MIMS – Multi Asset Global Opportunities Fund

Portfolio Management Team

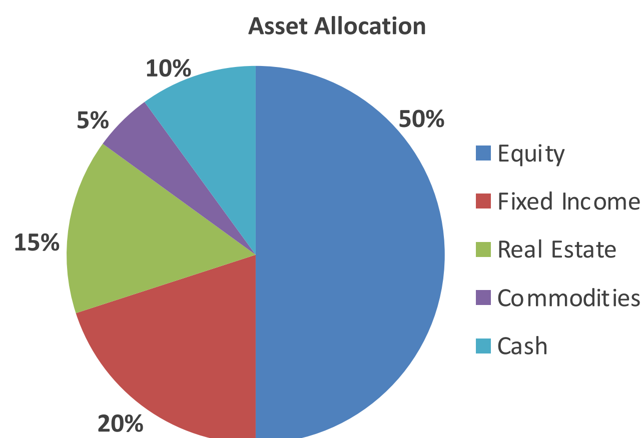
Report – December 2020

Fund description

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

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

In total, the asset allocation will aim to include around 30 different securities with a changing risky component to take advantage of contingent market conditions. The dynamic asset allocation prevents us from using a reference benchmark. The portfolio will be rebalanced every six months, with exceptional reviews to position for market shocks. The holdings only include instruments from the public markets, spread across equity, fixed income, real estate and commodities. ETPs might be considered to take additional exposures to niche markets.



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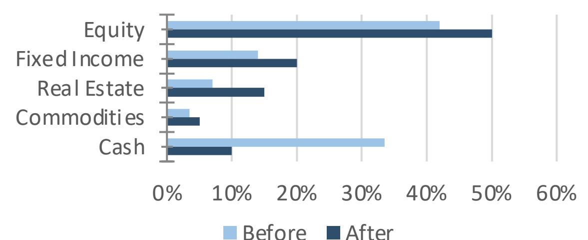


Investment Approaches

Top-down approach

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

Bottom-up approach

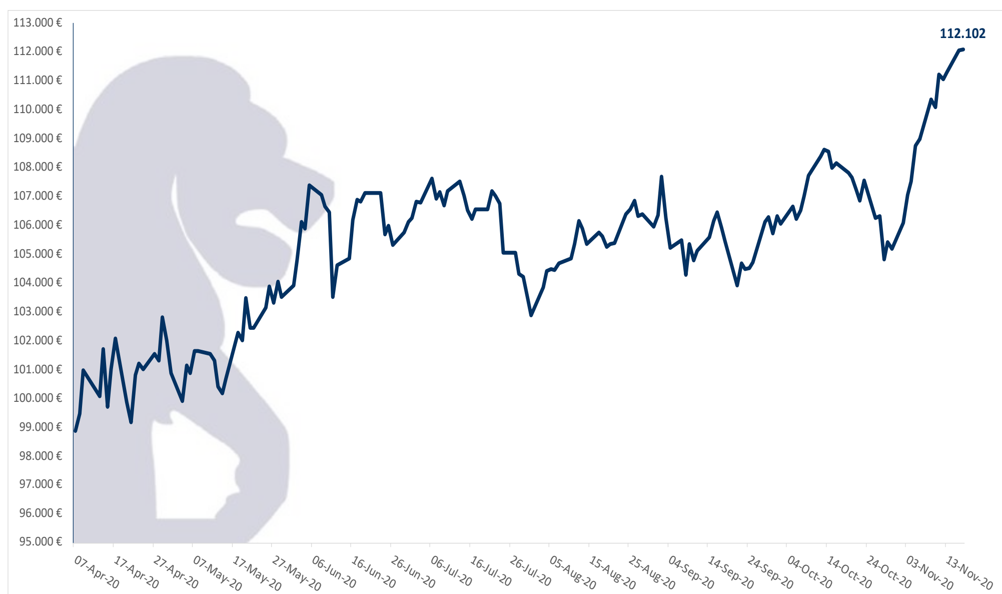
If a security stands out to one of the Investment Analysts, the suggestion is discussed with the Team and further analysis follows.
Long-term growth potential combined with high ESG standards and limited risk downsides both on a micro and macro level are required to consider the investment.

Research contribution

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

Performance since inception

07.04.2020 - 17.11.2020



Initial holdings have been monitored since 05.12.2019 and additional ones have been introduced on 24/03/2020. The official starting date for the portfolio is 07.04.2020 and a second rebalancing took place on 23.11.2020.

The analysis considered the cumulative gain over the entire period since inceptions. Any security is held only in a discrete number, stock dividends and bond coupons are reinvested at the end of the day in which payments are received.

The fund value is measured at the close of each trading day. Corporate events, dividend reinvestment and fund rebalancing are carried out at the market close.

Considering an initial value of € 100 000 at the market open of 07/04/2020, the portfolio reached a final cumulative value of € 112 102 at the close of 17/11/2020.

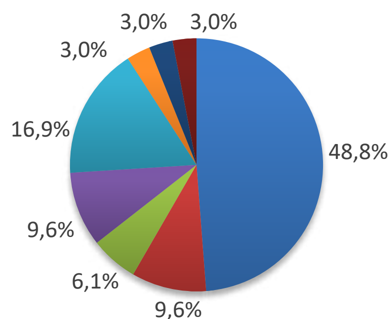
	1 month	2 months	3 months	Since inception	Daily Volatility	Sharpe Ratio
Multi Asset Fund	3.98%	5.84%	5.99%	12.10%	0.76%	1.23

Top 5 Holdings

Security	Weight
APPLE	5.0%
ALPHABET	5.0%
AIRBUS	5.0%
MONCLER	5.0%
ASML	5.0%

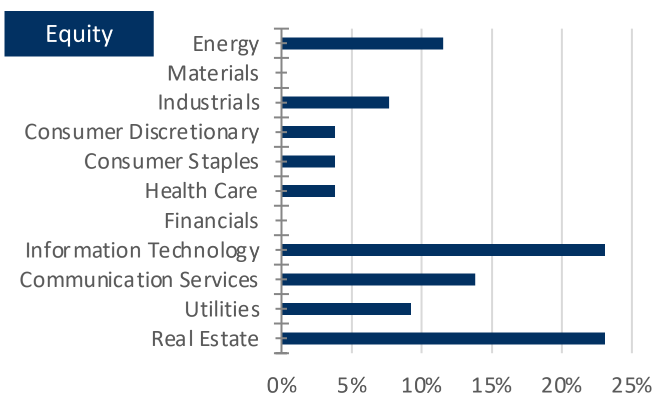
Note: the weights are a product of a mean-variance optimization where stock allocations are capped at 10% of the Equity portion.

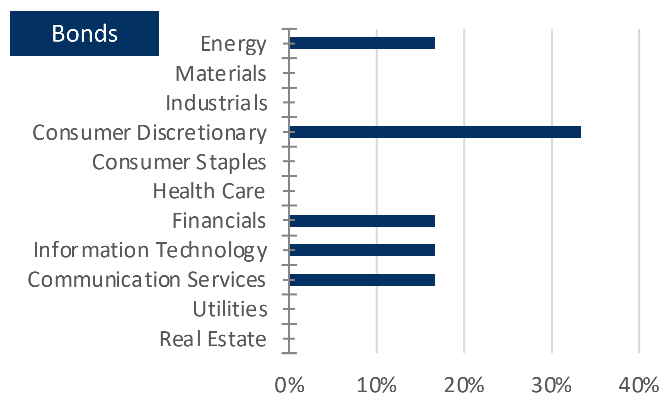
Geographical Asset Allocation



USA Germany Netherlands France
Italy Japan Brazil India

Sector breakdown





Source: Minerva Investment Management Society and Bloomberg. References of the analysis of this report are available upon request.
Please note that the value of investments and income produced from them can rise as well as fall and that past returns are not a good indicator of future performance.

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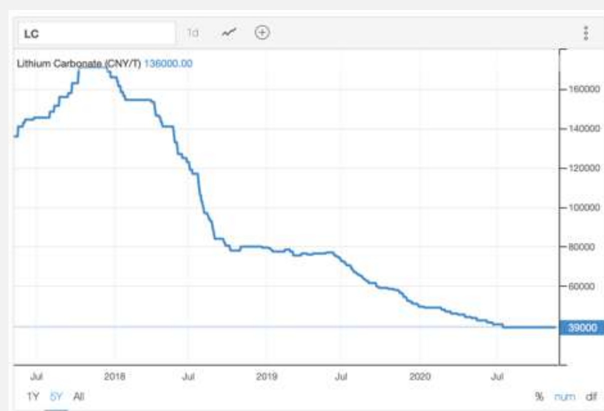
Divestment Case

Global X Lithium & Battery Tech ETF (LIT)



In the last few years Lithium has been hyped as the expected demand for electric cars soared. However, we must focus on the supply as well: Lithium is plentiful all over the world and cheap to mine, and even if electric cars increase demand, there are many cheaper ways of mining it (or even recycling it).

The metal is mostly mined in South America, China and Australia, so a cartelization of Lithium-producing countries is not at all likely. Price fluctuations depend mostly on tariffs and subsidies, so a relaxation of the trade war could instead decrease prices, which are already low as the graph shows.

For these reasons, we decided to divest this commodity, cashing in on a very fruitful investment (98.80% return since inception comprising capital gain and cash distributions).

Holding Reassment after Covid - Case Studies

Airbus (AIR.PA)

Company Overview:

Airbus is a European Aerospace and Defense company. It operates through three divisions: Commercial aircrafts, Defense and Space, and Helicopters. Respectively the three business segments account for around 75%, 15% and 10% of revenues. (Market cap.: 70,78 Bn USD)

Financial Overview:

During the first three quarters of 2020 Airbus experienced a 35% decrease in revenue compared to the same period in 2019. Total comprehensive loss was 4.3 billion EUR, a further increase from the 3.8 billion loss in the first three quarters of 2019.

The current ratio stands at 1.08, just above its cut-off value of 1. The cash ratio is 0.2, which is worryingly low. However, Airbus has a new 15 billion credit facility to be used and has already announced the withdrawal of a 2019 dividend proposal with a cash value of 1.4 billion EUR. In parallel, governmental partners have supported the aerospace sector since the beginning of the crisis either through direct support to airlines and suppliers, or through partial unemployment schemes. The management believes that the Company has sufficient resources to continue operating for at least 12 months. Solvency ratios are not a source of concern as Airbus interest expenses account for only 313 million. Considering 101 million in interest income, Airbus is unlikely to default on its interest payments. Net increase in cash was 1.6 billion.

Price movements & recent news:

News over reassuring results of vaccine trials had a positive effect on the airline industry. Airbus stock increased 45% in the last month only, reaching a value of 90 EUR.

Conclusion:

Airbus has successfully adapted to the new business environment by reducing production. It is preserving its ability to meet customer demand while protecting its ability to further adapt as the global landscape evolves. Coupled with encouraging future prospect, we think that it is still a good holding.

Disney (DIS)

Company Overview:

Disney is a US multinational corporation which operates in the entertainment business. It has four divisions: Studio Entertainment, Parks, Experiences and Consumer Products, Media Networks, Direct-to-Consumer and International. Respectively, the four business segments account for around 15%, 35%,

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35% and 15% of revenues.
(Market cap.: 270,56 Bn USD)

Financial Overview:
In the 2020 fiscal year ended on Oct 3rd, Disney reported a 6% revenue decrease from 69.6 to 65.4 billion. This was mainly due to respectively 37% and 13% decreases from the Parks and the Studio entertainment businesses. On the other hand, Direct to Consumer experienced a staggering 81% increase due to the success of Disney+ which reached 73.7 million subscribers. Media networks revenue were up 14%. Overall operating income was down 45% from 15 to 8 billion. Net Income closed negative of 2.8 billion. Current ratio stands at 1.3 which is above the cut-off level. Cash ratio is 0.68, which is very reassuring. Cash coverage ratio is 5.1, well above its cut-off level of 3. Disney, despite the Covid-19 impact, is in excellent financial health.

Price movements & recent news:
New vaccine developments positively impacted Disney. It has reached its pre-crisis price at around 150 USD.

Conclusion:
Disney has very well reacted to the crisis. Some segments performance even improved. It proved to be an extremely solid company with solid financials and growth prospects. We recommended to hold it.

New Investments: Equity

Nestlé India (NESTLEIND.BO)

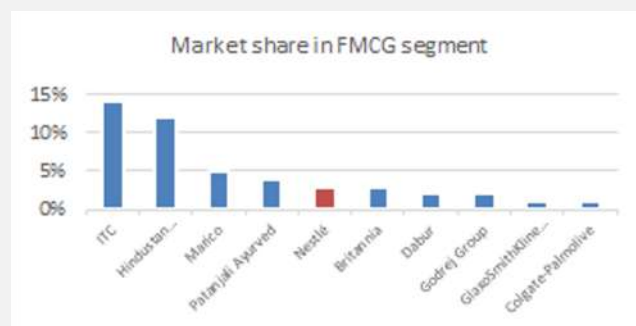
Company Overview:
Nestlé India Ltd is one the biggest players in the Indian fast-moving consumer goods (FMCG) segment. It is engaged in the food business, which incorporates many different product groups.

After weak growth on all fronts in the first half of the decade, Nestlé has done very well in the second half. In fact, the past 5 years have witnessed accelerated growth.

Industry Outlook and Competitors:
FMCG is India's fourth largest sector. The key drivers of this sector are growing awareness (especially about e-commerce), easier access and changing lifestyles, increased disposable income, growing per capita expenditure, higher brand recognition and consciousness.

Regarding the market size, revenues of the FMCG sector are estimated to be 103.7 billion USD in 2020 and to reach 220 billion by 2025. FMCG market is expected to grow at 9–10% in 2020.

The FMCG segment is led (in terms of revenues) by ITC with 14% of market share, followed by Hindustan Unilever with 12%, then by Marico, Patanjali Ayurved and finally Nestlé India with 3%.



Financial Analysis
Balance sheet:
Nestlé 's balance sheet is very liquid: it has a current ratio of 1,77 and a quick ratio of 1,18. The Debt-to-Equity ratio has historically been around 100%. In 2019 Nestlé issued a special dividend of accumulated profits of previous years. This had the effect of significantly reducing total equity, pushing the debt-to-equity ratio up at 260%.

A large portion of the company's debt is in the form of accounts payables, while for non-current liabilities, only a very small part is financial debt. The rest is under the Provisions line, which include pensions, gratuity, and contingencies (litigations, disputes). With respect to the ROE, it has averaged an attractive 40% in the last 5 years. The return on investment (ROI) has a 5-year average of 23%, which again is significantly higher than Nestlé's cost of capital.

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Income statement:

Sales of 2019 amounted to INR 123 bn, and since the end of 2016 Nestlé has had a growth rate in sales of almost 10%. Operating income (of INR 25 bn) growth has been 20%. Lastly, the net income amounted to INR 19,6 bn, with a CAGR that has reached an astonishing 25%.

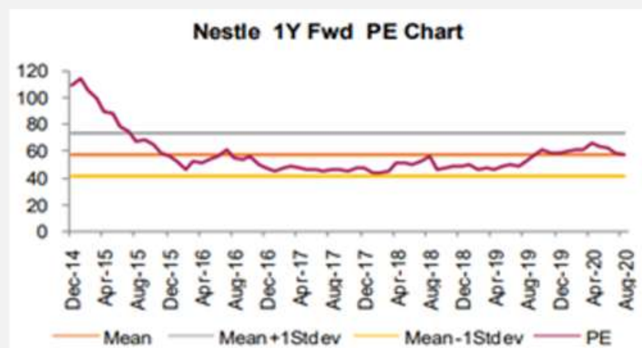
The company has a gross margin of 57%. This shows the substantial pricing power of Nestlé. Its net profit margin is 16% and has been increasing steadily over the past few years from the low in 2015 of 7%.

Cash flow statement:

Nestlé generated in 2019 INR 22 bn in cash from operating activities, with a CAGR of 15% from 2016. The operating cash flow margin (as % of sales) is 18%. Last year's capex amounted to INR 1,5 bn (or 1,2% of sales). The company has practically zero financial debt, so the only relevant voice in cash from financing activities is dividends paid.

Valuation:

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



At first sight, this may seem very expensive, however we must keep in mind that Nestlé India is growing its net income 25% each year (effectively it doubles every 3 years). Also, in India inflation is much higher than in western countries.

In addition, even after the post Covid rally in Nestlé's price, the company still provides a dividend yield of 1,50%, easily covered by operating cash flow.

SWOT Matrix:

S: Very little financial debt and very strong cash generating power.
Strong consumer brands (moat) and market leading positions in 85% of its product portfolio.
High product innovation to catch consumer trends. Ability to exploit the global product portfolio of its parent and tweaking it to Indian markets.

W: Vulnerability to reputation loss after the 2015 scandal in Maggi's noodles.

O: Covid-19 outbreak as an opportunity to drive e-commerce channel. Online sales grew 56% and amount now to 3% of total sales.
Immense growth in Ready to Eat (RTE). Nestlé's brands are well positioned to ride this growth.
Willingness to expand in rural areas (currently 20% of sales) by leveraging cluster-based strategy (division of India in 15 main clusters).

T: Slower than expected demand growth due to Covid-19 disruption and possible lockdowns. Economic slumps are negative for the company sales.
Input cost inflation, for products such as milk, wheat flour, sugar, and coffee. Sharp rises in the cost of these raw materials can negatively impact the company's margins.
Increase in royalties paid to the parent: they have increased from 3,5% to 4,5% of sales during the last decade. In the future they might grow, although this is not very likely.

Conclusion:

In the near term this stock can't be considered a bargain, however with a long-term perspective, this is a good holding given the stability of the business model, consistency in earnings growth, healthy balance sheet and superior cash flow generation.

In addition, buying a company like this is a way to capture the immense growth that will be taking place in India in the next decade, which will soon be the most populous country on earth.

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Neoenergia (NEOE3.SA)

Company Overview:
Neoenergia S.A. generates, transmits, distributes, trades in and commercializes electric energy in Brazil. The company operates 37 electricity generation plants comprising 14 hydroelectric, 2 thermoelectric, 16 wind, and 5 cogeneration plants. It has an installed electricity generation capacity of approximately 1,625 megawatts; and operates approximately 300 kilometers of transmission lines, as well as distributes electricity to approximately 37 million in the states of Bahia, Pernambuco, and Rio Grande do Norte. Neoenergia S.A. was founded in 1997 and is based in Rio de Janeiro, Brazil.

Industry Outlook and Competitors:
In the early 1990's, the electricity sector in Brazil was largely dominated by government-controlled companies that essentially operated essentially as regional monopolies. The first wave of privatizations changed that, allowing for private companies to compete and access the country's largely untapped hydropower potential. This process was halted by the administrations of Silva and Rouseff. As of 2020 however, there are 49 privately owned utility distribution concessions that hold 64% market share, Neoenergia S.A. being one of them.

The federal government is now once again granting concession contracts to private companies, thus reversing the policies of the aforementioned administrations. These policies create opportunities for well-established privately-owned companies to expand their market share. Brazil has an untapped hydropower potential of 180,000 MW, including about 80,000 MW in protected regions that the Government is now expected to fully develop by 2030.

Neoenergia S.A. holds roughly 1% of the market share, despite the appearances making it a sizeable non state-owned company in this fragmented sector.

Financial Analysis
Balance sheet:
Neoenergia's balance sheet is liquid: it has a current ratio of 1,25 and a quick ratio of 0.98. The Debt-to-Equity ratio is 140%.

Most of the company's debt is in the form of loans and financing, although a large proportion refers to trade payables.

Income statement:
The firm is experiencing a rapid growth in no small part due to favorable political environment. Despite the pandemic, sales of 2020's third quarter amounted to BRL 20.4 bn, with a growth rate of 10% when compared to 3Q19. Operating income (of INR 25 bn) growth has been 36%. Lastly, the net income amounted to BRL 814 mn. The company has a gross margin of 31%.

Cash flow statement:
Nestlé generated in 3Q20 BRL 3.7 bn in cash from operating activities, with a growth of 43% from 3Q19. Quarter's capex amounted to BRL 1,87 bn, a growth of 60% due to the progress of ongoing Wind and Transmission projects.

Net cash generation/loss from financial and investment activities is roughly null as the firm continues to rapidly invest in opening opportunities in the sector.

Valuation:
The company is trading at a 9.2x PE ratio, which is significantly lower than the BR Electric Utilities industry average (11.6x).

The stock price fell significantly (27%) during the pandemic. That being said, EPS (1.53 BRL) remained stable while revenues and profitability increased slightly throughout the year, a clear demonstration of the company's resilience. This is an ideal moment to enter the investment in this stock.

Fixed Income Strategy

The Maturity Ladder

In order to create a stable fixed-income portfolio, we have decided to set up a new fixed income strategy using a ladder structure. The strategy consists of buying bonds with sequential maturity dates out to the longest bond maturity, and it is generally implemented by equally weighting the bonds for each maturity.

The rationale of this strategy is to minimize the exposure to single maturities and to stifle the

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duration risk of the bond portfolio. Once the first bond matures, the investor will reinvest the proceeds in a bond maturing one year after the longest maturity.

The ladder approach has many advantages both in terms of investment flexibility and diversification. First of all, it gives the investor the possibility to exploit a changing rate environment. Furthermore, by using a ladder, part of the portfolio is maturing each year and it allows the investors to diversify and spread the risk along the yield curve instead of choosing a single maturity date.

More in detail, investments in the following six corporate bonds have been taken:

Issuer	Years to Maturity	Coupon (%)	Rating (S/M/F)
Volkswagen	2.3	0.875	BBB+/A3/NR
Intesa Sanpaolo	4.4	2.855	BB+/Ba1/BB
Apple	6.9	3.000	AA+/Aa1/NR
Target Co	8.3	3.375	A/A2/A-
Total SA	9.1	2.829	A+/Aa3/AA-
AT&T	14.4	4.500	BBB/Baa2/A-

The ladder strategy tries to cover the period between 2023 and 2035 (3 to 15 years) and it has been implemented by adding bonds belonging to diversified industries: consumer cyclical, finance, technology, consumer staples, energy and telecommunications. As it can be seen from the table above, the maturity structure is still incomplete since there is no bond maturing between 2031 and 2034, but the strategy will cover soon the entire target period in order to guarantee better diversification and continuity.

To conclude, a ladder strategy might be an effective tool in order to stabilize the fixed income portfolio and, especially in the current environment characterized by low interest rates, to always maintain protection against any change in policy rates.

Target Corp, 3.38%, 15/04/29 (US87612EBH80)

Target Corporation operates as a merchandise retailer in the US. The company offers food assortments, in-store amenities (such as Target Café) and many other products through its stores and digital channels. As of March 25, 2020, the company operated approximately 1,900 stores.

The company issued a 1 billion USD tranche of bonds on March 27th, 2019 rated A- by BBG Composite. The bonds come along with a 3.375% fixed coupon rate with semi-annual payments. As of Nov 22nd, the bond price was 116.14 USD, granting a YTM of 1.33%.

Looking at the financial situation, total comparable sales grew 20.7% in Q3, reflecting comparable stores sales growth of 9.9% and digital sales growth of 155%. Total revenues of 22.6 billion USD grew 21.3%. Operating income was 1.9 billion USD in third quarter 2020, up 93.1% percent from 1.0 billion in 2019. Moreover, given its strong cash position and performance, the company lifted its share repurchase suspension and terminated a supplementary 364-days credit facility (which had been secured in April given the uncertainty around Covid-19).

As the debt structure is concerned, the company displays the following situation as of Feb. 1st, 2020:

Debt Maturities (dollars in millions)	February 1, 2020 Rate [a]	Balance
Due 2020-2024	3.8 % $	2,205
Due 2025-2029	3.3	2,180
Due 2030-2034	4.2	1,305
Due 2035-2039	6.8	1,109
Due 2040-2044	4.0	1,468
Due 2045-2049	3.7	1,727
Total notes and debentures	4.1	9,992
Swap valuation adjustments		137
Finance lease liabilities		1,370
Less: Amounts due within one year		(161)
Long-term debt and other borrowings		$ 11,338

[a] Reflects the dollar weighted average stated interest rate as of year-end.

Required Principal Payments (millions)	2020	2021	2022	2023	2024
Total required principal payments	$ 94	$ 1,056	$ 63	$ —	$ 1,000

Long-term debt is diversified across maturities and most obligations contain covenants related to secured debt levels. The Equity/Total Asset ratio is 27.66% in 2020. Given its excellent rating (A by S&P), the company is able to take on debt in financial markets at a convenient rate and some callable issuances may be repaid in advance. According to Sustainalytics, the company has a strong ESG profile (ESG Risk Score: 14.5).

In conclusion, given its high rating, repayment structure and maturity, the bond represent a good investment opportunity within our portfolio.

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New Investments: Real Estate

Equity Residential

Investment Overview:
Equity Residential is a US-based REIT that focuses on acquiring, developing, and renting multifamily properties. It owns close to 80,000 apartments in expensive, populous cities, such as New York City, Boston, Los Angeles, and several others. Its main strategy favors buying older, upscale apartments and renovating them to rent at higher prices.

Historical Performance:
Since Equity Residential focuses on residential real estate, its performance is procyclical. In the chart, it can be observed that this REIT saw a major price drop during the 2007-2008 financial crisis, decreasing from 55.75 in January 2007 to a minimum of 16.99 in March 2009. Since then, it has shown a steady recovery. Just before the beginning of the Covid-19 pandemic, Equity Residential was trading at 88.01. By the end of October 2020, it was down to 46.98, but it has already gone up to 58.95 (as of December 1st, 2020).

Financial Outlook:
Equity Residential's price is likely to go up in the medium-long run, as the US economy recovers from the crisis, and so does the rental market. Besides, the REIT focuses on upscale apartments in very populated US cities, where comparatively more people rent apartments, instead of purchasing them. Additionally, the supply of properties in these cities cannot increase much, since the level of construction is already very high. On the other hand, the demand for apartments is prone to increase, as both the population and the number of jobs are expected to go up over the coming years.

As a REIT, Equity Residential presents a very nice dividend profile. It pays dividends quarterly and the current dividend yield is at 3.98%. The last payment was on September 23rd, 2020 and the dividend rate has been increasing over the previous years.

The financials of the company are solid, even though revenue decreased during the last quarter.

SWOT Matrix

S: The company is financially strong, and it pays high dividends. The properties it owns are located in growing US cities. Supply of properties does not have much room to expand, while demand has been increasing. Interest rates are likely to stay at near-zero levels, causing real estate prices to inflate.

W: Exposure is limited to the US rental housing market.

O: Equity Residential has lost over a quarter of its value since the beginning of the pandemic, due to the impact of the Covid-19 crisis. As the US economy begins to recover, the price is expected to rise, so now it is a good time to enter the investment.

T: Due to ever-increasing rent prices in these cities, more people are turning to the suburbs and to other cities with a more reasonable cost of living. Also, the dollar might depreciate against the euro in the medium run, which might decrease the euro return on the investment.

Conclusion:
Investing in Equity Residential would be a good way to gain exposure to the US rental housing market. Particularly, this REIT suffered a significant price drop, which is typical during recessions. Since it is one of the largest REITs in the world, the level of risk is low and the properties it invests in will only become more valuable. The dividend rate is also attractive.

This investment will substitute Link REIT in our portfolio, which was overly exposed to the Hong Kong market. The rationale of the switch is to focus on the US residential market to protect the portfolio from the political instability in Hong Kong.

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MIMS – Multi Asset Global Opportunities Fund

Risk Management Team

Report – December 2020

Introduction

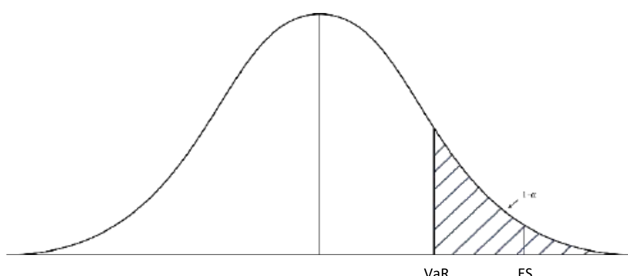
The main objective of this section is to assess and quantify the risk embedded in the Minerva IMS Multi Asset Global Opportunities Fund built by the portfolio team. We use a daily perspective on the potential extreme behavior of a basket of assets selected by the portfolio analysts. The analysis will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

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

- The daily Value at Risk (VaR): the maximum portfolio loss that occurs with α% of probability over a time horizon of 1 day. For instance, if the VaR (α=5%) = -3.00%, it means that tomorrow there is a 5% probability of encountering a loss in the interval [-100%, -3.00%] potentially;

- The daily Expected Shortfall (ES): the expected return on the portfolio in the worst α% of cases. So, it is just 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 1 year ago. All the analysis has been conducted with Python.

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VAR COV analysis

In this section we propose a VaR analysis for each stock 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 Fn, is:

$$Dn = \text{sup}x|(Fn - F)|$$

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 stock; 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.

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

where:
- w is the vector of the weighted VaR ($[w1VaR1$, $w2VaR2$, …, $wnVaRn]$);
- $Corr$ 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: - 3.42%
VaR99: - 4.91%

From both these analyses we can notice that the singular stock VaRs and the ones of the whole portfolio are quite high. This is obviously due to the pandemic effect that touched the markets; for instance, the worst stock is Airbus, a company that belongs to the most disrupted sector during last month, Airlines. With the belief that next months can be positive especially for such companies that suffered the crisis, we think that the current levels of VaR are acceptable.

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

	VaR95	VaR99	weights
TM	-3.05%	-4.33%	3.85%
NESTLEIND.BO	-3.53%	-5.11%	3.85%
IG.MI	-3.63%	-5.27%	5.38%
GOOGL	-4.05%	-5.87%	7.69%
ASML.AS	-4.11%	-5.97%	7.69%
EQIX	-4.30%	-6.37%	6.92%
SAP.DE	-4.43%	-6.30%	3.85%
BAYN.DE	-4.59%	-6.61%	3.85%
MONC.MI	-4.64%	-6.71%	7.69%
AAPL	-4.65%	-6.76%	7.69%
DIS	-4.93%	-7.04%	6.15%
PLD	-5.04%	-7.38%	6.92%
EQR	-5.39%	-7.61%	2.31%
NEOE3.SA	-5.75%	-8.16%	3.85%
ENI.MI	-5.84%	-8.34%	3.85%
INTC	-5.87%	-8.50%	3.85%
SAFE	-7.59%	-11.34%	6.92%
AIR.PA	-7.91%	-11.27%	7.69%

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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→+∞ (we have selected M=100.000 for instance);

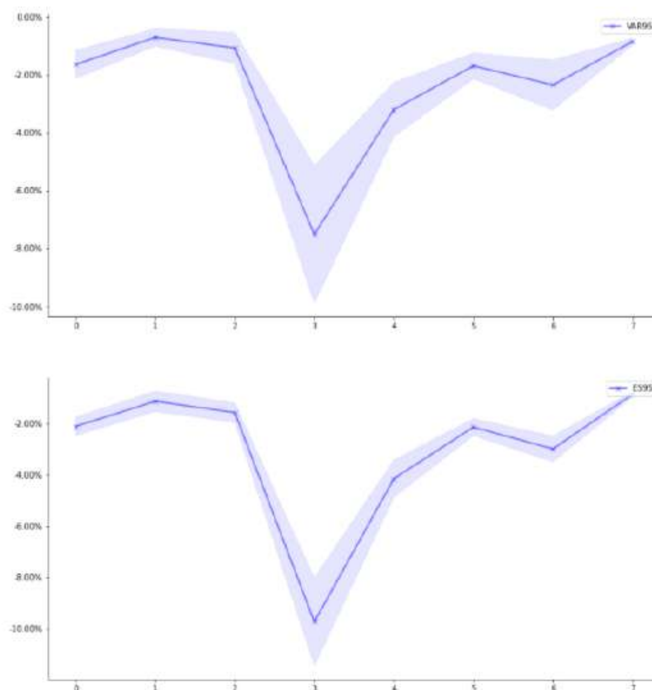
• Average and compute the standard error of the metrics estimated in each step.

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
Var95	-3.31%	0.49%
Var99	-7.83%	2.19%
ES95	-5.55%	0.96%
ES99	-9.20%	1.66%

Window analysis

With this method we have enough metrics to inspect the behavior of this fund composition in the last 18 months and we performed a window analysis on each 50 trading days.



As it is possible to notice from the graphs, the fourth window shows a huge increase in the portfolio VaR and ES at a confidence level of 5%. This specific window represents the months of February and March in which the majority of the stocks lost value and markets experienced an increase in volatility, as can be noticed by the widening of the standard errors bands. However, in the following windows, this particular stocks composition recovered very rapidly to the pre-crisis values; if this trend persists in the following months, the portfolio will experience moderate losses.

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Markowitz optimization

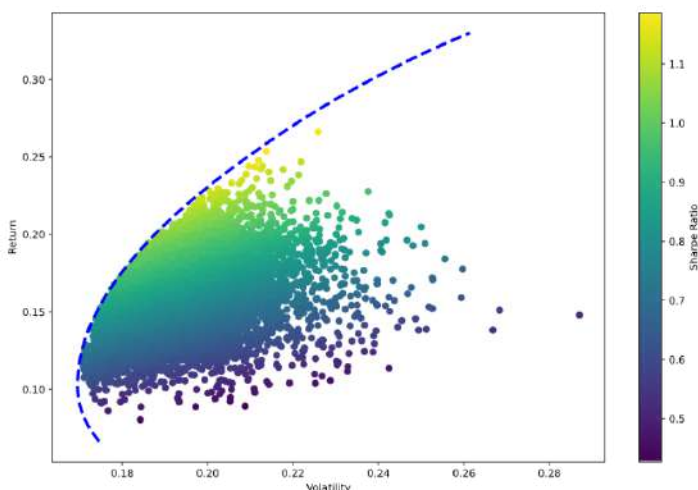
Modern portfolio theory, developed by Harry Markowitz in the 50s, is based on the idea that investors are risk adverse and therefore would only take on riskier investments if they provide a higher expected return. This idea allowed us to build portfolios with various risk/return profiles and therefore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

The problem of finding the best portfolio can be stated from a purely analytical perspective by minimizing the risk (variance) for each possible return. We added the constraints that the weights must sum to one and the weights must be positive as we are only going long. In the formulas below K_{xx} represents the variance covariance matrix for our portfolio and w represents the weight of each stock. Mathematically the problem can be framed as follows:

$$\min \ w^T K_{xx} w$$

$$\text{subject to} \sum_i w_i = 1 \text{ and } w_i \geq 0$$

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



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

Finally, to account for the fact that some of our equities where slightly correlated we added two additional constraints. We made sure the optimal weights were between 2.5% and 5% otherwise we would have a very unbalanced portfolio. The optimization resulted in the following weights for the equity selection.

Stock	Weight	Stock	Weight
AIRBUS	5.00%	MONCLER	5.00%
ALPHABET	5.00%	NEOENERGIA	2.50%
APPLE	5.00%	NESTLE_IN	2.50%
ASML	5.00%	SAP	2.50%
BAYER	2.50%	TOYOTA	2.50%
DISNEY	4.00%	EQUINIX	4.50%
ENI	2.50%	EQUITY_RES	1.50%
INTEL	2.50%	PROLOGIS	4.50%
ITALGAS	3.50%	SAFEHOLD	4.50%

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