

# MIMS - Diversified Passive Selection Fund

## Passive Portfolio Team

Report – December 2020

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 whilst capturing as little idiosyncratic risk as possible.



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### Asset Allocation

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. We took into account different strategies: our main driver was the focus of ESG and sustainability, as long as we consider it to be both an ethic and profitable investment opportunity. Moreover, we re-introduced the strategy of Smart Beta ETFs, whose brilliant response to the pandemic caught our attention.

Contrary to our previous portfolio we attributed more weight to equity than debt: indeed, thanks to the support of our Macro team, the 60/40 portfolio typical configuration isn't performing as expected from investors, so we decided to experiment this new allocation. Nevertheless, this may expose us to higher risks and this explain our bigger and more diversified hedging position. Achieving the current selection has been for our team an interesting opportunity to understand more complex instruments, like Volatility ETFs.

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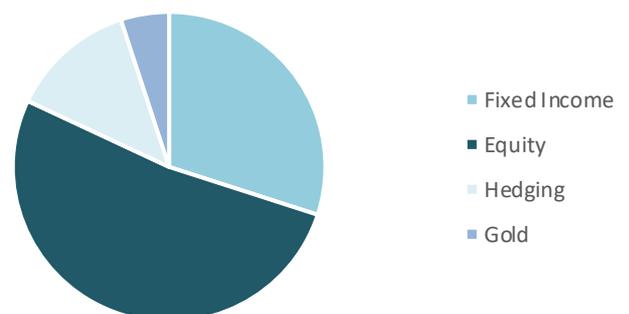
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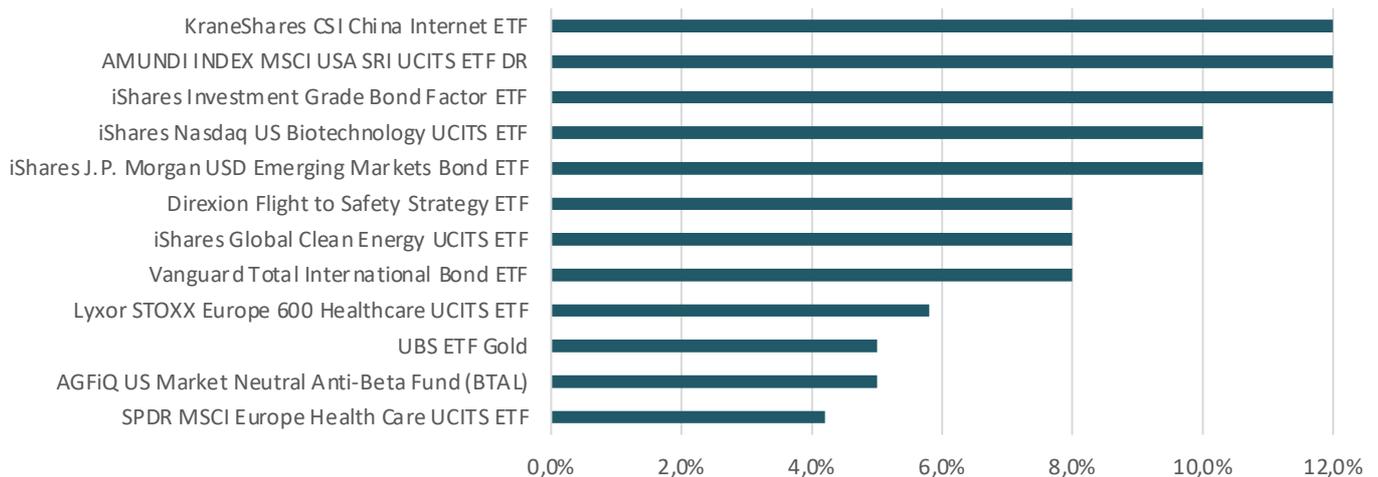
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### Capital Allocation

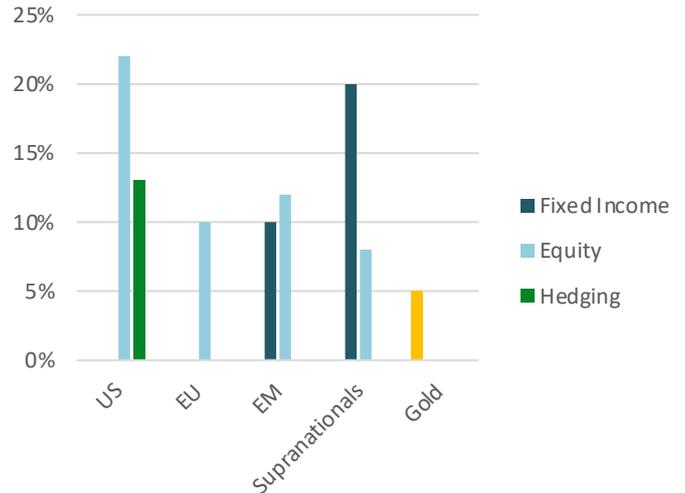


### ETF Breakdown



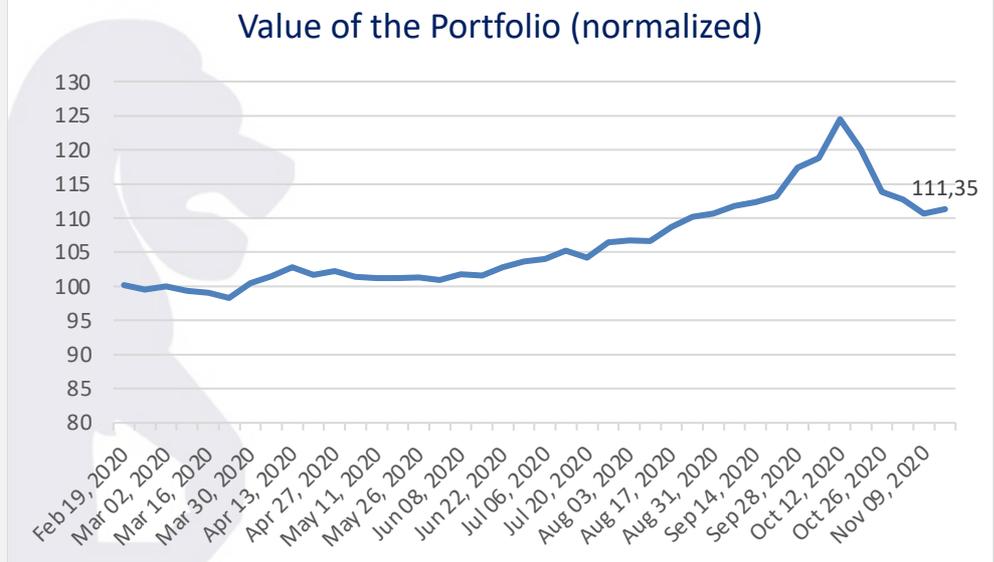
## Allocation Breakdown

Our asset allocation involves 52% investments into equities, most of which are exposed to the US market. The fixed income investment, instead, mainly related to the Smart Beta ETFs are not related to specific regions but have a worldwide risk exposure. Moreover, overall, we invested more in Emerging Markets (22%) rather than Europe (15%), exploiting the interest opportunities coming from the Chinese market. Finally, despite we provided different hedging products, we decided to keep a 5% investment in gold.



## Performance

To express the ongoing performance of our portfolio we normalized the value of the portfolio at time zero (February 2020) and analysed the compounded growth of its value. Coherently with our return calculations, the value of the portfolio at November 2020 is 111.36, as shown in the graph on left-hand side. The portfolio peaked at 124.48 in October 2020, before reducing its performance to the actual value mainly impacted by the Covid-19 second wave.



We considered the returns of the selected ETFs, weighted as decided in the capital allocation, in order to calculate the annual return of our portfolio. The time horizon we considered started in February 2020, including the Covid-19 outbreak. However, despite this black swan, we have been able to obtain a positive overall return. Starting from daily-based returns we calculated the weekly equivalents and then the annual one, achieving a return of +11.35%. The main contribution to the performance is attributed to the KraneShares ETF, which is a peculiar Chinese ETF on the tech sector (whose features will be further described in this report) hitting a yearly return of almost +50%. The outstanding performance of this product led us to invest a high share of our portfolio in it, although, for the sake of diversification, we didn't invest more than 12% in the same ETF. This said, we believe that our portfolio is now benefiting from the rebounding trend of the market, but we are confident in its performance even in bearish markets, because such events would trigger the hedging mechanism of the defensive ETFs we selected.

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## Environmental, Social and Governance Focus



The decision of investigating the ESG issue was the result of a careful analysis regarding the global trends towards sustainability. The main topic when it comes to ESG is minimizing volatility as firms may be exposed to transition risk and other risks which are not captured by financial data. However, the absolute returns reached by ESG investing are outperforming other positions. When investing in “green”, there are different options: “Thematic investing” is a direct investment towards certain specific themes positioned to solve sustainability challenges. On the other hand, there are instead ETFs indirectly ESG-related, meaning that there are tracking indexes which are excluding firms operating in “brown” sectors (like oil and gas) while valuing firms top ESG performing in each sector (SRI funds).

The latter is more sensitive to a variety of ethical factors, taking into account not only the environmental issue but the broader three pillars of the topic. The discriminating variables is such investments came from different, non-excludible approaches:

- **ESG screening:**  
intentionally avoiding investments in certain sectors, excluding securities which do not meet the requirements laid down
- **ESG integration:**  
considering ESG criteria alongside financial analysis to identify risks and opportunities
- **ESG enhanced:**  
re-weights investments to maximize ESG scores

### iShares Global Clean Energy UCITS ETF

Index: S&P Global Clean Energy Index

Expense Ratio: 0.65% Tracking Error Volatility: 3.15%

#### ETF Overview

The iShares Global Clean Energy UCITS ETF Fund seeks to track the performance of an index composed of 30 of the largest global companies involved in the clean energy sector that comply with ESG criteria.

#### Analysis

The strongest aspect of this ETF is its overall ability to return to a positive performance after the initial outbreak of the pandemic in March. After two months, it was able to recover and has demonstrated rapid growth since. It currently holds a YTD rate of 78.07%, compared to 46.56% last year.

While the ETF does hold a high volatility of 38.57%, this can be reasoned to be the result of the current situation with COVID-19 and the ETF’s rapid recovery from May to today.

This equity ETF’s highly diversified geographical exposure to the US, China, Denmark, New Zealand, among other countries other and its direct investment approach on high-performing clean energy companies make this ETF a promising opportunity to tap into sustainable ETFs.

### Amundi Index MSCI USA SRI

Index: MSCI USA SRI 5% Issuer Capped

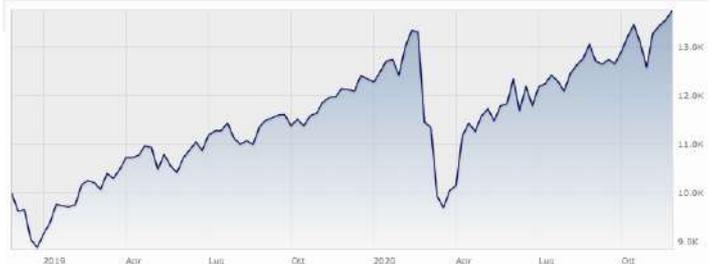
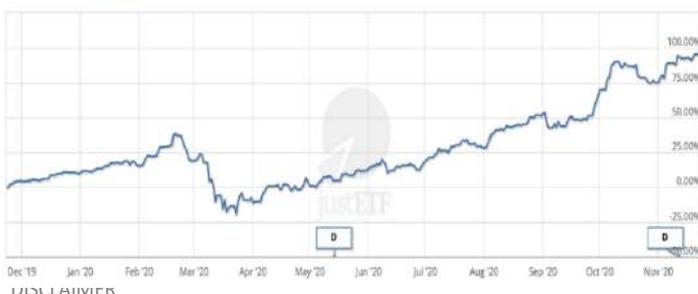
Expense Ratio: 0.18% Tracking Error Volatility: 0.1%

#### ETF Overview

This ETF aims to replicate the performance of the MSCI USA SRI 5% Issuer Capped Index. It provides exposure to large and mid-cap companies in the US market with the highest ESG ratings in each sector, according to a “SRI” policy. Issuers involved in sectors such as Nuclear, Coal, Tobacco, Alcohol, Gambling and Weapons are excluded from the portfolio, and the maximum weight of securities is capped at 5%.

#### Analysis

This rather new fund (created in 2018) has already proven capable of generating highly positive returns (more than 40% over 2-years period. Both annual volatility (25%) and TER (0.18%) are slightly below the average of direct SRI competitors as well as other ETFs based on broad US equity indexes. We felt like an “advanced” approach, such as SRI selection, would be more effective in reaping such benefits than the traditional screening approach. Furthermore, the ETF invests in a well-diversified portfolio including around 140 constituents well distributed across all sectors.



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## Smart Beta

As a rule, Smart Beta ETF underperform in bull markets and excel when markets fall. With markets having boomed for the past decade, investors have understandably not seen the need to pay the higher fees charged by smart beta compare to other market-cap ETFs. The space contains a broad spectrum of varying strategies and factors. And the strategies have certainly not performed in unison during the first four months of 2020. For example, momentum, dividend, fixed income and commodities were the only strategies to gather new flows. Conversely, multi-factor and value were hard hit by the coronavirus-triggered volatility, suffering net outflows of €1.8bn and €1.5bn respectively.

The success of smart-beta ETFs can be explained by their foundation in solid academic research, low fees and transparency. They are much easier to analyse than mutual funds as their strategy is clearly defined, the complete holdings tend to be available on the websites of the issuers for immediate download, and they are exchange-traded instruments. As such, the simplicity of smart-beta ETFs is a winning formula. However, given that smart-beta ETFs are effectively long-only products with slight factor tilts, diversification benefits and an associated risk reduction are likely to be limited.

We took into consideration the main categories of Smart Beta ETFs to analyse on which smart beta ETFs we should focus as a part of the Portfolio Management Team and we opted for the Fixed Income. Indeed, Smart beta has its roots in equity investment but is also making headway in fixed income. Some providers suggest it could even be better suited to capturing bond market factors. Moreover, Factor investing in fixed income has been heralded as the next frontier in asset management and defensive strategies reduced drawdowns during the ongoing coronavirus crisis.

Such ETFs target exposures to factors historically rewarded in fixed income securities. They are more difficult to analyse because factor definition is less homogenous. However, they allow an exposure to risk factors not comprised in other portfolios.

The main goals to be achieve with this product are (i) enhancing income (ii) offset risk from higher interest rates.

## Vanguard Total International Bond ETF

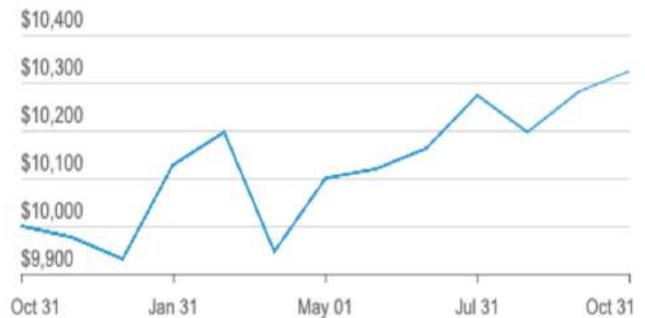
**Index:** Bloomberg Barclays Global Aggregate ex-USD Float Adjusted RIC Capped Index

**Expense Ratio:** 0.08% **Tracking Error Volatility:** 3.5%

The Vanguard Total International Bond ETF attempts to track the performance of the Bloomberg Barclays Global Aggregate ex-USD Float Adjusted RIC Capped Index (USD Hedged).

### Analysis

This fixed income ETF has had an overall lower performance last year, but still represents a fund with high liquidity and a low total expense ratio. Moreover, its large exposure to multiple markets (Europe, Asia, Latin America) makes it an attractive investment opportunity.



### Conclusion

The strongest part of this ETF is its diversification into the European, Asia Pacific, and Emerging Markets. Compared to other smart beta ETFs, the Passive Fund team found that this was the only ETF with a smaller concentration in the US market and a more complete investment on grade-bonds.

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## iShares J.P. Morgan USD Emerging Markets Bond ETF

Index: J.P. Morgan EMBI Global Core Index

Expense Ratio: 0.39% Tracking Error Volatility: 1.6%

### ETF Overview

The iShares J.P. Morgan USD Emerging Markets Bond ETF seeks to track an index composed of U.S. dollar-denominated emerging market bonds. It offers exposure to government and agency bonds, diversified across a broad number of emerging countries, focusing on different maturities with a preference for investment grade credit rating, but also high yield bonds.

### Analysis

The Net Asset Value has increased of 1.8% with a 10% volatility over the last year, negatively influenced by the Covid-19 outbreak in the first months of 2020 and pushed by the recovery in the growth of the emerging countries. This ETF is very well diversified (over 50 sovereign entities and over 500 bonds) and allows to reduce the risk associated to a specific emerging market. The main geographical exposures are in Mexico, Indonesia, Saudi Arabia, Qatar and Russia..



### Conclusion

The ETF offers exposure to EM which have good outlook and are expected to increase their importance in the world economic scenario, sustaining the performance of the bonds in the portfolio. Moreover, EM bonds show low correlation with other fixed income securities providing diversification to our portfolio in this period of uncertainty.

## iShares Investment Grade Bond Factor ETF

Index: BlackRock IG Enhanced Bond Index

Expense Ratio: 0.18% Tracking Error Volatility: 1.9%

### ETF Overview

The iShares Investment Grade Bond Factor ETF seeks to track the performance of an index that comprises US dollar-denominated investment-grade corporate bonds. The index objective is to deliver major risk adjusted returns. Hence, the ETF aims at mitigating risk and providing returns blending two factors, i.e. quality and value.

### Analysis

With an expense ratio of 0.18%, the ETF has obtained a 5.2% annual return with a moderate two-years volatility amounting to 7.2%. With a very low tracking error volatility, the Fund follows a stable benchmark which has provided good returns also in volatile periods. Finally, the Fund invests in firms with a BBB score.



### Conclusion

The ETF seems to be a safe source of return because of the stability shown by the index it tracks and its composition. Furthermore, investing in this ETF provides the portfolio with a focus on the US.

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## Can you buy the fear?

Among the products we have analysed to hedge our portfolio, there are the Volatility ETFs and ETNs. They have performed very well during the recent pandemic, as well as during the China trade war back to the last months of 2018. However, during period of expansions, their value may plummet to very low levels. In general, they try replicate the ‘fear gauge’ VIX and their movements are very similar to the peculiar VIX one with sudden spikes and smooth declines. Investors are not able to access the VIX index directly. Rather, VIX ETFs most commonly track VIX futures indexes (i.e. they tend to reflect the market’s expectation of further than 30-day volatility). Moreover, most VIX ETFs are, in fact, exchange-traded notes (ETNs), which carry a negligible counterparty risk of issuing banks.

From our point of view, these products are perfect hedges against markets declines only for an investor who is able to daily monitor and rebalance her or his portfolio, taking advantage of the typical spike movements of the VIX. However, such instruments are not advisable for a medium-long term investor because of the property of their underlying security to revert to the mean (and so coming back to low-volatility levels) and their loss in value caused by the daily rebalancing of the future contracts.

Rather it would be a good idea to insert ETFs that weight volatility without concretely tracking the VIX. One could think of low-volatility ETF as a mean of hedging against the volatility that might eventually turn up due to foreseeable events such as global lockdowns or bad news coming from calendar events. Indeed, we focused our investment on these types of alternative options: in particular we found an interesting investment opportunity with the AGFIQ US Market Neutral Anti-Beta Fund and the Direxion Flight to Safety Strategy ETF. Both ETFs will be described in detail in the following paragraphs of this report. Our aim was to diversify our hedging position, due to the extreme uncertainty of the market, with more complex (but still profitable) products, except than gold.

## Direxion Flight to Safety Strategy ETF (FLYT)

Index: Solactive Flight to Safety Index

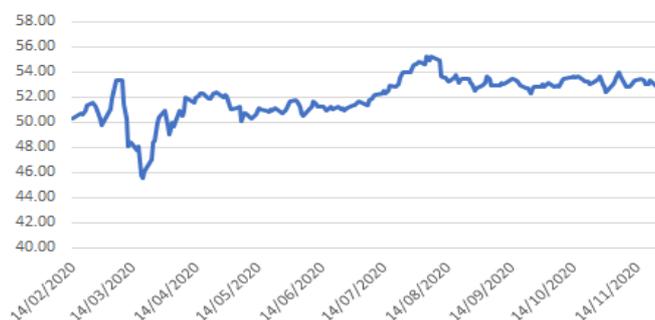
Expense Ratio: 0.40% Tracking Error Volatility: --

### ETF Overview

The Direxion Flight to Safety Strategy ETF seeks to provide total returns exceeding the total return of the Solactive Flight to Safety Index, which measures the performance of a basket of gold (25%), U.S. listed large-capitalization utility stocks (25%), and U.S. treasury bonds with remaining maturities of greater than 20 years (50%). The Fund is an actively managed ETF that does not seek to replicate the performance of a specified index and is not required to invest in the specific components of its benchmark index.

### Analysis

The fund aims to offer a hedge against equity market drawdowns while offering, at the same, long-term appreciation. The least volatile component of the Index, based on each component’s trailing 5-year volatility measure, receives the largest weighting, capping the gold component to 22.5% of the Index.



### Conclusion

As we think that the expansionary monetary policy of the Fed is likely to continue, the Treasury bonds of the fund will take advantage from it. For the equities, the fund invests in large-capitalization utility companies that are among the biggest providers of electric energy in US with increasing production from renewable or low-carbon sources that are expected to profit from the green wave momentum in the next few months.

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## UBS ETF (CH) Gold (USD) A-dis

Index: LBMA Gold Price

Expense Ratio: 0.25% Tracking Error Volatility: 0.1%

### ETF Overview

The UBS ETF - GOLD seeks to track the price and yield performance, before fees and expenses, of the LBMA Gold Price which is carried out twice daily by twelve banks via electronic auction platform.

### Analysis

When taking positions on gold, it is always difficult to understand which might be the best instrument to do so. Excluding futures, among many possibilities we have mint-companies funds and ETFs. This fund invests exclusively in physical gold in the form of standard bars weighing approximately 12.5 kg.



### Conclusion

A mere quantitative analysis would suggest not to buy Gold ETFs. Indeed, the Gold-to-CPI ratio, a measure that had a lot of success after the publication of Erb and Harvey (2013) 'The Golden Dilemma', as reached a level of 6.9-to-1, versus an historical average of 3.46-to-1, mainly driven by the a weak dollar and the expansionary monetary policy of the Fed that resulted in a weak dollar and a reduction of opportunity cost in many assets. However, we think that there is still some room for upside opportunities, especially for the Gold as a hedging asset. In fact, as the central banks are likely to inject more liquidity into the financial system and some uncertainty will be still present in the next few months, we strongly believe that Gold is an important hedging component of an investor's portfolio.

## AGFiQ US Market Neutral Anti-Beta Fund

Index: Dow Jones U.S. Thematic Market Neutral Anti-Beta

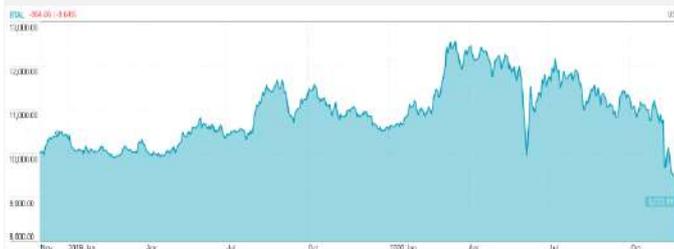
Expense Ratio: 2.19% Tracking Error Volatility: 5.18%

### ETF Overview

The AGFiQ US Market Neutral Anti-Beta Fund ETF aims to replicate the performance of the Dow Jones U.S. Thematic Market Neutral Anti-Beta Index. It provides exposure to the "anti-beta factor", taking a long position in in US equities with below average betas and shorting those with above average betas, within sectors. The "long" and the "short" portfolios are equally weighted and rebalanced monthly.

### Analysis

The results over last year have been rather negative (-16%): this is mostly explained by the recent underperformance of low-beta stocks, which by their very nature tend to somewhat struggle in periods of recovery. On the other hand, it should be noted how, thanks to its peculiar characteristics, the fund performed unusually well (compared to the market in general) in the worst period of 2020 (February-April). The TER of over 2%, undoubtedly high, is justified by the strategy of the fund, which is clearly more complex than the most common "indexing" approach and implies a certain volume of expenses, in particular related to short-selling operations. 20+ years UCITS ETF's one. The expense ratio is low when compared to peers.



### Conclusion

The ETF's most evident strength is the potential to obtain positive returns regardless of the direction of the market, as long as low beta stocks outperform high beta stocks. Our choice was mainly motivated by the idea that some kind of "betting against beta" component would bring balance to our portfolio which, in general, displays quite high betas and exposure to market trends.

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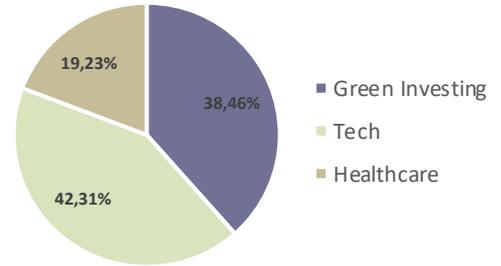


## Equity-Sector Diversification

Among the equity share of investment we pursued not only a geographical diversification, but we tried to have exposure to different sectors. The research of our team came out with many interesting paths including tech, biotech and healthcare sectors

### Healthcare

Our team decided to invest in healthcare ETFs, primarily as a result of the pandemic. The inclusion of these ETFs allows us to have a direct exposure to the pharmaceutical innovation occurring during our current time. Moreover, the ETFs in these sector are composed of diversified selection of pharmaceutical companies. The selection of Healthcare ETFs was done in collaboration with Minerva’s Risk Team, obtaining an optimal combination of 42% of a Lyxor ETF and 58% of SPDR ETF. Further details on such selection process will be discussed later in this report.



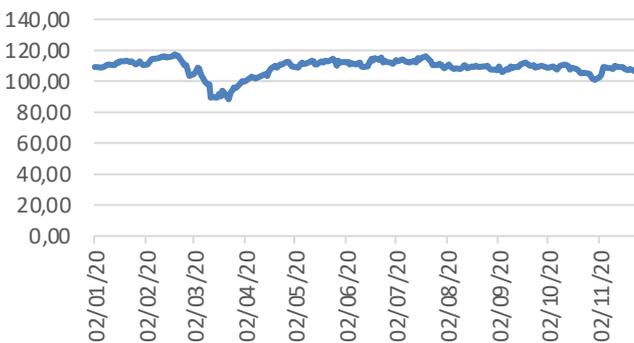
### Lyxor STOXX Europe 600 Healthcare UCITS ETF

Index: STOXX EUROPE 600 HEALTH CARE TRN

Expense Ratio: 0.3% TEV: 0.1%

#### ETF Overview

This Lyxor ETF aims to replicate, through a passive approach, the Europe 600 Healthcare Net Return EUR, composed by the amin pharmaceutical companies in Europe, selecting the “Supersectors” among the STOXX Europe 600.



#### Analysis

The replicating strategy of this ETF is indirect, swap-based, whose counterparty is Société Générale. Due to the consistent weight attributed to Swiss and British companies, changes in the exchange rates may affect the performance of such ETFs. However, the volatility level is lower compared to the one of its peers. This ETFs is one of the best performing in the Healthcare sector, providing a defensive and neutral position during the current market situation, being very low correlated with the economic cycle.

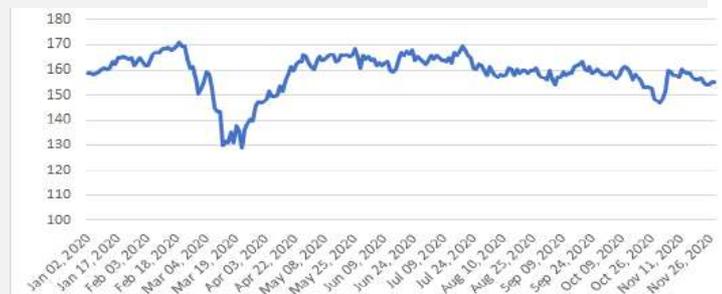
### SPDR MSCI Europe Health Care UCITS ETF

Index: MSCI Europe Health Care Index

Expense Ratio: 0.35% TEV: 6.2%

#### ETF Overview

The investment objective of the Fund is to track the performance of European large and mid-sized companies in the Health Care sector. The investment policy of the Fund is to track the performance of the MSCI Europe Health Care Index composed of large and mid cap companies classified in the Health Care sector across fifteen developed markets in Europe.



#### Analysis

After a deep analysis, we found out that this ETF, along with the Lyxor STOXX Europe 600 Healthcare UCITS ETF, tracks better than others the underlying index showing one of the lowest tracking error volatilities compared with its competitors. The fund invests according to a weighted-cap methodology. This results in a dominance of the first three biggest securities, Roche, Novartis, and Astrazeneca that together make 40% of the overall portfolio. We expect investors come back to big pharma companies , currently trading at a bargain and that highly invest in R&D.

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## Tech&Biotech

Technology ETFs are an excellent way to go for investors, particularly for new investors in the tech sector and those individuals who are more devoted to a specific sector than precise companies. According to ETF.com, the technology sector was the best performing sector for both 2017 and 2018, and it is projected to continue dominating over the next several years.

A middle way between the sectors mentioned above is the biotech. This sector is based on innovative tech solutions applied to the pharmaceutical industry, although a big difference: biotechnology is considered a risk-taking enterprise, while the pharmaceutical industry is about managing and diversifying risk. Nowadays such sector is trending, fuelled by an increase in chronic diseases and the healthcare costs associated.

### KraneShares CSI China Internet ETF

Index: CSI China Overseas Internet Index

Expense Ratio: 0.76% TEV: 0.57%

#### ETF Overview

The KraneShares CSI China Internet ETF aims at replicating an index designed to measure the performance of China-based listed companies that work in Internet-related sectors. Hence, it offers exposure to Chinese technology firms that act as Asian alternatives of big American companies.

#### Analysis

This ETF mainly benefits from the increasing domestic consumption by the growing Chinese middle class rather than international demand. This is something that might give it stability throughout the following months. With an annual return of 46.9%, the ETF is expected to grow even more in the future (making the 0.75% expense ratio a sustainable cost). Furthermore, the Fund shows strength in liquidity terms, with more than **€2 bln in net assets**

Data as of 11/25/2020

Since Inception 3 Month 6 Month YTD 1 Year 3 Years 5 Years



#### Conclusion

The prospect of a stronger increase in local technological demand makes this Fund appealing. Furthermore, it is expected that it will not suffer from eventual instability which might be registered in the following months.

### iShares Nasdaq US Biotechnology UCITS ETF

Index: NASDAQ Biotechnology Index

Expense Ratio: 0.35% TEV: 0.1%

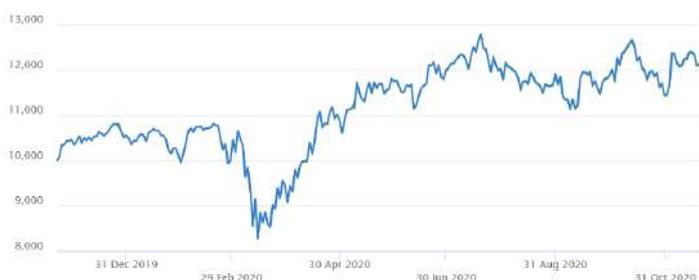
#### ETF Overview

The iShares Nasdaq US Biotechnology UCITS ETF seeks to track an index composed of biotechnology and pharmaceutical equities listed on the NASDAQ. It includes 201 positions having a sector specific exposure.

#### Analysis

The Net Asset Value has increased of 21.79% with a 28.65% volatility over the last year. Although negatively impacted by the Covid-19 outbreak, the strong performance has been driven by the strong momentum in the biotech and pharma sectors, with good returns achieved also before vaccine news. The ETF is concentrated in the US with some position in Chinese and French firms.

YTD 6M 1Y 3Y 5Y All Nov 21, 2019 to Nov 20, 2020



#### Conclusion

We believe that the performance in the past year will continue relying in the pandemic situation persistence and the attractiveness of biotech firms, given the high demand for both technological innovation and pharmaceutical research. Being diversified in the sector with a capped holding of each firm, it does not rely on the performance of a specific company, but the sector as whole. Additionally, the ETF is even more attractive since the expense ratio of 0.35% is lower than comparable ETFs.

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## Risk Management Team

### Report – November 2020

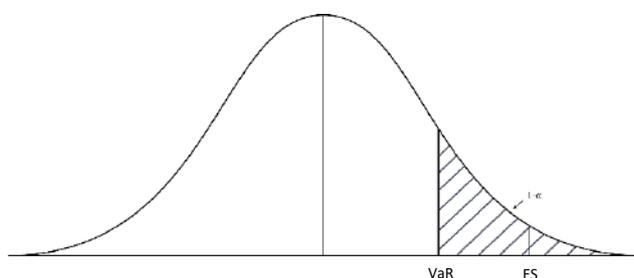
#### Introduction

The main objective of this section is to assess and quantify the risk embedded in the Minerva IMS diversified passive selection 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 two VaR models (one parametric and one non-parametric) and a “best ETF” selection model.

As the Investment Risk division, our focus is the estimation of the two main risk indicators:

- The daily Value at Risk (VaR): the maximum portfolio loss that occurs with  $\alpha\%$  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 an average of the returns lower than the VaR.

A simple technique to estimate these two measure is based on an historical approach; given a time series of a financial instrument, to estimate the VaR we can easily compute the desired quantile of the historical distribution and, after that, estimating 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 its 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 different techniques that provides better risk estimates:

- VaR-COV analysis
- 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 quantify the unexpected losses that we can encounter.

For both analyses we used historical daily market prices up to 9 months ago (Direxion Flight to Safety Strategy ETF inception date is 5<sup>th</sup> of February, so, in order to have all securities with the same time horizon, we collected prices from last February). All the analysis has been conducted with Python.

## VAR COV analysis

In this section we propose a VaR analysis for each ETF included in the portfolio and then, we estimate the VaRs for the whole fund by taking into consideration the correlation between our components.

The steps followed are:

1. Assessing stock distributions: it is possible to state that securities returns are not perfectly normally distributed due to "fat tails": unexpected events or announcements have a huge impact on the prices of these financial instruments and it is possible to observe extreme values more frequently than a Normal distribution. For this reason, we decided to assume T-Student distributions for our selected securities, choosing the degrees of freedom by selecting the ones that best approximate the empirical distribution function provided by historical data.

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 will be minimizing it by proposing various T-Student density functions with different degrees of freedom to approximate the empirical distribution function;

2. Computing parametric VaRs: once T-student distributions are computed; it is possible to retrieve the parametric estimate for VaR95 and VaR99 for each ETF; some results are displayed in the table below which show all the components ordered from the safest to the riskiest ;

3. Portfolio VaR: finally, by using the formula below, taking into consideration the correlation between the stocks, we estimated the VaR 95 and VaR 99 of the whole portfolio.

$$\text{Portfolio VaR} \approx \sqrt{w * \text{Corr} * w'}$$

where:

- $w$  is the vector of the weighted VaR ( $[w_1 \text{VaR}_1, w_2 \text{VaR}_2, \dots, w_n \text{VaR}_n]$ );
- $\text{Corr}$  is the correlation matrix;

The approximation is because of the T-student returns, it becomes an equality the closer the returns are to the Normal.

VaR95: -1.72%

VaR99: -2.49%

Both VaRs are quite low for the current period that we are going through; also the components show low risk estimates: the only instrument with a VaR95 over -4.00% is an ETF that tracks a sector with high volatility (3.28%), but with a positive average return (+0.29) on annual basis.

Another aspect that is possible to highlight with this method is the *diversification effect*. By using the same formula at point 3, we can compute the VaRs with  $\text{Corr} = I$  (the identity matrix): this provided us a measure of what would have been the risk without considering the diversification of the fund.

VaR95 undiversified: -2.77%

VaR99 undiversified: -3.87%

Both VaRs are 55.42% higher than the actual ones, thus we can state that the diversification chosen by the portfolio managers has been decisive.

Unfortunately with this method we are unable to compute a parametric Expected Shortfall.

	VaR 95	VaR 99	weights
Vanguard Total International Bo	-0.54%	-0.79%	8.00%
iShares Investment Grade Bond	-1.14%	-1.75%	12.00%
Direxion Flight to Safety Strategy ETF	-1.64%	-2.38%	8.00%
iShares J.P. Morgan USD Emergin	-1.69%	-2.41%	10.00%
UBS ETF Gold	-2.22%	-3.23%	5.00%
SPDR MSCI Europe Health Care UCITS ETF	-2.91%	-4.14%	4.20%
Lyxor STOXX Europe 600 Healthcare UCITS ETF	-2.92%	-4.15%	5.80%
AGFIQ US Market Neutral Anti-Beta Fund (BTAL)	-3.06%	-4.40%	5.00%
KraneShares CSI China Internet ETF	-3.68%	-5.33%	12.00%
iShares Nasdaq US Biotechnology	-3.79%	-5.54%	10.00%
AMUNDI INDEX MSCI USA SRI UCITS	-3.85%	-5.51%	12.00%
iShares Global Clean Energy UCITS ETF	-4.44%	-6.40%	8.00%

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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.

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.

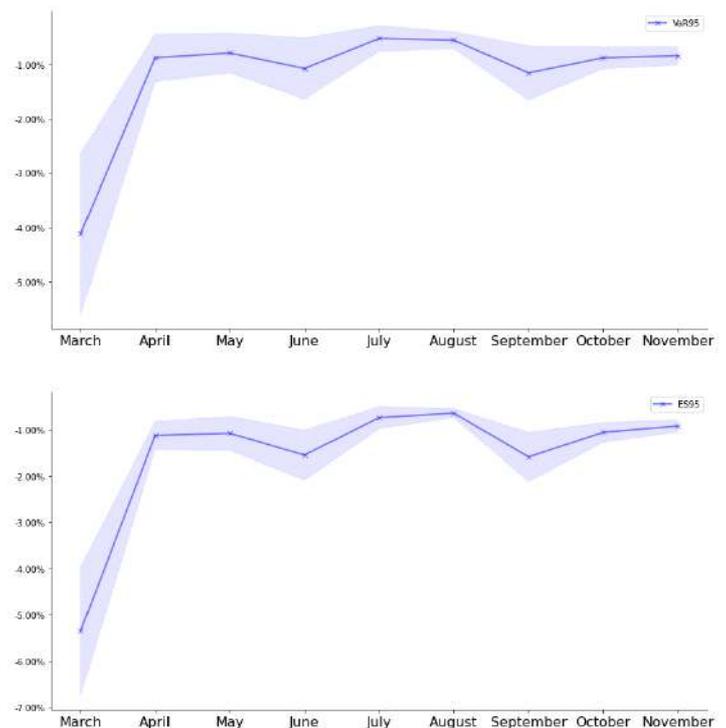
With this method, by estimating the expected shortfall and the standard errors, we can retrieve a more insightful view of our fund, but in this case, we are losing the risk contribution of each stock that we had in the previous case.

	Estimate	Standard error
<b>Var95</b>	<b>-1.46%</b>	<b>0.36%</b>
<b>Var99</b>	<b>-3.39%</b>	<b>1.13%</b>
<b>ES95</b>	<b>-2.80%</b>	<b>0.63%</b>
<b>ES99</b>	<b>-4.73%</b>	<b>1.27%</b>

It can be noticed that VaR99 is very different from the previous estimate; this is not due to computation errors or . By having only 186 observation for the portfolio, the VaR99 depends only on the lowest value of every subsample ( $0.01 \cdot 186 = 1.86$  that is approximated to 1 with "lower" as interpolation parameter); this creates high variance in the subsample estimates (as can be noticed in the previous table) and a static with low significance . For this reason we pursue the analysis with a confidence level  $\alpha=5\%$ .

### Monthly analysis

With this method we have enough metrics to inspect the behavior of this fund composition in the last 9 months.



After the downturn of February-March due to Covid, the current composition quick recovered from the losses suffered and reached VaR and ES levels quite stable and low. If the current trend persist in the following month, we can expect to not encounter huge losses and, consequently, create positive returns even in the short run.

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## Optimal ETF selection

With the goal of supporting the portfolio managers, we developed a tool able to select the best ETF among all the ones that replicates a certain market index. In order to do that, we selected the metrics:

- AUM (assets under management, a measure of liquidity);
- Expense ratio (Expenses/AUM, so commission per dollar, a measure of cost);
- TEV (standard deviation computed on the daily price difference with the underlying index, a measure of volatility).

The aim is to find an optimal ETF that has high liquidity, low cost and low volatility.

Portfolio managers provided us 4 ETFs (XTRACKERS, SPDR, LYXOR, ISHARES) which track the Europe Health Care index. Our goal is to select the best ETF or the best combination of ETFs. We built a linear optimization model called *ETF\_Selector* that allows the user to select two parameters  $\alpha$ ,  $\beta$ :

- $\alpha$  is the investor sensibility to the TEV;
- $\beta$  is the investor sensibility to the Expense ratio.

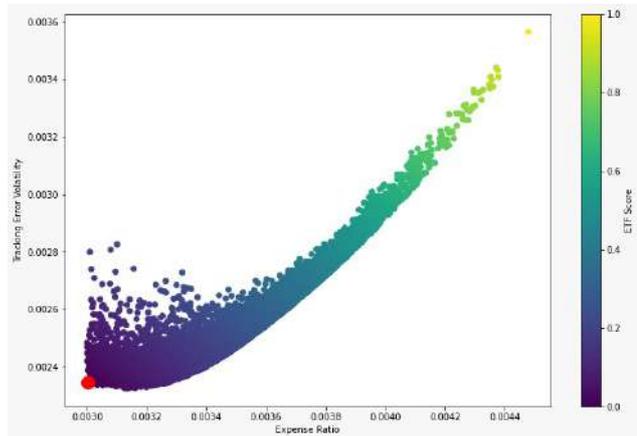
This parametrization allows for a high degree of freedom in choosing the optimal ETF portfolio. To choose the optimal ETF we must find the portfolio that minimizes a  $f(\alpha, \beta, TEV, ER)$  that we called **ETF score**.

To account for different AUMs between ETFs, we have allowed the user to specify the minimum value for the AUM he wants the portfolio of ETFs to have. We ran the optimization at various levels of AUM.

By considering the AUMs of the ETFs considered, we decided to settle for a minimum value of 466 million AUM in our optimization.

AUM Threshold	XTRACKERS	SPDR	LYXOR	ISHARES	ETF Score
400	27.36%	26.28%	46.36%	0.00%	0.26
433	19.74%	28.13%	52.14%	0.00%	0.27
466	12.11%	29.99%	57.90%	0.00%	0.27
500	4.26%	31.90%	63.84%	0.00%	0.27

Below we have plotted 10,000 simulated random portfolios with an average AUM at or above 466 million. The best portfolios are the ones closest to the origin, they have a lower tracking error volatility, expense ratio and ETF score. The red dot is the optimal portfolio described in the previous table with a minimum AUM of 466.



Considering the average AUM of the ETFs given to us and the weight associated with the Healthcare Sector, we decided to drop XTRACKERS and opted for a more balanced composition consisting in 42% invested in SPDR MSCI Europe Health Care UCITS ETF and 58% in LYXOR STOXX Europe 600 Healthcare UCITS ETF.

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