Integrated Alpha: The Future of ESG Investing

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Introduction and Summary

When making investment choices, a company's adherence to ESG principles is one that we believe is becoming increasingly relevant in today's climate. Customers' interests are a top priority and companies are incentivized to meet these, in addition to serving their various stakeholder communities. Companies understand that a good work environment is critical to their success. Shareholder interests are equally important in retaining and attracting new capital. Our research shows that companies which exhibit these principles not only historically outperform ones that do not incorporate them into the company's DNA, but may also experience less downside risk.

Investors are looking more and more at adopting strategies which combine these new ESG tenets with existing methods of identifying attractive investment opportunities. Assets invested in sustainable strategies rose to $22.89 trillion globally at the beginning of 2016, up 25% from the start of 2014, and accounting for 26% of all professionally managed assets globally[1]. Given its trajectory, we would anticipate significant growth to continue into the foreseeable future as investors and millennial investors in particular, become more sustainability-minded and will likely seek investments that reflect their values[2].

Still an evolving field, there is no well-defined process to best construct ESG portfolios which optimally combine profit-maximizing characteristics with ESG ones, all the while being mindful of client-specific requirements. At PanAgora, we believe an optimal approach to building ESG portfolios exists. An ESG portfolio can be constructed in a systematic way, with both traditional and ESG factors integrated in a manner that seeks to maximize performance based on objective measures. This may result in a portfolio which delivers alpha with ESG benefits that may accomplish both the return objectives and the values of the asset owner.

[1] http://www.pionline.com/article/20170327/ONLINE/170329906/global-sustainable-investment-strategy-assets-up-25-in-2-year-period-8212-report

[2] Bank of America Corporation 2016 Environmental, Social, and Governance Report, https://about.bankofamerica.com/assets/pdf/Bank-of-America-2016-ESG-Summary-Report.pdf

In this white paper, we survey the current state of ESG portfolio offerings and evaluate their strengths and drawbacks. We then share PanAgora's approach to incorporating current ESG investment best practices with our proprietary ESG alpha factors, how we assess ESG alpha factors' materiality using a novel approach, and finally, discuss our integrated portfolio construction framework that allows for flexibility in a differentiated manner than other providers. The appendices cover the mathematics behind our integrated portfolio construction framework and terminologies used in this paper.

Current ESG Investment Landscape

A wide spectrum of ESG investment solutions exists as a result of various approaches being taken to address a growing desire for ESG portfolios. The challenge for the investment community, however, is that asset owners who invest in ESG-centric strategies assign different relative importance between ESG and alpha. The chart below shows the continuum of ESG products offered by asset managers ranging from purely ESG-focused (impact investing) to ESG agnostic (classic investing). Another consideration is which ESG issues specifically should a portfolio incorporate and address? While there is universal agreement amongst asset owners that outperforming their stated benchmark is desirable, there is much less agreement when it comes to ESG incorporation[3]. For example, one asset owner may primarily be concerned with environmental pollution, while another may care more about gender equality and workplace diversity.

Shown for illustrative purposes only. Source: PanAgora.

The current ESG offerings can be grouped as follows:

- Restriction-list-based: This approach, commonly called SRI (Socially Responsible Investing), is the earliest form of ESG investing[4]. This method

[3]For example, MSCI ESG has more than 37 dimensions along which to measure a company's ESG performance. There is no industry-wide agreement which ESG measures are the desirable or useful ones.

[4]An early example of this type of investment was during the 1980's where South African companies are excluded due to Apartheid.

excludes companies involved in controversial topics such as tobacco, gambling, cluster munitions, etc. from the investable universe. Portfolios based on this approach typically result in lower achieved alpha versus their non-exclusion-list counterparts. The smaller opportunity set reduces the maximum obtainable return by the manager. Furthermore, for those stocks in the investment universe, no distinctions are made between relatively good or bad ESG companies. Therefore, this is a rudimentary approach to ESG investing that likely will deliver less than optimal ESG and Alpha results.

- Integration Investing: In this approach, ESG factors are incorporated into stock selection and portfolio construction considerations. A growing body of research suggests that ESG factors can contribute to long-term financial performance either through increasing upside opportunities or minimizing downside risks[5]. As a result, ESG becomes another criteria upon which stocks are evaluated, much like value, quality, etc. This approach is attractive from the perspective that ESG issues are evaluated only along the alpha dimension.

- Impact Investing: In this approach, investors direct capital towards companies which provide solutions to social and environmental issues, and to affect real world outcomes. One key challenge of this approach is the measurability of outcomes. Increasingly, the UN Sustainable Devel-opment Goals (SDGs) is emerging as the dominant framework around which impact investment results are measured[6]. Popular ESG vendor metrics are also used to measure a portfolio's impact or ESG rating. In this approach, a given portfolio is evaluated along both ESG and alpha dimensions.

Given the increased availability of data and computing power, the investment community is increasingly adopting quantitative approaches. However, when it comes to ESG portfolios, we believe even quantitative managers do not optimally integrate their traditional and ESG factors in such a way as to maximize joint ESG and alpha performance according to reasonable metrics. The reason for this is because in the traditional sense, the manager's job is to maximize alpha per unit of risk. However, for ESG investing the goal could be to optimize along two distinctive dimensions, ESG and alpha.

PanAgora believes there is a better way for ESG portfolios to be constructed in an integrated, theoretically-consistent, and optimal framework that spans the spectrum of asset owners' ESG needs along both of the following dimensions:

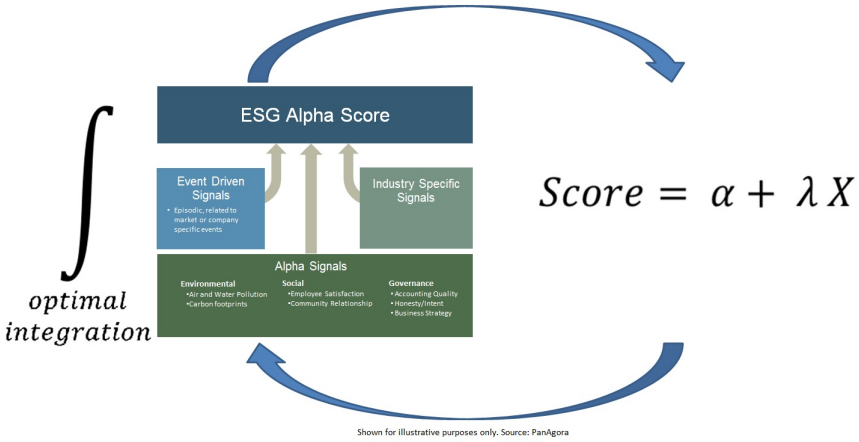
- How important is ESG performance versus alpha?

- Which ESG metrics matter to the asset owner?

[5]For example, see [GS, 2017].

[6]For more information on SDGs, see: https://sustainabledevelopment.un.org/sdgs

Furthermore, we have discovered alpha-enhancing ESG factors which incorporate newly available data sources and the latest computation methods such as natural language processing (NLP) which also capture sensible fundamental rationale. We term such ESG factors "ESG Alpha", to distinguish them from "Standard Alpha" factors constructed without ESG considerations[7]. To this effect, we have developed a framework and library of ESG alpha factors that address the issues and desired characteristics outlined here. The diagram below illustrates PanAgora's approach to ESG portfolio construction.



Shown for illustrative purposes only. Source: PanAgora

Do ESG Factors Drive or Detract From Alpha?

One of the most common challenges for asset owners seeking to integrate ESG portfolios into their asset allocation is understanding whether ESG might dampen portfolio returns. Historically, this would have been the case with an SRI-based approach as a smaller universe limits investment opportunities when compared to the unconstrained portfolio. In fact, this has been PanAgora's experience. With the newer Integration and Impact approaches, the investment community is beginning to realize that ESG and alpha generation are not mutually exclusive. Our research, in fact, shows that in many cases including ESG conscious firms in a portfolio can be additive while also providing downside protection. Firms that rank high on ESG metrics have shown an ability to deliver above-market returns. Below is an example of lapses in certain ESG criteria that may lead to higher business risks and negatively impact stock performance:

- The GEO Group. This company operates private correctional facilities in the US and other countries. The GEO Group faces a litany of allegations for human rights and civil liberty abuses, which has business implications as these allegations hinder its position in government contract bid-

[7]Factors such as sentiment, quality, momentum, etc.

ding[8]. The company also faces employee lawsuits on issues such as unpaid wages, poor working conditions, and sexual harassment. Over the past year, the GEO Group's equity has underperformed the Dow Jones Equity All REIT total return index by more than 30%[9].

Another potential benefit of considering ESG alpha sources is that high ESG-rated companies tend to have lower exposures to systematic and company-specific risk factors, which leads to lower cost of capital and higher longer term valuation under the DCF framework. Many other channels of linkages between ESG and alpha are being discovered, and the list of industry and academic studies documenting such connections is growing rapidly[10].

PanAgora's ESG Investment Philosophy

PanAgora has a long history of innovative alpha factor development. Our investment philosophy is rooted in quantifying the fundamental drivers of company performance. Our current suite of factors not only identify companies that have dominant competitive advantage within their industry, but also ones which take into consideration their shareholders', employees', and customers' best interests, as well as the environment, when devising their corporate mission.

For over a decade we have been identifying management decisions that have an impact on a company's valuation. After interviewing forensic accountants who manually go through thousands of pages of company filings to find signals of potential earnings manipulation, we developed a quantitative process to identify the same red flags over a much broader universe of companies more quickly. In the process, PanAgora has become the second heaviest user of EDGAR, the SEC's document service[11].

During hundreds of discussions with career sell-side analysts and management consultants, we synthesized the age-old challenge of evaluating the skill of executive management teams into a list of quantifiable criteria. The companies the algorithm chooses are the top based on minimizing the agency conflict between shareholder rights and personal executive gain. They also have independent board members who ensure the highest level of corporate governance and oversight.

The firms we invest in also typically have motivated employees. We don't want to simply take the management's word on the morale of their employees, which is why we employ web-scraping techniques to "read" millions of direct comments from employees on their thoughts of management, how likely they are to recommend their company to a friend, and their overall job satisfaction.

[8]For example, see: http://www.mcclatchydc.com/news/politics-government/article24738229.html

[9]As of March 1, 2018. The GEO Group classifies itself as a REIT.

[10]For example, see [MSCI, 2017], [UBS, 2017], [KPS, 2016], [CIS, 2014], [DLTY, 2011], [DRTY, 2012], and [KGY, 2016], amongst others.

[11]See [CCU, 2018]

We want to invest in companies which recognize the importance of employee happiness on their success.

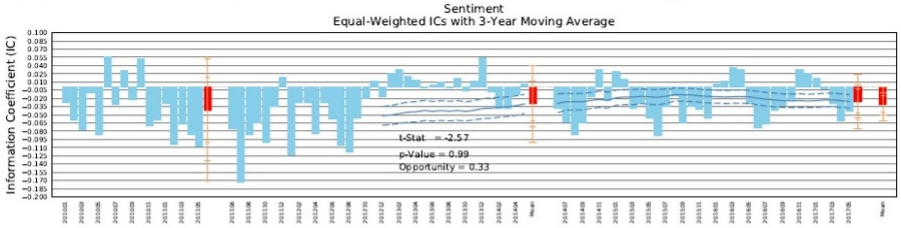
Management behavior insights are also used to develop ESG alpha factors. As an example, there is a common behavioral tendency for C-Suite executives to avoid disclosing negative news too early[12]. As a result of this behavioral tendency, we verified that upon disclosure of negative ESG news, companies tend to work to remedy their ESG related issue, and this results in improved ESG alpha. Furthermore, the act of disclosing ESG related issues indicates that ESG is important to a firm's management. Constructing this ESG alpha factor entails developing a proprietary ESG dictionary, reading through millions of companies' internal corpus to identify and assign relevant ESG information using natural language processing (NLP) techniques, and then applying machine learning techniques to access the relative impact of ESG comments.

Shown for illustrative purposes only. Source: PanAgora

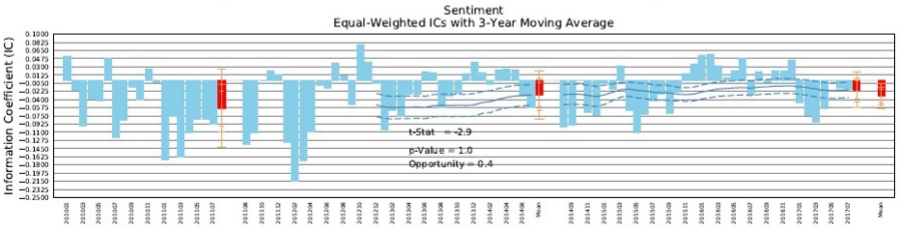
Below shows the alpha performance of this factor in the US and International universes, constructed around Russell 2000 and MSCI World ex. US indices, respectively, and described in disclosures. Signs are flipped because disclosing negative ESG news is positive for ESG alpha, and vice versa.

[12]This is a well-known behavioral bias. For example, see [KSW, 2008].

- For R2000 universe (Return Horizon=6 month, from 2010 to 2017)

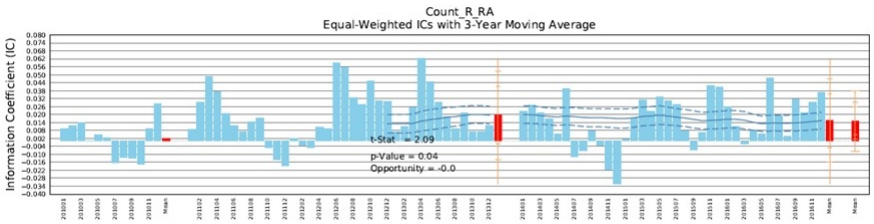


- For INTL universe (Return Horizon=3 month, from 2010 to 2017)



2010-2017. Source: PanAgora. Past results are not a guarantee of future returns.

As a final example of ESG alpha factors in our library, we utilize the wisdom of informed investors. Many studies have documented that stocks commonly held by institutional investors have better alpha performance over time[13]. The same conclusion can be drawn for stocks held by ESG funds with respect to ESG ratings, and subsequently alpha through economic channels mentioned above. Below is the alpha performance for this factor in the US.



2010-2017. Source: PanAgora. Past results are not a guarantee of future returns.

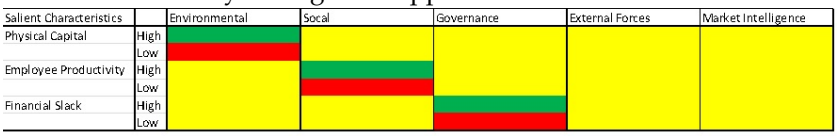
PanAgora's ESG Factor Materiality Categorization

Materiality of ESG factors varies across companies. Environmental issues are important to industrial companies although not as important to professional service companies, while employee satisfaction is important to professional service companies and not as important to companies whose assets are mostly physical capital-based. The common approach to identifying materiality is to segment companies by industry. However, we believe this is not the most ideal method to measure materiality.

PanAgora utilizes Contextual Modeling, as documented in a 2005[14] paper,

[13]For example, see [WYZ, 2012]
[14]See [QHS, 2007]

which identifies the power of factors, such as value, quality, and momentum, has different efficacy across various risk contexts. In recent years, PanAgora has applied a similar approach across its suite of ESG alpha factors, not along risk dimensions as in [QHS, 2007] but rather depending on salient firm characteristics, to evaluate materiality of ESG alpha factors and determine which ESG alpha factors are most relevant to each company. This process cuts through industry group and can identify differences across companies within an industry. For example Netflix and Yum! Brands are both in the consumer discretionary sector however we believe relevant ESG alpha (and standard alpha) factors are different for the two companies. The below graph shows examples of ESG alpha factor materiality through this approach.



Legend	Color	Materiality
		High
		Standard
		Low

Shown for illustrative purposes only. Source: PanAgora

PanAgora's Integrated ESG Portfolio Construction

We believe investors generally focus on maximizing alpha generation while minimizing downside risk. ESG-minded investors face additional decisions we believe may be equally important:

- How important is ESG exposure versus alpha? For example, is the asset owner willing to give up some expected alpha in order to improve her portfolio's ESG rating by a certain percentage?
- Which ESG metrics matter? That is, while carbon footprint may be a priority for certain sovereign wealth fund, workplace equality could be the most important ESG issue for a local government employee pension fund.

The answer will differ between asset owners and even when this is known the challenge still remains in constructing an ESG portfolio with the objective of maximizing along two dimensions: ESG and Alpha. In addition to innovative, proprietary ESG alpha factors and evaluating the materiality of these factors via a novel approach, PanAgora has also developed an Integrated ESG Modeling Framework. We believe this framework addresses the above concerns of asset owners by constructing a bespoke portfolio which holistically integrates standard and ESG alpha factors, in a manner that seeks to satisfy the dual objectives of maximizing alpha and ESG performance. The Integrated ESG Modeling Framework has the following characteristics:

- **Flexibility**: The Framework has the ability to adjust standard and ESG alpha levers based on asset owner preferences or investment policy requirements. The framework is agnostic to the relative importance an asset owner assigns between ESG and alpha performance.
- **Relevance**: The Framework takes in any ESG metric the asset owner cares about. Since it is agnostic to the ESG measure selected, each asset owner may select the particular ESG metric that matters to them.
- **Dynamic**: The two arrows in the diagram of the framework on page 4 reflect a feedback loop. As alpha and ESG performance of the various standard and ESG alpha factors ebb and flow, the model dynamically adjusts factor weights in an effort to optimize alpha generation and ESG performance.

The full mathematical detail of the framework can be found in the appendix.

PanAgora's ESG Portfolio Measurement and Reporting

We believe measurement and reporting are critical components to assessing the impact of ESG measures within portfolios. As a quantitative firm, PanAgora provides portfolio attribution reports by utilizing in-house tools to assess alpha and external vendor ESG data to strive for consistency with broad-based metrics when evaluating ESG characteristics and measuring performance. Examples of ESG measures and reports that can be provided to asset owners include, but are not limited to, the following:

- Overall portfolio ESG rating
- Carbon exposure
- Alignment of portfolio companies with SDGs to access real world impact

In addition, in-depth reporting of various companies owned in the portfolio is also possible. We believe the choice of using independent, third party ESG measurement providers offers unbiased results.

Conclusion

As the world becomes increasingly ESG-minded and a new generation of investors begins to drive change in the investment world, we will see more ESG strategies come to market. We believe one of the challenges for investors is the lack of a broadly accepted definition or guideline for constructing ESG portfolios. There are however certain networks, such as the United Nations Principles for Responsible Investment (UN PRI), that help to define and hold members accountable for such practices. As a signatory of the UN PRI, we have utilized these guidelines to develop our ESG framework.

As a result, PanAgora has created a library of ESG alpha factors, evaluating the materiality of factors through contextualization technology, and an

integrated ESG portfolio construction framework, that we believe is flexible, relevant and dynamic. ESG is a rapidly evolving investment field with myriad definitions, and no well-defined process to construct a portfolio. At PanAgora, as described above, we believe an ESG portfolio can be constructed using our framework in a manner that seeks to meet both the return objectives and values of the asset owner.

Appendix-Mathematical Derivation

In [QHS, 2007], the authors devised a framework to optimize information ratio of an active portfolio using average IC, $E(IC)$, and standard deviation of IC, $\sigma(IC)$, where by definition, IC is the correlation of the factor model score and stock returns. For an ESG minded investor that cares about *both* the portfolio return and the portfolio companies' ESG characteristics, the question comes up on how can one optimize the total utility derived from owning the ESG portfolio in the same manner as a typical investor whose main goal is portfolio return? After all, portfolio return and ESG characteristic are seemingly on two different dimensions.

The insight to solving this problem comes from the fact that for an ESG minded investor, utility comes not only from positive portfolio returns (α in the traditional sense) but also from the portfolio's ESG characteristics. I.e., similar to portfolio return, the *higher* the measure of portfolio ESG characteristic the *better*. With that insight, to jointly optimize a quantitative ESG portfolio along both α and ESG dimensions, driven by a quant model containing both α and ESG factors, one need to put both the stock returns and the stock's ESG measure on the range in the real line for a given horizon (for example, if we are optimizing over a 1 month horizon on the S&P500 universe, then the ESG measure should be ordered over roughly 10% to -10%, similar to 1 month returns of the SP500 universe constituents).

With this insight, and following [QHS, 2007], we construct the jointly optimal α and ESG portfolio as follows:

- Take any third party derived, unbiased, ESG measure at time t, R_t^{ESG}that the investor wants to optimize against[15]. We map the measure to real numbers (if not so already) and adjust it by a tunable scalar γ to put it in the same range as stock returns for a given optimization time horizon, as discussed above[16]. The score $\gamma R_t^{ESG}$is the investor's utility along the ESG dimension.

[15]There are no industry agreed upon ESG measures, and each investor may have their own favorite ESG measure they'd like to optimize against. Our framework is agnostic to the ESG measure used.

[16]There is another use for the scalar parameter γ that we shall see in the Practical Considerations section.

- Next we define:

$$\begin{aligned} \textit{Combined return}: \quad R_t^c &= R_t + \gamma R_t^{ESG} \\ \textit{Combined factor}: \quad F_t^c &= \sum_{i=1}^{M} \nu_i F_{i,t} + \sum_{j=M+1}^{N} \nu_j^{ESG} F_{j,t}^{ESG} \end{aligned}$$

where $F_{i,t}$ is an α factor, $F_{j,t}^{ESG}$ is an ESG factor, and ν_i, ν_j^{ESG} are weights. For ease of notation, we alternatively refer $F_{i,t}$ and $F_{j,t}^{ESG}$ as $F_{i,t}^c$, and ν_i and $\nu_j^{ESG}, \nu_i^c, i = 1, .., M, M+1, .., N$. Combined return R_t^c is the return during the period t (available at the end of the period) and combined factor F_t^c (and its constituent factors) is available at the beginning of period t.

- The single period excess return is

$$\begin{aligned} \alpha_t &= \tfrac{(N-1)}{\lambda_t} cov(F_t^c, R_t^c) \\ &= \tfrac{(N-1)}{\lambda_t} \rho(F_t^c, R_t^c) \sigma(F_t^c) \sigma(R_t^c) \end{aligned} \tag{1}$$

and

$$\begin{aligned} cov(F_t^c, R_t^c) &= cov\left(\textstyle\sum_{i=1}^{M} \nu_i F_{i,t} + \sum_{j=M+1}^{N} \nu_j^{ESG} F_{j,t}^{ESG}, R_t^c\right) \\ &= \textstyle\sum_{i=1}^{M} \nu_i cov(F_{i,t}, R_t^c) + \sum_{j=M+1}^{N} \nu_j cov(F_{j,t}^{ESG}, R_t^c) \\ &= \left[\textstyle\sum_{i=1}^{M} \nu_i IC_{i,t} \sigma(F_{i,t}) + \sum_{j=M+1}^{N} \nu_j^{ESG} IC_{j,t}^{ESG} \sigma(F_{j,t}^{ESG})\right] \sigma(R_t^c) \end{aligned} \tag{2}$$

where

$$\begin{aligned} IC_{i,t} &= \rho(F_{i,t}, R_t^c) \\ IC_{j,t}^{ESG} &= \rho(F_{j,t}^{ESG}, R_t^c). \end{aligned}$$

Also,

$$\lambda_t = \frac{\sqrt{N-1}\sigma(F_t^c)}{\sigma_{model}} \tag{3}$$

$$\sigma(F_t^c) = \sqrt{\nu^{cT} \Phi_t^c \nu^c} \tag{4}$$

where

$$\begin{aligned} \nu^c &= \left[\nu, \nu^{ESG}\right]^T, \\ \Phi_t^C &= \left(\phi_{i,j,t}^c\right)_{i,j=1}^{N}, \quad \phi_{i,j,t}^c = \sigma(F_{i,t}^c, F_{j,t}^c) \end{aligned}$$

and σ_{model} is the target tracking error.

- Substituting (3) into (1), we have:

$$\alpha_t = IC_t^c \sqrt{N-1} \sigma_{model} \sigma(R_t^c)$$

and

$$IC_t^c = \rho(F_t^c, R_t^c) = \frac{\sum_{i=1}^{N} \nu_i^c IC_{i,t}^c \sigma(F_{i,t}^c)}{\sqrt{\nu^{cT} \Phi_t^c \nu^c}} = \frac{\sum_{i=1}^{M} \nu_i IC_{i,t} \sigma(F_{i,t}) + \sum_{i=M+1}^{N} \nu_j^{ESG} IC_{j,t}^{ESG} \sigma(F_{j,c}^{ESG})}{\sqrt{\nu^{cT} \Phi_t^c \nu^c}} \tag{5}$$

- Assuming
  1. Time-invariant factor correlation
  2. Time-invariant model weight
  3. Factors are standardized to unit standard deviation $\sigma(F_{i,t}^c) = 1$

  then (5)becomes:

$$\begin{aligned} IC_t^c &= \frac{1}{\tau} \left(\sum_{i=1}^{M} \nu_i IC_{i,t} + \sum_{j=M+1}^{N} \nu_j^{ESG} IC_{j,t}^{ESG} \right) \\ \tau &= \sqrt{\nu^{c,T} \Phi^c \nu^c} \end{aligned}$$

- With the above assumptions, average and standard deviation of composite IC becomes

$$\begin{aligned} \overline{IC^c} &= \frac{1}{\tau} \left(\sum_{i=1}^{M} \nu_i \overline{IC_i} + \sum_{j=M+1}^{N} \nu_j^{ESG} \overline{IC_j^{ESG}} \right) \\ &= \frac{1}{\tau} \nu^T \overline{IC} \\ \sigma(IC^c) &= \frac{1}{\tau} \sqrt{\nu^{cT} \Sigma_{IC}^C \nu} \end{aligned}$$

  where

$$\begin{aligned} \overline{IC} &= (\overline{IC_1}, \ldots, \overline{IC_M}, \overline{IC_{M+1}^{ESG}}, \ldots, \overline{IC_N^{ESG}})^T \\ \Sigma_{IC}^c &= \left(\rho_{i,j,IC}^c \right)_{i,j=1}^{N} \end{aligned}$$

  and $\rho_{i,j,IC}^c$ is time-series covariance of factors F_i^c and F_j^c's IC.

- $IR^c$is

$$IR^c = \frac{\overline{IC^c}}{\sigma(IC^c)} = \frac{\nu^T \overline{IC}}{\sqrt{\nu^T \Sigma_{IC}^c \nu}} \tag{6}$$

- To find the optimal weights, we take derivative of (6) and set equal to zero since this is an unconstrained optimization

$$\begin{aligned} \frac{\partial(IR^c)}{\partial \nu} &= \frac{\overline{IC}}{\sqrt{\nu^T \Sigma_{IC}^c \nu}} - \frac{(\nu^T \overline{IC}) \Sigma_{IC} \nu}{(\nu^T \Sigma_{IC}^c \nu)^{3/2}} \\ \nu^* &= s \Sigma_{IC}^{C,-1} \overline{IC} \end{aligned}$$

  where s is an arbitrary scalar.

Practical Considerations

- Note that time invariant factor correlation and weight do not really hold in practice. For implementation, we use rolling window to estimate correlation and optimize accordingly.
- Even though s can be any arbitrary scalar, in practice we choose it so that the weights sum up to 1 .
- The scalar parameter γ can used to tune how much do we want to tilt toward ESG factors, F_i^{ESG}, in the portfolio. For example, if we want to split the model evenly between α and ESG factors, then one would tune γ such that $\sum_{i=1}^{M} \nu_i = \sum_{j=M+1}^{N} \nu_j^{ESG} = 0.5$. In practice, we'd use slightly modified combined return $R_t^c = (1-\eta)R_t + \eta\gamma R_t^{ESG}$, where γ is still used to scale ESG measure to the same range as stock returns for a given horizon, and η is between 0 and 1 and used to choose the portfolio's ESG tilt.
- The framework developed here is agnostic to the ESG measure used. As long as the measure can be translated to a numerical score, it will work. In practice, we want to use numerical ESG measures in the same range as stock returns, fora given return horizon.
- The optimal IR^*, using weight ν^*above, is

$$IR^* = \sqrt{\overline{IC}^T \Sigma_{IC}^{c,-1} \overline{IC}}$$

Appendix-Terminology

Since ESG is a still evolving field, many times multiple terms are used to express the same concept. Here we define what the terms used in this paper mean.

- ESG Investing: ESG is a broad field encompassing several distinct approaches, discussed in the paper. In addition, several terms are used interchangeably by the investment community with ESG investing, including sustainable investing, socially responsible investing, thematic investing, etc. We will use the term ESG investing in this paper as a general term for the field.
- ESG Alpha: Alpha factors constructed with both alpha and ESG considerations. These factors are expected to both deliver positive alpha and desirable ESG characteristics.
- Standard Alpha: Alpha factors constructed purely based on alpha considerations.
- Materiality: A factor is considered material if it likely will have non-negligible impact on a firm's operations.

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