MIMS – Long-Short Equity Fund

Portfolio Management Team

Report – November 2021

Fund description

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

Market update

- Strong earnings seasons and persistent central bank stimulus have made broad market indexes hit new all-time records. However, some investors are worried that persistent high inflation, driven by brisk demand for goods and disrupted supply chains, may force officials to raise interest rates sooner than expected in 2022.
- The Federal Reserve approved plans to begin scaling back its bond-buying stimulus program this month and end it by June 2022, a major step toward withdrawing its strong pandemic-driven support amid a recent inflation surge. The Fed will reduce monthly purchases by $15 billion. Fed officials have also announced that they don't want to lift rates until after they have ended the bond purchase program.
- The missed $83.5 million coupon payment of Evergrande on its dollar-denominated bonds, which were due on Sept. 23, shook market and investors' sentiment. Concerns started to spread through the bond market that the industry would suffer broadly, set off after Fantasia Holdings Group Co., another major Chinese developer, missed a $206 million U.S. dollar bond payment on Oct. 4. Additionally, the main fear was that an eventual escalation of defaults by the sector's major players could have sent shockwaves across the world's second biggest economy, as real estate and related industries account for as much as 30% of Chinese GDP.
- On Nov. 19 the U.S. House of Representatives passed a roughly $2 trillion social-spending and climate legislation that includes billions in renewable energy tax credits, healthcare and affordable housing. Now Democrats will need to move the legislation through the evenly divided Senate. It is relevant to state that tax increases on companies and wealthy individuals may allow the plan to be self-paid or cause little additional deficit per annum. More specifically the framework comprehends a 15% minimum tax on corporations reporting over $1 billion in profits, a 1% excise tax on corporate buybacks and a 15% separate minimum tax on profits earned by U.S. companies abroad.

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Factor Investing Strategy

VALUE	MOMENTUM
QUALITY	VOLATILITY
SIZE	ESG

3 steps Investment Approach

Multi Factor Analysis

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.

Screening and Normalization

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.

Strategic Asset Allocation

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 lower price-to-book ratio and lower EV/EBITDA than peers); (2) 'momentum' (investments with relatively strong recent performance); (3) 'quality' (as reflected by indicators such as ROE and the difference between consensus forward and trailing EPS); (4) low idiosyncratic 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 partially considered: the model can in fact take larger long or short positions in certain sectors, but only within defined limits.

Factor Analysis

In rebalancing the previous portfolio and building the new one, we decided to maintain the foregoing set of factors, as the motivations that led us to select them in our view are still valid.

Specifically, we stand behind our decision of including the Value factor. Indeed, eventual future interest rates hikes would hurt growth stocks more than value ones, since their expected cash flows are further away in the future. Moreover, the vaccination campaign is proceeding well in US and in Europe and the economic recovery still looks like the most probable outcome for the foreseeable future.

Moreover, Momentum and Growth factors in the past have showed to be positively correlated (0.22 between April 2021-November 2021). Positive correlation (0.39) could be identified during the same time-window also between Growth and Quality factors. Therefore, tilting the investment strategy towards the value factor would then imply better diversification, reducing the risk of extreme negative returns over the semester.

We believe this updated model to be able to choose stocks coherently with the macroeconomic scenario we expect, while not seeking excessive risk.

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 sum of the 12 monthly returns preceding the last one divided by 11, as a buy signal. In practice, we assume that the stocks that had a recent high average return will keep doing well in the future. In other words, we assume that the market will not invert its trend soon.

Quality Factors (Buy high quality stocks, Sell low quality stocks)

- FW 12m EPS minus Trailing EPS: a higher value of this metric represents a buy signal. Although not widespread, we introduced this factor in order to capture analysts' views (analysts' revisions) on the future of the company. It is indeed computed as the difference between the future twelve-months EPS forecasted by analysts and the trailing twelve-months recorded. We thus assume that a high positive value of this indicator will be associated with a stock price increase, as the stock price will mirror the future earnings' behavior.
- 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

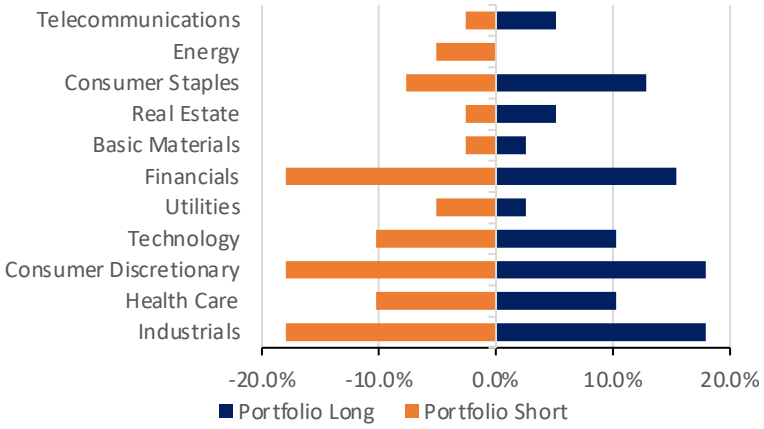
The rebalancing of the long-short portfolio consists in buying stocks with the highest total score and short-selling stocks with the lowest.

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 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.

Finally, an important change has been adopted regarding sector neutrality. We did not want to implement sector neutrality to allow the model to take positions that are coherent with our investment philosophy. However, we also did not want the model to excessively outweigh one sector with respect to the others, as this would have increased our risk assumption too much and compromise diversification, as for instance last year when the good performance of banks hurt returns because they were heavily shorted by the model.

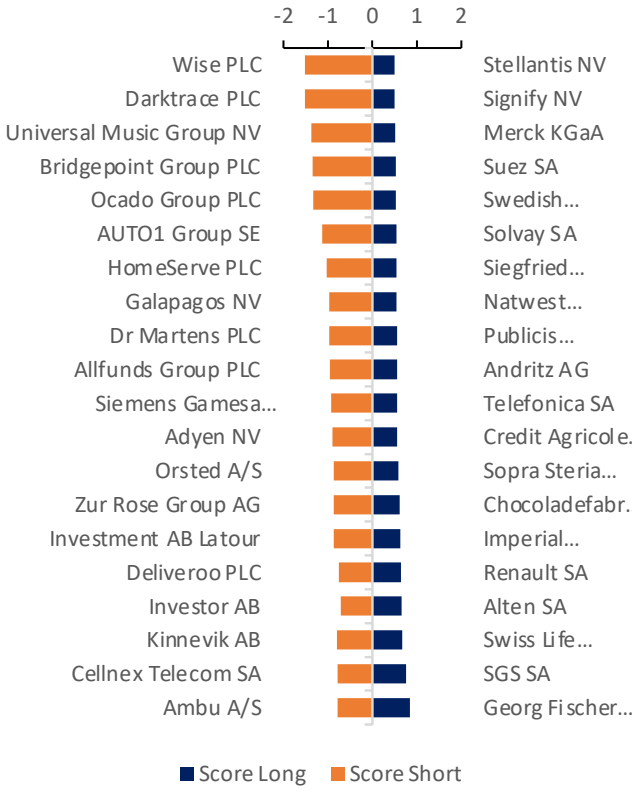
Therefore, we decided to take an intermediate approach by putting a cap equal to approximately 18% (2 / # of sectors) on the positions the model can assume for each industry. In particular, this restriction has been applied to the short leg of consumer discretionary and to the long leg of the industrial.

As a result of this approach, we now have both long and short exposure in all industries but one, namely Energy, and the overall net exposure in both the aforementioned capped industries is zero.



S&P500

EUROSTOXX600



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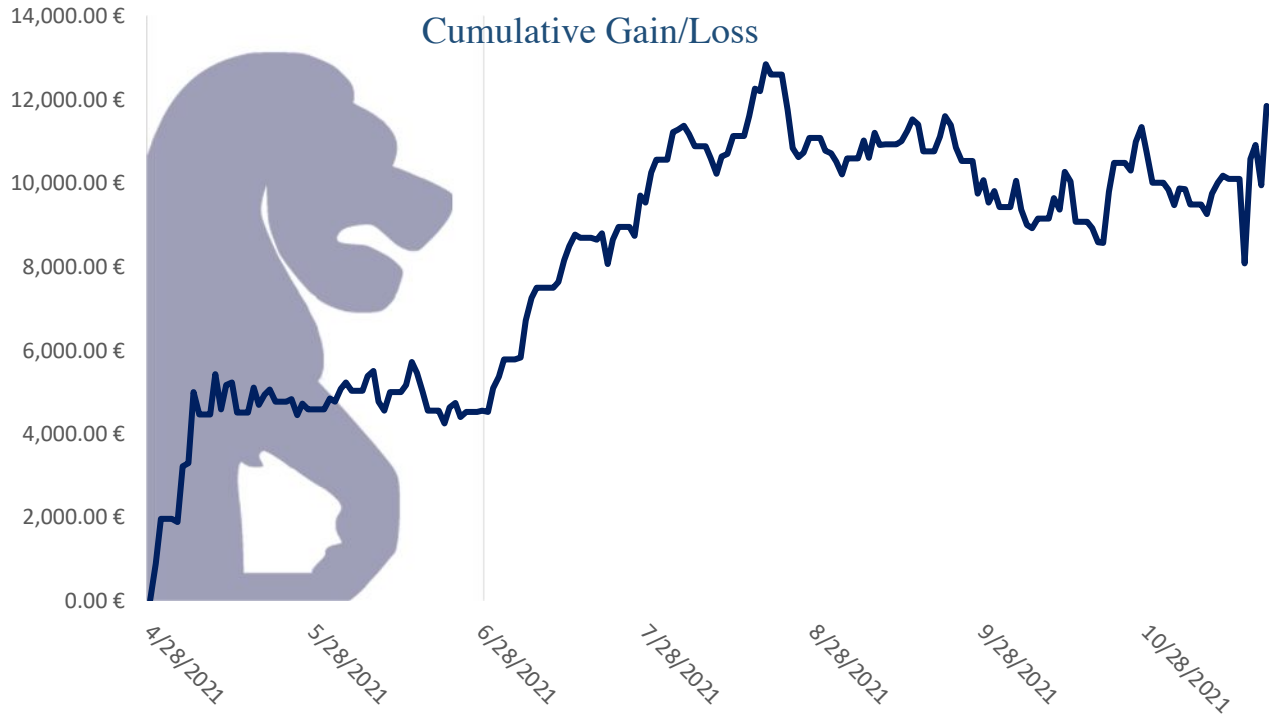


Performance

The inception of the new portfolio took place on *April 28*. Therefore, the timeframe considered goes from *April 28 to November 19*. During the considered time-period, our portfolio obtained a satisfactory $11 849.54 absolute return.

All but one of our best positions were taken on components of the EUROSTOXX600. Indeed, on the long side, the best performers were Croda International Plc, SEGRO plc and Bath & Body Works Inc, with respectively +48.0%, +40.6% and +39.84%. These substantial performances can be briefly explained by analyzing the movements of their sectors' indexes. In fact, they belong to the industrial, property and retail sectors, respectively. More specifically, these companies' results were such due to the growth-enhancing monetary policies implemented by central banks and high demand environment.

On the other hand, the short positions that had the best outcomes were Trainline, Ambu A/S and TUI AG. They respectively achieved the following performances: -37.3%, -46.5% and –50.3%; hence allowing us to make a profit on their share prices' downturn.

The first and third components of this group are among the biggest players of the travel-related and tourism industries, respectively. These peculiarities may give us some insight information, regarding the poor performance of companies that were most affected by the unfavorable environment caused by the COVID-19 pandemic. Indeed, the travel and leisure/hospitality sectors are among the few that still have not bounced back to pre-pandemic levels.

Conversely, we also took some positions that, if avoided, would have further boosted our fund's performance. This predominantly happened in the short side of our portfolio. Indeed, the main industry that achieved results opposite to what we expected was banking. This sector's components that deserve to be mentioned are Nordea Bank Abp (+35.9%), Banco de Sabadell S.A. (+28.0%) and Commerzbank AG (+29.4%). However, on an absolute basis, the short positions that mostly dragged down our final performance were Dexcom Inc, Tesla Inc and Enphase Energy Inc, which grew 52.0%, 61.3% and 56.4%, respectively. We believe that the predominant motives for such high and fundamentally illogical capital gains and valuations are due to the current euphoric market sentiment toward technology and biotechnology driven companies.

BREAKDOWN IN FACTORS

In order to evaluate the performance of the fund, we decided to perform a deeper analysis, whose aim was to construct six 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 six selected factors have been Size, Momentum, Value, Quality, Volatility and ESG. The procedure to create the factor mimicking portfolios has been inspired by Fama and French (1993) seminal paper and it consists in the following steps:

1. 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;

2. After excluding the stocks that were in the middle terciles, we divided the remaining stocks in sixty-four portfolios, because for each of the six factors they could have been either in the top or bottom tercile ($2^6 = 64$);

3. We constructed the time series of returns of each of these portfolios, giving an equal weight to the stocks in the portfolios;

4. We constructed six equal weighted portfolio. For example, for the Portfolio SMB (Small minus Big), that is, the Portfolio exposed to the Size factor, we took the average of the thirty-two portfolios with Small inside and subtracted the average of the thirty-two portfolios with Big inside;

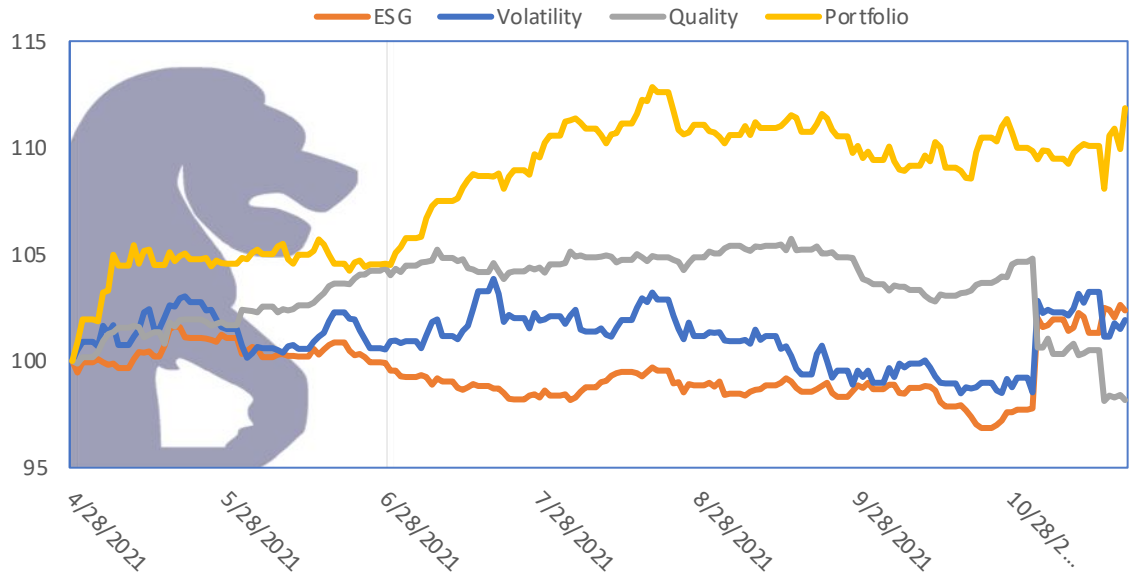
5. We computed the risk premium for each factor and regressed the time series of our portfolio against the excess returns of these 6 factor mimicking portfolios.

Empirical Evidence

During the time-frame of interest, our portfolio has been mostly driven by the ESG, Volatility and Quality factors. Indeed, all these factors were statistically significant at the 5% level and the signs of our exposure, represented by the signs of the beta coefficients, were respectively negative, positive and positive. Unfortunately, we were not able to properly capture the ESG as we wished: the estimated exposure presented an opposite sign with respect to our intentions.

From the inception to the end of October, the Quality and the ESG (recall the negative sensitivity) have propelled our performance, whereas the Volatility factor has been relatively steady. However, at the beginning of November we have observed a sort of reversion of the previous pattern: Quality plummeted and both ESG and Volatility rallied. Nonetheless, the overall performance was not that much affected. and the portfolio was able to gain back what it has lost during the small plunge of mid-month.

It is particularly interesting how sudden and contemporaneous was the reversion of factors' performance. Furthermore, it should be highlighted how the diversification towards several factors has generated a good degree of resilience to this phenomenon, allowing the portfolio to withstand the setback.



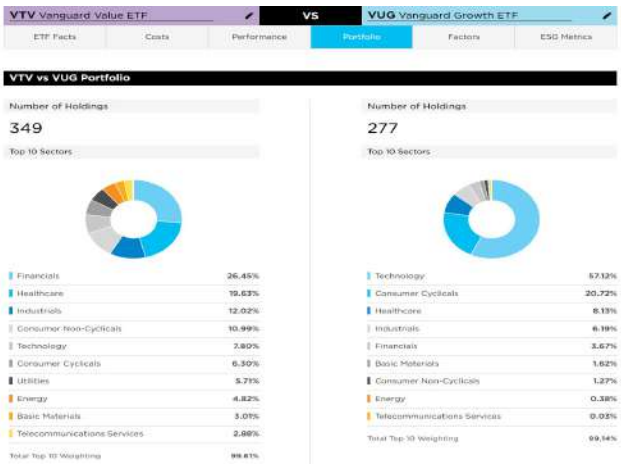
We Still Like Value

After having switched the last semester to the value factor, we are firmly convinced to stand by our position also for this one.

As it is stated on a recent paper, in fact, "the degree of concentration and value for money are important determinants of performance. In this sense, the strategies of investing in concentrated portfolios that differ from the benchmark and with undervalued assets in terms of price earnings ratio (PER)-return on assets (ROA) achieve better results." **(Otero-Gonzalez, *et al*. 2021)**. Analysing the performance of pension funds invested in the Euro area from 2000 to 2017, the authors of the paper found that active management, concentrated portfolios and (also quoting Cremers, 2017) patient investment in assets yield better results, concluding that "it is confirmed that the selection of funds based on “Value Investing” can have a positive impact on future performance".

Furthermore, the current high level of inflation makes us rely more on value investing rather than growth investing. Indeed, current inflationary pressures are highlighting the necessity of an intervention by central banks, and the chances of a restrictive monetary policies are slowly increasing, as reflected in recent market’s expectations. Theoretically, inflation and eventual future higher interest rates would likely hurt value stocks less than growth stocks, as their cash flows are less distant in the future. Therefore, a raise in interest rates would play in favour of value investing. Among the many academic sources on this topic, we could mention the recent paper "Value Investing is Dead?" of **Emidio Checcone and Brian Ear (2021)** which underlines how we are very likely to go towards an increase in interest rates with consequent overperformance of value stocks.

Another interesting publication was made by **Mr. James Royal (2021)**, who analysed the current struggle for supremacy between Value and Growth. As he put it, "Growth stocks may do better when interest rates are low and expected to stay low, but many investors shift to value stocks as rates rise. Growth stocks have had a stronger run recently, but value stocks have a good long-term record.".
To quantify the change in yields, a recent Bankrate survey showed experts expect the yield on the 10-year Treasury, a fundamental variable for valuations, to rise by an average of 40 basis points, reaching 1.86 percent, by the end of the third quarter 2022.
An asset manager Mr. Royal interviewed also pointed out that that, in the last decade, Energy and Financials (two sectors that are strongly present in value funds, as showed in the following charts) struggled to perform well as investors were looking for companies with an "ability to increase earnings in a low-growth, disinflationary environment". The likely change in monetary policy would change this status quo, as banks should strongly benefit from this.

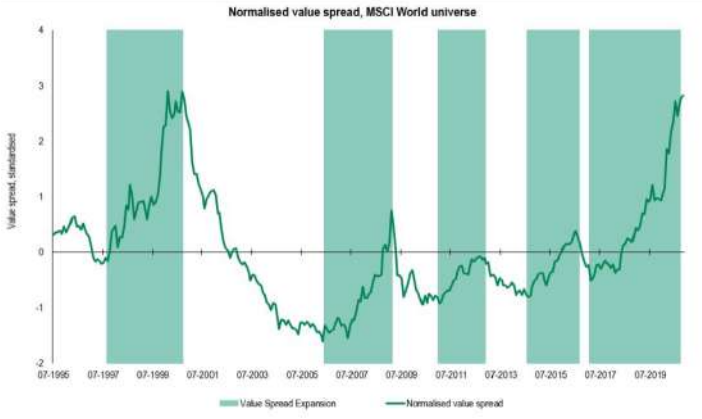


Composition of Vanguard Value ETF and Vanguard Growth ETF

Furthermore, as mentioned in the past semester's report, we are now assisting to a commodity boom due to a surge in demand and to supply chain disruption that has resulted in sky-rocketing prices for oil and other commodities. Clearly, the Energy sector should greatly benefit from this trend that does not look to come to an end any soon. For all these reasons, it should not come as a surprise the very good performance of these traditional value companies, as investors are pricing in these higher profits.

On the eternal struggle of Value vs Growth, **Dr. Robert Johnson**, finance professor at Creighton University, pointed out that "From 1927 through 2019, according to the data compiled by Nobel Prize laureate Eugene Fama and Dartmouth professor Kenneth French, over rolling 15-year time periods, value stocks have outperformed growth stocks 93 percent of the time,” he says. Moreover, 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.

Finally, as stated by **Benoit Bellone** (Senior Quantitative Analyst in the Research Lab of the Quantitative Research Group at BNP Paribas Asset Management) in his article "*Value investing: Is this the biggest opportunity since the tech bubble?*" (23/04/2021), during the recent period, value spreads rose as high as they were in 2000 at the peak of the tech bubble across all regions and sector. This means that value stocks are cheaper than ever, with huge potentials of gain. Also, considering that the world economy is showing strong signs of recovery, and that Value is procyclical, we believe that by exploiting this factor we can reach good results during the following semester.



Quantitative Research Team

Risk Report – November 2021

Introduction

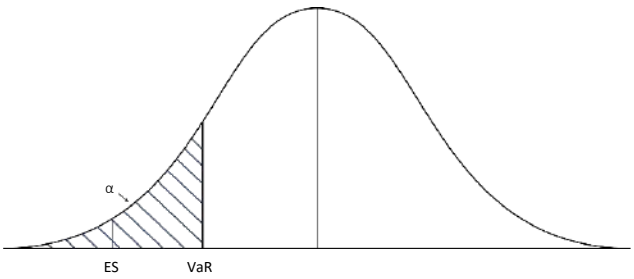
The main objective of this section is to assess and quantify the risk embedded in the Minerva IMS long-short equity fund built by the portfolio team. We use a daily perspective on the potential extreme behavior of a basket of assets selected by the portfolio analysts. The analysis will include three 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:

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

where $\boldsymbol{VaR_\alpha}$ and $\boldsymbol{ES_\alpha}$ are column vectors of individual stock VaR and ES, respectively and $\boldsymbol{\rho}$ 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 slightly higher than the simple approach ones, potentially due to the recent volatility in the markets. Indeed, 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
$VaR_{95\%}$	-2.19%	-2.55%
$VaR_{99\%}$	-3.17%	-4.30%
$ES_{95\%}$	-2.79%	-3.69%
$ES_{99\%}$	-3.69%	-5.77%

TOP & BOTTOM 5 stocks (simple approach)

	VaR 95	VaR 99	ES 95	ES 99
CLNX	-0.55%	-0.57%	-0.56%	-0.59%
MRK	-1.07%	-1.57%	-1.38%	-1.84%
SGSN	-1.22%	-1.77%	-1.56%	-2.05%
LISP	-1.70%	-2.52%	-2.21%	-2.94%
MSI	-1.76%	-2.58%	-2.26%	-3.00%

	VaR 95	VaR 99	ES 95	ES 99
TSLA	-5.38%	-7.81%	-6.87%	-9.04%
ROSE	-5.60%	-8.07%	-7.12%	-9.33%
DARK	-5.81%	-8.41%	-7.41%	-9.75%
AMBU-B	-5.95%	-8.56%	-7.56%	-9.93%
ENPH	-6.95%	-10.21%	-8.96%	-11.97%

TOP & BOTTOM 5 stocks (GARCH)

	VaR 95 (GARCH)	VaR 99 (GARCH)	ES 95 (GARCH)	ES 99 (GARCH)
CLNX	-0.50%	-0.50%	-0.50%	-0.50%
MRK	-0.40%	-0.79%	-0.67%	-1.22%
SGSN	-1.40%	-2.15%	-1.87%	-2.63%
AIZ	-1.62%	-2.51%	-2.17%	-3.06%
UMG	-1.19%	-2.79%	-2.46%	-5.51%

	VaR 95 (GARCH)	VaR 99 (GARCH)	ES 95 (GARCH)	ES 99 (GARCH)
AMBU-B	-6.88%	-11.87%	-10.15%	-16.18%
GLPG	-7.36%	-14.48%	-12.42%	-23.20%
TSLA	-8.63%	-14.66%	-12.54%	-19.54%
AG1	-8.37%	-16.49%	-14.09%	-26.05%
DARK	-7.79%	-16.48%	-14.18%	-28.38%

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:

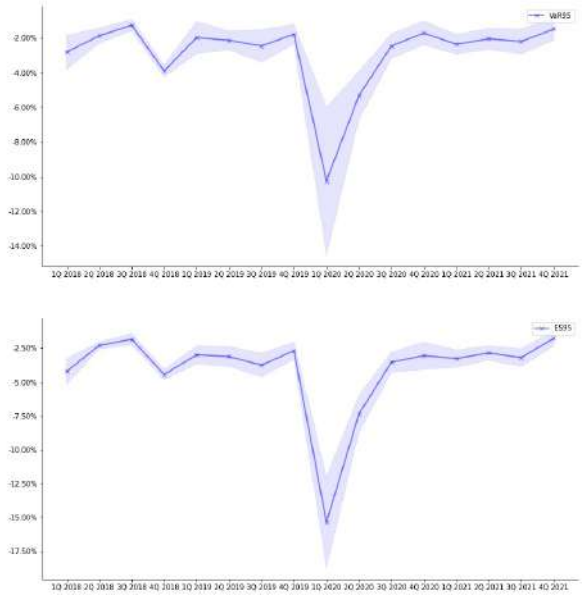
- Sample with replacement n times from the original sample (note that one observation could be selected more than once);
- Compute the metric of interest (in our case the VaR or ES) on this newly created sample and save it;
- Repeat the previous steps M times with M→+∞ (we have selected M=100.000 for 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
$VaR_{95\%}$	-2.15%	0.37%
$VaR_{99\%}$	-3.67%	0.44%
$ES_{95\%}$	-3.00%	0.32%
$ES_{99\%}$	-3.96%	0.36%

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 recovered significantly among the subsequent market rally and both returned to pre-COVID levels. We expect both indicators not to significantly deteriorate in the future. However, many headwinds for the global economy remain, ranging from the emerging Omicron variant of the coronavirus to how the incoming tightening of monetary policy would be handled by the FED and the ECB.

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 Q4 2021 the bands narrowed consistently due to the restoration of market confidence. We estimate that these bands will not significantly widen in the upcoming months and will remain at their current levels.