

# MIMS – Diversified Passive Selection Fund

## Portfolio Management Team

Report – May 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 we face a period characterized by great market uncertainty and rising geopolitical tensions, with the potential for an economic slowdown to occur due to the strengthening of reciprocal tariffs, we kept the existing equity exposure (overall 50%) to invest in non-cyclical defensive sectors that can protect the returns of the portfolio in such a period of uncertainty. In fixed income, we diversified across both corporate and sovereign bond ETFs with short and medium durations to reduce exposure to interest rates volatility. We maintained a position in short-term Treasuries (1 to 3 years maturity) and selectively added exposure to the European government securities and Asian and Australian corporate bonds. This approach aims to benefit from attractive yields while reducing the exposure to wild rates fluctuations.

Our portfolio allocation is now balanced across equities (50%), fixed income (40%), and commodities (10%).

#### Geographical Allocation

Our portfolio is strategically diversified across the United States, Europe, Asia and Australia. Our strategy emphasizes an accurate opportunity-seeking asset allocation in the US and Europe, where we invest in counter-cyclical sectors to



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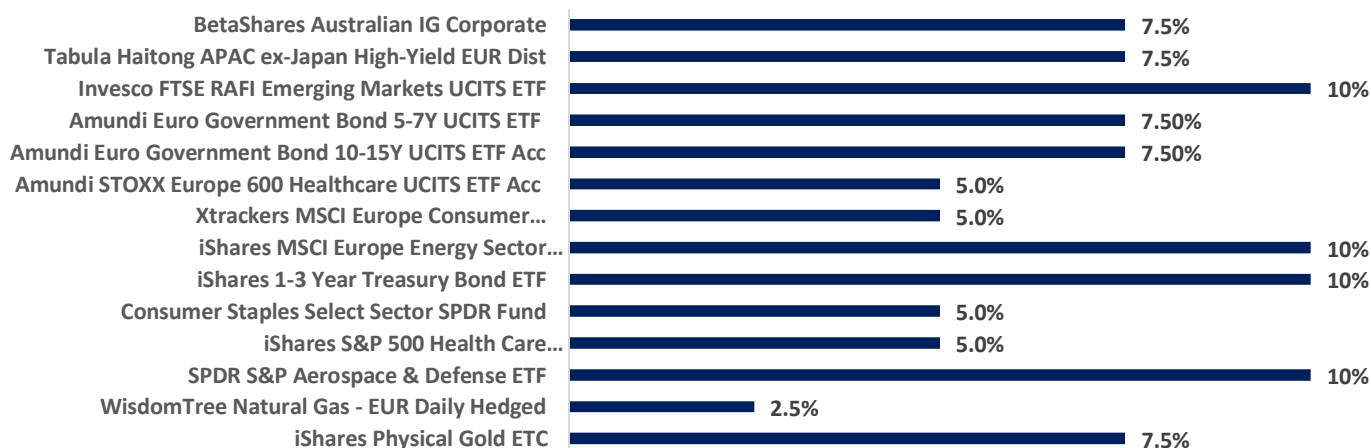
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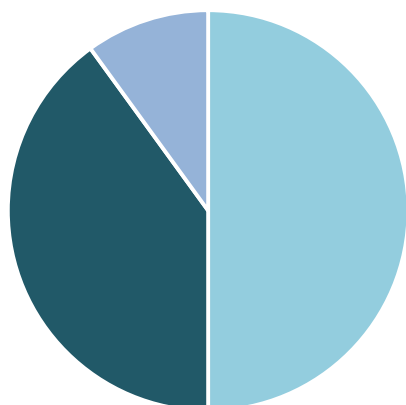
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hedge against a potential economic slowdown. In Asia, we reduce exposure to India, where market valuations appear stretched relative to fundamentals, and increase the allocation to China and Taiwan despite their geopolitical risk. On the fixed income side, we exploit attractive yields driven by trade-related uncertainties, while offsetting potential currencies devaluation through EUR hedging and further diversifying through Australian investment-grade corporate bonds.

### ETFs Breakdown

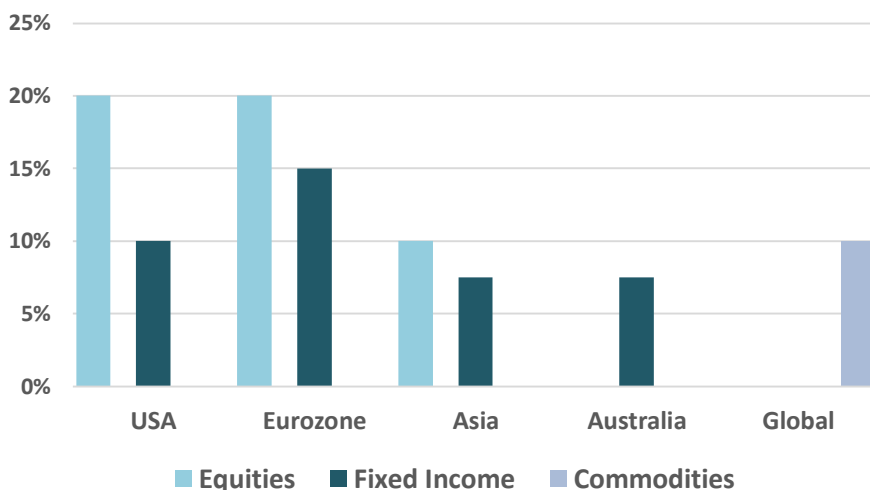


## Asset Allocation



■ Equities ■ Fixed Income ■ Commodities

## Allocation breakdown



## Performance

|   |        |
|---|--------|
| <b>Period Return</b><br>02/12/2024 - 24/04/2025 | -7.70% |
|---|--------|

|                               |        |
|-------------------------------|--------|
| <b>Daily Mean Return</b>      | -0.08% |
| <b>Daily Volatility</b>       | 0.773% |
| <b>Annualized Mean Return</b> | -18.4% |
| <b>Annualized Volatility</b>  | 12.27% |

## Portfolio Value (\$million)



In order to evaluate the performance of our investments, we track the daily value of the portfolio over a period of time stretching from the 2<sup>nd</sup> of December 2024 to the 24<sup>th</sup> of April 2025. At the beginning of the observed period (02/12/2024), we assume an initial investment of € 10,386,402.07 and calculate the number of shares of each ETF that will be bought and held in portfolio, according to the weights chosen during the asset allocation process. Keeping track of the funds' prices, we can easily determine the value of the portfolio until the end of the period (24/04/2025). We record a final value of €9,586,299.36, with an overall return of approximately -7.70% in approximately 5 months, driven by the overall bad performance and huge level of volatility witnessed in the markets at the beginning of 2025.

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## Portfolio Overview

Our portfolio can be ideally divided in 3 main sections:

- “equity indexes ETFs”
- “fixed income ETFs”
- “commodities ETFs”

### Equity Indexes ETFs

With respect to last semester, we maintained the same equity exposure, which remains 50% of the total allocation, split across 7 ETFs covering different geographic areas: US (20%), Europe (20%), Emerging Markets (10%). We adopted a top-down approach to define the geographical allocation of our portfolio, in order to capitalize on the ongoing macroeconomic trends and changes in assets’ valuations. The main theme that has impacted the first quarter of 2025 was certainly the one of the tariffs introduced by the Trump administration, which aimed at reducing the US trade deficit and therefore targeted their key trade partners, including the EU and, even more heavily, China. The announcement was followed by extensive losses in the equity markets worldwide, with increasing fears that a continued trade war might lead to stagflation and a global recession. While the short-term effects of such trade war seem to be clear, with most countries, especially the US, seeing cuts in their economic outlooks, the long-term is still clouded by uncertainty. For these reasons, we adopted a cautious equity strategy focused on sectors with more stable earnings profiles. Specifically, we increased exposure to counter-cyclical industries such as healthcare and consumer staples in both the US and Europe, which tend to perform more consistently during periods of economic strain. Furthermore, we added allocation to the European defense sector, which stands to be the primary target of increased government spending and long-term strategic investment, especially given the recent developments in the Trump administration foreign policy and in the Ukraine-Russia war. In Asia, we have decided to increase our exposure to China and Taiwan. In particular, as far as the former is concerned, we believe that the US tariffs will force it to focus on its internal problems, like supporting domestic consumption, and that therefore these markets currently present compelling opportunities to acquire quality businesses at fair valuations, even after accounting for geopolitical risks.

### Fixed Income ETFs

With respect to last semester, we maintained the same fixed income exposure, which remains 40% of the total allocation, split across 5 ETFs covering different geographic areas: US (10%), Europe (15%), Emerging Markets (7.5%) and Australia (7.5%). However, the profile of the chosen ETFs is different, following a significant change in the outlook of fixed income markets and monetary policies worldwide with the introduction of the US tariffs and rising expectations of a global economic slowdown. In Europe, we decided to invest in medium-term government bonds in order to strike a balance between seeking attractive yields and benefiting from potential rate cuts by the European Central Bank, while not being too exposed to short-term interest rates volatility, given the uncertainty surrounding the global economic outlook ahead of the US tariffs and the role of the “Bond vigilantes”. Furthermore, while following Germany’s elections and the announcement of greater government spending, yields across the Eurozone have risen, accompanied by a strengthening of the euro against the dollar, we believe that the broader trend might suggest a potential reversion to the mean, again supporting the exposure to medium-term duration. In Asia, on the other hand, we chose to invest in high-yield corporate bonds to benefit from attractive yields driven by trade-related uncertainties due to Trump’s tariffs, while offsetting potential currencies devaluation through EUR hedging. Finally, to balance the portfolio’s risk profile, we diversified into investment-grade corporate bonds in Australia.

### Commodities ETFs

To align with our cautious yet opportunity-seeking strategy, we have decided to maintain our 10% allocation to commodities, but with a more focused approach to selection.

Given the rising uncertainty in the markets and stronger geopolitical tensions, we have chosen to open positions in gold. Despite the all-time high values recently reached by gold, we view it as a compelling investment opportunity, due to its being a safe haven asset, as well as due to the rising demand by Central Banks worldwide. Furthermore, we decided to maintain, although with a much lower weight, our previous position in natural gas, in order to benefit from the expected rise in demand, especially from emerging Asian economies.

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## iShares Physical Gold ETC

Index: LBMA Gold Price

Expense Ratio: 0.12% Tracking Error Volatility: N/A

### Overview

This fund seeks to track the return of the gold spot price in US Dollar.

### Analysis

The gold market has reached record highs, peaking at \$3,120 per ounce, driven by ongoing geopolitical tensions, including the trade war with China, the Russia-Ukraine conflict, and new trade tariff policies under President Donald Trump, which have boosted U.S. gold imports. Central banks have also played a significant role, increasing their gold purchases to diversify away from U.S. dollar reserves amid fears of its potential weakening. Additionally, widespread economic uncertainty and concerns over possible global slowdowns have further supported the surge in gold prices. Finally, the ETF is currency unhedged, which means that even in case the FED raises US interest rates, the value of the fund will benefit from a stronger USD.



### Conclusion

We chose this exposure to capitalize on the ongoing global macroeconomic dynamics while also positioning ourselves to navigate the rising uncertainties in global markets.

## WisdomTree Natural Gas - EUR Daily Hedged

Index: Bloomberg Natural Gas index

Expense Ratio: 0.49% Tracking Error Volatility: N/A

### Overview

The WisdomTree Natural Gas seeks to track the Bloomberg Natural Gas index hedged to EUR. The Bloomberg Natural Gas index tracks the price of futures contracts on natural gas.

### Analysis

The fund provides an opportunity to capitalize on the rising demand for gas, driven mainly by emerging Asian economies, population growth, and the role of natural gas as a transitional fuel from coal to renewables. Indeed, world production is expected to reach 4,372 BCM by 2030, a 4.34% increase from 2024, according to the International Energy Agency, while demand grew by 2.8% in 2024, outpacing the previous decade's average. However, short-term uncertainty arises from the recently announced tariffs on natural gas trade, which could restrict supply and increase volatility, as well as for the potential implications of further US-EU agreements.



### Conclusion

For all the reasons explained above, we chose to keep this fund from the previous allocation, but reducing its overall weight from 5% to 2.5%.

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## Amundi STOXX Europe 600 Healthcare UCITS ETF Acc

Index: STOXX Europe 600 HealthCare Index

Expense Ratio: 0.3% Tracking Error Volatility: 1%

### Overview

The objective of this investment is to replicate the performance of the Stoxx Europe 600 HealthCare. This index tracks the performance of European pharmaceutical and healthcare firms.

### Analysis

The ETF presents a compelling investment opportunity at this moment due to a combination of attractive valuations and sector resilience. Following a 15% decline over the past month, driven by concerns over potential U.S. tariffs, valuations have become more appealing, especially given the defensive nature of healthcare. European pharmaceutical leaders such as Novartis, Novo Nordisk, Roche, Sanofi, Lonza, and AstraZeneca dominate global markets particularly for oncology and rare disease treatments.

While trade tensions raise concerns, U.S. policies have focused mainly on generic drugs, not the patented therapies where European firms excel. Novartis and Roche' \$70 billion investment in U.S. capacity reflects the sector's strong positioning and lobbying power. With much of the downside already priced in, and a targeted EU-U.S. deal still plausible, the ETF offers attractive upside. Its 51 holdings are profitable, non-cyclical, and financially solid—key traits for navigating European economic uncertainty.



### Conclusion

Our idea is to increase the exposure over an undervalued anti-cyclical sector such as the healthcare. This can provide a buffer against market volatility while ensuring long-term growth driven by innovation.

## Amundi Euro Government Bond 10-15Y UCITS ETF Acc

Index: Bloomberg Euro Treasury 50bn 10.15 years

Expense Ratio: 0.15% Tracking Error Volatility: 1%

### Overview

Amundi Euro Government Bond 10-15Y tracks the performance of 49 European Government Bond with maturities between 10 and 15 years. The fund is exposed to different economies such as France, Italy, Germany, Spain and Belgium.

### Analysis

The ETF presents a compelling investment opportunity at this moment due to a favourable rate environment and strong macro tailwinds. Yields on AAA-rated Eurozone government bonds in the 10–15 years range currently hover between 2.5% and 2.8%. Germany's fiscal expansion has pushed yields higher and strengthened the euro, signalling renewed policy momentum in the region.

While the European economy continues to struggle with weak demand and industrial contraction, the outlook for monetary easing is improving. A resolution to the war in Ukraine or a worsening in U.S. trade policy could lower inflation and allow the ECB to cut rates steadily—potentially to 1.75% by year-end. With medium-to-long duration exposure, this ETF stands to benefit from falling rates. At the same time, the euro's appreciation may accelerate this trend by weighing on competitiveness and pressuring policymakers to act.



### Conclusion

We chose this funds to benefit from declining interest rate in the EuroZone. Moreover, a possible global economic slowdown could foster demand for long-term government bonds.

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## iShares MSCI Europe Energy Sector UCITS ETF EUR (Acc)

Index: MSCI Europe Energy 20/35 Capped Index (EUR)

Expense Ratio: 0.18%; Tracking Error Volatility: 0.5%

### Overview

The iShares MSCI Europe Energy Sector UCITS ETF EUR (Acc) offers investors a focused exposure to some of Europe's leading energy companies, encompassing both the European Union and the United Kingdom. These companies produce and distribute energy for domestic consumption within Europe's integrated market.

### Analysis

One of the defining strengths of this ETF is its geographic diversification within Europe. After Russian invasion of Ukraine in 2022 investing in the energy sector through multiple countries exposure it's mandatory. The considered ETF mitigates the risk associated with any single market's regulatory changes or political climate. This characteristic is particularly relevant during periods of heightened uncertainty, as it helps stabilize returns when individual regions experience volatility.



### Conclusion

Recent market turmoil driven by tariffs should minimally impact Europe's energy sector, as companies primarily supply domestic markets, thus limiting tariff effects. The sector offers strong growth potential amid favourable conditions, like rising oil prices or heightened energy demand from industrial rearmament. Additionally, energy companies typically remain resilient during downturns, supporting essential economic activities. This blend of growth potential and defensive qualities makes the ETF attractive for balanced investment exposure.

## Xtrackers MSCI Europe Consumer Staples Screened UCITS ETF

Index: MSCI Europe Consumer Staples ESG Screened 20-35 Select

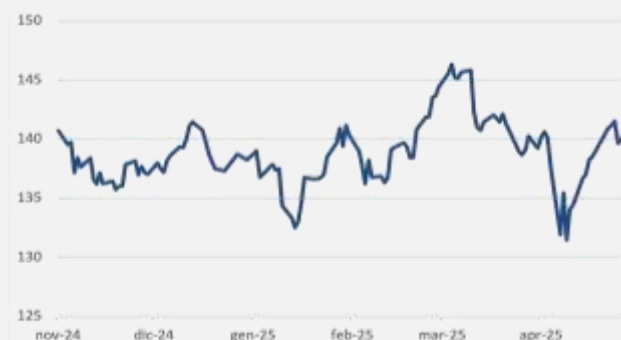
Expense Ratio: 0.17%; Tracking Error Volatility: 0.04%

### Overview

Xtrackers MSCI Europe Consumer Staples Screened UCITS ETF focuses on the European consumer staples sector, investing in established companies that typically demonstrate resilient demand patterns and steady revenue streams. The ETF offers broad geographic diversification across the European Union and the United Kingdom, mitigating the impact of regional fluctuations and providing a balanced approach to capturing growth prospects in different markets.

### Analysis

The ETF presents a relatively low volatility compared to more cyclical or high-growth equity sectors. Over the long term, consumer staples have historically exhibited stable performance, driven by the consistent demand for essential goods and services. As a result, this ETF can function as a stabilizing force in a scenario of increasing possibility of US recession, which would hurt European real economies as well. Indeed, in moderate downturns, these businesses often remain less affected, allowing the ETF to offer returns that are positive or only slightly negative. In more severe market disruptions, the sector's resilience helps to contain extreme drawdowns.



### Conclusion

Given the current volatile and uncertain economic landscape, this ETF stands as a prudent consideration. Its defensive qualities, coupled with an extensive geographic reach, make it a strategic choice to fortify against unfavorable conditions. By focusing on companies that provide essential consumer products, the ETF aims to deliver a balance between risk mitigation and the pursuit of steady returns.

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## Amundi Euro Government Bond 5-7Y UCITS ETF

Index: Bloomberg Euro Treasury 50bn 5-7 Year Bond Index

Expense Ratio: 0.15%; Tracking Error Volatility: 0.03%

### Overview

Amundi Euro Government Bond 5-7Y UCITS ETF Acc provides an opportunity to gain exposure to European government bonds within a medium-term maturity range, between five and seven years.

### Analysis

In a market environment where credit spreads are widening, there is a strong case for prioritizing government over corporate debt. Widening spreads signal rising risk premiums and uncertainty in the corporate sector. Furthermore, investing in a 5-7 year maturity band offers a balance between yield potential and sensitivity to interest rate movements. Current yield levels in this segment, ranging from approximately 3% to 4%, are particularly attractive. At the same time, these bonds are less exposed to immediate market volatility driven by “bond vigilantes”, who have become increasingly vigilant in scrutinizing debt markets following recent turmoil in the U.S. Treasury market.



### Conclusion

By focusing on mid-duration securities, investors can avoid the heightened price swings typically associated with longer-term bonds during periods of heightened investor scrutiny and policy uncertainty. Still, the above-mentioned mid-duration profile allows for partial participation in any potential economic downturn, which could lead to a more substantial decline in interest rates than is currently priced in. A deteriorating macroeconomic environment often translates into lower yields as central banks ease monetary policy to stimulate growth.

## SPDR S&P Aerospace & Defense ETF

Index: S&P Aerospace & Defense Select Industry

Expense Ratio: 0.35%; Tracking Error Volatility: N/A

### Overview

This ETF holds a portfolio of aerospace and defense stocks, as defined by GICS, and aims at a 40/40/20 weighting among large, mid and small caps respectively.

### Analysis

Governments around the world are committing to structurally higher defense spending in the upcoming years. Although much of this has already been priced in, the geopolitical tensions showcase that this is not a temporary bump, but a trend that will be increasingly important for national security. Moreover, the long-term contracts offer predictable cash flows and earnings. XAR is equal-weighted, which means that smaller high-growth companies (like AeroVironment, BWX Technologies) have a significant impact which is good because innovation are driving growth in this sector. With expected sector EPS growth of +10–12% annually through 2027 and due to the political uncertainty, we think it is understandable and logical. In the context of tariffs, compared to other sectors, this sector has more domestic production which makes it a little bit less exposed to tariffs.



### Conclusion

We want to benefit from the continuously increasing spending and investments in the defense sector. In the growing uncertainty, this is one of the few sectors which grows in value and significance, and this can hardly be changed by factors like the implementation of tariffs.

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## iShares S&P 500 Health Care Sector UCITS ETF (Acc)

Index: S&P 500 Capped 35/20 Health Care

Expense Ratio: 0.15%; Tracking Error Volatility: N/A

### Overview

The iShares S&P 500 Health Care Sector UCITS ETF (Acc) seeks to track the S&P 500 Capped 35/20 Health Care index. The S&P 500 Capped 35/20 Health Care index tracks the US healthcare sector.

### Analysis

Global GDP growth is expected to be around 2.8% in 2025, and so investors are preferring sectors with non-cyclical demand. Generally, healthcare spending is not so affected by recessions since people continue needing drugs, surgeries, and medical services even when there is an economic slowdown. New treatments in oncology, obesity, gene therapy, and AI-driven diagnostics are creating significant revenue streams. Between mRNA platforms, CRISPR gene editing, or the new cancer immunotherapies, the healthcare sector is in a strong period of innovations and growth. Cash-rich big companies are currently acquiring biotech firms to boost their product pipelines, and our diversified ETF will benefit on both sides. We think that recently valuations have reset, but the fundamentals are staying strong.



### Conclusion

The healthcare sector is characterized with low demand elasticity, which is important in an uncertain environment. Moreover, it is a hedge against inflation, which is a likely consequence of the high tariffs that are currently being imposed. Lastly, the healthcare sector is a main beneficiary of the expansion in AI operations.

## Consumer Staples Select Sector SPDR Fund

Index: Consumer Staples Select Sector Index

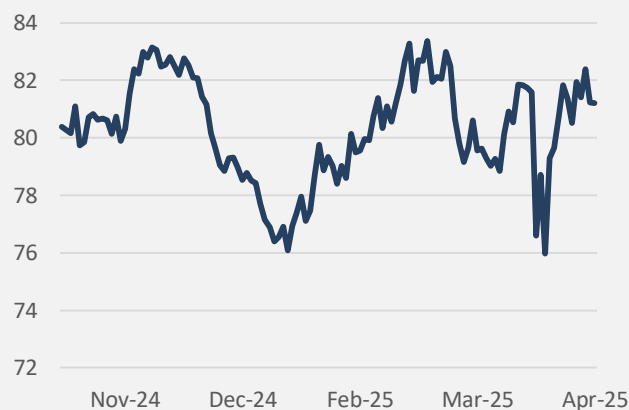
Expense Ratio: 0.09%; Tracking Error Volatility: N/A

### Overview

Consumer Staples Select Sector SPDR Fund is created with the goal to track the Consumer Staples Select Sector Index. It includes companies from industries such as food & staples retailing, household products; food products beverages, and personal products. Component stocks include Procter & Gamble, Philip Morris International, Coca-Cola, Costco and Pepsi.

### Analysis

Global consumer staples spending is projected to grow at a 5.1% CAGR from 2024 to 2030, even amid slowing global GDP growth. If the economy slows further or hits a mild recession, consumer staples will outperform because people still need food, beverages, and basic household items. The valuations are reasonable, slightly higher than historical averages, but still cheaper than many other sectors like tech. Pricing power of giants like Procter & Gamble, PepsiCo, and Nestlé remains strong. In the context of tariffs, costs can be passed to consumers more easily compared to other sectors. Companies like General Mills and Unilever and many others have shifted production closer to end markets, which is a trend in recent years.



### Conclusion

Amid the global uncertainty, consumer staples is traditionally a safe choice, so we would like to use it as a defensive sector that can perform positively both during a crisis and in normal times.

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## IShares 1-3 Year Treasury Bond ETF (SHY)

Index: ICE U.S.Treasury 1-3 Year Bond Index

Expense Ratio: 0,15%; Tracking Error Volatility: N/A

### Overview

The SHY ETF offers exposure to short-term U.S. Treasuries with maturities between 1 and 3 years. It is designed to minimize interest rate risk while maintaining high credit quality, liquidity, and capital preservation.

### Analysis

In the current market environment, SHY represents a safer and more flexible fixed-income position. Its short duration significantly reduces sensitivity to interest rate volatility while still delivering competitive short-term yields. Given the ongoing macro uncertainty around inflation, monetary policy, and fiscal risks, SHY offers better downside protection than long-duration bonds. It plays a key role in stabilizing the portfolio and complements more cyclical or risk-on assets by serving as a highly liquid and conservative anchor.



### Conclusion

SHY is a more effective defensive allocation in today's uncertain environment. It provides capital stability, preserves purchasing power, and offers meaningful yield—without the asymmetric risks embedded in long-duration instruments.

## Invesco FTSE RAFI Emerging Markets UCITS ETF

Index: FTSE RAFI Emerging Net index TR

Expense Ratio: 0.49% Tracking Error Volatility: 0,85%

### Overview

The Invesco FTSE RAFI Emerging Markets ETF invests in large and mid-cap companies from emerging markets, selected according to a value-oriented, fundamental approach; considering factors such as sales, cash flow, book value, and dividends. Consequently, the index is less prone to excessive concentration arising from market fads, which can result in over-exposure to individual companies, sectors or countries.

### Analysis

The Asian markets offer attractive opportunities, particularly in times of trade reorganization, which presents both risks and opportunities for investment. We believe that focusing on strong fundamentals will provide exposure to businesses most likely to withstand and overcome volatile and stressful periods. In particular, the ETF allocation is concentrated in China and Taiwan, where there are compelling opportunities to acquire good businesses at fair prices. It also provides interesting exposure to other emerging markets, such as Brazil, which have promising outlooks for the future.



### Conclusion

We perceive this investment as a strategic exposure to fundamentally strong companies in emerging markets. Since structural reforms and improving market efficiency are already reflected in valuations, the RAFI methodology targets firms with proven financial resilience and sustainable earnings potential.

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## BetaShares Australian IG Corporate

Index: Solactive Australian IG Corporate Bond Select TR Index

Expense Ratio: 0.25% Tracking Error Volatility: 0,28%

### Overview

The BetaShares Australian IG Corporate Bond ETF invests in a portfolio of senior, fixed-rate, investment grade corporate bonds issued by Australian companies. The index tracked selects up to 50 bonds with strong liquidity and maturities between 5 and 10 years, remaining broadly diversified across sectors.

### Analysis

Australia's corporate bond market is dominated by investment grade issuers, providing a relatively defensive fixed income option for investors. The fund's focus on high-quality, senior bonds and its preference for securities with superior expected excess returns over government bonds can offer attractive yields with lower default risk. As the Australian economy remains stable (GDP growth projected to stay between 1.8-2.4%yoy per S&P) and the market for junk bonds is limited, investment grade corporate bonds are likely to benefit from ongoing demand for income and portfolio diversification, especially during periods of equity market volatility. Moreover, the ETF is denominated in AUD, which typically has a lower volatility against the EUR.



### Conclusion

We consider this ETF a defensive exposure to high-quality Australian corporate debt, benefiting from stable economic conditions and demand for reliable income. It ensures to the fund a steady source of income while managing to diversify both currency and geography.

## Tabula Haitong APAC ex-Japan High-Yield EUR Dist

Index: iBoxx MSCI Scored&Screened USD Asia ex-Japan High Yield

Expense Ratio: 0.60% Tracking Error Volatility: 0,72%

### Overview

This Tabula Haitong APAC ex-Japan Bond ETF invests in high-yield corporate bonds from companies across the APAC region, excluding Japan. The fund tracks an ESG-screened index of sub-investment grade issuers, offering diversification across countries and sectors, and currency risk mitigation through euro hedging.

### Analysis

In the Asia-Pacific region (ex-Japan), we see compelling opportunities in high-yield corporate bonds, supported by ongoing economic growth and infrastructure development, which will be probably boosted by a strengthening of the inter-Asian trade due to trump's tariffs. The Tabula Haitong Asia ex-Japan High Yield Corporate Bond ETF offers attractive income potential (average coupon: 8.8%) while limiting exposure to any single country. Its euro hedging helps offset currency risks, particularly relevant given ongoing trade-related volatility and the expansive monetary policy of those regions. Although the fund's small size pose some liquidity limitations, its ESG screening adds a layer of risk mitigation.



### Conclusion

We view this ETF as a targeted exposure to the Asia-Pacific bond market, offering attractive yields compared to alternatives while offsetting currencies risks. This investment aligns with the objective of the fund, adding a position exposed to a different risk profile with higher expected returns.

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## Quantitative Research Team

### Risk Report – May 2025

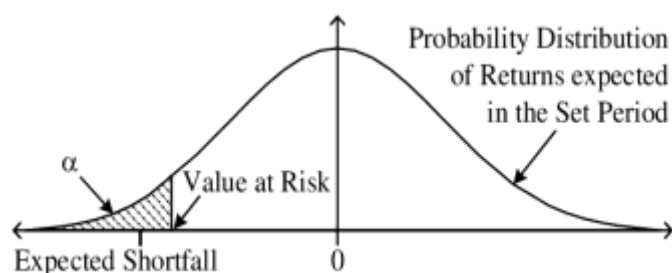
#### Introduction

The main objective of this section is to assess and quantify the risk embedded in the allocation 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.

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 allows to understand 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.

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## 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  $\alpha$ -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  $\mu$ , volatility  $\sigma$  and number of degrees of freedom  $\nu$ .

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,  $\mu$  is estimated as a simple average of daily returns.
2. Volatility of returns  $\sigma$  is calculated as a simple standard deviation of returns.

3. Number of degrees of freedom  $\nu$  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  $\nu$  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 (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  $\sigma$  is the estimated volatility of a security,  $T_{\nu}^{-1}(\alpha)$  is the  $\alpha$ -percentile of a Student-t distribution with  $\nu$  degrees of freedom, and  $\mu$  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  $\nu$  degrees of freedom it can be proven that the expected shortfall would be given by:

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

where  $\sigma$  is the estimated volatility of a security,  $T_{\nu}^{-1}(\alpha)$  is the  $\alpha$ -percentile of a Student-t distribution with  $\nu$  degrees of freedom,  $\tau_{\nu}(\cdot)$  is the probability density function of Student-t distribution with  $\nu$  degrees of freedom and  $\mu$  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  $VaR_{\alpha}$  and  $ES_{\alpha}$  are column vectors of individual stock VaR and ES, respectively and  $\rho$  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 estimates are slightly higher than the simple approach ones, potentially due to the higher volatility in the markets lately. Indeed, GARCH puts more weight on the most recent observations, thus, it better estimates the future volatility and allows to produce more reliable risk metrics.

|                          | Simple approach | GARCH  |
|--------------------------|-----------------|--------|
| <b>VaR<sub>95%</sub></b> | -0.77%          | -1.01% |
| <b>VaR<sub>99%</sub></b> | -1.11%          | -1.71% |
| <b>ES<sub>95%</sub></b>  | -0.98%          | -1.47% |
| <b>ES<sub>99%</sub></b>  | -1.28%          | -2.32% |

### TOP & BOTTOM 5 funds (simple approach)

|   | VaR 95 | VaR 99 | ES 95  | ES 99  |
|---|--------|--------|--------|--------|
| <b>Amundi Euro Government Bond 5-7Y UCITS ETF</b>       | -0.42% | -0.60% | -0.53% | -0.70% |
| <b>Amundi Euro Government Bond 10-15Y UCITS ETF Acc</b> | -0.76% | -1.09% | -0.96% | -1.26% |
| <b>iShares 1-3 Year Treasury Bond ETF (SHY)</b>         | -0.89% | -1.27% | -1.12% | -1.47% |
| <b>BetaShares Australian IG Corporate</b>               | -0.95% | -1.34% | -1.19% | -1.55% |
| <b>Tabula Haitong APAC ex-Japan High-Yield EUR Dist</b> | -1.00% | -1.45% | -1.27% | -1.68% |

|   | VaR 95 | VaR 99 | ES 95  | ES 99  |
|---|--------|--------|--------|--------|
| <b>iShares S&amp;P 500 Health Care Sector UCITS ETF (Acc)</b> | -1.67% | -2.38% | -2.11% | -2.74% |
| <b>Amundi STOXX Europe 600 Healthcare UCITS ETF Acc</b>       | -1.90% | -2.70% | -2.39% | -3.11% |
| <b>Invesco FTSE RAFI Emerging Markets UCITS ETF</b>           | -2.03% | -2.95% | -2.60% | -3.45% |
| <b>iShares MSCI Europe Energy Sector UCITS ETF EUR (Acc)</b>  | -2.30% | -3.28% | -2.91% | -3.80% |
| <b>SPDR S&amp;P Aerospace &amp; Defense ETF</b>               | -2.63% | -3.79% | -3.34% | -4.37% |



## 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  $M \rightarrow +\infty$  (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.

|                          | Estimate | Standard error |
|--------------------------|----------|----------------|
| <b>VaR<sub>95%</sub></b> | -0.66%   | 0.16%          |
| <b>VaR<sub>99%</sub></b> | -1.79%   | 0.50%          |
| <b>ES<sub>95%</sub></b>  | -1.29%   | 0.26%          |
| <b>ES<sub>99%</sub></b>  | -2.31%   | 0.41%          |

### TOP & BOTTOM 5 funds (GARCH)

|  | VaR95 (GARCH) | VaR99 (GARCH) | ES 95 (GARCH) | ES 99 (GARCH) |
|--|---------------|---------------|---------------|---------------|
| <b>Amundi Euro Government Bond 10-15Y UCITS ETF Acc</b>          | -0.85%        | -1.36%        | -1.17%        | -1.72%        |
| <b>BetaShares Australian IG Corporate</b>                        | -1.37%        | -2.18%        | -1.88%        | -2.76%        |
| <b>iShares 1-3 Year Treasury Bond ETF (SHY)</b>                  | -1.32%        | -2.27%        | -1.94%        | -3.06%        |
| <b>iShares S&amp;P 500 Health Care Sector UCITS ETF (Acc)</b>    | -1.71%        | -2.81%        | -2.42%        | -3.65%        |
| <b>Xtrackers MSCI Europe Consumer Staples Screened UCITS ETF</b> | -1.82%        | -2.83%        | -2.46%        | -3.50%        |

|   | VaR95 (GARCH) | VaR99 (GARCH) | ES 95 (GARCH) | ES 99 (GARCH) |
|---|---------------|---------------|---------------|---------------|
| <b>Consumer Staples Select Sector SPDR Fund</b>         | -2.62%        | -4.14%        | -3.58%        | -5.19%        |
| <b>Tabula Haitong APAC ex-Japan High-Yield EUR Dist</b> | -1.90%        | -4.25%        | -3.67%        | -7.72%        |
| <b>Invesco FTSE RAFI Emerging Markets UCITS ETF</b>     | -3.15%        | -5.57%        | -4.76%        | -7.79%        |
| <b>SPDR S&amp;P Aerospace &amp; Defense ETF</b>         | -3.57%        | -5.91%        | -5.08%        | -7.72%        |
| <b>WisdomTree Natural Gas - EUR Daily Hedged</b>        | -6.54%        | -9.68%        | -8.49%        | -11.50%       |

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