MIMS – Multi Asset Global Opportunities Fund

Portfolio Management Team

Report – May 2021

Fund description

MIMS – Multi Asset Global Opportunities Fund is an actively-managed fund by Minerva Investment Management Society, based on environmental, social, and governance (ESG) criteria.

The ultimate goal of this portfolio is to achieve long-term growth whilst controlling volatility. To that end, this fund will be comprised of a multitude of securities with the possibility, in exceptional cases, to take short term speculative positions. Hedging positions might be implemented through financial derivative instruments. To ensure diversification, this virtual portfolio is spread across geographies, sectors and asset classes, and is built through fundamental analysis, ESG integration and macroeconomic views.

In total, the asset allocation will aim to include around 40 different securities with a changing risky component to take advantage of contingent market conditions. The dynamic asset allocation prevents us from using a reference benchmark. The portfolio will be rebalanced every six months, with exceptional reviews to position for market shocks. The holdings only include instruments from the public markets, spread across equity, fixed income, real estate and commodities. ETPs might be considered to take additional exposures to niche markets.

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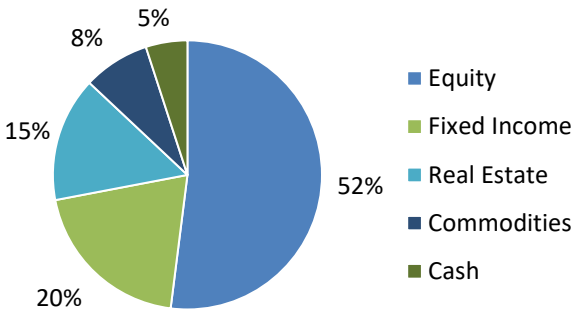
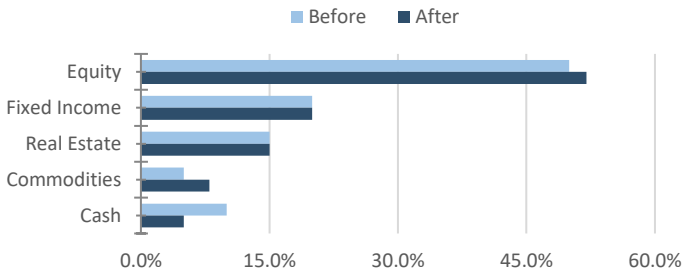
Asset Allocation



Results of the current rebalancing



Investment Approaches

Top-down approach

Starting from the macroeconomic outlook provided by the Macro Research Team, the Investment Team identifies appealing industries, geographies and asset classes for which the best-performing securities will be analyzed thoroughly.
The Team applies a shared approach to the different asset classes by considering the main return drivers for any holding.

Bottom-up approach

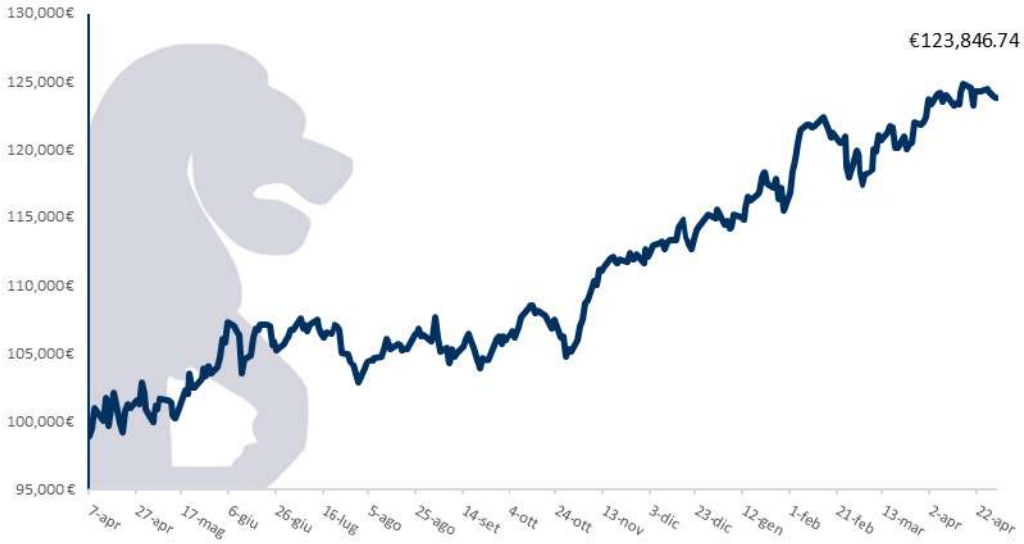
If a security stands out to one of the Investment Analysts, the suggestion is discussed with the Team and further analysis follows.
Long-term growth potential combined with high ESG standards and limited risk downsides both on a micro and macro level are required to consider the investment.

Research contribution

The investment process uses internal research produced by the Research division of Minerva IMS.
The Macro Team provides the outlook underlying the top-down approach. The Equity Team provides recommendations on potential stock holdings. Findings by the Markets and Alternatives Team are used for particular asset classes.

Performance since inception

07.04.2020 - 30.04.2021



Initial holdings have been monitored since 05.12.2019 and additional ones have been introduced on 24.03.2020. The official starting date for the portfolio is 07.04.2020, a second rebalancing took place on 23.11.2020, and a third on 10.05.2021. The analysis considered the cumulative gain over the entire period since inceptions. Any security is held only in a discrete number, stock dividends and bond coupons are reinvested at the end of the day in which payments are received.

The fund value is measured at the close of each trading day. Corporate events, dividend reinvestment and fund rebalancing are carried out at the market close. Considering an initial value of € 100 000 at the market open of 07.04.2020, the portfolio reached a final cumulative value of € 123,847 at the close of 30.04.2021.

	1 month	2 months	3 months	Since inception	Daily Volatility	Sharpe Ratio
Multi Asset Fund	1.19%	5.05%	7.19%	23.85%	0.71%	1.82

Top 5 Holdings

Security	Weight
APPLE	4.0%
ALPHABET	4.0%
ANHUI CONCH CEMENT	4.0%
TOYOTA	4.0%
ASML	4.0%

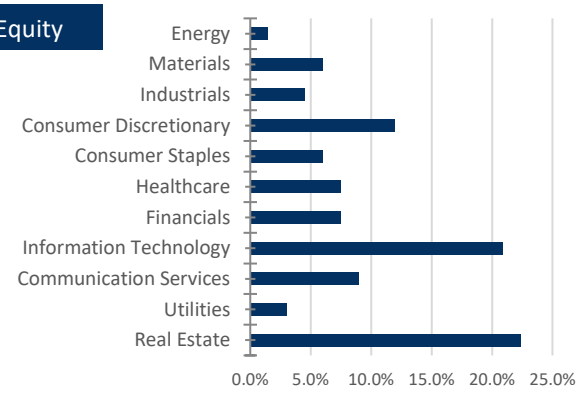
Top 5 Countries

Country	Weight
USA	44.3%
ITALY	14.8%
JAPAN	9.2%
CHINA	7.9%
FRANCE	6.7%

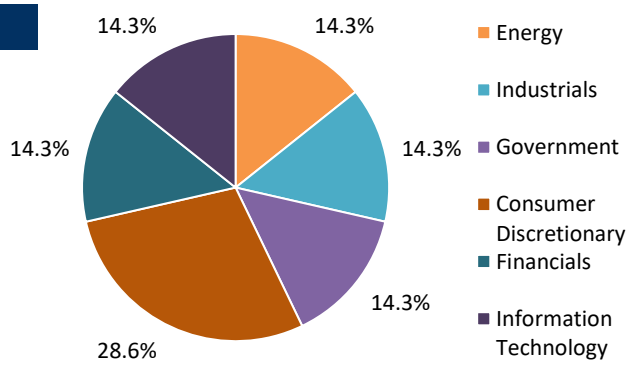
Note: the weights are a product of a mean-variance optimization with cap at 4% and floor at 1%.

Sector breakdown

Equity



Bond



Source: Minerva Investment Management Society and Bloomberg. References of the analysis of this report are available upon request.

PORTFOLIO OVERVIEW

The rebalancing of the portfolio has been carried out with the idea of 'building' instead of 'cutting'. Indeed, if certain ideas have not been profitable in the last six months, it is important to remind that each investment is taken with a long-term view of approximately five years. In any case, before looking for new investments, we have carried out a deep analysis of the previous securities to assess their soundness.

EQUITY

Our portfolio now comprises twenty companies diversified both geographically and by industry. As it is deepened in the following pages, we basically worked on four sectors. First, we saw a great opportunity coming from the Financial sector, which can profit from an increase in interest rates. Second, we increased our position in consumer discretionary in US following the trillions-dollar stimulus packages. Third, among the different sub-sectors of the semiconductors, we opted to invest in the DRAM industry where Micron Technology is an important player. Fourth, we aim to take advantage from the opportunities in the telehealth with M3, located in Japan. The last novelty comes from an Equity Research finding. As all the Minerva divisions worked to deepen our knowledge of the Chinese market, we took the advice to invest in Anhui Conch Cement, the largest cement manufacturer or seller in the mainland China.

FIXED INCOME

We are currently exposed to seven different bonds from different emitters. As the Market Division suggested us, we decreased our duration by divesting from the AT&T bond with maturity in 2035, as it would have been very exposed to increases in interest rates.

This way our portfolio comprises only bonds with maturity less than ten years from the current rebalancing. At the same time, we opted to diversify both by sector and by country. The two new entries are indeed a 2026 maturity TIPS (Treasury Inflation Protected Security) and a 2022 maturity bond from Central China Real Estate, as suggested by the Market Research Division.

REAL ESTATE

We increased our Real Estate components from four to five REITs (Real Estate Investment Trusts). Importantly, the five REITs operate in different fields. Indeed, our philosophy is to invest in a number of specialized (not general) REITs in order to cover as many segments as possible. Indeed, we spatiate from industrial to residential, from providers of data centers to innovative REITs which propose to revolutionize ground leases such as Safehold. After the current rebalancing, we aim to take advantage from healthcare related properties with CareTrust REIT.

COMMODITIES

We increased our position to five different commodities: Gold, Copper, Oil, Nickel, Lithium. The last two new entries, whose rationale is carefully explained in a dedicated page. Regarding the first three, we are aware of the recent increase in the price of many commodities. However, we opted to maintain our exposure after this rebalancing for reasons which are idiosyncratic to each one of them. For instance, regarding copper, (one of the most hyped commodities) we are bullish on a strong demand for its use in power generation as the 'world moves towards a low carbon energy future' (World Bank, 2017). Gold still represents a safe haven security as inflation points up and oil price may be sustained by a strong demand in the foreseeable future as forecast by OPEC.

New Idea: Financials in Europe

Intesa & UBS

As it concerns our choice for the industry, we focused on financials in Europe considering the performance of this sector during the Covid-19 pandemic and for its prospects during the recovery phase. The Financial Services sector has outperformed the market by 13.2%. Moreover, an expected increase in marginal interest rates for the economic revival is likely to make commercial banks able to take advantage of it by increasing the marginal profitability on deposits. The upward movement of interest rates could lead to institutional, organizational and capital strengthening of commercial banks in Europe.

Investment Idea:
Our idea for financials in Europe is to invest in two stocks: Intesa Sanpaolo S.p.A. and UBS Group AG. The first Italian bank has delivered a solid performance despite the Covid-19 crisis and has been able outperform the market by 15%. More interestingly, the merger by incorporation of UBI Banca S.p.A. into Intesa Sanpaolo S.p.A. was filed on 29 January 2021. This combination is likely to yield substantial synergies, the expected yearly amount is over €1 bn. Intesa Sanpaolo proves to be a safe and reliable financial with a growth outlook.

The second stock we considered for our investment is UBS which is more focused on the investment bank sector and has delivered an outstanding performance in the last years. It has experienced great financial results in 2020, with an earnings increase of + 54%. Moreover, in the past year UBS has outperformed the S&P 500 by 28.0% and its sector by 14.8%.

Another factor that we considered is UBS's relatively low exposure in Archegos scandal. UBS proved to be a resilient and stable investment compared to its competitors and represents a solid investment with very attractive future prospects in terms of revenue and profitability.

New Idea: Health Care in Japan

M3

Japan is the second largest healthcare market in the world, with over 180,000 medical facilities. The country's national medical expenditure was a whopping ¥43.4 trillion as of the year 2018, having grown significantly year-on-year for over a decade; its national medical expenditure being ¥37.4 trillion in 2010. With nearly 45% of their medical devices being imported, the rapidly advancing medical technology being used in conjunction with their population (one of the world's most aging populations), the Japanese healthcare industry is incredibly vast, wildly competitive and difficult to successfully penetrate. Japanese citizens are all covered by extensive public medical insurance systems - culturally they also happen to be remarkably health-focused which contributes to the widely-recognized stability of the healthcare industry in Japan; that has maintained not only it's size but it's growth rates through any and all economic climates. M3, Inc. engages in the provision of medical related services through the Internet. It operates through the following segments: Medical Portal, Evidence Solutions, Overseas, Clinical Platform, and Others.

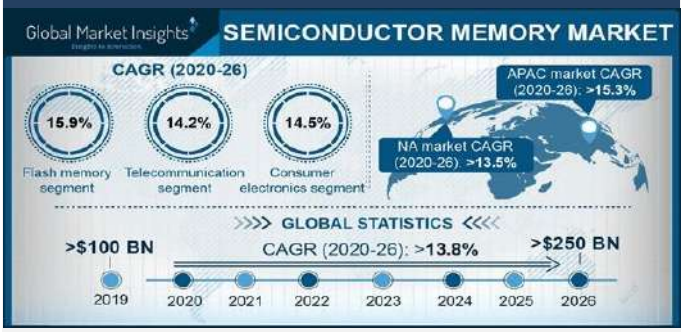
The company has a market capitalization of ¥5.14 trillion and was founded on September 29, 2000 and is headquartered in Tokyo, Japan. As a company that provides healthcare-related services through the internet, the global pandemic has benefitted them greatly. This can be substantiated by the unprecedented growth they've experienced as can be seen in the figures below. Average growth rates across the past five years (ending 03/31/2020) are the following: Revenue (+20.51%), Net Income (+14.59%), Earnings Per Share (+13.02%), Capital Spending (+56.04%), Gross Margin (+57.81%) and Cash Flow (+22.61%). Top competitors include WebMD Health, Kantar Health; with M3 Inc. being the outperforming when held up against the others in terms of revenue. M3 Inc., is differentiated in the sense that they provide more personalized services than their competitors. Fundamentals are quite reasonable across the board with an attractive Profit Margin of 53.26% and Return on Equity of 16.34%. The stock price grew significantly over the past year. Growth from this point onwards is hotly contested as some believe that the worst of the pandemic (which was highly beneficial to the company) is over and there could be potential deflation/correction as the world recovers from the pandemic while others believe the convenience of certain services that grew popular through the pandemic are here to stay.

Projected value for M3 Inc. currently is approximately ¥10,100. Given the unprecedented growth the company has experienced over the past year (attributed almost solely to the pandemic), while there remains expected growth potential, returns in the short term are not anticipated. This investment's success relies on the premise that a global shift in consumer preference to online services (where possible and/or convenient) will, for the most part, continue to be the case even when physical services are possible.

As an investment it will have to be a long-term position in order to experience notable upside.

Focus: Semiconductors and DRAM

Micron



Intro Semiconductors. The semiconductor industry is relatively young: it originated in the US with the invention of the transistor in 1947. Semiconductors are the brains of modern electronics, enabling highly advanced technologies in healthcare, communications, computing, and transportation, among many other applications. The industry's global market size is expected to grow by USD 90.80 billion during 2020-2024, progressing at a CAGR of over 4% during the forecast period.

Despite its high-tech character, the market for semiconductors is extremely capital intensive as it requires large investments for manufacturing as well as for R&D. Another fundamental characteristic of this market is the cyclicality: when times are good, high demand causes supply shortages and leads to higher prices and revenue growth. This encourages chipmakers to boost capacity which will eventually lead to higher (over-) supply and therefore falling prices and negative revenue growth.

We are now at the point in the cycle where there is an evident global chip shortage that began roughly in Q2 2020 when chipmakers saw surging demand for semiconductors used to enable remote healthcare, work-at-home, and virtual learning, which were needed during the pandemic. In the long term, even considering the cyclicality of the industry, global demand for chips is bound to rise as they are essential in the development of secular growth areas

of technology, to name just a few, electronic vehicles and 5G.

The above considerations justify our investment pick: Micron Technology, Inc., founded in 1978 and headquartered in Boise, Idaho.

Company Overview:

Micron is one of the largest makers of memory chips in the world. The memory chip market is a very specific niche within the semiconductor manufacturing industry. The two main products that Micron manufactures are DRAM and NAND. While most companies (including Intel) compete in the NAND market, Micron is the only American player in the DRAM market where the top three players (Samsung, SK Hynix and Micron), control ~95% of the market. The oligopolistic nature of the market with its high barriers to entry has allowed participants to enjoy high margins and high ROE.

Balance Sheet:

Micron has a significant portion of its assets invested as Property, Plant and Equipment (32bn over total assets of 54 bn) as can be expected considering the significant investments required in the industry. Notwithstanding that, its balance sheet remains surprisingly liquid with a current ratio of 3.1x and a quick ratio of 1.9x. Growing its balance sheet without overshooting on debt financing, Micron has slowly reduced its D/E ratio over time, leading to an LTM result of around 18%.

Income Statement:

Micron delivered a Q2-2021 revenue of $6.24 billion, up 8% quarter-over-quarter and up 30% year-over-year. However, behind this impressive revenue growth, one should also account for the high cyclicality of the business discussed earlier. Thanks to the increase in DRAM prices and cost declines, gross margins expanded to 33% (a 2% increase from the prior quarter). Finally, quarterly net income was 600 million for a total yearly result of 3.2 billion.

Valuation:

The company almost doubled its market capitalization in the last year, going from $50 billion in September 2020 to around $94 billion as of April 2021. However, the company still trades at reasonable multiples, especially compared to its peers in the industry. The actual P/E is 31x, and factoring in expected growth, either through a PEG (0.5) or through NTM P/E (9x), the valuation becomes even more appealing.

A two-stage DCF valuation allowing for 7 years of "high" growth (starting from 20% and decreasing to 10%) followed by "stable" growth in perpetuity (3.5%) delivers an implied valuation of around 87$.

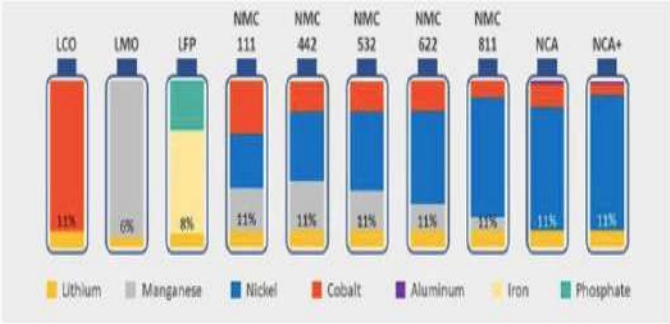
Conclusion and Threats:

Overall, despite the recent run-up, we believe Micron still has room to grow. The last quarterly results were significantly above analyst's expectations: the sales growth was the strongest since Q4 FY18 and extended a streak of four straight quarters of double-digit revenue expansion.

To conclude, some geopolitical considerations and possible investment risks. On the one hand, being the only American player in the chip memory business, Micron is likely to benefit from governmental policies aimed at sustaining national producers. On the other hand, China might constitute a source of uncertainty. Due to the current trade war, the company was forced to halt its sales to Huawei, historically one of its most important customers. Moreover, China's prospects of becoming independent in the production of semiconductors by 2030 may deprive foreign producers of a significant market share.

The stock price is currently trading at a high PE multiple of 78. However, if we look at the forward PE multiple, we see that it's not trading far from its historical mean of 60.

Commodities



Our new portfolio strategy has overweighted commodities allocation in terms of relative weights and new entries, to bet on the green energy mega trend.

The investment idea is based on solid researches highlighted in few crucial points.

First of all, Covid-19 has clearly accelerated the transition process to clean energy and new investments in infrastructures and technologies are worldwide increasing.

One of the most exposed sector is the automotive ones, which is considered by analysts a real game changer for green energy transition process. Consequently, the automotive trend has benefitted for governments incentives and policies, more in-depth automotive car-makers are converting their existing vehicle models in electric ones increasing, simultaneously, R&D investments to find out new technologies and applications.

Our investment philosophy

Considering this trend, our investment idea is focused on the roots of the electric process. We analyzed in detail electric vehicles batteries (BEV) in order to catch more closely the green idea.

EV batteries demand is developing fast, and this implies a high amount of materials needed. The main commodities used in the production are Nickel, Lithium and Cobalt. Following a more general idea of ESG investment we excluded Cobalt from the analysis because of troubles related with mining pollution and child exploitation in DR Congo mines, where Cobalt is extracted.

Lithium: Global X Lithium & Battery Tech

Lithium is an essential commodity for the current BEV but also for near future development of clean energy. The percentage of Lithium Hydroxide in BEV is about 10% in each kind of Lithium-Ion battery (NMC 111, NMC 622, NMC 811) and the properties of this commodity are at the basis of the entire electrification process.

Lithium supply sector is expanding extremely to cover the increasing demand and new entries in the sectors are expected in the next years, so we anticipate a more stable supply/demand mechanism and consequently a less volatile price for this commodity.

The security we add to the portfolio is an equity thematic ETF which invests in the full lithium cycle, from mining through battery production. This investment in the lithium chain gives us a complete and significant exposure to the leading green commodity.

WisdomTree Nickel (NICK.MI)

Nickel is considered the commodity of the future and it is suffering a lack of supply.

79% of Nickel mined in the world is used for stainless steel production and so subjected to a stable demand, especially from China. Despite BEV seems not to be the main Nickel product, EV batteries contained a percentage in a range between 50-60% of this commodity depending of the alloy. The need of this commodity in BEV production is due to its heat and corrosion resistance which are fundamental to lithium ions exchanges between cathodes, in other words, to guarantee the entire green electricity generation process.

For this reason, one of the most crucial challenge in the next future is to increase the production of Nickel to cover the higher expected demand.

We find an investment in ETC more suitable than entering in a futures contract, in order to have more liquidity and price stability. Definitely, we expect a rapid growth returns supported by the raising demand and the lack of supply

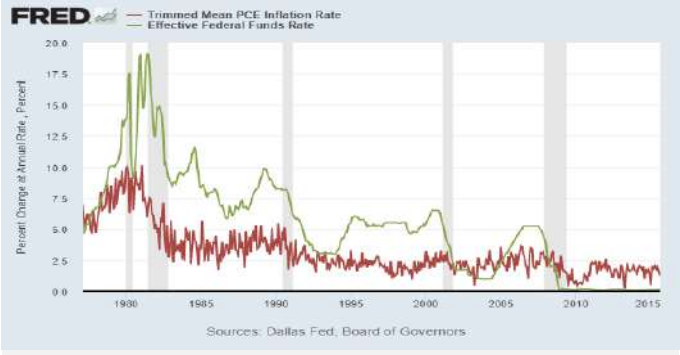
Bonds: belts fastened

A resilient portfolio has to cope with the artificial low-interest world that we discovered with the beginning of quantitative easing policies by central banks and that has been 'supported' by the strong monetary response to Covid-19. After discussing with team from Market research we concluded that it was worth doing basically three things:

1. Decrease our duration. When interest rates increase, the long-duration bonds are the most affected as the price variation is strictly linked to the value of the duration. We decided to sell the AT&T bond whose maturity is in May 2035.

2. Bet on a higher-than-expected inflation. The actual 10-year Breakeven Inflation Rate (a measure of the expected inflation implied in non-indexed and indexed securities) stands at 2.4% while some investors are ready for higher levels of inflation in the US. This convinced us to invest in TIPS (Treasury Inflation-Protected Securities) since there is the opportunity to profit from capital gains.

3. Diversification. As our bond's emitters were only based in Europe and US, we opted to invest in a High Yield bond from Central China Real Estate, the leading construction company in China's Henan province. This security has been carefully analysed from the Market Research team and we saw a good fit for our portfolio, as it decrease the duration (maturity is in August 2022) and offers an interesting YTM above 5%.

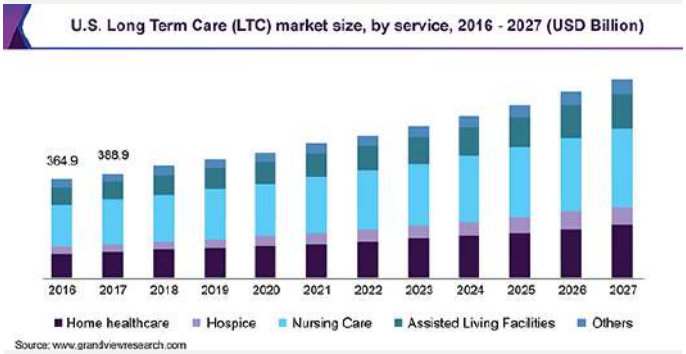


Real Estate: ready for the new elderly world

As the 'Silver Tsunami' (i.e., the expected increase in the senior population) is soon to arrive, we decided to analyse some securities that may profit from it.

Finally, our decision has been to invest in CareTrust REIT, which focuses on 'smaller healthcare operators and looking at consolidation of ownership in a very fragmented market'. Among the properties it owns, It has 158 skilled nursing facilities and 39 assisted living facilities across 28 states leased to 22 different tenant-operators. Importantly, almost all the properties operate under a triple net lease (triple-Net or NNN) which is a lease agreement whereby the tenant promises to pay all the expenses of the property including real estate taxes, building insurance, and maintenance.

Even if its price saw a big increase during 2020, there may be still some upside thanks both to the demographic trends and to strong fundamentals. Over the past five years, the average raise in the dividend has been an interesting 9.75% per year reaching a current yield of 4.4% which may increase also in the foreseeable future.



In the figure above you can see that the long term care (LTC) is expected to see a huge increase because of, among others, aging baby boomers and government funding. Moreover, insurance payers, along with Medicare and Medicaid, are funding long term care solutions so that the middle-aged demographic group can benefit from it.

Risk Management Team

Report – May 2021

Introduction

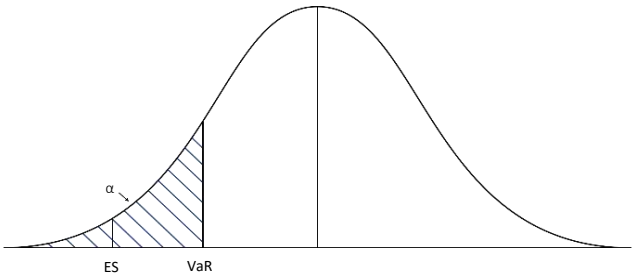
The main objective of this section is to assess and quantify the risk embedded in the Minerva IMS Multi Asset Global Opportunities Fund built by the portfolio team. We use a daily perspective on the potential extreme behavior of a basket of assets selected by the portfolio analysts. The analysis will include three VaR and ES models (two parametric and one non-parametric) and an advanced Markowitz optimal selection model.

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 Jul.19 – Apr.21. All the analysis ha 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 considering the correlation between portfolio constituents.

Parametric approach assumes 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 100 return observations, which correspond almost to 4-months 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.

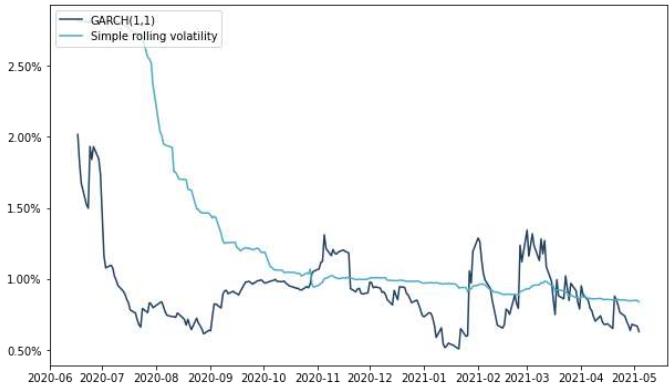
Time-series modelling approach

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 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
$VaR_{95\%}$	-1.63%	-1.50%
$VaR_{99\%}$	-2.40%	-2.50%
$ES_{95\%}$	-2.10%	-2.15%
$ES_{99\%}$	-2.80%	-3.28%

Since the last publication of Risk report, VaR (both from simple approach and GARCH) ha 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
Gold (GC=F)	-1.97%	-2.85%	-2.51%	-3.33%
Toyota (TM)	-2.11%	-3.06%	-2.69%	-3.55%
Italgas (IG.MI)	-2.18%	-3.16%	-2.78%	-3.67%
Nickel	-2.28%	-3.32%	-2.92%	-3.86%
Nestlè India	-2.37%	-3.40%	-3.00%	-3.94%

BOTTOM 5 stocks (simple approach)

	VaR 95	VaR 99	ES 95	ES 99
Bayer (BAYN.DE)	-3.94%	-5.86%	-5.14%	-6.98%
M3 (2413.T)	-4.08%	-6.02%	-5.27%	-7.05%
Micron (MU)	-4.24%	-6.15%	-5.42%	-7.12%
Airbus (AIR.PA)	-5.38%	-8.37%	-7.25%	-10.26%
ViacomCBS	-6.28%	-9.11%	-8.01%	-10.55%

TOP 5 stocks (GARCH)

	VaR 95 (GARCH)	VaR 99 (GARCH)	ES 95 (GARCH)	ES 99 (GARCH)
Italgas (IG.MI)	-1.59%	-2.30%	-2.03%	-2.66%
Safehold INC (SAFE)	-1.97%	-3.22%	-2.77%	-4.11%
Prologis Inc. (PLD)	-1.97%	-3.22%	-2.77%	-4.11%
Equity Residential	-2.04%	-3.20%	-2.77%	-3.96%
Toyota (TM)	-2.22%	-3.70%	-3.18%	-4.86%

BOTTOM 5 stocks (GARCH)

	VaR 95 (GARCH)	VaR 99 (GARCH)	ES 95 (GARCH)	ES 99 (GARCH)
Lithium (LIT)	-3.83%	-6.81%	-5.78%	-9.37%
Bayer (BAYN.DE)	-4.19%	-7.66%	-6.54%	-11.19%
ViacomCBS	-4.76%	-8.36%	-7.11%	-11.33%
Intel (INTC)	-4.81%	-9.09%	-7.73%	-13.53%
Disney (DIS)	-5.49%	-11.12%	-9.52%	-18.15%

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:

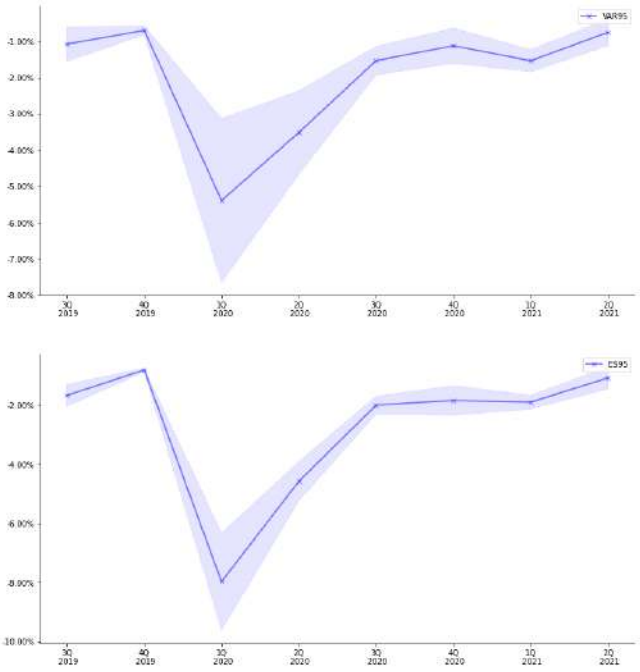
- Sample with replacement n times from the original sample (note that one observation could be selected more than once);
- Compute the metric of interest (in our case the VaR or ES) on this newly created sample and save it;
- Repeat the previous steps M times with M→+∞ (we have selected M=100.000 for 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
$VaR_{95\%}$	-1.50%	0.21%
$VaR_{99\%}$	-2.52%	0.68%
$ES_{95\%}$	-2.15%	0.29%
$ES_{99\%}$	-3.14%	0.77%

Quarter analysis

With this method we have enough metrics to inspect the behavior of this fund composition in the last 8 quarters.



As it is possible to notice from the graphs above, the first quarter of 2020 showed a huge increase in the portfolio VaR and ES at a confidence level of 5%. This specific window represents the months of February and March in which the majority of the stocks lost value and markets experienced an increase in volatility, as can be noticed by the widening of the standard errors bands.

However, in the following quarters, this particular stocks composition recovered very rapidly to the pre-crisis values; if this trend persists in the following months, the portfolio will experience moderate losses.

Expected Shortfall Markowitz Optimization

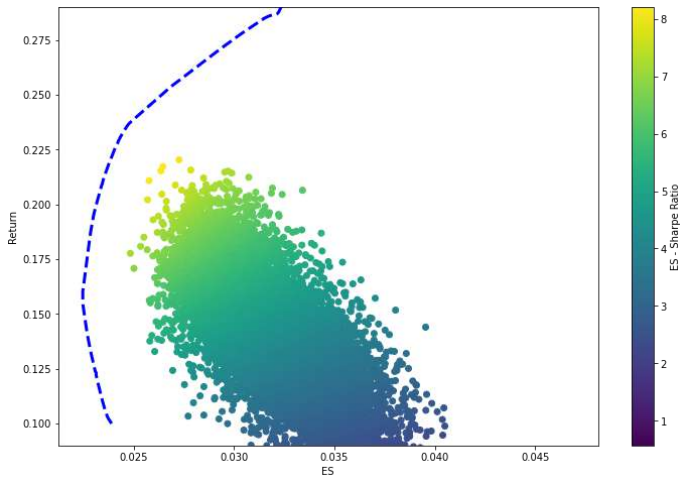
Modern portfolio theory, developed by Harry Markowitz in the 50s, is based on the idea that investors are risk adverse and therefore would only take on riskier investments if they provide a higher expected return. This idea allowed us to build portfolios with various risk/return profiles and therefore give the investor the option to choose the portfolio that best suits his risk profile.

Classical Markowitz model uses volatility as risk measure while, in our framework, we decided to use the Expected Shortfall for evaluating the riskiness of our securities.

The problem of finding the best portfolio can be stated from a purely analytical perspective by minimizing the risk (ES) for each possible return. We added the constraints that the weights must sum to one and the weights must be positive as we are only going long. In the formulas below $\mathrm{K_{xx}}$ represents the variance covariance matrix for our portfolio, **w** represents the weight of each stock and $\boldsymbol{ES_{95}}$ is the vector of the stocks' Expected Shortfall with α=5%. Mathematically the problem can be framed as follows:

$$\min \sqrt{ES_{95}^{T}\mathrm{w^{T}K_{xx}w}\,ES_{95}}$$

$$\text{subject to} \sum_{i} \mathrm{w_i} = 1 \text{ and } \mathrm{w_i} \geq 0$$



The solution of this minimization problem is the Efficient Frontier, a branch of hyperbola that represents the optimal portfolios to be chosen for different risk profile. An investor therefore can select the best portfolio for his preferred level of risk.

The plot shows the efficient fronter where the optimal portfolios lie. The dots are 10,000 simulated portfolios and their positions in the return-ES plane. Moreover, on the right axis we a color map for the ES-Sharpe Ratio, that is simply the ratio between the return and the expected shortfall (we assumed a risk-free equal to 0 for simplicity); instead of defining a risk-profile for our average investors, we decided to pick the best portfolio by looking at this metric: the higher the better.

Finally, to account for the fact that some of our equities where slightly correlated we added two additional constraints. We made sure the optimal weights were between 1% and 4% otherwise we would have a very unbalanced portfolio. The optimization resulted in the following weights for the equity selection.

Stock	Weight	Stock	Weight
AIRBUS	3.00%	TOYOTA	4.00%
ALPHABET	4.00%	ANHUI	4.00%
APPLE	4.00%	VIACOMCBS	1.00%
ASML	4.00%	M3	4.00%
BAYER	1.00%	UBS	1.00%
INTESA	4.00%	EQUINIX	4.00%
DISNEY	1.00%	EQUITY_RES	2.00%
ENI	1.00%	PROLOGIS	4.00%
MICRON	4.00%	SAFEHOLD	4.00%
INTEL	1.00%	CARETRUST	1.00%
ITALGAS	1.00%	COPPER	2.00%
MONCLER	4.00%	CRUDE OIL	1.00%
NEOENERGIA	1.00%	LITHIUM	3.00%
NESTLE_IN	4.00%	GOLD	1.00%
SAP	1.00%	NICKEL	1.00%