Minerva Investment Management Society
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MIMS – Long-Short Equity Fund

Portfolio Management Team

Report – April 2021

Fund description

MIMS – Long Short Equity Fund is an actively-managed fund by Minerva Investment Management Society, based on a zero-net investment 'multi-factor' strategy. The Fund has the investment objective of achieving a positive absolute return, through long-term capital appreciation.

Market update

− The markets have remarkably exceeded pre-pandemic levels, and they are still increasing their values on the hopes of a quick return to normality. However, the gap with the real economy is still wide, since several countries (especially European ones) are still subject to severe restrictions.

− The default of Archegos Capital Management put under pressure several banks in the world, impacting on the performance of the banking sector after the big rally experienced from November to March. In particular, Crédit Suisse has been forced to raise cash, since its exposure to the fund was about $20 Billion.

− After long debating, in March 2021 President Biden has signed the $1.9 trillion Relief Program, which includes direct payments to eligible citizens and unemployment aid. The program was the third massive fiscal stimulus in less than one year and has raised some serious concerns regarding inflation. As a result, yields increased significantly and Q1 has been the worst quarter since 1980 for the US Treasury Market.

− The Biden Administration is currently discussing the introduction of a $2 trillion infrastructural plan, which aims at enhancing infrastructure and support the Green Transition over the next decade. The spending would be partially funded by an increase in the corporate tax level. Given markets reaction to this news, it seems that the expectation of future growth is currently outweighing the costs associated with this new tax level.

− In a reopening economy, where cyclical factor leads recovery, the value factor tend to outperform, consequently we close our tactical call (TAA) on the growth factor to shift back to our strategic view (SAA) on the value one.

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Factor Investing Strategy	
VALUE	MOMENTUM
QUALITY	VOLATILITY
SIZE	ESG

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3 steps Investment Approach

Multi Factor Analysis	Screening and Normalization	Strategic Asset Allocation
Fundamental metrics are identified that best proxy each of the 6 factors on which the investment style is grounded. The process involves theoretical-based frameworks as well as empirical evaluations. Cross-team expertise and Minerva IMS insights are deployed.	Stocks are evaluated on the basis of their exposure to each single factor. Through a 3-step Winsorization test, outliers are discarded with reference to each factor. The output of the process is a synthetic score, on the basis of which stocks are ranked.	Portfolio allocation comes to live. Based on the ranking produced, long and short positions are taken accordingly. Macro environment is always monitored. Significant changes may lead to reconsider the chosen set of factors, or their weights, thus affecting the first step of the process.

Investment Approach

The Fund uses a «multi-factor» based investment style adopting a quantitative proprietary model in order to achieve a systematic, rules-based approach to stock selection. Stocks are selected from the broad US Equity market (S&P 500 Index) and the European Equity market (Euro STOXX 600 Index).

A score is produced with reference to each considered style factor: (1) 'value' (stocks with high dividend yield and a lower price-to-book ratio than peers); (2) 'momentum' (investments with relatively strong recent performance); (3) 'quality' (as reflected by indicators such as ROE and consensus EPS forecasts); (4) low volatility; (5) size (in terms of market float); (6) ESG factor (as conveyed by Thomson Reuters ESG Score). A systematic procedure is implemented to isolate and discard the most extreme stocks with reference to each single factor. Each factor is given equal weight in the process of building a final score for each stock. Sector-neutrality is not pursued in the process of selecting stocks.

Factor Analysis

In rebalancing the previous portfolio and building the new one, we decided to close the growth factor call to align back to our strategic view on the value factor. This is supported by empirical evidence, explained in detail later in the report, which suggests to act as fast as possible to catch the value premium. In fact, real economy is recovering from the pandemic shocks and value stocks will benefit in the future.

Furthermore, following a mimicking portfolios argument we have been able not only to decompose part of the portfolio returns, but also to prove analytically the performance of the growth factor (intended as a long short portfolio, long on growth stocks and short on value ones).

Momentum and Growth factors are positively correlated (0.44 on Nov. 2020-Apr.2021). Tilting the investment strategy towards value factor would imply also a better diversification, reducing the risks of extreme negative returns over the semester.
Moreover, Value stocks are pro-cyclical investment: they tend to deliver good performances when the economy is healthy. In 2021, it is likely that consumption and investment will significantly increase, pulling value stocks high.
Furthermore, the increase in the interest rates, led by inflation concerns, makes growth stocks less attractive, because they will suffer more than value ones from the higher discount rates.

Finally, as stated before we took actions to actively adjust the strategy. This new portfolio should be able with its exposures to better capture the market drivers, keeping well performing factors (for instance, Size and Quality) while waiving the growth one.

Fund Factors

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.

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.

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.

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.

Size Factor (Buy small cap, Sell large cap)
- Free-Float 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).

ESG Factor
- Thomson Reuters ESG Combined Score: we assume a higher ESG score to be a positive signal, since it reveals more attention to 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.

Portfolio Composition

The rebalancing of the long-short portfolio consists in buying stocks with the highest total score and short-selling stocks with the lowest.

The total score for each security is an equally weighted average of the final factors' scores that each stock has registered, after having applied the Winsorization technique and the data normalization procedure. We can observe the bar indicating the level of score for each stock in the portfolio.
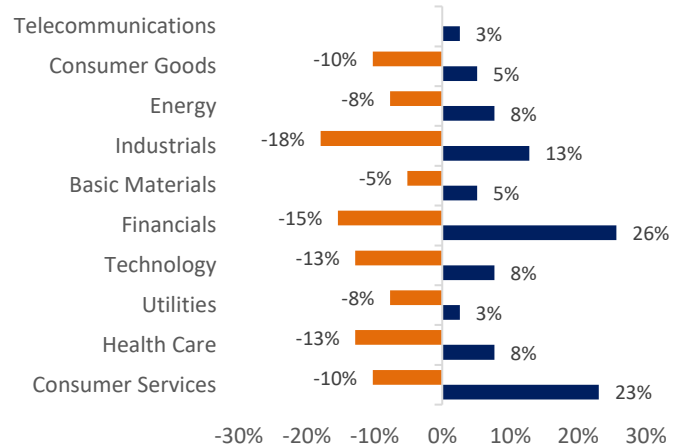
The equally weighted scheme has been adopted in order to preserve the factors' identity. In this way we avoided the possible drawbacks that optimization techniques, such as the ones based on the mean-variance approach, could have caused to our portfolio.

In order to keep the analysis coherent, we have removed the sector neutrality constrain as we can see from the figure on the right-hand side, where long and short positions for each industries are shown.

The overall long position in some industries and the overall short position in others is in line with the underlying assumptions of the model.

We see then a smooth distribution for the stocks scores, without any relevant jump.

Finally, we can outline a predominance of the consumer goods sector in both the long and short legs, whereas financials appear mainly in the short side of the portfolio.

S&P500
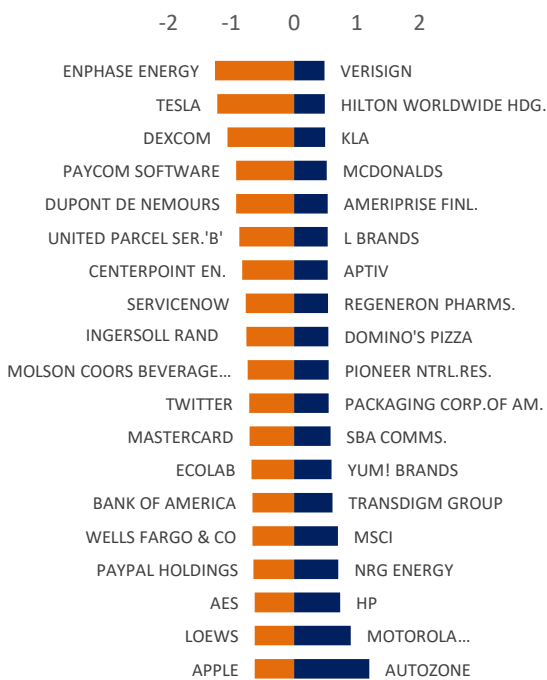
EUROSTOXX600

■ Score Long ■ Score Short

Nov 2nd, 2020 – Apr 20th,2021

Cumulative Gain/Loss
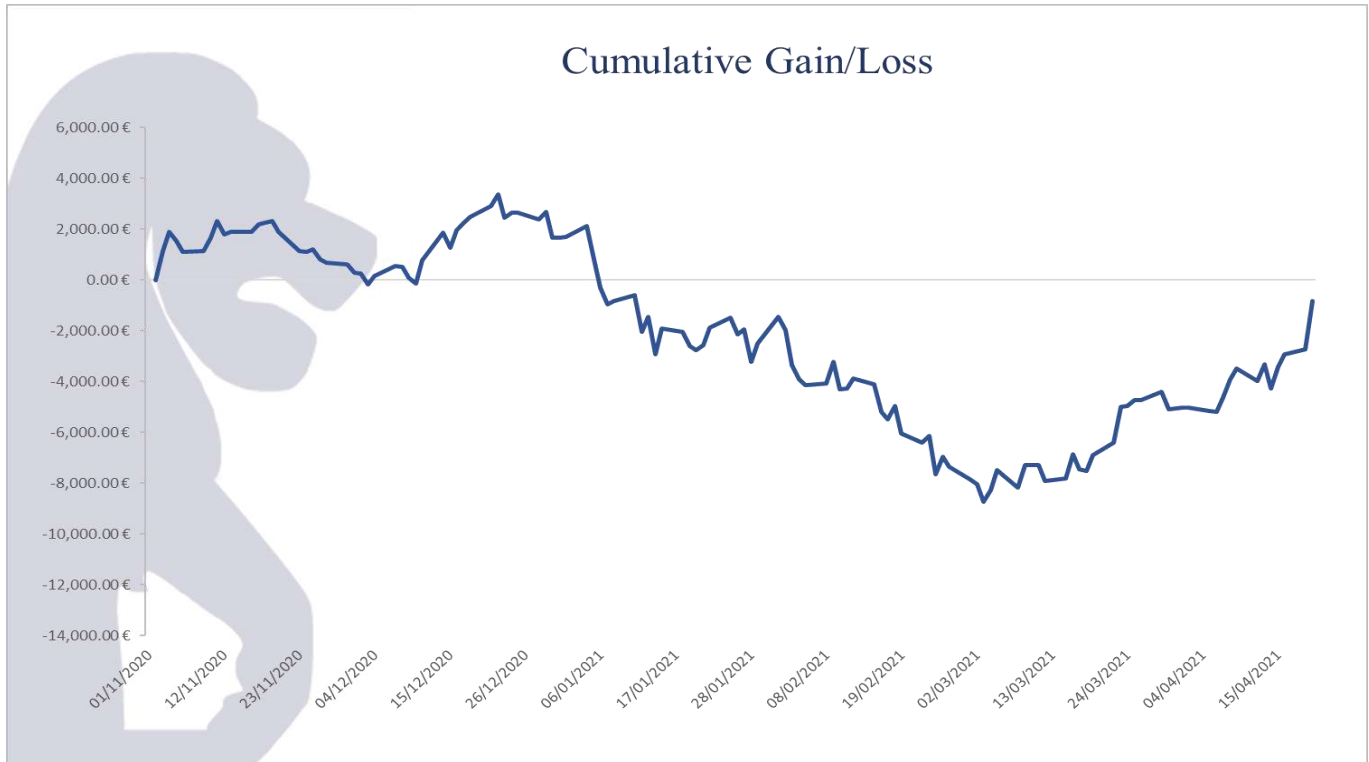
Performance

During the considered period, our portfolio showed a slightly negative performance, ending up at €844 loss. Until December 4th, the portfolio was composed of the stocks of the old report portfolio. That day represents the inception of the new portfolio, which has been updated through a new calculation of the scores for each factor for every stock in the S&P 500 and the Eurostoxx 600. After a positive, but small, performance at the beginning and in the days just after the update, our portfolio started to display a negative trend which lasted for the majority of the period, until the recovery starting from March.

On the long leg, the best performers, after the rebalancing, were HCA Healthcare, HP and Ameriprise Financial. Therefore, we can say that the main driver was not a single sector, as those three stocks belong to the healthcare, technology and financial services sectors, respectively. Among them, the clear winner for us was HP that scored an astoundingly +33,14% from Dec. 4th to the end of the period.

To mention the strong performers of the short leg, we recall Wells Fargo, Apache and Citigroup. As you can appreciate, two of those three belong to the banking sector. Indeed, a strong driver of our under-performance was the financial sector. On the other hand, Apache is a company that works in the commodity world, more precisely in hydrocarbon exploration.

On the Eurostoxx 600 side, the top performers were Billerud Korsnas (+16.83%), along with Georg Fischer and IMI. Once again, the driver was not a single sector, although two of the best performers are industrial companies, while the other belongs to basic materials. This behavior reflects the recovery of the global economy, as these sectors are typically considered procyclical. On the short side of the portfolio, the results were not as bright. The fund took a short position on EQT and Thyssenkrupp, which grew 42.11% and 83.41%, respectively, significantly damaging the net result of the overall investment.

Taking a deeper look at the drivers of the performance, we can analyse which factor drove the results of our portfolio. As mentioned, banking was a critical sector for us. This can be reconducted to the size and the value factor. Banks are typically big-caps firms; our model has underweighted these assets, relying on the empirical evidence that historically small-caps companies outperformed the larger ones. However, the factor decomposition will show later in the report that size was not the main driver of Minerva's fund performance.

In fact, the key driver has been value factor. Banks are characterized by low levels of P/BV, therefore they have been assigned a low score in our model, and they have been placed in the short leg of our portfolio, because of our tactical call. To conclude, the quicker than expected vaccine campaign and the rapid deployment of massive reform in US led our tactical asset allocation on growth stocks to poor results. A realignment with factor-style investing expectations will, nevertheless, grant positive returns for the future periods.
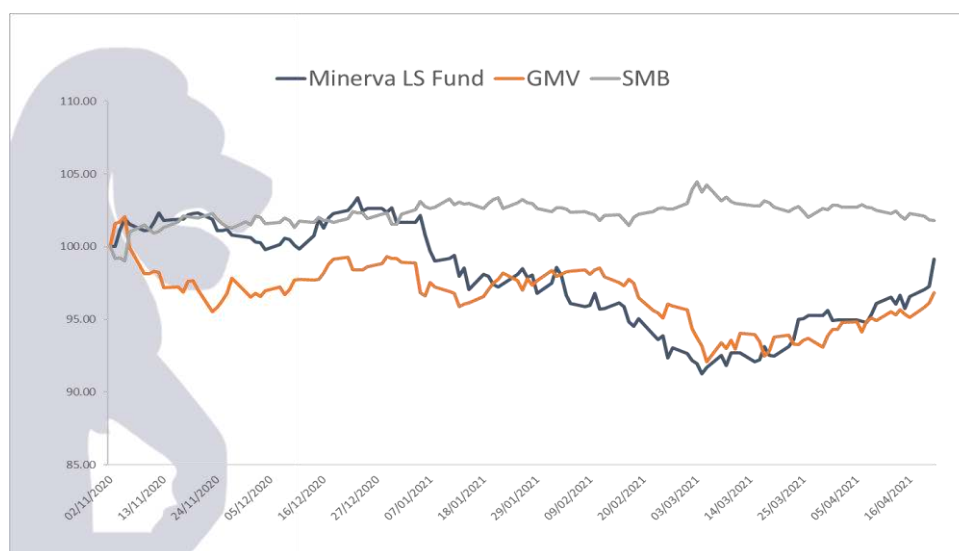
BREAKDOWN IN FACTORS

In order to evaluate the performance of the fund, we decided to perform a deeper analysis, whose aim was to construct four factor mimicking portfolios: each of those has been built in order to maximize the exposure to a single factor and to be neutral to the remaining ones. The four selected factors have been the size, the momentum, the value and the quality factor. The procedure to create the factor mimicking porfolios has been inspired by Fama and French and it is the following:

i. Each stock of the S&P 500 and the EuroStoxx 600 was ranked in top tercile, medium tercile or bottom tercile for each of the factors considered;
ii. After excluding the stocks that were in the middle tercile for one or more factors, we divided the remaining stocks in sixteen portfolios, because for each of the four factors they could have been in the top or bottom tercile (2^4 = 16);
iii. We constructed the Time series of returns of each of these portfolios, giving an equal weight to the stocks in the portfolios;

iv. We constructed four equal weighted portfolio. For example, for the Portfolio SMB (Small minus Big), the Portfolio exposed to the size factor, we took the average of the eight portfolios with Small inside and subtracted the average of the eight portfolios with Big inside;
v. We computed the risk premium for each factor and regressed the time series of our portfolio to the returns of the 4 factor mimicking portfolios.

EMPIRICAL EVIDENCE

While at the beginning of the period Minerva LS fund's performance seemed to be tied mostly to the size factor, after the mid of January the influence of the growth factor has become noticeable. In fact, the decline and the subsequent rebound are highly correlated with the one of growth stocks, which have underperformed the value ones after almost 14 years. We remind that the previous model of this fund invested in growth stocks.

In the graph below, we plot the two most significant factors, small minus big (SMB) and growth minus value (GMV) along with the overall fund performance.

Value factor is not outmoded

Last semester, Minerva opted for the growth as a tactical call (please see the previous report for further information), shifting from the long-dated strategic value factor. The volatility in the markets and overall global uncertainty caused value stocks to heavily underperform and, therefore, made growth a stronger investment strategy. As a matter of fact, last year the MSCI US Growth Index and the MSCI EMU Growth Index surged, respectively, by 42.01% and 16.09%, while the MSCI US Value Index and MSCI EMU Value Index lagged far behind, gaining 0.95% and 0.9%.

Four months later, the fund has decided to close the TAA (Tactical Asset Allocation) call to shift back to value investing as a result of predicted reflation, a possible commodity "boom", an opportunity for factor diversification, and the current price of value stocks, as is explained in detail below.

While it is important to recognize the value factor's overall underperformance over the last 14 years, it is just as important not to look at empirical data as an accurate representation of the future, but as a tool that we use to make better decisions. After analysing the reasons behind the boom of growth stocks over the past several years, we are confident that this trend is a cyclical, not structural phenomenon, and will not carry on in the years to come: as a result of the Biden $1.9 trillion dollar stimulus plan, the risk of a reflationary environment is concrete and makes value stocks an interesting investment alternative.

In the second part of 2021, we are very likely to go towards a steady economic recovery, with Governments around the world adopting heavy public spending strategies, hoping to increase consumption and investments. According to one of Blackrock's publications, under these circumstances, value stocks should perform well given their procyclicality.

As a matter of fact, historically some of the best years for Value came right after prolonged periods of underperformance, e.g. the great performance following the Dot-com bubble.

In the past few months, the inflation concerns have caused a surge in interest rates, which makes Growth stocks less attractive relative to Value ones as a consequence of lower discounted expected values. Moreover, the great attention investors have shown for Growth during the past years has encouraged a rally in prices. Therefore, all future expectations equal, expected returns are lower. On the opposite, the lack of interest for Value has made prices cheaper and expected returns higher, all else equal.

Finally, it is noteworthy that factors show some degrees of correlation (0.4 in our considered period), therefore it makes total sense to take advantage of this pattern and diversify.

For all the reasons above, we are confident that our multi-factor portfolio would significantly benefit from the re-inclusion of Value.

Moreover, the team's investment decisions can also be justified by academic research. Supporting our conclusions on the market environment, **Lopez et al. (2021)** show that, historically, inflation and tightening credit spread levels have been the most supportive factors for value stocks, both in Europe and in the US. Indeed, the post-Covid environment may be more than suited to this description.

Our research was further complemented by **Ilmanen et al. (2019)** investigation, which discussed how factors have been statistically significant in the past century and have been characterized by some pattern of cyclicality. Hence, despite having been "dormant" in the recent past, the relevance of the Value Factor in the future remains not in doubt.

Value Funds are Outperforming Growth Peers
Vanguard Value ETF Return (VTV) Vanguard Growth ETF Return (VUG)
Source: Bloomberg. Performance figures are quarterly, and as of Mar. 17 for Q1, 2021.

Ilmanen's research is also tied to **Peace et al. (2021)**'s publication that argues that the post-vaccine economic recovery should favor undervalued cyclical value stocks over expensive technology and growth stocks. Relative to the U.S., the rest of the world is overweight cyclical value stocks. Moreover, the U.S. stimulus plus the reopening from lockdowns should boost the earnings growth of cyclical sectors such as materials and industrials that also have a high weight in the value index. Other interesting findings are pointed out by **Bannister (2021)**, discussing a possible commodity "boom", which will, in turn, lead to the rise of 10-year yield. Moreover, Bannister's viewpoint supports that of Peace, as both authors discuss how the Biden spending and the Federal Reserve plan will lead to a rise in value reflected in the financials, energy, industrials, and the basic materials industries.

Lastly, addressing the counterargument, **Arnott et al. (2021)** dismiss the hypothesis that Value premium has been arbitraged away because of its popularity. Instead, they suggest that the actual level of valuations makes Value stocks cheaper relative to growth and the gap is currently wider than it used to be during the Dot-com bubble.

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Risk Management Team

## Report – April 2021

Introduction

The main objective of this section is to assess and quantify the risk embedded in the Minerva IMS long-short equity fund built by the portfolio team. We use a daily perspective on the potential extreme behavior of a basket of assets selected by the portfolio analysts. The analysis will include three VaR and ES models (two parametric and one non-parametric) and an overview of how sentiment analysis can be considered a factor for short term investments.

As the Investment Risk division, our focus is the estimation of the two main risk indicators:

- The daily Value at Risk (VaR): the maximum portfolio loss that occurs with α% of probability over a time horizon of 1 day. For instance, if the VaR (α=5%) = -3.00%, it means that tomorrow there is a 5% probability of encountering a loss in the interval [-100%, -3.00%] potentially;

- The daily Expected Shortfall (ES): the expected return on the portfolio in the worst α% of cases. So, it is just a mean of the returns lower than the VaR.

A simple technique to estimate these two measure is based on a historical approach: given a time series of returns of a financial security, we can easily compute the desired quantile of the historical distribution to estimate the VaR, and, after that, estimate the ES just by averaging the values below this threshold.
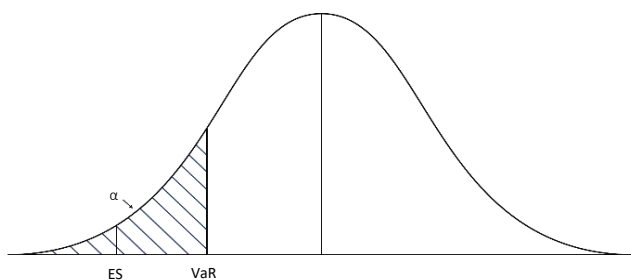
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However, this naive approach is not well suited for our purpose: in fact, by considering our portfolio as a single financial asset, we are losing all the information that comes from all the components; moreover, with this approach we are simply focusing on the past behavior of the fund, while our main goal is to retrieve a risk metric for the future possible trends.

In order to overcome these issues, we propose two alternative techniques that provides better risk estimates:

• Parametric approach (simple approach and time-series modelling approach)
• Bootstrapping

The first method is very well suited for understanding the main vulnerabilities in the portfolio composition, while with the second one it is possible to observe how the metrics varied in the past quarters.

For both pieces of analysis we used daily market prices of portfolio constituents for the period Mar.20 – Mar.21. All the analysis has been conducted with Python.

Parametric approach

In this section we propose to analyze VaR and ES separately for each asset included in the portfolio and then, to estimate the VaR and ES for the whole fund by taking into account the correlation between portfolio constituents.

Parametric approach is based on the assumption that returns of a financial security follow some theoretical distribution. Thus, VaR and ES can be expressed as an α-percentile of the distribution. The crucial step to accurately estimate VaR and ES is to select the appropriate distribution of returns and estimate it's parameters.

It is possible to state that stock returns do not follow Gaussian distribution due to the presence of "fat tails": unexpected events might have a huge impact on the stock prices, so it is possible to observe extreme values more frequently than a Normal distribution would predict. For this reason, we assume that stock returns follow a Student-t distribution, thus, the parameters to be estimated are the mean μ, volatility σ and number of degrees of freedom ν.

To obtain more valid and robust results, we proceed with two alternative parameter estimation approaches – (a) simple approach, and (b) time-series modelling approach. For all parts of analysis, we use the last 252 return observations, which correspond to 1-year window.

Simple approach

Under the simple approach, we estimate the above-mentioned parameters in the following way:

1. We assume that the mean historical daily return of each security are a good estimate for the expected future return. Thus, μ is estimated as a simple average of daily returns.

2. Volatility of returns σ is calculated as a simple standard deviation of returns.

3. Number of degrees of freedom ν is selected in a way that it best approximates the empirical distribution of returns. In order to do that, we used the Kolmogorov-Smirnov statistic that, for a given empirical cumulative distribution function F and a proposal Fn, is:

$$Dn = \sup x \, | (Fn - F) |$$

Ideally it should be equal to 0 for a perfect fit, so our goal is to minimize it by proposing different ν for Student-t distribution.
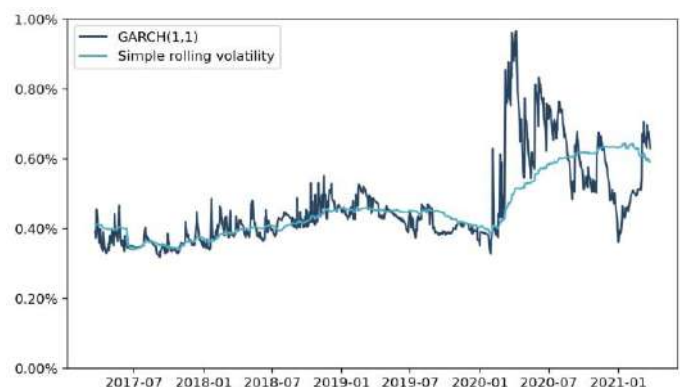
Time-series modelling approach

Because the volatility of returns is not constant over time, it is often modelled by conditional heteroscedasticity processes. The most common way to model volatility is through a Generalized Autoregressive Conditional Heteroscedasticity model GARCH(p,q), where the forecast of the next-period volatility depends on the previous p shocks to stock returns (derived from some mean model) and previous q forecasts of volatility:

$$\sigma^2_{t+1|t} = \omega + \sum_{i=1}^{p} \alpha_i \epsilon^2_{t-i} + \sum_{j=1}^{q} \beta_j \sigma^2_{t-j+1|t-j}$$

The advantage of GARCH model is that it allows to better estimate the current forecast of return volatility by putting more weight on more recent information. Thus, in the periods of market turbulence GARCH model will produce higher volatility forecasts than the simple average of squared deviations from the mean (see the graph at the bottom).

Because the portfolio is composed exclusively of equity instruments traded on liquid markets, we can assume that prices are efficient, and thus returns can be described by a constant mean model for GARCH(p,q) process, which implies that current mean estimates do not depend on previous returns or shocks. GARCH(p,q) then is estimated by Maximum Likelihood (MLE), which optimizes the distribution parameters. We subsequently use MLE estimates of distribution to derive VaR and ES.

Parametric approach (continued)

Value-at-risk

Once the parameters of stock returns are known, it is possible to calculate VaR. We estimate the VaR for 95% and 99% confidence level by applying the following formula:

$$VaR_\alpha = \sigma * T_\nu^{-1}(\alpha) + \mu$$

where σ is the estimated volatility of a security, $T_\nu^{-1}(\alpha)$ is the α-percentile of a Student-t distribution with ν degrees of freedom, and μ is the expected return of a stock.

Expected shortfall

Expected shortfall is defined as a conditional expectation of loss, given that the loss occurred. If we introduce the assumption of a continuous distribution of returns of a security, then parametric expected shortfall is simply defined as a tail conditional expectation, and thus can in general be defined by the following formula for any security X :

$$ES_\alpha(X) = -\frac{1}{\alpha}\int_0^\alpha VaR_\gamma(X)\,d\gamma$$

Under the assumption of Student-t distribution with ν degrees of freedom it can be proven that the expected shortfall would be given as:

$$ES_\alpha(X) = \sigma * \frac{\nu + \left(T_\nu^{-1}(\alpha)\right)^2}{\nu - 1}\frac{\tau_\nu\left(T_\nu^{-1}(\alpha)\right)}{\alpha} + \mu$$

where σ is the estimated volatility of a security, $T_\nu^{-1}(\alpha)$ is the α-percentile of a Student-t distribution with ν degrees of freedom, $\tau_\nu(\cdot)$ is the probability density function of Student-t distribution with ν degrees of freedom and μ is the expected return of a stock.

We estimate the ES for 95% and 99% confidence level.

Portfolio VaR and ES

Considering the correlation between the stocks, we estimate the VaR and ES of the whole portfolio for 95% and 99% confidence level by applying the following formulas:

$$VaR_{\alpha,ptf} \approx \sqrt{VaR_\alpha * \rho * VaR_\alpha{}'}$$
$$ES_{\alpha,ptf} \approx \sqrt{ES_\alpha * \rho * ES_\alpha{}'}$$

where VaR_α and ES_α are column vectors of individual stock VaR and ES, respectively and ρ is the correlation matrix between securities

The approximation arises because of the assumption of Student-t distribution of returns – the formulas above become an equality the closer the distribution of returns is to the Gaussian.

Results

GARCH results appear to be more conservative than the simple approach ones. Indeed, while simple approach equally weights all observations, GARCH puts more weight on the most recent observations, thus, it better estimates the future volatility and allows to produce more reliable risk metrics.

	Simple approach	GARCH
VaR$_{95\%}$	-1.09%	-1.16%
VaR$_{99\%}$	-1.52%	-1.93%
ES$_{95\%}$	-1.35%	-1.67%
ES$_{99\%}$	-1.75%	-2.61%

Since the last publication of Risk report, VaR (both from simple approach and GARCH) has decreased because of the gradual recovery from COVID crisis. Because parametric ES is estimated for the first time, we are unable to make a comparison with the previous results.

TOP 5 stocks (simple approach)

	VaR 95	VaR 99	ES 95	ES 99
CHOCOLADEFABRIKEN LINDT & SPRUENGLI	-1.86%	-2.68%	-2.37%	-3.11%
MCDONALDS	-2.10%	-3.04%	-2.67%	-3.52%
CRODA INTERNATIONAL	-2.38%	-3.49%	-3.06%	-4.07%
SEGRO	-2.39%	-3.53%	-3.10%	-4.17%
AUTOZONE	-2.44%	-3.54%	-3.12%	-4.11%

BOTTOM 5 stocks (simple approach)

	VaR 95	VaR 99	ES 95	ES 99
TECHNIPFMC (PAR)	-7.28%	-10.42%	-9.21%	-12.05%
INTL.CONS.AIRL.GP.	-7.93%	-11.27%	-9.98%	-12.98%
TESLA	-8.53%	-11.85%	-10.57%	-13.55%
ENPHASE ENERGY	-9.43%	-13.41%	-11.88%	-15.54%
TUI (LON)	-9.72%	-13.80%	-12.23%	-15.88%

TOP 5 stocks (GARCH)

	VaR 95 (GARCH)	VaR 99 (GARCH)	ES 95 (GARCH)	ES 99 (GARCH)
ENTRA	-1.02%	-1.91%	-1.63%	-2.83%
SNAM	-1.72%	-2.51%	-2.20%	-2.92%
CHOCOLADEFABRIKEN LINDT & SPRUENGLI	-1.70%	-2.69%	-2.33%	-3.37%
YUM! BRANDS	-2.08%	-3.05%	-2.68%	-3.58%
MCDONALDS	-1.96%	-3.23%	-2.77%	-4.18%

BOTTOM 5 stocks (GARCH)

	VaR 95 (GARCH)	VaR 99 (GARCH)	ES 95 (GARCH)	ES 99 (GARCH)
INTL.CONS.AIRL.GP.	-8.31%	-14.06%	-12.04%	-18.69%
TESLA	-9.34%	-15.48%	-13.34%	-20.59%
TRAINLINE	-9.52%	-17.49%	-14.95%	-25.71%
ENPHASE ENERGY	-10.67%	-17.69%	-15.26%	-23.62%
TUI (LON)	-10.44%	-19.12%	-16.29%	-27.67%

Bootstrapping

When estimating a certain metric, one of the main problems in Statistics is the lack of the whole population data and the consequent use of only a sample. In our case the population data is the complete historical price data of the securities that are part of our portfolio, in which we only have the data of recent years.

Bootstrapping is a statistical technique that by having only a sample of the population data, provides estimates of statistical metrics that are closer to the ones obtained from the population data.

Given a sample of size n, implementing bootstrap is very simple:
• Sample with replacement n times from the original sample (note that one observation could be selected more than once);
• Compute the metric of interest (in our case the VaR or ES) on this newly created sample and save it;
• Repeat the previous steps M times with M→+∞ (we have selected M=100.000 for instance);
• Average and compute the standard error of the metrics estimated in each step.
With this method, by estimating the expected shortfall and the standard errors, we can retrieve a more insightful view of our portfolio, but in this case, we are losing the risk contribution of each stock that we had in the previous case.

	Estimate	Standard error
VaR$_{95\%}$	-1.04%	0.12%
VaR$_{99\%}$	-1.67%	0.23%
ES$_{95\%}$	-1.37%	0.13%
ES$_{99\%}$	-1.83%	0.18%

Quarter analysis

With this method we have enough metrics to inspect the behavior of this fund composition in the last 5 years.
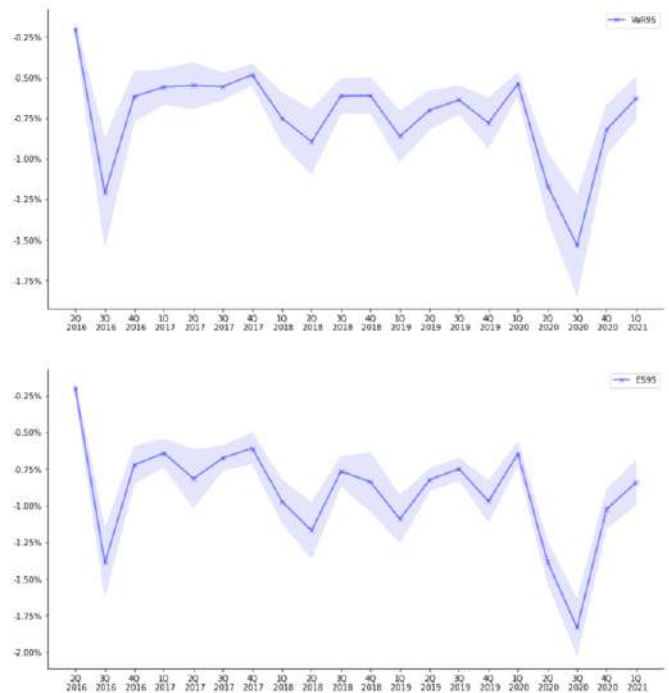
Between 1Q 2016 and 4Q 2019 the metrics were pretty much stable, while deteriorating in the Q2 and Q3 2020 due to the COVID-19 pandemic. Nevertheless, both VaR and ES show signs of recovery and as of Q1 2021 they both returned to pre-COVID levels. We expect both indicators not to significantly deteriorate in the future, nevertheless, further recovery is conditional upon restoration of market confidence and significant events that might impact the market volatility (such as, for example, the third wave of COVID, announcements of government support and changes in government monetary and fiscal policies).

Moreover, it can be noticed that in 2020 standard errors bands (light-blue area) were wider than the previous quarters ones. This remarks a volatility increase due to COVID outbreak that markets suffered in those months. As of Q1 2021 these bands are narrowing because of gradual restoration of market confidence. We estimate that these bands will not significantly widen in the upcoming months and will remain at their current levels.