Pricing ESG risk in sovereign credit

Research paper

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Q3 2019

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In 2017, Hermes Investment Management published its first study on the relationship between environmental, social and governance (ESG) factors and corporate credit spreads[1]. The research filled a void left by the dearth of external studies and tools to help price ESG risks in credit markets, and was reinforced by subsequent work[2]. The most important finding was the existence of a significant relationship between ESG factors and credit spreads – and that issuers with stronger ESG performance benefit from lower credit-default swap (CDS) spreads. In this paper, Hermes partners with Beyond Ratings to learn whether ESG risk is similarly potent in sovereign-bond markets.

This research aims to contribute to the growing body of literature that points to the importance of ESG considerations across asset classes[3], and for fixed income investors. It has three main objectives:

1. to establish whether there is a relationship between ESG factors and sovereign CDS spreads;
2. if so, to determine which of the three ESG factors have the strongest relationship with sovereign CDS spreads; and
3. to create an implied CDS spread curve that depicts the relationship between country-level ESG scores and sovereign CDS spreads.

We believe the findings of this paper will give investors a better understanding of the full range of risks that sovereign bonds involve. This should help Hermes make better-informed investment decisions and enable Beyond Ratings to improve its sovereign credit assessments.

Key findings

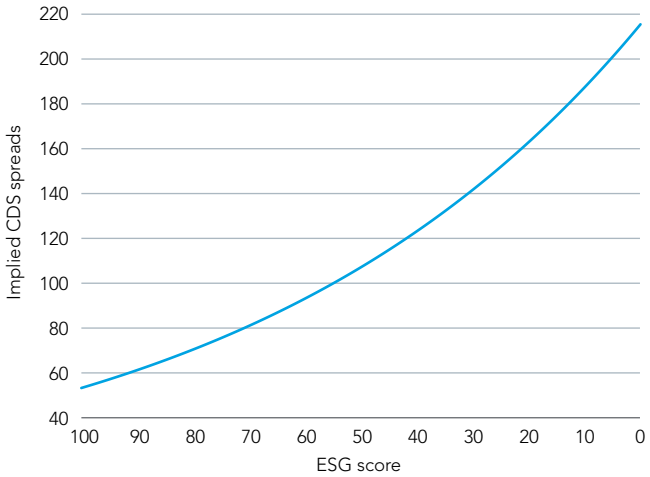
To price ESG risk for sovereign bonds, we use Beyond Ratings' ESG scores, which measure a country's ESG performance by using a rigorous quantitative method. They range from 0 to 100, with a high score indicating strong ESG performance.

Our study shows that:

- countries with the lowest ESG scores have, on average, the widest CDS spreads, and countries with the highest ESG scores have the tightest spreads (see figure 1);
- there appears to be a positive correlation between sovereign ESG scores and sovereign credit ratings. However, there is a very wide variation in ESG scores within each rating band, suggesting that credit ratings do not entirely explain the extent of CDS spreads (see figure 7);
- among the three dimensions of ESG, governance has the strongest relationship with sovereign CDS spreads (see figure 6). Environmental risks do not seem to have a strong relationship with sovereign CDS spreads, which could be explained by the fact that these problems are not currently fully reflected in sovereign ratings.

Based on the strong relationship between ESG scores and sovereign CDS spreads, we derived a sovereign pricing model for ESG risk that is comparable to the model that Hermes developed in its original study on corporate credit. This model could be used by investors to identify countries with wide spreads and high ESG scores (outperformers), and those with tight spreads but poor ESG performance (underperformers), which might be exposed to more risk than traditional credit ratings imply.

Figure 1. Sovereign ESG risk: implied CDS spreads and corresponding ESG scores



Source: Hermes, Beyond Ratings as at May 2019.

[1] "Pricing ESG in Credit Markets" – research report by Hermes Investment Management: https://www.hermes-investment.com/ukw/wp-content/uploads/sites/80/2017/04/Credit-ESG-Paper-April-2017.pdf

[2] See "Pricing ESG risk in credit markets: reinforcing our conviction" available at https://www.hermes-investment.com/uki/insight/fixed-income/pricing-esg-risk-credit-markets-reinforcing-conviction/

[3] See, for example, Bauer and Hann (2010), Kleimeier and Viehs (2016), Chava (2014) and, most recently, Eichholtz, Holtermans, Kok and Yonder (2019).

About the partnership

Hermes Investment Management and Beyond Ratings partnered in this study because both companies wanted to better understand the relationship between ESG risks in sovereigns and their CDS spreads. The two entities' complementary skillsets and experience in ESG investment and credit-risk assessments made it a natural partnership. In this study, we use Beyond Ratings' proprietary ESG score, which is a significant component of its sovereign assessments. Having already carried out a similar study focused on corporate credit, Hermes had the blueprints to run the analysis, as well as access to historical sovereign CDS spreads. Together, we combined our efforts to design and run this groundbreaking study on a significant market that remains under-investigated in relation to ESG.[4]

ESG factors and sovereign risk

When assessing the willingness and ability of governments to meet their financial obligations, it is of course necessary to take political, economic and financial factors into consideration. But focusing solely on these matters when analysing sovereign risk is not enough. In our view, investors must also consider ESG factors to obtain a more complete picture of a country's risk profile.

These factors can affect sovereign risk in several ways. For example, climate change can hit agricultural production, which could in turn trigger economic and financial stress and political and social uncertainty. In 2016 and 2017, for instance, the El Nino phenomenon led to 160 deaths and adversely affected 185,000 people in Peru – impairing livelihoods, creating hunger, displacing communities. It caused agricultural output to fall by 3.8% between January to May 2017 relative to the previous year, contributing to economic growth declining from 4.0% in 2016 to 2.5% in 2017. Meanwhile, according to the World Meteorological Organization, Hurricane Katrina in 2005 caused an economic loss of $146bn in the US, and flooding in Thailand in 2011 resulted in an economic loss of $40bn. A drought in Morocco in 2000 caused economic losses of $1.2bn.

These direct impacts of climate change can affect the creditworthiness of countries, and in this paper we test the following hypothesis: that there is a direct link between country-level ESG scores and sovereign CDS spreads.

The critical element here is to assess whether ESG factors have a material effect on sovereign risk. And, if they do, to assess the probability and timing of such an impact. We show in this paper that integrating ESG factors in sovereign risk analysis is just as strong an imperative as it is when analysing credit risk for corporates.

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Underlying methodology and data

To establish whether there is a relationship between ESG factors and sovereign credit risk and to determine whether it is possible to draw an implied credit curve based on those ESG factors, we analysed the relationship between five-year CDS spreads and ESG scores for 59 countries between 2009 and 2018. In total, this delivered 2,036 country-quarter observations.

We sourced sovereign five-year CDS spreads from Bloomberg and used Beyond Ratings ESG scores – as described below – as our proxy for ESG risk. Credit-rating information also came from Bloomberg: we used the Bloomberg composite credit rating, which is a blend of the credit ratings from the three major rating providers.[5]

We chose to use CDS spreads rather than spreads of physical bonds because they are the purest market-driven measure of sovereign credit risk. Rolled CDS have no maturity and they are essentially immune to changes in interest rates as they are floating-rate instruments: CDS roll into a refreshed five-year maturity every six months. Sovereign CDS, in most cases, are also more liquid than the underlying physical bonds, which may not trade very often. Meanwhile, the spreads of physical bonds become more static at lower levels as the security rolls down the maturity curve and approaches maturity. As such, it becomes less a reflection of credit risk and therefore less useful in a time-series study.[6]

We used Beyond Ratings' ESG scores, which are one of three underlying factors that determine the firm's aggregate sovereign risk scores, the other being a country's economic and financial profile. (A detailed explanation of Beyond Ratings' ESG scores can be found below.)

First, we consider the relationship between ESG scores and sovereign CDS spreads.

[4] The analysed period is characterised by unconventional monetary policies, such as the quantitative-easing programmes led by the US Federal Reserve and the European Central Bank, which may have an impact on the results and could be addressed in further publications.

[5] Bloomberg explains the calculation of the BB composite credit ratings as follows: "The agency ratings are evenly weighted when calculating the composite. The composite is the average of existing weighting rounded down to the lower rating in case the composted is between two ratings.

[6] In all the analyses, we winsorised the distribution of the observed CDS spreads at the 97.5% level to remove significant outliers that would bias our analyses and conclusions.

Beyond Ratings' ESG scores

For the key independent variable in our analysis – a country's ESG profile – we used Beyond Ratings' ESG scores, which measure a country's ESG performance. These scores have been calculated quarterly according to a systematic, quantitative approach based on 40 indicators from the end of 1999.

To calculate an aggregate ESG score, individual environmental, social and governance scores are weighted 30%, 30% and 40% respectively. The weights for each indicator are estimated using an econometric modelling technique called Partial Least Squares (PLS), with a score for Variable Importance in Projection (VIP) added on. The methodology also assesses ESG risks, taking into account a country's state of development.

The assessment of a country's environmental performance takes into account three dimensions: energy policy, climate risks, and natural-resources endowment and management. Energy policy considers energy as a production factor that has direct and indirect effects on economies and societies. It captures the government's efforts in terms of access to affordable energy and use of renewable energies. In the long term, this indicator measures the inclusiveness and sustainability of the country's energy policy. Climate-related risk follows the Task Force on Climate-related Financial Disclosures definition. It assesses countries' exposure to two types of climate-related risks: (i) physical risk and (ii) the transition to a lower-carbon economy. The natural resources assessment provides information about potential risks related to food security, clean air and purified water. This dimension aims to assess whether a country manages renewable and non-renewable resources sustainably.

The social performance assessment includes five dimensions: human capital and innovation, health, inequality, employment and societal. Human capital and innovation measures a country's capacity to develop new technologies and high value-added production. Health measures a country's capacity to keep its population, and thus its labour force, healthy. Inequality measures the dispersion of incomes and wealth within the country. Societal performance is a measurement of a country's progress in terms of the society's political and social freedom. Finally, employment measures a country's capacity to provide jobs for the entire working population, thus maximising its potential output.

The governance performance assessment measures risks related to corruption, government effectiveness, the rule of law, regulatory quality, political stability and the absence of violence, and voice & accountability. These indicators refer to World Bank estimates from the Worldwide Governance Indicators database.

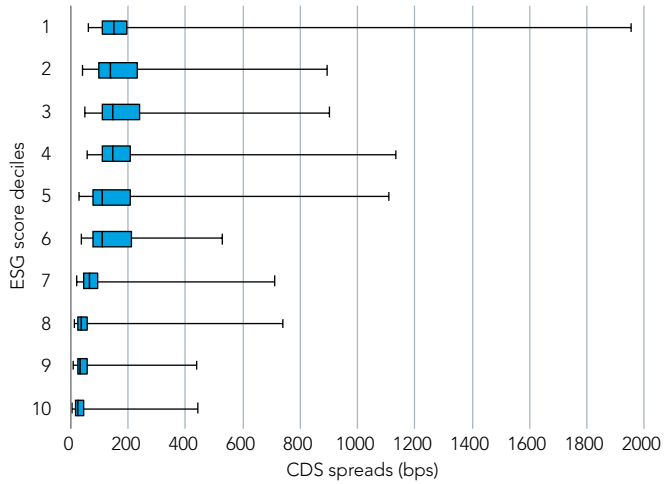
The relationship between ESG risk and sovereign CDS spreads

First, we performed an analysis that was similar to what we did in our original ESG in credit paper, looking at the relationship between ESG and CDS spreads in an unconditional way, without controlling for any confounding effects that might influence the observed relationship.

Figure 2. Beyond Ratings' ESG scores

We started by splitting the underlying data sample into 10 deciles based on each country's ESG score, with decile one representing those countries with the lowest ESG scores and decile 10 those with the highest. We then looked at the distribution of the observed CDS spreads in each decile. Figure 3 shows boxplots of the underlying CDS spread distribution in each decile.

Figure 3: Sovereign CDS spreads by ESG decile, 2009–18

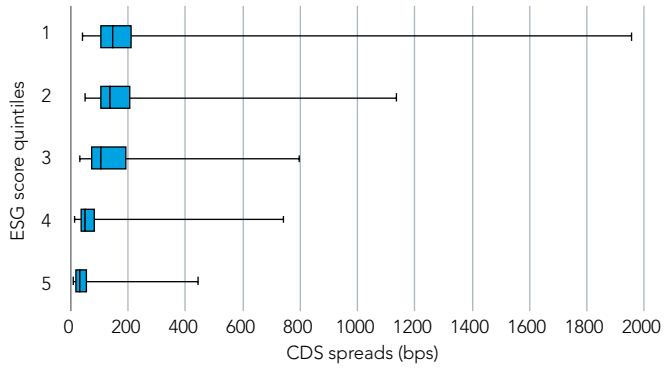


Source: Beyond Ratings and Bloomberg. Data as at April 2019. Hermes calculations.

Each boxplot depicts the median spread for that decile (the vertical line within each box), within the minimum and maximum spreads. We can see that countries with the lowest ESG scores (decile 1) have the highest median CDS spreads and the widest distribution of observed CDS spreads. This implies that countries with lower ESG scores produce more volatile investment returns than countries with the highest ESG scores – those that make up deciles nine and 10. It is important to note that deciles two to eight have significantly greater distributions of spreads than other deciles, which suggest that investors might wish to consider carrying out additional assessments of creditworthiness on the very worst-performing countries in terms of ESG risk.

If we group the deciles together into quintiles – bands of 20% rather than 10% – the picture becomes even more convincing. Figure 4 shows the results.

Figure 4. Sovereign CDS spreads by ESG quintile, 2009–18

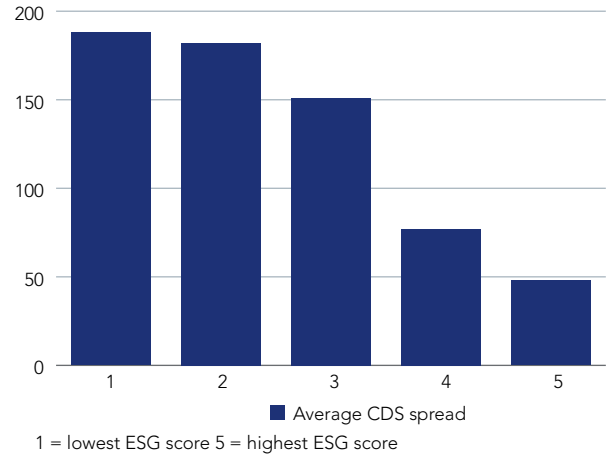


Source: Beyond Ratings and Bloomberg. Data as at April 2019. Hermes calculations.

We can see that our previously documented relationship between CDS spreads and ESG scores is robust, and in a quintile context almost linear: countries with the lowest ESG scores tend to have the highest CDS spreads, and those spreads are significantly more widely distributed than for quintiles four and five. We should point out, at this stage, that in this unconditional analysis the results so far only point towards certain correlations and do not necessarily imply a cause-and-effect relationship.

To shed further light on the question if countries with the worst ESG scores have on average the highest CDS spreads, we went on to calculate the average CDS spread for each ESG quintile. Figure 5 shows the results.

Figure 5. Average sovereign CDS spreads by ESG quintile, 2009–18



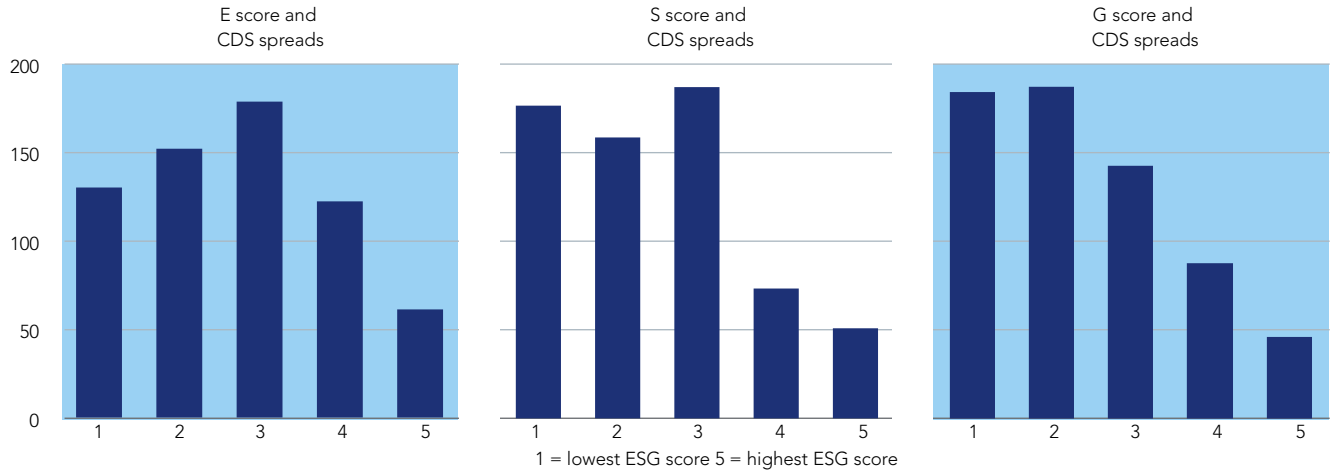
Source: Hermes and Beyond Ratings. Data as at April 2019.

Figure 5 clearly indicates that countries with the highest ESG scores (quintile five) have the lowest average CDS spreads, while those with the lowest ESG scores (quintile one) have the highest average CDS spreads. The difference in average spreads between these quintiles in terms of basis points is 140bps. Again, it is important to note that these results are unconditional: we do not control for any confounding effects that might affect the relationship between ESG scores and CDS spreads.

Then, we repeated this analysis for the three sub-dimensions of ESG – environment (E), social (S) and governance (G) – to determine which has the strongest link with spreads. We can see the results in figure 6.

It is important to consider the three sub-dimensions of ESG separately. For countries, just like for companies, exposure to the three sub-categories can differ depending on the nature of a sustainability topic.

Figure 6: Average sovereign CDS spreads by individual environmental, social, and governance quintiles 2009–18



Source: Hermes and Beyond Ratings. Data as at April 2019.

We can see from figure 6 that no matter which ESG dimension is analysed, countries with the highest scores for each dimension (quintiles five) have the lowest average CDS spreads. Unlike for corporate issuers, we can see that the correlation exists for governance scores: the relationship between governance scores and CDS spread quintiles is almost linear and the difference in spreads between the first and fifth quintiles is 138bps. The only slight discrepancy is that countries in the second quintile have marginally higher average CDS spreads than those in the first.

For the environmental and social sub-dimensions, we observe similar, but less linear, effects. Interestingly, the third quintile in terms of environmental and social performance have the highest average spreads, at close to 180bps. We would have expected that the first quintile of countries, which have the worst performance on those dimensions and might therefore be more exposed to environmental and social risks, would have had the highest spreads.

The fact that the relationship of the environmental dimension with CDS spreads is the least linear could be explained by the fact that environmental issues are not yet fully reflected in sovereign risk ratings. We also acknowledge that the risks associated with environmental issues, in particular climate change, are difficult to quantify (whether in terms of transition risk or physical climate risk) and their time horizon is even more uncertain.

The fact that the relationship of the environmental dimension with CDS spreads is the least linear could be explained by the fact that environmental issues are not yet fully reflected in sovereign risk ratings.

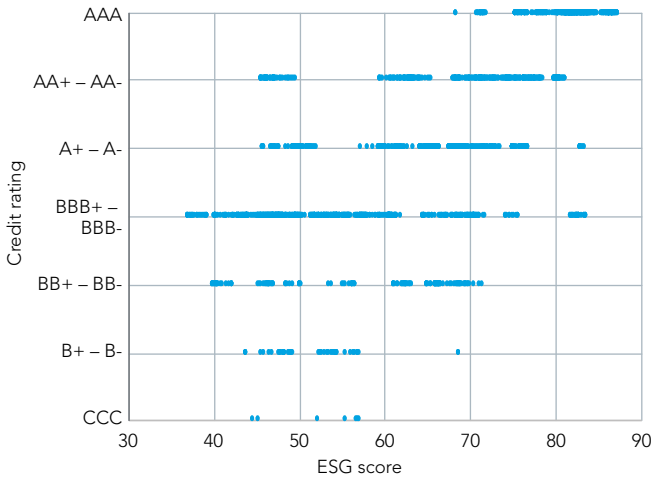
Are ESG scores correlated with sovereign credit ratings?

The obvious question that emerges, after having established the relationship between ESG scores and sovereign CDS spreads, is whether credit ratings incorporate ESG risk. To investigate this question, we compared the ESG scores with countries' credit ratings. Figure 7 shows a positive correlation between ESG scores and credit ratings, implying that to a certain extent sovereign credit ratings integrate ESG information, so that countries with higher ESG scores tend to have better credit ratings.

What is striking is that despite the positive relationship between sovereign credit ratings and ESG scores, there is huge variation in ESG scores within each credit rating band. For example, in the AA category, we observe ESG scores between 45 and 80. For the single A category, ESG scores range between 45 and 83. These results show that while sovereign credit ratings are positively correlated with ESG scores, there are still many countries that have very good

credit ratings despite relatively low ESG scores. This raises a question about whether ratings for those countries properly take ESG risk into account.

Figure 7: Sovereign ESG scores by credit rating from 2009–18



Source: Beyond Ratings and Bloomberg. Data as at April 2019.

The pricing chart

Based on the correlations we observed between sovereign CDS spreads and ESG scores, we went on to replicate the ESG pricing model we developed in the original Hermes paper on pricing ESG risk in corporate credit. Ultimately, we wanted to test the idea if a similar relationship exists between sovereign CDS spreads and ESG scores even after controlling for credit ratings.

To ensure our quantitative study on sovereign CDS spreads and ESG was robust and credible, we used a pooled regression approach covering the nine years of our sample period, between Q4 2009 and Q4 2018. A cross-sectional study would only have provided details of the relationship between sovereign CDS spreads and ESG risk at a single moment in time, and this might look totally different from another point in time. Such an approach is important if we wish to be able to draw any substantial conclusions and develop a useful tool for asset managers, asset owners and credit-rating agencies.

We conducted an ordinary least squares (OLS) regression model in which the natural logarithm of the quarterly five-year CDS spread was the dependent variable and the ESG score and the credit rating the independent (or explanatory) variables. We lagged both independent variables by four quarters, as we did in the original Hermes ESG credit study.[7]

The results of the regression indicate that there is a significant negative relationship between credit ratings and CDS spreads: that is, on average, the higher the credit rating, the lower the CDS spread. Our results also suggest a significant negative relationship between CDS spreads and ESG scores: countries with higher ESG scores have lower CDS spreads, on average, even after controlling for credit ratings.[8]

Based on an econometric specification that we used (see appendix), we calculated an implied CDS spread per ESG score. We show the results in figure 8.

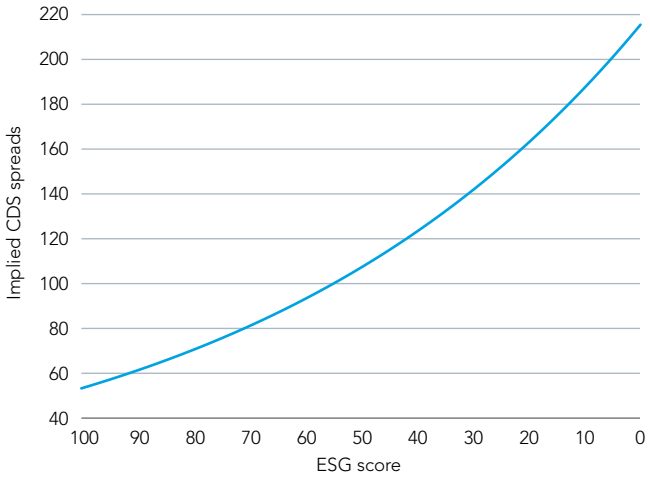
Figure 8: Implied CDS spreads based on ESG scores

ESG score	Implied CDS spreads
100	53.2
90	61.2
80	70.3
70	80.9
60	93.0
50	107.0
40	123.1
30	141.6
20	162.8
10	187.2
0	215.4

Source: Hermes, Beyond Ratings as at May 2019.

Based on the implied CDS spreads in figure 8, we plotted the results in figure 9, which represents our illustrative ESG pricing chart for sovereign bonds. It shows the implied CDS spreads from our OLS regression, which expressed the natural logarithm of the sovereign CDS spread with the ESG scores from Beyond Ratings and the credit rating.

Figure 9: The relationship between implied sovereign CDS spreads and ESG scores



Source: Hermes, Beyond Ratings as at May 2019.

[7] The OLS regression model is estimated using robust standard errors.
[8] In some cases it is possible that a more ESG-friendly government can also be perceived as being more likely to increase debt issuance, therefore leading to a widening of the spread.

Conclusion

In this paper we found, first and foremost, that the bonds of countries with the lowest ESG scores tend to have, on average, the highest CDS spreads. Zooming in on the individual sub-dimensions of ESG, we documented that the strongest (and almost linear) relationship exists between governance factors and sovereign CDS spreads (see figure 6).

We also identified a positive correlation between credit ratings and ESG scores. However, the distributions of ESG scores for each rating category are very wide: countries with good ratings can have relatively low ESG scores, giving rise to additional risks that might not be picked up by conventional credit ratings (see figure 7).

We empirically established that there is a significant negative relationship between ESG scores and sovereign CDS spreads, even after controlling for credit ratings. This means that investors should consider ESG factors as part of their assessments of countries' creditworthiness, because they might not be fully reflected in credit ratings (see figures 1 and 8).

The model we developed could be used to identify outliers, outperformers and risky investments – just like the model in our study on the link between ESG and corporate credit. Our model helps investors identify countries with tight spreads and low ESG scores – these are investments that investors might wish to avoid as the CDS spreads may not fully reflect the ESG risk inherent in these countries. The model can also help identify countries with wide spreads and high ESG scores given that the ESG risk may not – according to our model – be properly reflected in the price.

Looking ahead

In this study, we looked at 59 countries from around the world. There are obviously interesting research questions to be asked regarding the effects of ESG on sovereign credit in various markets. In particular, the extent to which environmental risks are captured in sovereign CDS spreads warrants further examination. As a follow-up, we have started looking at the different effects of ESG on sovereign credit spreads in developed markets compared to emerging, and also in the context of investment-grade relative to high-yield bonds, as well the aspect of change in CDS. While this study has focused on risk, we may also want to further investigate the contribution of ESG factors to returns in future publications.

Appendix

1. Ordinary least squares regression analysis

The table below shows the output of the underlying regression model for our pricing model, using robust standard errors.

$$ln(Quarterly\ average\ CDS\ spreads)_{i,t} = Constant + ß1 * ESG\ score_{i,t-4} + ß2 * Credit\ Rating_{i,t-4} + Error_{i,t}$$

	ln (CDS spreads)
ESG score (-4)	-0.0140***
	0.0012
Credit ratings (-4)	-0.4024***
	0.0126
Constants	7.4389***
	0.0627
R-squared (adj.)	60%
Degrees of Freedom	1816
F-Statistics	1351

***,**,* indicate statistical significance at 1%, 5% and 10%.

2. Credit rating conversion table

Bloomberg index rating	Rating grade	Assigned rating code
AAA	Investment	7
AA1		6
AA2		6
AA3		6
A1		5
A2		5
A3		5
BBB1		4
BBB2		4
BBB3		4
BB1	Speculative	3
BB2		3
BB3		3
B1		2
B2		2
B3		2
CCC1		1
CCC2		1
CCC3		1
CC		1
C		1

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