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The Quantitative Approach for Sustainable Investing

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PanAgora

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Eric Sorensen, PhD

President & Chief Executive Officer

Dr. Sorensen is the President and Chief Executive Officer of PanAgora, and a member of the firm's Board of Directors, Investment, Operating, Risk, Code of Conduct & Ethics, and Directors' Committees. He is responsible for PanAgora's business and investment activities.

He took over leadership of PanAgora in 2004 and established a new research and investment direction for the firm. Prior to joining PanAgora, Dr. Sorensen was Director of Quantitative Research at Putnam Investments, overseeing the activities of several quantitative teams including equity, fixed income, asset allocation and financial engineering. He was also Chief Investment Officer of Structured Equity, which managed institutional portfolios using advanced quantitative approaches.

Between 1986 and 2000 Dr. Sorensen was the Global Head of Quantitative Research at Salomon Brothers (now Citigroup). At the end of his 14 years on Wall Street, he led a group of 55 quantitative analysts comprising teams in New York, London, Singapore, Tokyo and Australia. During that time, he published extensively, and consulted with institutional investor clients around the world. His honors include many years on the Institutional Investor All American Research Team, and several Graham and Dodd awards for excellence in financial writing.

Prior to Wall Street, he was a professor with a productive academic career from 1974 to 1986. For a decade he was Professor of Finance and Department Head at the University of Arizona. He has published over 50 journal articles and served on the editorial boards of several academic Finance journals. He is also co-author of the recent book, Quantitative Equity Portfolio Management.

Between 1969 and 1974 he served the country as a United States Air Force Officer and jet pilot. His primary mission was instructor pilot in high-performance jet aircraft.

With over 45 years of quantitative research and investment experience, Dr. Sorensen is a leading expert in the industry. He continues to maintain affiliations in both the industry and academia.

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University of Oregon, Ph.D.
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Director, Equity Investments

Dr. Chen is a Director at PanAgora. In this role, he is responsible for novel alpha research and model development across PanAgora's Equity strategies, and daily management of firm's Dynamic Equity portfolios. Dr. Chen's current research interests are in the areas of machine learning/alternative data, ESG, and China A. Previously, he was a Portfolio Manager on PanAgora's Stock Selector Equity team.

Prior to joining PanAgora, Dr. Chen was a Portfolio Manager at BlackRock's Scientific Active Equity (SAE) team, where he was responsible for portfolio management and research into alpha insights for use across the entire SAE platform. While at SAE, Dr. Chen won "Signal of the Year" award for a signal he researched and developed. Prior to BlackRock, Dr. Chen worked at Google where he was a member of the team that managed Google's fixed income investment portfolio and FX exposures. Dr. Chen started his career at Morgan Stanley in New York where he traded and managed a portfolio of exotic US rates derivatives. While at Morgan Stanley, Dr. Chen researched, developed and patented a framework that allowed for pricing of derivatives based on two rate curves with dynamic multiplicative spread, one of the first such models on the street.Dr. Chen graduated from the University of Illinois in 2005 with a Ph.D. in Electrical and Computer Engineering. He has published in leading engineering and applied mathematics journals, and had been invited to talk at numerous academic and industry conferences.

George D. Mussalli, CFA

Managing Director & Chief Investment Officer, Equity Investments

Mr. Mussalli is Managing Director, Head of Equity Research, and Chief Investment Officer of Equity Investments at PanAgora. He is responsible for the oversight of the firm's Dynamic and Stock Selector Equity strategies, as well as the Equity Trading & Implementation, Data Science, and Portfolio Strategy teams. He is also a member of the firm's Investment, Operating, Risk, and Directors' Committees.

As the Chief Investment Officer of Equity Investments, Mr. Mussalli directs innovative equity research used in the development of models implemented in PanAgora's equity strategies. Mr. Mussalli's current focus is centered on combining fundamental and quant investing using big data. As a leader in the field, he was appointed to the Editorial Board for The Journal of Financial Data Science as well as the AI and Data Science in Trading Advisory Board.

Prior to becoming Managing Director and Chief Investment Officer of Equity Investments, Mr. Mussalli served as Head of PanAgora's Stock Selector strategies. His work focuses on combining fundamental insights with sophisticated quantitative techniques to develop proprietary models designed to analyze companies across many dimensions. In addition to overseeing the management of the firm's Stock Selector strategies, he has significantly contributed to the proprietary pool of equity research leveraged across the entire firm during his tenure.

Before joining PanAgora, he was a Portfolio Manager on the Putnam Investments Structured Equity team, where he was responsible for Structured Equity portfolios. He contributed to quantitative research and analysis that supported all equity strategies, including International and Global strategies.

Prior to joining Putnam, Mr. Mussalli worked as a Senior Investment Analyst at John Hancock Funds.

The Quantitative Approach for Sustainable Investing

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KEY FINDINGS

- Quantitative methods have unique advantages for sustainable investing in the areas of portfolio construction, data application, and scaling domain knowledge.
- The skillful quantitative practitioner can create the optimal blend of human insight and computing power to extract sustainability insights from data.

ABSTRACT

Sustainable (also known as environmental, social, and corporate governance [ESG]) investing is currently of intense interest in the investment world. In this article, the authors consider the salient challenges associated with ESG investing and how quantitative approaches may address them. Compared to fundamental methods of sustainable investing, the authors see quantitative methods as having several advantages: These methods can build on and extend the vast analytical toolbox of modern portfolio theory to incorporate investor preference in portfolio construction; they can leverage the recent data explosion to obtain insights on many intangible sustainability metrics; and they do not have the black box label. Instead, subjective judgment applied to building the quantitative system is essential. A thoughtful analytical system can be applied to a large universe of stocks, and quantitative methods may also be leveraged to predict popular ESG vendor ratings. Although these are the early days of quantitative sustainable investing, the authors believe these advantages will prove the quantitative method's worth in sustainable investing.

TOPICS

ESG investing, portfolio theory, portfolio construction, statistical methods*

Professional investing that embodies advanced quantitative approaches is alive and well. For the past 45 years, academically inspired (and equipped) professionals have advanced the science of modern investing. The field has now entered a golden age.[1] However, the relatively recent tidal current toward socially and environmentally motivated preferences has ushered in a new challenge for quantitative practitioners. Indeed, it is a new global landscape with new hurdles and complexities. This new frontier is environmental, social, and corporate governance, otherwise known as ESG. The professional investing acronym ESG has become a portfolio goal; it introduces a utility preference that is orthogonal to and perhaps complicates the now age-old modern portfolio theory (MPT) paradigm.

*All articles are now categorized by topics and subtopics. **View at PM-Research.com**.

[1] See Sorensen (2019).

The objective also known as sustainable investing essentially represents an alternative (or an addition) to MPT. MPT formally describes (and offers normative techniques) to achieve investor wealth creation by attaining the best return–risk trade-off in the long run. ESG identifies factors that reflect environmental considerations (E), societal preferences (S), and governance of the firm (G) and may complement, or compete with, classical MPT in forming an efficient portfolio of stocks. It is complementary if the ESG factors enhance alpha. It is competitive if the factors detract from alpha. For example, Chen and Mussalli (2020) were first to lay out a framework for implementing an optimal portfolio choice trade-off between owners' wealth attentiveness on one level and societies' public preferences on the other.[2]

Horizon has important implications in determining the complementary (or competitive) influence of ESG factors with alpha. On one hand, if the consensus belief among market participants is that an ESG attribute improves fundamentals (i.e., enhances earnings levels or quality) in the near term, the result should be complementarity. On the other hand, if an ESG factor makes no near-term fundamental contribution but perhaps creates demand for the stock in the long term, it may detract from portfolio performance. Our proprietary ESG research at PanAgora identifies complementarity through rigorous backtesting, combined with fundamental causality intuition. For example, studies show that governance considerations tend to work over shorter horizons, whereas environmental and social considerations tend to work over longer horizons.[3]

In this article, we consider the salient challenges associated with ESG investing and how quantitative approaches to ranking ESG contributing factors may address these challenges. Currently, managers typically use fundamental approaches to assess stocks and build ESG portfolios. However, just as the advances in quantitative MPT portfolios have gained ground over fundamental analyses of stock returns in past years, so can quantitative rankings of ESG factors improve on purely fundamental ESG approaches in future years. Our intent is to address the advantages and possibilities of quantitative capabilities in ESG investing.

THE EVOLUTION OF ESG INVESTING RECIPES

Our observation regarding alternative ESG portfolio approaches belongs to one of three nonoverlapping categories. When we consider a universe of stocks, each with a potential weighting in the portfolio, three choices exist in altering an otherwise ESG-agnostic portfolio: (1) slicing, (2) seasoning, and (3) solving.

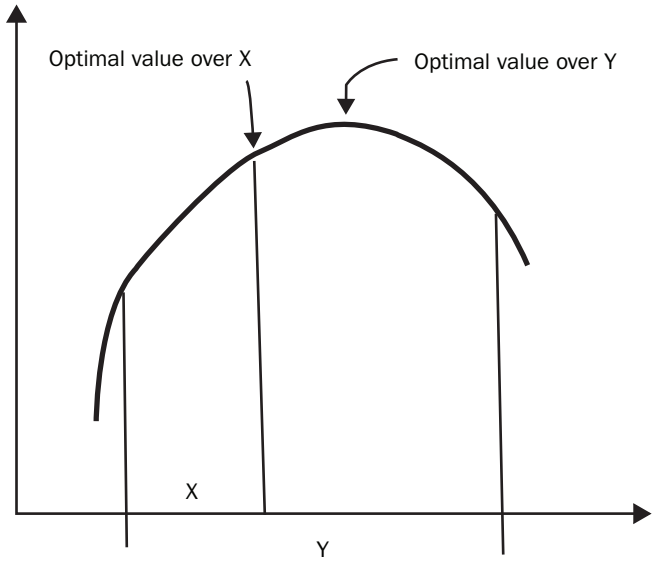
First, a pre-ESG socially responsible investing (SRI) approach was used historically to simply *slice* (or cut out completely) a set of offensive stocks. For example, when health concerns around the use of tobacco began to impinge on society's sensitivities, some institutions sought tobacco-free portfolios by completely excluding tobacco companies. In studying SRI portfolios, such as those that are tobacco-free, academics did empirical analyses on whether the efficiencies of the resulting sliced portfolio were enhanced or hindered. Although the empirical results are mixed, erosion of alpha was occasionally found. Mathematically this makes sense because optimizing (which is what investment portfolio building is mathematically) over a smaller set unambiguously results in a likely suboptimum solution that at best is equal to the uninhibited optimum solution.[4] Exhibit 1 illustrates this point.

Second, in seeking to appease social interests, an artful approach is to *season* or *spice* the portfolio with additives—specific stocks that have high ESG grades.

[2] See Chen and Mussalli (2020).
[3] See Giese, Nagy and Lee (2021).
[4] See, for example, Guler (2010).

EXHIBIT 1

Optimal Solution over Larger Set *Y* Dominates Smaller Set *X*, if *X* ∋ *Y*



NOTE: For illustrative purposes only.

Let's call this *interior decorating*. This approach is like adding salt to food.[5] Most humans appreciate salt applied to many types of foods, such as fried chicken. Too little leaves the food less tasty, and perhaps leaves it lacking iodine, a mineral necessary for metabolism control contained by many salts. Too much salt dominates the dish's flavor and can be harmful to one's health because it may cause hypertension and other health issues. Metaphorically, the absence of any ESG salt may render the portfolio unpalatable because the portfolio investments may include some socially objectionable companies. Too much ESG salt may greatly detract from the alpha performance if it is the only ingredient used in the investment process. For most investors, the right approach is a blend of ESG and non-ESG factors that deliver on both alpha and positive ESG characteristics.

Third, following the previous point, we should consider a rigorous approach for formally *solving* factor exposures. Chen and Mussalli (2020) provided a quantitative roadmap to achieve a recipe of blended ingredients—alpha factors mixed with ESG factors. This approach allows the asset owners the flexibility to optimize for their specific preferences, along with any possible trade-off[6] between pecuniary objectives and societal preferences.[7] The evolution of this third approach will be the future of formally integrating ESG with wealth creation. Candidly, sustainable investing is a much more difficult problem than a one-dimensional maximization of alpha (per unit risk). With sustainable investing, the objective is not only alpha but also targeted sustainability metrics. Not only does the quantitative approach accommodate the merging of higher dimensionality, it also accommodates the customization of the asset owner's values over the ESG spectrum. We believe there are several advantages of this approach.

FIRST ADVANTAGE: BETTER INTEGRATION WITH MODERN PORTFOLIO THEORY

MPT has a long and rich analytical literature on approaches to stock portfolio creation, with origins dating back to the 1950–1980 period. The literature and practice includes expected utility maximization, definitions of risk, capital asset pricing models, efficient market theory, the innovations of factor models, and much more.[8] In a sense, the substitution over ESG factors is an extension on this vast literature, in which utility based on optimizing alpha is substituted by a combination of alpha

[5] After all, salt is a preservative, thus making food more sustainable, in a temporal sense.

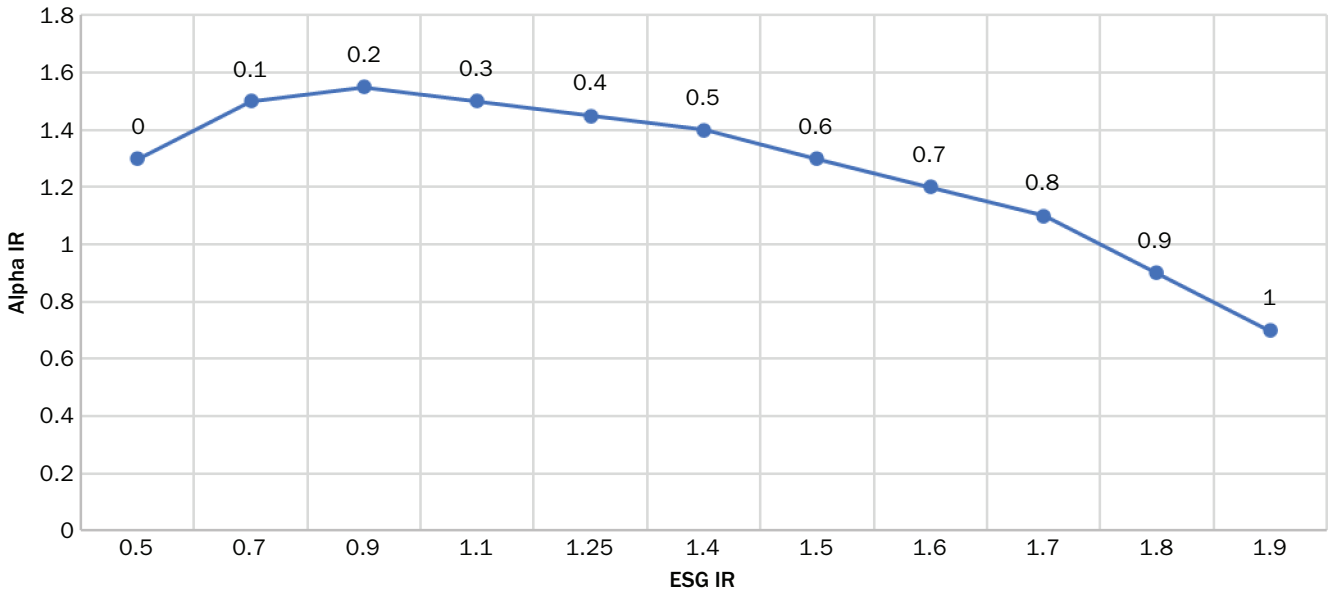
[6] Note that in certain situations, a trade-off between alpha performance and ESG preference may not be necessary. The key factor to consider here is the concept of materiality. For more on this, see, for example, Khan, Serafeim, and Yoon (2015).

[7] Because ESG investing incorporates an asset owner's preference, customization is a fundamental feature of this investment category. Because an ESG asset owner has many potential preferences, there is no specific ESG solution that fits all investors.

[8] For a review of the salient historical applications of MPT literature, see Sorensen (2009).

EXHIBIT 2

ESG-Alpha Efficient Frontier for an Environmentally Focused, Sustainable Portfolio



NOTES: For illustrative purposes only. The data labels on the ESG-alpha efficient frontier are the l value used to obtain that point on the frontier. For more details on λ and how the ESG-alpha efficient frontier may be obtained, see Chen and Mussalli (2020).

and certain ESG metrics of choice.[9] To apply this vast literature, the pecuniary return and the societal preferences of the factor-solving method must be addressed with modern quantitative techniques and by a quantitatively minded engineer. Exhibit 2 is an example of ESG-alpha efficient frontiers obtained under the solving extension of MPT for an environmentally focused, sustainable portfolio. The approach used to obtain this curve is discussed by Chen and Mussalli (2020).

In addition to constructing optimal portfolios for both alpha and sustainable goals, we believe that the areas in which quants excel for alpha generation apply also to ESG scoring. In practice, what a good quantitative system should do includes the following:

- exploiting data by reading and manipulating deep and vast information sets;
- applying domain knowledge by mimicking fundamental experts; and
- perfecting digital representation of various attributes associated with thousands of stocks in the investment universe simultaneously, upon which domain knowledge can be applied quantitatively to discover new intelligence and insights.

Following advances made by quantitative techniques in purely alpha-focused investments, we believe that quantitative techniques are also desirable for ESG-focused investments beyond the optimal factor solving framework. That is, quantitative methods are helpful beyond optimization mathematics. In alpha-focused investing, quantitative researchers continue to enhance returns by leveraging the intersection

[9] We argue that just as all investors get positive utility from above-benchmark alpha performance, similarly ESG-minded investors get positive utility from above-benchmark ESG performance for their portfolio. Moreover, the investor can determine the elements of the benchmark.

of the domain knowledge, the digital technology, and the data expanse.[10] Similarly, quants can lean on these three pillars to build models that assign ESG rankings to stocks. Applying these quant strengths to ESG investing may also lead to alpha generation, as we shall discuss in the following.

SECOND ADVANTAGE: BETTER BUILDING WITH BIGGER/DEEPER DATA

One of the biggest challenges faced by sustainable investors has to do with ESG data.[11] Compared to standard financial data, there are no global regulations governing or requiring reporting on ESG data.[12] Thus, ESG data typically are deficient in the following areas:

- **Quantity:** Not enough data are available.
- **Consistency:** Companies often report different ESG data items. It is rare to find an ESG data item that is disclosed uniformly across a reasonably large investment universe.
- **Quality:** Methodologies used to derive or compute the reported ESG data may vary across companies.

To overcome the data challenge, many ESG investors rely on commercial ESG rating providers to gain insights into how companies perform across the various sustainability dimensions. A growing number of alternative sources of ESG ratings are commercially available.[13] In addition, the amount of assets under management (AUM) invested, according to these commercial ESG ratings, is also rapidly growing. Exhibit 3 shows the amount of public-facing AUM following MSCI-ESG exchange-traded funds, based on MSCI ESG ratings.[14]

Despite the availability of commercial ESG ratings and the AUM that is invested according to these ratings, there appears to be inconsistency among providers. Commercial ESG rating providers' scores exhibit a variety of biases and dissimilarities.[15]

Quants have various apparatuses in their toolkit that can help them overcome some of the challenges ESG data pose. We give a few examples:

- For the quantity and consistency challenges, some of the data gap may be filled by venturing into unstructured data to obtain insights. For example, one may want to understand whether a company's management is honest in its public communications. This metric can affect a company's governance score, but it is also a metric not many will disclose. If the company were to disclose it, they would almost certainly present the best view. Seasoned investors know that corporate management communication is typically not completely honest and transparent. One can gain insights into this governance issue by

[10] For a review of recent quantitative advances in equities, see Sorensen (2019), who elaborates on the spheres of domain, digital, and data.

[11] For challenges with ESG data, see Kotsantonis and Serafeim (2019).

[12] This is something the European Union is trying to address. See the EU Taxonomy Regulation (2018/0178[COD]) and the Regulation on Disclosures (EU/2019/2088).

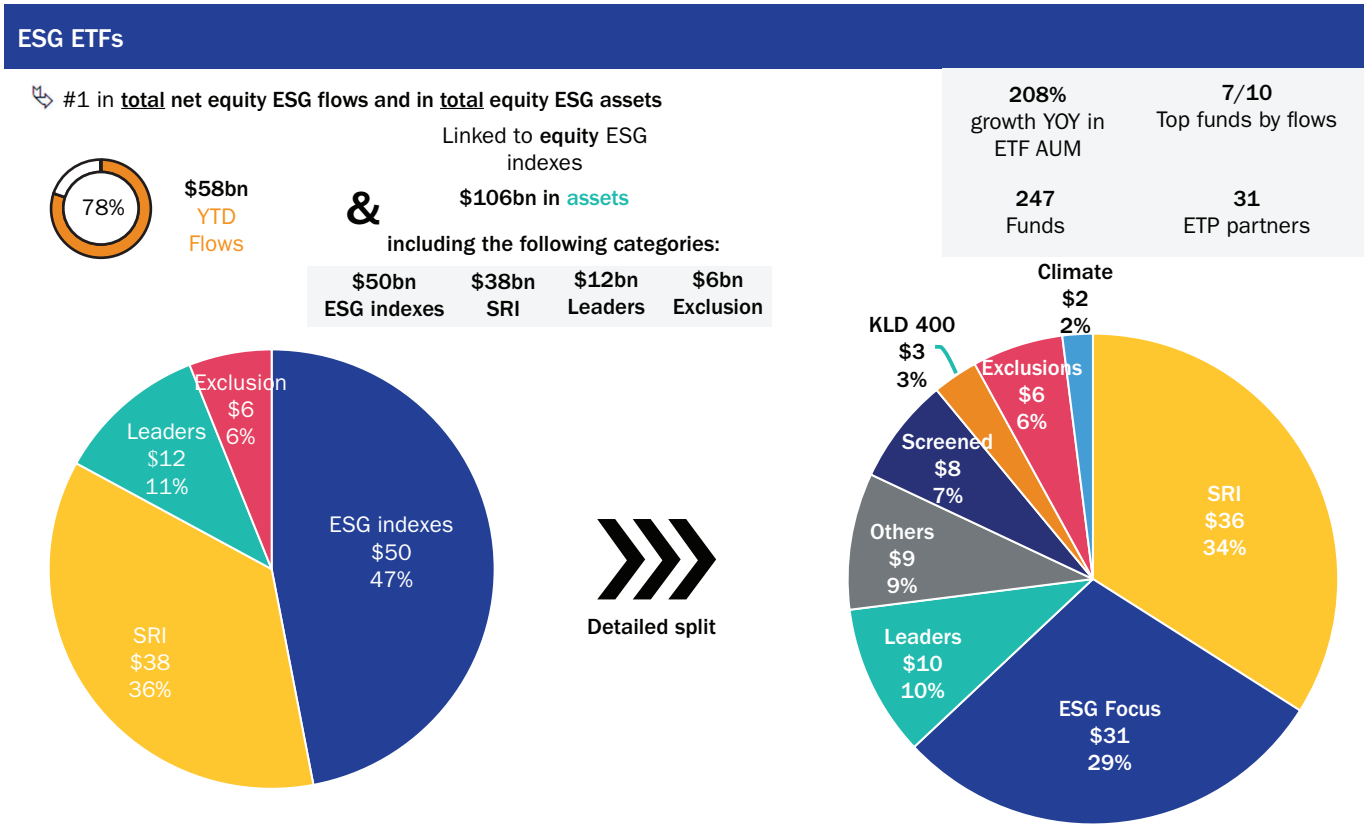
[13] For example, KLD (MSCI Stats), Sustainalytics, Vigeo-Eiris (Moody's), RobecoSAM (S&P Global), Asset4 (Refinitiv), and MSCI.

[14] MSCI is a market-leading commercial ESG rating provider.

[15] For more details, see Berg, Kolbel, Rigobon (2020), and Chen et al. (2021).

EXHIBIT 3

The Amount of AUM Following a Commercial ESG Rating Has Exploded in Recent Years



NOTE: For illustrative purposes only.

SOURCE: MSCI (2021).

collecting conference call transcripts and applying natural language processing (NLP) techniques to gauge the honesty of corporate communication.

- Quants also have a variety of methods to deal with ESG data quality issues. For example, to detect outliers, quants may normalize ESG data by industry group, corporation size, and so on to detect whether a company's reported data are outside a standardized range. In addition, missing data may be estimated in certain cases if one knows other facts associated with the specific corporation.[16]

After collecting and cleaning ESG data, quants can apply financial domain knowledge, coupled with advanced statistical techniques, to extract insight on various ESG issues. Continuing with the aforementioned NLP example, after collecting various conference call transcripts, quants can apply a technique in the field of NLP called *latent semantic analysis* (LSA)[17] to determine whether the words used in the call tend

[16] For example, for utilities, if one knows the generation technology (e.g., combined cycle gas turbine, wind) and the amount of electricity produced, one may back out the amount of carbon emitted in the process of generating that electricity.

[17] For more information on LSA, see https://en.wikipedia.org/wiki/Latent_semantic_analysis.

EXHIBIT 4

Concrete and Ambiguous Word Clouds Obtained Using LSA

Top 50 by Semantic Consistency

↓

Most Concrete Words

Bottom 50 by Semantic Consistency

↓

Most Ambiguous Words

NOTE: For illustrative purposes only.

to be concrete or ambiguous.[18] Exhibit 4 shows two word clouds obtained using this approach, one for concrete and one for ambiguous terms.

By examining the words used in corporate communication with this concrete-ness measure, one may grade corporations on the relative transparency of their communications.

THIRD ADVANTAGE: BETTER SYSTEMIZING INTO DOMAIN KNOWLEDGE

One of the proverbial criticisms of modern quant is the black box label. That critique is unjust. Experiential and superior domain knowledge is essential in designing an expert system that mimics an intelligent human process. Good quant is more than financial engineering and undirected data mining. It takes intuition and subjectivity—yes, *subjective* judgment:

"Subjective judgment is alive and well in the world of quantitative management—but in perfecting the comprehensive system rather than comprehending the perfect stock" (Sorensen 2009).[19]

Ratings are disparate across the data services that ascribe ESG ratings to stocks. Berg, Kolbel, and Rigobon (2020), as well as others, recently studied the differences in ratings.[20] Unlike other types of rating services, such as bond credit ratings, the rank order correlation across commercial ESG ratings is relatively low. This is in

[18] Yu and Chen (2020).

[19] See Sorensen (2009).

[20] For example, see Berg, Koelbel, Rigobon (2020); Dimson, Marsh, and Staunton (2020); and Yoon and Serafeim (2021).

contrast to the relative consistency of bond ratings and corporate bond prices.[21] Berg, Kolbel, and Rigobon (2020) found that ratings correlation across six providers is on average around 50% and much lower in the tails of the ratings (very high or very low). The agencies they used for data are KLD (MSCI Stats), Sustainalytics, Vigeo-Eiris (Moody's), RobecoSAM (S&P Global), Asset4 (Refinitiv), and MSCI. They reduced the 709 factor inputs provided by these data suppliers to 65 categories.

Why do the ratings vary across the services? Berg, Kolbel, and Rigobon posited three explanations. First, there is considerable disagreement on how to define ESG. Second, given the acceptable definitions, there are a variety of avenues to access data for measurement. Third, there are highly subjective differences in the specific weightings (or importance) of the inputs.

This third aspect of ESG weightings is often referred to as *materiality*, a key concept for sustainable investors. Functionally speaking, materiality provides the link between sustainable performance and financial performance. A sustainable metric is considered material if a corporation's good performance on that metric is likely to result in good financial performance as well.[22]

The traditional approach to defining materiality is through industry classification, by organizations such as the Sustainability Accounting Standards Board.[23] However, in today's rapidly shifting economic landscape, organizing materiality through industry classification is insufficient. For example, Netflix and Disney are both in the entertainment industry category, per the Global Industry Classification standard classification scheme. However, the two companies' business models are radically different, along with their environmental footprint, material ESG issues, and so on. Using the traditional industry classification–based materiality determination may lead to misidentification of material issues for one or both companies.

The determination of material ESG issues is an example in which subjectivity can be applied in the quantitative sustainable investment process. Rather than following an industry-based materiality approach, Chen and Mussalli (2020) proposed an alternate materiality method, evolved from the contextualization methodology developed by Sorensen, Hua, and Qian (2005)[24] based on statistical tests to determine materiality. Under that approach, assessing the sensibility of each ESG factor, the quantitative investor can apply domain knowledge and fundamental intuition to look for salient firm characteristics (termed investment materiality metrics [IMM]). This will most clearly delineate the investment universe into sets in which the factors have alpha prediction ability and in which they do not. For example, for certain social ESG factors, we find that employee productivity is the primary IMM that can link ESG performance to alpha performance. Exhibit 5 illustrates the IMM-based materiality approach, in which we seek the ability to avoid pitfalls associated with industry classification.[25]

FOURTH ADVANTAGE: BETTER REPLICATION WITH DIGITAL ESTIMATION

In the previous section, we cited evidence of ESG rating divergence across professional services. However, is this really a problem? Perhaps it is an opportunity for the quant. As the expression goes in the software industry, it may be a feature, rather

[21] Sorensen (1980) and Sorensen and Wert (1981).

[22] For more on materiality, see Kahn, Serafeim, and Yoon (2016) and Consolandi, Eccles, and Gabbi (2020).

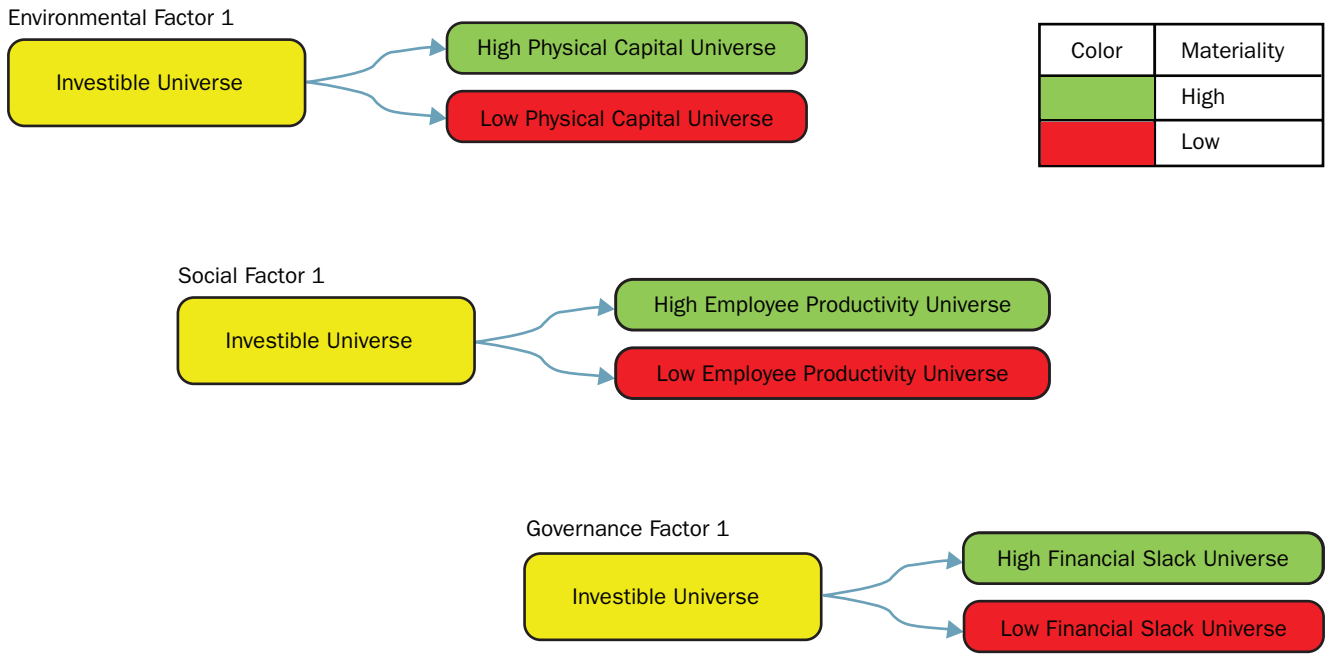
[23] https://www.sasb.org/.

[24] Sorensen, Hua, and Qian (2005).

[25] For more details, see Chen and Mussalli (2020, 2021).

EXHIBIT 5

Example IMM



NOTE: For illustrative purposes only.

than a bug. Likewise, ESG disagreement may also be a feature rather than a bug. The framework of Chen and Mussalli (2020) presumes that there should never be 100% agreement in ESG opinions. This makes customization both desirable and necessary.

As shown in Exhibit 3, a significant amount of AUM now follows commercial ESG ratings, and it may be beneficial for the active sustainable investor to consider alternatives to the literal commercial ESG ratings. Just as quants can statistically explain (predict) bond ratings from agencies with corporate metrics, they can also econometrically fit ESG ratings.

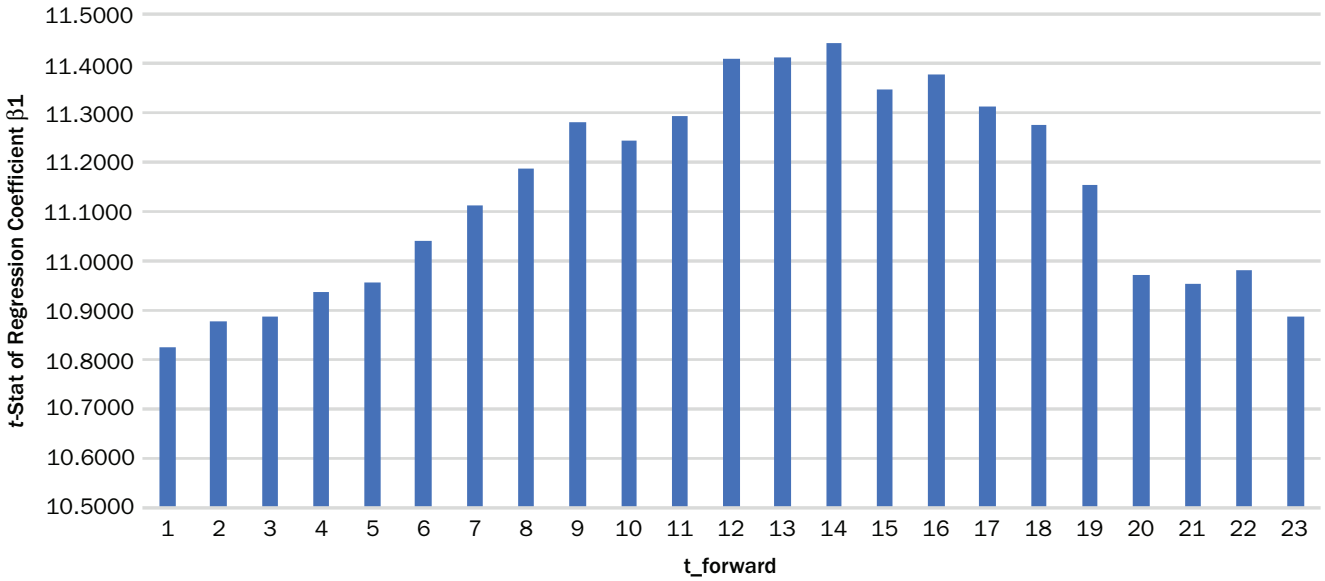
In their article on divergence, Berg, Kolbel, and Rigobon (2020) conducted econometric estimations to determine the categorical difference in ratings by the various raters. Their main interest was explaining the drivers of rating divergence. Although they did not elaborate on the econometric model, their statistics indicated they could fit the ratings (dependent variable) as a function of the categorical inputs (independent variables). The R2 statistics increased monotonically with the number of factor categories supplied by the agency. This was true for each rater. Can we extend Berg, Kolbel, and Rigobon's descriptive econometric exercise approach toward a normative goal? Can we create superior portfolios with dual objective functions?

As an example following Berg, Kolbel, and Rigobon, we conducted a similar exercise. The purpose was to determine whether we can replicate commercial ESG vendors' ratings using PanAgora's proprietary ESG factors.[26] We performed a variety of regressions with a rating agency score as a function of inputs PanAgora has been using in modeling alpha and ESG. Using a linear combination of PanAgora's ESG factors, we found a reasonable model with contemporaneous factor betas that

[26] PanAgora equity research and portfolio management has used ESG-like inputs to manage money for two decades.

EXHIBIT 6

PanAgora's Proprietary ESG Factors Are Effective in Predicting Forward Commercial ESG Ratings



NOTE: For illustrative purposes only.

correspond to prior intuition. We also tested for predictive power by estimating the forward ESG score.[27] Using the following regression model

$$ESG(t + t\_forward) \sim \beta_0 ESG(t) + \beta_1 \sum_i PanAgora\,ESG\,Factor_i(t) + \varepsilon$$

we can obtain statistically significant *t*-statistics of the regression coefficient vector that increase with forward time, *t_forward*, peaking at about 12–14 months. The results of this regression model are illustrated in Exhibit 6.

The regression is performed over data from January 2012 to June 2020[28] using names in the Russell 1000 Index. The data used are historical and point in time for the universe (Russell 1000), MSCI ESG rating, and PanAgora's proprietary ESG factors. This is just one illustration of how a quantitative science can use domain knowledge with data and digital advances to build an expert system. Quantitative research thus allows us to build explanatory (predictive) models to replicate fundamental human processes. In this case, we have built an expert system to allow us to predict commercial ESG ratings.

CONCLUSIONS

One of the primary aspects of quantitative investing targets the development of models based on historical relationships to assign predictive alpha scores to a list of stocks. There are well-documented strengths and weaknesses of such approaches.

[27] The commercial ESG scores for the example shown here are those from MSCI.

[28] Although we have historical, point-in-time MSCI ESG scores from earlier, we conducted this regression exercise using data beginning from 2012. This is because MSCI changed its ESG ratings methodology starting around that period. To use earlier MSCI ESG scores would be logically inconsistent.

In the end, our view is that expert systems that replicate complicated human decisions win the day, like the one that won the Battle of Britain.[29]

In addition to alphas, quants have the tools to simultaneously assess sustainability. In so doing, superior domain knowledge is irreplaceable, as in the Battle of Britain example. With the addition of modern data access and modern digital machinery, quants will win the day in ESG investing. Among them, the winners will be researchers who thrive on creative discovery and position themselves at the intersection of domain, data, and digital spheres.

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[29] Korda (2009), discussing the World War II air war between Britain and Germany, recounts that the RAF and Luftwaffe fighter pilots and their respective aircraft (Spitfires versus Messerschmitts) were more or less equally matched in the summer of 1940. The difference was that Hugh Dowding, the meticulous and visionary commander of the RAF, implemented a remarkable network comprising air crew, command posts, highly integrated civilian ground teams, and the latest (untested) technology—radar. Dowding built a comprehensive expert system to mimic and anticipate the Luftwaffe's movements, and it worked.

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