Issuing bonds during the Covid-19 pandemic: is there an ESG premium?*

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Abstract

We rely on the ESG ratings assigned by four distinct agencies (MSCI, Refinitiv, Robeco, and Sustainalytics) to study the link between ESG scores and firms' cost of debt financing during the early stage of the Covid-19 pandemic. We document the existence of a statistically and economically significant significant ESG premium, i.e. better rated companies access debt at lower cost. Despite some heterogeneity across rating agencies, this result is robust to the inclusion of issuer's credit standing as well as several bond and firms' characteristics. We find that the effect is mainly driven by firms domiciled in advanced economies whereas creditworthiness considerations prevail for firms in emerging markets. Lastly, we document that the existence of a lower cost of capital for highly-rated ESG firms is explained by both risk-based considerations unrelated to corporate credit risk and by investors' preference towards more sustainable assets.

JEL classification: G12, G23, G32, G4

Keywords: ESG scores; Covid-19; bond issuance; yield spreads

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1 Introduction

In the early months of 2020, the spread of the Covid-19 pandemic triggered an abrupt reaction in global financial markets with pervasive and unprecedented impacts across geographical regions and asset classes. The most dramatic phase of the financial turbulence occurred between 21 February 2020, when the first lockdown measures were announced in Italy, and the last week of March, when unprecedented central banks' support measures prompted a gradual turnaround in global financial markets. During these weeks, the MSCI world market index dropped by 33%, the VIX index jumped by more than 44 points, reaching a record high value of 82, the global EMBI spread rose by around 370 basis points, the dollar appreciated by almost 3%, and portfolio outflows from funds investing in emerging markets exceeded 80$ billions.[1]

During this period of major turbulence and acute economic uncertainty, global bond issuance was extremely abundant, see Figure 1. Notably, the first three quarters of 2020 ranked as those with the largest global debt issuance on record, both in terms of proceeds and number of offerings, with a steep acceleration since late March as firms sped up their refinancing process to profit from the easing of global financial conditions and the adoption of massive programs of bond purchases by leading central banks worldwide (IMF, 2020a). Interestingly, and contrary to similar episodes of market and economic downturn, this surge in bond issuance was not limited to bonds rated A or higher, but also extended to issues with higher credit risk, as shown by Halling et al. (2020a).

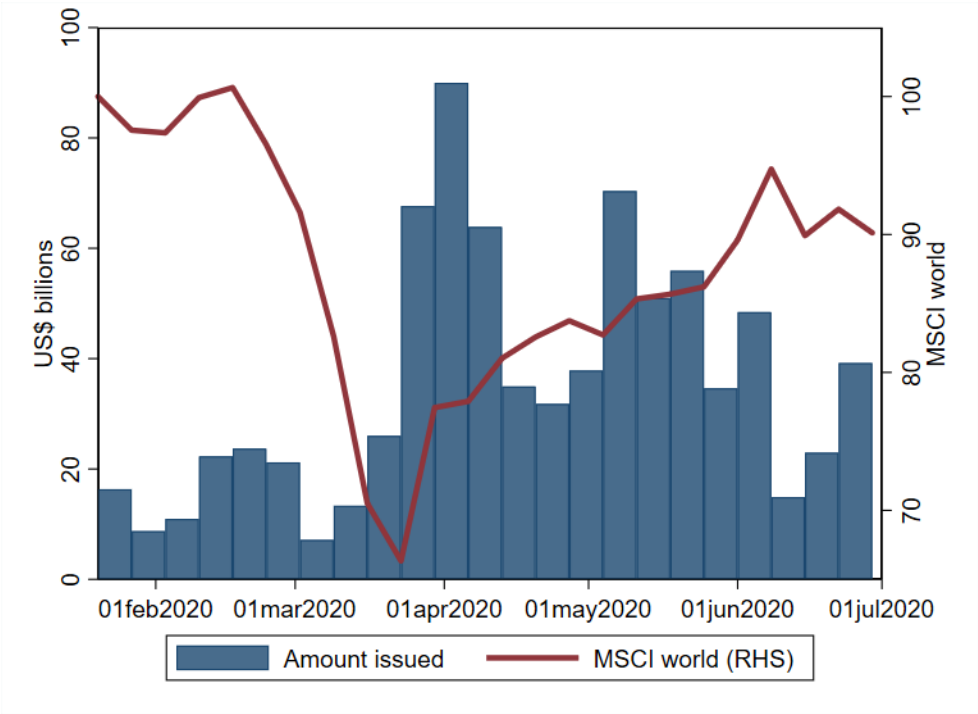
In this paper we focus on bond issuance during the early stages of the Covid-19 pandemic and study whether the environmental, social and governance (ESG) profiles[2] of firms influences their funding costs beyond what could be explained by corporate fundamentals and bond characteristics. In general, ESG scores should matter as determinants of corporate funding costs to the extent that they are able to identify some specific component of inherent corporate risk (e.g. firms' exposure to climate risk) or are useful to capture investors' preferences towards more sustainable financial assets (Pástor et al., 2021). The unexpected and exogenous nature of the health shock triggered by the Covid-19 outbreak offers an ideal setting to investigate the interlink between ESG attributes and financial conditions, as the rapid and abrupt reaction observed in financial markets limited firms' ability to respond to the crisis (Albuquerque et al., 2020). In turn, this implies that any relation between ESG scores and cost of funding must necessarily reflect firms' preexisting conditions so that endogeneity concerns related to the joint determination of credit spreads and ESG attributes should be minimized.

We focus on the primary bond market because it allows a more direct analysis of firms'

[1] See FSB (2020), Ramelli and Wagner (2020), IMF (2020b), Ding et al. (2021), Gormsen and Koijen (2020), and Ferriani (2021) among many others for some analyses of the pandemic-induced market turmoil.

[2] In the following we will use the terms ratings, score, ranking, profile, attributes as interchangeable.

Figure 1: **Bond issuance and MSCI world dynamics**



Bond issuance and MSCI world index dynamics. The graph displays the weekly amount of bond issuance between 20th January and 30th June 2020; see Section 3 for details about the bonds included in the sample. MSCI world index data come from Refinitiv and are normalized at 100 on 20th Janaury 2020.

funding costs and is less likely to be affected by liquidity issues compared to the secondary bond market. We measure firms funding costs in terms of asset swap spreads (ASS) and combine these data with the ESG ratings developed by four different data providers: MSCI, Refinitiv, Robeco, and Sustainalytics; with the only exclusion of MSCI, our dataset also allows to dissect the analysis not only at the aggregate level, i.e. in terms of the composite ESG score, but also with respect to the three distinct components of the ESG rating. As discussed in Section 2, previous research has found some disagreement across ESG ratings, so that the availability of multiple scores is a paramount condition to exclude the possibility that the connection between firms' ESG score and funding costs is driven by the assessment made by a specific rating provider.

Our empirical analysis highlights several results of interest. First, we find that ESG scores are unconditionally correlated with the ASS or, in other words, firms with better ESG attributes achieved lower financing costs during the Covid-19 crisis. When an extensive set of controls related to bond and firms' characteristics is also included in the model, then the negative and statistically significant link between ESG scores and bond risk premia somehow weakens but it is still confirmed for MSCI and Robeco. The impact of the ESG rating, where statistically significant,

is nevertheless not negligible in economic terms; for example a one standard deviation increase in the MSCI ESG score is associated with a 15 basis point decrease in the ASS, approximately 7% of the average yield spread at issuance. A similar result is also obtained when multiple ESG scores are combined via principal component analysis (PCA) in order to maximize the informative content across different rating agencies.

Second, we replicate the baseline results but we split the sample to evaluate the relation between ASS and ESG scores with respect to several dimensions including firms' domicile, industrial sector, and time phases of the Covid-19 crisis. We find strong evidence of a different impact of ESG ratings when distinguishing observations with respect to firms' nationality. Our estimates point to a more sizable effects for firms domiciled in advanced economies (AEs) rather than in emerging market economies (EMEs), a result possibly driven by differences in investors' preferences and in the development of the ESG industry across geographical areas. As a collateral finding, we document that the issuer's creditworthiness plays a crucial role in explaining ASS variation for firms domiciled in EMEs: the coefficient of the S&P rating for bonds issued in EMEs is more than twice the corresponding estimate for firms in AEs, with a sizable economic magnitude amounting to more than 100 basis points of lower ASS for a one standard-deviation increase in the issuer's rating. The within-industry analysis of the relation between the ESG score and firms' cost of funding hardly points out the existence of a sectoral-specific impact, with some minor exceptions for the consumer and the energy sector; indeed, most of the coefficients are not statistically significant and in a few cases even divergent across rating agencies. Moreover, we do not document generally find evidence of a structural break in the pricing of ESG factors across the different stages of the Covid-19 crisis.

Third, we explore the role of the individual components of the ESG rating, namely the environmental, social, and governance scores, as determinants of the bonds' yield spreads. As a matter of fact, the composite ESG score signals the attitude of firms towards an extensive list of "sustainable purposes" such as preserving the environment, pursuing energy efficiency, enhancing employee welfare, mitigating controversies with customers and suppliers, sustaining board independence, and strengthening governance mechanisms. To discern the specific contribution of each ESG subcomponents on firms' financing costs we regress the ASS on the three individual scores (E, S, G) assigned by each data provider. In general, our results show a very limited informativeness of the ESG subcomponents when included as distinct regressors in our empirical specification. However, and more interestingly, their combination via PCA to develop a synthetic aggregate ESG score confirms the negative link between sustainability and bond yield spreads.

Finally, in view of the general evidence pointing to a negative relation between ESG performance and corporate funding costs, we devote the last part of the paper to examine the possible channels shaping the relation between ESG scores and ASS. Our analysis is inspired by the the-

oretical model introduced by Pástor et al. (2021) who identify two motivations behind the lower yields of highly-rated ESG firms: investors' preference towards sustainability (*non-pecuniary channel*) and the ability of more sustainable firms to provide a hedge against climate shocks or unexpected deteriorations in the regulation related to the environmental and the social dimension of corporate activity (*risk-channel*). To the best of our knowledge, our paper is the first to provide some empirical evidence of the interlink between these two channels and bond yield spreads. We proxy the contribution of these two factors using the share of sustainable funds holding the bond issuer's stock and a firm-level measure of exposure to climate change extracted from the earning call transcripts and developed by Sautner et al., 2020. We do not find any of the two channels mutually excluding the other; on the contrary they both play a role in the determination of corporate cost of funding during the first months of the Covid-19 pandemic, with an impact of around 31 basis points for the non-pecuniary channel and up to 19 basis points for the risk channel.

Our study contributes to the literature investigating the relationship between the sustainability performance of companies and their cost of capital; in this regard we deliver multiple valuable insights and implications by focusing on the primary bond-market during a major period of crisis such as the one induced by the Covid-19 pandemic. First and from the perspective of bond issuers, we show that firms with better ESG profiles are generally able to finance their activity at a lower cost. This result is obtained by observing yield spreads throughout a period of abundant corporate debt issuance combined with elevated market uncertainty and it is robust to the inclusion of several controls, and in particular traditional measures of credit risk. Second, from a demand perspective, the attention towards sustainable investments is part of a trend that has shaped the financial industry in recent times and has remarkably accelerated since the onset of the Covid-19 pandemic, see for instance ECB (2020), GSIA (2021), and Mohommad and Pugacheva (2022). As a result, an increasing amount of sustainable investments has been included in global portfolios (almost 36% at the end of 2020 according to GSIA, 2021) and financial service providers announced the launch of equity and bond indexes explicitly tracking companies with high ESG profiles.[3] Even more interestingly, ESG considerations and benchmarking have been integrated in the portfolio decisions of central banks (Bernardini et al., 2021) and in their collateral framework for monetary policy operations.[4] We document that this shift in investors' preference is not just a tendency of the industry but it has also important implications in terms of asset pricing, with more sustainable firms benefiting from lower cost of capital. Lastly, from a regulatory and policy perspective, our study highlights some degree of heterogeneity across rating agencies in the assessment of firms' ESG profiles and this must be necessarily taken into account when analyz-

[3]See for example the launch of the S&P 500 ESG index in 2019, the announcement in 2021 of two Euronext ESG indexes targeting the French and the Italian stock exchanges respectively, and the launch in 2021 of a Citi equity benchmark tracking best-in-class ESG performers across global markets.

[4]See the ECB decision at https://bit.ly/2WrhBrW.

ing the relation between ESG scores and the price of financial assets. The availability of multiple ESG scores is generally a very infrequent feature of most empirical research in this field, which makes us confident that the evidence and the conclusions presented in this paper are not flawed by data constraints. In this respect, our analysis reinforces the urgency of initiatives to overcome the current limitations and inconsistencies in ESG classifications and to deliver a common taxonomy that enhances data comparability and transparency for investors (see Visco, 2019, Signorini, 2020, Kleimeier and Viehs, 2021). Efforts in this regard are likely to accelerate in the near future as policy actions to embrace the ESG paradigm are spreading rapidly, see the decision of the European Commission to issue around 30% of its Covid-19 recovery program (NextGenerationEU) as green bonds[5] or the recommendation by the European Banking Authority to incorporate ESG considerations in the risk management and capital allocation process of credit institutions.[6]

The remainder of this paper is organized as follows. Section 2 briefly reviews the relevant literature for this study, Section 3 introduces the dataset and presents some descriptive statistics, Section 4 discusses the empirical results, while Section 5 examines the channels of the bond yields spreads. Finally, Section 6 offers our concluding remarks.

2 Literature

Over the last decade we have witnessed a growing body of research investigating the connection between firms' ESG attributes and multiple dimension of corporate financial performance such as equity returns, bond yields, access to credit market, see Friede et al. (2015) Brooks and Oikonomou (2018), Matos (2020), and Gillan et al. (2021) for some comprehensive reviews. As a matter of fact, a large part of the previous empirical studies has focused on the equity market, in particular the US one, and it has limited the analysis to both tranquil market periods and a single data provider for ESG scores. On the contrary, we concentrate on the global primary bond market during the Covid-19 crisis and we use multiple data providers to analyze the interlink between corporate sustainability and debt cost of capital. The interest for this topic is at least twofold. First of all, the Covid-19 period was characterized by a drastic, although limited in time, deterioration of firms' liquidity and funding conditions, resulting in a dash-for-cash episode with direct effects on corporate risk premia and access to credit (Acharya and Steffen, 2020 and FSB, 2020). In this regard, the existence of any ESG premium could deliver important insights for both firms and investors about corporate resilience throughout a crisis period. Second, the Covid-19 pandemic has been an incredible wake-up call for the importance of sustainability factors (e.g. Mohommad and Pugacheva, 2022) so that it is worth analyzing if any ESG premium has been channeled via

[5]See a brief summary of the program at https://bit.ly/38i6P9D.
[6]See the details of the EBA announcement at https://bit.ly/2WspFZt.

the increasing investors' attitude towards more sustainable financial assets.

In principle, there exist two main theoretical motivations to explain why firms chose to embrace ESG objectives and how this choice influences the price of financial assets, as discussed in Pástor et al. (2021).[7] On one side, the interest towards firms with high ESG scores could be driven by individuals' intrinsic preference for more sustainable assets, which make investors willing to acknowledge a premium to highly-ranked ESG firms on the basis of non-pecuniary considerations. On the other side, and from a more financial perspective, it can also reflect investors' conviction that more sustainable assets deliver better risk-adjusted returns and that ESG factors capture some source of risk that is not fully account for by traditional credit metrics. Firms could be incentivized to improve their ESG profile as far as it reduces the corporate inherent risk by way of an increase in the value of corporate assets or a reduction in income volatility. As an example, this may occur because firms with higher ESG scores are less exposed to capital and operational losses due shifts in environmental regulation, adverse climate events, strikes, corruption cases. As a result ESG considerations deliberately enter the asset allocation decisions of individuals and institutions, in particular of those with more long-term investment horizons (e.g. Dimson et al., 2015, and Dyck et al., 2019, and Krueger et al., 2020), thus contributing to make ESG assets less exposed to asset turnover and massive disinvestment during periods of market turmoil.

As concerns the interaction between ESG scores and firms' cost of debt, previous research has generally documented a lower cost of financing for more sustainable firms in terms of bond yields and credit spreads on loan data, with most of the studies explicitly targeting the US market. Bauer and Hann (2010) provide evidence that firms' credit standing and the yield spreads of newly issued bonds are influenced by the exposure of US firms to environmental concerns. Oikonomou et al. (2014) investigate the impact of several distinct dimensions of sustainability in the primary and secondary US bond market and find lower risk premia and higher credit ratings for firms with less social transgressions. Ge and Liu (2015) present similar evidence also focusing on the US primary market but using aggregate measures of corporate sustainability and adopting an IV approach to mitigate endogeneity concerns between ESG performance and bond yield spreads determination. Goss and Roberts (2011) and Chava (2014) respectively report that corporate social responsibility (CSR)[8] and lack of environmental concerns also matter for corporate access to bank credit, with better positioned firms achieving lower spreads on their loans. Díaz and Escribano (2021) show that "green" energy firms, identified as those included in the Dow

[7] We refer to Heinkel et al. (2001), Renneboog et al. (2008), Goss and Roberts (2011), Albuquerque et al. (2019), Albuquerque et al. (2020), Halling et al. (2020b), and Pedersen et al. (2021) for some other contributions offering a theoretical rationale of ESG investing.

[8] The boundaries and the differences between CSR and ESG are not immediate to outline and are nevertheless out of the scope of this research; consistently with other contributions in the literature (e.g. Gillan et al., 2021), and without loss of generality, in this study we consider the two terms as synonyms.

Jones Sustainability Index, benefit of a sustainability premium when issuing bonds as opposed to their "brown" counterparts. As to the European bond market results are partially mixed: Menz (2010) document marginal statistical significance of the connection between CSR and the price of bonds, Stellner et al. (2015) show that sustainable firms are rewarded in terms of rating and yield spreads only to the extent that they operate in a sustainability friendly environment as expressed by the ESG profiles of their corresponding countries, while La Rosa et al. (2018) concentrate only on the social performance score and recover a positive role in reducing firms' cost of debt.

As already mentioned, being the nature of the Covid-19 shock essentially exogenous (Albuquerque et al., 2020), the crisis induced by the pandemic should represent an ideal framework to test the presence of a sustainability premium. The analysis of the connection between ESG factors and the performance of financial assets during the Covid-19 turmoil is rapidly accelerating and extending to several fields.Ferriani and Natoli (2020) and Pástor and Vorsatz (2020) show that investment funds with more sustainable assets attracted a larger amount of net inflows and delivered better returns during the Covid-19 crisis as compared to funds with high ESG risk. Ding et al. (2021) find that the drop in stock returns across 61 countries during the first five months of 2020 was milder for firms with stronger CSR activities prior to the pandemic pointing at sustainability as a factor of resilience in times of heightened market stress. A similar evidence is also reported by Albuquerque et al. (2020) who expand the analysis to cover return volatility and several measures of operating performance and confirm the superior dynamics of firms with better environmental and social scores in the US equity market whereas it contrasts with Bae et al. (2021) who do not find evidence that CSR affected stock return in US companies during the stock market crash. Gianfrate et al. (2021) provide a cross-country and multi-asset study on the resilience of ESG investing during the Covid-19 market crash; they document a complementarity between corporate sustainability and national sustainability as they find that green assets outperformance is limited to countries with relatively lower national environmental capital. Halling et al. (2020b) do not explicitly target the Covid-19 period, but also cover the pandemic phase in their analysis of bond yield spreads in the primary market. Contrary to us, they do not rely on multiple ESG ratings but on a unique measure of sustainability built by aggregating firms' strengths and concerns over environmental and social attributes based on company data available at the end of 2018. Most importantly, and at odds with evidence reported in this study, they do not find that firms with higher sustainability scores benefited from lower bond spreads during the crisis.

Finally, our paper also relates to research focusing on the misalignment of ESG ratings across different data providers, see Dorfleitner et al. (2015), Berg et al. (2019), and Billio et al. (2020) Gibson Brandon et al. (2021) for some contributions on this topic. Although we do not explicitly tackle the motivations behind the divergence across various ESG ratings, one major advantage of this study is the availability of several ESG metrics. In general terms, the simultaneous use of

multiple ESG scores is designed to avoid that our findings and conclusions are driven by the use of a specific rating agency. This is not a minor issue being the evidence of the interplay between firm performance and ESG attributes somewhat mixed in the literature (Gillan et al., 2021). As we show in the empirical analysis, we confirm the existence of some disagreement across rating agencies which in turn implies a different assessment of the impact of the ESG scores on bond risk premia. Our study hence presents new evidence in support of academic and policy contributions calling for greater methodological transparency and comparability in the measurement of corporate ESG performance (e.g. Visco, 2019, Boffo and Patalano, 2020, Iosco, 2021, and Kleimeier and Viehs, 2021).

3 Data

We rely on multiple sources to create the sample for our analysis. From Refinitiv we retrieve data on the global issuance of bonds by non-financial firms, starting from the 20th of January 2020 (the date of confirmed human-to-human transmission of Covid-19) throughout all the first semester of 2020, having financial markets recovered almost all of their pandemic-induced losses by the end of June 2020. For each issuer, we also use Refinitiv to complement the dataset with balance-sheet information (e.g. total assets, leverage...), market capitalization, and Scope 1-3 greenhouse gas (GHG) emissions[9]; all these data refer to the last available fiscal year. Then, we add information on the aggregate ESG scores at the issuer level which are obtained from four different data providers: MSCI, Refinitiv, Robeco, and Sustainalytics. MSCI ESG aggregate scores are collected from the MSCI website via its ESG ratings corporate search tool, Refinitiv (Asset4) aggregate scores are retrieved from Eikon, Robeco and Sustainalytics ESG aggregate scores are obtained from Bloomberg. MSCI ESG aggregate scores are measured via a 7-step rating scale ranging from CCC (lowest score) to AAA (highest score); the other data providers develop a rating scheme ranging from 0 to 100, with higher values associated with superior ESG performance. Whatever the data provider, we always consider the latest available score at the end of 2019, i.e. the last score available to investors immediately before the outburst of the Covid-19 pandemic. In the case of Refinitiv, Robeco, and Sustainalytics we also have access to the three scores related to the subcomponents of the ESG valuation, namely the environmental, social, and governance individual scores; the three dimensions are again valued on a 0-100 scale with larger values indicating a better standing. Finally, we resort to Bloomberg to obtain data on the S&P long-term rating of

[9]Based on the definition of the GHG Protocol, GHG emissions can be broken down into three categories: scope 1 emissions are defined as those caused directly by the organization's activities, scope 2 emissions count indirect emissions resulting from the organization's energy consumption, while scope 3 emissions are defined as all other indirect emissions that are a result of the organization's operations but are generated from sources that are not owned or controlled by the organization itself.

Table 1: **Descriptive statistics**

	N	Mean	St.Dev.	25p	50p	75p
MSCI ESG	899	4.1	1.6	3.0	4.0	6.0
Refinitiv ESG	1052	64.9	18.3	55.6	69.7	78.0
Robeco ESG	933	53.8	28.5	32.0	56.0	77.0
Sustainalytics ESG	694	67.6	23.5	53.4	72.3	88.6
S&P issuer rating	839	10.3	2.6	9.0	10.0	12.0
Refinitiv E	1052	63.5	23.9	51.3	70.7	81.4
Refinitiv S	1052	67.7	21.7	56.1	74.2	83.3
Refinitiv G	1052	61.0	21.0	46.0	63.6	77.7
Robeco E	979	55.0	28.5	33.0	57.0	79.0
Robeco S	979	54.2	28.6	31.0	56.0	77.0
Robeco G	979	52.8	28.6	29.0	54.0	77.0
Sustainalytics E	688	66.4	24.3	45.4	73.0	86.1
Sustainalytics S	688	66.3	24.6	50.0	72.5	86.7
Sustainalytics G	688	63.7	25.8	45.1	67.0	86.9
Asset swap spread (bps)	1078	217.1	178.9	98.3	179.9	273.0
Tenor (years)	1073	9.8	8.8	5.0	7.0	10.0
Advanced economy (%)	1078	0.7	0.5	0.0	1.0	1.0
Dividend	1003	2.7	2.0	1.3	2.3	3.7
Amount issued (US$ millions)	1078	761.8	737.6	200.0	600.0	1000.0
Total assets (US$ billions)	1078	70.2	101.1	11.7	31.2	84.4
Revenues (US$ billions)	1078	39.4	56.4	6.9	18.6	51.3
Leverage (%)	1078	0.3	0.1	0.2	0.3	0.4
Interest coverage ratio	1063	12.5	25.4	3.7	7.0	12.3
Dividend	1003	2.7	2.0	1.3	2.3	3.7
Price to book	1062	3.6	8.7	1.2	2.4	5.1
Carbon intensity	1072	0.0	0.0	0.0	0.0	0.0

Descriptive statistics for bond issued globally by non-financial corporations between 20th January 2020 and 30th June 2020.

the issuer and on the ASS of each bond on its placement day. The ASS represents our measure of firms' cost of debt and is defined as the difference between the bond yield and the yield of an asset swap contract with similar characteristics; the use of the ASS rather than the yield spread computed by resorting to interpolated yield curves of sovereign securities is more appropriate for corporate market instruments and during periods of high volatility, see Zaghini (2016) and Zaghini (2021) on this point.[10]

[10]Bonds where the ASS is missing are excluded from the sample. The main results of this study are nevertheless qualitatively similar when considering yield spreads with respect to a benchmark sovereign rate; estimates are available upon request. The S&P long term rating of the issuer is remapped on a 17-step scale based on ratings observed in the sample, from 1 (CCC+) to 17 (AAA).

Table 2: **Correlation matrix of S&P and ESG ratings**

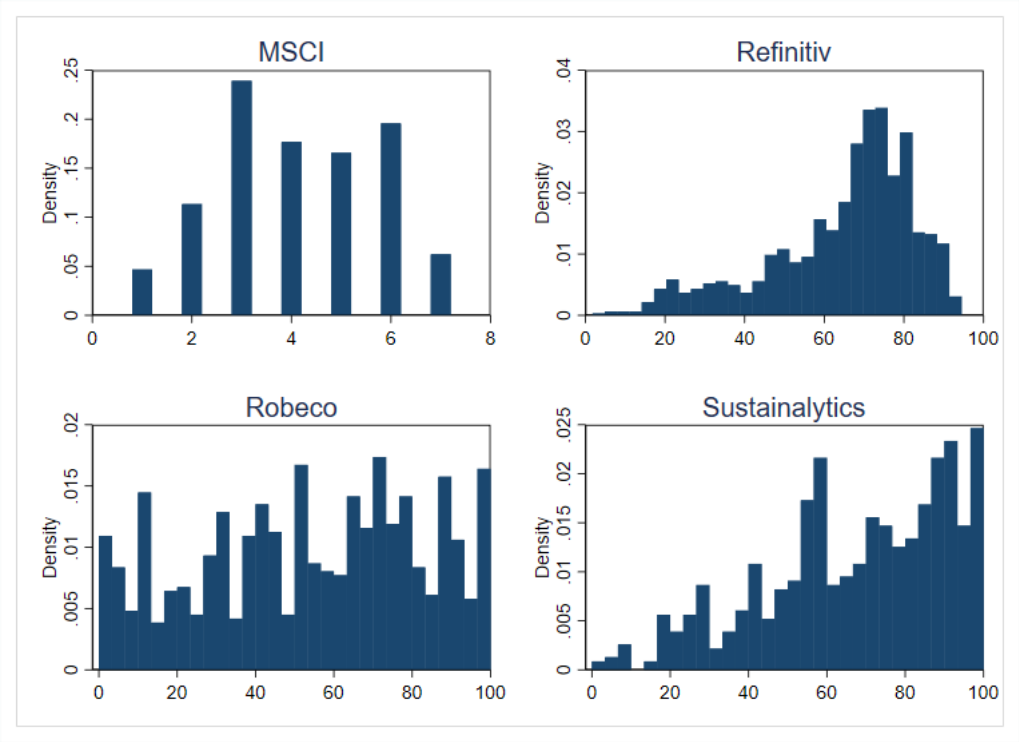
	S&P	MSCI ESG	Ref. ESG	Rob. ESG	Sust. ESG	Ref. E	Ref. S	Ref. G	Rob. E	Rob. S	Rob. G	Sust. E	Sust. S	Sust. G
S&P	1.00													
MSCI	0.27	1.00												
Refinitiv	0.37	0.40	1.00											
Robeco	0.15	0.35	0.63	1.00										
Sustainalytics	0.16	0.55	0.51	0.57	1.00									
Ref. E	0.36	0.32	0.84	0.62	0.49	1.00								
Ref. S	0.33	0.40	0.91	0.64	0.54	0.75	1.00							
Ref. G	0.16	0.26	0.65	0.22	0.19	0.31	0.40	1.00						
Rob. E	0.16	0.37	0.62	0.93	0.59	0.64	0.64	0.20	1.00					
Rob. S	0.18	0.37	0.63	0.98	0.56	0.61	0.62	0.24	0.94	1.00				
Rob. G	0.13	0.35	0.59	0.93	0.45	0.53	0.58	0.28	0.86	0.92	1.00			
Sust. E	0.14	0.51	0.42	0.52	0.87	0.44	0.48	0.11	0.57	0.51	0.39	1.00		
Sust. S	0.13	0.47	0.48	0.50	0.89	0.45	0.54	0.14	0.50	0.49	0.40	0.65	1.00	
Sust. G	-0.05	0.47	0.40	0.43	0.74	0.30	0.37	0.30	0.44	0.42	0.37	0.53	0.56	1.00

The table displays the correlation matrix of the S&P (issuer based) and the ESG ratings (scores defined both at the aggregate and the subcomponent level). MSCI ESG rating is only available at the aggregate level.

Descriptive statistics on the sample are reported in Table 1. The sample consists of 1078 bonds for which at least one of the four ESG ratings is available and reduces to 640 when we only consider bonds for which all the 4 ESG scores are available (i.e. the "common sample"). On average, the aggregate ESG score is approximately 4 in the case of MSCI which corresponds to a BBB rating of its 7-step scale, it is almost 65 for Refinitiv and around 68 for Sustainalytics, while it is slightly less than 54 for Robeco. As to the three subcomponents of the ESG scores we observe a very similar pattern, with Refinitiv and Sustainalytics providing comparable average ratings, generally above 60, while the three equivalent scores assigned by Robeco are generally lower and in the range 50-55. The rating assigned to the "Governance" component tends to be lower than the one assigned to the Environmental and Social dimensions across the three data providers with subcomponent ratings. The average ASS is approximately equal to 217 basis points and the sample mainly includes long-term bonds, with the average maturity being almost equal to 10 years. The average S&P rating is larger than 10 corresponding to a BBB+ once converted to the proprietary S&P codification, with approximately 90% of rated firms sample comprised in the investment grade category. Almost 70% of the bonds are issued in advanced economies and the average amount issued is around 762 USD millions.

The distribution of the aggregate ESG score is displayed in Figure 2. We observe some heterogeneity across rating providers: the distribution exhibits a quite evident negative skewness for both Refinitiv and Sustainalytics where the mode is equal to 74 and 100, respectively; on the

Figure 2: **ESG score distribution**



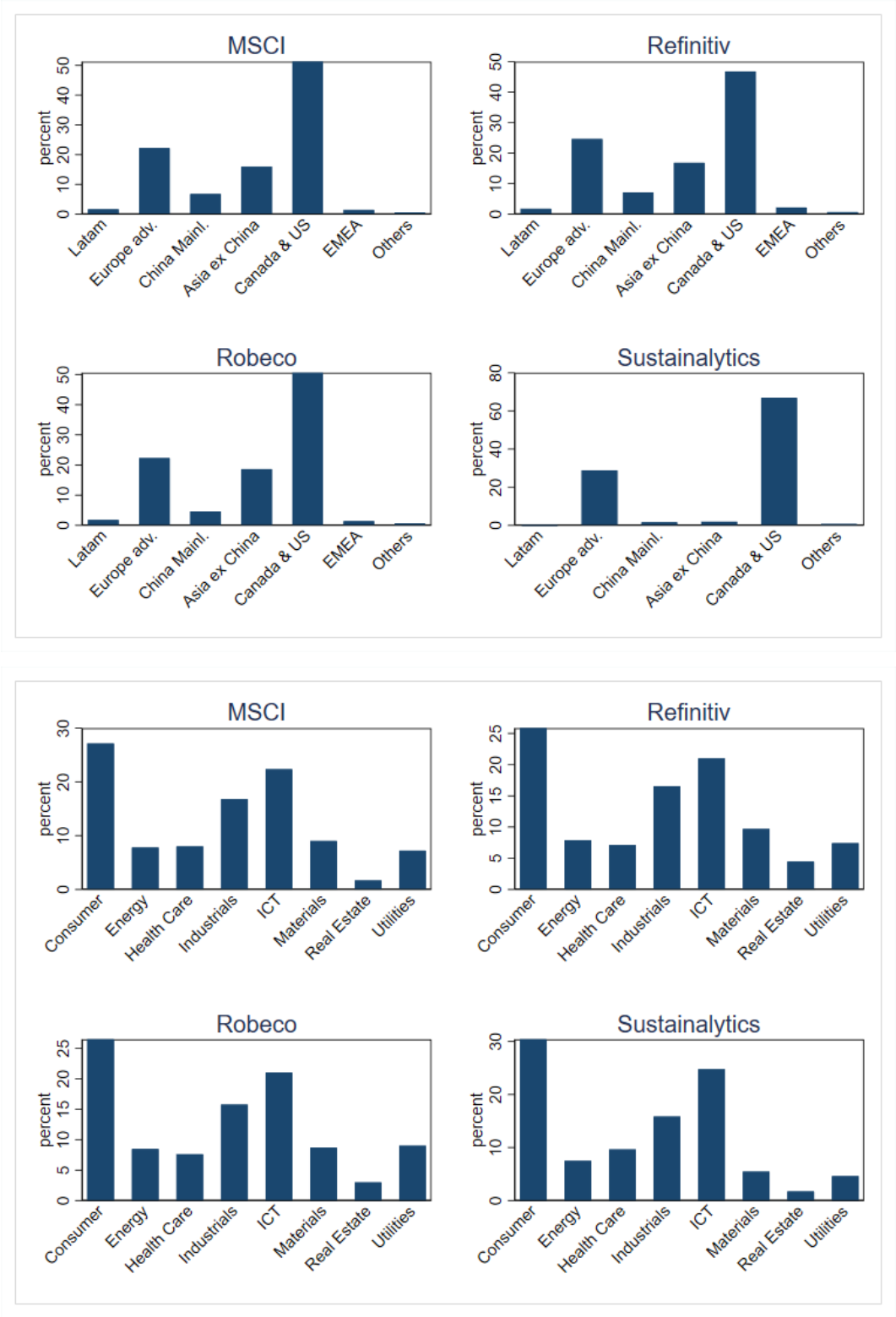
Frequency distribution of the ESG aggregate scores. MSCI rating spans over a 7-step scale, the other scores are defined on a 0-100 scale.

contrary, the distribution tends to be somewhat more uniform for Robeco (mode equal to 66) and MSCI where the mode is equal to 3 (BB in the original scale).[11] Table 2 displays the correlation matrix of the S&P issuer rating and the ESG scores at the aggregate as well as at the subcomponent level. As expected the correlation is positive although not extremely high for several pairwise combination, a fact already emphasized in other empirical studies (e.g. Dorfleitner et al., 2015 and Berg et al., 2019). In particular, the correlation is generally quite low between the S&P and the ESG ratings, both at the aggregate and subcomponent level, which may be indicative of the different sources of risk that are captured by the two metrics. Correlations tend to be higher within each data provider (e.g. Refinitiv ESG aggregate rating vs. Refinitiv score at the subcomponent level) and across similar dimensions (e.g. Refinitiv E vs. Robeco E vs. Sustainalytics E).

Finally, Figure 3 presents the frequency distributions of bond issues with respect to issuers' nationality and Global Industry Classification Standard (GICS) sectors. The upper plot shows that a sizable share of issuers is domiciled in advanced economies, especially in United States

[11] The distribution of the scores at the subcomponent level mimics quite closely the one displayed for the aggregate ESG ratings; graphical evidence is available upon request.

Figure 3: **Residence and industrial sector of the issuer**



The upper panel displays the distribution of the issuers' residence across geographical areas, the lower panel presents the distribution of issuers with respect to GICS sectors. Full list of countries included in each geographical area is available upon request; GICS sector "Consumer" include both Consumer Discretionary and Consumer Staples, whereas GICS sector "ICT" include both Information Technology and Communication Services.

and Canada with a relative weight generally equal or larger than 50% across all rating providers. Around 20% of the bond issuers are located in European advanced economies, while the remaining observations are generally split between China and other Asian countries with the main exception of Sustainalytics where the fraction of issuers located outside Europe, Canada and US is minimal. In our sample, the frequency distribution with respect to the issuer industrial sector is quite similar across different rating providers, with about a fourth or more of the observations belonging to the Consumer sector. Other sectors accounting for a sizable share of the observations are ICT and Industrial; a fraction approximately equal to a third of the sample is distributed across the remaining sectors, namely Energy, Health care, Materials, Real estate, and Utilities.

4 Results

To assess the impact of the ESG scores on firms' cost of debt we are interested in estimating regression models of the following forms:

$$\begin{aligned} Spread_i &= ESG\,score_i + X_i + \gamma_t + \delta_i + \epsilon_i \\ Spread_i &= E\,score_i + S\,score_i + G\,score_i + X_i + \gamma_t + \delta_i + \epsilon_i \end{aligned}$$

where $Spread$ is the logarithm of the asset swap spread of each bond on its placement day, $ESG\,score$ is the ESG metrics assigned by one of the four data providers, $E\,score$, $S\,score$, and $G\,score$ are the score of the three subcomponents, X_i includes a set of corporate and bond characteristics, γ_t are time fixed effects controlling for the month of issuance, δ_i are geographical and industrial sector fixed effects, and ϵ is the error term. The first equation is meant to analyze the impact of the aggregate ESG rating on bond ASS, while the second equation focuses on the separate impact of each individual component of the ESG metrics.

In our first model specifications, we limit the set of explanatory variables to the ESG composite rating in addition to industry, geographic, and time fixed effects to account for possible composition effects related to the Covid-19 period. Results are reported in Table 3 and are based on the whole set of observations available for each data provider; we display standardized coefficients to compare the impact across different ESG metrics. We find strongly statistical evidence across all rating providers that a higher score is associated with a lower cost of funding. The effect is also sizable in economic terms: in the case of MSCI, a one standard deviation increase in the aggregate ESG score (approximately equal to a 1.5 rating upgrade on a 7 step scale) generates a 11% decline in the cost of debt at the issuance or alternatively 24 bps with respect to the average asset swap spread. The effect is smaller and similar for the remaining rating providers where a one standard deviation increase in the aggregate ESG score (or equivalently an upgrade by 18-29

Table 3: Bond spreads and aggregate ESG scores: baseline results

	(1)	(2)	(3)	(4)
MSCI ESG	-0.117***			
	(-4.172)			
Refinitiv ESG		-0.061**		
		(-2.414)		
Robeco ESG			-0.062***	
			(-2.581)	
Sustain. ESG				-0.069***
				(-2.857)
N	899	1052	933	694
R^2	0.31	0.25	0.26	0.32

The first line reports standardized coefficients defined as the marginal effect of a one standard deviation increase in each regressor on the log-ASS; t-statistics based on robust standard errors are displayed between parentheses in the second line. All models include industrial, geographic (geographical macroareas), and time (month of issuance) fixed-effects.

points on a 100 scale depending on the provider) reduces the ASS in the range between 13 and 14 basis points.

The relative importance of the aggregate ESG ratings somehow changes when we augment our baseline specifications with a wide set of controls referred to bond and firms' characteristics, and especially with a synthetic measure of the issuer's creditworthiness, namely the S&P issuer rating. Estimates are reported in Table 4 where several results are worth emphasizing. First of all, we notice that firm's creditworthiness turns out to be the most important driver of the ASS, with a marginal effect largely outpacing the one of the ESG score: a one standard deviation increase in the S&P issuer rating (corresponding to about a 2.5 notch upgrade) diminishes the ASS between 60 and 78 basis points on average, depending on the specification. Indeed, this is not an unexpected result as it is reasonable to observe investors assigning a larger weight to indicators of credit risk when pricing new bond issues. As a second remark, we notice that ESG scores generally maintain a negative connection with firms' funding costs, however only two out of the four ESG scores preserve their statistical significance, namely MSCI and Robeco; in economic terms, the marginal effect is now close to 5-7% of the average ASS and it reduces to 15 and 11 basis points for MSCI and Robeco, respectively. Despite being not uniform across different data providers, our estimates reveal that better ESG standing was rewarded in terms of lower cost of debt at issuance. This result is particularly interesting as it survives the inclusion of an extensive bunch of controls, the most notably being issuer's creditworthiness, and indicates that ESG scores are able to capture some previously unexplained component of corporate cost of funding. Most of the remaining controls do not display a statistically significant results as the S&P rating is likely

Table 4: Bond spreads and ESG scores: augmented specifications

	(1)	(2)	(3)	(4)
MSCI ESG	-0.073***			
	(-2.863)			
Refinitiv ESG		0.020		
		(0.657)		
Robeco ESG			-0.052**	
			(-2.177)	
Sustain. ESG				-0.025
				(-1.216)
S&P	-0.368***	-0.445***	-0.450***	-0.328***
	(-15.314)	(-19.418)	(-19.999)	(-13.861)
Firm size	0.014	-0.016	0.009	-0.011
	(0.514)	(-0.481)	(0.290)	(-0.364)
Leverage	-0.012	-0.022	-0.034	-0.099***
	(-0.433)	(-0.894)	(-1.410)	(-3.971)
Dividend	0.047*	0.057**	0.060***	0.087***
	(1.704)	(2.531)	(2.744)	(3.700)
ICR	0.009	-0.002	-0.008	-0.013
	(0.308)	(-0.084)	(-0.307)	(-0.465)
PtB	0.003	-0.007	0.000	-0.015
	(0.187)	(-0.530)	(0.001)	(-0.960)
Tenor	0.195***	0.170***	0.166***	0.204***
	(8.906)	(8.077)	(7.728)	(10.070)
Amount issued	0.139***	0.148***	0.124***	0.114***
	(3.692)	(4.355)	(3.364)	(4.126)
Carbon intens.	0.018	0.001	0.004	0.102***
	(0.770)	(0.067)	(0.186)	(3.538)
Industry FE	Y	Y	Y	Y
Geographic FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
N	685	743	714	579
R^2	0.56	0.57	0.60	0.58

The first line reports standardized coefficients defined as the marginal effect of a one standard deviation increase in each regressor on the log-ASS; t-statistics based on robust standard errors are displayed between parentheses in the second line. S&P is the long-term rating of the issuer, firm size is the total revenues of the issuer in log terms, leverage is the ratio between issuer's total debt and total assets, ICR is the interest coverage ratio defined as Ebit/Interest expenses, PtB is the price to book value (winsorized at 1% on both tails), dividend yield is the ratio between dividend and stock price, tenor is the maturity in (log) years, amount issued is the (log) amount of the bond issuance expressed in USD, carbon intensity is the logarithm of Scope 1 emissions over firm market value. All models include industrial, geographic (geographical macroareas), and time (month of issuance) fixed-effects.

Table 5: Bond spreads and ESG scores: AEs vs EMEs

	AE	EME	AE	EME	AE	EME
MSCI ESG	-0.124***	0.065				
	(-5.303)	(0.991)				
Refinitiv ESG			-0.067**	0.182**		
			(-2.175)	(2.432)		
Robeco ESG					-0.087***	0.064
					(-3.512)	(0.944)
S&P	-0.250***	-0.746***	-0.357***	-0.671***	-0.343***	-0.774***
	(-10.659)	(-7.381)	(-14.852)	(-6.918)	(-15.194)	(-8.980)
Controls	Y	Y	Y	Y	Y	Y
Geographic FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
N	558	127	599	144	574	140
R^2	0.54	0.77	0.51	0.76	0.53	0.81

The first line reports standardized coefficients defined as the marginal effect of a one standard deviation increase in each regressor on the log-ASS; t-statistics based on robust standard errors are displayed between parentheses in the second line. S&P is the long-term rating of the issuer. Controls include variables to account for firms' size, leverage, ICR, price to book, dividend yield, tenor and amount of the bond issue, and corporate carbon intensity; see Table 4 for the exact definition of each regressor. All models include industrial, geographic (geographical macroareas), and time (month of issuance) fixed-effects.

to account for most of the heterogeneity in the data; we nevertheless find that firms paying larger dividends and bonds with longer maturities and larger amounts outstanding are generally associated with higher ASS. We also include in this specification a variable measuring carbon intensity and defined in line with Ilhan et al. (2020) as the amount of Scope 1 emissions over issuer's market value.[12] This variable clearly covers only a fraction of the whole ESG spectrum; it is nevertheless indicative of companies that are potentially more exposed to the costs of future climate regulation and it is included because the environment dimension and its inherent risks are likely to attract most of investors' interest (see for example Seltzer et al., 2021 and Pastor et al., 2021, Bolton and Kacperczyk, 2021 among many others). Our estimates do not reveal the presence of an explicit premium for less polluting firms, with the only exception of Sustainalytics-rated bond samples in which investors charge between 23 basis points for a one standard deviation in market-value normalized emissions. Lastly, but not unexpectedly, we notice that the overall goodness of fit of the model achieve a remarkable improvement and increases by around three decimal points across all specifications.

[12]We limit the definition of carbon intensity to Scope 1 that includes GHG emissions more closely related to the issuer's activity; results relying on the whole range of Scope 1-3 emissions are qualitatively similar.

Table 6: Bond spreads and ESG scores: industrial sectors

	Consumer	Energy	Health c.	Industrials	ICT	Materials	Real est.	Utilities
MSCI ESG	-0.016	-0.472*	0.042	-0.372***	-0.074	0.767**	NA	0.160**
	(-0.281)	(-1.742)	(1.090)	(-4.097)	(-1.370)	(2.341)	NA	(2.623)
N	193	59	56	102	153	55	12	55
R^2	0.68	0.77	0.91	0.62	0.58	0.93	NA	0.92
Refinitiv ESG	-0.069	-0.445***	-0.005	0.114*	-0.017	-0.085	NA	0.064
	(-1.303)	(-2.874)	(-0.125)	(1.929)	(-0.168)	(-1.554)	NA	(1.191)
N	206	62	56	108	166	63	22	60
R^2	0.71	0.74	0.90	0.55	0.56	0.88	NA	0.91
Robeco ESG	-0.119***	0.004	-0.015	0.021	-0.075	-0.110	NA	0.104
	(-3.433)	(0.037)	(-0.314)	(0.319)	(-1.079)	(-0.921)	NA	(0.679)
N	196	62	56	103	152	55	16	74
R^2	0.72	0.65	0.90	0.56	0.59	0.89	NA	0.92
Sustain. ESG	-0.081**	-0.018	-0.036	0.026	0.062	-0.569**	NA	NA
	(-1.976)	(-0.281)	(-0.832)	(0.477)	(1.379)	(-2.240)	NA	NA
N	180	46	56	92	139	30	9	27
R^2	0.74	0.87	0.91	0.67	0.54	0.88	NA	NA
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Geographic FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y

The first line reports standardized coefficients defined as the marginal effect of a one standard deviation increase in each regressor on the log-ASS; t-statistics based on robust standard errors are displayed between parentheses in the second line. S&P is the long-term rating of the issuer. Controls include variables to account for firms' size, leverage, ICR, price to book, dividend yield, tenor and amount of the bond issue, and corporate carbon intensity; see Table 4 for the exact definition of each regressor. All models include geographic (geographical macroareas), and time (month of issuance) fixed-effects. Results are not displayed for industrial sectors with less than 30 observations.

In Table 5 we estimate our augmented specifications but distinguish between firms domiciled in advanced ed emerging market economies. To save space we only present the estimates referred to the ESG and S&P issuer rating; the full set of results is nevertheless available upon request. In the case of Sustainalytics we have a very marginal share of bonds issued by firms domiciled in EMEs, therefore we only report the results for MSCI, Refinitiv, and Robeco to enhance the comparability of the estimates.[13] Table 5 offers some important insights on the previous set of estimates. For the subsample of firms domiciled in AEs, the impact of the ESG composite

[13] In the case of Sustainalytics and with respect to bonds issued in EMEs, the inclusion of fixed effects and other controls generates an additional loss of observations resulting in a very few degrees of freedom and not very meaningful estimates.

score is always negative and statistically significant; moreover, the marginal effect substantially increases, suggesting that the subsample of EMEs firms actually generates some sort of dilution effect of the results obtained on the whole set of observations. The picture for the subsample of bonds issued in EMEs turns out to be quite different: a higher ESG score is generally positively related with the ASS although the estimates are not statistically significant with the exception of Refintiv. The interpretation of this finding is not straightforward and once more underscore some degree of divergence in the assessment of ESG profiles across rating agencies and subsamples. As mentioned in the Introduction, this result could not only reflect differences in terms of firm coverage and rating methodologies but it could suggest that ESG valuations in EMEs are not as common and developed as the ones referred to firms domiciled in AEs, also possibly because of the different level of firms' voluntary disclosure.[14] As a second remark, it is worth emphasizing the different impact of issuer's creditworthiness across the two subsamples: the S&P coefficient for bonds issued in EMEs is in the range of 1.9-3.0 larger than the corresponding estimate for AEs, which corresponds to up to 117 basis points of lower ASS for the Robeco-EME subsample. In other words, geographical differentiation especially matters in terms of the relative weight assigned by investors to the external assessment of corporate credit standing with a larger penalization for firms domiciled in countries where financial conditions are possibly more fragile, financial markets are less developed, and corporate financial and accounting disclosure less established.

As several papers have highlighted the existence of sectoral differences in assessing the relative importance of ESG scores (e.g. Albuquerque et al., 2020, Bae et al., 2021, and Pastor et al., 2021), Table 6 explores the variation in ASS at the industry level and evaluates the relation between ESG score and cost of funding within each industry.[15] In general, it is extremely hard to identify a clear-cut evidence of sectoral-specific impacts, rather the results reported in Table 6 are not statistically significant most of the times. For some industry (e.g. materials and utilities), the sign of the effect is even divergent across rating agencies, whereas for the consumer and the energy sector we notice a higher level of agreement (i.e. a negative relation), although not all coefficients are statistically different from zero. The rationale behind these findings can be manifold and it is not the main goal of this research. On one side, within each sector, firm and bond idiosyncratic variables could capture a substantial amount of data variation as confirmed by the very high R^2 obtained in each model. In addition, we underscore that industry-specific analysis is likely to exacerbate any divergence across rating agencies driven, for instance, by firm coverage or by methodological assumptions such as industry-specific adjustments or the relative

[14]Under the assumption of home-investor bias, firms issuing in AEs are also more likely to face investors with broader and more complex preferences embracing social responsibility as an additional criterion beside standard risk-return considerations; this could also explain the premium in terms of lower ASS for firms domiciled in AEs

[15]In view of the relatively high number of parameters to be estimated and in order to present sufficiently reliable results, we do not estimate our model for industrial sectors consisting of less than 30 observations.

Table 7: Bond spreads and ESG scores: crisis vs recovery

	Crisis	Recov.	Crisis	Recov.	Crisis	Recov.	Crisis	Recov.
MSCI ESG	-0.091*	-0.071**						
	(-1.910)	(-2.248)						
Refinitiv ESG			-0.067	0.037				
			(-1.449)	(0.946)				
Robeco ESG					-0.057	-0.027		
					(-1.645)	(-0.892)		
Sustain. ESG							-0.003	-0.013
							(-0.116)	(-0.481)
S&P	-0.235***	-0.396***	-0.354***	-0.460***	-0.349***	-0.462***	-0.151***	-0.365***
	(-5.724)	(-12.976)	(-8.650)	(-14.168)	(-8.957)	(-14.902)	(-4.220)	(-11.572)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
Geographic FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
N	256	429	279	464	275	439	198	381
R^2	0.71	0.54	0.68	0.55	0.71	0.56	0.77	0.52

The first line reports standardized coefficients defined as the marginal effect of a one standard deviation increase in each regressor on the log-ASS; t-statistics based on robust standard errors are displayed between parentheses in the second line. S&P is the long-term rating of the issuer. Controls include variables to account for firms' size, leverage, ICR, price to book, dividend yield, tenor and amount of the bond issue, and corporate carbon intensity; see Table 4 for the exact definition of each regressor All models include industrial sector, geographic (firms' nationality aggregated at the macroarea level) and time (month of issuance) fixed-effects. Column "crisis" presents the estimates for bonds issued from January to March 2020, while column "recovery" refers to bonds issued from April until June 2020.

weight assigned to each individual dimension of the ESG score.

In Table 7 we study the impact of ESG scores on bonds' ASS across different stages of the Covid-19 pandemic and to this purpose we split the sample into two distinct sub-periods. The first period, labeled as crisis in the table, includes bonds issued since late January to March 2020, i.e. during the early stage of the pandemic outbreak and the most intense phase of stock market crash; the second period, referred to as recovery, encompasses bonds issued from April to June 2020 and it embraces the stage of gradual rebound in global financial markets. We find limited evidence of differences in the pricing of ESG scores across different stages of the Covid-19 crisis. The impact tends to be slightly larger during the most acute phase of the crisis; however, even when the estimates are statistically significant, they are comparable in terms of magnitude. Interestingly, and contrary to what is observed for the ESG score, the coefficient of the S&P rating is sizable and statistical significant in all specifications and market stages; in this case, the test of coefficient

Table 8: Bond spreads and ESG scores: joint inclusion of ESG ratings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
MSCI ESG	-0.065***	-0.076***					
	(-2.616)	(-2.935)					
Refinitiv ESG	0.010	0.018					
	(0.320)	(0.580)					
Robeco ESG	-0.047*	-0.042*					
	(-1.827)	(-1.767)					
Sustain. ESG	0.006						
	(0.182)						
PCA all			-0.068***				
			(-2.784)				
PCA ex MSCI				-0.040*			
				(-1.682)			
PCA ex Refinitiv					-0.074***		
					(-3.387)		
PCA ex Robeco						-0.064***	
						(-2.684)	
PCA ex Sust.							-0.070**
							(-2.392)
S&P	-0.280***	-0.392***	-0.285***	-0.327***	-0.284***	-0.280***	-0.397***
	(-11.690)	(-16.011)	(-11.843)	(-13.691)	(-12.049)	(-11.459)	(-16.638)
Controls	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y
Geographic FE	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y
N	547	655	547	566	547	558	655
R^2	0.58	0.59	0.58	0.58	0.58	0.58	0.59

The first line reports standardized coefficients defined as the marginal effect of a one standard deviation increase in each regressor on the log-ASS; t-statistics based on robust standard errors are displayed between parentheses in the second line. S&P is the long-term rating of the issuer. Controls include variables to account for firms' size, leverage, ICR, price to book, dividend yield, tenor and amount of the bond issue, and corporate carbon intensity; see Table 4 for the exact definition of each regressor. All models include industrial sector, geographic (firms' nationality aggregated at the macroarea level) and time (month of issuance) fixed-effects. "PCA all" measures the first principal component from the four composite ESG scores; analogously, "PCA ex MSCI", "PCA ex Refinitiv", "PCA ex Robeco", and "PCA ex Sustainalytics" measure the first principal component from composite ESG scores but excluding one aggregate score at a time. All models include industrial sector, geographic (geographical macroareas), and time (month of issuance) fixed-effects.

equality reveals that the economic impact is always larger during the phase of market recovery. This finding can be possibly attributed to the steep acceleration in bond issuance started at the end of March. Following a phase of pervasive market crash hitting indistinctly all categories of financial assets, investors increasingly relied on external credit assessment to discriminate among

firms throughout a period of abundant bond issuance. However, the evidence of a structural break in investors' preferences towards sustainability assets is not clear-cut in the literature, and the empirical analysis is still preliminary in this regard. As concerns the equity market, Albuquerque et al. (2020) show that environmental and sustainable ratings have grown in importance to explain the differences in cumulative stock returns following the Covid-19 shock, with a sizable increase of their relative loading since late February 2020 before flattening at the end of March. Explicitly focusing on the first semester of 2020, Ferriani and Natoli (2020) find that the ESG exposure of mutual funds has been increasingly considered by fund investors during the recovery of financial markets, while Pástor and Vorsatz (2020) using a longer time interval show that the Covid-19 pandemic did not result in a structural break of investor sustainability preferences before and during the Covid-19 crisis.

Table 8 simultaneously considers the informative content of the four ESG ratings.[16] To this purpose we first include all ESG aggregate ratings in the same specification then, and in the same spirit, we also create a synthetic ESG index by extracting the first principal component from composite ESG rankings. We consider two possible alternatives for this second approach: one combining all the available scores and one where we exclude one rating agency per time. The first two columns of Table 8 display a negative and statistically significant for both MSCI and Robeco, with an economic magnitude not dissimilar from the one reported in Table 4. This result should not be interpreted as a ranking across the four ESG metrics and we are not claiming the superiority of a specific rating provider compared to the others, although some previous research pointed out substantial differences across rating agencies in terms of firm coverage and rating use by professional investors (e.g. Eccles and Stroehle, 2018, Hirai and Brady, 2021). As a matter of fact, the estimates in Table 8 are not necessarily explained by the better informative content of one particular score but could be related to other motivations including, but not limited to, the coverage of firms, the specific sample analyzed in this study, the public availability of ratings, the estimating technique. In this regard, the use of PCA is particularly useful as it allows to exploit data variation in our sample without imposing any ranking across rating agencies. Rather, in the assessment of the relation between ESG performance and bond yield premia, the PCA allows to maximize the informative content conveyed by different ESG scores. Depending on the specific version of the PCA index, the first principal component explains between 60% and 68% of the variance and is therefore able to capture a substantial amount of heterogeneity in the data. The last five columns unanimously confirm the existence of a negative relation between ESG score and cost of funding, albeit with some minor differences in terms of economic and statistically

[16] We emphasize that this approach is equivalent to estimate the model on the common set of observations across the four rating providers and we recall that this essentially corresponds to restrict the estimation to bonds issued by firms domiciled in AEs being the Sustainalytics scores scarcely available for firms domiciled in EMEs.

significance.

Finally, in our last empirical exercise we investigate the relation between ASS and ESG ratings at the subcomponent level, namely the environmental, social, and governance scores.[17] We re-estimate the model substituting the composite ESG rating with the three individual scores (E, S, G) obtained from each data provider; moreover, we also include a synthetic composite ESG score defined as the first principal component of the E-, S-, and G- individual scores. In general, the estimates reported in Table 9 highlight a limited or almost non-existent informativeness of the ESG subcomponents on the cost of debt at issuance, being regression coefficients not statistically significant in most of the cases. These findings are consistent with other studies showing that better achievements at the subcomponent level do not always result in a superior financial performance, see for example Pástor and Vorsatz (2020) and Ferriani and Natoli (2020) for mutual funds, Broadstock et al. (2021), Ding et al. (2021) for the equity market, and Oikonomou et al. (2014), Ge and Liu (2015), Halling et al. (2020a) for the bond market. Even in the case of Robeco, where the S and G dimension are found to be statistically significant (and with the opposite sign) we emphasize that the estimates should be interpreted with extreme caution in view of the very high level of correlation across ESG subcomponents within each rating agency; indeed, this is particularly true for Robeco ratings as displayed by the correlation matrix in Table 2 and confirmed by a post-estimation VIF test. On one side this lack of statistical significance could reveal investors' inclination towards a more comprehensive assessment of firms' ESG profiles; in absence of further analysis we cannot nevertheless rule out the hypothesis that individual ESG dimensions *per se* are not successful in capturing unexplained components of corporate risk or investors' preference for a specific dimension of firms sustainability. On the contrary, and more interestingly, we notice that the PCA index obtained from the three individual score is able to convey an information content very close to its native aggregate counterpart, i.e. more sustainable firms benefit from lower cost of capital, with an impact that is also statistically significant and economically sizable for Robeco and Sustainalytics.

5 Determinants of the ESG yield premium

In the previous Section, we provide a robust evidence of a negative link between ESG scores and ASS. Despite some differences in terms of economical and statistically significance across rating agencies and analysis subsamples, we generally find that better ESG performance is associated with lower funding costs for firms, even after controlling for an extensive list of bond and corporate characteristics, including firms' credit rating. In this Section we extend our investigation and focus on the channels that are likely to inform the ESG-yield relation. Our empirical analysis is

[17] We recall that this classification is not available for MSCI in our dataset.

Table 9: Bond spreads and ESG subcomponents scores

	(1)	(2)	(3)	(4)	(5)	(6)
Refinitiv E	-0.006					
	(-0.244)					
Refinitiv S	0.046					
	(1.462)					
Refinitiv G	-0.023					
	(-1.123)					
PCA Ref. subc.		0.002				
		(0.075)				
Robeco E			-0.023			
			(-0.445)			
Robeco S			0.216***			
			(2.618)			
Robeco G			-0.265***			
			(-4.411)			
PCA Rob. subc.				-0.087***		
				(-3.342)		
Sustain. E					-0.027	
					(-0.982)	
Sustain. S					-0.034	
					(-1.517)	
Sustain. G					0.031	
					(1.309)	
PCA Sust. subc						-0.093***
						(-4.546)
S&P	-0.448***	-0.463***	-0.459***	-0.467***	-0.321***	-0.376***
	(-19.410)	(-18.282)	(-19.959)	(-19.112)	(-13.288)	(-15.981)
Controls	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Geographic FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
N	743	743	736	736	579	579
R^2	0.58	0.50	0.60	0.52	0.58	0.53

The first line reports standardized coefficients defined as the marginal effect of a one standard deviation increase in each regressor on the log-ASS; t-statistics based on robust standard errors are displayed between parentheses in the second line. S&P is the long-term rating of the issuer. Controls include variables to account for firms' size, leverage, ICR, price to book, dividend yield, tenor and amount of the bond issue, and corporate carbon intensity; see Table 4 for the exact definition of each regressor. All models include industrial sector, geographic (geographical macroareas), and time (month of issuance) fixed-effects. "PCA Refinitiv subcomponents", "PCA Robeco subcomponents", "PCA Sustainalytics subcomponents" measure the first principal component of the E-, S-, and G- sucomponent scores for each rating agency.

informed by the theoretical model developed by Pástor et al. (2021) who identify two main mechanisms as the rationale for lower expected returns in green assets. On one side some investors derive utility from holdings of more sustainable firms and they are willing to pay a premium to include these assets in their portfolio, ultimately lowering firms' cost of capital (non-pecuniary channel). On the other side, firms with better ESG scores are also more likely to offer a hedge against climate shocks or unexpected deteriorations in the regulation concerning the environmental and the social dimension of corporate activity, so that investors require a higher compensation to hold the assets of less sustainable firms (risk channel).

To the best of our knowledge, our paper is the first to present a joint investigation of these two channels in the fixed-income market; moreover, the time-period analyzed in this study covers a phase combining extreme market turbulence with a rapidly increasing media and investor attention towards sustainability. To test whether these channels were at play in our sample or whether any of the two prevailed on the other, we substitute the ESG score with some proxies to account for both investors' preference towards sustainability and firms' exposure to climate risk. As to the first measure we use Morningstar to retrieve the share of sustainable funds holding the stock of the bond issuer in the quarter immediately before the bond issuance.[18] We consider as sustainable those funds that are assigned a Morningstar's Sustainability rating (the so-called "globes") equal to 4 or 5 on a 1-5 scale; previous research (e.g. Hartzmark and Sussman, 2019) has shown that this rating is successful in capturing investors' non-pecuniary motivations and explaining fund performance beyond traditional risk-return considerations. We consider firms' equity rather than the corresponding bond issued during the Covid-19 period as the first is a much more liquid category of corporate asset; moreover, newly-issued bonds are likely to be included into mutual funds' portfolios with some delay, which could have limitations both in terms of representativeness and exogeneity of our sustainability measure. As shown in Dimson et al. (2015), Krueger et al. (2020), and Dyck et al. (2019) among many others, institutional investors increasingly inform their investment decisions on climate risk considerations so that the inclusion of a particular equity in the portfolio of sustainable funds accounts for a reasonable proxy of investors' preference towards more sustainable firms.

Then, we measure the exposure of firms to climate change using the data provided by Sautner et al. (2020). By applying machine learning techniques to earning calls transcripts, the authors are able to quantify *firm-level* exposure to climate change shocks. In a few words the exposure to climate change is measured by counting the frequency with which certain climate change bigrams (i.e. pre-sepcified combination of words) occur in the transcript, scaled by the total number of bigrams in the transcript; we nevertheless refer to the original paper for a more

[18]The share is computed with respect to any mutual fund holding the issuer's stock. Mutual funds holding the stock but not assigned with a Sustainability score are excluded from the computation

Table 10: Bond spreads and ESG scores: underlying channels

	(1)	(2)	(3)	(4)
Share sust. funds (%)	-0.154***	-0.151***	-0.145***	-0.150***
	(-3.518)	(-3.406)	(-3.305)	(-3.422)
CC expos.	0.086***		0.090***	
	(3.790)		(4.045)	
CC regul. expos.		0.049**		
		(2.089)		
CC phys. expos.		-0.017		
		(-0.523)		
CC Risk			0.063*	
			(1.702)	
CC PCA				0.062*
				(1.957)
S&P	-0.346***	-0.353***	-0.364***	-0.359***
	(-12.784)	(-12.934)	(-12.371)	(-12.786)
Controls	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Geographic FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
N	657	657	657	657
R^2	0.59	0.59	0.59	0.58

The first line reports standardized coefficients defined as the marginal effect of a one standard deviation increase in each regressor on the log-ASS; t-statistics based on robust standard errors are displayed between parentheses in the second line. *Share of sustainable funds* is the share of sustainable funds (Morningstar's Sustainability equal to 4 or 5) holding the bond issuer's stock in the quarter immediately before the bond issuance. CC exposure, CC regulatory exposure, CC physical exposure, and CC risk measure firm-level exposure to climate change and its corresponding degree of uncertainty, see Sautner et al. (2020) for the exact definition of each variable; CC PCA is the first principal component of CC risk and of the two components of CC exposure (i.e. regulatory and physical exposure). S&P is the long-term rating of the issuer. Controls include variables to account for firms' size, leverage, ICR, price to book, dividend yield, tenor and amount of the bond issue, and corporate carbon intensity; see Table 4 for the exact definition of each regressor. All models include industrial sector, geographic (geographical macroareas), and time (month of issuance) fixed-effects.

precise description of the methodology. The authors do not only develop a broad assessment of climate change exposure, but also other measures capturing the frequency with which bigrams related to regulatory and physical shocks linked to climate change occur in the transcripts of analyst conference calls. Moreover they also provide a measure of risk related to climate change exposure defined as the relative frequency of climate change bigrams mentioned in the same sentence with words such as "risk" or "uncertainty" (or their synonyms). We make use of all these variables as well as of their combination via PCA to address corporate exposure to climate

risk and study its relation with firms' cost of funding.[19]

Table 10 displays our estimates on the determinants of the ESG yield premium.[20] All variables are statistically significant and with the expected sign, suggesting that both the non-pecuniary and the risk channel actively played a role in the determination of firms' cost of funding. The economic impact of investors' preference towards sustainability is substantial and equal to up -31 basis points for a one standard deviation increase in the share of sustainable funds holding the equity stock of the bond issuer. On the contrary, firms more exposed to climate change pay a premium on their bond yields; this effect is mainly driven by the exposure to adverse regulatory shocks such an unexpected tightening of environmental regulation rather than a physical threat (see Krueger et al., 2020, Seltzer et al., 2021). Finally, also the risk assessment of climate change exposure does play a role, with firms required to pay up to 13 basis points more as exposure to climate change increased by one standard deviation.

6 Conclusions

We study the relation between corporate ESG scores and the yield spreads paid on bonds issued by global non-financial corporations during the first phase of the Covid-19 pandemic. Despite the episode of major turbulence in international financial markets, corporate activity in the primary bond market was substantial as firms strove to alleviate the funding and liquidity strains induced by the pandemic. Our analysis investigates the presence of a sustainability premium to be intended as a lower cost of debt for firms meeting ESG objectives. To this purpose we rely on ESG scores assigned by four distinct rating agencies (MSCI, Refinitiv, Robeco, and Sustainalytics) and highlight several new results of interest. First, we generally document a negative relation between aggregate ESG scores and asset swap spread at issuance; even when measure of creditworthiness are explicitly included in the empirical specifications we find that the connection between ESG profiles and bond risk premia is economic meaningful and amounts up to 15 basis points or approximately 7% of the sample average asset swap spread. Second, we find that the ESG premium is remarkably more sizable for firms domiciled in advanced economies whereas issuer's creditworthiness is largely regarded as the most critical determinants of corporate cost of capital for firms domiciled in emerging market economies. When comparing the market crash and the recovery stage we do not find any structural break in the pricing of the ESG factor and we also document marginal differences in the interlink between ESG scores and yield spreads

[19] In analogy with the previous variable "Share of sustainable funds", the measures of climate change exposure and risk are defined with respect to the quarter immediately preceding the bond issuance.

[20] Because of data availability we are not always able to match the information either on the firm-level exposure to climate change or on the share of sustainable funds holding issuer's equity stocks; clearly, these bond issues are excluded from the analysis of the ESG yield premium.

across different industrial sectors; moreover, we show that ESG individual dimensions *per se* do not adequately capture neither additional sources of corporate riskiness nor represent investors' preferences for a particular element of corporate sustainability. Finally, but not less importantly, we empirically test the theoretical rationale behind the ESG premium and show that both non-pecuniary motivations as well as risk-based considerations explain investors' preference towards more sustainable assets. The findings reported in this study set the stage for future research avenues including, but not limited to, the investigation of the interdependence between ESG scores and bond yield premia during periods of tranquil financial markets or the analysis of the increasing role played by new categories of investors (e.g. central banks) in the ESG arena. In terms of policy implications, our study underscores how the divergence across ESG ratings should be carefully taken into consideration when studying the impact of ESG scores on the price of financial assets, ultimately supporting the initiatives to rapidly achieve a common and transparent taxonomy of ESG risks.

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