FACTOR INVESTING AND ESG INTEGRATION

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EXECUTIVE SUMMARY

Over the past decade, many long-term institutional investors have incorporated Environmental, Social and Governance (ESG) considerations into their portfolios, by creating segregated ESG mandates or by incorporating ESG criteria across the entire portfolio.[1]

Adding ESG criteria into long-term portfolios raises some important questions:

- What is the impact of ESG on portfolio performance and characteristics?

- How does it alter the risk profile and the factor exposures of portfolios?

- How does it affect investors' ability to pursue their investment strategy?

To answer these questions, we first analyzed the relationship between ESG characteristics and traditional risk factors. We found that ESG scores had positive correlations with size, quality and low volatility. Then we assessed the impact of ESG integration on different investment strategies through a consistent portfolio construction framework. Our results show that integrating ESG criteria into passive strategies generally improved risk-adjusted performance over the period 2007 to 2016 and tilted the portfolio towards higher quality and lower volatility securities.

When we integrated ESG into factor strategies, we found that significant improvements in the ESG profile of these strategies was achieved with relatively modest impacts on target factor exposure. However, not all strategies were affected to the same extent. In particular, minimum volatility strategies experienced only a 7% reduction in target factor exposure for a 30% enhancement in their ESG rating. On the other hand, value strategies incurred a 22% reduction in target factor exposure for a similar 30% improvement in their ESG characteristics.

This analysis has implications for passive investing, factor investing ("smart beta") and active portfolio management. Our results suggest that passive investors would have been able to improve the ESG characteristics of their strategies without a negative impact on their ability to capture market returns efficiently. Defensively oriented factor strategies (where ESG had positive correlation with the target factors), such as high quality and low volatility, could have increased their ESG ratings without impairing their ability to pursue their primary investment objective. Even dynamic, strategies such as those based on the value and momentum factors, could have enhanced their ESG profile with only a relatively modest impact on target factor exposures and *ex-ante* information ratios.

DATA AND METHODOLOGY

Several studies address integration of ESG criteria into equity portfolios, focusing on the effects on company financial performance or portfolio performance. The majority of these studies report a positive relationship (see Friede (2015)). In recent years, some studies have also proposed explicit ways to integrate ESG criteria into a fundamental or quantitative investment process. Nagy et al. (2013, 2015) have shown that in a classical quantitative portfolio construction framework, ESG data can be used to construct portfolios of various risk levels that are tilted towards better ESG-rated stocks or stocks with improving ESG ratings. Backtested results show these portfolios outperformed their benchmarks. Similar results were found in other quantitative-oriented studies (see, for example, Jussa et al. (2013)), Hitchens et al. (2015)). When it comes to passive factor investing products (smart beta products), initial results have also been positive. For example, a Northern Trust study showed that an ESG signal combined with a Quality portfolio yielded returns above those of a portfolio focused solely on ESG (Northern Trust, 2014).

In this paper, we provide a systematic overview of the interaction between factor investing and ESG integration, two areas of growing interest to institutional investors. As these two structural trends continue into the future, the list of factors and strategies that investors would like to implement in a more sustainable way may become longer. We examine the implications of ESG integration beyond the realm of pure factor investing and assess the impact of ESG criteria on passive investing and active management in general, using a bottom-up approach. We first look at stock-level relationships between familiar risk factors and ESG metrics. This analysis provides the necessary information about the interaction between ESG and factors. We then move to portfolio-level analysis and assess the potential effects of adding ESG constraints on different passive and active strategies.

We use the constituents of the MSCI World Index as the basis of our analysis. The MSCI World Index constituents represent the largest and most liquid stocks in global developed equity markets. For a list of globally relevant factors, we turn to the MSCI Global Equity Model for Long Term Investors (GEMLT), which contains 16 well-established style factors, based on fundamental or technical stock characteristics that are significant drivers of price movements and correlations.[2] Technical factors in GEMLT include beta and momentum, while fundamental factors include size, value, earnings yield, dividend yield and several aspects of quality. Combined, these factors encompass the relevant systematic risk drivers identified by practitioner and academic research, and also incorporate many factors that investors use in alpha models to harvest return premia (also known as "systematic equity strategy factors"[3]).

To analyze the ESG tilts of portfolios, we use the MSCI ESG Ratings data set. This data is derived by identifying key issues by industry, determining their relative importance and

assigning weights to them accordingly. Each company is then assigned a score ranging from 0 - 10, based on how much exposure it is deemed to have to the relevant key issues. Exposure scores are aggregated into the three pillar scores (Environment, Social and Governance) and the weighted average key issue score. The final score is adjusted by industry; it thus describes each company's ESG performance relative to its industry peers.[4]

The paper is organized as follows. We start by reviewing the relationship between ESG and other familiar risk factors in the context of a fundamental factor model. Then we analyze the impact of ESG integration into three broad classes of investment strategies: passive strategies, defensive strategies and dynamic strategies. Finally, we summarize our findings and show the tradeoff between the ESG profile improvement and the impact on target factor exposure for all the strategies we investigated.

TREATING ESG AS A FACTOR

Investors generally view ESG as a consideration in their portfolio management process and not necessarily as a traditional systematic risk factor. Nevertheless, at the technical level, ESG data can be integrated into the framework of equity factor models as a potential new factor. Since companies are assigned numerical ESG scores, they can be easily transformed into exposures (i.e., z-scores) that form the basis of factor models. By putting ESG on an equal footing with other factors, we can subject it to a series of standard tests to evaluate its strength and relevance as a systematic factor.

First, we create monthly rebalanced equally weighted decile portfolios by sorting stocks on their ESG exposure, and compare their performance relative to the equally weighted opportunity set (MSCI World Index constituents) over the period January 2007 to June 2016. As we can see in **Exhibit 1**, better-rated deciles did not systematically outperform worse-rated deciles. The best decile produced a positive excess return but the intermediate deciles showed no clear trend.

Decile portfolio performance, however, is a crude measure of factor strength, as it does not control for cross-sectional relationships between the analyzed factor and other factors. The next step is to evaluate the ESG factor in a multivariate framework, i.e., examine its risk and return after controlling for the effects of other factors. Depending on what factors we use as control variables, we have two multivariate versions: one where we control for all the factors of GEMLT and one where we control for all but the style factors.

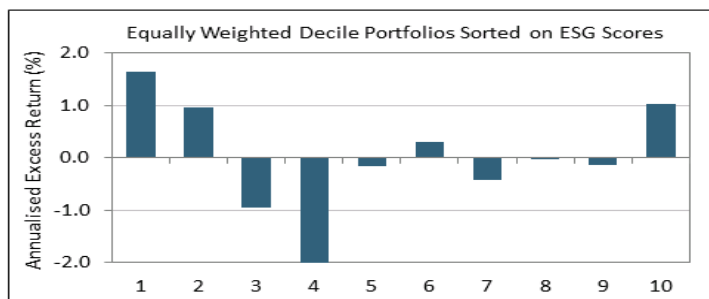**Exhibit 1: ESG "Factor" Performance and Correlations**

Chart 1.1

Equally Weighted Decile Portfolios Sorted on ESG Scores

Chart 1.2

ESG Pure Factor Return Based on Multivariate Regression

Table 1.1

Correlations	ESG	E	S	G
Mid Capitalization	-0.17	-0.19	-0.07	-0.04
Earnings Variability	-0.12	-0.12	-0.08	-0.10
Residual Volatility	-0.07	-0.07	-0.06	-0.11
Book-to-Price Ratio	-0.06	-0.08	-0.03	-0.07
Liquidity	-0.04	-0.03	-0.01	0.01
Leverage	-0.03	0.02	0.00	-0.03
Beta	-0.03	0.00	-0.02	-0.07
Growth	-0.02	0.00	-0.02	-0.02
Momentum	0.00	0.02	-0.01	0.03
Earnings Yield	0.01	0.01	-0.03	0.01
Earnings Quality	0.03	0.05	0.04	0.03
Long-Term Reversal	0.04	0.01	0.04	-0.03
Profitability	0.06	0.06	0.03	0.08
Dividend Yield	0.07	0.04	0.05	0.07
Investment Quality	0.08	0.09	0.05	0.05
Size	0.17	0.19	0.07	0.04

Table 1.2

Correlation T-stats	ESG	E	S	G
Mid Capitalization	-6.87	-7.59	-2.81	-1.65
Earnings Variability	-4.95	-4.62	-2.96	-3.99
Residual Volatility	-2.97	-2.65	-2.49	-4.46
Book-to-Price Ratio	-2.32	-3.09	-1.11	-2.63
Liquidity	-1.43	-1.24	-0.43	0.26
Leverage	-1.29	0.92	0.01	-1.03
Beta	-0.98	0.05	-0.77	-2.71
Growth	-0.87	-0.02	-0.88	-0.79
Momentum	-0.15	0.92	-0.38	1.34
Earnings Yield	0.31	0.56	-1.03	0.27
Earnings Quality	1.24	1.99	1.47	1.03
Long-Term Reversal	1.50	0.48	1.47	-1.08
Profitability	2.17	2.35	1.25	3.23
Dividend Yield	2.68	1.69	1.89	2.88
Investment Quality	3.17	3.36	1.78	2.07
Size	6.62	7.46	2.76	1.47

January 2007 – June 2016

Chart 1.2 plots the return of the "pure" ESG "factor" in these settings.[5] There was no clear trend over the 10-year period, a similar conclusion to the decile analysis. We also note that limiting exposure to style factors subtracted from ESG factor performance. This result indicates that gaining exposure to ESG entails exposure to style factors delivering positive performance. Besides evaluating ESG factor performance, we look at its risk characteristics. Its statistical significance (measured by the t-statistic) and volatility places it among the least volatile factors of the GEMLT model (along with factors such as growth and earnings quality), but without having a significant return associated with it.

We have seen that cross-sectional relationships with other factors influenced the performance of the stand-alone ESG factor. As a next step, we look at these relationships in more detail. The simplest way to measure the dependency between factors and ESG scores

at the individual stock level is via cross-sectional correlations of stock-level factor exposures with stock-level ESG scores. For completeness, we also included similar measures for the three ESG pillar scores. Tables 1.1 and 1.2 show results for the 16 style factors of GEMLT.

Two general observations can be drawn from these results. First, the average level of correlation between factors and ESG scores is low, i.e., ESG scores are a largely independent, new source of information, but we can still find some intuitive and statistically significant relationships.

Second, the pillar scores had varying correlations to equity factors. While the level of correlation was generally low, many of those relationships were stable and highly significant over time. For example, we observe a positive correlation with the size factor and a negative correlation with the Midcap factor. These observations both indicate that, on average, larger companies tended to have better scores. We also note that this relationship persisted at the pillar level, but was strongest for the Environmental pillar score, and weaker for the Social and Governance scores.

We conclude this section by examining the distribution of ESG scores for selected countries and sectors, and by assessing how quickly ESG scores changed over time.

Chart 2.1 shows ESG score distributions for selected countries, while Chart 2.2 presents the same information for selected sectors, as of September 30, 2016. As expected, the country scores reveal that European companies tend to have better ESG characteristics than their peers in Japan and in the U.S. The distribution of sector scores confirms that there were no major biases in the way companies were assessed relative to their sector peers.

Chart 2.3 reveals that ESG ratings remained stable 68% of the time (on an annual basis) over the period of analysis. Most annual changes in ratings were upgrades or downgrades by one unit, while 8% of the change in ratings was by two units or more. Finally, Chart 2.4 shows positive autocorrelations for up to 36 months, suggesting that the information contained in ESG ratings, which are updated annually, tends to decay over a period of approximately three years.

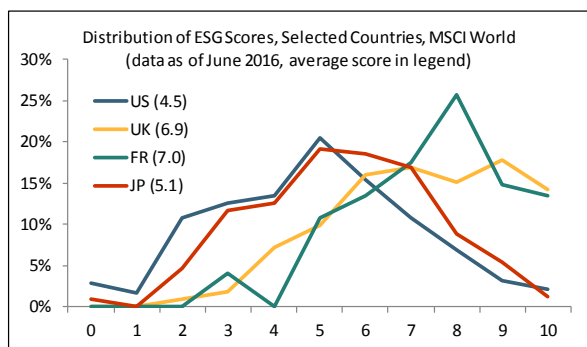**Exhibit 2: Distribution of ESG Scores and Frequency of Change**

Chart 2.1
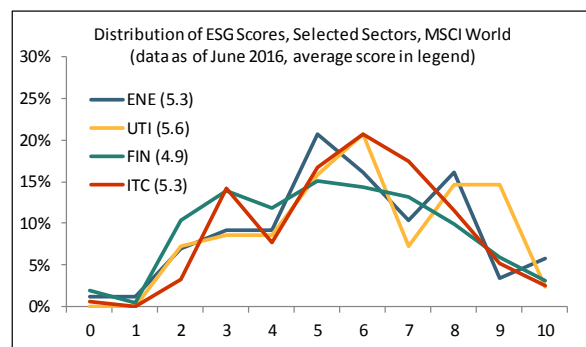
Distribution of ESG Scores, Selected Countries, MSCI World
(data as of June 2016, average score in legend)

- US (4.5)
- UK (6.9)
- FR (7.0)
- JP (5.1)

Chart 2.2

Distribution of ESG Scores, Selected Sectors, MSCI World
(data as of June 2016, average score in legend)

- ENE (5.3)
- UTI (5.6)
- FIN (4.9)
- ITC (5.3)

Chart 2.3

Frequency of change in ESG Ratings Year on Year
(Jan 2007 - Jun 2016)

-3	-2	-1	0	1	2	3
1%	3%	12%	68%	13%	3%	1%

Chart 2.4

Average Autocorrelation in ESG Scores as a Function of Lag
(months)

January 2007 – June 2016

In this section, we analyzed the relationship between ESG and traditional risk factors and found that ESG had low but statistically significant positive correlations with quality and low volatility. We also found that the correlation between ESG and other factors, such as value, momentum and low size, tended to be zero or negative. In the next three sections, we assess the impact of ESG considerations on three classes of investment strategies: passive strategies, defensive strategies and dynamic strategies.[6]

INTEGRATING ESG INTO PASSIVE STRATEGIES

Investors are actively pursuing a range of strategies to integrate ESG analysis into their investment process.[7] Some asset owners have started to more explicitly incorporate these beliefs in their policy benchmarks. Other investors have explored overlays of ESG factors into passive strategies. Finally, some investors have started to deploy factor-based or active strategies incorporating ESG criteria. Regardless of strategy, investors share a common concern: Does ESG integration impair or enhance the ability of each strategy to meet its investment objective? In the following section, we first investigate the impact of ESG in benchmark construction and then test a range of passive and active strategies.

To address the need for benchmarks that reflect ESG criteria, we investigate how a typical cap-weighted benchmark such as the MSCI World Index could be modified to account for the ESG characteristics of its constituents. To achieve this goal, we combine ESG ratings with the market cap weight of each stock to derive "tilted" index weights. We examine three variants of this index construction process. The first method (ESG Level) is based only on current ratings and therefore rewards companies that have already achieved best-in-class ESG performance. The second method (ESG Change) focuses on changes in ratings during the previous 12 months, emphasizing improvement in ESG characteristics, even from a low base. Finally, the third approach (ESG Tilt) combines current ratings and 12-month changes in ratings.

Exhibit 3 shows that all three variants experienced low tracking error and risk-adjusted performance (as measured by the Sharpe ratio) relative to the MSCI World Index, over our study period of June 2007 to June 2016. This analysis suggests that it may be possible to construct diversified benchmarks that capture the broad opportunity set and incorporate ESG criteria through simple and transparent rules, without impairing the ability of these benchmarks to reflect the performance of the underlying market.

MSCI

Exhibit 3: Simulated Benchmarks Incorporating ESG

Table 3.1

Performance & Characteristics	MSCI World	ESG Level	ESG Change	ESG Tilt (Lev + Chg)
Total Return (%)	3.1	3.0	3.2	3.0
Total Risk (%)	17.2	17.1	17.1	17.1
Return/Risk	0.18	0.18	0.19	0.18
Sharpe Ratio	0.13	0.13	0.14	0.13
Active Return (%)	0.0	-0.1	0.1	-0.1
Tracking Error (%)	0.0	0.7	0.4	0.7
Information Ratio	NA	-0.15	0.25	-0.14
Historical Beta	1.00	0.99	0.99	0.99
Price To Book	1.9	2.0	1.9	2.0
Price to Earnings	16.1	15.8	16.1	15.8
Ret on Equity (%)	11.8	12.7	11.8	12.7
Dividend Yield (%)	2.7	2.8	2.7	2.8
ESG Score	5.3	6.3	5.4	6.2
ESG Trend Pos (%)	17.8	19.2	19.8	20.1
Turnover (% p.a.)	2.2	7.9	8.3	10.2
Days to Trade 95%	0.3	0.7	0.5	0.7

Table 3.2

Active Exposure (GEMLT Factors)	ESG Level	ESG Change	ESG Tilt (Lev + Chg)
Book to Price	-0.05	-0.01	-0.05
Earnings Yield	0.00	-0.01	0.00
Size	0.06	0.00	0.05
Mid Cap	-0.04	0.00	-0.04
Momentum	-0.01	0.00	-0.01
Long-Term Reversal	0.02	0.00	0.01
Beta	-0.05	-0.01	-0.04
Residual Volatility	-0.03	-0.01	-0.03
Leverage	0.01	0.01	0.00
Earnings Quality	0.00	-0.01	-0.01
Investment Quality	0.05	0.01	0.04
Profitability	0.03	0.00	0.03
Earnings Variability	-0.07	-0.01	-0.06
Dividend Yield	0.03	0.00	0.03
Growth	-0.01	0.01	-0.01
Liquidity	-0.02	0.01	-0.01

June 2007 – June 2016

Next we assess how ESG can be incorporated into passive portfolios that track traditional benchmarks. Passive investing is well established as an alternative portfolio implementation method, offering a transparent and efficient way to capture the return associated with a broad market or asset class. Asset managers who offer standard passive investment solutions may wish to incorporate ESG into their portfolios, but may wonder to what extent ESG may impair the ability of their passive strategies to capture market returns.

To address this question, we simulated optimized index-tracking strategies that aim to maximize the portfolio's ESG rating, subject to different active risk budgets.[8] Specifically, we tested four strategies with active risk budgets of 25, 50, 100 and 200 basis points. This analysis, presented in **Exhibit 4**, shows that optimized index-tracking strategies have achieved substantial improvement in the ESG rating of the portfolio, as well as superior risk-adjusted performance compared to the underlying benchmark, over our study period of June 2007 to June 2016.[9]

Exhibit 4: Simulated Passive Strategies Incorporating ESG

Table 4.1

Performance & Characteristics	MSCI World	ESG Tilt	25 bps active risk	50 bps active risk	100 bps active risk	200 bps active risk
Total Return (%)	3.1	3.0	3.2	3.2	3.3	4.1
Total Risk (%)	17.2	17.1	17.3	17.5	17.5	17.5
Return/Risk	0.18	0.18	0.18	0.19	0.19	0.23
Sharpe Ratio	0.13	0.13	0.14	0.14	0.14	0.19
Active Return (%)	0.0	-0.1	0.05	0.1	0.2	1.0
Tracking Error (%)	0.0	0.7	0.4	0.8	1.2	2.1
Information Ratio	NA	-0.14	0.13	0.16	0.14	0.47
Historical Beta	1.00	0.99	1.00	1.01	1.01	1.01
Price To Book	1.9	2.0	1.9	1.9	1.9	1.9
Price to Earnings	16.1	15.8	16.0	16.1	16.4	16.8
Ret on Equity (%)	11.8	12.7	11.9	11.8	11.6	11.3
Dividend Yield (%)	2.7	2.8	2.7	2.7	2.7	2.7
ESG Score	5.3	6.2	6.4	6.9	8.1	9.1
ESG Trend Pos (%)	17.8	20.1	16.6	16.8	15.6	11.4
Number of Stocks	1671	1472	767	447	311	222
Days to Trade 95%	0.3	0.7	1.4	2.9	4.9	18.4

Table 4.2

Active Exposure (GEMLT Factors)	ESG Tilt	25 bps active risk	50 bps active risk	100 bps active risk	200 bps active risk	200-Tilt
Book to Price	-0.05	-0.01	-0.01	-0.03	-0.04	0.01
Earnings Yield	0.00	0.00	0.00	-0.01	-0.05	-0.05
Size	0.05	0.01	0.00	-0.05	-0.18	-0.23
Mid Cap	-0.04	0.00	0.00	0.04	0.13	0.17
Momentum	-0.01	0.00	-0.01	-0.01	-0.03	-0.02
Long-Term Reversal	0.01	0.01	0.02	0.02	0.05	0.04
Beta	-0.04	0.01	0.00	-0.01	-0.08	-0.04
Residual Volatility	-0.03	-0.03	-0.07	-0.11	-0.19	-0.16
Leverage	0.00	-0.01	-0.01	-0.03	-0.01	-0.01
Earnings Quality	-0.01	0.01	0.02	0.00	0.00	0.01
Investment Quality	0.04	0.03	0.06	0.08	0.14	0.10
Profitability	0.03	0.00	0.01	0.02	0.04	0.01
Earnings Variability	-0.06	-0.03	-0.06	-0.10	-0.15	-0.09
Dividend Yield	0.03	0.01	0.02	0.01	-0.03	-0.06
Growth	-0.01	0.00	-0.01	-0.01	-0.01	0.00
Liquidity	-0.01	0.01	0.01	0.00	0.00	0.01

June 2007 – June 2016

The 200 bps active risk strategy achieved the highest information ratio and largest improvement in ESG rating. Factor exposures show that maximizing ESG through active risk optimization tilted the portfolio towards companies with higher quality, lower size and low volatility characteristics. These results suggest there is scope for developing passive strategies that would capture the equity risk premium efficiently by tracking cap-weighted benchmarks while holding companies with superior ESG characteristics.

INTEGRATING ESG INTO FACTOR STRATEGIES

The correlation analysis presented in Exhibit 1 shows that ESG is linked to factors such as low volatility and quality. In this section, we examine explicitly the impact of ESG integration on six strategies, targeting the low volatility, quality, and yield, value, size and momentum factors.

MINIMUM VOLATILITY

Low volatility strategies have become increasingly popular as many investors seek to lower the risk of their portfolios while maintaining exposure to equities and their attractive long-term return characteristics. Minimum volatility strategies in particular offer a structured way to lower *ex-ante* portfolio risk while controlling other exposure and investability parameters

(Alighanbari, 2016). One important question for minimum volatility investors who wish to incorporate ESG into their portfolios is the extent to which ESG may impact the risk reduction properties of low volatility strategies.

Exhibit 5 presents five simulated minimum volatility strategies that are subject to the same factor exposure and investability constraints[10] and are rebalanced quarterly with a 40% annual one-way turnover budget. The only difference between the five strategies is how large an ESG constraint is incorporated in the portfolio; the constraint gradually increases from 20 to 50% in terms of the required improvement in ESG score relative to the underlying benchmark index (the MSCI World Index).

### Exhibit 5: Impact of ESG on Simulated Min Vol Strategies

Table 5.1

Performance & Characteristics	MSCI World	Min Vol	ESG20	ESG30	ESG40	ESG50
Total Return (%)	3.1	6.7	6.9	6.7	6.4	6.1
Total Risk (%)	17.5	11.2	11.4	11.7	12.3	13.2
Return/Risk	0.18	0.60	0.60	0.57	0.52	0.47
Sharpe Ratio	0.14	0.55	0.56	0.53	0.47	0.42
Active Return (%)	0.0	3.6	3.8	3.7	3.3	3.1
Tracking Error (%)	0.0	9.3	8.8	8.2	7.3	6.0
Information Ratio	NA	0.39	0.43	0.45	0.45	0.51
Historical Beta	1.00	0.56	0.58	0.62	0.66	0.72
Price To Book	1.9	2.3	2.3	2.2	2.2	2.1
Price to Earnings	16.1	16.8	16.7	16.7	16.6	16.5
Ret on Equity (%)	11.8	13.7	13.8	13.2	13.3	12.7
Dividend Yield (%)	2.7	2.9	2.9	2.9	2.9	2.9
ESG Score	5.3	5.1	6.3	6.8	7.3	7.9
ESG Trend Pos (%)	17.9	11.5	11.5	11.5	12.2	13.7
Number of Stocks	1660	287	261	239	211	181
Days to Trade 95%	0.1	3.5	3.2	3.4	4.0	5.4

Table 5.2

Active Exposure (GEMLT Factors)	Min Vol	ESG20	ESG30	ESG40	ESG50	50-NC
Book to Price	-0.21	-0.20	-0.20	-0.19	-0.18	0.03
Earnings Yield	-0.11	-0.10	-0.10	-0.10	-0.10	0.01
Size	-0.25	-0.24	-0.23	-0.21	-0.17	0.08
Mid Cap	0.19	0.18	0.17	0.16	0.13	-0.06
Momentum	0.09	0.09	0.08	0.07	0.05	-0.04
Long-Term Reversal	-0.02	-0.01	-0.02	-0.01	0.01	0.03
Beta	-1.02	-0.97	-0.92	-0.85	-0.74	0.28
Residual Volatility	-0.19	-0.21	-0.21	-0.21	-0.19	0.00
Leverage	0.04	0.04	0.03	0.03	0.02	-0.02
Earnings Quality	0.02	0.04	0.04	0.05	0.05	0.03
Investment Quality	0.14	0.15	0.16	0.16	0.16	0.02
Profitability	0.20	0.20	0.20	0.19	0.20	0.00
Earnings Variability	-0.26	-0.26	-0.26	-0.25	-0.25	0.01
Dividend Yield	0.19	0.19	0.19	0.18	0.16	-0.03
Growth	-0.16	-0.15	-0.14	-0.13	-0.12	0.04
Liquidity	-0.22	-0.21	-0.20	-0.18	-0.15	0.07

Chart 5.1

ESG Score and Realized Volatility

Chart 5.2

% Change in Realized Volatility
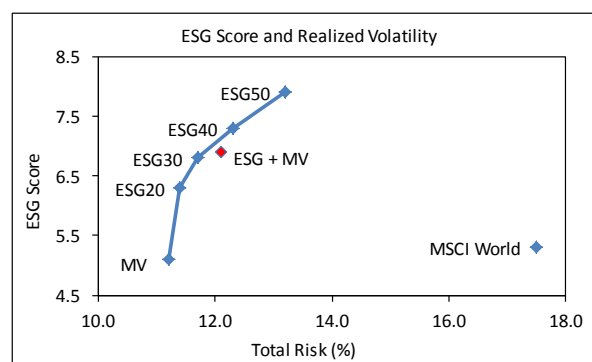
December 2007 - June 2016
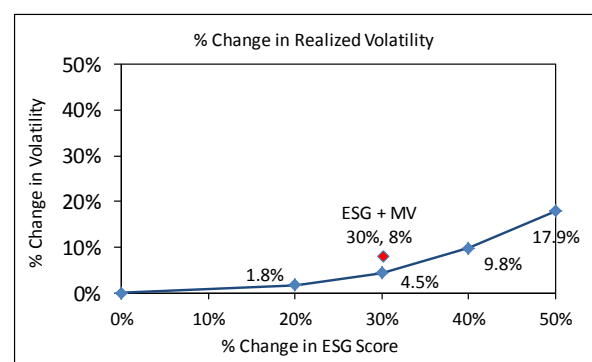
These historical simulations show that adding an ESG constraint increased realized volatility. But the increase in volatility (Total Risk in Table 5.1) was only 20 and 50 basis points for a 20% and 30% improvement in ESG rating respectively. Even for a 50% improvement in ESG rating, the minimum volatility portfolio experienced volatility that was still 4.3 percentage points lower than the MSCI World Index. [11]

In terms of factor exposures and portfolio characteristics, the main effect of the ESG constraint was an increase in beta, which rose from 0.56 to 0.72 for the 50% ESG constrained portfolio. The constraint also reduced the negative size and value tilts (book to price and earnings yield) and increased the positive quality tilt of the minimum volatility strategy, but these effects were relatively small. In addition, the ESG constraint limited the overweight to North America and underweight to Europe of the unconstrained strategy, and resulted in lower tracking errors and higher information ratios.

An alternative to a single-step optimization would be a two-step process (denoted in Exhibit 5 as ESG + MV), where we first exclude securities with ESG ratings below 5 and then minimize volatility on the remaining universe. Charts 5.1 and 5.2 show that the integrated approach dominates the two-step process, as the latter lies below the ESG-volatility "efficient frontier." The two-step process led to an 8% increase in volatility for 30% ESG enhancement while the integrated approach led to only 4.5% higher volatility for the same 30% increase in the ESG score.

Overall, adding an ESG constraint did not alter the profile of the minimum volatility strategy and produced only a small increase in realized volatility, which was not statistically significant. It may therefore be possible to improve the ESG ratings of minimum volatility strategies without a significant impact on the risk reduction properties and overall characteristics of the strategy.

QUALITY STRATEGIES

Quality strategies typically focus on companies with high profitability, stable earnings, low accruals, conservative investments and low financial leverage. Historical long-term outperformance of quality stocks has been reported in a number of empirical studies (for example, Novy-Marx, 2013). Many active investment management processes incorporate quality as a security selection criterion, usually as part of a growth or growth at a reasonable price (GARP) process.

When we examined ESG in the context of a factor model, our results show that companies with high quality characteristics tend to have above-average ESG ratings relative to their peers (see Exhibit 1). In earlier research, Lee et al. (2015) examined rules-based portfolio

construction strategies combining financial quality and corporate governance. They reported that combining these two attributes resulted in superior risk-adjusted performance. In this section, we look at the impact of integrating an ESG constraint into a quality portfolio through optimization while all other portfolio parameters remain constant.

Exhibit 6 shows historical simulations of a systematic quality strategy with gradually improving ESG profiles. This strategy uses optimization to maximize exposure to the quality factor while targeting 3% *ex-ante* active risk relative to the MSCI World Index.[12] The analysis presented in Exhibit 6 shows that improving the ESG profile of a quality strategy leaves the information ratio constant and has only modest impacts on the strategy's ability to find stocks with quality characteristics.

In addition to the integrated approach, we also examined a two-step process that eliminates stocks with ESG scores below 5 and then maximizes quality on the remaining screened universe (ESG+QTY). Similar to the minimum volatility results, the two-step approach was less efficient than the integrated approach, as the former resulted in lower ESG scores for the same level of exposure to quality.

Exhibit 6: Impact of ESG on Simulated Quality Strategies

Table 6.1

Performance & Characteristics	MSCI World	Quality	ESG20	ESG30	ESG40	ESG50
Total Return (%)	3.1	6.4	6.6	6.6	6.0	5.8
Total Risk (%)	17.5	15.6	15.5	15.6	15.9	16.2
Return/Risk	0.18	0.41	0.43	0.42	0.38	0.36
Sharpe Ratio	0.14	0.38	0.39	0.39	0.34	0.33
Active Return (%)	0.0	3.3	3.5	3.5	2.9	2.8
Tracking Error (%)	0.0	3.1	3.1	3.1	2.8	2.6
Information Ratio	NA	1.09	1.13	1.15	1.05	1.05
Historical Beta	1.00	0.88	0.88	0.88	0.90	0.92
Price To Book	1.9	2.4	2.3	2.3	2.3	2.2
Price to Earnings	16.1	16.3	16.3	16.5	16.7	16.7
Ret on Equity (%)	11.8	14.7	14.1	13.9	13.8	13.2
Dividend Yield (%)	2.7	2.7	2.8	2.8	2.8	2.8
ESG Score	5.3	5.6	6.4	6.9	7.4	7.9
ESG Trend Pos (%)	17.9	20.8	16.5	17.4	18.6	19.8
Number of Stocks	1660	368	338	316	277	238
Days to Trade 95%	0.1	3.6	3.7	4.0	3.6	4.1

Table 6.2

Active Exposure (GEMLT Factors)	Quality	ESG20	ESG30	ESG40	ESG50	50-NC
Book to Price	-0.23	-0.23	-0.23	-0.22	-0.21	0.02
Earnings Yield	-0.01	-0.01	-0.02	-0.02	-0.03	-0.02
Size	-0.17	-0.13	-0.11	-0.08	-0.03	0.14
Mid Cap	0.12	0.09	0.08	0.06	0.02	-0.10
Momentum	0.07	0.06	0.06	0.05	0.05	-0.02
Long-Term Reversal	-0.03	-0.02	-0.01	-0.01	0.00	0.03
Beta	-0.24	-0.24	-0.24	-0.24	-0.23	0.01
Residual Volatility	-0.06	-0.08	-0.09	-0.09	-0.09	-0.03
Leverage	0.06	0.01	0.00	-0.01	-0.02	-0.08
Earnings Quality	0.49	0.46	0.43	0.38	0.29	-0.20
Investm Quality	0.53	0.51	0.49	0.44	0.38	-0.15
Profitability	0.80	0.76	0.70	0.62	0.50	-0.30
Earnings Variab	-0.11	-0.14	-0.16	-0.17	-0.20	-0.09
Dividend Yield	0.08	0.08	0.08	0.07	0.06	-0.02
Growth	-0.09	-0.10	-0.09	-0.09	-0.08	0.01
Liquidity	-0.03	-0.03	-0.03	-0.04	-0.04	-0.01

Chart 6.1

ESG Score and Profitability Factor Exposure

Chart 6.2

% Change in Profitability Factor Exposure
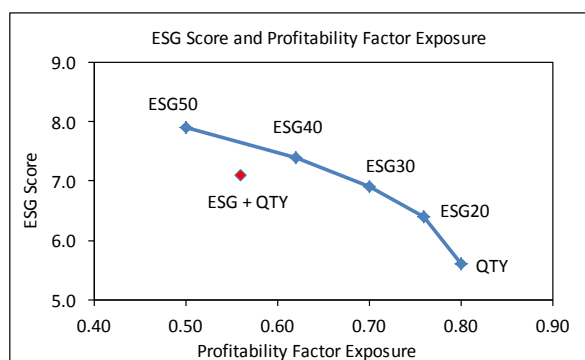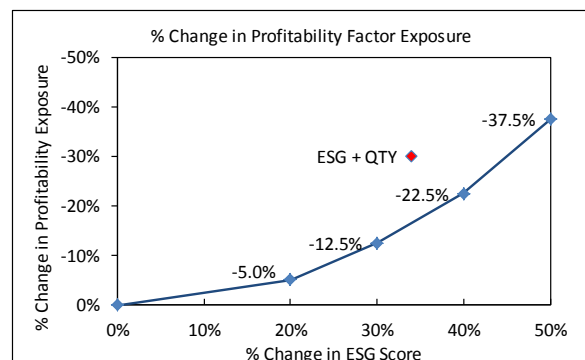
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YIELD STRATEGIES

Income investing has a long tradition in equity portfolio management. Quantitative easing policies and aggressive interest rate cuts implemented by most major central banks since the global financial crisis have led to unprecedented levels of low or even negative interest rates across large swathes of the fixed income market, providing newfound demand for strategies seeking income through high dividend yield (HDY) equities. How are HDY strategies affected when ESG ratings are incorporated into the portfolio construction process? Can yield investors harvest equity income in a sustainable manner? Are HDY

strategies with superior ESG profiles still able to meet their primary objective of delivering a high level of yield while maintaining similar risk-adjusted total returns?

In **Exhibit 7,** we review the impact of incorporating ESG constraints into equity strategies aiming to provide a high dividend yield. To ensure our results are comparable across different strategies, we use the same optimized portfolio construction framework that we used for quality.[13] We set a constant 3% active risk budget and maximize exposure to the dividend yield factor. Without any constraint on ESG, this simulated HDY strategy achieved an information ratio of 0.59 and an average dividend yield of 4.8% over our period of analysis. When we enhance the ESG profile of the HDY portfolio by 30%, dividend yield drops to 4.4%, while the information ratio increases marginally to 0.65. When we implement a more aggressive 50% increase in ESG rating, dividend yield drops to 3.8% but remains well above the market level of 2.7%.

A two-step approach that first eliminates stocks with ESG scores below 5 and then maximizes dividend yield over the remaining universe leads to lower ESG scores for the same level of dividend yield. Factor analysis reveals that improving the ESG profile of HDY portfolios increased exposure to size and quality factors. Overall, adding an ESG constraint to our simulated HDY strategy improved historical risk-adjusted performance and reduced the level of dividend yield. However, the reduction in yield was only marginal, while adding the constraint resulted in a significant improvement in the ESG score.

Exhibit 7: Impact of ESG on Simulated Yield Strategies

Table 7.1

Performance & Characteristics	MSCI World	HDY	ESG20	ESG30	ESG40	ESG50
Total Return (%)	3.1	5.4	5.2	5.4	5.4	5.0
Total Risk (%)	17.5	15.9	15.9	15.9	16.0	16.3
Return/Risk	0.18	0.34	0.33	0.34	0.34	0.31
Sharpe Ratio	0.14	0.30	0.29	0.31	0.30	0.27
Active Return (%)	0.0	2.3	2.1	2.4	2.3	1.9
Tracking Error (%)	0.0	3.9	3.8	3.7	3.4	2.9
Information Ratio	NA	0.59	0.56	0.65	0.68	0.67
Historical Beta	1.00	0.89	0.89	0.89	0.90	0.92
Price To Book	1.9	1.8	1.8	1.8	1.8	1.8
Price to Earnings	16.1	14.2	14.5	14.6	14.8	15.0
Ret on Equity (%)	11.8	12.7	12.4	12.3	12.2	12.0
Dividend Yield (%)	2.7	4.8	4.6	4.4	4.2	3.8
ESG Score	5.3	4.8	6.3	6.9	7.4	7.9
ESG Trend Pos (%)	17.9	18.7	19.0	17.8	17.9	14.6
Number of Stocks	1660	303	449	400	394	334
Days to Trade 95%	0.1	3.4	3.7	4.0	4.4	3.9
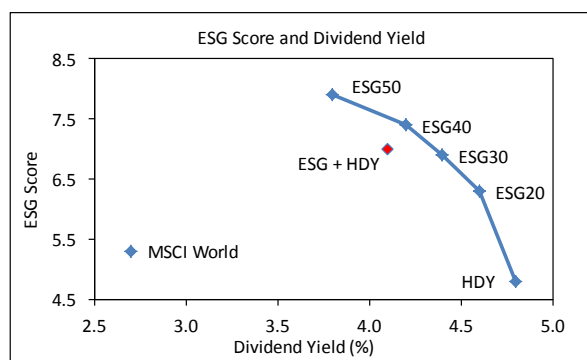
Table 7.2

Active Exposure (GEMLT Factors)	HDY	ESG20	ESG30	ESG40	ESG50	50-NC
Book to Price	0.06	0.04	0.02	0.01	0.00	-0.06
Earnings Yield	0.15	0.13	0.13	0.12	0.11	-0.04
Size	-0.10	-0.02	-0.01	0.03	0.06	0.16
Mid Cap	0.06	0.01	0.00	-0.03	-0.05	-0.11
Momentum	-0.06	-0.06	-0.05	-0.05	-0.03	0.03
Long-Term Reversal	0.05	0.07	0.07	0.07	0.05	0.00
Beta	-0.23	-0.24	-0.24	-0.24	-0.23	0.00
Residual Volatility	-0.14	-0.14	-0.15	-0.16	-0.14	0.00
Leverage	0.18	0.17	0.14	0.09	0.07	-0.11
Earnings Quality	0.12	0.12	0.11	0.10	0.09	-0.03
Investment Quality	0.10	0.11	0.13	0.16	0.19	0.09
Profitability	-0.05	-0.04	-0.03	-0.01	-0.01	0.04
Earnings Variability	-0.07	-0.11	-0.14	-0.16	-0.19	-0.12
Dividend Yield	1.13	1.03	0.94	0.82	0.63	-0.50
Growth	-0.26	-0.26	-0.25	-0.24	-0.21	0.05
Liquidity	-0.07	-0.11	-0.11	-0.12	-0.13	-0.06

Chart 7.1

Chart 7.2

December 2007 - June 2016
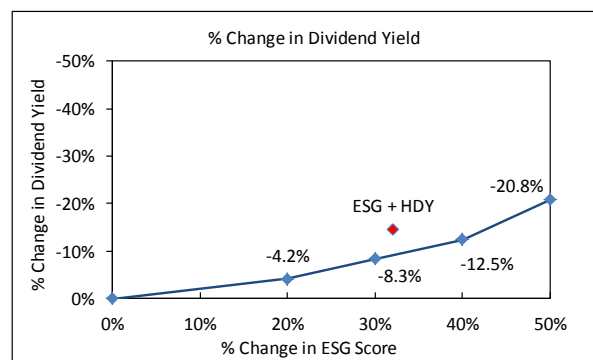
We have investigated ESG integration into defensive strategies based on the low volatility, quality and yield equity factors. We found that the impact of ESG on the historical performance of these strategies was positive, with information ratios remaining constant or improving over the period of analysis. We also found that a significant 30% improvement in ESG score can be achieved with a modest impact on the primary objectives of these strategies.

We now turn to the impact of ESG on strategies targeting the value, momentum and low size factors. The analysis presented in Exhibit 1 demonstrates that these factors had zero or negative correlations with ESG scores, suggesting that integrating ESG into strategies targeting these factors may be more difficult and costly in terms of reduction in target factor exposure.

VALUE STRATEGIES

Value investing is well established across the active portfolio management industry. Many research studies show that value strategies have strong long-term returns (for example, see Chen et al., 1998) but value has recently suffered a period of underperformance. Has ESG improved the historical performance of value strategies? To what extent has adding an ESG constraint raised the valuations of the underlying holdings of these strategies? Would higher valuations have prevented value managers from meeting their stated investment objective of holding companies that are discounted by the market?

Exhibit 8: Impact of ESG on Simulated Value Strategies

Table 8.1

Performance & Characteristics	MSCI World	Value	ESG20	ESG30	ESG40	ESG50
Total Return (%)	3.1	4.3	4.4	4.5	4.7	4.8
Total Risk (%)	17.5	16.0	16.0	16.2	16.4	16.5
Return/Risk	0.18	0.27	0.28	0.28	0.29	0.29
Sharpe Ratio	0.14	0.23	0.24	0.24	0.26	0.26
Active Return (%)	0.0	1.2	1.4	1.4	1.6	1.7
Tracking Error (%)	0.0	3.1	2.9	2.7	2.6	2.4
Information Ratio	NA	0.40	0.47	0.53	0.64	0.71
Historical Beta	1.00	0.90	0.90	0.92	0.93	0.94
Price To Book	1.9	1.5	1.5	1.6	1.6	1.7
Price to Earnings	16.1	10.6	10.9	11.3	11.9	12.8
Ret on Equity (%)	11.8	14.2	13.8	14.2	13.4	13.3
Dividend Yield (%)	2.7	3.0	3.0	3.0	3.0	3.0
ESG Score	5.3	4.9	6.3	6.8	7.4	7.9
ESG Trend Pos (%)	17.9	19.2	16.9	14.1	14.5	15.8
Number of Stocks	1660	368	328	298	265	399
Days to Trade 95%	0.1	3.6	3.9	4.2	4.0	4.0

Table 8.2

Active Exposure (GEMLT Factors)	Value	ESG20	ESG30	ESG40	ESG50	50-NC
Book to Price	0.42	0.34	0.28	0.22	0.12	-0.30
Earnings Yield	0.65	0.60	0.55	0.48	0.37	-0.28
Size	-0.14	-0.09	-0.05	-0.01	0.02	0.16
Mid Cap	0.10	0.06	0.03	0.00	-0.02	-0.12
Momentum	-0.03	-0.03	-0.03	-0.03	-0.03	0.00
Long-Term Reversal	0.01	0.01	0.02	0.03	0.03	0.02
Beta	-0.24	-0.24	-0.24	-0.23	-0.23	0.01
Residual Volatility	-0.12	-0.13	-0.13	-0.14	-0.14	-0.02
Leverage	-0.03	-0.05	-0.05	-0.05	-0.04	-0.01
Earnings Quality	0.07	0.09	0.08	0.07	0.04	-0.03
Investment Quality	0.11	0.13	0.15	0.16	0.17	0.06
Profitability	0.02	0.04	0.05	0.05	0.05	0.03
Earnings Variability	0.03	-0.01	-0.03	-0.08	-0.14	-0.17
Dividend Yield	0.24	0.23	0.23	0.22	0.20	-0.04
Growth	-0.22	-0.21	-0.20	-0.18	-0.15	0.07
Liquidity	-0.03	-0.03	-0.04	-0.05	-0.07	-0.04

Chart 8.1

ESG Score and Earnings Yield Factor Exposure
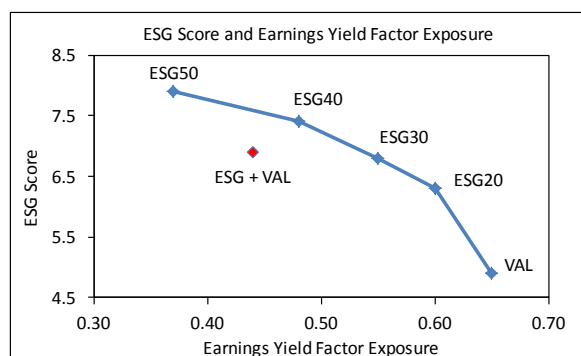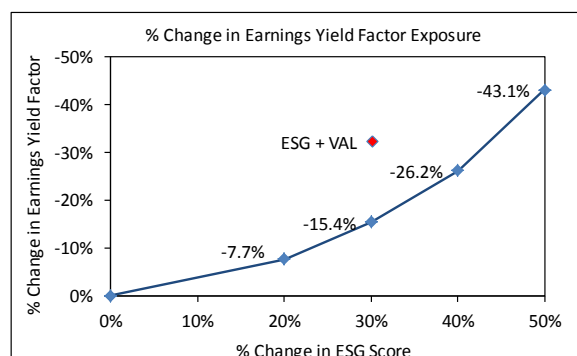
Chart 8.2

% Change in Earnings Yield Factor Exposure

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Exhibit 8 shows historical simulations of a systematic value strategy with a gradually improving ESG profile. The strategy uses optimization to maximize exposure to the value factor subject to a 3% active risk budget.[14] The results show that improving the ESG profile of a value strategy led to a higher information ratio historically and had a modest impact on the strategy's ability to select stocks with attractive valuations. For example, the average P/E ratio of the value strategy increased only by 0.7 for a 30% ESG improvement. Even for a 50% ESG enhancement, the P/E ratio rose only by 21% to 12.8 and remained well below the market multiple of 16.1. Factor analysis reveals that enhancing the ESG rating of the strategy

led to lower exposure to value factors (book to price and earnings yield) by 0.3 cross-sectional standard deviations, while size exposure increased by 0.2 and earnings variability exposure fell by a similar margin. Introducing ESG into a value strategy tilted the portfolio towards larger companies with more stable earnings.

MOMENTUM STRATEGIES

We used the same systematic portfolio construction framework to investigate the impact of ESG on momentum strategies.[15] We observed a minor drop in risk-adjusted performance (IR) from 0.95 to 0.82 and a 13.3% reduction in target factor exposure for a 30% improvement in the ESG rating of an optimized 3% active risk momentum strategy.
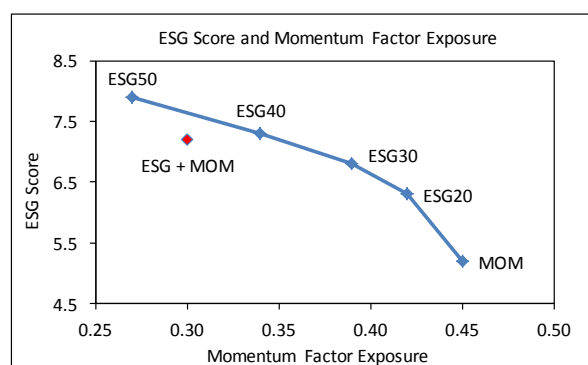
Exhibit 9: Impact of ESG on Momentum Strategies

Table 9.1

Performance & Characteristics	MSCI World	MOM	ESG20	ESG30	ESG40	ESG50
Total Return (%)	3.1	6.4	5.9	5.7	5.3	5.3
Total Risk (%)	17.5	15.6	15.6	15.8	16.0	16.2
Return/Risk	0.18	0.41	0.38	0.36	0.33	0.33
Sharpe Ratio	0.14	0.38	0.34	0.32	0.30	0.30
Active Return (%)	0.0	3.3	2.8	2.6	2.2	2.3
Tracking Error (%)	0.0	3.5	3.4	3.2	2.9	2.7
Information Ratio	NA	0.95	0.85	0.82	0.76	0.84
Historical Beta	1.00	0.88	0.88	0.89	0.90	0.92
Price To Book	1.9	2.3	2.3	2.3	2.3	2.2
Price to Earnings	16.1	16.1	16.2	16.3	16.3	16.6
Ret on Equity (%)	11.8	14.3	14.2	14.1	14.1	13.3
Dividend Yield (%)	2.7	2.4	2.4	2.4	2.5	2.5
ESG Score	5.3	5.2	6.3	6.8	7.3	7.9
ESG Trend Pos (%)	17.9	19.2	15.4	15.4	15.4	14.6
Number of Stocks	1660	510	429	374	314	445
Days to Trade 95%	0.1	2.9	2.8	2.8	2.9	2.9

Table 9.2

Active Exposure (GEMLT Factors)	MOM	ESG20	ESG30	ESG40	ESG50	50-NC
Book to Price	-0.19	-0.20	-0.20	-0.20	-0.20	-0.01
Earnings Yield	-0.07	-0.07	-0.08	-0.08	-0.08	-0.01
Size	-0.17	-0.13	-0.10	-0.07	-0.02	0.15
Mid Cap	0.14	0.10	0.08	0.05	0.02	-0.12
Momentum	0.45	0.42	0.39	0.34	0.27	-0.18
Long-Term Reversal	-0.22	-0.21	-0.19	-0.16	-0.11	0.11
Beta	-0.22	-0.22	-0.23	-0.23	-0.23	-0.01
Residual Volatility	0.03	0.02	0.01	-0.01	-0.03	-0.06
Leverage	0.01	-0.02	-0.04	-0.05	-0.06	-0.07
Earnings Quality	-0.02	0.01	0.01	0.01	-0.01	0.01
Investment Quality	0.08	0.09	0.10	0.11	0.13	0.05
Profitability	0.18	0.18	0.19	0.19	0.19	0.01
Earnings Variability	0.00	-0.05	-0.08	-0.12	-0.17	-0.17
Dividend Yield	-0.09	-0.09	-0.10	-0.09	-0.08	0.01
Growth	0.09	0.08	0.08	0.07	0.05	-0.04
Liquidity	0.02	0.02	0.01	0.00	-0.03	-0.05

Chart 9.1

ESG Score and Momentum Factor Exposure

Chart 9.2

% Change in Momentum Factor Exposure

December 2007 - June 2016
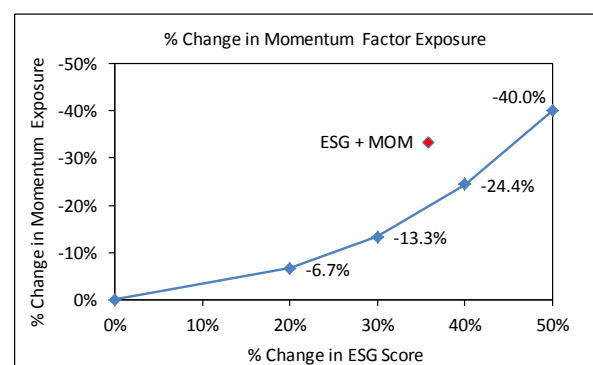
LOW SIZE STRATEGIES

We complete the empirical portfolio construction analysis by investigating the impact of ESG on low size strategies.[16] For a 30% improvement in the ESG rating of an optimized 3% active risk low size strategy, we observe that IR drops from 0.94 to 0.65, while size factor exposure diminishes by 22.3%.

Exhibit 10: Impact of ESG on Simulated Size Strategies

Table 10.1

Performance & Characteristics	MSCI World	Size	ESG20	ESG30	ESG40	ESG50
Total Return (%)	3.1	6.3	5.3	5.2	5.1	5.0
Total Risk (%)	17.5	16.1	16.4	16.5	16.5	16.7
Return/Risk	0.18	0.39	0.32	0.32	0.31	0.30
Sharpe Ratio	0.14	0.36	0.29	0.28	0.28	0.27
Active Return (%)	0.0	3.2	2.2	2.1	2.0	2.0
Tracking Error (%)	0.0	3.4	3.3	3.2	3.1	3.0
Information Ratio	NA	0.94	0.67	0.65	0.65	0.66
Historical Beta	1.00	0.90	0.92	0.93	0.93	0.94
Price To Book	1.9	1.9	1.9	1.9	2.0	2.0
Price to Earnings	16.1	18.4	18.3	18.3	18.2	17.8
Ret on Equity (%)	11.8	10.3	10.4	10.4	11.0	11.2
Dividend Yield (%)	2.7	2.4	2.4	2.4	2.5	2.5
ESG Score	5.3	4.8	6.3	6.9	7.4	7.9
ESG Trend Pos (%)	17.9	12.5	13.2	13.0	14.0	15.0
Number of Stocks	1660	1001	846	773	637	520
Days to Trade 95%	0.1	3.6	4.0	4.2	4.4	4.6

Table 10.2

Active Exposure (GEMLT Factors)	Size	ESG20	ESG30	ESG40	ESG50	50-NC
Book to Price	0.03	-0.02	-0.05	-0.08	-0.11	-0.14
Earnings Yield	-0.19	-0.19	-0.19	-0.18	-0.15	0.04
Size	-1.12	-0.97	-0.87	-0.73	-0.54	0.58
Mid Cap	0.79	0.69	0.62	0.52	0.38	-0.41
Momentum	0.03	0.03	0.04	0.04	0.04	0.01
Long-Term Reversal	0.00	0.01	0.01	0.01	0.01	0.01
Beta	-0.23	-0.23	-0.23	-0.23	-0.23	0.00
Residual Volatility	-0.25	-0.25	-0.25	-0.24	-0.23	0.02
Leverage	0.06	0.04	0.03	0.03	0.03	-0.03
Earnings Quality	0.00	0.02	0.03	0.04	0.04	0.04
Investment Quality	0.00	0.03	0.06	0.08	0.11	0.11
Profitability	0.07	0.10	0.12	0.13	0.15	0.08
Earnings Variability	0.00	-0.05	-0.07	-0.11	-0.14	-0.14
Dividend Yield	-0.17	-0.15	-0.14	-0.11	-0.09	0.08
Growth	-0.03	-0.03	-0.02	-0.02	-0.02	0.01
Liquidity	0.18	0.18	0.17	0.14	0.10	-0.08

Chart 10.1

ESG Score and Size Factor Exposure

Chart 10.2

% Change in Size Factor Exposure
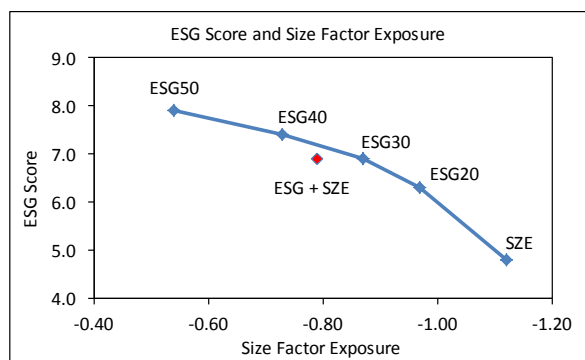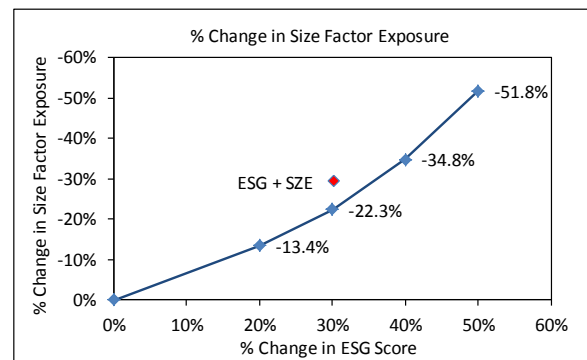
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ARE FACTORS SIGNIFICANT SOURCES OF RETURN AFTER INTEGRATING ESG?

In the previous two sections, we found that it was generally easier to integrate ESG into defensive strategies as their target factors had positive correlation with ESG.

In this section, we examine the returns attributed to the target factors of each strategy through formal factor attribution analysis. Through this process, we were able to decompose and attribute the active return of each simulated strategy into systematic and specific sources. In addition, we were able to assess whether the active return attributed to these sources was statistically significant or not.

Exhibit 11: Active Return Attribution to Factors and their Statistical Significance
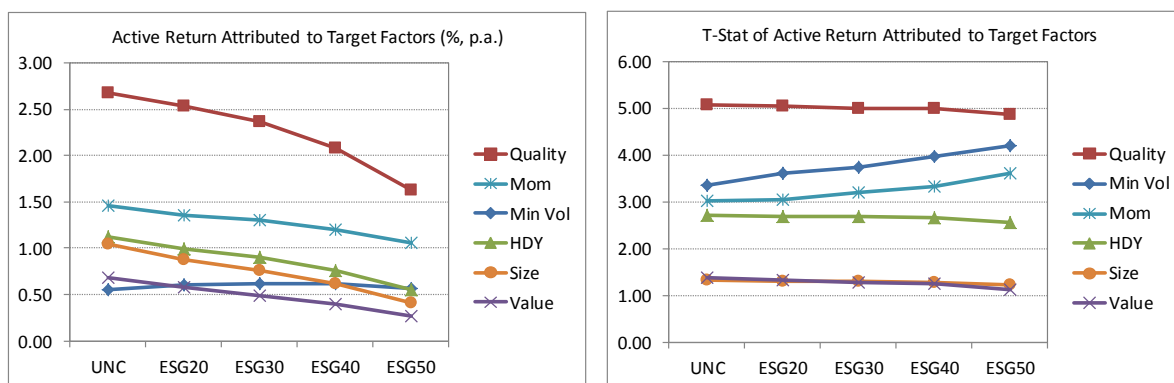
Factor attribution analysis, presented in **Exhibit 11**, confirms that ESG integration into defensive strategies did not impair the ability of these strategies to generate significant active returns from their target factors. Active returns attributed to residual volatility, profitability, earnings quality, investment quality and dividend yield remained relatively high and statistically significant through the range of examined ESG enhancements. Institutional investors pursuing these defensive strategies could have improved the ESG profile of their portfolios while still enjoying statistically significant positive target factor returns historically. The same holds true for momentum over the period of analysis. Value and low size strategies also enjoyed positive active returns from their respective target factors, but these returns were lower in magnitude and were not statistically significant over our sample period.

DOES ESG IMPROVE THE OVERALL SUSTAINABILITY PROFILE?

Investors who wish to integrate ESG considerations into their strategies are typically motivated by specific targets or objectives. These objectives may include long-term risk considerations, for example, avoiding investments in companies that are involved in certain types of activities, have high carbon exposure or suffer from severe controversies associated with their ESG-related policies and practices. Other investors may place more emphasis on a particular pillar, for example the governance pillar, and may wish to quantify how their strategy offers superior characteristics relative to the broad investment universe.

How did a portfolio constraint at the ESG score level impact these multiple dimensions of sustainable investing? The analysis presented in Exhibit 12 shows more detailed information about several ESG-related objectives for the simulated minimum volatility and quality strategies.[17] This analysis looks beyond the portfolio-level ESG score improvement and drills down into specific themes associated with sustainable investing. Topics covered include portfolio allocation to leaders and laggards, level of improvement in the three individual pillar scores, key governance metrics (such as the percentage allocation to companies that lack an independent board majority), and certain values or belief-based metrics (such as the percentage of the portfolio allocated to companies that may be experiencing ESG-related controversies).

Exhibit 12: ESG Constraint Impact on Key ESG Metrics

ESG Metrics	MSCI World	Min Vol	ESG20	ESG30	ESG40	ESG50
Key Integration Metrics						
ESG Score	5.3	5.1	6.3	6.8	7.3	7.9
ESG Leaders (AAA-AA) (%)	20.8	18.1	33.5	42.5	52.7	64.9
ESG Laggards (B-CCC) (%)	17.0	14.8	4.3	2.3	1.1	0.0
ESG Pillars						
Environmental Score	5.5	5.4	6.0	6.3	6.5	6.7
Social Score	4.3	4.1	4.6	4.9	5.2	5.5
Governance Score	5.0	4.9	5.2	5.3	5.5	5.6
Key Governance Metrics						
Lack of Indep. Board Majority (%)	13.1	15.4	15.0	15.6	16.7	17.3
Deviation from 1 Share1 Vote (%)	21.3	22.9	21.1	19.5	17.3	15.0
No Female Directors (%)	6.6	9.5	8.7	8.5	8.6	8.2
Values						
Global Compliance Watch List (%)	13.9	12.5	8.8	6.5	4.4	3.6
Red Flag Controversies (%)	2.8	1.4	1.0	0.9	0.5	0.0
Orange Flag Controversies (%)	27.8	22.7	19.2	17.4	15.9	14.6

ESG Metrics	MSCI World	Qual	ESG20	ESG30	ESG40	ESG50
Key Integration Metrics						
ESG Score	5.3	5.6	6.4	6.9	7.4	7.9
ESG Leaders (AAA-AA) (%)	20.8	25.8	36.6	46.6	57.3	68.5
ESG Laggards (B-CCC) (%)	17.0	11.1	4.6	1.6	0.8	0.2
ESG Pillars						
Environmental Score	5.5	5.9	6.3	6.5	6.8	7.0
Social Score	4.3	4.3	4.7	5.0	5.2	5.4
Governance Score	5.0	5.0	5.2	5.3	5.5	5.7
Key Governance Metrics						
Lack of Indep. Board Majority (%)	13.1	18.6	17.6	17.8	16.9	16.1
Deviation from 1 Share1 Vote (%)	21.3	19.9	17.5	16.0	15.0	15.8
No Female Directors (%)	6.6	7.4	7.6	7.7	6.9	6.4
Values						
Global Compliance Watch List (%)	13.9	12.1	6.5	6.3	4.9	5.8
Red Flag Controversies (%)	2.8	3.9	1.9	1.0	0.0	0.0
Orange Flag Controversies (%)	27.8	21.5	20.2	20.5	17.5	17.3

December 2007 - June 2016

The results reported in Exhibit 12 show that portfolio-level ESG scores were improved by overweighting leaders and underweighting laggards. In addition, even though our

simulations constrained only the ESG score, we observe consistent and significant improvement across all three individual pillar scores. The same consistently improving picture emerges when we examine the portfolio allocation to companies on the global compliance watch list and those that are subject to ESG controversies.[18] Enhancing the ESG score of the simulated strategies also led to a consistent and significant reduction in portfolio allocation to companies that deviate from the one-share, one-vote principle. Overall, top-level ESG constraints improved most of the ESG dimensions we evaluated.

CONCLUSION

We assessed the impact of ESG integration on simulated passive and active strategies over the last 10 years. We found that ESG criteria have generally improved the risk-adjusted performance of the strategies we evaluated. However, historical performance is no guarantee of future results. Therefore, we also examined closely the impact of ESG integration on each strategy's ability to pursue its stated investment objective. Passive investors need to be able to capture the broad equity risk premium cheaply and efficiently after they add ESG criteria to their portfolios. Factor-based strategies need to be able to maintain high exposure to their target factors and active managers must retain enough flexibility to find alpha opportunities through their active security selection process.

To quantify the potential impact of ESG constraints on the *ex-ante* information ratio of different strategies, we focused on *percentage reduction in target factor exposure*. As target factor exposures are effectively expected return proxies for factor strategies, the percentage reduction in active target factor exposure is the right measure to quantify the impact of ESG constraints on the *ex-ante information ratios* of these strategies. In other words, for factor investors, an x% reduction in target factor exposure due to the ESG constraint translates directly into an x% drop in *ex-ante* information ratio, all else being equal.

Exhibit 13 shows the trade-off between increase in ESG score and reduction in target factor exposure[19] for the six strategies we evaluated. It shows that significant improvements in the ESG profile of these strategies, of the order of 30%, were achieved with relatively modest impacts on target factor exposure, ranging between 7% and 22%. When we seek to achieve more substantial ESG improvement, the reduction in target factor exposure becomes greater. For 50% ESG enhancement, the impact on target factor exposure ranged from 23% to 54%.

This exhibit also demonstrates that not all strategies were affected to the same extent. Incorporating an ESG constraint had a remarkably low impact on simulated minimum volatility strategies. Target factor exposure decreased only by 7% for a 30% ESG improvement. Even for a 50% ESG improvement, volatility factor exposure dropped only by 23%. Simulated quality strategies were also affected relatively modestly, suffering 11% and 36% reductions in target factor exposure for 30% and 50% improvements in ESG ratings, respectively. On the other hand, value, size, momentum and yield strategies experienced more significant target factor exposure reductions, ranging between 13% and 22% for a 30% ESG improvement.

Exhibit 13: ESG Score and % Change in Target Factor Exposure
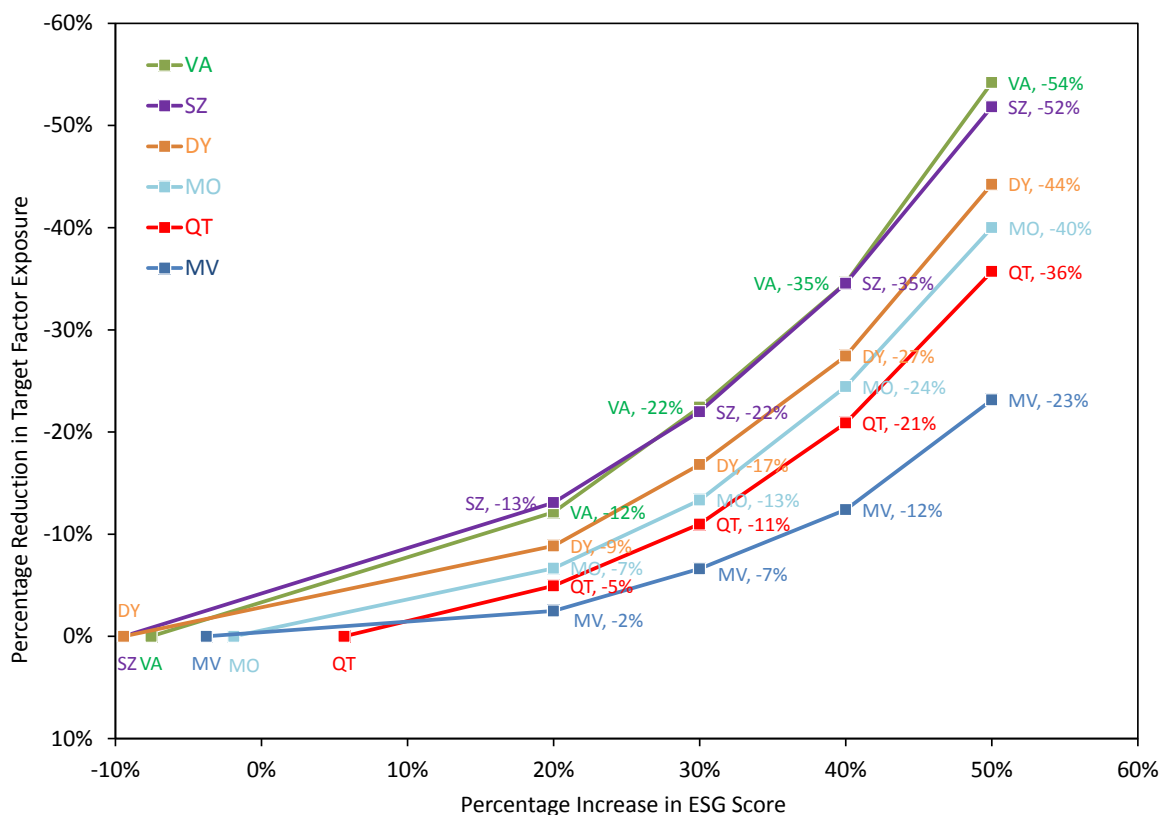
December 2007 - June 2016

These results may provide guidance to passive and active managers who wish to incorporate ESG criteria into their strategies. They show that historically ESG has generally improved the information ratio of many typical passive and factor-based investment strategies. They also show that the impact of ESG on the *ex-ante* information ratio of these strategies is relatively moderate, and varies according to the primary investment objective and target factors of the underlying strategy.

ENDNOTES

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[1] Many institutions committed to ESG principles have become signatories of the Principles for Responsible Investments (PRI). As of April 2016, some 1,500 financial institutions with total assets in excess of $60 trillion were PRI signatories. Further information can be found on www.unpri.org.

[2] For a full list of factors and more details on the MSCI Global Equity Model, see Morozov et al. (2015).

[3] For more information on SES factors and their use in active portfolio management, please see Balint (2016).

[4] For more information on the ratings methodology, see MSCI ESG Ratings Methodology, May 2015, available on msci.com.

[5] For a review of the underlying theory and practical applications associated with pure factor portfolios linked to the factor returns from multivariate regressions, see Melas et al. (2010).

[6] While passive strategies are well defined, we do not have strict criteria for classifying active strategies into defensive and dynamic. For the purposes of this paper, we classify strategies that have below market volatility and counter-cyclical performance as defensive, while we classify strategies that tend to lead to above market volatility and pro-cyclical performance as dynamic. We examined three defensive strategies, yield, quality and low volatility and three dynamic strategies, value, momentum and low size. This classification is consistent with earlier research. For example, Alighanbari et al. (2014) report 40-year historical performance for typical long-only factor strategies and find that yield, quality and low volatility strategies had below-market volatility while value, momentum and low size strategies had above-market volatility. Morozov et al. (2015) analyze factor returns over 20 years and show that yield, quality and low volatility factors had negative correlation with the market while value and low size factors had positive correlation with the market.

[7] For example, see "Sweden's AP4 Shuns Fossil Fuels," Financial Times, August 15, 2016.

[8] The following constraints and parameters were used in the simulated index-tracking strategies. The objective of the optimization was to maximize the ESG score of the index-tracking portfolio, subject to *ex-ante* active risk budgets of 25, 50, 100, 150, 200 bps. All GEMLT style factors were left unconstrained. All GICS® sectors (the global industry classification standard jointly developed by MSCI and Standard & Poor's) and countries were constrained to +/- 5% w.r.t. the parent index. Max security weights were set at min (parent weight+2%, parent weight*10). Minimum security weights were set at max (parent weight-2%, 0). The simulated portfolios were rebalanced quarterly with an annual one-way turnover budget of 20%.

[9] These results are consistent with Nagy (2016) who reports positive information ratios for optimized strategies based on current ratings and change in ratings, with the latter achieving higher IR.

[10] The following constraints and parameters were used in the simulated minimum volatility strategies. The objective of the optimization was to minimize *ex-ante* portfolio risk. The beta and residual volatility factors were left unconstrained. All other GEMLT style factors were constrained to within +/- 0.25 cross-sectional standard deviations w.r.t. the parent index. All GICS sectors and

countries were constrained within +/- 5% w.r.t. the parent index. Max security weights were set at min (1.5%, parent weight*20). Min security weights were set at 0.05% (for selected securities).

[11] We run a one-sided F-test for equality of variances, to see if the realized volatility of the ESG strategies was significantly higher than the volatility of the unconstrained minimum volatility strategy. The F-ratios for the simulated ESG20, ESG30, ESG40 and ESG50 strategies were 1.03603, 1.09127, 1.20607 and 1.38903 while the critical F-value at the 10% probability level was 1.29177. In fact, at the 5% probability level the critical F-value was 1.38941, therefore none of the four strategies had variance significantly higher than the unconstrained simulated minimum volatility strategy at the 5% or at the 1% level of probability.

[12] The target factor for the simulated quality strategy was an equally weighted combination of the profitability, earnings quality and investment quality factor exposures from GEMLT. In addition, the earnings variability and leverage factors were left unconstrained as they are typically associated with the concept of quality. All other GEMLT style factors were constrained to within +/- 0.25 cross sectional standard deviations w.r.t. the parent index. All GICS sectors and countries were constrained within +/- 5% w.r.t. the parent index. Max security weights were set at min (parent weight+2%, parent weight*10). Min security weights were set at max (parent weight-2%, 0).

[13] The target factor for the simulated high dividend yield strategies was the dividend yield factor in the GEMLT model. All other optimization constraints and parameters were exactly the same as for the simulated quality strategy.

[14] The target factor for the value strategy was a combination of 80% earnings yield factor exposure and 20% book to price factor exposure, using the two factors in GEMLT. Earnings yield received an 80% weight as it contains four value descriptors: historical earnings to price, forward earnings to price, cash earnings to price and earnings before interest, tax, depreciation and amortization over enterprise value. Book to price factor received a 20% weight as it contains only one descriptor, book to price. All other optimization constraints and parameters were exactly the same as for the simulated quality strategy.

[15] The target factor for the simulated momentum strategies was the momentum factor in the GEMLT model. All other optimization constraints and parameters were exactly the same as for the simulated quality strategy.

[16] The target factor for the simulated low size strategies was the size factor in the GEMLT model. All other optimization constraints and parameters were exactly the same as for the simulated quality strategy.

[17] We show detailed ESG metrics for these two strategies only as they are the most likely candidates for ESG integration due to their defensive nature. We conducted the same analysis for all simulated strategies with broadly similar conclusions. These additional results are available upon request.

[18] For more detailed information on the precise definition and method of calculation as well as the sources used to derive these measures, see MSCI ESG Ratings Methodology, available on msci.com.

[19] Target factors for each of the six strategies were defined based on GEMLT factors as follows. For minimum volatility, we took the average of beta and residual volatility. For the quality strategy, we took the average of earnings quality, investment quality and profitability. For the value strategy, we used the average of the earnings yield and book to price factors. For the low

size strategy, we took the average of size and midcap, with the later sign inverted. Finally, for the high dividend yield and for the momentum strategies we used the dividend yield factor and the momentum factor, respectively.

REFERENCES

Alighanbari, M., R. A. Subramanian and P. Kulkarni. (2014). "Factor Indexes in Perspective." MSCI Research Insight.

Alighanbari, M., S. Doole and D. Shankar. (2016). "Designing Low-Volatility Strategies." *Journal of Index Investing*. Forthcoming.

Balint, I. and D. Melas. (2016). "Using Systematic Equity Strategies." MSCI Research Insight.

Chen, N. and F. Zhang. (1998). "Risk and Return of Value Stocks." *Journal of Business*, Vol. 71, No. 4, pp. 501-535.

Friede, G., T. Busch and A. Bassen. (2015). "ESG and Financial Performance: Aggregated Evidence from more than 2000 Empirical Studies." *Journal of Sustainable Finance & Investment*, Vol. 5, No. 4, pp. 210-233.

Hitchens, R, S. McCullagh and C. Parks. (2015). "Finding Alpha in ESG." Credit Suisse, ESG- α Series.

Jussa, J., M-A. Alvarez, S. Wang, Y. Luo and Z. Chen. (2013). "SRI Integration Using Smart Beta." Deutsche Bank, Markets Research.

Lee, L.-E., S. Doole, R. Marshall and N. Kumar. (2015). "Raising Minimum Governance Standards – Selecting Quality Companies for the Long Term." MSCI Research Insight.

Melas, D., R. Suryanarayanan and S. Cavaglia. (2010). "Efficient Replication of Factor Returns: Theory and Applications." *Journal of Portfolio Management,* Vol. 36, No. 2, pp. 39-51.

Morozov, A., S. Minovitsky, J. Wang and J. Yao. (2015). "Barra Global Total Market Equity Model for Long-Term Investors." MSCI Empirical Notes.

Nagy, Z., D. Cogan and D. Sinnreich. (2013). "Optimizing Environmental, Social and Governance Factors in Portfolio Construction: Analysis of three ESG-tilted strategies." MSCI Research Insight.

Nagy, Z., A. Kassam and L.-E. Lee. (2015). "Can ESG Add Alpha?" MSCI Research Insight.

Northern Trust. (2014). "Doing Good and Doing Well – How Quality Can Enhance Your ESG Strategy."

Novy-Marx, R. "The Other Side of Value: the Gross Profitability Premium." Journal of Financial Economics, Vol. 108, No. 1, pp. 1-28.

APPENDIX: HOW MUCH ESG SHOULD YOU ADD TO YOUR PORTFOLIO?

In this paper, we investigated the impact of ESG constraints ranging from 20% to 50%. Exhibit 13 shows that target factor exposure (the ESG "delta") changes monotonically, but at different rates for different strategies. For example, the delta for minimum volatility was 0.10 for a 20% change in the ESG score and rose progressively to 0.46 for a 50% change in the ESG score, while the delta for value rose from 0.60 to 1.08 over the same interval. Is there a way to determine the "right" level of ESG enhancement? Can we link this level to factor exposures in typical long-only dedicated active strategies? Does this level depend on the cross-sectional distribution of ESG scores?

Traditional factor exposures on the order of 0.2 cross-sectional standard deviations (z-scores) are generally deemed significant in long-only active portfolios while empirical evidence suggests that active mutual funds that pursue dedicated investment strategies had approximately 0.5 standard deviations exposure to their target factors.[i] **Exhibit 14** plots a time series of cross-sectional standard deviations for the ESG scores of MSCI World Index constituents. This standard deviation was around 2.6 during the earlier part of the sample and has recently dropped to about 2.3. In the same exhibit, we also plot the cross sectional mean, median, 75th, 80th and 90th percentiles over time.

Exhibit 14: Cross-Sectional Standard Deviation and Breakpoints of MSCI World ESG Scores
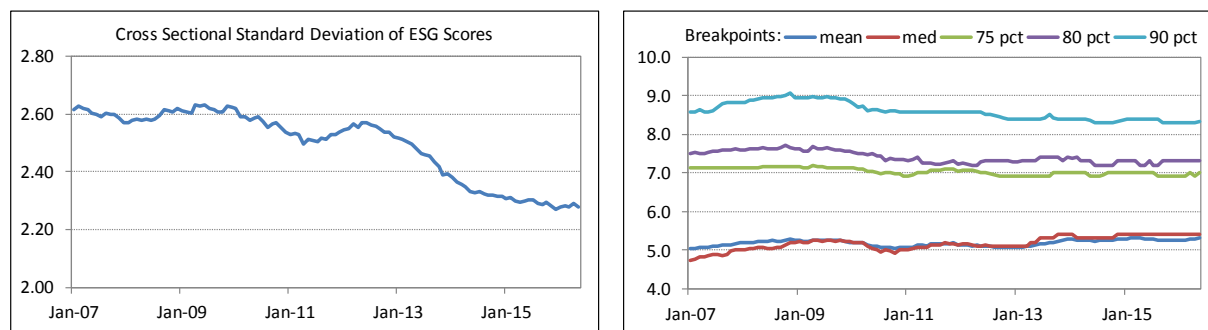
This analysis reveals that a 30% increase in the ESG score relative to the market, which is equivalent to about 1.5 units, would roughly correspond to 0.57 cross-sectional standard deviations, a level similar to average target factor exposures of dedicated active mutual funds, reported in Balint (2016). An ESG increase of 40%, corresponding to about 2.0 units,

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[i] For example, Balint et al. (2016) analyzed active U.S. mutual funds based on their self-classifications and found average target factor exposure of 0.46 for value funds, 0.34 for momentum funds, 0.50 for volatility funds, 0.45 for quality funds, 0.36 for high dividend yield funds and 0.42 for growth funds. See Exhibit 3.

would put the portfolio in the top quartile of cross-sectional stock level ESG scores. So this analysis suggests that 30% may be an appropriate ESG level for an active investor, while 40% would locate the ESG rating of the portfolio in the top ESG quartile.

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