

MIMS – Multi Asset Global Opportunities Fund

Portfolio Management Team

Report – May 2025

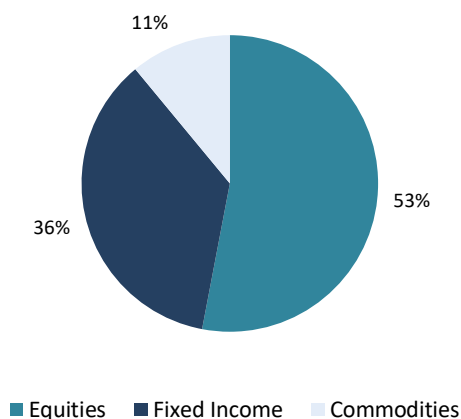
Fund description

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 30 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.

Asset Allocation



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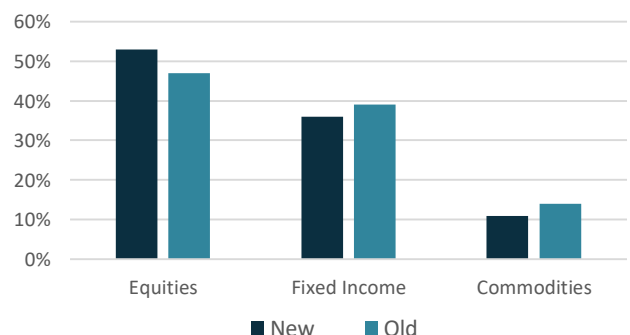
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Asset Class Rebalancing



Investment Approaches

Top-down approach

Starting from a macroeconomic outlook, the investment analysts identify a particularly appealing industry or geography of which the best operating corporations will be analyzed thoroughly. A strong growth potential combined with high ESG standards is of crucial importance.

Bottom-up approach

If a security stands out to one of the investment analysts, a detailed analysis is to be done with a bottom-up approach. From that point, an internal discussion follows in order not only to contemplate the validity to the suggested investment, but also to assess the fitting within the portfolio in terms of risk-return contribution as well as diversification considerations.

Equity Research Team

An equity investment can be undertaken following a suggestion by the Equity Research Team of Minerva IMS. This work is revised in the light of new events and company news which might have occurred since the release of the equity research report.

Performance

14.11.2024- 28.04.2025



Update on performance

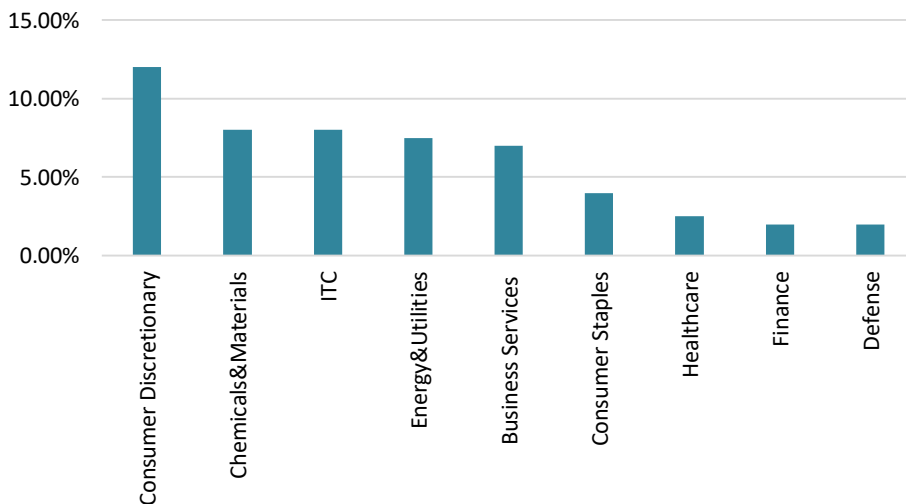
During the current semester, the fund achieved a profit of 2.23%, increasing from €9,958,052 to €10,179,641, corresponding to an annualized performance of 4.92%.

The fund's returns were volatile, mainly due to the equity component. Overall, however, the net performance remained broadly in line with that of a 50/50 equity-bond portfolio. Equity markets were relatively flat during the period, and our individual selections performed reasonably well.

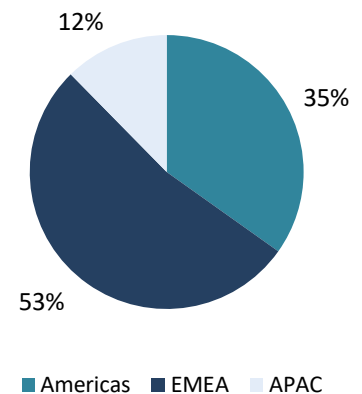
Methodological note

The analysis considered the cumulative gain over the entire period since inception. Stock dividends 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.

Portfolio Breakdown by Sector



Portfolio Breakdown by Geography



Top 10 holdings

Security	Weight	Security	Weight
Spain 3.45% OCT34 EUR	8.00%	MercadoLibre	4.00%
Bundesrep.Deutschland Anl.v.2022 (2032)	6.00%	BTP FX 3.2% JAN26 EUR	4.00%
Venture Global LNG 7.75% 2035 bond	6.00%	BTP 0.45% FEB29	4.00%
UK (0.125% 30/01/2026 (LSE:T26))	5.00%	ASML	3.00%
Gold	5.00%	Uranium	3.00%

Our view for the next six months

-  Liquidity ensures tactical flexibility
-  Increased volatility
-  Relocation of capital to the Eurozone

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New entries

- ↗ Bundesrep.Deutschland Anl.v.2022 (2032)
- ↗ Venture Global LNG 7.75% 2035 bond
- ↗ UK (0.125% 30/01/2026)
- ↗ Titan Cement
- ↗ Tata Consumer
- ↗ Pt Adaro Andalan
- ↗ Trip.com
- ↗ Miniso Group
- ↗ Alfen
- ↗ Eramet
- ↗ Nu Holdings
- ↗ Equinor
- ↗ Siemens
- ↗ Adyen

Outs

- ↘ Abbott India
- ↘ Copper
- ↘ Eu Tf 0,25% Ot26 Eur
- ↘ EUUNI 0.700 06-JUL-2051
- ↘ ROMANIA TF 2,124% LG31 EUR
- ↘ Snam
- ↘ UST 3.875 30-NOV-2027
- ↘ Walmart

REBALANCING RATIONALE

As per fund approach, every 6 months the portfolio is rebalanced. We monitor in depth the evolution of our securities' prices and when we believe they have reached our target or when we recognize that they are positioned sub-optimally due to changing economic conditions, we substitute them with other securities with higher potential.

EQUITIES

New equity investments have been carefully selected based on a bottom-up approach. The focus of the placement was industrial transformation and electrification, digitalization and emerging market consumption. We reduced exposure to the US and instead rebalanced globally, keeping strategically defensive plays.

FIXED INCOME

Given the volatile macroeconomic climate, the fixed income component is tailored to maximize yield while minimizing duration risk. Hence our strategy prioritizes EUR-denominated bonds to hedge against the ongoing USD depreciation, driven by global capital outflows and rising trade tensions under the Trump administration. USD exposure risks FX-driven return erosion. Therefore, we favor short maturities (2–5Y) and increase the overall liquidity of the portfolio. On top of this slowing European growth may prompt earlier-than-expected ECB rate cuts, supporting short-term bond prices.

COMMODITIES

We have chosen to maintain a substantial allocation to commodities within the portfolio. Exposure to Gold (increased) and Natural Gas is retained given persistent geopolitical tensions and their safe-haven or strategic value. Conversely, we have closed our position in Copper, as we believe it has reached a level that sufficiently prices in recent upside drivers. Our investment thesis for Uranium remains unchanged.

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Siemens AG

Company overview:

Founded in 1847 and headquartered in Munich (Germany), Siemens AG is a leading international company focused on electrical engineering and electronics through industrial automation, digitalization, electrification, and mobility. The company provides cutting-edge solutions for intelligent infrastructure, digital industries, and transportation, with a focus on sustainability and innovation.

Financial analysis:

In FY24, Siemens generated €78.1 billion in revenue, a 9.4% year-over-year increase, with its Digital Industries segment achieving a 22.3% margin. The company's return on capital employed (ROCE) of 15.2% significantly exceeds the peer group average of less than 10%, reflecting operational excellence. In Q1 2025, Siemens reported €18.4 billion in revenue (+3% on a comparable basis), with orders reaching a record €118 billion. The Industrial Business margin was 14.1%, and net income surged 52% to €3.9 billion, driven by the sale of its Innomotics business.

Considerations:

Siemens is optimally positioned to capitalize on the industrial automation and electrification megatrends driving the European Union's and the United States' decarbonization initiatives, especially as featured by the EU's Green Deal infrastructure plans and smart grid investments. Its Smart Infrastructure and Mobility businesses are witnessing strong momentum fueled by a massive jump in orders. Despite a revisiting of the green shift on a scaled-down basis, its diversified portfolio and record order book provide good growth prospects; nonetheless, manufacturing declines worldwide, especially in Germany, represent a threat.

Adyen N.V.

Company overview:

Founded in 2006 and located in the city of Amsterdam (Netherlands), Adyen N.V. is a global payments platform that provides end-to-end payment solutions for businesses. Its unified solution supports online, retail, and mobile payments and serves big-name customers like Nike and eBay within the industries of e-commerce, retail, and hospitality.

Financial analysis:

In H2 2024, Adyen's net revenues grew 22% year-over-year to €1,082.7 million, driven by onboarding over 200 new enterprise clients, including high-quality names like Nike and eBay. The company's focus on large, integrated clients has improved its revenue mix, contributing to a recovery in profitability following margin pressures in 2023. Adyen's scalable platform supports high transaction volumes, positioning it to capture growing digital payment flows.

Considerations:

Adyen's recovery from a challenging 2023 highlights its resilience and premium enterprise client focus. The company's cross-border payments platform benefits from growing cross-border volume within e-commerce, while its global footprint and full-stack model give it a structural advantage. With the worldwide increase in digital payments, Adyen should be positioned for continued expansion. However, the competitive environment within the payments sector and potential margin erosion due to the onboarding of new clients represent two significant challenges. Its current valuation, as represented by a forward price-to-earnings ratio of 16.5 times (below historical averages), suggests undervaluation against its forecasted 12% compound earnings-per-share growth earnings per annum through 2027.

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Equinor ASA

Company overview:

Founded in 1972 and headquartered in Stavanger (Norway), Equinor ASA is an integrated energy company with operations in oil, gas, and renewable energy. It is a leading producer of hydrocarbons in Europe and is currently expanding its renewable portfolio, including offshore wind and carbon capture technologies.

Financial analysis:

Equinor gained an approximately 10.2% free cash flow yield during FY24 and reserved over 30% of its budget for renewables. A possible underpricing is indicated by its price-to-earnings ratio at 7.1x and Enterprise Value to EBITDA of 3.4x. Its robust cash flows are supported by stable production from the Johan Sverdrup field and strong European LNG demand, particularly following Russian sanctions.

Considerations:

Equinor's growth is supported by stable cash flow from its oil and gas assets (the "old" business model) and growing investments in renewables (the "new" business model), making the company unique in the industry. The key drivers of the growth are increased European LNG demand, new offshore wind developments, and steady, consistent production from key fields. The company is spending a lot on renewables, aligning with the EU's vision of carbon neutrality. Equinor is also characterized by an attractive value due to a low price-to-earnings multiple and a great free cash flow yield. There are risks such as fluctuating oil and gas prices and potential delays on renewable projects execution.

Nu Holdings Ltd.

Company Overview

Founded in 2013 and headquartered in São Paulo, Brazil, Nu Holdings Ltd. is a leading digital financial technology company in Latin America, best known for its flagship platform Nubank. As the largest digital bank in Brazil, Nu Holdings has disrupted traditional banking by offering a seamless, mobile-first financial experience. The company provides credit cards, digital payments, personal loans, and savings products across Brazil, Mexico, and Colombia. It operates at the center of Latin America's rapidly evolving fintech landscape, benefiting from favorable regulatory developments such as Brazil's Open Banking initiative launched in 2020.

Financial Analysis

As of December 31, 2024, Nu Holdings served 114.2 million customers globally, a 22 percent year-over-year increase. In Brazil, it has become the third-largest financial institution by customer count, according to the Brazilian Central Bank. For full-year 2024, the company generated \$11.51 billion in revenue—up 58 percent on an FX-neutral basis—and net income of \$1.97 billion, nearly double that of FY 2023. Its efficient, low-cost operating model kept the cost to serve at just \$0.80 per active customer and improved the efficiency ratio to 29.9 percent in Q4 2024.

Considerations

Nu Holdings stands out in a region experiencing rapid fintech adoption, aided by pro-growth government policies and an increasingly digital-native population. Beyond its dominant position in Brazil, Nu is also expanding aggressively into Mexico and Colombia, fueling its international growth trajectory. Despite valuation concerns, the company's scalable platform, regional momentum, and solid backing from major institutional investors position it as a compelling growth play in the global digital banking sector.

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Tata Consumer

Company Overview

Founded in 1962 and headquartered in Mumbai, India, Tata Consumer Products is a key entity within the Tata Group, operating in the fast-moving consumer goods (FMCG) sector. The company's portfolio spans tea, coffee, bottled water, salt, pulses, spices, snacks, and ready-to-eat packaged foods. It operates through two main segments: the Branded Business, which delivers consumer-facing products under well-known labels like Tata Tea and Tata Salt, and the Non-Branded Business, which manages plantations and sources raw materials—primarily tea and coffee. With more than 70% of revenue generated in India, Tata Consumer maintains strong brand equity and is building an expanding presence in the US and UK.

Financial Analysis

Tata Consumer has demonstrated steady revenue growth and consistent profitability, with a net margin of approximately 7.5%. The company maintains a lean cash position due to its active M&A strategy, aimed at broadening its product offerings and enhancing its market position. While it doesn't trade at a discount, its valuation premium aligns with broader Indian equity markets, which have experienced a multi-year bullish trend.

Considerations

Tata Consumer stands to benefit from India's shift in fiscal policy—away from capital expenditure incentives and toward household-driven consumption support. Its deep penetration across diverse consumer segments and minimal reliance on international trade make it resilient to global disruptions such as tariffs or supply chain shocks. As the company continues to invest in brand-building and product innovation, it represents a compelling play on the structural rise of Indian domestic consumption, supported by favorable demographics and policy trends.

PT Adaro Energy

Company Overview

Founded in 2004 and headquartered in Jakarta, Indonesia, PT Adaro Energy Indonesia Tbk is one of the largest integrated coal mining and energy companies in Southeast Asia. The company operates across several key Indonesian coal basins, managing the entire value chain—from mining and logistics to power generation. While Adaro is primarily known for its low-pollutant sub-bituminous coal, it has also diversified into renewable energy and infrastructure, aligning partially with the broader energy transition while maintaining its core focus on fossil fuels.

Financial Analysis

Based on FY 2024 EPS of US \$0.0107, the stock trades at a trailing P/E of roughly 2.4x—well below regional peers—as well as an EV/EBITDA of 2.9 underscoring potential undervaluation. The company exited the year with an interest coverage of 15 and a net margin of 23%. While revenue declined in 2024, recent positive earnings revisions in Q1 2025, fueled by rising regional energy demand, support a bullish outlook.

Considerations

PT Adaro offers a compelling value play in the energy sector, combining deep local market integration with upside from resurgent energy demand. Despite the global pivot toward renewables, the near-term energy mix in Southeast Asia still heavily relies on coal, and Adaro is well-positioned to capitalize on this reality. Its low valuation, improving earnings momentum, and limited exposure to geopolitical shocks make it a strong candidate for investors seeking contrarian opportunities in emerging market energy.

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Alfen N.V.

Company Overview

Founded in 1937 and headquartered in Almere, Netherlands, Alfen N.V. is a leading player in Europe's energy transition. The company operates through three synergistic business lines: smart grid solutions, energy storage systems, and EV charging stations. This comprehensive portfolio positions Alfen as a key enabler of electrification across Europe—supplying everything from transformer substations and battery buffers to the infrastructure supporting electric vehicle adoption. As the continent accelerates its efforts to phase out internal combustion engines and move toward net-zero emissions, Alfen is at the center of this transformation.

Financial Analysis

Despite recent market headwinds—including falling battery prices and a temporary slowdown in EV sales—Alfen maintains a solid balance sheet and benefits from strong structural tailwinds. Hence FY 2024 marked a temporary contraction, with negative net income (-€27M) and EBIT (-€23M), the outlook for 2025 and 2026 shows a clear rebound, supported by projected revenue growth (to €538M in 2026), margin recovery (ROE rising to 10.01% by 2026), and positive free cash flow. The EV charging segment remains underpinned by EU-wide targets for public infrastructure expansion, reinforcing its long-term potential. From a valuation standpoint, the stock trades at a forward P/E of 29x (2025E), with EV/EBITDA dropping to 8.08x—well below historical averages. Following a sharp share price correction and with balance sheet strength (net cash position of €55M by 2026).

Considerations

Alfen offers an attractive risk-reward profile. While short-term pressures have weighed on investor sentiment, the company's exposure to critical electrification infrastructure, sound fundamentals, and alignment with EU climate policy make it a compelling long-term growth story.

Trip.com Ltd.

Company Overview

Founded in 1999 and headquartered in Shanghai, China, Trip.com Group is one of the world's leading online travel services providers. Through its suite of brands—including Trip.com, Ctrip, Skyscanner, and Qunar—the company offers a comprehensive platform for booking flights, hotels, trains, car rentals, and tours. While the bulk of its revenue is concentrated in Greater China (China, Taiwan, and Hong Kong), the group maintains a globally diversified footprint through international brands and platforms.

Financial Analysis

Trip.com Group has shown strong profitability with a 32% net margin in FY2024, significantly outperforming the industry average of 14.2%. After experiencing severe disruptions in 2020 due to the COVID-19 pandemic, the company has not only recovered but now surpasses pre-COVID revenue and income levels, signaling a robust rebound in travel demand, particularly in China. From a valuation standpoint, the company trades at a P/E ratio of 16.5, in line with industry peers, suggesting the market may not fully reflect its above-average profitability.

Considerations

Trip.com offers a compelling investment thesis centered on China's domestic recovery, supported by improving consumer confidence and government fiscal support. Additionally, the company's tech-driven infrastructure positions it well to capture value not only as a travel intermediary but also as a digital platform within the broader tech ecosystem. With renewed consumer momentum and a resilient financial profile, Trip.com stands out as a well-leveraged play on China's economic reopening and digital travel adoption.

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Miniso Group Holdings Ltd.

Company Overview

Founded in 2013 and headquartered in Guangzhou, China, Miniso Group is a global lifestyle retailer known for offering affordable, design-driven products spanning homeware, toys, beauty, and accessories. The brand applies a “fast fashion” model to everyday goods. Since its inception, Miniso has expanded rapidly and now operates over 5,500 stores worldwide, with a strong presence in Asia-Pacific and a growing footprint in the Americas and other international markets. Its global expansion is primarily driven by a franchise-heavy model, especially outside China, enabling scalable and capital-light growth.

Financial Analysis

Miniso derives approximately 79% of its revenue from the Asia-Pacific region, while 18.5% comes from the Americas, exposing it partially to geopolitical and trade risks. In FY2024, the company achieved a 15% net margin, reflecting improved profitability and disciplined cost control. Importantly, Miniso consistently generates positive free cash flow, with a dividend payout ratio around 50%, underscoring a commitment to shareholder returns. This financial resilience is bolstered by its asset-light operating model and tight supply chain integration.

Considerations

Miniso offers a defensive entry point into China’s discretionary retail sector. Miniso caters to demand for affordable, trend-sensitive items—making it well-positioned for a gradual rebound in consumption.

er spending. Its franchise-led international strategy mitigates exposure to capital risk and trade disruptions.

Bundesrep.Deutschland Anl.v.2022 (2032)

Global investors are increasingly reconsidering their exposure to U.S. Treasuries amid heightened geopolitical risks and growing policy uncertainty under President Donald Trump. Simultaneously, alternative developed markets are offering more attractive yield opportunities. German 10-year Bunds, currently yielding approximately 2.66%, present compelling value for euro-based investors. While U.S. Treasuries still offer higher nominal yields, the advantage is diminished once currency hedging costs and lower FX volatility are accounted for. Moreover, the euro is strengthening as a reserve currency, underpinned by significant EU-driven defense and infrastructure investments funded through sovereign debt issuance. In this context, we are reallocating part of our portfolio toward German Bunds.

UK (0.125% 30/01/2026):

Amid elevated interest rates and persistent global uncertainty, short-dated UK government bonds present a compelling low-risk income opportunity. The UK Gilt maturing on 30 January 2026 currently offers a yield-to-maturity of approximately 3.15%, supported by its discounted price of around £97.5. While the bond is denominated in GBP and currency exposure is not hedged, its short maturity horizon limits potential FX impact. Given the 5% weight, this tactical allocation reflects a calculated balance between yield pickup and manageable currency risk. The discount to par further enhances the margin of safety. Beyond its attractive yield and strong credit profile, given the negligible sovereign risk, the gilt also strengthens portfolio diversification by adding liquidity and stability—qualities especially valuable alongside higher-risk assets. This investment supports our objective to shorten portfolio duration and increase cash allocation during a period of heightened market volatility.

Venture Global LNG 7.75% 2035 bond

The Venture Global LNG 7.75% 2035 bond offers an attractive high-yield opportunity within the expanding U.S. energy export sector. Delivering a 7.75% coupon—well above the BB-rated average of 6.3%—the bond has benefited from strong institutional demand, leading to an upsizing of the issuance from \$1.5 billion to \$2.5 billion. Venture Global’s operational momentum is robust: the Calcasieu Pass facility is fully operational, Plaquemines LNG has initiated exports, and total capacity is set to exceed 45 MTPA with additional expansion. Recent regulatory approval for CP2 and a final investment decision further strengthen the credit profile. In 2024, the company reported \$5 billion in revenue and \$1.5 billion in net income, underpinned by long-term contracts with major off takers such as Shell and BP, ensuring resilient cash flows across market cycles. The bond provides long-duration, high-yield exposure backed by tangible infrastructure assets and benefits from strong sector fundamentals, including heightened energy security priorities and continued U.S. policy support for LNG exports. While key risks include customer disputes, regulatory shifts, and execution challenges, the combination of a high coupon, strategic positioning, and visible cash flow generation makes this bond a compelling addition for investors willing to accept moderate credit risk.

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Detailed Holdings

Spain 3.45% OCT34 EUR	ES0000012N35	8.00%	IQVIA Holdings	US46266C1053	2.00%
Bundesrep.Deutschland Anl.v.2022 (2032)	DE0001102580	6.00%	Leonardo	IT0003856405	2.00%
Venture Global LNG 7.75% 2035 bond	USU91913AB62	6.00%	Miniso Group	US66981J1025	2.00%
Gold	IE00B579F325	5.00%	Pt Adaro Andalan	ID1000207509	2.00%
UK (0.125% 30/01/2026 (LSE:T26))	GB00BL68HJ26	5.00%	Siemens	DE0007236101	2.00%
BTP 0.45% FEB29	IT0005467482	4.00%	Dollar general	US2566771059	1.50%
BTP FX 3.2% JAN26 EUR	IT0005584302	4.00%	Equinor	NO0010096985	1.50%
MercadoLibre	US58733R1023	4.00%	Imperial Brands	GB0004544929	1.50%
ASML	NL0010273215	3.00%	JSB S.A.	US4661101034	1.50%
Natural Gas	JE00BN7KB334	3.00%	Rentokil	GB00B082RF11	1.50%
Oat Tf 1,25% Mg36 Eur	FR0013154044	3.00%	Adyen	NL0012969182	1.00%
Uranium	UXXc2	3.00%	Alfen	NL0012817175	1.00%
Albemarle Corp	US0126531013	2.50%	Entegris	US29362U1043	1.00%
Enav	IT0005176406	2.50%	Nu Holdings	KYG6683N1034	1.00%
Hindustan Unilever	INE030A01027	2.50%	Occidental Petroleum	US6745991058	1.00%
Nutrien	CA67077M1086	2.50%	Tata Consumer	INE192A01025	1.00%
Philip Morris	US7181721090	2.50%	Titan Cement	BE0974338700	1.00%
Shimano	JP3358000002	2.50%	Trip.com	US89677Q1076	1.00%
UnitedHealth Group	US91324P1021	2.50%	Verizon	US92343V1044	1.00%
Cameco	CA13321L1085	2.00%			

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Quantitative Research Team

Risk Report – May 2025

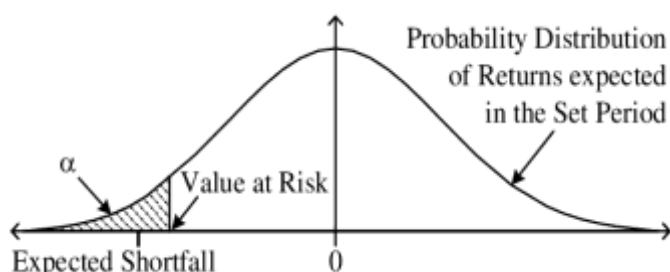
Introduction

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 Quantitative Research 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 $\alpha\%$ of probability over a time horizon of 1 day. For instance, if the VaR ($\alpha=5\%$) = -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 $\alpha\%$ 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 past 250 trading days. 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 its 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 F_n , is:

$$D_n = \sup x |(F_n - F)|$$

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:

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

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.

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Parametric approach

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:

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

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.

	Simple approach	GARCH
VaR_{95%}	-0.89%	-1.25%
VaR_{99%}	-1.28%	-2.26%
ES_{95%}	-1.13%	-1.94%
ES_{99%}	-1.48%	-3.31%

TOP & BOTTOM 5 stocks (simple approach)

	VaR95	VaR99	ES95	ES99
BTP 0.45% FEB29	-0.31%	-0.45%	-0.40%	-0.53%
BTP FX 3.2% JAN26 EUR	-0.33%	-0.48%	-0.42%	-0.56%
UK (0.125% 30/01/2026 (LSE:T26))	-0.53%	-0.77%	-0.68%	-0.89%
Bundesrep.Deutschland Anl.v.2022 (2032)	-0.54%	-0.78%	-0.69%	-0.90%
Spain 3.45% OCT34 EUR	-0.59%	-0.86%	-0.76%	-0.99%

	VaR95	VaR99	ES95	ES99
Cameco	-5.13%	-7.30%	-6.46%	-8.40%
Natural Gas	-5.68%	-8.16%	-7.21%	-9.45%
Entegris	-6.29%	-8.98%	-7.95%	-10.40%
Albemarle Corp	-6.65%	-9.44%	-8.37%	-10.90%
JSB S.A.	-7.76%	-11.85%	-10.32%	-14.38%

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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.

	Estimate	Standard error
VaR_{95%}	-0.85%	0.10%
VaR_{99%}	-1.52%	0.25%
ES_{95%}	-1.26%	0.17%
ES_{99%}	-1.81%	0.25%

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 $M \rightarrow +\infty$ (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.

TOP & BOTTOM 5 stocks (GARCH)

	VaR 95 (GARCH)	VaR 99 (GARCH)	ES 95 (GARCH)	ES 99 (GARCH)
BTP FX 3.2% JAN26 EUR	-0.23%	-0.49%	-0.42%	-0.85%
BTP 0.45% FEB29	-0.30%	-0.52%	-0.44%	-0.69%
UK (0.125% 30/01/2026 (LSE:T26))	-0.48%	-0.81%	-0.69%	-1.07%
Bundesrep.Deutschland Anl.v.2022 (2032)	-0.60%	-0.96%	-0.83%	-1.20%
Spain 3.45% OCT34 EUR	-0.68%	-1.13%	-0.97%	-1.46%

	VaR 95 (GARCH)	VaR 99 (GARCH)	ES 95 (GARCH)	ES 99 (GARCH)
Entegris	-8.95%	-15.11%	-12.96%	-20.23%
Alfen	-8.40%	-16.97%	-14.49%	-27.45%
UnitedHealth Group	-8.40%	-16.97%	-14.49%	-27.45%
Uranium	-8.67%	-17.77%	-15.25%	-29.56%
JSB S.A.	-12.43%	-21.99%	-18.79%	-30.86%

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