

Optimizing Environmental, Social, and Governance Factors in Portfolio Construction

An Analysis of Three ESG-tilted Strategies

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Summary

Institutional investors wanting to integrate Environmental, Social and Governance (ESG) factors in their investment strategies need the right tools to measure portfolio risk characteristics and performance. MSCI's BarraOne and Barra Portfolio Manager can provide this utility with Intangible Value Assessment (IVA) ratings from MSCI ESG Research.¹ In this study, we examine the use of IVA ratings with the Barra Global Equity Model (GEM3) to build optimized portfolios with improved ESG ratings, while keeping risk, performance, country, industry, and style characteristics similar to conventional benchmarks, such as the MSCI World Index. The currently available dataset of IVA scores allowed us to compare three strategies during the period between February 2008 and December 2012, using current IVA ratings methodology. Of the three strategies, we found the best active returns during this period were achieved by overweighting firms whose IVA ratings improved over the recent time period, showing ESG momentum. Underweighting assets with low ESG ratings also raised portfolio performance during this period. The highest ESG rated assets had more uneven performance; they generally did better in periods of limited risk appetite during this volatile market cycle.

Introduction

For the last two decades, institutional investors have debated whether considering Environmental, Social and Governance (ESG) factors can lead to better financial returns. Skeptics maintain that so-called "Socially Responsible Investing" (SRI) does not support fundamental analysis, restricts the investable universe, and runs counter to tenets of Modern Portfolio Theory. Proponents argue that markets do not efficiently price ESG factors because they address long-term risks that have not been absorbed by the economy, and that alpha generation is possible as markets begin to recognize these undervalued influences. Academic studies and industry analyses have supported both sides of this argument, although on balance they find that investors employing ESG factors do not impose a significant performance penalty, that investors can achieve comparable risk-adjusted returns to non-ESG tilted strategies, and that investors may be able to enhance their returns through the use of certain ESG strategies.²

In this paper, we analyze the effect of ESG ratings on portfolio performance for the period of February 2007 through December 2012, and the effect of ratings changes starting in February 2008.³ For the ratings, we apply Intangible Value Assessment (IVA) scores that evaluate sector-specific ESG material risks and opportunities on a 10-point scale, which are converted into final letter grades of 'AAA' to 'CCC.' We adopt the MSCI World Index as our performance benchmark and as the asset universe for the optimized portfolios. The Barra Global Equity Model (GEM3) is used to build and analyze three families of optimized ESG-tilting strategies.

Unlike the majority of studies that seek to test the alpha generation of companies with high or low ESG ratings, we use the model to create portfolios that have region, sector and investment style risk profiles similar to the benchmark's exposures. The risk model also allows us to separate systematic sources of active return – that is, *common factor contributions* – from *asset specific* return sources associated with

¹ MSCI ESG Research is produced by Institutional Shareholder Services Inc. or its subsidiaries ("ISS"). ISS is a wholly owned subsidiary of MSCI Inc.

² See, for example, Mercer Investment Consulting, "Shedding Light on Responsible Investment: Approaches, Returns, Impacts," November 2009; and Mark Fulton, Bruce Kahn and Camilla Sharples, "Sustainable Investing: Establishing Long-term Value and Performance," Deutsche Bank Climate Change Advisors, June 2012.

³ This period was selected to allow back-testing of a time series using current IVA ratings methodology.

IVA scores. While our study was designed primarily as an enhanced indexing exercise, focused on achieving benchmark returns comparable to the MSCI World Index, we also found three possible strategies during the observed period that can raise ESG ratings and improve active returns with minimal effects on benchmark tracking error. We acknowledge that this research is based on a short sample of data, spanning almost six years. As additional data becomes available to extend the time period, investors may wish to conduct further research on these strategies to compare the results presented here.

Three Strategies that Lead to an ESG Tilt

We explore three optimized strategies that implement an ESG tilt of the MSCI World Index, based on the IVA scores of underlying portfolio holdings.

- The first strategy is called an **“ESG worst-in-class exclusion”** approach (hereafter referred to as “ESG exclusion”). It is based on excluding the companies with the lowest current ratings (‘CCC’), which results in a narrower investment universe. We first analyze the performance of this restricted market cap weighted portfolio. As a second step, we further enhance this pure exclusion strategy by overweighting stocks with high current ESG ratings and underweighting those with low current ratings inside the smaller universe, while maintaining other exposures of the portfolio very close to the benchmark’s exposures.
- The second strategy is called a **“simple ESG tilt”** approach. Here we do not exclude any stocks based on their ESG ratings. Rather, we overweight stocks with high current ESG ratings and underweight those with low current ratings, while maintaining other exposures of the portfolio very close to the benchmark’s exposures.
- The third strategy is called an **“ESG momentum”** approach. Here again, we do not exclude any stocks based on their ESG ratings. Instead, we overweight stocks that have *improved* their ESG ratings during the preceding 12 months, and underweight stocks that have decreased their ESG ratings over the same period. We expect the resulting portfolio to reflect companies whose ESG trajectory is positive, even though it will be less tilted towards companies with high current ESG ratings than the simple ESG tilt portfolio referenced above.

The implementations of these strategies share some common characteristics, especially regarding the investment constraints that were applied in the construction of the portfolios. The goal of these constraints is to assure that the optimized portfolios have region, sector and style characteristics close to the benchmark’s characteristics and close to each other, and thus minimize the effect of these factors on portfolio performance.

In this section, we provide a high-level comparison of these strategies. In subsequent sections, we give more details on each strategy, and on the sources of their performance. General optimization methodology and settings are described in greater technical detail in the Appendix.

Table 1: Comparison of ESG Strategies, February 2008 – December 2012.⁴

ESG strategy	ESG Exclusion	ESG Tilt	ESG Momentum
Active return (annual, %)	0.10	0.05	0.35
Common factor contribution (annual, %)	0.06	0.03	0.08
Asset specific contribution (annual, %)	0.05	0.01	0.27
Tracking error (ex-post, annual %)	0.45	0.46	0.36
Information ratio	0.23	0.10	0.97
Average improvement in ESG score	1.27	1.21	0.46
Average relative improvement in ESG score (%)	23	22	8

In Table 1, we compare risk and performance characteristics of our three approaches relative to the MSCI World Index. Due to the one-year lag in applying ratings changes in the ESG momentum strategy, we show statistics for the common time period ranging from February 2008 through December 2012. All three strategies achieved positive active returns, with important *asset specific* contributions (except for the ESG tilt strategy), meaning that ESG scores provided these active returns once other systematic contributions were factored out.

At the same time, the resulting portfolios were tilted towards companies with higher ESG scores. ESG exclusion and ESG tilt strategies led to a higher average ESG portfolio rating than ESG momentum strategies, but their risk-adjusted performance trailed by a distinct margin. We conclude that during this period it would have been possible to raise the ESG tilt of the MSCI World Index by one ratings notch, from ‘BBB’ to ‘A,’ without harming portfolio performance in terms of active returns, while maintaining a small tracking error.

Details of ESG Worst-in-Class Exclusion Approach

The ESG worst-in-class exclusion approach comes closest to traditional forms of Socially Responsible Investing. However, instead of excluding entire sectors based on objectionable business practices, for this exercise we only excluded ‘CCC’-rated companies from the investment universe, representing approximately 7 percent of MSCI World stocks. This approach takes advantage of IVA ratings that reflect ESG risks of companies *relative* to their industry peers; therefore, the excluded companies are less likely to concentrate in specific industries, and no industries are excluded entirely.

As shown in Table 2, the average active weight of any sector was less than 1 percent above or below the benchmark sector weight. The largest deviation was for Health Care, with an active sector weight 2.05 percent below the benchmark value.

⁴ To be consistent in comparing results, the figures presented in this table are for February 2008 – December 2012 only, corresponding to the time period available for the ESG momentum strategy. The portfolio ESG score is calculated over the indicated time period as the market capitalization weighted average score of portfolio constituents, where missing values are replaced by zero. The benchmark portfolio is the MSCI World Index and had an average IVA score of 5.4 during the period February 2007 – December 2012, as well as during the period February 2008 – December 2012.

Table 2: Active Sector Weights of the MSCI World ex 'CCC' portfolio, February 2007 – December 2012.

Sector	Average Active Weight (%)	Minimum Active Weight (%)	Maximum Active Weight (%)
Energy	-0.64	-1.10	-0.08
Materials	0.03	-0.30	0.32
Industrials	0.25	0.04	0.49
Consumer Discretionary	0.66	-0.05	1.29
Consumer Staples	0.17	-0.96	0.61
Health Care	-0.86	-2.05	-0.37
Financials	-0.99	-1.91	-0.35
Information Technology	-0.15	-0.62	0.35
Telecommunication Services	0.94	0.73	1.16
Utilities	0.58	0.05	1.05

We consider this first strategy as a reference point for the ESG exclusion approach (referred to as Strategy 1). Strategies 2-4 take the process one step further, and apply an optimized tilt towards higher rated stocks and away from lower rated stocks *inside* the reduced investment universe. We also aim to maintain country, industry and style exposures of the portfolio close to the benchmark's exposures, and vary the investor's aversion to tracking error only (see the Appendix for execution details). Summary statistics for the full period are gathered in Table 3.

Table 3: Summary Statistics of ESG Exclusion Strategies, February 2007 – December 2012.

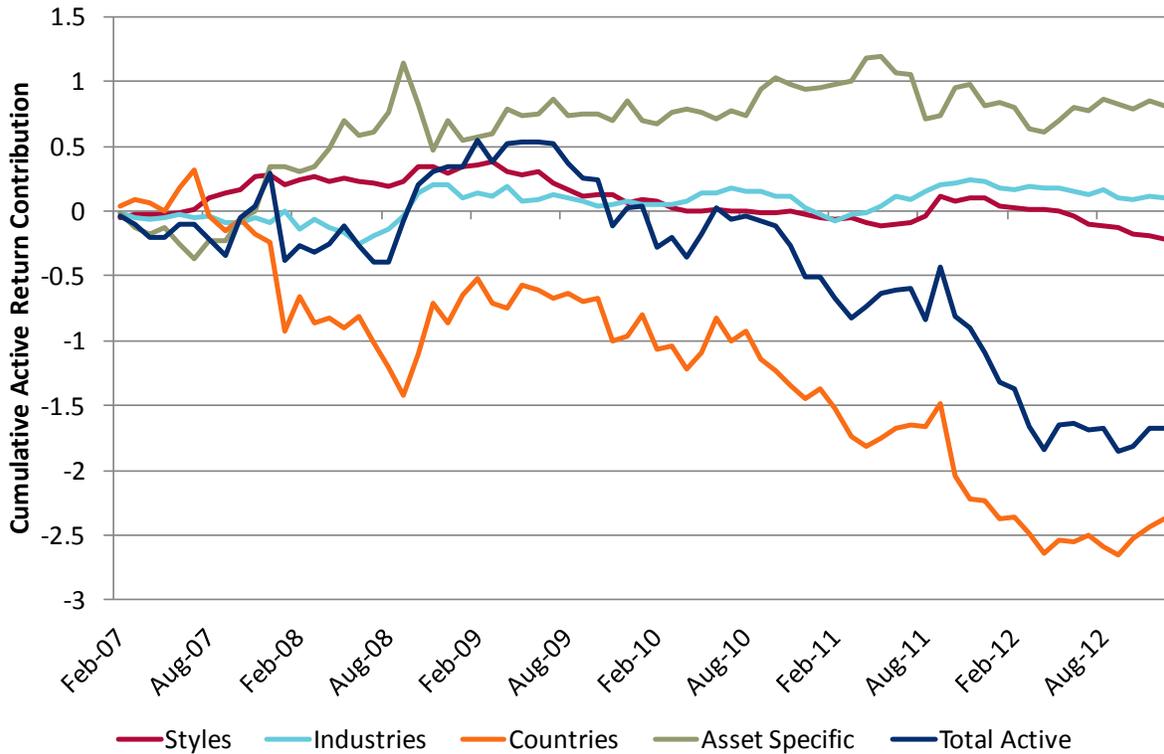
	ESG Exclusion 1	ESG Exclusion 2	ESG Exclusion 3	ESG Exclusion 4
Active return (annual, %)	-0.16	0.02	-0.01	-0.20
Common factor contribution (annual, %)	-0.30	0.04	0.04	0.01
Asset specific contribution (annual, %)	0.13	-0.02	-0.05	-0.21
Tracking error (ex-post, annual %)	0.66	0.42	0.52	1.02
Information ratio	-0.24	0.05	-0.02	-0.19
Average improvement in ESG score	0.64	1.19	1.42	2.20
Average relative improvement in ESG score (%)	12	22	26	41
Turnover (annual, %)	4	20	20	20

Excluding ‘CCC’-rated companies (Strategy 1) without any further adjustment led to a low tracking error of 0.66 percent and a small negative active return of -0.16 percent. This was due mainly to country biases that contributed -0.39 percent to the annual active return (see Figure 1 below). However, the exclusion itself contributed positively, as evidenced by the 0.13 percent asset specific contribution, meaning that eliminating ‘CCC’-rated companies raised portfolio performance once the other residual factors were factored out. The average improvement in the portfolio ESG score was modest, however, rising only 0.6 points, from 5.4 to 6.0, on a scale of 0 to 10.

Strategies 2-4 yielded better improvements in average ESG portfolio scores, ranging from 6.6 to 7.6. This put the realized ESG tilt well into the ‘A’-rated category. At the same time, benchmark tracking errors could be reduced, as shown in Strategies 2 and 3. However, Strategy 4, which provided the highest ESG portfolio tilt, increased the tracking error and significantly reduced active returns, asset specific contributions and information ratios.

These results suggest that the lowest-rated ESG stocks tended to underperform during the study period relative to the benchmark, since eliminating them from the portfolio raised active returns. This supports our hypothesis that worst-in-class ESG-rated stocks could potentially be eliminated without significantly changing risk and performance characteristics relative to the MSCI World Index. However, this does not resolve whether employing other ESG tilt strategies can provide additional performance benefits. We address this question next.

Figure 1: Return Decomposition of ESG Exclusion Strategy 1, February 2007 – December 2012.



Details of ESG Tilt Approach

We now analyze the effect of an optimized tilt towards higher-rated stocks in the *entire* MSCI World universe without excluding low-rated stocks (see the Appendix for optimization details). Summary statistics of these strategies, with varying tracking error levels, are presented in Table 4 below and compared to the ESG exclusion strategy, showing the best results.

We found that allowing for larger tracking error in an effort to maximize ESG portfolio scores did not lead to superior returns over the time period (see especially Strategy 3). Also, strategies with much more limited active risk produced a minimal negative active return, while improving the 5.4 ESG score of the MSCI World Index by at least 1.10 points. Even so, these low-risk ESG tilt strategies did not match the performance of the lowest risk exclusion strategy, as defined in the previous section (and labeled as *ESG Exclusion 2* in Table 4).

Table 4: Comparison of Statistics of the ESG Tilt and ESG Exclusion Strategies, February 2007 – December 2012.

	ESG Tilt 1	ESG Tilt 2	ESG Tilt 3	ESG Exclusion 2
Active return (annual, %)	-0.01	-0.03	-0.19	0.02
Common factor contribution (annual, %)	0.02	0.03	0.01	0.04
Asset specific contribution (annual, %)	-0.03	-0.06	-0.20	-0.02
Tracking error (ex-post, annual %)	0.44	0.54	1.01	0.42
Information ratio	-0.03	-0.06	-0.19	0.05
Average improvement in ESG score	1.10	1.37	2.15	1.19
Average relative improvement in ESG score (%)	20	25	40	22
Turnover (annual, %)	20	20	20	20

Taking ESG tilt Strategy 1 as an example and looking at its performance over the entire time period, we observe a cyclical behavior in our sample (Figure 2). Most notably, there was a two-year period of outperformance of the strategy between May 2008 and April 2010, relative to the MSCI World Index. This corresponded with a “flight to quality” in stock selection at the beginning of the period that favored companies with strong long-term reputations and high ESG ratings.⁵ The outperformance of high ESG-rated assets continued as global markets recovered and assumed more of a “risk-on” mentality. The outperformance ended as market signals finally turned neutral, completing a cycle of risk-off, risk-on and neutral phases.⁶

The European debt crisis and U.S. credit downgrade in the summer of 2011 once again reset market expectations. A new cycle began with high ESG-rated assets in Europe particularly subject to downward pricing pressure in the first risk-off phase. As the market bottomed and entered a new risk-on phase, high ESG-rated assets outperformed in the first half of 2012, followed by choppier performance in the second half of the year. In other periods of this time series, the asset specific contribution of high ESG-rated assets was mostly negative; hence, we realized a slight negative contribution from an ESG tilt over the entire time series.

⁵ For historical comparisons, see Robert Eccles, Ioannis Ioannu and George Serafeim, “The Impact of Corporate Culture of Sustainability on Corporate Behavior and Performance,” Harvard Business School Working Paper 12-035, Nov. 4, 2011; and Sandra A. Waddock and Samuel B. Graves. “Finding the Link Between Stakeholder Relations and Quality of Management,” *Journal of Investing*, Winter 1997.

⁶ Risk on, risk off has recently become a common way to describe market behaviour, but the delimitation of the different periods is not well-defined. See Costabile, Marossy “Risk On, Risk Off in a Multifactor World” for a more quantitative approach to the problem. They describe and estimate a global regime switching model with three market states: risk-on, risk-off, neutral. In this paper, we use the risk-on/risk-off/neutral periods defined therein.

Figure 2: Return Decomposition of ESG Tilt Strategy 1, February 2007 – December 2012.⁷



Analysis of the Asset Specific Component

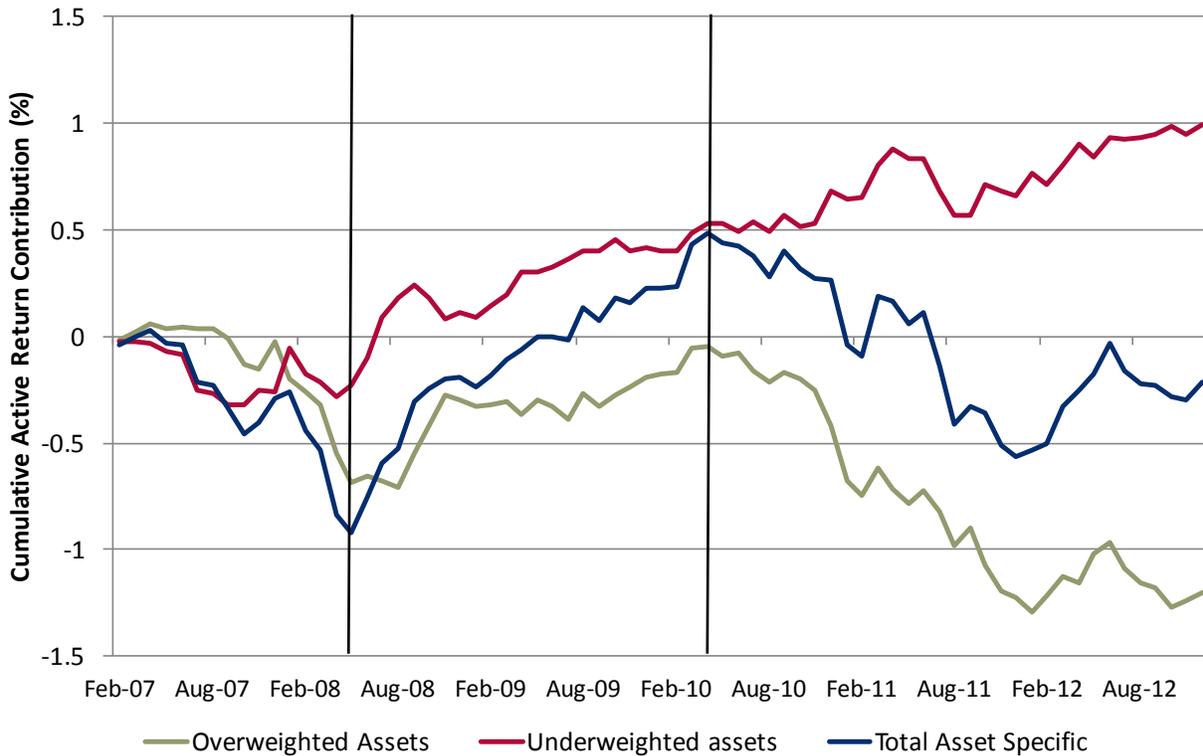
The asset specific component – reflecting the effect of ESG tilt net of any other systematic risk source – can be further decomposed into contributions from both overweighted and underweighted stocks. For the purpose of this paper, we selected the decomposition of Strategy 1 shown in Figure 3 below, but the results are qualitatively similar for the other strategies.

Figure 3 provides further insight to this cyclical behavior of the asset specific contribution into contributions, and allows us to disentangle the role of higher- and lower-ESG rated stocks. The intended result of employing this ESG tilt strategy is a “symmetric” positive contribution to asset specific returns, whereby lower-ESG rated assets tend to underperform (and thus have a positive contribution due their underweighting), while high-ESG rated assets tend to outperform and are overweighted to boost returns. However, our results over the observed time period show an “asymmetry,” where underweighted assets tended to underperform as intended with this strategy, while overweighted assets did not outperform consistently and showed a mostly negative and more uneven, cyclical contribution. In line with our previous observation, the positive contribution was concentrated in the

⁷ Vertical lines denote May 2008 and April 2010.

complete regime switching cycle that started with an extended “risk-off” period in 2008 followed by a risk-on period in 2009.⁸

Figure 3: Decomposition of the Asset Specific Component of ESG Tilt Strategy 1, February 2007 – December 2012.



In general, this finding suggests that the market’s overall reaction to companies with above average and below average ESG practices and ratings was not treated equally during this period. The market placed a more consistent pricing penalty on companies with lower ESG scores than it rewarded companies with higher ESG scores.

We offer some possible explanations for this asymmetric result. Due to investors’ aversion to loss, downside ESG risks may be incorporated more quickly into stock prices than long-term upside ESG opportunities. Lower ESG ratings take into account event-driven “bad” news like accidents, product recalls, governance controversies and regulatory decisions that pose immediate threats to financial performance.

Conversely, higher ESG ratings reflect and anticipate “good” news that is more secular and long-term in nature and, hence, more subject to market discounting. Examples include: implementation of sustainable resource practices, progress toward low-carbon energy use, increases in employee training and motivation, consumer-driven product innovations and shareholder-led governance reforms. It

⁸ While it is outside the scope of this paper, ESG ratings may be seen as a proxy for forces external to the market that are subject to near-term regulatory control. Over the recent time period, high-rated ESG assets tended to outperform at times of heightened anticipation of regulatory risks and underperformed as these risks subsided. This may be subject to further research.

follows that company efforts to enhance their ESG performance may take longer to appreciate in market value than their ESG shortcomings, which are more instantly recognized and priced into the market.

Details of ESG Momentum Approach

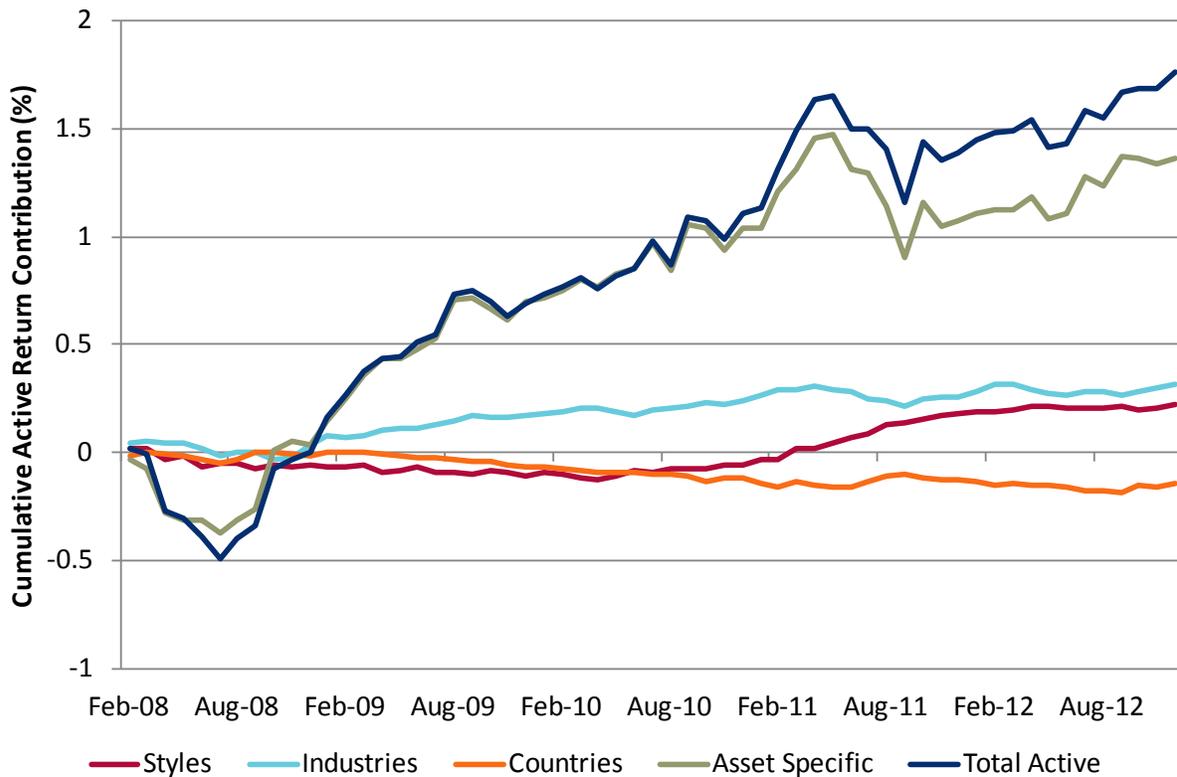
The high latency that may characterize the incorporation of positive ESG ratings into stock prices, as explored earlier, is a motivation for a third and final ESG investing strategy addressed in this paper. In the ESG momentum strategy, we replace the ESG ratings with the *change* in ratings over the past 12 months as our input variable for portfolio optimization. By doing this, we aim to overweight, relative to the MSCI World Index, companies that increased their ESG ratings during the recent past and underweight those with decreased ESG ratings (see the Appendix for technical details). Due to the 12-month period over which ratings changes are calculated, our analysis for this strategy starts in February 2008 and runs through December 2012.

Table 5: Comparison of ESG Momentum Strategies with ESG Tilt Strategy 1, February 2008 – December 2012.

	ESG Momentum 1	ESG Momentum 2	ESG Momentum 3	ESG Tilt 1
Active return (annual, %)	0.35	0.40	0.29	0.05
Common factor contribution (annual, %)	0.08	0.10	0.09	0.03
Asset specific contribution (annual, %)	0.27	0.30	0.21	0.01
Tracking error (ex-post, annual %)	0.36	0.43	0.84	0.46
Information ratio	0.97	0.92	0.35	0.10
Average improvement in ESG score	0.46	0.52	0.65	1.21
Average relative improvement in ESG score (%)	8	10	12	22
Turnover (annual, %)	20	20	20	20

Results corresponding to a range of tracking error levels are summarized in Table 5. We find that during the observed period low active-risk ESG momentum strategies performed better on a risk adjusted basis than the lowest-risk ESG tilt strategies. Another observation is that the contribution of the asset specific component was also higher than in the simple ESG tilt strategies (see Figure 4 for the time series return attribution). This may reflect that markets are more likely to react to news of companies showing changes in their ESG scores than to those who had already attained top-level ratings in their sectors.

Figure 4: Return Decomposition of ESG Momentum Strategy 1, February 2008 – December 2012.



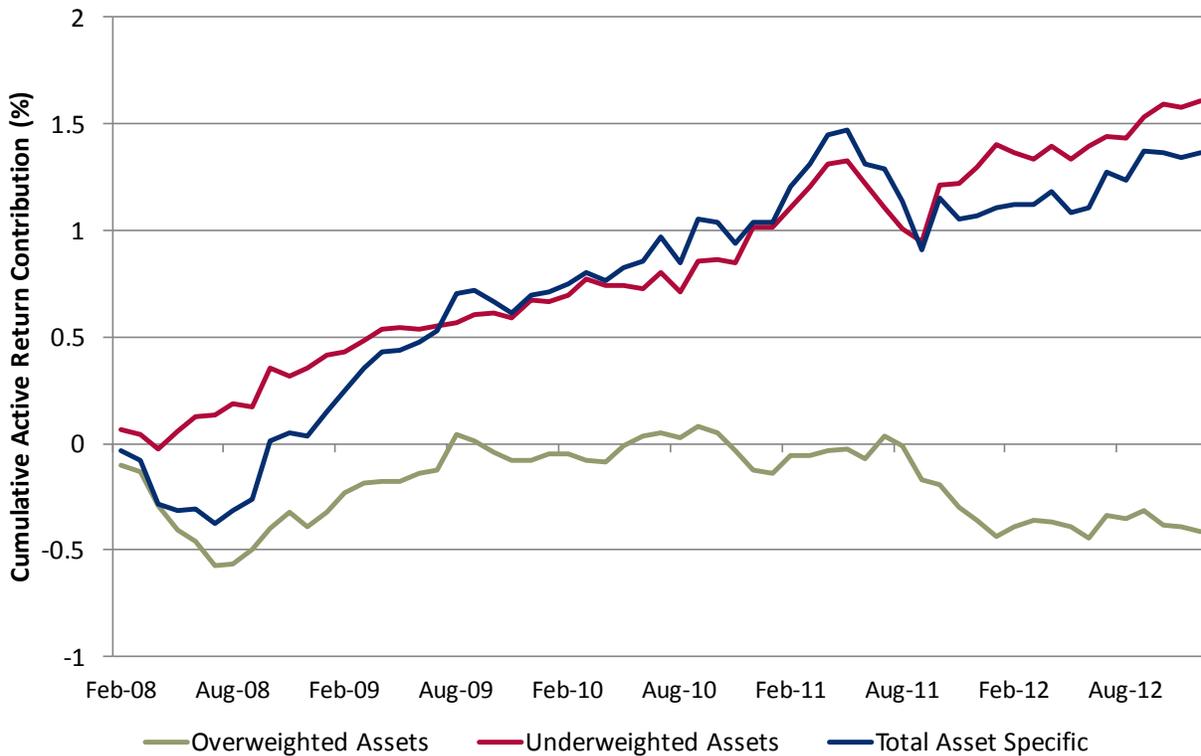
On the other hand, this relatively better performance came at the price of a smaller improvement in the portfolio’s overall ESG rating. For Strategy 1, the gain with respect to the MSCI World Index was only 0.46 points for the ESG momentum strategy, compared to 1.18 points for the simple ESG tilt strategy.

Comparing the asset specific contributions of the ESG tilt and ESG momentum strategies on Figure 3 and Figure 5, we find some similarities and differences. On the one hand, we again observe an asymmetry between contributions coming from underweighted assets that received ratings downgrades over the time period and contributions from overweighted assets that were upgraded. As Figure 5 shows, underweighted, downgraded assets tended to have a consistent positive contribution to portfolio performance, whereas overweighted, upgraded stocks had a small, more cyclical and overall negative contribution over the time period.

On the other hand, the asymmetry between over- and underweighted assets’ contributions was smaller in the ESG momentum strategy than in the ESG tilt strategy, and thus more in line with the intended results for portfolio performance. Underweighted assets in the ESG momentum strategy contributed approximately 1.6 percent in positive cumulative active returns over the study period, or 0.6 percent more to the active returns than in the ESG tilt strategy shown in Figure 3. While overweighted assets in the ESG momentum strategy still contributed to portfolio underperformance, the effect was smaller than in the ESG tilt strategy. As shown in Figure 5, the negative cumulative active return was less than 0.5 percent over the study period, compared to a negative return of 1.2 percent for the ESG tilt strategy.

This decomposition of ESG momentum results reinforces our earlier finding that companies associated with negative ESG factors – as reflected in low ratings or ratings *downgrades* – consistently underperformed the market benchmark over the study period, while those with high ratings or ratings *upgrades* had more uneven market performance. This also lends further support to the hypothesis that downside ESG risks, as reflected in low ratings or ratings downgrades, receive a more instantaneous market reaction than long-term upside ESG opportunities, as reflected in high ratings or ratings upgrades. Moreover, over the study period the market appeared to be more sensitive to ratings *changes* than to the effect of *absolute* ESG scores, with ratings downgrades compounding market perception of potential adverse material impacts among the affected firms, while ratings improvements drew added investor recognition to positive ESG factors with less market discounting among companies showing such momentum.

Figure 5: Decomposition of the Asset Specific Component of ESG Momentum Strategy 1, February 2008 – December 2012.



Finally, while the ESG momentum strategy limited the overall ESG tilt of the portfolio, the trade-off came in exchange for a higher information ratio over the study period. This strategy rewarded companies demonstrating *progress* in managing ESG risks and realizing ESG opportunities, even if they had not yet achieved top-level scores. Accordingly, for this study period, institutional investors tilting to companies that made continual progress in addressing ESG material risks would have seen a lower ESG rating for their portfolio overall, relative to the simple tilt strategies, but with the benefit of higher active returns and a lower tracking error.

Conclusion

We examined possible implementations of ESG-tilt strategies based on MSCI's ESG Research Intangible Value Assessment (IVA) scores. Our observations are limited to the historical period that we studied (February 2007 through December 2012), and do not necessarily reflect the results or performance of other periods or future periods. As additional data becomes available to extend the time series, investors may wish to conduct further research on these strategies to compare the results presented here.

Using the MSCI World Index as a benchmark, and the Barra Global Equity Model (GEM3) as a risk model, we ran a series of backtests for the period February 2007 – December 2012 with the same constraints on systematic exposures, but with increasing tracking error levels. We found that during the observed period it was possible to build portfolios with equivalent risk, performance, industry, country or style characteristics as conventional benchmarks, while also raising ESG portfolio scores. We presented three families of strategies, all based on the IVA dataset.

The first strategy – based only on the exclusion of low-rated companies before the application of the ESG tilt – led to a small improvement in ESG scores, and negative performance results. There was a positive contribution from stock selection based on IVA scores, but the resulting residual bets led to a negative active return. Applying a further systematic tilt on top of the exclusion reduced the residual contributions and led to a small positive active return for the lowest risk strategy, while also improving the ESG rating of the portfolio from 'BBB' to 'A.'

When we applied the optimized ESG tilt strategies to the entire MSCI World universe, we found that the active return was generally small, and slightly negative. At the low-risk end of the ESG-tilted spectrum, a 44 basis point tracking error strategy also attained a one-notch increase in overall ESG portfolio rating to 'A' with returns that matched the market. Decomposing active performance into systematic and stock-specific components, we observed that the low cumulative performance in the ESG tilt strategy was due to the cyclical nature of the stock-specific component.

Moreover, between May 2008 and April 2010, and more recently in the first half of 2012, the active performance of higher-rated ESG companies turned significantly positive. We observed that during this period high-rated ESG assets started to outperform when the market was in a defensive, "flight to quality" mode and extended their gains when more of a "risk-on" market mentality took hold. The outperformance ended when market signals turned neutral, completing a regime switching cycle. We further hypothesize that downside ESG risks potentially may be incorporated into stock prices more quickly than long-term ESG opportunities. This is because downside risks tend to be more event-driven and instantly recognized than long-term ESG opportunities that are evolving, discounted, and correlated with changing market and geo-political conditions.

Based on this observation, we implemented a third series of strategies based on the change in company ESG scores. Our analysis revealed that during the observed period the ESG momentum strategy tended to deliver better risk-adjusted performance than the other strategies we analyzed. We found that when we decomposed the ESG momentum strategy, ESG ratings downgrades had a consistent negative effect on asset specific performance over the time series, while ESG ratings upgrades had a more positive effect during "risk off–risk on" periods in the regime switching cycle. While the ESG momentum strategy came with a lower ESG tilt, it still supported positive movement on ESG scores at the portfolio level.

Our study's main conclusion is that asset managers would have been able to employ ESG factors to attain higher ESG portfolio scores with low active risk, and still achieve moderate benchmark outperformance over the time period from February 2007 through December 2012.

Appendix: Backtest Parameters

The benchmark portfolio was the MSCI World Index. The company universe was also the MSCI World Index, except for the ESG exclusion strategies, where the universe was the MSCI World portfolio without the 'CCC'-rated stocks.

The long-horizon Barra Global Equity Model (GEM3L) was used as a risk model.

Stock-level alpha was calculated as follows. The IVA scores (for ESG tilt and exclusion strategies), or the changes in IVA scores (for ESG momentum strategies) were transformed into alpha following the heuristic method described by Richard C. Grinold, in "Alpha is Volatility times IC times Score."⁹ Namely, when defining the alpha, the stock's standardized score was adjusted by the specific volatility forecast of the stock.

We applied the following constraints on country, industry and style characteristics:

- Maximum +/-1% region weight deviation relative to the benchmark. The three regions are North America, EMEA and Asia Pacific
- Maximum +/-1% GICS® sector weight deviation relative to the benchmark
- Maximum +/-0.25 GEM3 style factor active exposure relative to the benchmark

We set a lower and upper bound on the weight of benchmark stocks in the optimized portfolio at 0.001 percent and 5 percent (except for the ESG exclusion strategies).

The portfolios were rebalanced quarterly starting in February 2007, with a 5 percent turnover limit.

The risk aversion parameter ran through the values of 1, 4 and 6. The ratio of common factor to asset specific risk aversion was set to 1.

⁹ Richard C. Grinold, "Alpha is Volatility times IC times Score," *The Journal of Portfolio Management*, Summer 1994.

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