaR (500 days) at 1% confidence level: 1.80%
- FHSReVaR at 5% confidence level: 5.19%
- FHSReVaR at 1% confidence level: 2.00%

We can conclude that Filtered Historical Simulation ReVaR is the most robust and reliable measure at a 5% confidence level, as it is very responsive and has demonstrated to be the most accurate one. At a 1% confidence level, the Historical Simulation ReVaR (500 days) outperforms other ReVaR methods, but

we have some doubts on the responsiveness and utility of this measure, as it was flat at a low level for most of the year 2023. The times the Active Return has surpassed the ReVaR threshold during the period of consideration have been only 5.19% and 1.80% respectively, while with other measures the frequency with which the underperformance is below the Relative Value at Risk is worse.

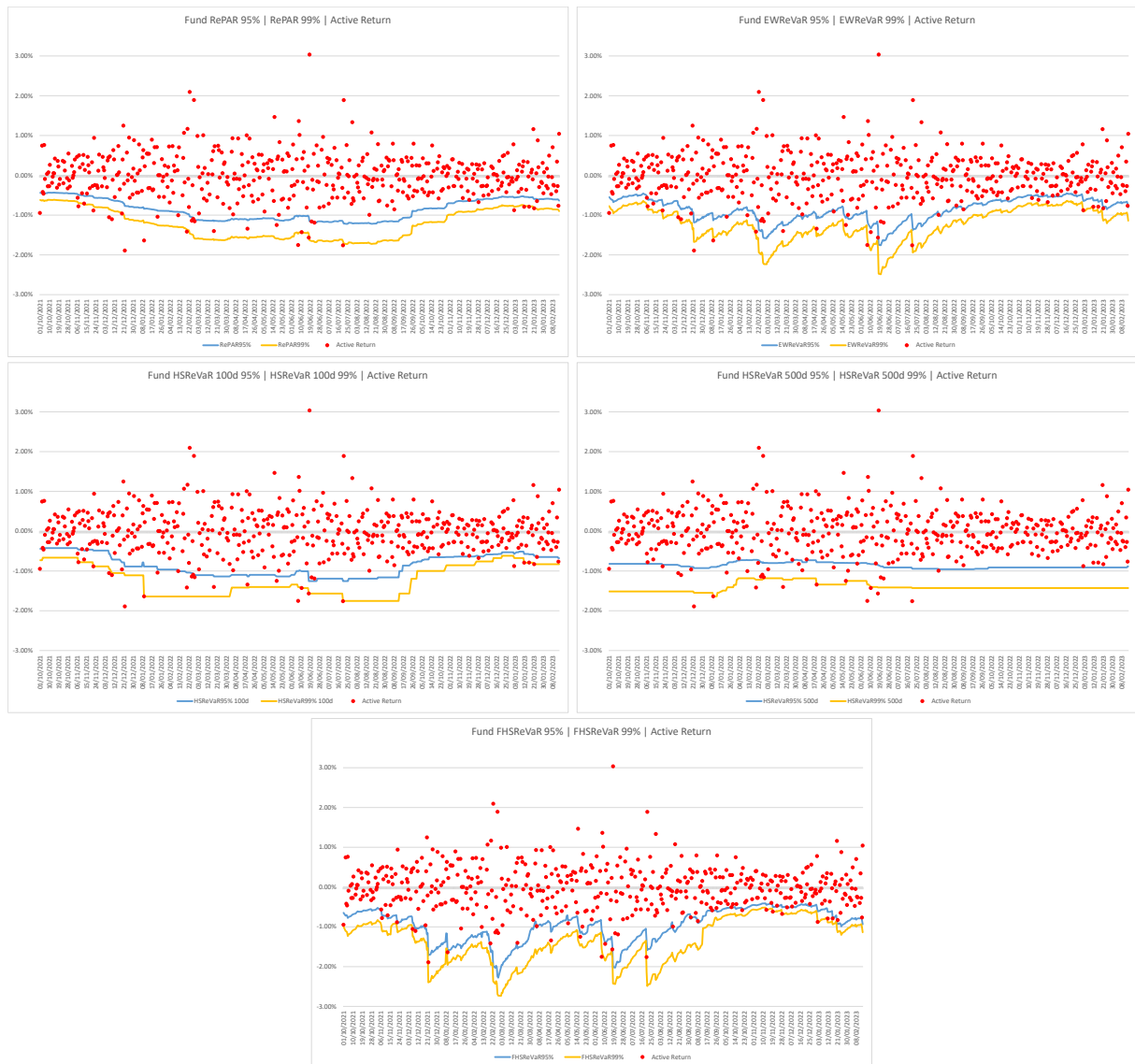


Figure 8 - ReVaR measures vs Active Return

In the figures above (Figure 8) we plotted the lines of different ReVaR measures (at 5% confidence level in blue, and at 1% confidence level in yellow) with the scatter of all fund's active returns for the period of consideration (in red).