



Performance of ESG and Machine Learning investment approaches

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Executive Summary

ESG integration in investors' portfolios is becoming a market standard. ESG ratings measure the strengths and weaknesses of a company along many specific criteria related to Environmental, Social and Governance issues. Many reasons lie behind this gradual switch, from genuinely motivated investors willing to align their investments to their values, to investors that recognise the reputation risk related to controversial investment practices, finally to investors that recognise the financial risks coming from companies with poor ESG profiles. If investors agree on the usefulness of ESG integration for risk management purposes, there is still no clear consensus about the ability of ESG integration in delivering higher returns. The prevalently negative assessment between Corporate Social Performance (CSP) and Corporate Financial Performance (CFP), in vogue in the '1970 has changed significantly over time, and now the overwhelming majority of empirical research share a clear optimism about the link between CSP and CFP. Although we do not share the most extreme optimism regarding the power of ESG as performance-enhancer, we recognize the connection between economic strength and sustainability from a general perspective. Therefore, if ESG filtering does not bring out-of-sample outperformance, it is not necessarily because ESG information is not relevant. There is indeed no fundamental reason for an aggregated metric such as ESG to deliver consistent outperformance over time. ESG ratings average very diverse indicators and therefore are not well suited to differentiate stocks from different sectors or countries for financial purposes. Knowing if ESG can bring performance is an important issue since both regulation and industry trends are pushing investors towards widespread ESG integration.

In this research note we will show how simple ESG filtering approaches fail to outperform their benchmark, even if we must acknowledge that, overall, they do not bring specific underperformance either. Our results are in line with what investor can achieve by tilting their portfolios towards the best ESG performers: As an example, over the period Dec, 2010 to Dec, 2018, the MSCI World ESG Leaders Net Return USD Index delivered a compounded 71.42%, slightly less than the market benchmark MSCI World Net Return USD Index at 73.19%. Even if the former shows a better ESG profile, ESG itself did not bring any particular performance improvement. Optimistically-minded investors can still see that the gap is very little and worth to pay in order to achieve an improved ESG profile, but this does not dispense us from questioning why. While several motives may operate simultaneously, both the diversity of the investment universe and the lack of granularity in ESG ratings (which are usually used in their aggregated form) represent a challenge from a financial perspective. In other words, the lack of consistent outperformance for simple ESG filtered strategies is due to the difficulty to extract useful information from large and sparse data such as ESG ratings in an efficient way.

In the second part of this note, we explicitly design a machine learning algorithm that enables us to extract useful information from ESG data. More precisely, it identifies strong and consistent patterns between companies' ESG profiles and their expected likelihood to outperform. We finally show how granular ESG information and machine learning provide robust financial signals and how to use them efficiently even in simple investment strategies.

The investment universe considered in this paper is the capitalization-weighted Solactive GBS World Index¹ which includes the largest companies listed in the US, Canada, Western Europe, Japan, Australia, New Zealand, Hong Kong and Singapore, from October 2012 to December 2018. Portfolios are calculated in USD. Stock prices and dividends are taken from Thomson Reuters/Datastream while ESG ratings from Sustainalytics².

ESG Filtering

Building portfolios by filtering out companies with poor ESG ratings is one of the most popular approaches among investors. While this approach is easy to understand and improves the overall ESG profile of the portfolio, it should not be thought of as a way to enhance performance. In order to analyse this topic, we have built three cap-weighted portfolios that consist of companies whose ESG ratings belong to the top tercile among peer groups (hereafter *ESG Top*), to the middle tercile (hereafter *ESG Mid*) and finally to the lowest tercile (hereafter *ESG Low*, the one with the poorest ESG ratings). Figure 1 shows annualized performances, volatilities and Sharpe ratios for these portfolios and the benchmark.

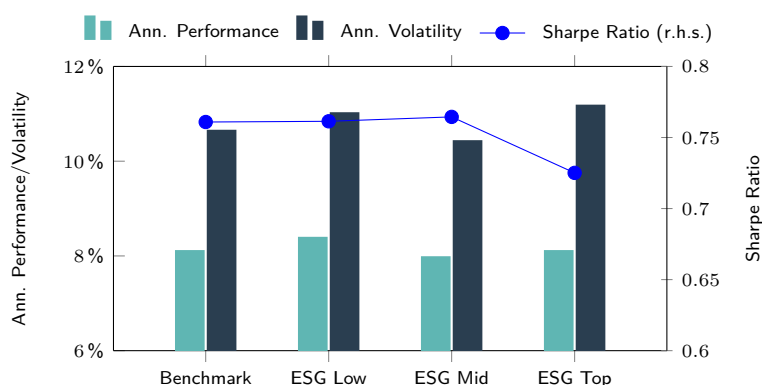


Figure 1: Annualized performances, volatilities and Sharpe ratios for the benchmark and the three portfolios sorted by ESG ratings.

The Best-In-Class filtering approach based on peer groups, i.e. groups of stocks with very similar characteristics and operating in similar businesses, does not alter the economic structure of the initial investment universe. This is because ESG ratings have a structural, sector-driven bias which usually favour specific sectors (e.g. Information Technology or Healthcare) while penalizing others (e.g. Energy or Utilities). For example, this approach makes sure that the portfolio ESG Low does not systematically pick companies from sectors that have structurally lower ESG ratings.

From a simple risk/return perspective it appears that variations in ESG ratings among peer groups are not responsible for changes in performances or risks. Poorly rated ESG companies realize a similar performance, if not higher, compared to the ESG Top portfolio.

The same conclusions can be drawn if we perform the analysis with portfolios ranked according to single Environment (E), Social (S) or Governance (G) ratings, as shown in Figure 2.

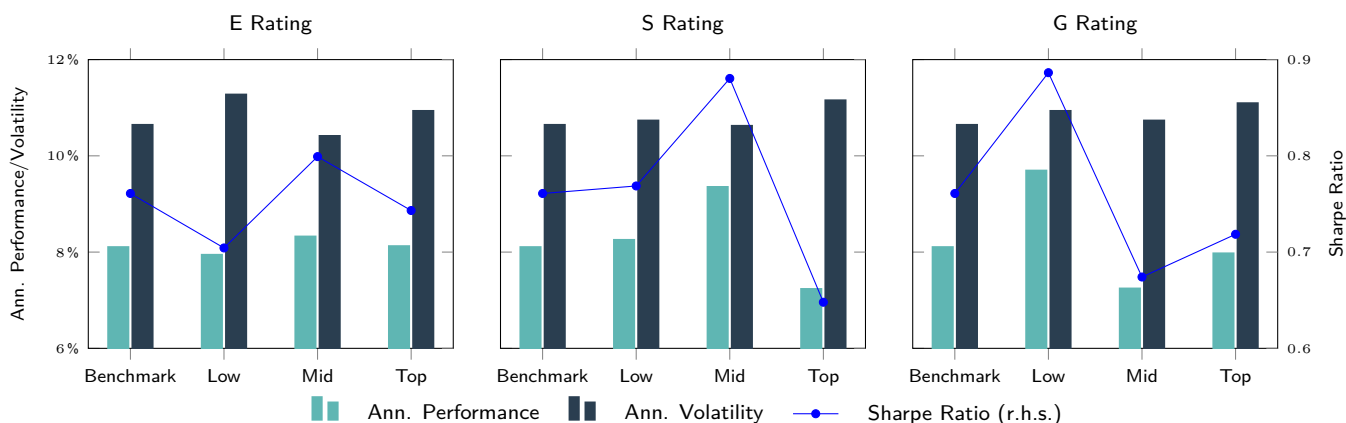


Figure 2: Annualized performances, volatilities and Sharpe ratios for the benchmark and the three portfolios sorted by E (resp. S and G) ratings.

When we narrow our analysis on different regions, the results are more diverse, obviously because we are now exposed to different regional market factors, as illustrated in Figure 3. If volatility-wise we are on similar levels, the performances of the three groups of portfolios are clearly different, with the US based portfolios leading and the European counterparts lagging behind. Nevertheless, the gap in performances between ESG Low and ESG Top portfolios in the three regions are very small. We find small outperformance in top ESG rated European companies compared to poorly rated ones, but this is not verified in the US nor in the Asia Pacific region.

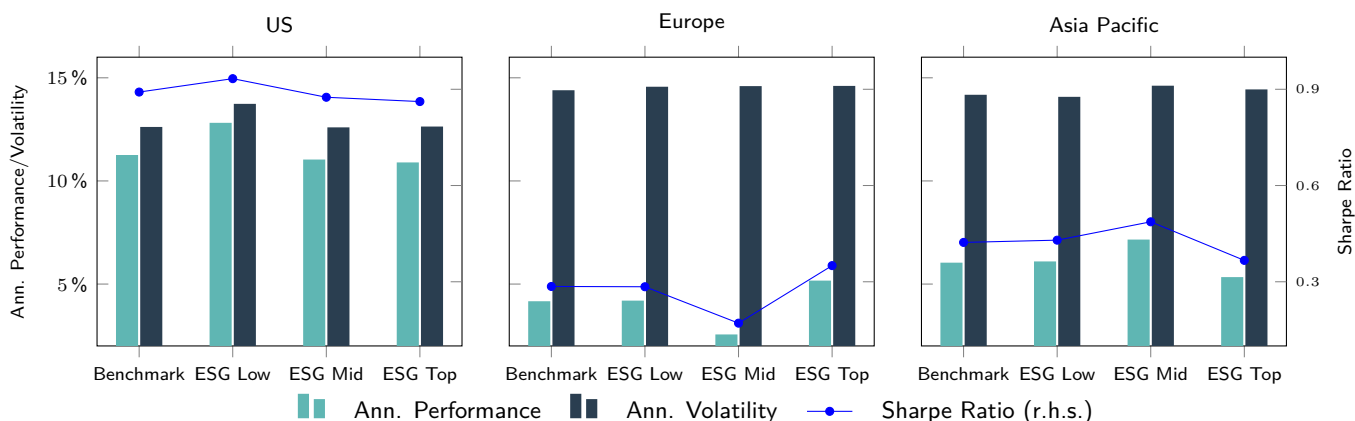


Figure 3: Annualized performances, volatilities and Sharpe ratios for the benchmarks and the three portfolios sorted by ESG ratings relatively to the US, European and Asia-Pacific markets. The benchmarks are cap-weighted regional portfolios derived from the initial global developed benchmark.

Machine Learning

We have seen how simple universe screening by ESG ratings fails to provide significant performance enhancement. More often than not, the lower tercile of the ESG distribution outperforms both the higher tercile and the benchmark. This is not to say that ESG is a persistent drag on performance. Rather, it is the non-homogeneous nature of the investment universe (especially the large global developed) coupled with the loss of information that comes from aggregated ESG ratings to be responsible for such a behaviour. We will show that with a different approach we are able to extract useful information and create financial value from ESG data.

Our Machine Learning (ML) approach relies on the assumption that there is a link between the ESG profile of a company and its economic/financial performance, but this link is not direct nor stable over time, and does not involve all the available ESG data. Stated otherwise, there are possibly few ESG metrics that have a material impact on the financial performance of the company. And the experience tells us that usually there are thresholds in the ESG metrics above which there is no more differentiation among companies (i.e., above a given level on a specific ESG indicator, we cannot say with sufficient accuracy, that company A can outperform company B because A is better rated than B).

The Objective: *The ML objective is to exploit ESG data and find a robust separation of the investment universe in two set; each set is made of stocks that, given their ESG profile, are likely to represent an opportunity (resp. a risk) from a financial perspective.*

The Expert. The core of our ML algorithm is the *expert*. Like a human expert, an expert in the context of ML

- learns from the observations it has access to,
- is characterized by its own knowledge,
- is able to provide an *answer* when asked about the prospect of a company given its ESG profile.

In our specific application, the expert will look at ESG data and uncover a pattern between some ESG metric and financial performance. A simple (but usually not true, as we just saw) pattern would be of the form "... Stocks whose ESG ratings are high outperform their peers...". In this example, the expert observes that, historically, there is a relationship between ESG ratings and performance (the knowledge). When asked about the likelihood for a company to outperform, the expert will look the current ESG rating (profile) of the company and, through its knowledge, it will answer: Yes, No or I don't know.

One expert is usually not enough to determine if a company is an opportunity or a risk. To improve its performance, the ML algorithm will build a *Panel of Experts*, each characterized by its own knowledge. Each expert represents a different pattern. When we ask the panel about the likelihood of a company to be an opportunity (or a risk) the panel put together the answers of its members and give a final answer of the form: Yes, No or I don't know.

The final decision will account for the majority of the panel so that the use of many experts produces better-informed decisions and more robust answers. Over time, the ML lets the experts evolve, eventually by replacing some of them with new ones.

This could be thought as an economic advisory board. The board is made of many experts, each of them specialized in a field and able to provide useful insights on a given economic issue.

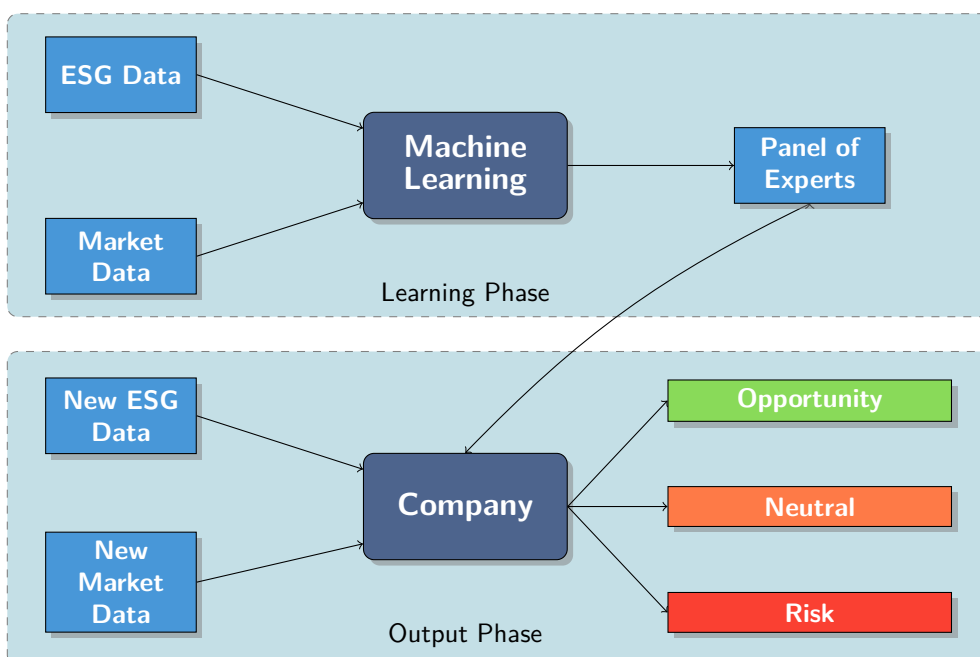


Figure 4: Schematic diagram of the Machine Learning algorithm.

Figure 4 shows the two-step algorithm. In the learning phase, the ML works with the ESG data to uncover patterns and build the panel of experts. In the output phase, for a given company in the investment universe, we use the related ESG data of the company (that the ML has not previously seen) as well as other market data. The panel of experts uses this data and produces a final assessment of the likelihood the company has to outperform the benchmark, given its ESG

and market profile. For example, a company is labelled as Risk if a statistically significant majority of experts has given a negative assessment on its financial prospects. The Neutral label corresponds to the *I don't know* answer, which is common in finance where signals may be contradictory and a clear assessment cannot be done.

Building the panel of experts is the most challenging and complex part of the ML algorithm. Indeed we must find the right ESG variables defining the experts, the thresholds (which represent the knowledge) and the outputs (which represent the experts' answers). And, more importantly, the ML needs to determine how many experts it must retain and how to discriminate among them.

With respect to the simple ESG screening, where one first aggregates all the metrics into one ESG rating and then looks at patterns between ESG ratings and financial performance, in our case we take the opposite way: We look at patterns in the granular ESG metrics and we then aggregate the answers.

Our approach therefore selects material ESG metrics through the definition of the experts, and can easily replicate non-linearities in the relationship between ESG data and financial performance. Indeed, we would not expect to find experts based on ESG indicators that have no material impact on performance, while these indicators will always appear in the aggregated ESG rating, making them very inefficient and noisy for performance enhancement.

Machine Learning and application to investment strategy design

To test the power of the selection process performed by the ML, we design a very simple strategy that screens the investment universe for all stocks labelled as Opportunity (hereafter *ML Opportunity*) while keeping the capitalization-weight allocation. We also consider the portfolio made of excluded stocks, labelled as Neutral or Risk (hereafter *ML Risk*) where again each stock is weighted by its market capitalization.

Figure 5 shows the annualized performances, volatilities and Sharpe ratios for the two ML portfolios together with the benchmark and the ESG screened portfolios.

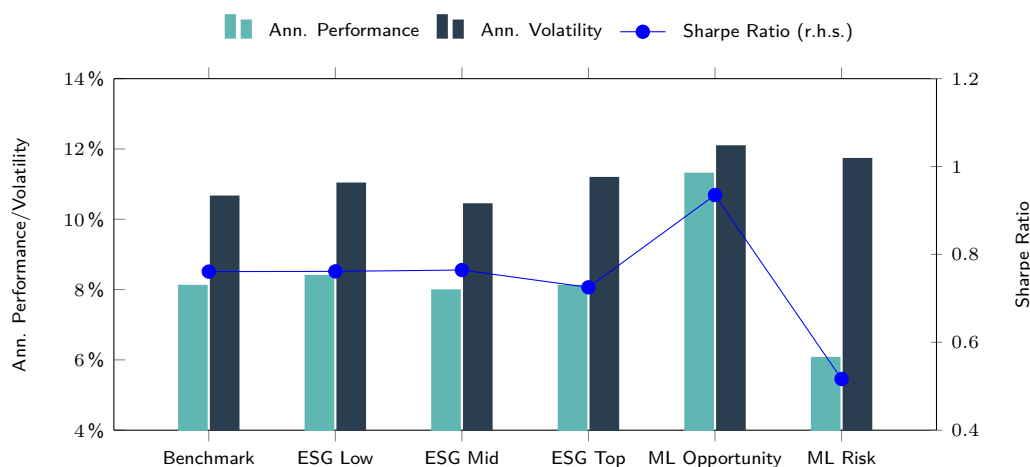


Figure 5: Annualized performances, volatilities and Sharpe ratios for the benchmark, ML Opportunity and ML Risk portfolios and the three portfolios sorted by ESG ratings and the Machine-Learning portfolios.

We observe a significant increase in the out-of-sample performance of ML Opportunity portfolio compared to the benchmark, the three ESG sorted portfolios and the ML Risk portfolio, which shows the lowest performance. More precisely, over the period the ML Opportunity portfolio realizes an annualized performance of 11.2% compared to 8.09% for the benchmark and 6.04% for the ML Risk portfolio.

Clearly the ML algorithm has been able to efficiently separate the investment universe between Opportunity stocks and Risk stocks. Even with a standard portfolio construction (here cap-weighted) we can assess the efficiency and the power of ML techniques when it comes to detect signals from sparse but rich ESG data.

Figure 6 highlights the historical performances of both ML Opportunity and ML Risk portfolios (left) and the relative strength ratio of the ML Opportunity portfolio over the benchmark (right) that shows how the ML Opportunity portfolio adds sizeable value over time.

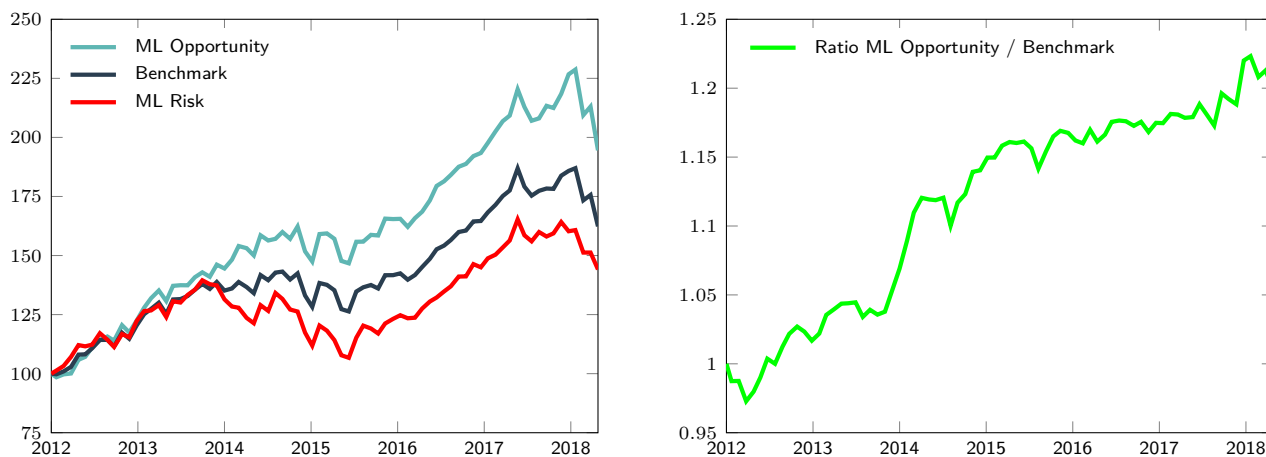


Figure 6: Left: Historical portfolio levels for the benchmark, the ML Opportunity and ML Risk portfolios. Right: the relative strength ratio between the ML Opportunity portfolio and the benchmark.

Finally, Figure 7 shows performances, volatilities and maximum drawdowns for three variations of the ML-based portfolios. More precisely, we select stocks by separating Opportunities from Risks based on the ML screening, but we weight them to match size, sector or country exposures, to ensure that all the performance comes only from the picking ability of the ML rather than from unwanted or unexpected style exposures.

The ML Opportunity portfolio outperforms the ML Risk portfolio, whether we match the size, the sector or the country exposures. The gaps in annualized performance are roughly 6% and stable across the three different versions. More interestingly, the maximum drawdowns of the ML Risk portfolios are systematically higher. This is another out-of-sample confirmation of the ML's ability to extract useful information for ESG data, especially by avoiding companies that represent sizeable idiosyncratic risks in the portfolio.

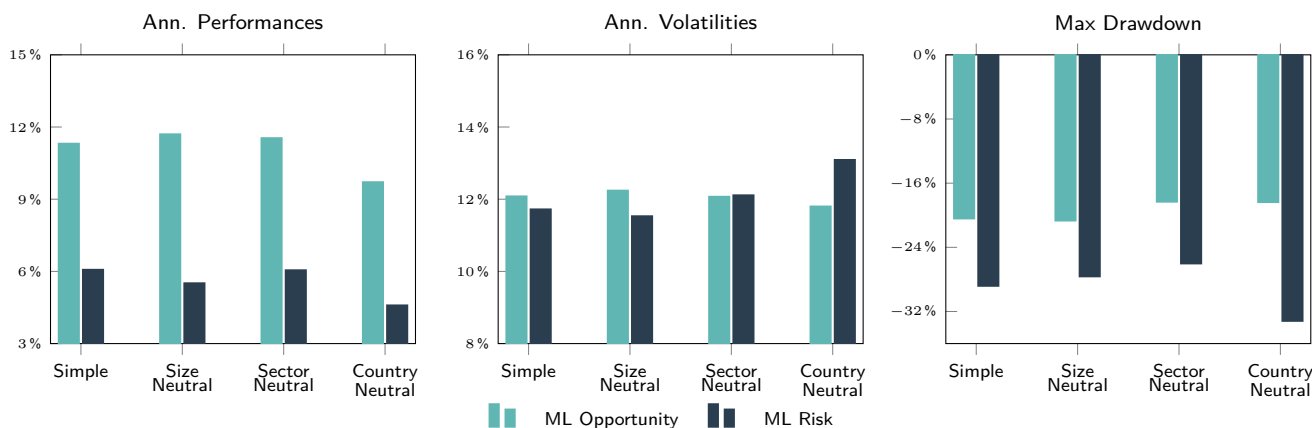


Figure 7: Annualized performances, volatilities and maximum drawdowns for the ML Opportunity portfolio and the ML Risk portfolios where the implementation is done by matching size, sector or country exposures.

Conclusion

Global interest in ESG investment solutions has been soaring in the last couple of years. But investors should be aware that filtering and selecting top ESG rated companies is not necessarily a way to enhance returns. Indeed, in many occasions, the opposite turns out to be true. One of the main factors behind this underperformance is that ESG ratings are aggregated scores that miss significant pieces of information regarding the strengths and weaknesses of companies. They also systematically underweight those indicators that could potentially have an impact on their business models. As ESG will become more integrated in the portfolio construction process, there is no doubt that it will play a significant role in stocks' returns.

To exploit valuable ESG data, we have designed a Machine Learning algorithm that, through the intermediation of a Panel of Experts, identifies ESG patterns and profiles related to financial performance. Our Machine Learning algorithm exploits granular and derived variables from ESG data sets and is able to select what is really material for companies from an ESG perspective.

We test our algorithm with simple investment strategies and show how it is possible to complement financial objectives with ESG integration, by delivering significantly better financial results. We finally show that this significant improvement is not due to unexpected style exposures. It is instead the result of an efficient use of powerful innovative techniques.

Notes

¹The data relative to the investment universe is a courtesy of Solactive (hereafter the *Benchmark*) and is related to the Global Benchmark Series (GBS) that the index provider recently launched.

²The ESG data is a courtesy of Sustainalytics, a leading provider in ESG research and analytics.

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