

MIMS – Diversified Passive Selection Fund

Portfolio Management Team

Report – December 2025

Fund description

The Passive Fund is composed by a number of Exchange Traded Funds selected by Minerva Investment Management Society, reflecting the output of the research of the Passive Portfolio Team. These ETFs aim to replicate as closely as possible the performance of a basket of securities with specific common properties, thus being effective instruments for investors who wish to express a certain view on industry sectors or economic trends while capturing as little idiosyncratic risk as possible. Each ETF was carefully chosen in line with the macroeconomic outlook. Our allocation is based on a diversification process achieved among geographies, asset classes and sectors.

Allocation Breakdown

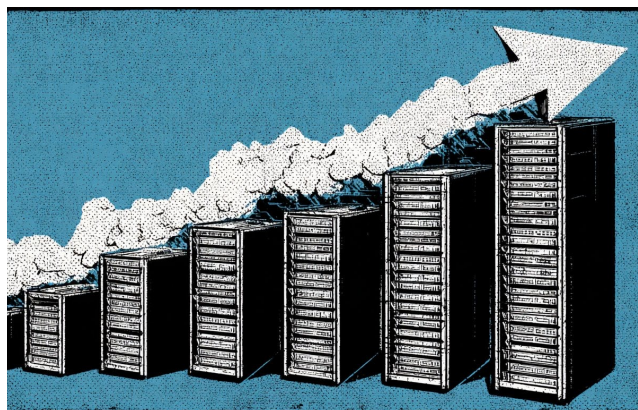
Asset Allocation

As the impact of tariff-related risks on global growth appears to be moderating, market attention has shifted toward the ability of the AI and technology cycle to effectively deliver on expectations despite stretched valuations, creating brief periods of heightened volatility. At the same time, slowing economic activity and easing inflation create room for additional monetary accommodation. Against this backdrop, we maintain a neutral 60/40 allocation between equities and fixed income. The recent strong performance of precious metals leads us to adopt a more cautious stance in the short term, anticipating a potential normalisation in prices.

Geographical Allocation

Our portfolio is diversified across the United States, Europe, Japan and Emerging Markets.

In the US, we keep a positive view on equity and on rates. In Europe, we remain slightly underweight in equities due to modest growth prospects and sensitivity to trade-related risks, while keep a positive outlook for bonds.



Head of Asset Management

Daniele Biondi: daniele.biondi@studbocconi.it

Head of Portfolio Management

Michele Rinaldi: michele.rinaldi@studbocconi.it

Portfolio Manager

Filippo Forzan: filippo.forzan@studbocconi.it

Portfolio Analysts

Matteo De Guidi: matteo.deguidi@studbocconi.it

Daniele Stella: daniele.stella@studbocconi.it

Gian Nicola Buda: gian.buda@studbocconi.it

Anton Michels: anton.michels@studbocconi.it

Gabriele Traina: gabriele.traina@studbocconi.it

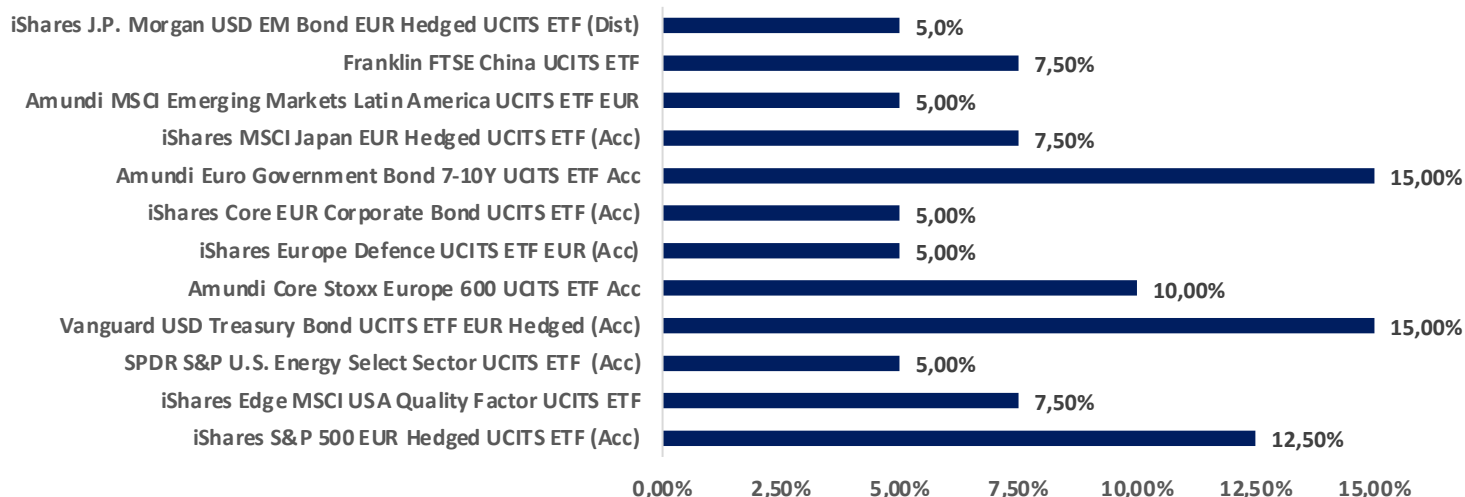
Michele d'Andrilli: michele.dandrilli@studbocconi.it

Matteo Caligaris: matteo.caligaris@studbocconi.it

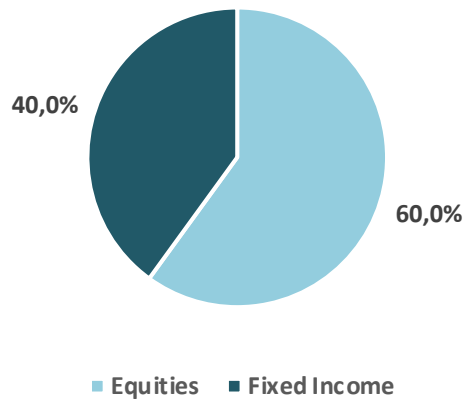
We then hold a 7.5% exposure to Japanese equity, while hedging currency risk.

At last, our Emerging Markets exposure amounts to 17.5% and includes primarily China, Brazil and Mexico.

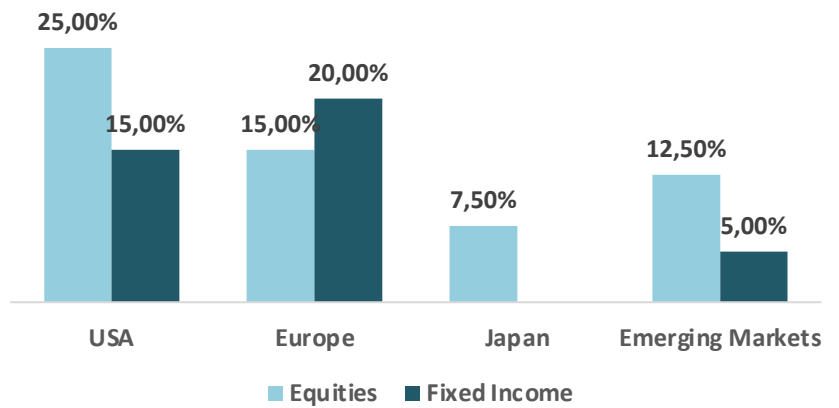
ETFs Breakdown



Asset Allocation



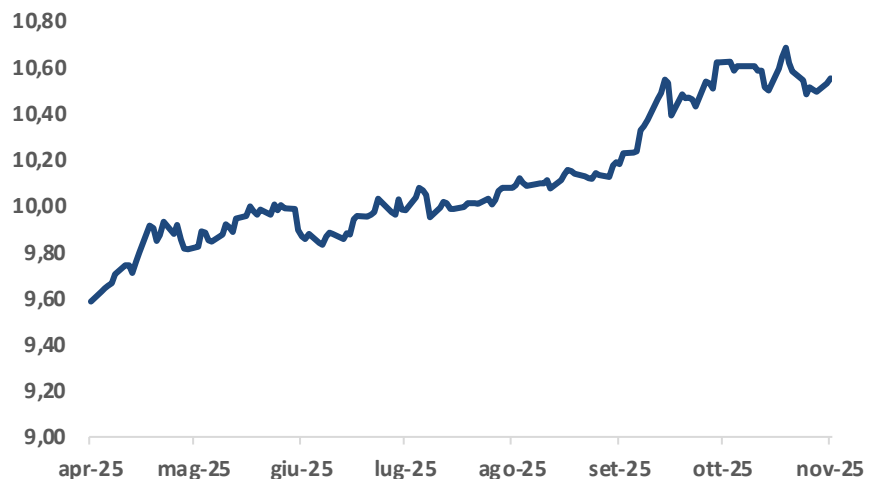
Allocation breakdown



Past Performance

Portfolio Value

Period Return (25/04/2025 – 25/11/2025)	10,08%
Daily Mean Return	0,06%
Daily Volatility	0,38%
Annualized Mean Return	17,26%
Annualized Volatility	6,08%



To evaluate the performance of our fund, we monitored the daily portfolio value over the period from 25 April 2025 to 25 November 2025. The portfolio started the period with an initial value of €9.586.299, we continuously tracked changes in asset weights driven by market price fluctuations. At the end of the observation window, the portfolio reached a final value of €10.552.618, corresponding to a total return of 10,08%.

It is worth noting that a fund rebalancing was executed in October 2025, which introduced several adjustments to the asset allocation and restored the original target weights.

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Portfolio Overview

Our portfolio can be ideally divided into 2 main sections:

- Equity Indexes ETFs
- Fixed Income ETFs

We will now delve into the narrative and rationale that drove our allocation in the two asset classes.

Equities

Equity markets have long moved past the tariff-related shocks, fully recovering the losses recorded after the initial disruptions. More recently, the extended US government shutdown reduced the availability and timeliness of public economic data, contributing to a degree of uncertainty for investors monitoring the US economy.

Over the past months, the dominant theme has once again been the strong performance of AI and Tech-related equities, which have continued to drive market returns. Early November, however, brought a brief spell of volatility as stretched valuations, elevated capex plans and uncertainty around the future returns of those investments weighed on investor sentiment.

Against this backdrop, we decided to gain exposure to the US equity market through a core ETF tracking the S&P 500, which naturally provides a substantial allocation to the Technology and AI ecosystem. We complement this with targeted diversification via a Quality factor ETF and a dedicated exposure to the Energy sector.

In Europe, we maintain a neutral stance on equities as economic growth remains weak. Our allocation combines a broad exposure to the Stoxx 600 with a focused position in the Defence sector, which we believe stands to benefit from fiscal expansion and increased defence spending among European governments.

Japanese equities have experienced a strong performance, supported by improvements in corporate governance, rising shareholder returns and a recovery in domestic economic growth. We therefore initiated a broad exposure to the Japanese equity market.

Within emerging markets, we identify opportunities primarily in China and Latin America. In China, we selected a broad index with meaningful representation of the Consumer Goods sector, reflecting our view that fiscal support and a gradual stabilisation of the domestic economy following the real estate downturn may help unlock value.

In Latin America, our exposure is focused on Brazil and Mexico, where relatively stable political environments, favourable demographics and supportive medium-term growth drivers provide an attractive driver for equity returns.

Fixed Income

As inflation shows signs stabilization and the unemployment rate in the US has begun to edge higher, the room for additional monetary easing has increased. Against this backdrop, we remain constructive on duration. At the same time, we acknowledge that a more accommodative Federal Reserve stance could weigh on the US dollar, thus we have decided to partially hedge our USD exposure across both the fixed income and equity sleeves.

In Europe, rate expectations have become more uncertain, with growing market speculation about a potential rate hike as inflation dynamics remain uneven. We remain constructive, however, given that underlying economic momentum is still quite weak and in need of support. In our view, this backdrop should ultimately favour a return to policy easing, and we remain optimistic about the possibility of a rate cut over the medium term, once growth and inflation show clearer signs of moderation.

In the corporate bond market, credit spreads remain extremely tight across both investment grade and high yield. We believe that, particularly in the high yield segment, current valuations may not be sustainable over the long term and could eventually widen as default risks normalise. To enhance the carry of our fixed income allocation while maintaining a relatively conservative risk profile, we included an ETF focused on investment grade corporate bonds with stronger average credit ratings.

Lastly, we added a diversified Emerging Markets Government Bond ETF to gain measured exposure to higher-yielding countries. This allocation aims to further improve the portfolio's carry while providing additional geographical diversification within the overall fixed income bucket.

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iShares S&P 500 EUR Hedged UCITS ETF (Acc)

Index: S&P 500 (EUR Hedged)

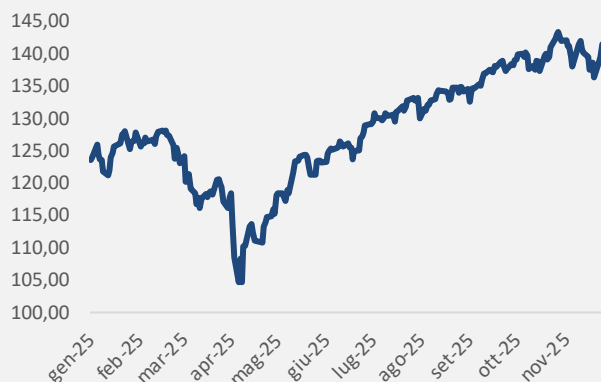
Expense Ratio: 0.20% Tracking Error Volatility: 0.04%

Overview

The iShares S&P 500 EUR Hedged UCITS ETF tracks the S&P 500 Index while hedging USD exposure back to EUR every month. The fund invests physically in the 500 largest US companies across all major sectors, providing broad US large-cap exposure with reduced currency risk for European investors.

Analysis

This ETF offers a straightforward way to participate in the US equity market and the AI-driven earnings cycle, while neutralising most FX volatility. Recent research from Deutsche Bank projects the S&P 500 could reach 8,000 by the end of 2026, citing robust earnings growth and continued investment in artificial intelligence as key drivers. Other strategists similarly highlight AI as a structural tailwind for S&P 500 earnings and index levels over the next few years. In our framework, this product gives “core” exposure to those trends without over-concentrating, and the EUR hedge aligns with the view that the US dollar may weaken over time against the euro.



Conclusion

We select IUSE as the primary US equity building block: it captures the broad AI-supported S&P 500 upside while aligning with our currency view through systematic EUR hedging and maintaining diversified, large-cap exposure.

iShares Edge MSCI USA Quality Factor UCITS ETF

Index: MSCI USA Sector Neutral Quality Index

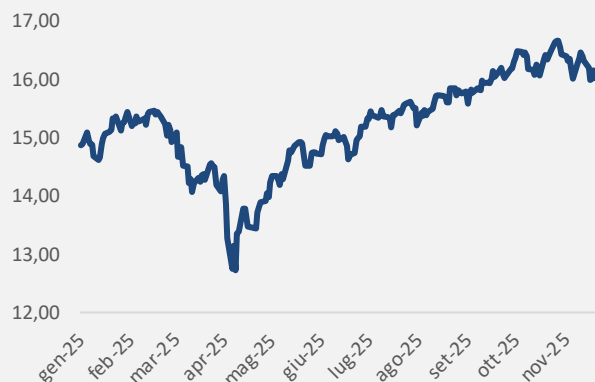
Expense Ratio: 0.20% Tracking Error Volatility: 0.10%

Overview

The iShares Edge MSCI USA Quality Factor UCITS ETF tracks an MSCI index that selects high quality large-cap and mid-cap US stocks. These stocks typically have high return on equity and stable earnings growth. The fund invests in a concentrated basket of quality companies across major sectors which gives targeted exposure to financially strong US businesses rather than the full market.

Analysis

This ETF provides a way to stay exposed to US equities and AI-related gains while focusing on firms with strong fundamentals and consistent profitability, which tend to be more stable if AI expectations disappoint. There is a real risk that AI capex may not deliver and could trigger a “bubble burst”, but these high-quality stocks are likely to hold up better. In addition, it complements a core S&P 500 position by tilting North America exposure toward companies that are better positioned to handle margin pressure and a possible pullback in overvalued AI leaders, improving downside protection without giving up growth.



Conclusion

This ETF offers a resilient complement to our core US equity exposure, strengthening the portfolio's defensive profile while preserving participation in long-term structural growth themes.

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SPDR S&P U.S. Energy Select Sector UCITS ETF (Acc)

Index: S&P Energy Select Sector Index

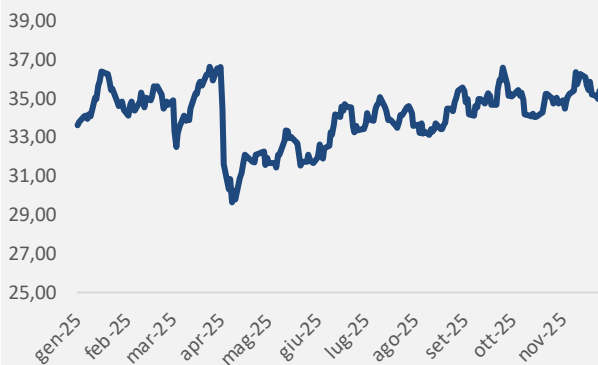
Expense Ratio: 0.15% Tracking Error Volatility: 0.12%

Overview

The SPDR S&P U.S. Energy Select Sector UCITS ETF aims to track the performance of large US energy companies in the S&P 500, including integrated oil majors, exploration and production firms, and refiners. This fund gives straightforward access to the U.S. energy sector in one ETF. It's easy to trade, follows EU regulations (UCITS), and the fee is relatively low.

Analysis

The ETF provides direct exposure to the growing need for oil and electricity in the US, a second-order effect of the AI build-out that is often overlooked. As onshored manufacturing, electrification, and the expansion of AI data centres pick up speed, Deloitte predicts an increase in US electricity consumption. According to other industry analysis, data centres may soon account for a high single-digit portion of the country's power consumption, necessitating further investments in fuel and generation. Growing volumes and possibly favourable commodity prices will help large, diverse US energy companies. Additionally, the industry provides a partial hedge against supply shocks and inflation while diversifying a tech-heavy portfolio.



Conclusion

We include the SPDR S&P U.S. Energy Select Sector UCITS ETF as a targeted satellite position within US equities, designed to capture the energy-intensive nature of the AI transition and the broader upswing in US power demand, while diversifying away from pure tech exposure.

Amundi Core Stoxx Europe 600 UCITS ETF Acc

Index: STOXX Europe 600 Index

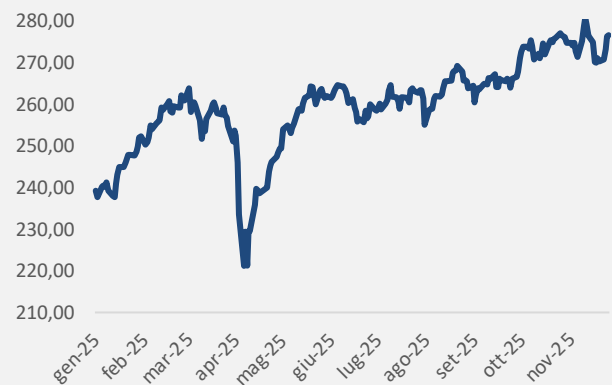
Expense Ratio: 0.07% Tracking Error Volatility: 0.09%

Overview

The Amundi Core Stoxx Europe 600 UCITS ETF Acc aims to track the STOXX Europe 600 Index, which covers 600 of the most liquid large and mid-cap companies across developed European markets. The fund uses physical replication, reinvests dividends, and offers broad, market-cap-weighted exposure to the full European equity universe in a single, low-cost vehicle.

Analysis

This ETF provides a neutral, highly diversified exposure to European equities, consistent with keeping a strategic but prudent allocation to Europe versus the US. Country and sector diversification help limit idiosyncratic risk, while the contained ex-post tracking error means the fund tracks almost perfectly the index, making it suitable as a core benchmark holding rather than a source of active risk.



Conclusion

We include Amundi Core Stoxx Europe 600 UCITS ETF Acc as a low-cost, liquid core position for developed Europe. It keeps broad European equity exposure in the portfolio at minimal cost and tracking risk, while leaving room to allocate additional risk budget to more targeted sectors.

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iShares Europe Defence UCITS ETF EUR (Acc)

Index: STOXX Europe Targeted Defence index

Expense Ratio: 0.35% Tracking Error Volatility: n/a

Overview

This ETF tracks the STOXX Europe Targeted Defence index, including the European companies that are engaged in the military or defence industry.

Analysis

The ETF offers an exposure to many European companies operating in the military and defence industry. We hold positive sector's growth expectations thanks to fiscal spending and for the tensions in the middle East and in Ukraine. At the 2025 NATO Summit, participating countries agreed to target defence- and security-related spending of 5% of Gross Domestic Product (GDP) annually by 2035. This agreement represents a non-discretionary, long-term stable fiscal commitment that will drive a revenue growth for many players in the defence sector in the following years, even if economic growth remains stagnant. The military conflicts in Ukraine and Middle East have also catalyzed renewed urgency for defence spending and capability development across Europe for defence purposes.



Conclusion

The ETF presents a reasonable entry opportunity, with medium-term prospects supported by sustained defence-related investment across Europe. It adds focused exposure to a segment that shows comparatively resilient fundamentals within a challenging broader European equity environment.

Franklin FTSE China UCITS ETF

Index: FTSE China 30/18 Capped

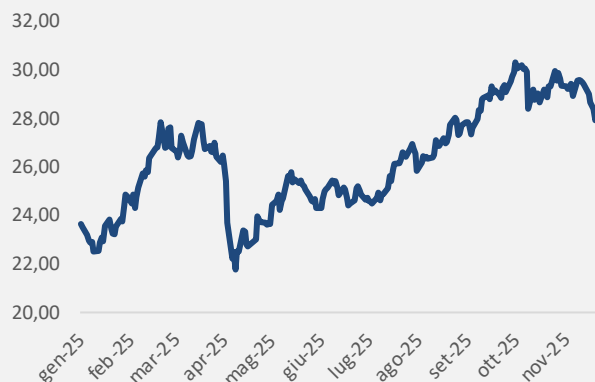
Expense Ratio: 0.19% Tracking Error Volatility: 0.20%

Overview

This ETF tracks the FTSE China Index, targeting a wide range of Chinese companies and sectors with a balanced approach.

Analysis

The index is well-balanced in terms of sectors, with exposure in particular to consumer goods companies (around 30%) and less exposed to tech stocks such as Tencent and Alibaba than the typical MSCI China. The Chinese market displays sustained growth, and the continuous fiscal incentives that the government is approving to sustain depressed internal consumption are helping to support the ongoing economic recovery. We believe that fiscal support may continue to provide a stabilizing backdrop for medium-term growth, especially for consumer goods companies. The fund is USD-denominated and not hedged, maintaining an FX risk that would have been too expensive to hedge looking at the current level of interest rates in China.



Conclusion

This ETF allows us to benefit from the recovery of the Chinese market and diversify our global exposure in the largest and most strategically important emerging market.

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Amundi MSCI Emerging Markets Latin America UCITS ETF EUR

Index: MSCI Emerging Markets Latin America

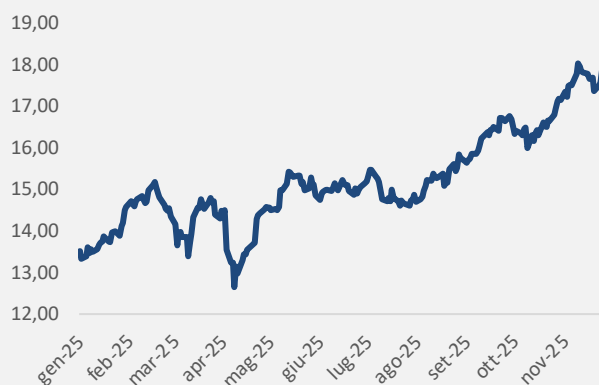
Expense Ratio: 0,20% Tracking Error Volatility: 0,01%

Overview

The ETF provides low-cost, diversified exposure to large- and mid-cap equities across major Latin American markets, led by Brazil and Mexico. The fund uses synthetic replication, providing efficient access to markets that are costly or complex to trade physically. Sector exposure is concentrated in financials, materials, energy and communication services, reflecting the region's economic structure.

Analysis

The ETF provides exposure to a region with macro cycles distinct from the US, Europe and Asia, adding valuable diversification. At the same time, structural reforms in Brazil and Mexico, improving fiscal frameworks, and favorable demographics support the region's medium-term growth prospects. Political volatility and FX swings remain risks, but they are partly offset by attractive valuations and solid cash generation among the index's leading companies. Overall, the ETF strengthens the portfolio by adding focused exposure to Latin America's key sectors particularly financials, materials and energy through dominant regional leaders such as Itaú Unibanco, Vale and Petrobras, thereby enhancing diversification while keeping the emerging-market volatility at a measured level.



Conclusion

The ETF provides a simple, liquid and cost-efficient way to access emerging Latin American equities, a region largely underweighted in global and EM benchmarks and not represented in our existing core equity sleeves. This helps diversify our geographical and macro exposure beyond Europe, the US and Asia.

iShares MSCI Japan EUR Hedged UCITS ETF (Acc)

Index: MSCI Japan (EUR Hedged)

Expense Ratio: 0.64% Tracking Error Volatility: 0.20%

Overview

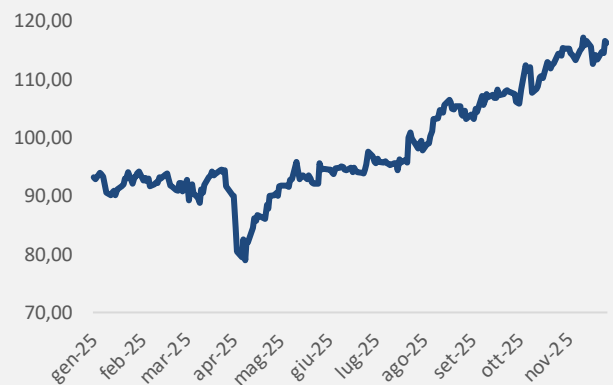
This ETF tracks the MSCI Japan Index (EUR Hedged), granting a good exposure to a market that, after many years of muted equity performance, is showing signs of sustained improvements. The ETF is also Euro hedged.

Analysis

The MSCI Japan Index provides a more balanced and diversified exposure to the Japanese equity market than the traditional Nikkei 225. The main holdings are in Industrial, Consumer Goods, and Financials, with IT, which weighs only 14.5%, resulting in a more measured exposure to the AI theme.

Japan is recovering from a long period of economic stagnation, with signs of gradual normalization, and this ETF allows us to benefit from the impact of inflation on corporate earnings, economic growth, and the gradual improvement in corporate governance practices, which are increasingly aligned with shareholders' interests.

The currency hedge protects us from further fluctuations in the JPY/EUR exchange rate.



Conclusion

The ETF offers a diversified and currency-hedged exposure to a strengthening Japanese equity market, making it a stable building block within the portfolio.

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Vanguard USD Treasury Bond UCITS ETF EUR Hedged (Acc)

Index: Bloomberg Global Aggregate US Treasury Float Adjusted (EUR Hedged)

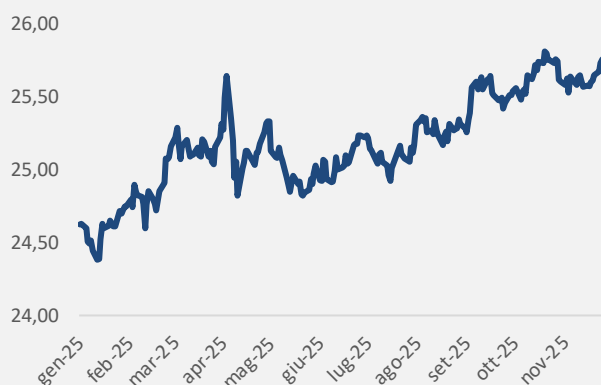
Expense Ratio: 0.10% Tracking Error Volatility: 0.11%

Overview

The Vanguard USD Treasury Bond UCITS ETF EUR Hedged (Acc) offers broad US Treasury exposure across maturities, hedged into EUR. It uses sampling, reinvests coupons, and with a 0.10% TER provides a low-cost way for euro investors to access the US government bond market without USD risk.

Analysis

This fund is the natural core instrument to express our constructive view on US interest rates. According to UBS's Chief Investment Office (House View, November 2025), even after a recent uptick, the 10-year US Treasury yield is expected to resume its decline as the Federal Reserve proceeds with rate cuts, making high-quality, medium-duration Treasuries attractive again. Against this backdrop, a diversified, EUR-hedged US Treasury exposure offers a defensive anchor to the portfolio and allows us to lock in current yields and maintain upside potential if yields fall, all without taking on currency risk. In both scenarios we consider (a sharper slowdown with faster rate cuts, or a more gradual easing cycle), this instrument balances income and downside protection, making it a stable core in the fixed-income allocation.



Conclusion

We choose the Vanguard USD Treasury Bond UCITS ETF EUR Hedged as the core US fixed-income allocation, aligning with our expectation of eventual Fed easing while limiting FX risk, and providing a high-quality stabiliser against equity and sector-specific volatility.

Amundi Euro Government Bond 7-10Y UCITS ETF Acc

Index: Bloomberg Euro Treasury 50bn 7-10 Year Bond index

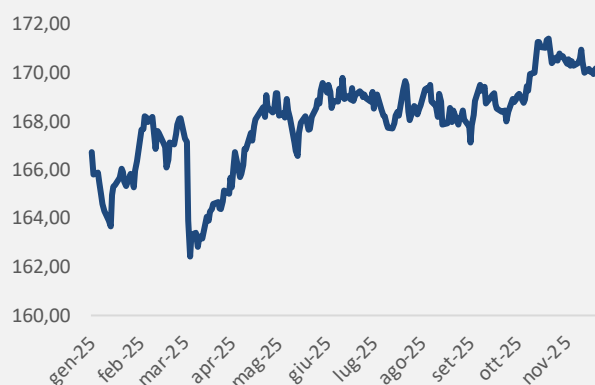
Expense Ratio: 0.15% Tracking Error Volatility: n/a

Overview

This ETF tracks the Bloomberg Euro Treasury 50bn 7-10 Year Bond index, tracking Euro denominated government bonds issued by members of the eurozone. The index targets bonds with maturities between 7 and 10 years.

Analysis

This ETF offers a well diversified exposure to government bonds issued by major European countries. The 7-10 years maturity positions the fund to benefit from future interest rates cuts from the ECB. If inflation continues to gradually decline and stabilize near the ECB's 2% target, the European Central Bank could continue cutting rates in 2026, possibly bringing the deposit rate towards 1.5-1.75% by the end of the year. This would support bond prices, especially those with medium-to-long duration. This maturity allows to balance possible upsides with a contained volatility. Lastly, the investment grade rating reduces default risk.



Conclusion

This ETF offers a liquid, diversified and cost-effective exposure to the European bond market. In this moment of uncertainty, it represents a prudent way to position for potential future rate cuts, while maintaining a balanced approach.

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iShares Core EUR Corporate Bond UCITS ETF (Acc)

Index: Bloomberg Euro Corporate Bond

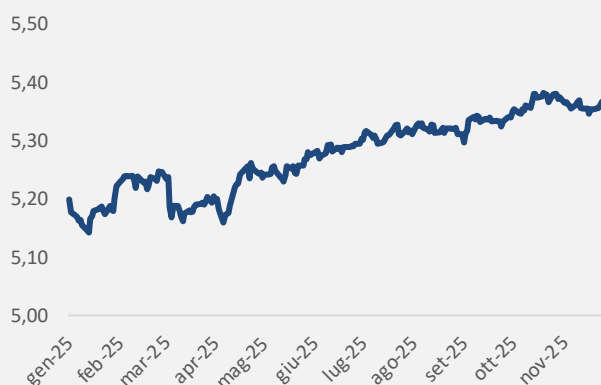
Expense Ratio: 0.09% Tracking Error Volatility: 0.28%

Overview

The iShares Core € Corp Bond UCITS ETF (Acc) aims to track the Bloomberg Euro Corporate Bond Index, which covers a broad universe of EUR-denominated investment-grade corporate bonds issued by industrial, utility and financial companies in the Eurozone and Eurobond markets. The fund uses physical sampling, is EUR-denominated, and reinvests coupons, offering a low-cost core exposure to the euro corporate bond market.

Analysis

This ETF provides diversified exposure to high-quality euro corporate credit, matching the idea of adding carry within the EUR fixed-income bucket while remaining prudent on credit risk. It complements Euro government bond holdings by adding spread income at a time when spreads remain compressed across both investment-grade and high-yield markets. Given current expectations on rates and on the outlook for European growth, IEAA can benefit from stable spreads, while the still relatively low volatility and tracking error keep it suitable as a core credit position rather than a tactical trade.



Conclusion

We use the iShares Core € Corp Bond UCITS ETF (Acc) as a core euro corporate bond holding within the fixed-income allocation. It offers broad investment-grade exposure and efficient benchmark implementation, making it a good building block alongside Euro government bonds to achieve the desired mix of rate and credit risk in Europe.

iShares J.P. Morgan USD EM Bond EUR Hedged UCITS ETF (Dist)

Index: JP Morgan EMBI Global Core (EUR Hedged)

Expense Ratio: 0.50% Tracking Error Volatility: 0.26%

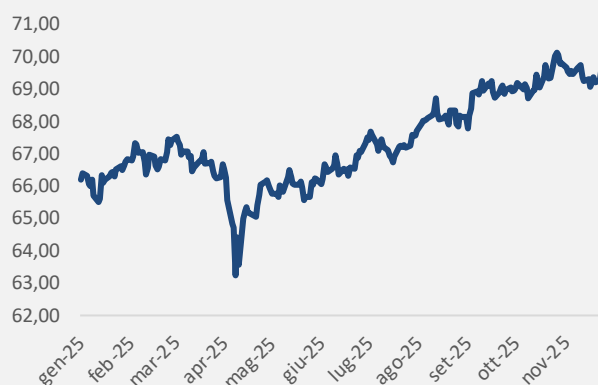
Overview

This ETF tracks the JP Morgan EMBI Global Core Index, providing exposure to a broad range of emerging market government bonds, with an EUR currency hedge.

Analysis

The ETF provides diversified exposure across emerging markets in EMEA, Asia and Latin America. The portfolio combines a mix of investment-grade and high-yield sovereign issuers, with an average duration of around 7 years, resulting in a balanced exposure to credit and interest-rate risk.

The EUR hedge, combined with still relatively high yields across many EM sovereign issuers, makes this ETF attractive from a carry perspective, providing yield pickup without additional currency risk, in a market environment where EM sovereign credit fundamentals remain broadly stable.



Conclusion

The ETF helps diversify our fixed-income allocation by adding exposure to emerging markets, reducing concentration in US and European bonds and enhancing the portfolio's yield potential.

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Quantitative Research Team

Risk Report – December 2025

Introduction

Measuring and managing downside risk is central to modern portfolio management, particularly for diversified portfolios containing assets with heterogeneous volatility and heavy-tailed return distributions. Traditional risk metrics based on Gaussian assumptions often fail to capture extreme losses observed in financial markets, motivating the use of alternative models that explicitly account for fat tails, volatility clustering, and dynamic dependence structures.

This report analyses the risk profile of a multi-asset long–short equity portfolio using three complementary approaches: a non-parametric historical method, a parametric Student-t model, and a dynamic GARCH-t specification. Daily portfolio returns are constructed from a cross-section of U.S. and European equities using fixed portfolio weights. The historical approach provides a model-free benchmark for Value-at-Risk and Expected Shortfall, while the parametric Student-t framework captures unconditional heavy-tailed behavior. To account for time-varying volatility and conditional tail risk, per-asset GARCH-t models are estimated and aggregated to the portfolio level using the empirical correlation structure.

In addition, the report compares static and conditional tail risk measures and examines the dynamics of portfolio volatility through a rolling GARCH(1,1) specification. This multi-layered framework allows for a comprehensive assessment of portfolio risk under both unconditional and conditional distributions, highlighting the importance of volatility dynamics and tail behavior in risk measurement.

Portfolio Return Computation

Once the matrix of daily asset returns has been constructed and aligned with the portfolio allocation vector, portfolio returns are computed through a matrix–vector product. Let $R_{\{t,i\}}$ denote the daily return of asset i at time t and let w_i be its corresponding portfolio weight. The portfolio return at time t is defined as

$$R_t^p = \sum_{i=1}^N w_i R_{t,i}$$

In vector notation, this can be written compactly as

$$\mathbf{R}^p = \mathbf{R}\mathbf{w},$$

Co-Head of Quantitative Research

Ianina Tarca: ianina.tarca@studbocconi.it

Analysts

Afonso Tavares: afonso.tavares@studbocconi.it

where $\mathbf{R}$ denotes the return matrix and $\mathbf{w}$ the weight vector. In the implementation, portfolio returns are computed via a matrix multiplication between the return matrix and the weight vector.

A final consistency check ensures that the ordering of asset returns exactly matches the ordering of portfolio weights before the computation is performed. The resulting portfolio return series is then stored as a time-indexed vector, preserving the original trading dates. This series represents the daily performance of the long–short strategy and constitutes the basis for all subsequent performance and risk analysis.

Per-Asset Risk Modelling

To assess the risk profile of the individual assets in the portfolio, daily returns are modelled on a per-asset basis using a Student-t distribution. For each asset i , we assume

$$R_{t,i} \sim t_{\nu_i}(\mu_i, \sigma_i^2)$$

where μ_i denotes the location parameter (mean), σ_i the scale parameter (volatility) and ν_i the degrees of freedom controlling tail thickness. The parameters μ_i and σ_i are estimated by the sample mean and sample standard deviation of the historical return series.

The degrees of freedom ν_i are selected via a Kolmogorov–Smirnov (KS) goodness-of-fit procedure. Specifically, for each candidate $\nu \in \{2, \dots, 99\}$, synthetic returns are simulated from a Student-t distribution with parameters (μ_i, σ_i, ν) and the two-sample KS statistic is computed between the simulated sample and the empirical returns of asset i . The value ν_i is chosen as the minimiser of this KS distance, thereby selecting the Student-t specification whose distribution is closest to the empirical one in the KS sense.

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Per-Asset Risk Modelling (continued)

Given the fitted Student-t model, one-day parametric Value-at-Risk (VaR) and Expected Shortfall (ES) are computed at the 95% and 99% confidence levels. For a one-day horizon and tail probability α (e.g. $\alpha = 0.05$ or $\alpha = 0.01$), the per-asset VaR is given by

$$\text{VaR}_{\alpha,i} = \mu_i + \sigma_i t_{v_i}^{-1}(\alpha),$$

where $t_{v_i}^{-1}(\alpha)$ denotes the α -quantile of the standard Student-t distribution with v_i degrees of freedom. The corresponding ES has a closed-form expression under the Student-t assumption:

$$\text{ES}_{\alpha,i} = \mu_i - \sigma_i \frac{v_i + q_{\alpha,i}^2}{v_i - 1} \frac{f_{v_i}(q_{\alpha,i})}{\alpha},$$

where $q_{\alpha,i} = t_{v_i}^{-1}(\alpha)$ and f_{v_i} denotes the Student-t probability density function with v_i degrees of freedom. These measures provide a static, distribution-based assessment of the tail risk of each individual asset over a one-day horizon, taking into account fat tails through the estimated degrees of freedom. Tables 1 and 2 report the five riskiest and five safest assets in the portfolio according to the Expected Shortfall at the 95% confidence level. Expected Shortfall measures the expected loss conditional on extreme negative outcomes and therefore provides a coherent metric of tail risk.

The worst-performing assets in terms of downside risk include SMCI, MRNA, and MOH, all of which exhibit high volatility and relatively heavy tails, as reflected by their large Expected Shortfall values. In particular, SMCI shows an $\text{ES}_{0.95}$ close to -9.4%, indicating substantial expected losses during extreme market downturns. These assets contribute disproportionately to tail risk and are therefore critical drivers of portfolio risk under stressed conditions. Conversely, the safest assets, such as DTE, URW.PA and ALLN.SW, display significantly lower volatility and much smaller tail losses, with $\text{ES}_{0.95}$ values close to -1.5%. These stocks provide natural risk stabilization within the portfolio and behave more defensively during adverse market movements.

Overall, this ranking highlights the strong heterogeneity in tail risk across assets and confirms the importance of modeling heavy tails when evaluating risk in long-short equity portfolios.

Conditional Risk Modelling with GARCH-t

The static Student-t specification provides a distributional description of unconditional returns, but it does not account for time-variation in volatility.

To incorporate volatility clustering, we estimate, for each asset i , a univariate GARCH model with Student-t innovations of the form

$$R_{t,i} = \mu_i + \varepsilon_{t,i}, \quad \varepsilon_{t,i} = \sigma_{t,i} z_{t,i},$$

where the conditional variance follows

$$\sigma_{t,i}^2 = \omega_i + \sum_{j=1}^{p_i} \alpha_{i,j} \varepsilon_{t-j,i}^2 + \sum_{k=1}^{q_i} \beta_{i,k} \sigma_{t-k,i}^2$$

and the standardized innovations $z_{t,i}$ are assumed to follow a Student-t distribution with $v_i^{(\text{GARCH})}$ degrees of freedom. For each asset, the orders (p_i, q_i) are selected by minimising the Bayesian Information Criterion over a grid of candidate specifications.

From the fitted GARCH-t model, we obtain the one-step-ahead conditional mean and variance forecasts, denoted by $\mu_{i,t+1}^{(\text{G})}$ and $\sigma_{i,t+1}^{(\text{G})}$, as well as the estimated degrees of freedom $v_i^{(\text{GARCH})}$. Under this conditional distributional assumption, the one-day ahead Value-at-Risk and Expected Shortfall at tail probability α are given by

$$\text{VaR}_{\alpha,i}^{(\text{GARCH})} = \mu_{i,t+1}^{(\text{G})} + \sigma_{i,t+1}^{(\text{G})} t_{v_i^{(\text{GARCH})}}^{-1}(\alpha),$$

$$\text{ES}_{\alpha,i}^{(\text{GARCH})} = \mu_{i,t+1}^{(\text{G})} - \sigma_{i,t+1}^{(\text{G})} \frac{v_i^{(\text{GARCH})} + q_{\alpha,i}^2}{v_i^{(\text{GARCH})} - 1} \frac{f_{v_i^{(\text{GARCH})}}(q_{\alpha,i})}{\alpha}$$

where $q_{\alpha,i} = t_{v_i^{(\text{GARCH})}}^{-1}(\alpha)$ and $f_{v_i^{(\text{GARCH})}}$ is the Student-t density. These quantities represent conditional tail risk measures, as they are computed given the current estimated volatility level.

Table 1: Worst 5 Assets by ES at 95% CI

Asset	VaR _{0.95}	ES _{0.95}
Euro Defence ETF	-2,83%	-3,70%
FTSE China ETF	-1,81%	-2,31%
MSCI Japan ETF	-1,68%	-2,15%
MSCI EM LatAm ETF	-1,33%	-1,72%
S&P500 ETF	-1,10%	-1,43%

Table 2: Best 5 Assets by ES at 95% CI

Asset	VaR _{0.95}	ES _{0.95}
MSCI US Quality Factor ETF	-1,08%	-1,40%
JPMorgan EM Bonds ETF	-0,44%	-0,57%
Amundi EU Gov Bonds ETF	-0,40%	-0,51%
Vanguard US Treasuries ETF	-0,38%	-0,48%
iShares EU Corporates ETF	-0,21%	-0,27%

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Conditional Risk Modelling with GARCH-t

Tables 3 and 4 report the five most and least risky assets in terms of 1-day Expected Shortfall at the 99% confidence level under the GARCH-t specification. The riskiest names (DXCM, MOH, EPAM, SMCI, and PLTR) exhibit both elevated conditional volatility and very low estimated degrees of freedom, indicating extremely heavy tails. In particular, DXCM displays an $ES_{0.99}^{(GARCH)}$ of approximately -74%, reflecting the presence of extreme conditional downside risk in periods of high volatility.

In contrast, the safest assets (SYI, DTE, URW.PA, MOBN.SW and ALLN.SW) are characterised by low conditional volatility and very large degrees of freedom, with $\nu^{(GARCH)}$ often exceeding 70. This implies that, conditionally, their return distributions are close to Gaussian with relatively thin tails, and their $ES_{0.99}^{(GARCH)}$ values remain below -3% in magnitude. The comparison between static and GARCH-based ES rankings highlights that incorporating time-varying volatility and heavy-tailed innovations can substantially amplify the estimated tail risk for certain growth and technology stocks, while leaving stable, defensive stocks relatively unaffected.

Portfolio Parametric and GARCH-t VaR and ES and Portfolio level risk summary

Having obtained the time series of daily portfolio returns, we next model the distribution of the portfolio as a whole and compute corresponding one-day risk measures. Let R_t^p denote the portfolio return at time t , obtained as a weighted sum of individual asset returns,

$$R_t^p = \sum_{i=1}^N w_i R_{t,i}.$$

From the empirical series $\{R_t^p\}_{t=1}^T$, we estimate the sample mean μ_p and standard deviation σ_p and assume that portfolio returns follow a Student-t distribution

$$R_t^p \sim t_{\nu_p}(\mu_p, \sigma_p^2),$$

with unknown degrees of freedom ν_p .

Table 3: Top 5 most risky assets by 1-day ES at 99% (GARCH-t)

Asset	$ES_{0.99}(GARCH-t)$
MSCI Japan ETF	-7,40%
Euro Defence ETF	-3,94%
FTSE China ETF	-3,16%
S&P500 ETF	-2,69%
MSCI EM LatAm ETF	-2,39%

In order to select ν_p , a Kolmogorov-Smirnov goodness-of-fit procedure analogous to the per-asset case is applied. For each candidate $\nu \in \{2, \dots, 99\}$, synthetic returns are generated from a Student-t distribution with parameters (μ_p, σ_p, ν) and the two-sample KS statistic between the simulated and empirical portfolio returns is computed. The value ν_p is chosen as the minimiser of this distance. In the empirical application, the procedure selects $\nu_p = 54$, indicating relatively thin tails at the portfolio level, consistent with diversification across assets. Given the fitted Student-t model, one-day portfolio Value-at-Risk (VaR) and Expected Shortfall (ES) at tail probability α are computed as

$$VaR_\alpha^p = \mu_p + \sigma_p t_{\nu_p}^{-1}(\alpha),$$

and

$$ES_\alpha^p = \mu_p - \sigma_p \frac{\nu_p + q_\alpha^2}{\nu_p - 1} \frac{f_{\nu_p}(q_\alpha)}{\alpha}$$

where $q_\alpha = t_{\nu_p}^{-1}(\alpha)$ denotes the α -quantile of the standard Student-t distribution with ν_p degrees of freedom and f_{ν_p} is its probability density function.

These quantities provide a parametric estimate of the portfolio's potential one-day loss under extreme market conditions, with ES capturing the average loss beyond the VaR threshold.

To obtain a conditional, model-based measure of portfolio tail risk, we combine the per-asset GARCH-t estimates with the empirical correlation structure between assets. Let $\mu_i^{(G)}$ and $\sigma_i^{(G)}$ denote the one-step-ahead conditional mean and standard deviation forecasts for asset i from its GARCH-t model and let ρ be the $N \times N$ correlation matrix of asset returns. The conditional covariance matrix implied by the GARCH forecasts is then constructed as

$$\Sigma^{(G)} = D \rho D,$$

where $D = \text{diag}(\sigma_1^{(G)}, \sigma_2^{(G)}, \dots, \sigma_N^{(G)})$ is the diagonal matrix of conditional standard deviations.

Given the portfolio weight vector $\mathbf{w}$, the one-step-ahead conditional mean and variance of the portfolio return are

$$\mu_p^{(G)} = \mathbf{w}^\top \mu^{(G)}, \sigma_p^{(G)2} = \mathbf{w}^\top \Sigma^{(G)} \mathbf{w}$$

with $\sigma_p^{(G)} = \sqrt{\mathbf{w}^\top \Sigma^{(G)} \mathbf{w}}$.

Table 3: Top 5 least risky assets by 1-day ES at 99% (GARCH-t)

Asset	$ES_{0.99}(GARCH-t)$
MSCI US Quality Factor ETF	-1,65%
JPMorgan EM Bonds ETF	-0,66%
Vanguard US Treasuries ETF	-0,48%
Amundi EU Gov Bonds ETF	-0,44%
iShares EU Corporates ETF	-0,29%

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Portfolio Parametric and GARCH-t VaR and ES and Portfolio level risk summary

The portfolio degrees of freedom $\nu_p^{(G)}$ are approximated by a weight-averaged combination of the per-asset degrees of freedom, which provides an effective tail-thickness parameter for the portfolio.

Assuming that the one-day ahead portfolio return follows a Student-t distribution

$$R_{t+1}^p \sim t_{\nu_p^{(G)}}(\mu_p^{(G)}, (\sigma_p^{(G)})^2),$$

the corresponding VaR and ES at tail probability α are given by

$$VaR_\alpha^{(GARCH-t)} = \mu_p^{(G)} + \sigma_p^{(G)} t_{\nu_p^{(G)}}^{-1}(\alpha),$$

$$ES_\alpha^{(GARCH-t)} = \mu_p^{(G)} - \sigma_p^{(G)} \frac{\nu_p^{(G)} + q_\alpha^2}{\nu_p^{(G)} - 1} \frac{f_{\nu_p^{(G)}}(q_\alpha)}{\alpha}$$

where $q_\alpha = t_{\nu_p^{(G)}}^{-1}(\alpha)$ and $f_{\nu_p^{(G)}}$ denotes the Student-t density.

This yields conditional, correlation-aware tail risk measures for the portfolio.

Result at Portfolio Level

Table 5 compares the portfolio 1-day VaR and ES obtained from the historical, parametric Student-t, and GARCH-t approaches. All three methods deliver broadly similar risk estimates at the 95% and 99% confidence levels, which suggests that the Student-t specification provides a reasonable parametric approximation to the empirical distribution of portfolio returns.

However, the GARCH-t model systematically produces slightly more conservative (more negative) Expected Shortfall values, particularly at the 99% level.

This reflects the fact that the GARCH specification explicitly accounts for time-varying volatility and conditional clustering of large returns, leading to higher estimated tail losses in periods of elevated risk.

Table 5: Portfolio 1-day VaR and ES under different modelling approaches

Method	VaR _{0.95}	ES _{0.95}	VaR _{0.99}	ES _{0.99}
Historical	-0,54%	-0,85%	-1,03%	-1,24%
Param t	-0,57%	-0,74%	-0,85%	-0,99%
GARCH t	-0,60%	-0,78%	-0,89%	-1,03%

Time-Varying Portfolio Volatility

In order to analyse the dynamics of portfolio risk over time, we construct two measures of time-varying volatility for the portfolio return series. Let R_t^p denote the daily portfolio return. First, a simple rolling volatility measure is computed as the sample standard deviation over a moving window of $w = 60$ trading days,

$$\sigma_t^{(roll)} = \sqrt{\frac{1}{w-1} \sum_{j=1}^w (R_{t-j+1}^p - \bar{R}_t^p)^2},$$

where $\bar{R}_t^p$ is the average portfolio return over the window $\{t-w+1, \dots, t\}$.

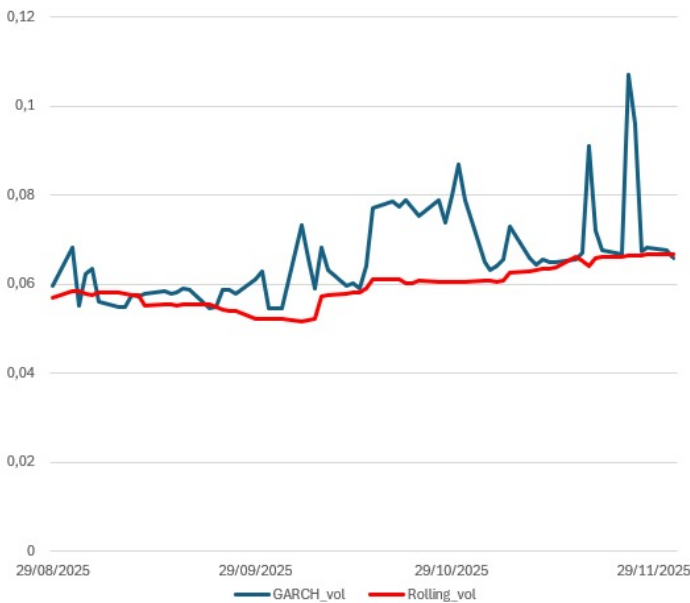
Second, a model-based conditional volatility estimate is obtained from a rolling GARCH(1,1) specification with Student-t innovations. For each time t , the model

$$R_s^p = \mu_t + \varepsilon_{s,t}, \quad \varepsilon_{s,t} = \sigma_{s,t} z_{s,t}, \quad z_{s,t} \sim t_{\nu_t},$$

is re-estimated on the most recent 60 observations $\{R_{t-w+1}^p, \dots, R_t^p\}$, and the one-step-ahead conditional standard deviation $\sigma_{t+1|t}^{(GARCH)}$ is extracted as the GARCH-based volatility estimate at time t . Both volatility series are annualised by multiplying daily standard deviations by $\sqrt{252}$.

Figure 1 compares the annualised GARCH(1,1) volatility to the simple rolling volatility over the sample period. The two measures co-move closely in tranquil periods, while the GARCH-based volatility responds more sharply to clusters of large returns, capturing volatility persistence more effectively than the purely backward-looking rolling standard deviation.

Figure 1: GARCH vs Simple Rolling (annualized)



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