

# Sustainable Systematic Credit

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## Abstract

Interest in sustainable investing has exploded in recent years, initially focused on public equity markets, but now evolving into fixed income. We assess various aspects of sustainable investing for developed market corporate bond markets (both Investment Grade and High Yield). Using a representative set of sustainability measures spanning environment, societal and governance (ESG) constructs we find: (i) credit spreads are only marginally associated with ESG measures, (ii) ESG measures are only marginally associated with standard return forecasting measures for corporate bonds, (iii) ESG measures are not reliably associated with future credit excess returns, and (iv) ESG measures are negatively associated with the future volatility of credit excess returns. While the direct investment impact of sustainability is modest, there is still considerable interest from asset owners to ensure credit allocations are sustainable. We find that it is possible to incorporate (i) both static and dynamic exclusion screens, (ii) positive tilts toward more sustainable issuers, and (iii) economically meaningful reduction in carbon intensity, with minimal portfolio distortions. Thus, a well-implemented systematic approach has the potential to offer attractive risk-adjusted returns in a sustainable manner.

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*Key words:* ESG, credit, fixed income, portfolio choice, socially responsible investing, CSR

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## Introduction

The dramatic rise of sustainability-oriented strategies is no longer surprising: the investment media continuously provide new reports on flows and AUM into ESG-oriented strategies (note we will be using ‘sustainability’ and ‘ESG’ interchangeably). More interesting, however, is that after decades of being dominated by public equity market strategies, the popularity of ESG investing is now expanding to other asset classes. Interest in ESG is relevant beyond corporate securities (spanning the entire capital structure of claims), and increasingly includes country-level investment decisions (for both local and hard currency bonds, and country equity allocations), and even commodity allocation decisions. We discuss extending sustainable investing up the capital structure, with a specific focus on corporate bonds issued by issuers domiciled in developed markets, covering both Investment Grade (IG) and High Yield (HY) rated corporate issuers. While our empirical analyses focus on developed markets, we posit that the patterns we describe will hold for emerging issuers as well (subject, of course, to data reliability issues). We also focus on “traditional” bonds, because today’s issuance is still dominated by them (e.g., Bank of America, 2021, reports only a quarter of European IG issuers have any labeled bonds), and traditional general purpose bonds are likely to remain key for core credit portfolios. Of course, as labeled bonds become more popular, ESG-oriented portfolios will surely include them.

There have been substantial flows into sustainable IG and HY strategies recently. Goldman Sachs (2021) reports inflows of \$79.2B into ESG-labeled corporate IG strategies, and \$31.6B into ESG-labeled HY strategies, from January 2020 through January 2021, across both US and European markets. While this growth is exceptionally large relative to history, it is still small relative to the respective size of the US (EU) corporate bonds market of nearly \$10T

(\$3.5T). With the continued rise of asset ownership in sustainable-linked investments and regulatory pressure to ensure investments are linked to sustainable objectives, this is a trend that is likely to continue and perhaps even accelerate.

We have two primary sets of empirical analyses. First, we assess the direct investment relevance of ESG measures for corporate bonds. This includes an examination of how ESG measures correlate with (i) credit spreads, (ii) other well-known forecasts of credit excess returns, (iii) future credit excess returns, and (iv) future volatility of credit excess returns. These correlations depend on whether measures of sustainability are priced ex ante in credit markets, which in turn is a function of how these measures affect expectations of cash flow generating capability of the corporate issuer and associated discount rates. This is a complicated system to fully specify ex ante, so one can view our exercise as an in-sample exercise to assess whether, and how, a given set of measures of sustainability relate to outcome variables in credit markets. While the framework we develop can be used with any ESG measure, for our empirical test we focus on the data from the MSCI ESG database as a representative measure of ESG data used in real-world portfolios.

Consistent with Polbennikov et al. (2016), we find only modest evidence that ESG measures explain cross-sectional variation in credit spreads, at least in the presence of typical explanatory variables such as distance-to-default.<sup>1</sup> We find no evidence that ESG measures are related to future credit excess returns, but we do find some evidence that ESG measures are associated with the volatility of future credit excess returns. We acknowledge that the limited time series of data and relatively low correlation of ESG measures across providers (Christensen,

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<sup>1</sup> Rahman et al. (2021) perform a similar analysis of sovereign bonds, also finding that higher issuer ESG scores correlates with tighter credit spreads.

Serafeim, and Sikochi, 2021), means it is challenging to make strong statements about the usefulness of ESG measures to directly improve return or risk forecasts. This may seem bad news for ESG investing advocates, but we also note that ESG measures are relatively lowly correlated with standard forecasts of returns. This means that even a modest correlation with excess returns could still be incrementally useful in an investment process.

Second, we examine how ESG measures can be incorporated in an investment process to help achieve the joint objective of maximizing risk-adjusted returns and a sustainability target. Our conversations with allocators and broadly available survey evidence (e.g., Callan, 2020) suggest a range of design choices that are typical for many investors: (i) static tilts to remove issuers engaged in generally accepted non-sustainable business models (e.g., controversial weapons, tobacco, or coal), (ii) dynamic tilts to remove issuers that score poorly relative to their peers across ESG measures, (iii) tilting toward issuers that score favorably relative to their peers across ESG measures, and (iv) reducing the carbon intensity of the portfolio via under-weighting heavy greenhouse gas emitters. There is an obvious reduction in investment breadth because of the exclusions, but there are still enough ‘sustainable’ issuers to be able to engage in security selection and still provide benchmark-relative performance. Specifically, we find only modest distortions (lower expected returns and possibly higher tracking error from reduced investment opportunity set) from incorporating such ESG objectives. Consistent with the work in Fitzgibbons, Pedersen and Pomorski (2020), we find that the ESG-efficient frontier for a sustainable systematic credit portfolio is, within our examined tilts, relatively flat.

## **Data**

### **Credit Market Data**

We use data from ICE/BAML for our analysis of secondary market data for corporate bonds. We examine four distinct categories of corporate bonds: (i) US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index, (ii) US HY bonds (ICE/BAML H0A0 index), (iii) European (EU) IG includes all GBP and EUR denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index, and (iv) EU HY bonds (ICE/BAML HP00 index). All of our bonds are issued by corporations domiciled in developed markets.

Figure 1 plots the market capitalization of the four indices over our sample period. As of December 2020, the total market capitalization of corporate bonds is \$14.05 trillion dollars, led by US IG (\$8.12T) and with European IG (\$3.84T). The HY markets are smaller with \$1.55T (\$0.54T) outstanding for US (European) markets respectively. The large size of these markets, and the role of corporate bonds in asset owner allocations, motivates our study of sustainability for this market. Another important consideration of the sustainability footprint of corporate bond investments is that these securities are senior claims in the capital structure (a focus solely on the junior equity claim risks missing a larger part of the enterprise value of firms).

As we highlighted in the introduction, there are meaningful inflows into ESG-oriented portfolios. As of 2021, these still add up to only a small minority of total AUM but are likely to increase in importance in the future, as more allocators consider ESG objectives.

Figure 2 plots the number of unique issuers across the four indices. Clearly, part of the growth in corporate bond markets is attributable to a growing number of companies seeking to

raise debt financing in public bond markets. As of December 31, 2020, there were 1,134 (794) issuers in the US (EU) IG markets, and 860 (362) issuers in the US (EU) HY markets. An important aspect of the corporate bond market is that each corporate issuer may have multiple issues (bonds) outstanding. Figure 3 plots the number of issues across the four indices. Again, there is a clear increase in the number of issues (bonds) over time reflecting the general increase in the size of corporate bond markets. The occasional ‘drops’ in number of issues are attributable to changes in index inclusion rules (e.g., changes in the minimum allowable size of the bond). As of December 31, 2020, there were 9,166 (4,334) issues in the US (EU) IG markets, and 2,030 (756) issues in the US (EU) HY markets. Figure 2 and 3 show that the average issuer in US (EU) IG market currently has about 8 (5) bonds outstanding, and the average issuer in the US (EU) HY market currently has about 2 (2) bonds outstanding. In our later empirical analysis, we make full use of the corporate bond data available to us, but the multiple issues per issuer phenomenon requires adjustments to standard errors to account for correlation across observations.

## **ESG data**

There are a variety of ESG data investors may consider, and some commentators go as far as to argue that each investor’s ESG needs are unique. We do not believe this is necessarily the case, and we do not attempt to test all possible databases from a plethora of providers, if only because of data mining concerns. Instead, we focus on two broad metrics that are meant to capture the typical applications in this space, stressing that the framework we develop here is general enough to be applicable to any ESG data that other researchers may want to consider.

For the overall ESG profile of an issuer, we use MSCI ESG data, measuring the issuer’s ESG score relative to industry peers, from 0 (worst) to 10 (best in class). MSCI ESG data is

designed to give users a holistic assessment of companies' ESG risks, leveraging a range of company disclosures (e.g., corporate filings, CSR reports, etc.) and information from sources not controlled by the company (e.g., news media, government data, etc.). The scores reflect ESG risk exposures based on issuers' business and geographic segments, and reflect if, and how, the issuer manages such underlying ESG risks. Prior work in equity markets has shown that this data is correlated with issuers' risk profile, whether measured by traditional risk models or by quality-type factors and that this ESG data has some power to predict issuers' future risks, as much as five years out (see e.g., Dunn, Fitzgibbons, and Pomorski, 2018).

Moreover, to capture an increasingly important ESG objective, we consider an issuer's greenhouse gas emissions, expressed in terms of carbon dioxide (CO<sub>2</sub>) equivalents, and provided to us by Trucost. We focus on scope 1 plus scope 2 emissions here, as scope 3 data, while very important in principle, is not currently measured precisely enough for many asset owners to rely upon. For example, Callan (2020) reports that while some of their survey respondents considered scope 3 data, none adopted it in live portfolios.

## **Initial Results**

Table 1 reports summary statistics for our four corporate bond universes. Our sample covers the December 2012 through to April 2021 period. We start our sample in December 2012 to ensure sufficient coverage of MSCI ESG data across our corporate bond universes. In each month we compute the average, median, lower quartile (Q1) and upper quartile (Q3) of our key variables which include: (i) credit spreads, (ii) spread duration, (iii) DTS (the product of credit spread and spread duration, often used as a heuristic for credit risk), (iv) credit excess returns

(labeled XS\_Return and computed as the difference between total returns (cum-coupon) for the bond less the total return of a key-rate matched government bond, (v) Size (par value of the bond), and (vi) ESG and its constituent measures. Table 1 then reports the median value of the respective cross-sectional distributional statistics across the 101 months in our sample period.

A few observations are worth noting from Table 1. First, as indicated by the number of observations in each row, the coverage of ESG data from MSCI is not complete. For example, the median coverage in ESG data for US (EU) IG is about 84 (74) percent on average. This is less than 100 percent for two reasons: (i) MSCI does not compute ESG data for all public issuers, and (ii) private issuers tend not to be covered historically. The coverage is lower in EU, where there is a higher concentration of private issuers. Across public issuers, MSCI ESG data coverage spans over 90 (87) percent in the US (EU) IG universes in 2012, and over 80 (82) percent of the US (EU) HY universe in 2012. Coverage is well over 90 percent of public bonds for all four corporate bond universes toward the end of our sample period. In our later empirical tests (i) linking measures of ESG to credit spreads and credit excess returns, we limit ourselves to the set of bonds that have MSCI ESG coverage, (ii) building sustainable systematic portfolios we include all bonds even those with missing ESG score (when we discuss Figure 8 and Table 8 we describe how the missing observations are handled).

Second, there is considerable variation in ESG and the constituent measures E, S and G across all four corporate bond universes. This suggests there should be sufficient power to identify any relation between measures of ESG and investment outcome variables. Third, the values of the constituent measures E, S and G are generally higher in the EU compared to the US, especially for HY. This difference has implications for portfolio construction choices on global corporate bond portfolios, but our focus in this section is on variation in each of our four



corporate bond universes. Fourth, credit excess returns have tended to be higher in HY markets relative to IG markets. This is not surprising as there is higher risk in HY markets relative to IG markets and over time there is a positive risk premium associated with that higher credit risk (e.g., Giesecke et al, 2011; Asvanunt and Richardson, 2017). More generally, there is considerable heteroskedasticity in credit excess returns both across and within IG and HY corporate bond markets. Our later empirical tests will account for this heterogeneity by seeking to explain cross-sectional variation in DTS-scaled credit excess returns (see e.g., Ben Dor et al., 2007).

Table 2 reports temporal variation in some of our key variables, showing median values for the month of December for each year. Credit spreads are regularly lower for IG issuers relative to HY issuers in both the US and EU. Spread duration has moderately extended over this time period (IG) reflecting the issuance of longer maturity corporate bonds over the last decade. There is a marginal increase in ESG scores over time (stronger for IG markets).

### **Sustainability and credit spreads**

Table 3 reports our first empirical results documenting the relation between measures of sustainability and credit spreads. Our tabulated results are based on a panel regression inclusive of time (year-month) fixed effects where standard errors are clustered on both the time and issuer dimensions. In untabulated tests we have also run Fama-Macbeth regressions, with very similar inferences. Due to some extreme values of spreads (primarily during early 2016 and early 2020) we remove the top 1 (3) percentiles of observations in each cross-section for IG (HY) universes respectively (consequently, the sample size for credit spreads is slightly smaller than the sample

used later for credit excess returns). Our inferences are unaffected if we retain all observations (i.e., ESG measures are only weakly correlated with credit spreads after controlling for default probability), but overall explanatory power is lower.

Our primary regression specification is as follows:

$$Spread_{i,t} = \alpha + \beta_{ESG} ESG_{i,t} + \beta_{PD} PD_{i,t} + \varepsilon$$

We estimate this regression eight times for each of our four corporate bond universes. The first specification includes only the industry adjusted ESG score from MSCI. The second specification adds a forecast of default probability (PD). We use a combined PD based on multiple forecasting methods (linear, structural and machine learning). Details of the typical PD measure used can be found in Correia, Richardson and Tuna (2012) and Correia, Kang and Richardson (2018). It is important to control for fundamental determinants of credit spreads (i.e., expected loss given default, E[LGD]). E[LGD] is comprised of two components: an expected default rate and an expected recovery rate. The former is explicitly controlled for in our regressions. The latter is less relevant for our setting because recovery rates primarily vary through time (e.g., are lower in bad states of the world), across sector (e.g., are higher in hard asset industries where resale value of assets is easier), and across the capital structure (e.g., are lower for subordinated bonds relative to senior bonds). This is because our analysis is primarily cross-sectional, industry-adjusted and within a reasonably homogenous slice of the capital structure (most bonds are senior unsecured). The remaining six specifications examine the relation between E, S and G and credit spreads with and without PD. Given the constituent E, S and G measures are not industry adjusted, regression specifications III-VIII include industry fixed effects.

Across all four corporate bond universes, regression specification I reveals a consistent negative relation between ESG and credit spreads. A negative relation implies that higher scores of sustainability are associated with lower credit spreads, suggestive of an ex ante pricing impact of ESG/sustainability. The negative relation generally extends to the component measures E, S and G across our corporate bond universes, albeit weaker in EU (specifications III, IV, and V). The regression coefficient of -4.57 for the US IG universe suggests that a change in the ESG score from the lower quartile (3.5) to the upper quartile (6.8) is associated with a 15-basis point lower credit spread. This corresponds to 10-15% of the typical credit spreads in our sample, meaning that the economic magnitude of the correlation is relatively sizeable.

However, inferences change when we account for underlying credit risk directly with the inclusion of default forecasts.<sup>2</sup> Regression specification II shows that after controlling for default probabilities directly, the negative relation between ESG and credit spreads is smaller across all four corporate universes and is only significant for US IG. This is also true for specifications VI, VII and VIII that examine E, S, and G individually, controlling for default probabilities. Of note is the large incremental explanatory power from default probabilities in explaining credit spreads (see e.g., Correia, Richardson and Tuna 2012; Correia, Kang and Richardson, 2018). Polbennikov et al. (2016) also find a negative univariate correlation between ESG scores and credit spreads for US IG corporate issuers over the 2006-2015 period, and document that this relation is evident after controlling for credit ratings and industry fixed effects.

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<sup>2</sup> Data on default forecasts does not have perfect coverage, so our sample size drops by 18-25% when we include it. This is primarily due to the requirement of equity market data to compute distance to default. Our results are unaffected if we restrict the universe to be the same across all specifications.

The panel regressions reported in Table 3 mask any temporal variation in the relation between measures of sustainability and credit spreads. As noted earlier, we have also run monthly Fama-Macbeth regressions and find similar results. A benefit of these monthly regressions is that it is possible to then observe temporal variation in the monthly estimated regression coefficients. Across all four universes, with or without controlling for default forecasts, we do not find reliable evidence of a temporal trend in the relation between measures of sustainability and credit spreads. There is a noticeable increase in the negative relation between measures of sustainability, mostly attributable to the E and S components, and credit spreads during the COVID pandemic (especially March 2020), but outside of that spike there is little to suggest a trend consistent with increasing importance given to sustainability considerations in the determination of credit risk.

The analysis in Table 3 includes a broad set of bonds covering many developed market corporate issuers, but also covering multiple maturities. This unique aspect of corporate bond markets provides a rich experimental setting where we can hold issuer effects fixed and focus on how a characteristic, such as sustainability, affects the term structure of credit spreads. Issues related to sustainability may take considerable time to manifest and impact operating, investing, and financing decisions of corporate issuers. To help isolate the longer-term risks related to sustainability we also examine pairs of bonds issued by the same corporate issuer. Specifically, for each corporate issuer that has more than one bond outstanding in each month, we select the bond with the highest option-adjusted spread duration. We then pair that bond with another bond of the same seniority from the same issuer, but with the lowest option-adjusted spread duration. We then compute the difference in credit spreads across these two bonds and scale it by the difference in spread duration. This metric captures the slope of the credit curve and is

standardized to allow comparison across corporate issuers who have differences in the maturity profile of their outstanding debt. In unreported analysis we run a panel regression for each of our four corporate bond universes projecting the slope of the credit curve onto ESG and only find a significant negative relation for the US IG universe, suggesting there is some evidence that the relation between measures of ESG and credit risk is attributable to longer term risks.

Overall, we interpret Table 3 as showing that while there is an unconditional association between ESG measures and credit spreads, this relation is not robust to the inclusion of fundamental measures of credit risk. It could mean that (i) the quality of data on ESG/sustainability is insufficient to identify the relation, (ii) ESG/sustainability does matter but over this sample period investors are not pricing this information *ex ante* into credit spreads, or (iii) inclusion of measures of credit risk is crowding out the potential for ESG/sustainability to explain credit spreads (i.e., part of ESG information that matters might be subsumed by our measures of default probabilities). While it is difficult to empirically distinguish these possible explanations, examination of other ESG/sustainability data sources can help address concern (i), and we will discuss that at the end of this paper, and examination of future credit excess returns can, in part, address concern (ii), and we will examine that in the coming sections.

### **Sustainability and systematic signals**

Before turning to return predictability tests, it is important to understand what is different or unique for ESG/sustainability measures relative to well-known characteristics that prior research has shown to be useful in explaining credit excess returns (see e.g., Correia, Richardson and Tuna 2012; Chordia et al., 2017; Houweling and van Zundert 2017; Israel, Palhares and

Richardson 2018). In Table 4 we report the median pairwise correlation of ESG, and constituent measures, with four sets of characteristic measures (carry, defensive, momentum and value).

Carry (C) is the expected return for each bond assuming the issuer hazard rate remains unchanged. Defensive (D) is a composite score targeting lower spread duration and higher quality as indicated by various financial statement metrics. Momentum (M) is a composite score reflecting the relative performance of the issuer, measured using a combination of price and fundamental metrics. Value (V) is a composite score reflecting systematic measures of ‘cheapness’, measured as the residual from a cross-sectional regression projecting credit spreads onto forecasts of default probability. We compute these measures at the issuer level and every month we compute correlations between ESG, E, S, G, C, D, M and V. We then compute the median pairwise correlation over time and report that in Tale 4 for each of our four corporate bond universes.

Across all four corporate bond universes and for both the composite ESG measure, and component measures, we see muted correlations with carry, defensive, momentum or value. Assuming there is information content in ESG that can help forecast changes in credit spreads, there is thus the potential for ESG/sustainability measures to provide a diversifying source of return predictability relative to already well-known characteristic forecasts of credit excess returns. The consistently mild negative correlation between carry and ESG measures, and mild positive correlation between defensive and ESG measures, is consistent with our earlier analysis showing an unconditional negative correlation between ESG measures and credit spreads (credit spread is a key input to the carry calculation).

Overall, the relatively low correlations have implications for portfolio design choices we assess below: portfolio that are managed with ESG dimensions in mind may not be strongly

biased toward or away from any specific investment style. Thus, the inclusion of ESG objectives may not distort the portfolio away from an investors' desired investment style composition.

### **Sustainability and future credit excess returns**

Table 5 documents the relation between measures of sustainability and future credit excess returns. As with our earlier analysis of credit spreads, our tabulated results are based on a panel regression inclusive of time (year-month) fixed effects where standard errors account for dependence in the data across both the temporal and cross-sectional dimension.

Our primary return regression specification is as follows:

$$\frac{XS\_Return_{i,t+1} - Beta_{i,t}XS\_Return_{m,t+1}}{DTS_{i,t}} = \alpha + \beta_{ESG}ESG_{i,t} + \beta_{ER}ER_{i,t} + \varepsilon,$$

where  $XS\_Return_{i,t}$  is a given bond's return for month t;  $XS\_Return_{m,t}$  is the overall index return for month t; and  $Beta_{i,t}$  is the bond-specific market beta. The first specification includes only the industry-adjusted ESG score from MSCI. The second specification adds a forecast of expected returns, ER. ER is based on a systematic investment model inclusive of measures of carry, defensive, momentum and value. The remaining six specifications examine the relation between E, S, and G and credit spreads with and without ER. The constituent E, S, and G measures are not industry-adjusted, so specifications III-VIII include industry fixed effects.

Our dependent variable is carefully computed to help mitigate the effects of heteroskedasticity and general market movements. First, we remove the effect of interest rates. This is important and surprisingly is not always done, especially with academic papers utilizing returns data generated from TRACE. Total (cum-coupon) returns for bonds contain two distinct

components: a rates component and a spread component. The rate component of returns can be computed as the product of key rate durations for a given bond with the contemporaneous yield changes at those key points; the spread component (or credit excess return) is then the difference. To the extent that ESG affects returns, it is likely to affect the latter rather than the former. So, ideally, the analysis would be limited to only that source of variation in returns. This is important because a variance decomposition of US IG corporate bond total returns over our sample period suggests that about half of the total return variation is attributable to the rate component of returns. Thus, examining variation in total returns is noisy at best, and worse can lead to incorrect inferences as the rate and spread component of returns tend to be negatively correlated.

Second, we remove the effect of overall credit market movements. To do this we empirically estimate an issuer specific beta. This beta is estimated using issuer and market level credit excess returns. The beta is specific to the local corporate bond universe that bond belongs to (e.g., US IG or EU HY). Third, to mitigate issues related to heteroskedasticity we scale the beta-adjusted credit excess returns by DTS (the product of spread and spread duration) at the start of the month. DTS has been shown to scale proportionally with spread volatility and is therefore useful to deflate realized returns (see e.g., Ben Dor et al. 2007).

Table 5 provides remarkably consistent results across our four corporate bond universes. The relation between credit excess returns and measures of ESG (or E or S or G individually) is virtually non-existent. This inference is true whether we include ex ante forecasts of expected returns or not.<sup>3</sup> In contrast, and consistent with prior research, systematic forecasts of expected returns significantly correlate with future credit excess returns for all four corporate bond

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<sup>3</sup> We confirm this in untabulated Fama-MacBeth regressions as well.



universes. For example, the regression coefficient on ER has an associated test-statistic between 4.88 for EU HY and 9.33 for US IG. Of course, the strength of this association needs the usual caveats (e.g., this is not an implementable portfolio as it assumes instantaneous trading into new positions at the start of each month without any cost).

One final aspect of credit excess returns is its volatility. Is it possible for ESG measures to help improve forecasts of risk? To address this issue, we compute rolling twelve-month volatilities of our beta-adjusted, DTS-scaled, credit excess returns ( $\sigma_{\beta-adj\ XS-RET}$ ) and test whether ESG measures forecast credit excess return volatility. This analysis is carried out at the issuer level. For each of our four corporate bond universes, we run a regression of future credit excess return volatility onto lagged credit excess return volatility and ESG measures. The base regression specification is as follows:

$$\sigma_{\beta-adj\ XS-RET_{i,t+12}} = \alpha + \beta_{ESG} ESG_{i,t} + \beta_{\beta-adj\ XS-RET} \sigma_{\beta-adj\ XS-RET_{i,t-12}} + \varepsilon$$

Table 6 reports the results. Panel A contains the regression results where credit excess returns are both beta-adjusted and DTS scaled. Across all four corporate bond universes we find very strong evidence of persistence in return volatility. However, we find very little evidence that ESG measures are associated with future return volatility. ESG is not significant in any of the four universes including or excluding lagged volatility. In unreported tests, we find that the E component of ESG is marginally significant (test statistic of -1.99) in the US HY universe and significant in the US IG universe (test statistic of -2.74). The S and G components are not significant in any of the regression specifications. A limitation of the DTS scaled returns is that any future change in the DTS of the issuer will affect the measure of volatility. While DTS scaling returns is standard to homogenize the return series, this could mask economically

important variation in credit excess returns, and to the extent that ESG is associated with DTS (which Table 3 suggested) this could dampen the ability of ESG measures to explain variation in return volatility. So, in panel B we repeat the analysis without scaling credit excess returns by DTS. In this specification we add DTS as an explanatory variable, measuring DTS contemporaneous with ESG at the start of the 12-month period over which return volatility is computed. The results in panel B suggest a reliably negative association between measures of ESG and future return volatility (only the EU HY universe has insignificant results). Note, however, that after including lagged values of return volatility and DTS the importance of ESG is reduced by two-thirds across all four investment universes. The economic significance of ESG for explaining future return volatility is also modest. For example, the regression coefficient of -0.0003 for the US IG universe, after controlling for lagged volatility and DTS, implies that an inter-quartile change in ESG (Table 1 reports 3.3 for US IG) is associated with a reduction in return volatility of 0.00099. Relative to the full sample average return volatility for US IG (2.48%) this is a reduction of 4 percent of the average value.

The key inference that measures of ESG/sustainability are not reliably associated with future credit excess returns and only weakly associated with volatility of future returns will be controversial. Does this mean that sustainability is not relevant for credit investors? We feel such a conclusion is premature. We have examined only one data provider for a limited period. All we can say is that over the period 2012-2020 with our datasets, we do not observe a relation between measures of ESG and credit excess returns. Perhaps with other data sets and different time periods results might be different. We return to this point in our concluding discussion.

## **Portfolio construction: a sustainable systematic corporate bond portfolio**

We now turn our focus to an implementable portfolio that has awareness of sustainability considerations. For this section of the paper we limit our analysis to the HY universe spanning both US and EU markets. Our portfolio seeks to maximize credit excess returns relative to a global high yield benchmark (ICE/BAML Developed markets High Yield Index, ticker: HYDM) whilst simultaneously targeting various sustainability objectives. The portfolio seeks to buy corporate bonds that have attractive expected returns based on a broad systematic model (including measures of carry, defensive, momentum and value described previously) whilst maintaining (i) an attractive liquidity profile (i.e., avoiding particularly illiquid bonds, sizing positions proportionately to underlying trading volumes, and transacting in corporate bonds in a liquidity aware manner), and (ii) a risk profile close to that of the benchmark (i.e., ensuring the selected bonds have a beta exposure similar to the overall benchmark, as well as region, maturity, rating, and sectors allocations similar to the benchmark). This would be a ‘standard’ systematic portfolio. The ‘standard’ portfolio already includes measures related to ‘governance’. Specifically, we include measures related to financial reporting quality that reflect the overall management governance of the firm (see e.g., Sloan, 1996 and Richardson, Sloan, Soliman and Tuna, 2005). These measures of financial reporting quality are included as part of the comprehensive forecast of expected returns.

To make the portfolio ‘sustainable’ additional choices need to be integrated into the portfolio construction process. First, we incorporate static screens to remove issuers whose business models cover controversial weapons, fossil fuels, and tobacco. Second, we incorporate tactical/dynamic screens that exclude the ‘worst’ corporate issuers from a sustainability perspective (defined as belonging to the bottom ten percent of ESG scores for that issuer’s

region). Third, we explicitly tilt the portfolio to achieve an overall ESG score that is ten percent better than the benchmark. Fourth, we ensure that the final portfolio always has a carbon intensity that is at least 25 percent below that of the benchmark.

### **Exclusions: how large and how significant?**

Historically, the most popular ESG design choice was an investment restriction (i.e., exclusion), ensuring that a portfolio does not have exposure to issuers considered particularly problematic. Exclusions are still important today as many asset owners have explicit views on corporations whose business models produce ‘undesirable’ outputs (e.g., tobacco, controversial weapons, or fossil fuels). These views may be driven by ethical considerations, peer pressure, stakeholder preferences, and regulation. Exclusions are necessary here to avoid any, and all, exposures to ‘undesirable’ corporations.

For our global HY portfolio we can assess the impact of screens via two types of exclusions. First, there are static business-activity based exclusions. For these screens we use MSCI data to identify corporate issuers in (i) tobacco (defined as corporations with more than 5 percent of revenue generated from tobacco), (ii) controversial weapons (defined as corporations involved in the production of, or key components to, or generating revenue from controversial weapons including cluster munitions, landmines, chemical and biological weapons), (iii) fossil fuels (defined as corporations with any fossil fuel reserves or deriving more than ten percent of their revenue from either thermal coal or oil sands). These exclusions are static (i.e., relatively fixed through time) as the business activities are generally core to each corporation.

Second, there are tactical exclusions based on industry-relative ESG scores. For this purpose, we use MSCI ESG scores as described previously. Specifically, each month for both the US HY and EU HY universes separately, we remove the bottom ten percent of issuers based on their industry-relative ESG score. This exclusion requires a non-missing ESG score to be available from MSCI. As was discussed earlier (see Table 1) the coverage of ESG data is not complete across private and public issuers. We retain issuers that do not have an ESG score from MSCI. This is equivalent to assuming the issuer is ‘average’ with respect to ESG relative to its peer group. In the absence of issuer specific ESG information it is difficult to justify any alternative treatment. A benefit of the tactical exclusions is that an issuer is not permanently excluded from the investment universe. If the underlying issuer improves along the environmental, social or governance pillars (at least as assessed by MSCI), it may re-enter the allowable investment universe.

The impact of exclusions remains an object of avid discussions. First, it is possible exclusions may affect performance if the excluded securities have higher expected returns, perhaps due to investor neglect. Second, and in our view more importantly, exclusions have a potentially greater impact on expected investment performance due to reduced breadth. Skilled managers may have investment insights on both expected returns and risks for excluded securities and ignoring this information will reduce ex ante investment performance. The ultimate question is: how much performance is left on the table?

To answer this question, we first look at the number, and market value, of excluded securities. Table 7 reports the fraction of market capitalization removed from each type of exclusion as well as their combined effects as of December 31, 2020. We report the effect of each exclusion independently to provide a sense of overlap. Panel A (B) shows the impact of

exclusions for US (EU) High Yield corporate issuers. The combined impact on breadth for the US HY universe is a loss of 18.1 percent of market capitalization and 93 out of 880 corporate issuers. The combined impact on breadth for the EU HY universe is a loss of 12.8 percent of market capitalization and 24 out of 362 corporate issuers. The reduction in breadth is larger for the US HY universe primarily due to a greater number of issuers removed due to static exclusion criteria, especially fossil fuel exclusions, with greater impact on corporate issuers within the energy and utility sectors. There is little overlap between the static and tactical exclusion criteria as the union of the two exclusions is close to the sum of independent screens. Importantly, the impact of the two exclusion criteria still leaves enough issuers to engage in security selection within sectors. We return to the investment impact of this loss of breadth later.

It is interesting to compare the above numbers to similarly defined exclusions for equity indexes. The same static screens in MSCI World add up to about 6% of market cap weight, with fossil fuels accounting for roughly 4% and tobacco and controversial weapons with sub-1% each. The severity of the screens is meaningfully lower in US equities, with less than 5% (3%) restricted in Russell 1000 or Russell 2000 indexes. In contrast, Table 7 Panel A shows that static restrictions remove over 9% of US HY index. As mentioned above, the key reason for the difference is the importance of fossil fuel issuers in credit relative to equity indexes. Interestingly, the severity of fossil fuel constraints had been much higher in the past also for equities, but price changes over the past decades reduced the importance of that sector in equity indexes.

The astute reader will note that the reduction in issuer count due to the tactical exclusions of the lowest 10 percent of MSCI industry adjusted ESG scores is less than ten percent. This is because the tactical exclusion is applied only to non-missing ESG scores. As of December 31, 2020 our MSCI ESG dataset covers over 90 percent of public issuers, and given that private

issuers are about 20 percent of the HY market (a little higher in EU), this translates to complete coverage of the global HY market of about 70 percent. Thus, the typical tactical exclusion is ultimately about 7 percent of issuers within an industry (there is sectoral variation as the fraction of private issuers is not constant across industries).<sup>4</sup> We observe a similar effect in equity indexes: while for large cap indexes such as MSCI World the coverage of MSCI ESG data is close to complete, for small cap indexes, where issuers are more similar to credit, coverage is noticeably weaker.

### **ESG: sustainable alpha?**

Asset owner interest in sustainability is not limited to exclusions. There is an avid interest, and belief, in the potential for sustainability to improve risk-adjusted returns as well. However, as was shown in the first section of this paper, the relation between measures of ESG and either credit spreads or future credit excess returns is difficult to identify in the data, at least with the ESG data we use, and over our time period.

Where ESG data may be material, it is best incorporated as a component of the overall investment view. The Governance pillar is perhaps where there is more agreement and data to support the potential for forecasting future security returns. Governance is material to all issuers, regardless of their industry, and it is important for all capital providers to the corporation, both equity holders and bond holders. Corporate governance arguably has a direct impact on the probability that a company will be able to service its contractual commitments by limiting

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<sup>4</sup> In untabulated analysis, we also examine the impact of both exclusion criteria over our full time period (2012-2020). The drop in issuer count varies between 7-11 percent for US HY corporate issuers and between 5-10 percent for EU HY corporate issuers. The coverage of MSCI ESG data further back in time is a little smaller, accounting for most of this temporal variation in exclusions.

excessive risk taking, aggressive accounting practices, etc. While there are many proxies an investor may consider for the quality of governance, one of the best known is a measure of earnings quality based on accruals. There is an extensive literature examining how such measures capture accounting distortions and how these distortions have direct implications for future profitability that is not fully understood by capital market participants and is also associated with earnings restatements, SEC enforcement actions and class-action lawsuits (see e.g., Sloan, 1996; Bradshaw, Richardson and Sloan, 2001; Richardson, Sloan, Soliman, and Tuna, 2006). Indeed, later research extended the results from equity markets to the corporate bond market (e.g., Bhojraj and Swaminathan, 2009). Such measures of financial reporting quality are directly considered as part of our forecasts of expected returns.

More generally, other proprietary insights with respect to environmental, societal and governance characteristics could be integrated into the portfolio construction process. However, for the purpose of this paper, we limit ourselves to previously documented results (e.g., accruals) and third-party data (e.g., MSCI). A key benefit of using third-party data, especially for the sustainability tilting and carbon awareness that we describe below, is that an asset owner can directly compare the sustainability profile across different mandates of their combined portfolio.

### **Sustainability ‘tilting’ and carbon reduction**

The final two sustainability considerations for our global HY corporate bond portfolio relate to targeting corporate issuers with a better sustainability profile (positive tilting) and ensuring an improved overall carbon footprint at the portfolio level. While our static and tactical exclusions will help achieve better outcomes along both dimensions, they do not guarantee



desired portfolio outcomes. For example, a portfolio that excludes issuers with high emissions and fossil fuel involvement might still overweight ‘medium-high’ emitters, leading to relatively unattractive carbon metrics versus a benchmark.

For this reason, we consider sustainable corporate bond portfolios that explicitly adopt two additional ESG-related objectives. First, we require the final portfolio to yield an ESG score that is at least ten percent better than the benchmark. We compute the ESG score of our portfolio, and the benchmark, limiting the calculation to those issuers that are covered by MSCI. As discussed previously, given the frequency of private issuers it is challenging to have complete coverage of HY corporate issuers. The implication of this choice is that issuers with missing coverage are essentially given an average score. So, corporate issuers with missing MSCI data are neither penalized in our tactical exclusions, nor rewarded with our positive sustainability tilts. Second, we require our portfolio to have lower carbon emissions than the benchmark. There are multiple choices to consider here. We limit ourselves to Scope 1 and Scope 2 emissions as the quality of that data is superior to that of Scope 3. We also measure carbon emissions relative to the issuer’s revenues to help ensure cross-sectional comparability across corporate issuers. Our selected portfolio constraint is carbon intensity at least 25 percent lower than that of the benchmark. For corporate issuers that have missing carbon emissions data from Trucost we impute values based on the average carbon intensity from all covered firms in the same Level-4 industry grouping. For carbon emissions data it is easier, and more prudent, to impute missing values than it is for industry adjusted ESG scores.

Figure 4 shows the ESG and carbon intensity score of our sustainable systematic corporate bond portfolio relative to the benchmark over our sample period. Interestingly, the constraints do not always bind, as there are occasions where the portfolio has an ESG score more

than 10 percent better than the benchmark and a carbon intensity that is less than 75 percent of the benchmark. This can happen if expected returns are aligned with the ESG objectives, for example when the desired positioning is underweight poor ESG, or high emission, issuers.

### **Calibrating ESG design choices and the resulting performance**

We note that portfolios maximizing risk-adjusted returns without any ESG objectives may still have attractive ESG characteristics, if only because the investment view could integrate, or otherwise correlate with, ESG signals, as we mention above. However, such attractive characteristics are not guaranteed unless ESG objectives are explicitly incorporated in the portfolio process (otherwise poor ESG, high emissions issuers may at least sometimes score well on other investment signals and consequently be held overweight).

Thus, to ensure a consistently sustainable profile, a portfolio needs some combination of static and tactical exclusions, sustainability tilts, and carbon intensity reduction. These should be calibrated to address two parallel objectives. On the one hand, the more aggressive these choices are, the larger the increase in the sustainability profile of the portfolio. On the other hand, the more binding the ESG considerations are, the higher is the potential negative impact on risk-adjusted returns for the portfolio. Ultimately, the parametrization of ESG objectives becomes an empirical exercise to trade off the desired gains in sustainability with the potential loss of expected return. We assess this trade-off based on ex ante portfolio expected return measures. We start with a ‘base case’ systematic corporate bond portfolio that includes ESG measures deemed to improve the risk-return tradeoff (see earlier discussion) but does not include static exclusions, tactical exclusions, sustainability tilts or carbon intensity reduction. We compute the

portfolio-level expected return for this portfolio, which is the inner product of the portfolio weight given to a specific bond and our modelled expected return for that bond.

We repeat the portfolio construction process for different threshold choices along the three dimensions where a choice needed to be made (i.e., tactical exclusions, sustainability tilts and carbon intensity reduction). This approach is akin to the ESG efficient frontier framework proposed by Pedersen, Fitzgibbons, and Pomorski (2020), where asset owners can assess the performance impact for different choices of the portfolio's sustainability profile.

The ex-ante results are summarized in Figures 5-7, which visualize the percentage of expected returns captured as a function of the various portfolio sustainability choices (all relative to the base case portfolio). Figure 5, and especially Figure 6, suggest a relatively flat surface for threshold choices on tactical exclusions and sustainability tilts, respectively. Our choice of ten percent for both is associated with only a marginal reduction in expected returns. Of course, when the choices are more aggressive (beyond the range of Figures 5 and 6), these ESG considerations will eventually detract significantly from expected portfolio performance. We can see such a pattern in Figure 7, which shows a similarly flat surface for expected returns across carbon intensity reduction up to about 60 percent. Beyond that point further reductions lead to significant loss in expected returns: portfolios that seek a very high carbon reduction may not afford to hold many moderately emitting issuers, eventually removing some that have an attractive investment view.

Overall, similar to what has been shown in equity markets, it is currently possible to have significant improvements in the ESG and carbon emission profile without meaningfully changing portfolio attractiveness, at least over the range of realistic parametrizations of ESG objectives that we believe reflect many allocators' preferences. Our choices with respect to these

three sustainability dimensions are defensible as they reside on the flat portion of the ESG frontiers. Importantly, at the portfolio level these constraints interact as they operate simultaneously so there is a need to be conservative when selecting thresholds for three constraints independently.

We stress the importance of using ex ante measures of portfolio returns when making choices about sustainability thresholds and targets. Looking at realized returns, particularly in short recent time periods, may lead to deficient choices. For example, over the 2012-2020 period energy companies and heavy carbon emitters have experienced poor relative returns. Whether this is expected to continue in the future is unclear. Without taking a stand on the driver of this premium, we acknowledge that for some investors it may be indicative of “green alpha” that may be there in the future as well; for others, this may be that the carbon constraint turned out to be lucky for a non-repetitive reason.

Finally, Figure 8 shows the portfolio cumulative return (net of expected transaction costs) versus that of the benchmark. The portfolio has annualized total returns of 7.1 percent over the 2012-2020 period relative to 6.1 percent for the benchmark. This translates into an Information Ratio of 0.84 for the full period. Figure 8 also includes a standard (base case) systematic portfolio that does not incorporate our ESG design choices. The cumulative returns for the standard systematic portfolio are very similar to the sustainable systematic portfolio. That similarity should not be too surprising given our earlier discussion. The outperformance of both portfolios is driven by the credit excess returns and is generally spread over the full period, with one exception. Q1 2020 was a difficult period for typical long-only systematic strategies: the defensive theme seeks exposure to corporate bonds with lower spread duration and Q1 2020 was a period of credit curve inversion leading to a meaningful detraction relative to the benchmark.

We note this as the sustainability aspects of the portfolio were not the primary driver of under-performance in 2020. Relatedly, Fridson et al. (2021) show that the (statistically insignificant) outperformance of ESG-aligned HY indices over standard HY indices is attributable to large sector and credit rating deviations that introduce considerable tracking error back to the original benchmark and conclude by noting that the evidence does not support a return benefit or penalty from ESG exclusions.

### **Characteristics: a sustainable systematic corporate bond portfolio**

Table 8 overviews the main characteristics of our sustainable systematic portfolio. We report the median characteristics across our sample period (2012-2020). Panel A reports typical measures of the bonds in both a sustainable and standard systematic portfolio relative to the benchmark. As described earlier, both systematic portfolios hold bonds within industry groupings that are attractive on specific dimensions (e.g., carry, defensive, momentum and valuation measures) and at the same time attempt to match the overall credit and rate risk of the benchmark. While both systematic portfolios hold slightly more than 300 out of the universe of nearly 2700 bonds (typically 10-15 percent of the universe), those bonds have a lower spread duration than the benchmark (a consequence of the defensive investment theme), a credit spread and yield slightly higher than the benchmark (a consequence of the carry investment theme). Importantly, the DTS (spread duration multiplied by credit spread is a proxy for credit beta) of the systematic portfolio is similar to that of the benchmark. Notably the characteristics of the sustainable systematic portfolio are very similar to the standard systematic portfolio: incorporating sustainability into the portfolio, at least with the thresholds we examine, does not distort the portfolio.

Panel B and C report the rating and sector exposures of the sustainable and standard systematic portfolio relative to the benchmark. For both systematic portfolios the market weights across ratings and sectors are similar to the benchmark. For the technical reader, the portfolio construction process limits rating and sector exposures in risk space rather than market weight space. So, small differences in market weights across rating or sector groups may be observed at times, but those differences are ‘capped’ in DTS contribution to the overall portfolio.

## **General discussion**

### **Sustainability and expected returns: the impact of ESG flows**

As discussed in Fitzgibbons, Pedersen and Pomorski (2020), Pastor, Stambaugh and Taylor (2021a) and others, the relation between measures of sustainability and expected returns is nuanced. In the presence of ESG-aware or ESG-motivated investors, it is unclear as to whether securities with higher ESG scores will earn lower or higher future excess returns, and when those return patterns will be realized. If investors shun securities with poor ESG attributes these securities will experience low returns whilst investors remove these securities from their portfolios. However, going forward those securities may earn a high return as compensation for the relative investor neglect. The dynamics depend on the mix of investor types and their trading decisions. Unfortunately, this can greatly complicate empirical analysis on the relation between ESG or sustainability measures and future returns due to the impact of in-sample flows into or out of securities with high or low ESG scores. Specifically, it may be the case that flows into securities with favorable ESG scores experience positive returns whilst that net flow is occurring, but once a new equilibrium of holdings has been reached those same securities will experience a

lower future return. Indeed, this is the exact point made in Pastor, Stambaugh and Taylor (2021b). This is important as it directly affects the potential usefulness of recent empirical studies attempting to show how ESG measures affect future security returns.

## **Green Bonds and Index Choice**

Our empirical analysis utilized a standard broad corporate bond index. In recent years there has been considerable growth in ESG/sustainable fixed income indices.<sup>5</sup> For example, as of April 2021 there are over 80 sustainable fixed income ETFs (source: Morningstar) and as recent as 2015 there were fewer than 5. Collectively there is about \$40B invested in these ETFs (note that these fixed income ETFs cover more than just corporate bond indices), which translates to less than 2 percent of all assets invested in fixed income ETFs. Furthermore, as of Q2 2021, across the set of 14,046 open ended fixed income funds with about \$10.5T assets under management covered by Morningstar, 867 funds claim ESG integration (about \$400B AUM) and 45 funds use an ESG/sustainable benchmark (\$21B AUM). So, while sustainable indices are new, there is a possible future equilibrium where these sustainable indices become the norm. In such a scenario the need for screens/tilts may lessen (as these will already be incorporated in the benchmark index) and the need for direct sustainable forecasts of return/risk may become more important.

One other aspect of sustainable fixed income investing is the development of labeled bonds. This includes a broad set of bonds: (i) green bonds with a stated use of proceeds

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<sup>5</sup> The increased issuance has recently attracted academic interest, with green bond studies including Baker et al. (2021), Larcker and Watts (2021), and Flammer (2021).

dedicated to a ‘green’ business activity; (ii) social bonds, typically used to fund eligible projects aimed at underserved and/or underprivileged groups, including projects aimed at providing or improving essential services and basic infrastructure; (iii) sustainability bonds with a stated use of proceeds that covers both green and social purposes; and (iv) sustainability-linked bonds whose coupon is typically linked to a specific environmental or social target. Bank of America (2021) forecast issuance of labeled bonds of between \$650B-\$750B for 2021. This is relative to issuance of \$450B in 2020, \$250B in 2019 and around \$50B in 2016. While this is clearly a growing area, it is important to note that these bonds are issued by sovereigns, supra-nationals, government agencies, local authorities, as well as corporate issuers. Of the total issuance of labeled bonds in Q1 2021, corporate issuers account for about two thirds of green bonds (\$111B total issuance), about ten percent of social bonds (\$82B total issuance), about two thirds of sustainable bonds (\$32B total issuance), and the majority of sustainability-linked bonds (\$9.5B total issuance). Corporate labeled bonds are therefore still a small fraction of outstanding corporate bonds. As this section of the market continues to grow this will be another area for sustainable-aware investors to consider in their credit portfolios.

## **Conclusion**

Sustainable investing has experienced a remarkable increase in popularity over the last decade. While most efforts for sustainable investing have been directed to public equity markets, there is an increasing push from asset owners and regulators to extend this to other asset classes, in particular fixed income. In this paper we take a comprehensive look at how measures of sustainability/ESG might be relevant for global developed corporate bond markets.



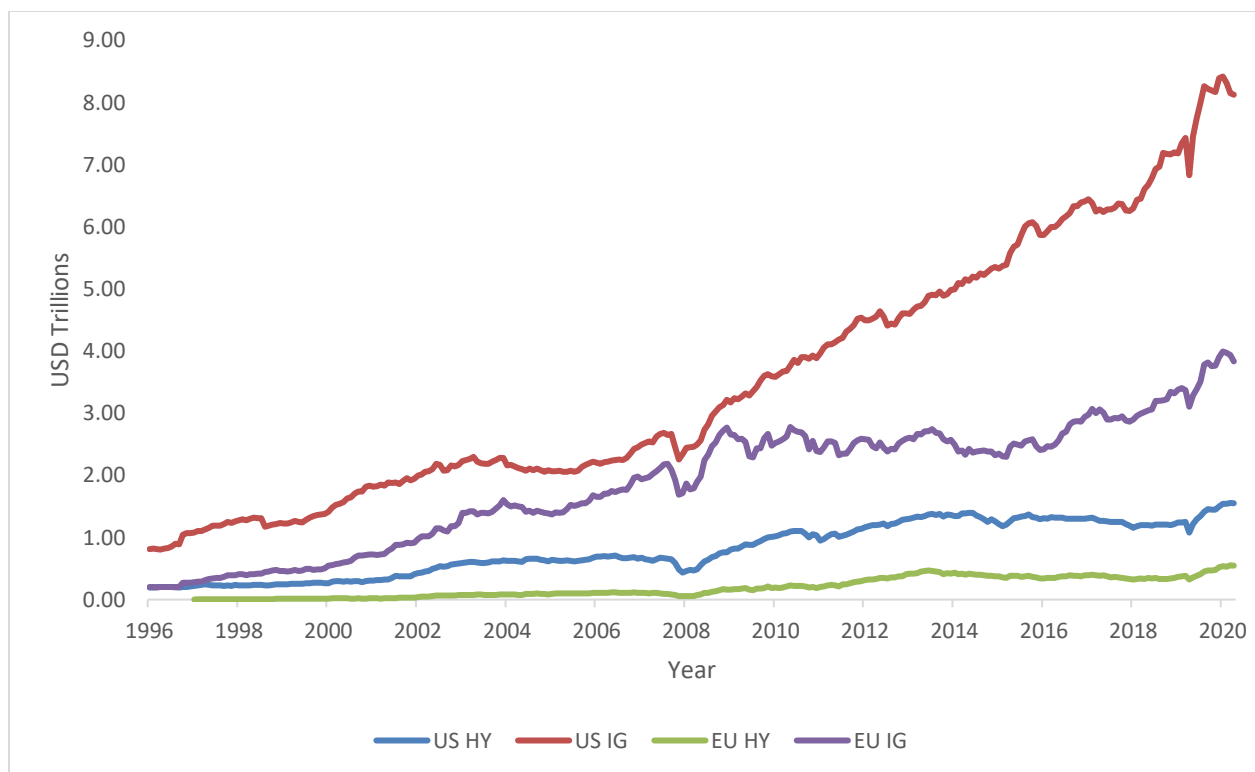
We find limited direct evidence that sustainability measures explain cross-sectional variation in credit spreads, no evidence that they predict future credit excess returns, and some evidence that they predict volatility of future credit excess returns. While the lack of a confirmatory finding for return predictability is limited by our time period and data sources, it is a cautionary reminder of the need for data-driven investment decisions in this space. Simple assertions that a more sustainable portfolio will deliver superior risk-adjusted returns should be treated with caution.

We do find, however, a relatively flat surface for most sustainability choices that could be made for corporate bond portfolios. Specifically, we find that the typical ESG exclusions, sustainability tilts (i.e., ensuring the overall portfolio is superior to the benchmark along the ESG dimension), and economically meaningful reductions in carbon intensity can be achieved without sacrificing much return potential. This leaves the asset owner with a favorable outcome: while pursuing sustainability objectives in and of themselves may not improve performance, incorporating sustainability awareness, up to a point, is not detrimental to expected returns.

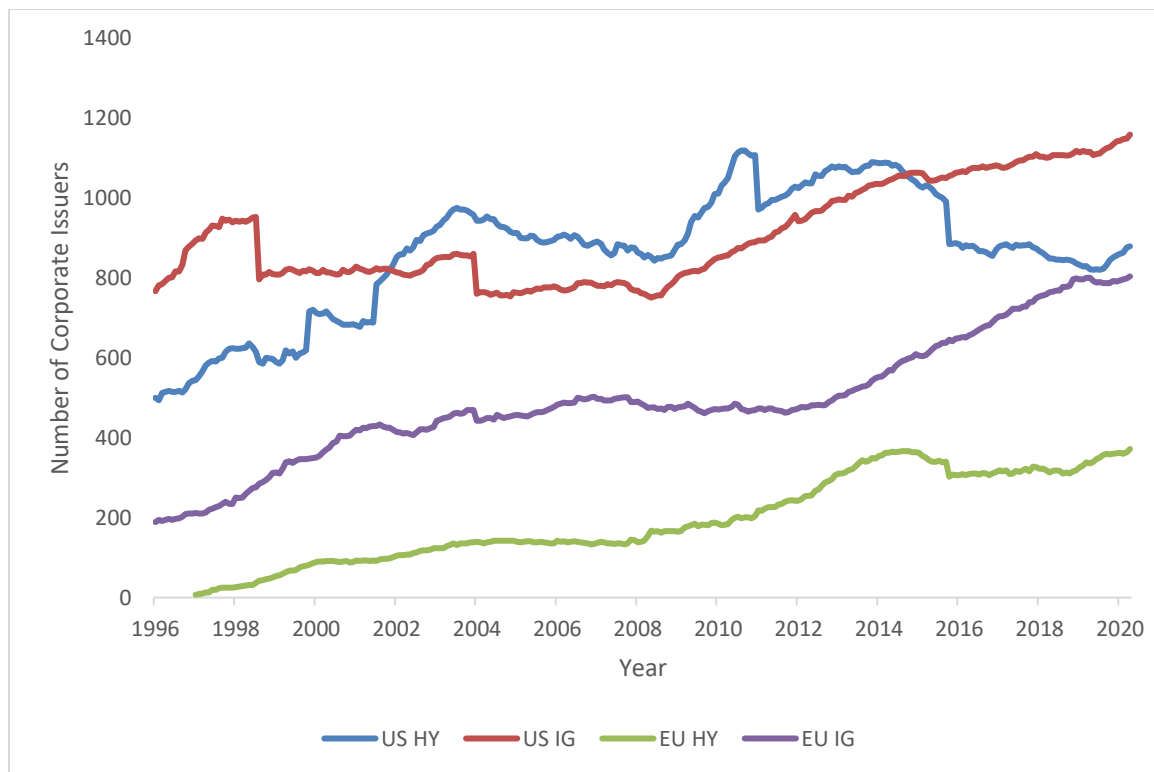
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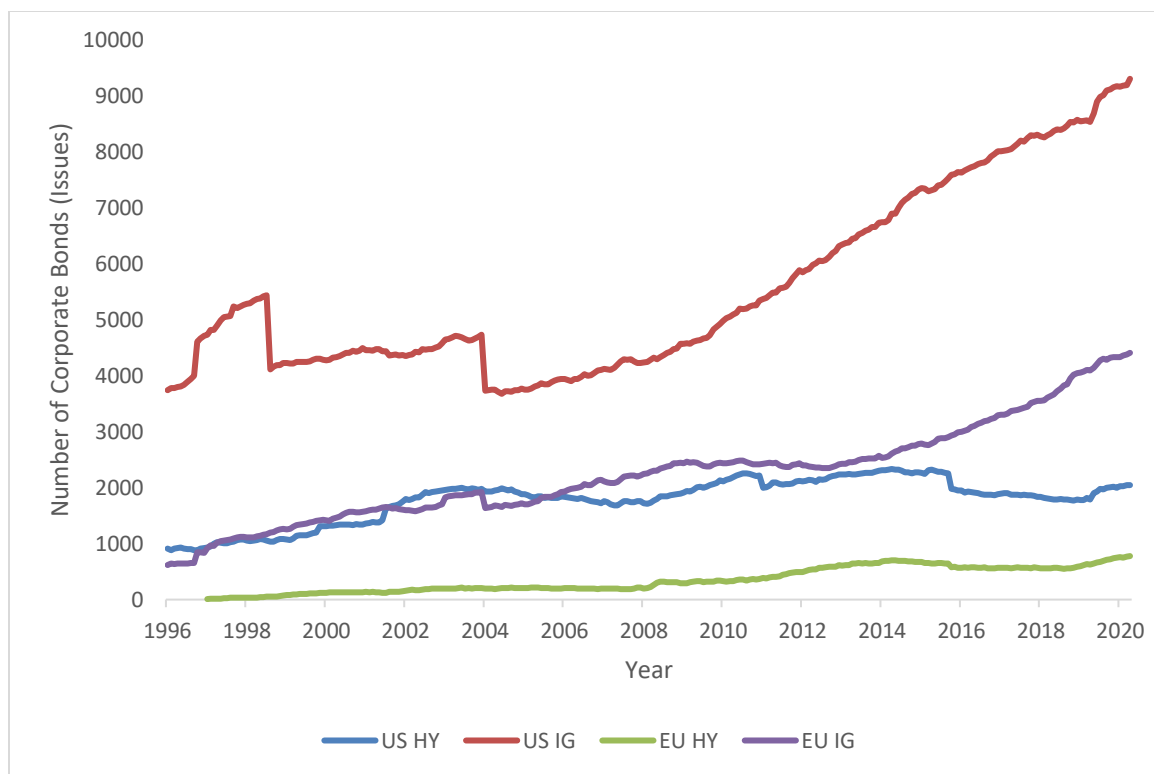
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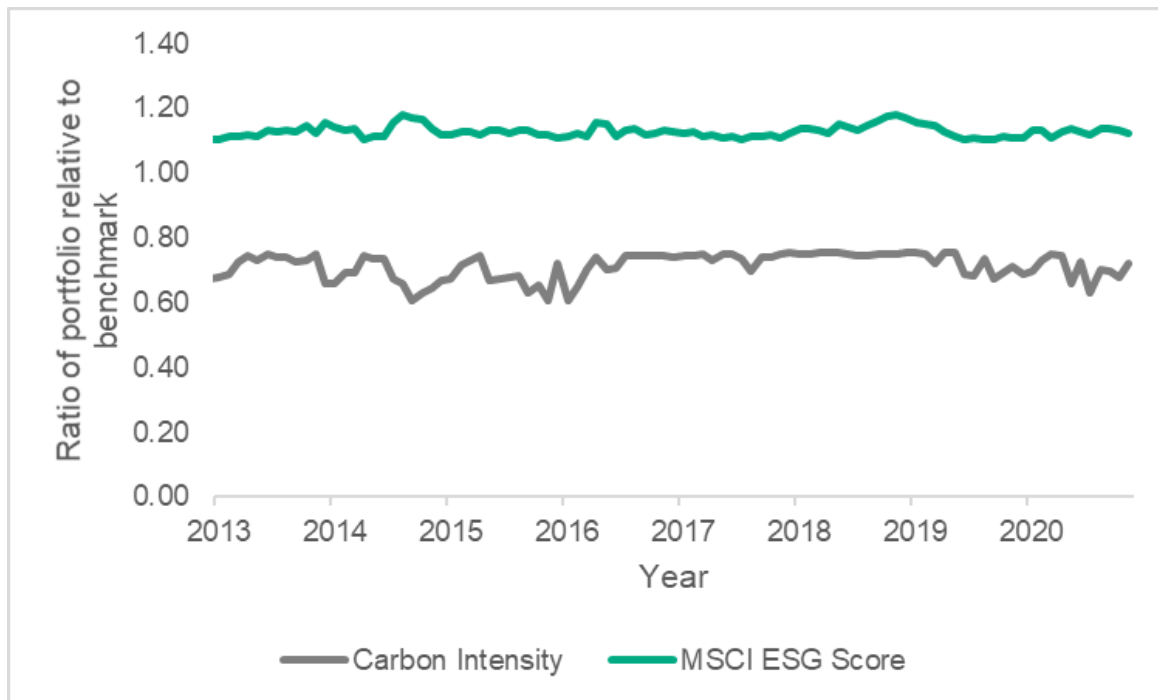
**Figure 1: Market capitalization.** This figure shows the market capitalization of our four credit universes. Market capitalization is measured in US dollars for all indices converting non-USD bond values to USD using the prevailing spot rate at the end of each month. US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. US HY is the US High Yield Index from ICE/BAML (ticker H0A0). EU IG includes all EUR and GBP denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. EU HY is the European Currency High Yield Index from ICE/BAML (ticker HP00).



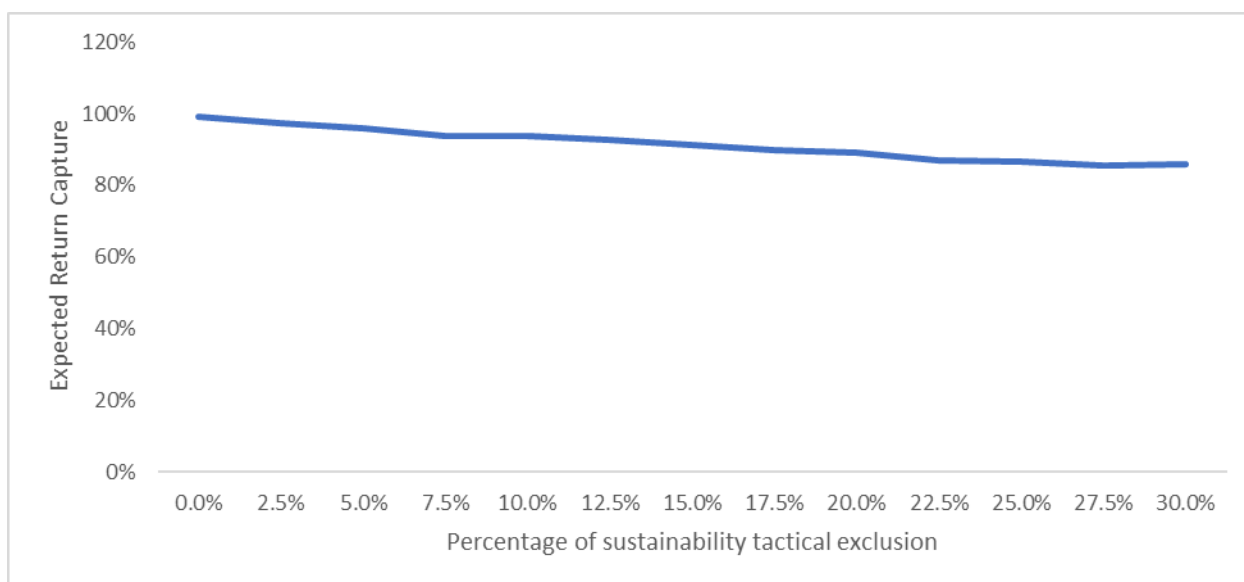
**Figure 2: Number of corporate issuers.** This figure shows the number of unique corporate issuers through time across our four credit universes. US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. US HY is the US High Yield Index from ICE/BAML (ticker H0A0). EU IG includes all EUR and GBP denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. EU HY is the European Currency High Yield Index from ICE/BAML (ticker HP00).



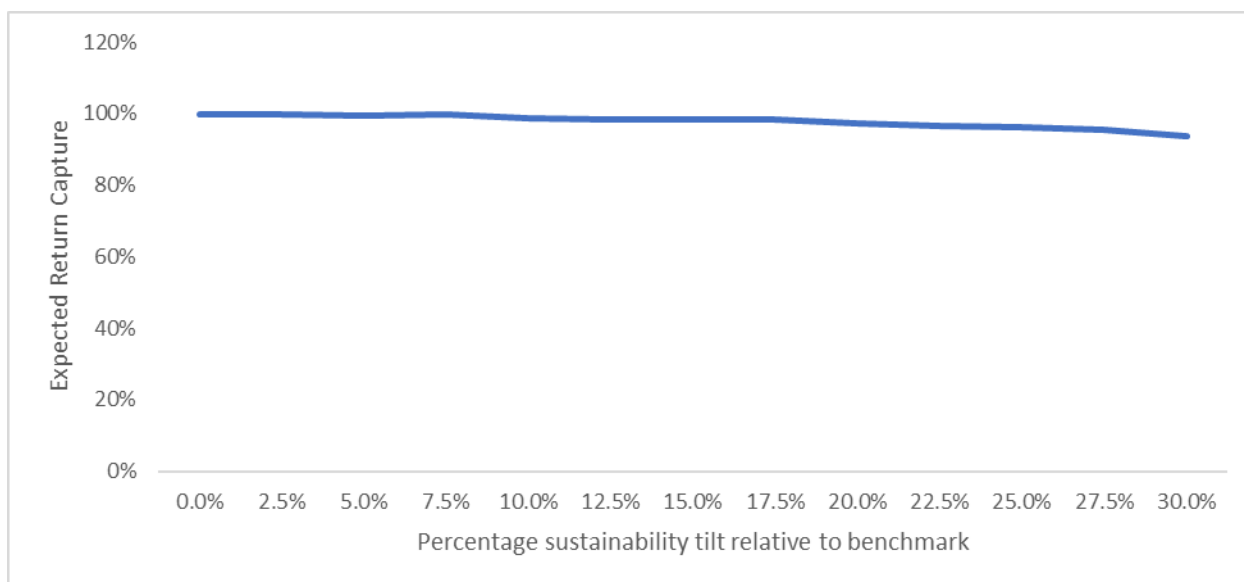
**Figure 3: Number of corporate bonds (issues).** This figure shows the number of unique corporate issues (bonds) through time across our four credit universes. US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. US HY is the US High Yield Index from ICE/BAML (ticker H0A0). EU IG includes all EUR and GBP denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. EU HY is the European Currency High Yield Index from ICE/BAML (ticker HP00).



**Figure 4: Sustainability tilt and carbon intensity.** This figure shows the sustainability score (MSCI ESG data) and carbon intensity (TruCost data) for our systematic portfolio relative to the benchmark (ICE/BAML High Yield Developed Markets Index, ticker HYDM). Sustainability scores are only computed for non-missing issuers. Missing data for carbon intensity are replaced with sub-industry averages using the full universe of TruCost data.

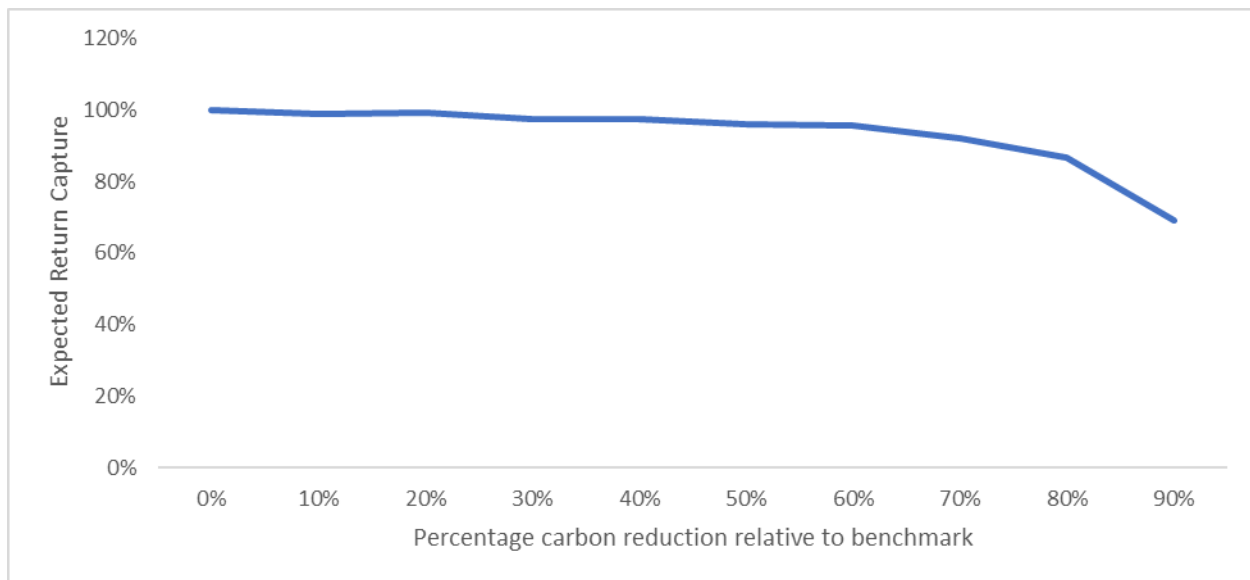


**Figure 5: Ex-ante return capture: Tactical Exclusions.** This figure reports the fraction of ‘base case’ expected returns captured across different thresholds for tactical sustainability exclusions. MSCI ESG scores are used as the basis of tactical exclusions. The base case portfolio is a standard systematic corporate bond portfolio that does not (i) use static or tactical exclusions, (ii) require sustainability tilts, or (iii) require any carbon emission reductions.

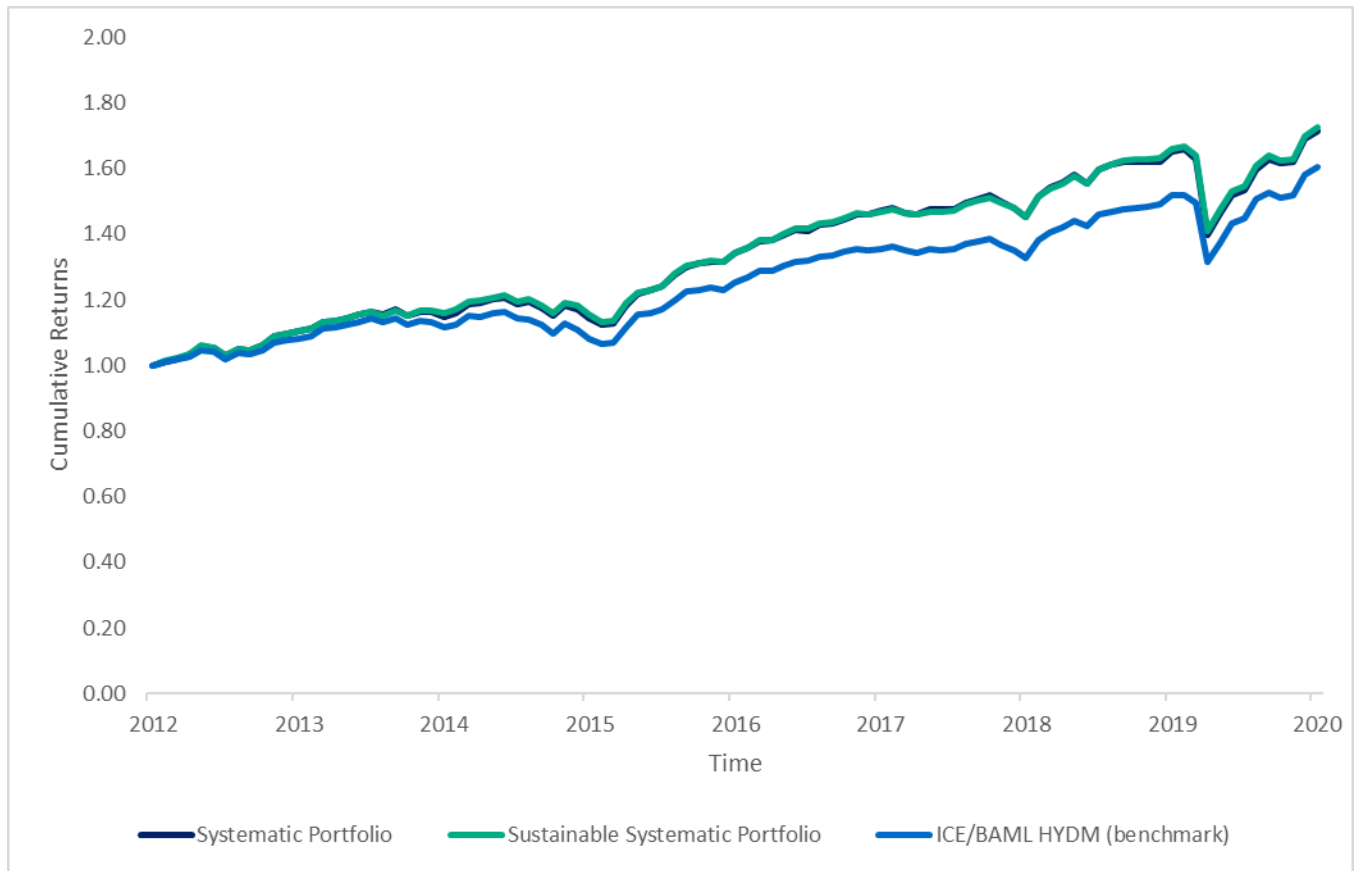


**Figure 6: Ex-ante return capture: Sustainability Tilts.** This figure reports the fraction of ‘base case’ expected returns captured across different thresholds for sustainability tilts relative to benchmark. MSCI ESG scores are used as the basis of sustainability tilts. The base case portfolio is a standard systematic corporate bond portfolio that does not (i) use static or tactical exclusions, (ii) require sustainability tilts, or (iii) require any carbon emission reductions.





**Figure 7: Ex-ante return capture: Carbon Intensity Reduction.** This figure reports the fraction of ‘base case’ expected returns captured across different thresholds of carbon intensity reduction relative to benchmark. TruCost data is used as the basis of carbon intensity reductions. The base case portfolio is a standard systematic corporate bond portfolio that does not (i) use static or tactical exclusions, (ii) sustainability tilts, or (iii) require any carbon emission reductions.



**Figure 8: Cumulative performance profile of sustainable systematic corporate bond portfolio.** This figure shows the cumulative returns of the (i) standard systematic bond portfolio, (ii) sustainable systematic bond portfolio, and (iii) the ICE/BAML Global High Yield Developed Markets (ticker: HYDM) benchmark for the 2012-2020 period. The portfolio returns are for a hypothetical portfolio as described in the text and are net of expected transaction costs.

**Table 1**  
**Summary statistics**

This table reports descriptive statistics for various credit market and ESG related data. There are 4 panels corresponding to our four credit universes. US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. US HY is the US High Yield Index from ICE/BAML (ticker H0A0). EU IG includes all EUR and GBP denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. EU HY is the European Currency High Yield Index from ICE/BAML (ticker HP00). Spread is the difference between the corporate bond yield and a key-rate duration-matched government bond yield. Duration is spread duration. DTS is the product of spread and duration. Credit-excess returns (XS\_Return) is the difference between total returns (cum-coupon) for the bond less the total return of a key-rate matched government bond. Size is the par value of the bond (in \$ millions). E, S and G are the individual (non-industry-adjusted) scores for Environmental, Societal and Governance as calculated by MSCI. ESG is the aggregate industry-adjusted score across all three components. Each month we compute the mean, median, Q1 and Q3 (where Q1 and Q3 are the lower and upper quartile respectively) of each variable and we then report the median of these values across time periods.

**Panel A: US Investment-Grade Corporate Bonds**

	<b>N</b>	<b>Mean</b>	<b>Q1</b>	<b>Median</b>	<b>Q3</b>
<b>Spread</b>	7698	127	78	117	163
<b>Duration</b>	7698	7.1	3.2	5.7	11.1
<b>DTS</b>	7698	1058	257	676	1698
<b>XS_Return</b>	7698	0.31%	-0.03%	0.19%	0.58%
<b>Size</b>	7698	735	340	500	998
<b>E</b>	6462	6.0	4.4	5.9	7.4
<b>S</b>	6462	4.5	3.3	4.5	5.6
<b>G</b>	6462	5.4	4.0	5.5	6.3
<b>ESG</b>	6462	5.1	3.5	5.2	6.8

**Panel B: US High-Yield Corporate Bonds**

	<b>N</b>	<b>Mean</b>	<b>Q1</b>	<b>Median</b>	<b>Q3</b>
<b>Spread</b>	2015	540	271	363	557
<b>Duration</b>	2015	3.8	2.2	3.6	4.9
<b>DTS</b>	2015	1817	707	1460	2364
<b>XS_Return</b>	2015	0.53%	-0.16%	0.54%	1.24%
<b>Size</b>	2015	666	375	500	750
<b>E</b>	1349	4.9	3.0	4.7	6.5
<b>S</b>	1349	4.1	3.1	4.1	5.1
<b>G</b>	1349	5.1	3.9	4.9	6.0
<b>ESG</b>	1349	3.8	2.5	3.7	5.1

**Panel C: EU Investment-Grade Corporate Bonds**

	<b>N</b>	<b>Mean</b>	<b>Q1</b>	<b>Median</b>	<b>Q3</b>
<b>Spread</b>	3037	121	78	102	144
<b>Duration</b>	3037	5.9	3.1	5.1	7.6
<b>DTS</b>	3037	780	268	549	1021
<b>XS_Return</b>	3037	0.23%	0.02%	0.13%	0.38%
<b>Size</b>	3037	799	548	684	990
<b>E</b>	2250	6.7	5.6	6.7	7.9
<b>S</b>	2250	4.9	3.9	4.9	5.9
<b>G</b>	2250	5.3	4.0	5.5	6.6
<b>ESG</b>	2250	6.3	4.9	6.5	8.0

**Panel D: EU High-Yield Corporate Bonds**

	<b>N</b>	<b>Mean</b>	<b>Q1</b>	<b>Median</b>	<b>Q3</b>
<b>Spread</b>	593	509	247	353	532
<b>Duration</b>	593	3.9	2.1	3.5	5.1
<b>DTS</b>	593	1705	609	1375	2340
<b>XS_Return</b>	593	0.53%	0.08%	0.51%	1.14%
<b>Size</b>	593	595	347	529	752
<b>E</b>	330	6.2	4.6	6.0	8.2
<b>S</b>	330	4.5	3.7	4.7	5.5
<b>G</b>	330	5.3	4.3	5.2	6.5
<b>ESG</b>	330	5.6	4.0	5.5	7.0

**Table 2****Sample coverage and average values of key variables through time**

This table reports descriptive statistics for various credit market and ESG related data through time. There are 4 panels corresponding to our four credit universes. US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. US HY is the US High Yield Index from ICE/BAML (ticker H0A0). EU IG includes all EUR and GBP denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. EU HY is the European Currency High Yield Index from ICE/BAML (ticker HP00). Spread is the difference between the corporate bond yield and a key-rate duration-matched government bond yield. Duration is spread duration. Credit-excess returns (XS\_Return) is the difference between total returns (cum-coupon) for the bond less the total return of a key-rate matched government bond. Size is the par value of the bond (in \$ millions). E, S and G are the individual (non-industry-adjusted) scores for Environmental, Societal and Governance as calculated by MSCI. ESG is the aggregate industry-adjusted score across all three components. For this table we compute median values of each variable in the last month of each year (December).

**Panel A: US Investment-Grade Corporate Bonds**

<b>Year</b>	<b># Bonds</b>	<b>Spread</b>	<b>Duration</b>	<b>XS_Return</b>	<b>E</b>	<b>S</b>	<b>G</b>	<b>ESG</b>
<b>2012</b>	4758	135	5.5	0.31%	5.5	4.6	6.9	4.9
<b>2013</b>	5411	113	5.6	0.21%	5.6	4.5	6.8	4.8
<b>2014</b>	5816	122	5.7	0.01%	5.6	4.3	6.8	5.1
<b>2015</b>	6462	151	5.7	-0.73%	5.8	4.4	4.7	4.6
<b>2016</b>	6356	118	5.6	0.19%	6.0	4.4	4.9	5.3
<b>2017</b>	6813	89	5.7	0.40%	6.0	4.5	4.6	5.2
<b>2018</b>	7069	140	5.7	0.69%	6.0	4.5	5.5	5.7
<b>2019</b>	7386	91	5.9	-0.05%	6.0	4.6	5.5	5.6
<b>2020</b>	7950	94	6.3	0.12%	6.4	4.7	5.1	5.8

**Panel B: US High-Yield Corporate Bonds**

<b>Year</b>	<b># Bonds</b>	<b>Spread</b>	<b>Duration</b>	<b>XS_Return</b>	<b>E</b>	<b>S</b>	<b>G</b>	<b>ESG</b>
<b>2012</b>	1225	474	3.6	1.67%	4.5	4.1	4.8	3.3
<b>2013</b>	1344	343	3.7	-0.20%	4.8	3.9	4.9	3.7
<b>2014</b>	1491	425	3.9	-0.88%	4.5	4.0	5.3	3.7
<b>2015</b>	1490	544	3.8	-2.38%	4.8	4.0	4.7	3.8
<b>2016</b>	1359	327	3.5	0.89%	4.6	4.1	4.6	3.6
<b>2017</b>	1322	271	3.5	1.31%	4.6	4.0	4.4	3.5
<b>2018</b>	1261	445	3.9	3.53%	4.6	4.1	5.2	4.0
<b>2019</b>	1272	241	2.8	-0.65%	4.9	4.3	5.2	3.9
<b>2020</b>	1469	337	2.9	0.33%	4.7	4.4	4.9	4.1

**Panel C: EU Investment-Grade Corporate Bonds**

<b>Year</b>	<b># Bonds</b>	<b>Spread</b>	<b>Duration</b>	<b>XS_Return</b>	<b>E</b>	<b>S</b>	<b>G</b>	<b>ESG</b>
<b>2012</b>	1810	140	4.6	0.16%	6.2	5.8	5.0	6.0
<b>2013</b>	1830	105	4.8	0.08%	6.4	5.2	5.3	6.0
<b>2014</b>	1917	87	5.2	0.09%	6.4	5.2	5.9	6.5
<b>2015</b>	2180	117	5.4	-0.49%	6.8	4.7	5.3	6.3
<b>2016</b>	2240	104	5.4	0.22%	6.7	4.7	5.4	6.7
<b>2017</b>	2517	79	5.2	0.58%	6.8	4.9	5.4	6.7
<b>2018</b>	2675	135	5.1	0.49%	6.7	4.8	5.6	6.7
<b>2019</b>	3104	86	4.9	0.15%	6.6	4.9	5.5	6.7
<b>2020</b>	3409	82	5.0	0.03%	7.1	4.9	5.2	6.9

**Panel D: EU High-Yield Corporate Bonds**

<b>Year</b>	<b># Bonds</b>	<b>Spread</b>	<b>Duration</b>	<b>XS_Return</b>	<b>E</b>	<b>S</b>	<b>G</b>	<b>ESG</b>
<b>2012</b>	246	476	3.7	1.30%	6.3	6.0	4.5	5.7
<b>2013</b>	324	342	3.5	-0.08%	6.4	5.0	4.4	5.7
<b>2014</b>	333	382	3.6	0.61%	5.7	5.0	4.6	5.5
<b>2015</b>	344	426	3.6	-1.77%	5.9	4.2	5.2	5.4
<b>2016</b>	324	349	3.2	1.11%	6.4	4.3	5.1	5.6
<b>2017</b>	318	258	3.4	1.11%	6.1	4.6	5.3	5.5
<b>2018</b>	327	466	4.0	2.07%	6.0	4.7	5.6	5.7
<b>2019</b>	346	252	3.0	-0.20%	5.9	4.8	5.7	5.6
<b>2020</b>	450	313	3.3	0.34%	6.0	4.5	4.8	5.4

**Table 3**  
**Cross-sectional credit spread regressions**

This table reports full sample panel regressions based on monthly data covering the December 2012 to April 2021 period. There are 4 panels corresponding to our four credit universes. US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. US HY is the US High Yield Index from ICE/BAML (ticker H0A0). EU IG includes all EUR and GBP denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. EU HY is the European Currency High Yield Index from ICE/BAML (ticker HP00). The dependent variable in all regressions is the credit spread (which is the difference between the corporate bond yield and a key-rate duration-matched government bond yield). The independent variables include ESG (and each component separately), with and without a measure of default probability (PD). E, S and G are the individual (non-industry-adjusted) scores for Environmental, Societal and Governance as calculated by MSCI. ESG is the aggregate industry-adjusted score across all three components. The regression we run is summarized below. PD refers to an out of sample forecast of default probability as described in Correia, Richardson and Tuna (2012). Each ESG measure is increasing in quality, so a negative coefficient implies that ‘better’ E or S or G is associated with lower credit spreads. PD is increasing in default probability, so a positive coefficient implies that a higher probability of default is associated with higher credit spreads. Standard errors are clustered across both the temporal and issuer dimension to account for serial dependence in ESG characteristics as well as dependence across issues of the same issuer. Test statistics are reported in italics beneath regression coefficients. Regression specifications examining E, S and G separately also include industry indicator variables as the individual measures are not industry-adjusted. Time fixed effects are included in all specifications (intercepts reflect conditional average spread levels over the entire sample period).

$$Spread_{i,t} = \alpha + \beta_{ESG} ESG_{i,t} + \beta_{PD} PD_{i,t} + \varepsilon$$

**Panel A: US Investment-Grade Corporate Bonds**

	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>
$\alpha$	151.18	129.27	131.20	120.40	114.78	99.36	86.73	80.75
	32.22	23.20	21.42	20.97	24.31	11.49	10.24	8.84
$\beta_{ESG}$	-4.57	-3.62						
	-5.76	-4.80						
$\beta_{PD}$		0.73				0.82	0.82	0.82
		5.09				4.97	4.93	4.89
$\beta_E$			-3.30			-3.11		
			-4.40			-4.54		
$\beta_S$				-2.20			-1.58	
				-2.29			-1.92	
$\beta_G$					-1.13			-0.39
					-1.70			-0.63
$R^2$	18.5%	24.3%	22.3%	21.8%	21.7%	29.8%	29.3%	29.2%
N	654029	493456	653998	653998	653998	493433	493433	493433

**Panel B: US High-Yield Corporate Bonds**

	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>
$\alpha$	477.88	311.36	508.33	467.94	453.94	366.75	277.89	315.88
	25.07	14.07	10.88	11.45	11.68	8.31	9.87	9.90
$\beta_{ESG}$	-15.96	-0.52						
	-4.11	-0.09						
$\beta_{PD}$		0.84				0.83	0.84	0.83
		6.34				7.38	7.42	7.29
$\beta_E$			-9.87			-8.31		
			-3.22			-2.50		
$\beta_S$				-9.03			5.66	
				-2.29			1.29	
$\beta_G$					-5.22			-2.95
					-1.85			-1.23
$R^2$	14.6%	48.5%	20.8%	20.7%	20.6%	53.0%	52.9%	52.8%
N	136538	111867	136538	136538	136536	111867	111867	111865



**Panel C: EU Investment-Grade Corporate Bonds**

	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>
$\alpha$	138.85 <i>24.46</i>	122.18 <i>19.77</i>	142.75 <i>19.69</i>	135.46 <i>20.77</i>	131.97 <i>22.83</i>	119.42 <i>14.77</i>	112.00 <i>17.18</i>	111.45 <i>18.25</i>
$\beta_{ESG}$	-2.76 <i>-3.11</i>	-1.29 <i>-1.36</i>						
$\beta_{PD}$		0.24 <i>5.43</i>				0.24 <i>5.02</i>	0.25 <i>5.02</i>	0.24 <i>5.01</i>
$\beta_E$			-2.35 <i>-2.54</i>			-1.26 <i>-1.33</i>		
$\beta_S$				-1.65 <i>-1.63</i>			-0.21 <i>-0.26</i>	
$\beta_G$					-1.30 <i>-1.33</i>			-0.14 <i>-0.18</i>
$R^2$	16.5%	20.3%	22.4%	22.3%	22.2%	27.3%	27.2%	27.2%
N	243026	181531	243020	243025	243025	181525	181530	181530

**Panel D: EU High-Yield Corporate Bonds**

	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>
$\alpha$	382.72 <i>17.85</i>	325.19 <i>13.71</i>	428.98 <i>11.45</i>	337.93 <i>8.22</i>	372.60 <i>11.14</i>	345.95 <i>9.04</i>	290.42 <i>7.03</i>	328.11 <i>10.20</i>
$\beta_{ESG}$	-7.82 <i>-2.22</i>	-5.52 <i>-1.53</i>						
$\beta_{PD}$		0.33 <i>3.97</i>				0.38 <i>4.19</i>	0.39 <i>4.23</i>	0.38 <i>4.26</i>
$\beta_E$			-11.32 <i>-2.89</i>			-3.51 <i>-0.79</i>		
$\beta_S$				4.26 <i>0.74</i>			7.07 <i>1.17</i>	
$\beta_G$					-3.03 <i>-0.79</i>			-0.94 <i>-0.23</i>
$R^2$	16.3%	31.3%	19.4%	18.4%	18.4%	34.8%	34.9%	34.7%
N	33906	26209	33899	33906	33906	26202	26209	26209

**Table 4**  
**Correlations between ESG measures and Systematic Signals**

This table reports results median parametric pairwise correlations across ESG measures and various standard systematic signals for our four credit universes. US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. US HY is the US High Yield Index from ICE/BAML (ticker H0A0). EU IG includes all EUR and GBP denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. EU HY is the European Currency High Yield Index from ICE/BAML (ticker HP00). E, S and G are the individual (non-industry-adjusted) scores for Environmental, Societal and Governance as calculated by MSCI. ESG is the aggregate industry-adjusted score across all three components. Value is a composite score reflecting systematic measures of ‘cheapness’, typically measured as the residual from a cross-sectional regression projecting credit spreads onto forecasts of default probability. Momentum is a composite score reflecting the relative performance of the issuer, measures using a combination of price and fundamental metrics. Carry is the expected return for each bond assuming the issuer hazard rate remains unchanged. Defensive is a composite score targeting lower spread duration and higher quality as indicated by various financial statement metrics. Example measures of each systematic theme are described in Israel, Palhares and Richardson (2018). Value, momentum, carry and defensive are sector and beta neutral. In each year we compute the correlation between ESG, E, S and G with our measures of Value, Momentum, Carry and Defensive. These correlations are estimated at the issuer level, so we compute average values of each systematic measure for issuers that have multiple bonds outstanding. The table reports the median pairwise correlations across the 2012-2020 sample period.

**Panel A: Correlations with ESG combined score**

	<b>US-IG</b>	<b>US-HY</b>	<b>EU-IG</b>	<b>EU-HY</b>
<b>Carry</b>	-0.07	-0.05	-0.12	-0.10
<b>Defensive</b>	0.08	0.06	0.07	0.04
<b>Momentum</b>	0.00	-0.01	0.04	0.05
<b>Value</b>	-0.05	0.02	-0.04	0.04

**Panel B: Correlations with E individual score**

	<b>US-IG</b>	<b>US-HY</b>	<b>EU-IG</b>	<b>EU-HY</b>
<b>Carry</b>	-0.01	-0.05	-0.08	-0.06
<b>Defensive</b>	0.05	0.01	0.06	0.04
<b>Momentum</b>	0.01	-0.01	-0.01	0.01
<b>Value</b>	-0.03	-0.03	-0.08	0.04

**Panel C: Correlations with S individual score**

	<b>US-IG</b>	<b>US-HY</b>	<b>EU-IG</b>	<b>EU-HY</b>
<b>Carry</b>	-0.05	-0.01	-0.05	-0.03
<b>Defensive</b>	0.00	0.02	0.03	-0.03
<b>Momentum</b>	0.00	-0.02	0.05	0.03
<b>Value</b>	-0.02	0.03	-0.07	0.01

**Panel D: Correlations with G individual score**

	<b>US-IG</b>	<b>US-HY</b>	<b>EU-IG</b>	<b>EU-HY</b>
<b>Carry</b>	-0.04	-0.06	0.00	-0.08
<b>Defensive</b>	0.02	0.08	0.05	0.09
<b>Momentum</b>	0.03	0.01	0.06	0.02
<b>Value</b>	0.01	0.03	0.04	0.05

**Table 5**  
**Cross-sectional credit excess return regressions**

This table reports full sample panel regressions. There are 4 panels corresponding to our four credit universes. US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. US HY is the US High Yield Index from ICE/BAML (ticker H0A0). EU IG includes all EUR and GBP denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. EU HY is the European Currency High Yield Index from ICE/BAML (ticker HP00). The dependent variable in all regressions is the beta-adjusted DTS scaled credit excess return. Credit excess return ( $XS\_Return$ ) is computed as the difference between total returns (cum-coupon) for the bond and the total return of a key-rate matched government bond. We compute credit excess returns at a monthly frequency and subtract beta times the contemporaneous market credit excess return. Betas are estimated for each issuer using historical data. We further scale beta-adjusted credit excess returns by DTS (product of credit spread and spread duration) to homogenize the returns. The independent variables include ESG (and each component separately), with and without a composite expected return (ER) forecast across systematic measures of carry, defensive, momentum and value. E, S and G are the individual (non-industry-adjusted) scores for Environmental, Societal and Governance as calculated by MSCI. ESG is the aggregate industry-adjusted score across all three components. The regression we run is summarized below. Each ESG measure is increasing in quality, so a positive coefficient implies that ‘better’ E or S or G is associated with higher credit excess returns. ER is increasing in expected returns, so we expect a positive coefficient implying that higher expected returns translate to higher realized returns. Standard errors are clustered across both the temporal and issuer dimension to account for serial dependence in ESG characteristics as well as dependence across issues of the same issuer. Test statistics are reported in italics beneath regression coefficients. Regression specifications examining E, S and G separately also include industry indicator variables as the individual measures are not industry-adjusted. Time fixed effects are included in all specifications.

$$\frac{XS\_Return_{i,t+1} - Beta_{i,t}XS\_Return_{m,t+1}}{DTS_{i,t}} = \alpha + \beta_{ESG}ESG_{i,t} + \beta_{ER}ER_{i,t} + \varepsilon$$

**Panel A: US Investment-Grade Corporate Bonds**

	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>
$\alpha$	0.00 <i>0.05</i>	0.00 <i>-0.02</i>	0.01 <i>2.11</i>	0.01 <i>2.07</i>	0.01 <i>4.82</i>	0.01 <i>2.04</i>	0.01 <i>2.10</i>	0.01 <i>4.93</i>
$\beta_{ESG}$	0.00 <i>0.44</i>	0.00 <i>0.64</i>						
$\beta_{ER}$		1.78 <i>9.33</i>				1.73 <i>9.87</i>	1.73 <i>9.91</i>	1.73 <i>9.92</i>
$\beta_E$			0.00 <i>0.51</i>			0.00 <i>0.58</i>		
$\beta_S$				0.00 <i>0.99</i>			0.00 <i>0.95</i>	
$\beta_G$					0.00 <i>0.01</i>			0.00 <i>0.00</i>
$R^2$	16.8%	16.9%	16.9%	16.9%	16.9%	17.0%	17.0%	17.0%
N	657813	657813	657783	657783	657783	657783	657783	657783

**Panel B: US High-Yield Corporate Bonds**

	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>
$\alpha$	0.00 <i>0.96</i>	0.01 <i>2.15</i>	0.00 <i>0.43</i>	0.00 <i>0.59</i>	0.01 <i>1.01</i>	0.01 <i>1.07</i>	0.01 <i>1.02</i>	0.01 <i>1.28</i>
$\beta_{ESG}$	0.00 <i>0.36</i>	0.00 <i>0.18</i>						
$\beta_{ER}$		2.12 <i>8.14</i>				2.02 <i>7.48</i>	2.01 <i>7.61</i>	2.02 <i>7.58</i>
$\beta_E$			0.00 <i>1.24</i>			0.00 <i>0.98</i>		
$\beta_S$				0.00 <i>1.80</i>			0.00 <i>1.33</i>	
$\beta_G$					0.00 <i>0.42</i>			0.00 <i>0.39</i>
$R^2$	3.0%	3.2%	3.0%	3.0%	3.0%	3.2%	3.2%	3.2%
N	138188	138188	138188	138188	138186	138188	138188	138186

**Panel C: EU Investment-Grade Corporate Bonds**

	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>
$\alpha$	0.00 <i>0.93</i>	0.00 <i>0.90</i>	0.01 <i>1.84</i>	0.00 <i>0.74</i>	0.01 <i>2.52</i>	0.01 <i>1.79</i>	0.00 <i>0.71</i>	0.01 <i>2.57</i>
$\beta_{ESG}$	0.00 <i>0.33</i>	0.00 <i>0.37</i>						
$\beta_{ER}$		0.06 <i>6.66</i>				0.06 <i>6.96</i>	0.06 <i>7.01</i>	0.06 <i>6.91</i>
$\beta_E$			0.00 <i>-0.24</i>			0.00 <i>-0.15</i>		
$\beta_S$				0.00 <i>1.65</i>			0.00 <i>1.72</i>	
$\beta_G$					0.00 <i>0.27</i>			0.00 <i>0.17</i>
$R^2$	5.2%	5.3%	5.3%	5.3%	5.3%	5.4%	5.4%	5.4%
N	244338	244338	244332	244337	244337	244332	244337	244337

**Panel D: EU High-Yield Corporate Bonds**

	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>
$\alpha$	0.01 <i>1.53</i>	0.01 <i>1.79</i>	-0.01 <i>-1.04</i>	-0.01 <i>-0.78</i>	-0.02 <i>-2.17</i>	-0.01 <i>-0.94</i>	0.00 <i>-0.45</i>	-0.02 <i>-1.95</i>
$\beta_{ESG}$	0.00 <i>-0.41</i>	0.00 <i>-0.56</i>						
$\beta_{ER}$		1.99 <i>4.88</i>				1.97 <i>4.87</i>	2.03 <i>4.89</i>	1.95 <i>4.75</i>
$\beta_E$			0.00 <i>-0.16</i>			0.00 <i>-0.16</i>		
$\beta_S$				0.00 <i>-1.62</i>			0.00 <i>-2.03</i>	
$\beta_G$					0.00 <i>1.25</i>			0.00 <i>1.09</i>
$R^2$	2.4%	2.5%	2.5%	2.5%	2.5%	2.6%	2.6%	2.6%
N	34066	34066	34059	34066	34066	34059	34066	34066

**Table 6**  
**Future credit excess return volatility regressions**

This table reports full sample panel regressions. US IG includes all CAD and USD denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. US HY is the US High Yield Index from ICE/BAML (ticker H0A0). EU IG includes all EUR and GBP denominated bonds issued by corporate issuers domiciled in developed markets within the ICE/BAML G0BC index. EU HY is the European Currency High Yield Index from ICE/BAML (ticker HP00). The dependent variable in all regressions is the 12-month future volatility of issuer credit excess returns. Panel A (B) reports results with (without) DTS (product of credit spread and spread duration) scaled credit excess returns. All returns are beta-adjusted. Credit excess return (XS\_Return) is computed as the difference between total returns (cum-coupon) for the bond and the total return of a key-rate matched government bond. We compute credit excess returns at a monthly frequency and subtract beta times the contemporaneous market credit excess return. Betas are estimated for each issuer using historical data. The independent variables include ESG with, and without, the lagged value of the dependent variable and DTS for the non-scaled return volatility specification. E, S and G are the individual (non-industry-adjusted) scores for Environmental, Societal and Governance as calculated by MSCI. ESG is the aggregate industry-adjusted score across all three components. The regression we run is summarized below. ESG is increasing in quality, so a negative coefficient implies that ‘better’ E or S or G is associated with lower future credit excess return volatility. Standard errors are clustered by time and issuer. Test statistics are reported in italics beneath regression coefficients. Time fixed effects are included in all specifications.

$$\sigma_{\beta-adj\ XS-RET_{i,t+12}} = \alpha + \beta_{ESG} ESG_{i,t} + \beta_{DTS} DTS_{i,t} + \beta_{\beta-adj\ XS-RET} \sigma_{\beta-adj\ XS-RET_{i,t-12}} + \varepsilon$$

**Panel A: Volatility of DTS scaled beta-adjusted credit excess returns**

	US IG		US HY		EU IG		EU HY	
	I	II	I	II	I	II	I	II
$\alpha$	0.2985	0.2142	0.4548	0.3603	0.2465	0.1730	0.5229	0.4562
	<i>26.16</i>	<i>12.09</i>	<i>25.94</i>	<i>13.24</i>	<i>13.85</i>	<i>8.80</i>	<i>5.01</i>	<i>4.02</i>
$\beta_{ESG}$	-0.0031	-0.0032	0.0037	0.0028	-0.0037	-0.0029	-0.0155	-0.0135
	<i>-1.55</i>	<i>-1.81</i>	<i>0.87</i>	<i>0.74</i>	<i>-1.47</i>	<i>-1.32</i>	<i>-1.04</i>	<i>-0.95</i>
$\beta_{\beta-adj\ XS-RET}$		0.3666		0.2630		0.3419		0.1431
		<i>4.65</i>		<i>4.94</i>		<i>8.04</i>		<i>3.33</i>
$R^2$	34.0%	38.0%	20.3%	22.8%	11.4%	16.6%	5.3%	6.5%
N	62914	62914	35983	35983	32106	32106	8341	8341

**Panel B: Volatility of beta-adjusted credit excess returns**

	US IG		US HY		EU IG		EU HY	
	I	II	I	II	I	II	I	II
$\alpha$	0.0294	0.0069	0.0994	-0.0076	0.0232	0.0071	0.0665	0.0071
	<i>23.27</i>	<i>6.07</i>	<i>15.63</i>	<i>-1.23</i>	<i>15.29</i>	<i>5.58</i>	<i>7.16</i>	<i>1.14</i>
$\beta_{ESG}$	-0.0008	-0.0003	-0.0059	-0.0019	-0.0009	-0.0003	-0.0021	-0.0006
	<i>-3.69</i>	<i>-2.08</i>	<i>-4.49</i>	<i>-2.47</i>	<i>-4.19</i>	<i>-2.26</i>	<i>-1.48</i>	<i>-0.59</i>
$\beta_{DTS}$		0.1151		0.4620		0.0726		0.1948
		<i>14.40</i>		<i>10.49</i>		<i>8.80</i>		<i>4.72</i>
$\beta_{\beta-adj\ XS-RET}$		0.4086		0.3396		0.4038		0.5290
		<i>7.34</i>		<i>5.05</i>		<i>7.80</i>		<i>4.66</i>
$R^2$	30.0%	48.7%	11.2%	38.1%	14.9%	37.3%	11.7%	36.8%
N	62914	62914	35987	35987	32106	32106	8342	8342



**Table 7**  
**Static and Tactical Exclusions**

This table reports the fraction of market capitalization and count of issuers affected by static and tactical sustainable exclusion criteria. We show exclusions broken down across the main sectors. Static exclusions are based on corporate issuer business activity. Using data from MSCI we identify corporate issuers in (i) tobacco (defined as corporations with more than 5 percent of revenue generated from tobacco), (ii) controversial weapons (defined as corporations involved in the production of, or key components to, or generating revenue from controversial weapons including cluster munitions, landmines, chemical and biological weapons), (iii) fossil fuels (defined as corporations with any fossil fuel reserves or deriving more than ten percent of their revenue from either thermal coal or oil sands). Tactical exclusions are based on contemporaneous ESG scores provided by MSCI. Issuers in the bottom ten percent of industry adjusted ESG scores are excluded on this criterion. Each exclusion criteria are applied independently to the US and EU High Yield corporate bond markets as of December 31, 2020. We also show the combined effect of both exclusions. There are 2 panels corresponding to US HY and EU HY. US HY covers all constituents in the US High Yield Index from ICE/BAML (ticker H0A0). EU HY covers all constituents in the European Currency High Yield Index from ICE/BAML (ticker HP00). Together these two indices capture most of the issuers within the ICE/BAML Global High Yield Developed Markets Index (ticker HYDM).

**Panel A: US High-Yield Corporate Bonds**

Sector	Market Capitalization				Issuer Count			
	BMK	Static	Tactical	Both	BMK	Static	Tactical	Both
Cyclical	31.8%	-0.7%	-5.9%	-6.5%	233	-6	-17	-23
Financial	6.6%	0.0%	-0.2%	-0.2%	65	0	-5	-5
Industry	15.6%	-1.6%	-0.7%	-2.3%	202	-8	-11	-17
Utility	3.2%	-1.3%	0.0%	-1.3%	19	-4	0	-4
Non-Cyc	9.3%	0.0%	-0.7%	-0.7%	94	0	-7	-7
Energy	13.4%	-5.9%	-1.2%	-6.6%	111	-28	-9	-34
Health	8.9%	0.0%	-0.3%	-0.3%	51	0	-1	-1
Services	4.5%	0.0%	-0.1%	-0.1%	51	0	-2	-2
TeleCo	6.8%	0.0%	0.0%	0.0%	34	0	0	0
TOTAL	100%	-9.4%	-9.2%	-18.1%	860	-46	-52	-93

**Panel B: EU High-Yield Corporate Bonds**

<b>Sector</b>	<b>Market Capitalization</b>				<b>Issuer Count</b>			
	<b>BMK</b>	<b>Static</b>	<b>Tactical</b>	<b>Both</b>	<b>BMK</b>	<b>Static</b>	<b>Tactical</b>	<b>Both</b>
Cyclical	34.2%	-0.3%	-4.7%	-5.1%	124	-1	-6	-7
Financial	18.6%	0.0%	-0.1%	-0.1%	68	0	-1	-1
Industry	15.5%	-0.8%	-1.2%	-2.0%	75	-1	-7	-8
Utility	5.0%	-2.8%	0.0%	-2.8%	13	-4	0	-4
Non-Cyc	7.0%	0.0%	-0.5%	-0.5%	29	0	-1	-1
Energy	1.4%	-0.6%	0.0%	-0.6%	5	-1	0	-1
Health	3.1%	0.0%	0.0%	0.0%	12	0	0	0
Services	4.6%	0.0%	0.0%	0.0%	19	0	0	0
TeleCo	10.6%	0.0%	-1.8%	-1.8%	17	0	-2	-2
TOTAL	100%	-4.5%	-8.3%	-12.8%	362	-7	-17	-24

**Table 8**  
**Portfolio characteristics**

This table reports characteristics of the (i) systematic corporate bond portfolio (Systematic Portfolio, base case), (ii) sustainable systematic corporate bond portfolio (Sustainable Systematic Portfolio), and (iii) benchmark (ICE/BAML Global High Yield Developed Markets Index, ticker HYDM). These portfolio characteristics are computed each month over the 2012-2020 sample period, and we report median values of these characteristics through time.

**Panel A: Overall portfolio characteristics**

<b>Characteristic</b>	<b>Systematic Portfolio</b>	<b>Sustainable Systematic Portfolio</b>	<b>Benchmark (HYDM)</b>
Number of Bonds	317	316	2705
Spread Duration	3.83	3.84	3.96
Maturity	6.04	6.14	6.03
Coupon	7.21	7.11	6.28
Option Adjusted Spread	483	477	428
DTS	1703	1695	1654
Yield to Maturity	6.69	6.70	6.05
Yield to Worst	6.15	6.16	5.64

**Panel B: Ratings exposures**

<b>Rating Category</b>	<b>Systematic Portfolio</b>	<b>Sustainable Systematic Portfolio</b>	<b>Benchmark (HYDM)</b>
BB	46.2%	46.7%	52.5%
B	39.5%	38.6%	35.9%
CCC	13.4%	14.3%	10.9%
<CCC	0.2%	0.3%	0.6%

**Panel C: Sector exposures**

<b>Sector</b>	<b>Systematic Portfolio</b>	<b>Sustainable Systematic Portfolio</b>	<b>Benchmark (HYDM)</b>
Consumer Cyclical	26.0%	26.7%	26.9%
Financial Services	10.0%	10.1%	11.0%
Basic Industry	21.9%	19.6%	18.0%
Utility	3.5%	2.3%	3.2%
Consumer Non-Cyclical	4.8%	5.8%	5.5%
Energy	14.9%	11.9%	11.2%
Healthcare	6.2%	6.7%	8.2%
Services	4.6%	5.8%	4.9%
Telecommunications	8.2%	9.4%	10.0%