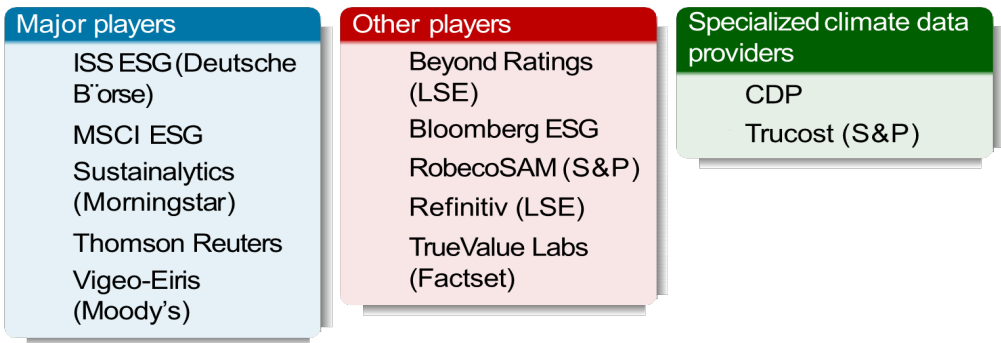| Reconciling Sustainability, market Performance and Customer Risk Appetite |
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| **Aymeric KALIFE, CEO at iDigital Partners & Adjunct Professor at Paris Dauphine University - PSL** |

1 Growing customer appetite for ESG assets while rising regulations on sustainability issues

An asset with a high ESG score means good sustainability practices within the company: among the E,S and G factors,

- The Environment factors refer to the behaviour on environmental issues such as resource depletions, climate change, pollution;

- The Social factors are related to the treatment regarding people, workers and local communities, including health and safety;

- The Governance factors refer to corporate policies and governance, including tax strategy, corruption, structure, remuneration.

Such ESG scoring is devised by major ratings agencies:

Major players	Other players	Specialized climate data providers
ISS ESG (Deutsche B¨orse)	Beyond Ratings (LSE)	CDP
MSCI ESG	Bloomberg ESG	Trucost (S&P)
Sustainalytics (Morningstar)	RobecoSAM (S&P)	
Thomson Reuters	Refinitiv (LSE)	
Vigeo-Eiris (Moody's)	TrueValue Labs (Factset)	

A positive relationship between highly ESG rated stocks and financial performance may be assumed as companies engage with stakeholders for value-enhancing purposes referred sometimes to as "doing well by doing good" (Benjamin Franklin). These companies may first experience less exposure to ESG-related risks which have positive influence on the stock performance. Adherence to ESG criteria should help minimize downside risk in a firm's financial performance, based on the premise that ESG-compliant firms are likely to be well-managed overall. Focusing on ESG is also expected to make it easier to obtain debt and equity financing in the future.

A high ESG score is thus likely to help a company to (i) attract more investors, (ii) lower the cost of capital, and (iii) result in better operational performance thus stock performance.

Therefore the ESG score is becoming an increasingly key factor in a portfolio asset allocation, The ESG AuM is expected to reach $50tn by 2025 (a third of Global AuM) within the context of growing customers 'demand (mostly institutional, as the very fast majority of millennials expresses an interest in sustainable investing) and regulatory requirements (for example in the insurance industry).

Actually, ESG is of most relevance to long-term products with an investment component, primarily unit-linked and pension savings products and to a lesser extent with-profits products.

ESG assets by geography and year in $ millions

| | 2016 | | 2018 | | |
	Amount	%	Amount	%	CAGR
Europe	12,040	53%	14,075	46%	8.1%
United States	8,723	38%	11,995	39%	17.3%
Japan	474	2%	2,180	7%	114.5%
Canada	1,086	5%	1,699	6%	25.1%
Australia	516	2%	734	2%	19.3%
Total	**22,839**	**100%**	**30,683**	**100%**	**15.9%**

Source: 2018 Global Sustainable Investment Review.

ESG assets as % of Managed Assets

	2014	2016	2018
Europe	58.8%	52.6%	48.8%
United States	17.9%	21.6%	25.7%
Canada	31.3%	37.8%	50.6%
Australia	16.6%	50.6%	63.2%
Japan		3.4%	18.3%

Source: 2018 Global Sustainable Investment Review.

Given the increasing popularity of ESG funds, and the fact that unit-linked investors bear the market risk associated with their investments, unit-linked providers are increasingly required by regulations to offer ESG fund options within product offerings, while credit rating agencies are including ESG factors into their ratings to better evaluate companies' risk of default.

ESG is still used primarily in the initial screening process at present but is expected to become a bigger driver of investment decisions over time. There are various approaches to ESG investing, ranging from simple exclusionary screening to integration of ESG into fundamental analysis of various firms.

ESG Investing Strategies	Description
Negative/exclusionary screening	Excluding companies or sectors based on ESG specific criteria
Norms-based screening	Screening of investments that comply with certain norms and standards (OECD, ILO, UN, UNICEF); May also be exclusionary
Positive/best-in-class screening	Investing in companies or sectors that demonstrate positive ESG performance versus peers
Sustainability-themed investing	Investment in themes or assets that address specific issues like climate change, food, water
ESG integration	Explicit overlay of ESG factors on financial analysis
Active ownership	Direct corporate engagement following comprehensive ESG guidelines
Impact investing	Targeted investments meant to solve social or environmental problems

Source: "The Investor Revolution" by Robert Eccles and Svetlana Klimenko, Harvard Business Review.

Annual growth of ESG strategies

	2014-2016	2016-2018
Exclusion	11.7%	14.6%
ESG Integration	17.4%	30.2%
Engagement	18.9%	8.3%
Values	19.0%	−13.1%
Selection	7.6%	50.1%
Thematics	55.1%	92.0%
Impact Investing	56.8%	33.7%

Source: Global Sustainable Investment Alliance (2015, 2017, 2019)

ESG still remains today a gating factor for active investors currently: a high ESG score alone is unlikely to help a company to attract more investors and attain a higher multiple, but a low score could hurt its ability to attract capital and could hurt a firm's multiple. Nearly 80% of respondents say ESG factors have caused them to limit exposure to or divest entirely from particular assets: tobacco companies, arms manufacturers and companies in the extraction, power, and real estate sectors due to climate change.

Some investors even express some concern about the overuse of ESG information. If ESG criteria and negative screening are too broad, they put too much restriction on the typical portfolio. On the upside, if a company can perform well economically, and at the same time have a positive social or environmental impact, then it is typically going to be more successful.

2 ESG vs. market performance and Customers' Risk Appetites

2.1. Regarding the literature review, reconciling market performance and sustainability is still an open issue

Regarding market performance, market timing usually plays a key role for high rated ESG assets, offering Downside protection during sustained crisis (2008, 2020). In the long run high rated ESG assets tend to drive performance, but with volatile performance trends: underperformed in 2010-13 then outperformed.

Regarding the academic literature review, reconciling market performance and sustainability is still an open issue, with no conclusive statistical findings and conclusions highly conflicting and with no clear answer:

- Until the early 90s, ESG integration suggested wasteful costs and competitive disadvantage as adding constraints Rudd (1981) – "a damaging permanent bias". Screening asset universes (with ESG constraints) bounders this number of stocks which would limit the Diversification.

- A second assumption is a neutral one as the decision of increasing a company's costs should lead to an increase of the benefits by matching funds: Halbritter and Dorfleitner (2015), Auer and Schuhmacher (2016); Revelli and Viviani (2012), Chong et al. (2006)

- Third axe: there is a positive correlation between return and sustainably managed companies: they may first experience less exposure to ESG-related risks which have positive influence on the stock performance (less specific risk Hoepner (2010), better risk management). Second, sustainable managed companies may have better operational performance by for instance reducing waste or reducing the greenhouse gas emission or improving their energy efficiency which can lead to long term cost savings and put them in the front line of providing innovation. Lastly, sustainable managed companies may be linked to the ability to better attract talent and create a customer loyalty due to a company's good brand image and reputation

Overall, no clear answer on the performance of best-in-class ESG stocks compared to passively investing in an index stock market. Both positive and negative returns can be found in the literature which can be due to a lack of supervision around ESG activities, and a large number of studies could not conclude on neither positive nor negative performance because of statistically insignificant results.

2.2. Reconciling Sustainability, market performance and Customers' Risk Appetites

Here we focus on one-year performance using weekly returns, from January 4th, 2010 to December 27th, 2019 across Europe. The studied companies are selected from the supranational index Stoxx600 that gathers the biggest European market caps from all industries. We use two types of indices that are the Stoxx600 and Stoxx600 ESG Index (which follows standardized ESG exclusion screens and thus excludes companies dealing with controversial weapons, tobacco or coal), used as benchmarks. Starting from this benchmark and to construct our portfolios, only the firms with 10 years of ESG scores and

close values were kept in the dataset, i.e. 410. The weekly Euribor rates has been used as proxy for the risk-free rate.

The ESG scores are provided by Refinitiv for the whole period 2010-2019, computed on a yearly basis until 2019. The Refinitiv framework divides 'ESG' in ten categories where each one of them depends on the firm's industry among a classification of 54 industries total initiated by Thomson Reuters. Each industry has around 186 specific meaningful indicators to evaluate a company on a total of 500+ initial measures. The ten categories eventually aggregate into the well-known three pillars with a specific weighting scheme for each indicator. All of the metrics used are publicly available.

<u>2.2.1. ESG Passive portfolio management usually underperform benchmark indices</u>

Although a naive diversification based on equally weighted best ESG stocks portfolio provides over time a positive trend in performance relative to the benchmark, and some outperformance during specific periods (e.g. 2020 market crash) or in the long term, it still most often underperforms worst ESG stocks portfolios over shorter time horizons (e.g. 1-year) in terms of overall returns, risk, and cost of capital:

- Lower Sharpe, Sortino (same logic as the Sharpe ratio but replacing the total volatility by the downside deviation), Treynor (same logic as the Sharpe ratio but replacing the total volatility by the Beta, considering the specific risk as fully diversifiable), Information (excess return to benchmark divided by its tracking error volatility) ratios,

- Higher Volatility, Beta, VaR, Max Drawdown for best ESG vs. market benchmark or even worst ESG

<u>Absolute returns:</u>

Sortino Ratios

Information ratios
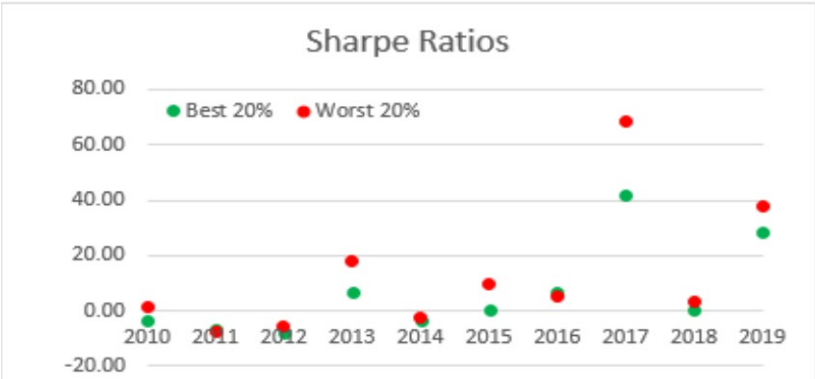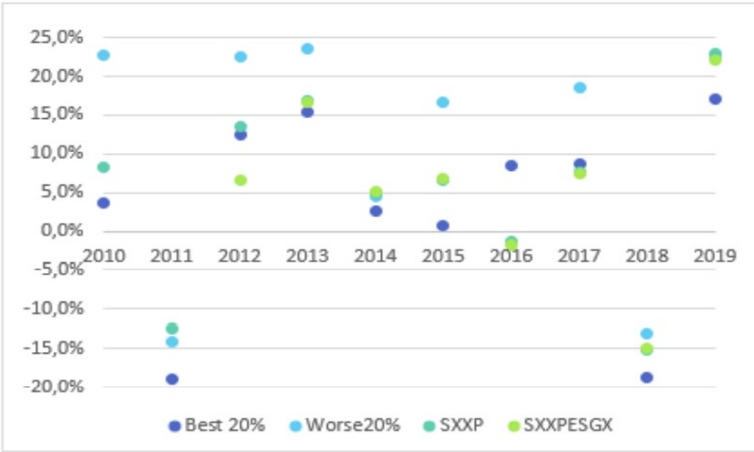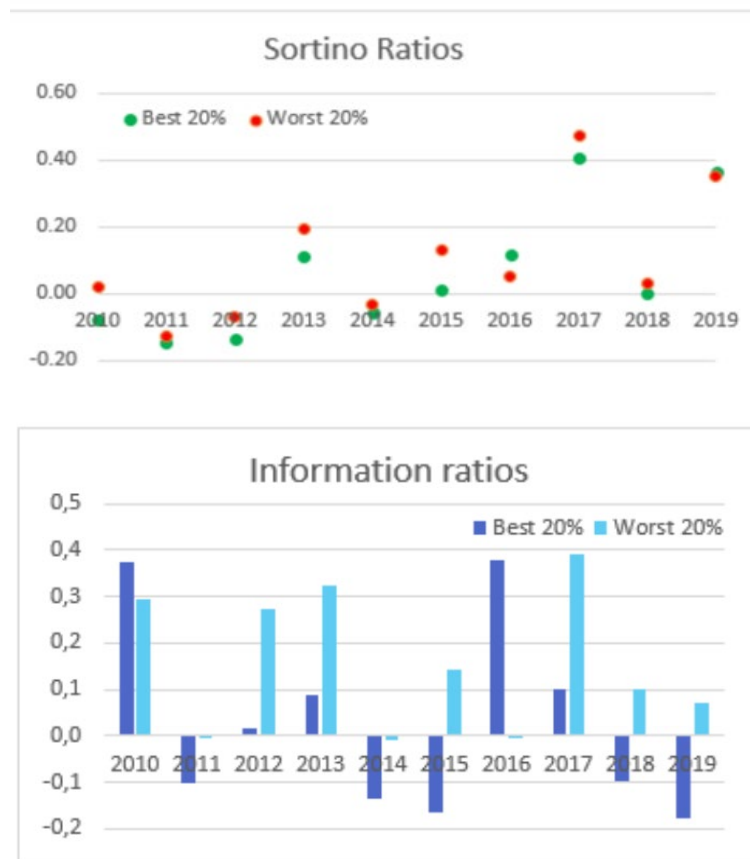
Potential lower performance of ESG stocks portfolios stems from the ESG screening that tends to reduce diversification, as measured by

- the Diversification Ratio

$$DR = \frac{\sum_{i=1}^{n}(x_i\sigma_i)^2}{\sigma_p^2}$$

The lower the Ratio is, the less powerful the Diversification Effect is ; or equivalently, the higher the Diversification Ratio is, the more Diversified the Portfolio is. In other words, a Portfolio with a high Diversification Ratio maximizes the number of non-correlated sources of Risk.

An immediate property is that the screened universe (such as the ESG-screened portfolio) cannot have a higher Diversification Ratio than the unscreened universe, simply because it is a subset of this whole universe, so the sources of non-correlated Risk must be smaller.

- The diversification measure

$$D = (\frac{\sigma_p}{\sigma_m} - \beta_p) * (r_m - r_f)$$

The lower diversification is NOT more than compensated by an extra alpha, as illustrated by the Negative Net Selectivity (= alpha – Diversification measure) for best ESG and positive one for worst ESG.

Such results are consistent with major studies on passive ESG portfolio asset allocations: Roncalli and al. (2018) see [1]. In particular, they do not find evidence of outperformance of ESG-focused ETFs compared to benchmark indices, even during the pandemic (Pavlova and de Boyrie (2021) see [5]), although their performance seems to be better compared to the pre-pandemic period. Several studies have attributed the greater returns of ESG-focused portfolios during the pandemic to spillover effects. i.e., investors redirecting capital to ESG-focused portfolios because of their risk aversion and, as a result, attention to corporate fundamentals (to avoid downside risk) increasing in response to the market shock created by the pandemic (see Singh, 2020, see [7]).

As a result a modified asset allocation is required by integrating the ESG constraints directly into the Markowitz approach.

2.2.2. Optimal ESG constrained active portfolio management opens the door to outperformance vs. benchmark indices: the ESG-CAPM model (Pedersen & al. 2021 see [6])

Within such model equilibrium asset returns satisfy an ESG-adjusted capital asset pricing model (CAPM), showing when higher ESG assets have lower or higher equilibrium expected returns.

Three types of investors are considered here:

- Type-U (ESG-unaware) investors are unaware of ESG scores and simply seek to maximize their unconditional mean-variance utility. They take expected excess returns to be E(r) with risk given by the variance-covariance matrix, var(r).

- Type-A (ESG-aware) investors also have mean-variance preferences, but they use assets' ESG scores to update their views on risk and expected return. They use assets' expected excess return, $\mu = E(r|s)$, conditional on the ESG information s, and the conditional variance-covariance matrix of excess returns var(r|s).

- Type-M (ESG-motivated) investors use ESG information and also have preferences for high ESG scores, they seek a portfolio with an optimal trade-off between a high expected return, low risk, and high average ESG score.

While optimizing across three characteristics (risk, return, ESG) can seem challenging, the investor's problem can be reduced to a trade-off between ESG and Sharpe ratio. In other words, risk and return can be summarized by the Sharpe ratio. Specifically, for each level of ESG, we compute the highest attainable Sharpe ratio (SR), translated into the ESG-SR frontier illustrated below, which is independent of investor preferences: an investment expert can first mechanically compute the frontier and then the investment board can choose a point on the frontier based on preferences. This separation property resembles that of the standard mean-variance frontier, which also depends only on security characteristics.
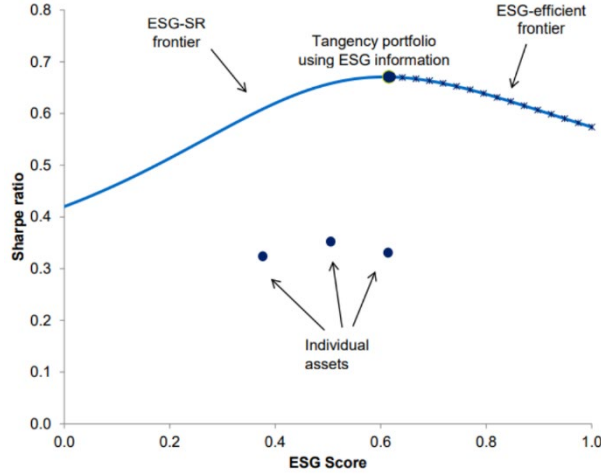
To understand why the ESG-SR frontier is hump-shaped,

- consider first the tangency portfolio known from the standard mean-variance frontier, which has the highest SR among all portfolios, so its ESG score and SR define the peak in the ESG-SR frontier.

- Further, the ESG-SR frontier is hump-shaped because restricting portfolios to have any ESG score other than that of the tangency portfolio must yield a lower maximum SR.

Type-A investors choose the portfolio with the highest SR, that is, the tangency portfolio using ESG information. Type-M investors have a preference for higher ESG, thus choose portfolios to the right of the tangency portfolio, on the ESG-efficient frontier, depending on their ESG preferences: with a small preference for ESG just to the right of peak with nearly the maximum SR (higher than the SR achieved by type-U), while with strong preference on the far right of the ESG-efficient frontier (possibly with lower Sharpe ratios than U investors). Finally, type-U investors may choose a portfolio below the frontier, because they compute the tangency portfolio while ignoring the security information contained in ESG scores (they condition on less information).

The portfolio problem for U and A investors has the standard Markowitz type of solution (albeit with potential different estimates of risk and expected returns), so we focus here on the solution for type-M investors, who seeks to maximize her utility U over final wealth W and average ESG score s, given the extended mean-variance framework:

$$U = E(\widehat{W} \mid s) - \frac{\bar{\gamma}}{2} \text{Var}(\widehat{W} \mid s) + W f(\bar{s})$$

$$\widehat{W} = W \left(1 + r^f + w'r\right)$$

Where W is the initial wealth; W^ is the final wealth; r is return of portfolio; rf is risk-free return f is a function $f : R \rightarrow R$ of the average portfolio ESG score and $\bar{\gamma}$ is absolute risk-aversion parameter.

Thus, with $\mu = E[r|s]$

$$U = W\left(1 + r^f + w'\mu\right) - \frac{\bar{\gamma}}{2}W^2 w'\Sigma w + W f(\bar{s})$$
$$= W\left(1 + r^f + w'\mu - \frac{\gamma}{2}w'\Sigma w + f(\bar{s})\right)$$

Considering r^f is constant we consider only:

$$\max_{\forall w}\left(w'\mu - \frac{\gamma}{2}w'\Sigma w + f(\bar{s})\right)$$

The maximum SR that can be achieved with an ESG score, denoted the ESG-SR frontier, is:

$$SR(\bar{s})\ _{\text{s.t. } \bar{s}=\frac{w's}{w'1}} = \max_{w}\left(\frac{w'\mu}{\sigma}\right)$$

In a standard mean-variance analysis, the investors choose separately the risky portfolio and the risk-free security (Fund separation theorem). In a similar way, we reorganize the maximization program as:

$$\max_{\bar{s}}\left[\max_{\sigma}\left(w'\mu - \frac{\gamma}{2}w'\Sigma w + f(\bar{s})\right)\right]$$
$$SR(\bar{s})\sigma = w'\mu$$
$$\sigma^2 = w'\Sigma w$$

After solving σ, the problem becomes

$$\max_{\bar{s}}\left[(SR(\bar{s}))^2 + 2\gamma f(\bar{s})\right]$$

Not surprisingly ESG affects the optimal portfolio choice, given that ESG is in the utility function. Such result illustrates this trade-off using a part that depends only on securities (the ESG-SR frontier) and another part that depends only on preferences (2γf(s)): just like the standard Markowitz theory with the mean-variance frontier, the ESG-SR frontier can be computed independent of preferences and then the investor can decide where on the frontier to place herself based on risk aversion.

Remark: this method works because the investors are assumed to care about the average ESG score only, which does not change when the investor chooses the risk level in the second step by choosing her cash holding. If investors care about total ESG instead of average ESG, then the investor's problem cannot be summarized as the ESG-SR frontier, which also shows that our frontier results are not trivial.

The steady-state equilibrium security prices and returns are then derived below, depending on the relative importance of investor types, starting with the simplest cases in which all investors are of the same type:

- If all investors are type-U (i.e. ignore ESG), then we are back to a standard CAPM equilibrium: all investors hold the unconditional tangency portfolio that equals the market portfolio, and each security's expected excess return is driven by its unconditional market beta:
  $$E\left(r_t^i\right) = \beta^i E(r_t^m)$$
  What is new here is that a (small) investor who understands that ESG scores are informative can exploit this insight: from the perspective of an investor who uses ESG scores, the equilibrium conditional expected excess return now depends linearly on ESG:

$$E\left(r_t^i | s\right) = \beta^i E(r_t^m) + \lambda \frac{s^i - s^m}{p^i}.$$

Where s^i is the stock I ESG score while s^m is the weighted-average ESG score of the market portfolio.

If a high-ESG score is indicative of a high future profit, that is, if $\lambda > 0$, then stocks with ESG scores above average have higher conditional expected returns than those with below-average ESG scores. This is in line with the empirical findings such as those of Gompers et al. (2003)

- If all investors are type-A (all investors use ESG signals, but without ESG preferences, then we get a conditional CAPM equilibrium, and investors can no longer profit from using the informational value of ESG scores because this information is already incorporated into prices.

- Finally, suppose that all investors use ESG in their signals and in their identical ESG preferences (i.e., all type-M), then the equilibrium conditional expected excess return is further modified, given by the standard conditional CAPM expression (for type-A investors) which is here adjusted for whether the ESG score is above or below that of the market:

$$E(r_t^i | s) = \bar{\beta}^i E(r_t^m | s) - \pi \left(s^i - s^m\right)$$

Where π is the parameter catching the strength of the preference for ESG ($\pi=0$ for type-A investors).

In other words, the firm's cost of capital is lower if its ESG score is higher or, equivalently, the firm can issue shares at higher prices. This low cost of capital encourages high-ESG firms to make real investments because, using this low discount rate, more projects would have a positive net present value.

If all types of investors exist, then several things can happen, depending on the relative importance of each investor type, leading to a relation between ESG and expected returns that is positive, negative, or neutral:

- When there are many type-U investors and when high ESG predicts high future profits, high-ESG stocks deliver high expected returns: high-ESG stocks are profitable, yet their prices are not bid up by type-U investors, leading to high future returns.

- When the economy has many type-A investors, then these investors bid up the prices of high-ESG stocks to reflect their expected profits, thus eliminating the connection between ESG and expected returns.

- Further, if the economy has many type-M investors, most investors are willing to accept a lower return for a higher ESG portfolio, then high-ESG stocks actually deliver low expected returns.

Whether favourable ESG characteristics signal good profitability or low profitability (the sign of λ) is an empirical question; that is, is an empirical question. For instance, Pedersen & al. 2021 [5] find E, S, and overall ESG as weaker predictors of future profits.

3 From theory to practice, trailblazing a way to reconciling Sustainability, market Performance and Customer Risk Appetites

As a result, given it is in practice impossible to measure the relative importance of each investor type, while extremely hazardous to estimate both λ and the π parameter (preference for ESG), in the following the optimal asset allocation will be restricted to the assumption λ = π = 0.

First we make sure that all required modelling assumptions of the CAPM are passed by econometrics tests (regarding the non-autocorrelation, the normality and the non-heteroscedasticity of returns), as illustrated below

| | Best 20% Portfolio | | Worst 20% Portfolio | | |
Assumptions	Y/N	p-value.s	Y/N	p-value.s	Test
1- Normality	✓	0.83848	✓	0.65974	χ^2
		0.77462		0.83069	JB
2- Homoskedasticity	✓	0.57165	✓	0.27558	BP (as.)
		0.53233		0.24539	White (as.)
3- Non Autocorrelation	✓	0.243	✓	0.0997	BG (as.)

3.1. Using too much restrictive ESG constraints improve the trend but don't yet outperform the benchmark indices

Why don't they outperform? Because the "Best-in-class" constraint on the ESG score is too restrictive: numerous analyses on single names illustrate that best-in-class ESG stocks (e.g. best 10%) do not provide higher market performance (neither improved excess return nor risk-adjusted – namely Sharpe, Sortino or Treynor ratios), while illustrating even larger VaR vs. benchmark index (S&P 500). In contrast with lower rated ESG assets of companies which progressively integrate ESG concerns into their activities thus with rising ESG scores. Further profit-driven investors should even consider bad ESG ratings stocks in a diversification purpose.

In that respect, MSCI ESG research study ("Can ESG add alpha?") shows that companies which managed to improve their ESG score have seen an increase in their share price during the following period of 12-18-month. Overall, the ESG Momentum strategy outperformed significantly the MSCI World Index over 2008-2014, further confirmed until 2018 by a study by SG Cross Asset Research department.

Still such optimal 10% Best-in-class ESG active "optimal" portfolio asset allocation improves both diversification, net selectivity (positive now and 4 times better) and returns (both absolute and risk adjusted ones), although the metrics remain weaker vs. a 10% Worst-in-class ESG active "optimal" portfolio asset allocation.

3.2. Using an ESG constraint on the average portfolio ESG score while meeting customer's risk appetite enables to outperform the benchmark indices (see [3] and [4]).

The average ESG criterion is as follows: the average ESG score of the optimal portfolio is required to be higher than the benchmark index ESG score.

Remark: requiring the average ESG of the optimized portfolio to be significantly higher than the average ESG score of the benchmark index adds significant constraints on its ability to outperform in term so returns and risk, as illustrated by De Spiegeleer & al. (2020) (see [2]) which imposes as the average ESG score constraint

$$\mathbf{ESG}^t \boldsymbol{w} \geq \mathrm{ESG}_{\mathrm{MV}} + 0.1 \cdot (\max\{\mathbf{ESG}\} - \min\{\mathbf{ESG}\})$$

In order to comply with the customer's Risk Appetite, another risk constraint is added to the average ESG criterion, whether based on a maximum volatility or VaR exposure.

As a result, an optimal asset allocation can be built based on a nonlinear Markowitz program upgraded by ESG information (the average ESG score of the optimal portfolio is required to be higher than the benchmark index ESG score) and more specific risk criteria (volatility as in Markowitz's model or Value-at-Risk or Conditional-Value-at-Risk which deals with the Solvency capital requirements), as follows:

$$\begin{cases} Max \quad r_p \\ s.c. \quad \nu^{opt} \leq \nu^n \\ \qquad \bar{s}_p^{opt} \geq \bar{s}_p^n \end{cases}$$

Specifically maximizing the absolute returns under two constraints:

- a minimum ESG score s
- and a maximum risk criterion v.

Even if the scope of stocks is restricted to the Best-in-Class ESG stocks (20%), it turns out to deliver a clear and resilient outperformance in terms of overall returns, risk, and cost of capital, to the benefit of both customers and insurance companies. More specifically

- a higher excess returns and downside Sharpe ratio (Sortino ratio) since 2016

- a lower downside deviation (only considers returns that fall below a minimum threshold) since 2013
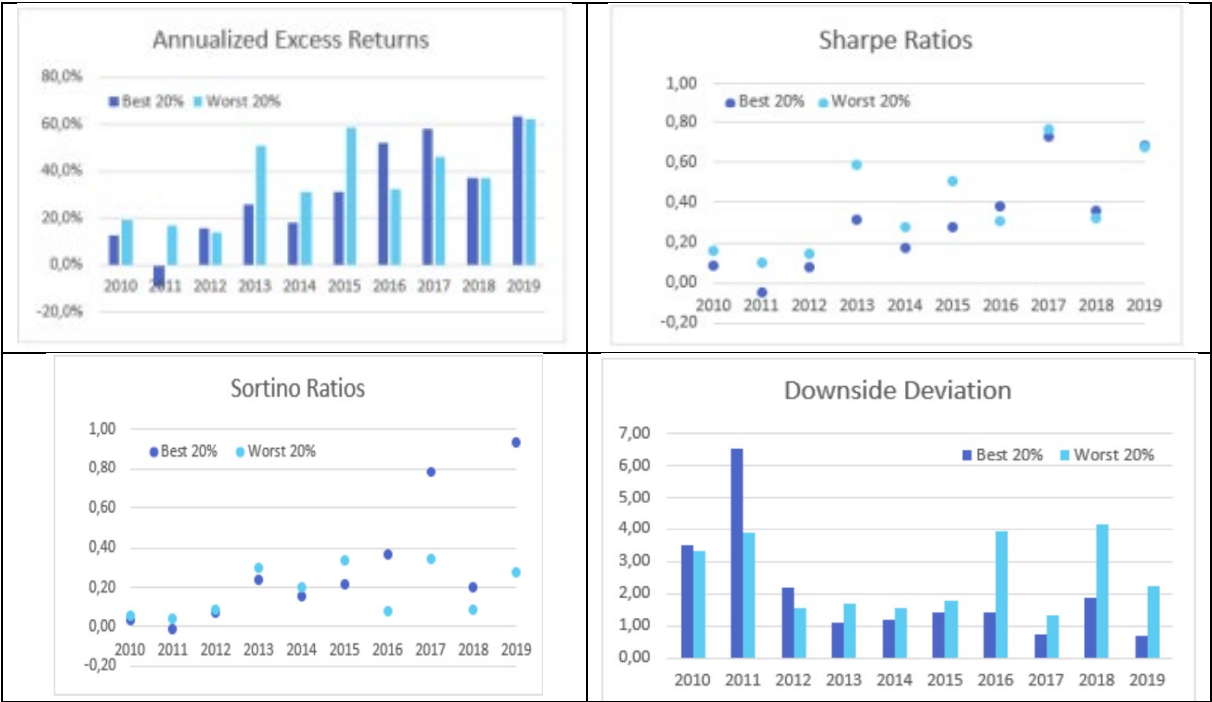
Remark: such results are consistent with Roncalli and al's at Amundi (2020)

The results can be further improved, in both magnitude and duration, if we extend the scope of stocks to the e.g. 80% best ESG rated stocks (by excluding the 20% worst ESG assets). Besides the constraint on ESG can be further alleviated by introducing "hybrid" ESG scoring metrics instead of a plain ESG scoring metrics, which combines both ESG scoring AND corporates KPIs (e.g. debt or EBITDA metrics). As a result the outperformance is confirmed since the availability of ESG data (2009), and this across
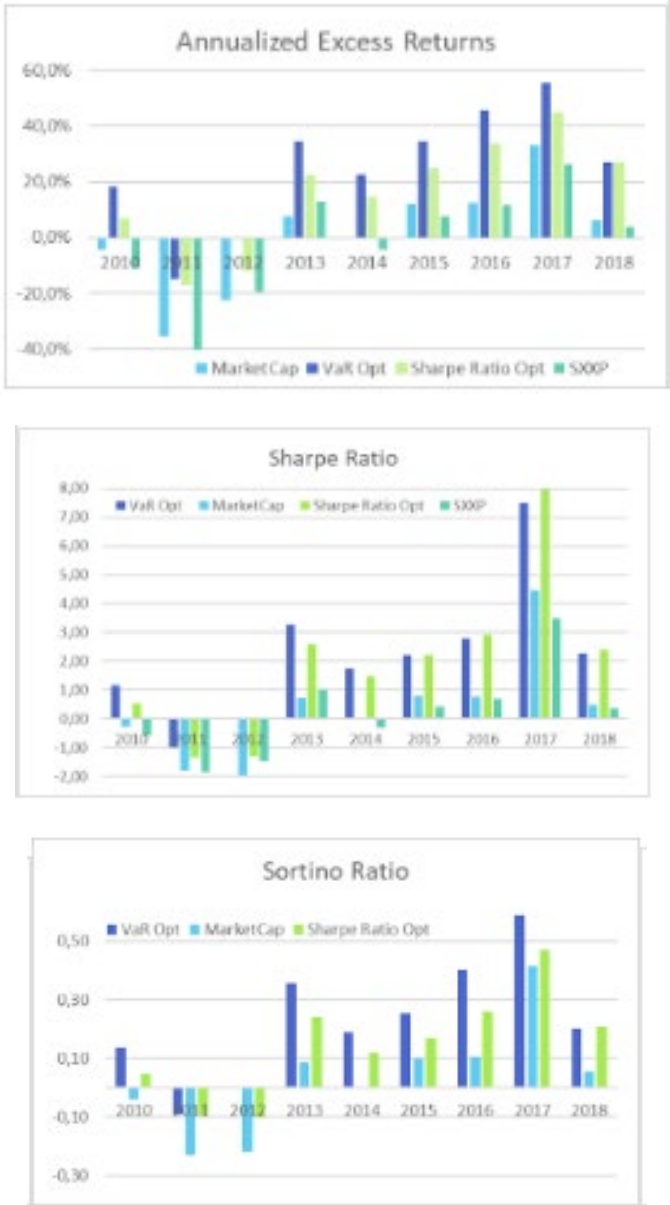
Such a hybrid ESG scoring metrics indeed evolve in parallel with the Sharpe ratios:
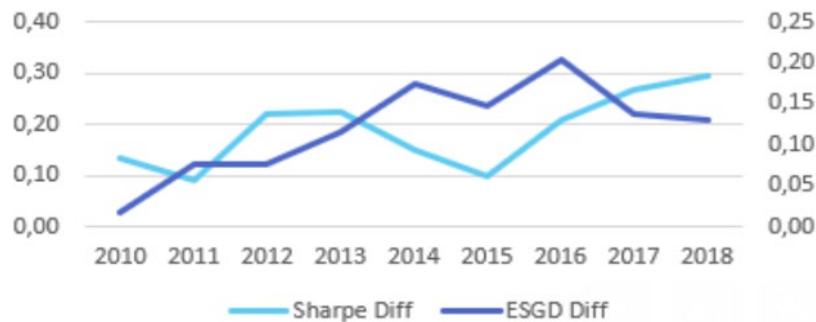
Conclusion

Within the context of growing customer appetite for ESG assets while rising regulations on sustainability issues, reconciling sustainability and market performance is still an open issue, with no conclusive statistical statistics, findings and conclusions highly conflicting with no clear answer, as illustrated by the poor performance of passive ESG Passive portfolio management that usually underperform benchmark indices.

Trailblazing a way to reconcile Sustainability, market Performance and Customers Risk Appetites is still possible through the modelling of a balanced Optimal ESG-constrained and risk-based active portfolio management that also meets customers Risk Appetites.

Beyond performance and risk metrics, the asset manager needs to make sure that the stock components of the resulting optimized portfolio meet her targets in terms of portfolio diversification, market capitalization, liquidity or sector diversity, which can also be included in the optimization program. Those additional constraints can be also part of the optimization through the use of dedicated metrics (e.g. diversification or concentration ratios).

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