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Environmental, Social and Governance (ESG) performance and sovereign bond spreads: an empirical analysis of OECD countries

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Abstract. *What are the determinants of borrowing cost in international capital markets? Apart from* macroeconomic fundamentals, are there any qualitative factors that might capture *sovereign bond spreads?* In this paper we consider to what extent *Environmental, social and governance (ESG) performance can affect sovereign bond spreads. First, countries with good ESG performance tend to have less default risk and thus lower bond spreads. Moreover, the economic impact is stronger in the long-run, suggesting that ESG performance is a long-lasting phenomenon. Second, we examine the financial impact of separate ESG dimensions, and find that the environmental dimension appears to have no financial impact whereas governance weighs more than social factors. Third, we examine cross-countries differences and show that ESG performance has a more significant and stronger impact in the Eurozone than elsewhere in OECD countries. Fourth, we include evidence from the global financial crisis and find stronger influence of country sustainability performance during crisis period*.

Keywords: *ESG performance, sovereign bond yield spreads*.

JEL Classification: G11, F34

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INTRODUCTION

In this article, we analyse the determinants of sovereign bond yield spreads and examine in particular the role of environmental, social and governance (ESG) factors. More precisely, we investigate whether sovereign bond risk is not only determined by macroeconomic and financial conditions, but by other non-economic factors as well.

The underlying arguments supporting the relationship between ESG performance and sovereign bond spreads can broadly be categorised in two groups. The first one builds upon the literature on investors' preferences which documents that altough the main motives for an investment decision are guided by returns and diversification, an increasing number of investors seem to be interested in the ESG performance of their portfolio too, for ethical/moral reasons (Bénabou and Tirole, 2010; Kitzmueller and Shimshack, 2012). The second argument is that sustainability can enhance financial performance by taking into account qualitative criteria. Considering non-financial factors in the investment process can bring various comparative advantages in terms of improved profitability and better risk management. Some financial firms advocate that ESG factors might improve asset management in fixed income markets (Bauer et al, 2009; Hoepner et al. 2016; Calvert, 2015). Investors may use ESG indicators of a country as a potential extra-guard against losses when they consider lending it money. Governments with low ESG scores should present a higher risk of sovereign default and investors would then charge a higher interest rate on debt.

In particular, ESG indicators can be useful in averting the fiscal fatigue, and could lead to an improvement in the fiscal balance once the debt limit has been reached. This may explain why Japan, which has the highest ratio of gross general country debt relative to GDP (at 244% of GDP) is facing much less market pressure and paying much lower interest rates than other industrialized countries, such as Greece, Portugal and Italy. According to Icaza (2016), the quality of institutions may play a role in determining whether and how a government reacts to debt. Icaza (2016) suggests there is a propensity to reach “fiscal fatigue”, in the sense that the higher the level of debt, at the margin, the lower the fiscal adjustment and the lower the fiscal space. This propensity can be mitigated if the economy is growing and if the government has support and does not have to worry about future elections when the debt limit is reached. In other words, through appropriate political institutions a government may have a broad support, useful when it decides to carry out fiscal adjustment. The ability to implement a stabilization program in difficult periods hence creates a reputational wealth for the government which can ultimately affect its sovereign risk.

Interestingly, although the aforementioned arguments can be used to motivate research on the financial impacts of ESG performance on sovereign spreads, the majority of the relevant studies focus on identifying the influence of ESG indicators on the cost of corporate bonds (Godfrey et al., 2009; Bauer et al., 2009; El Ghoul et al., 2011; Bauer and Hann, 2011; Hoepner et al., 2016). It has only been in the last few years that some attention has been paid to the possibility of a linkage between ESG performance and sovereign bond spreads (Drut, 2010; Berg et al., 2016). The lack of reliable data on ESG criteria and the absence of a clear definition of the methodology applied to assess the performance of countries in terms of environmental, social and governance issues may be behind this gap in the literature.

This paper's aim is twofold. First, we address the data gap by providing a database on indicators of environmental, social and governance concerns for 20 OECD countries and introducing a novel methodology for aggregating these indicators into four indexes, namely environmental quality index (ENVI), social development index (SODI) and governance quality index (GOVI), as well as a composite index: the ESG global index (ESGGI). The second objective is to investigate the relationship between sovereign risk and these ESG indicators. We will analyse how a country's ESG performance can be related to sovereign risk by: i) Exploring the link between overall ESG performance and sovereign bond spreads , ii) Decomposing the financial impacts of environmental, social, and governance factors, iii) Disentangling European from other advanced countries to examine whether sovereign risk has been overpriced in the Eurozone, especially in the peripheric countries (Greece, Ireland, Portugal, Spain, and Italy), and iv) Examining the role of the global financial crisis which may have altered the nature and/or strength of the ESG performance-sovereign risk link.

Our main results illustrate the complexity and variability of the economic impacts of country ESG performance on sovereign risk. We find that country ESG performance is significantly and negatively related to sovereign bond spreads. Hence, macroeconomic and ESG factors appear to be priced by sovereign bond markets, with good ESG practices being associated with less default risk and thus lower bond spreads. Our results thus suggest that it is important to take into consideration ESG performance when designing strategic asset allocation across countries. Moreover, when distinguishing between short-run and long-run relationships, we show that the relationship between country ESG performance and long-term sovereign bond spreads is stronger than that between a country's ESG performance and its short-term bond spreads. The intuitive explanation is that at the country level, ESG factors are long-lasting phenomenons. When considering the differentiated impact of the various ESG dimensions, we also provide evidence that governance has a stronger financial impact than social performance has, and that environmental performance appears to have no impact. Furthermore, the relationship between sovereign risk and a country's ESG performance is more significant and stronger in the euro area countries compared to the other advanced countries. Finally, our results reveal a stronger influence of ESG performance during the global financial crisis.

The rest of the paper is organized as follows. Section 2 presents the literature review and develops our hypotheses. Section 3 describes our data and provides some descriptive statistics. Section 4 details the methodology. Section 5 displays the empirical results. Section 6 concludes and presents key elements for further research.

1. LITERATURE AND HYPOTHESES

Several papers analyse the determinants of sovereign bond yields and/or spreads. These studies usually estimate a fixed effect panel model with fiscal variables and control variables in order to take into account the unobserved individual characteristics of the countries issuing the bonds (Poghosyan, 2012). Most approaches conclude that sovereign bond spreads depend on the fundamental conditions of the economy, in particular the fiscal accounts or the country's fiscal space (Ardagna et al., 2007; Attinasi, et al., 2009; Baldacci and Kumar, 2010; Aizenman and Hutchinson, 2013; Beirne and Fratscher, 2012, Ghosh et al., 2013). For example, when public deficits and debt increase, sovereign bond yields soar in recognition of the higher risk (default, monetization driven depreciation and inflation) carried by investors holding these securities.

However, the literature is still inconclusive on the dominant drivers of sovereign spread and before the debt crises, sovereign debt risks were under-estimated by the markets (Dufrénot, Gente and Monsia (2016), Since the global financial crisis then, the relationship between sovereign bond spreads and macroeconomic fundamentals seems to have broken down. For instance, DiCesare et al. (2012) find that a large part of the spreads observed for some countries during the euro area debt crisis is left unexplained and seems to be higher than what could be justified on the basis of fundamentals. De Grauwe and Ji (2013) observe that the decline in the spreads appears to be unrelated to the changes of the debt-to-GDP ratios (considered as the fundamental variable). Furthermore, Poghosyan (2012) notes that despite the piling up of general country debt in the United States of America in the aftermath of the global financial crisis, USA bond yields have been trending downward. Conversely, despite a relatively lower initial level of general country debt, sovereign borrowing costs in some euro area countries such as Spain have persistently exceeded those of more highly indebted countries such as the United Kingdom. Interestingly, a study by the IMF (2012) on the basis of a panel model of the 10-year interest rates of 21 advanced economies over the period 1980-2010 found that current sovereign spreads with respect to Germany of some euro-area countries are well above what could be justified on the basis of fiscal and other long-term fundamentals.

These findings have prompted renewed interest in the determination of sovereign bond spreads. Hence, an increasing number of papers have set out to explore the use of "*qualitative factors*" as potential determinants of sovereign bond spreads. Qualitative factors are designed to capture the "soft" aspects of a country's ability to adequately service its obligations. These factors especially try to capture the willingness -as opposed to the ability- of a country to pay interest, the flexibility of an economy and its growth capacity, the transparency of data, as well as a country's fiscal credibility and commitment to responsible borrowing. Nelson (2013) and Papanikos (2014) note that financial markets consider a variety of qualitative indicators (such as government reputation or political issues), not just debt levels, when evaluating a country's debt sustainability.

Hereby, we try to contribute to this latter strand of the literature by including environmental, social and governance factors in the analysis to explain sovereign bond spreads. In our view, ESG performance of a country falls within this group of soft variables that investors might take into consideration when considering lending money to sovereigns. Hence, our main research question: *Is there a link between the ESG factors and sovereign bond spreads*?

Interestingly, the recent literature suggests the existence of a link between environmental performance and sovereign bond spreads. For instance, Berg et al. (2016) observe that environmental information enables to better assess the expected value and the volatility of sovereign bond spreads. Gervich (2011) speculates that the economic failings that led to the downgrade on sovereign credit ratings could perhaps have been foreseen by observing specific environmental indicators. In particular, he notes that national petroleum consumption, CO2 emissions per capita, and the return on investment that a nation ‘receives for its pollution (annual GDP/annual CO2 emissions) could be useful environmental indicators of a country's future fiscal performance. In other words, environmental indicators may be a sort of “early warning” system that can predict a nation's financial collapse before it is predicted by more conventional financial indicators (such as debt levels).

Another strand of literature has drawn connections between sovereign bond spreads and empowerment and human development. For instance, Bundala (2013) shows that the equality-adjusted human development index and the unemployment rate affect the price of sovereign risk. In particular, countries with high equality-adjusted human development index and lower unemployment rate are associated with less default risk and thus lower cost of debt. Hoepner et al. (2016) argue that culture is priced by sovereign bond markets, and that 'good' culture ratings reduce government bond yields. Maplecroft (2012) notes that countries displaying poor ESG indicators are often more prone to shocks from social events (i.e. poverty, illiteracy, ethnic and religious differences, and demographic factors), leading to greater sovereign risk. This leaves growth markets including China, India and Russia at high risk of being downgraded. Conversely, improvement in these ESG factors would enhance the outlook for long-term growth, which in turn reduces risk.

Finally, sovereign bond spreads are also very sensitive to governance factors (i.e. the quality of legal institutions). An influential empirical study in this area was carried out by Erb, Harvey and Viskanta (1996), who showed that the ICRG indicator (International Country Risk Guide), which measures political risk, was an important determinant for a country's overall risk premium. In the same vein, Haque et al. (1998), who focus on the impact of political and economic variables on country's credit ratings, show that political variables can indeed improve the explanatory power of the regressions on sovereign credit ratings. Ciocchini et al. (2003) single out corruption and find that a one standard deviation decrease in corruption score causes the bond spread to fall by about 101 basis points (see also Butler et al., 2009).

In this paper, we contribute to this research by systematically including environmental, social and governance factors in our analysis and by trying to find out how they might interact within the setting of being assessed on their contribution to sovereign bond spreads. More precisely, grounded in the literature discussed above, we develop five hypotheses about the relationship between country ESG performance and sovereign bond spreads.

Our first hypothesis, builds upon the aforementioned arguments substantiating the links between sovereign bond spreads and macroeconomie "soft" (ESG) performance, and suggests that countries with high ESG scores will pay lower yields when issuing bonds. Hence, we hypothesize:

H1: There is a negative relationship between country's ESG performance and sovereign bond spreads.

Considering more deeply the relationship between ESG factors and sovereign bond spreads, we distinguish between short-run and long-run impacts. Poghosyan (2012) suggests that government bond yields can temporarily deviate from their long-run equilibrium levels because of market overreaction during periods of financial stress, when investor's decisions can be largely explained by herding behaviour amidst increased risk aversion rather than economic fundamentals. Additionally, there is evidence which suggests that a country's effort in terms of ESG policies can be regarded as investments with a long payback (Lydenberg, 2009). Indeed, it is often difficult to establish the materiality of a country ESG performance in the short term in relation to issue that materialize over longer time horizons such as climate change or resource scarcity. By nature, ESG policy and performance are set out to be long-term oriented. For example, actions to eliminate the level of corruption in a country requires several years. The impact of such a change on country risk will thus become visible only after several years too. On the other hand, as suggested by Poghosyan (2012), short-term relations are more affected by immediate events, such as monetary policy effects (money market rate) and nominal shocks (inflation), while there are other factors contributing to the deviation of sovereign borrowing costs from their long-run equilibrium level though being difficult to quantify (for instance, policy uncertainty). We therefore hypothesize that:

H2: The relationship between ESG performance and long-term sovereign bond spreads is stronger than the relationship between ESG performance and short-term sovereign bond spreads.

Further, we consider the differentiated impact of various ESG dimensions. This may be connected to Godfrey et al.'s (2009) view that combining distinct features of sustainability to create "*a single monolithic construct*" dilutes the observable financial effects of unidimensional features. From this perspective, governance factors, which refers both to political issues with immediate credit implications and policy issues with long-term economic and investment impact, have frequently been studied and found to be negatively related to different aspects of a country credit risk (Ciocchini et al., 2003; Afonso et al., 2007, Connolly, 2007; Butler et Fanver, 2006). However, social factors have been much less studied, as they often seem to be intertwined with the political and governance issues. As regards the environmental dimension, the risks that this factor poses to economic growth are well known and existing evidence support that the broader economic impacts of climate change, sustainable growth, large-scale environmental accidents and national energy policies have a decidedly macroeconomic focus (Grossman and Krueger 1991; Heyes, 2000; Decker and Woher, 2012). Yet, research shows little correlation to date between environmental issues and bond performance. For example, the UN Environmental Program Finance Initiative-Global Footprint Network Study on Environmental Risk Integration in Sovereign Credit Analysis (E-RISC) conducted in 2011, showed no correlation between a country's ecological balance and its credit rating. This is quite remarkable considering that these issues are highly material to a country's economic performance in the long, medium and even short term, according to the study. One of the biggest problems is agreeing on which indicators should be used to measure environmental risks in the context of sovereign fixed income. We hypothesize that within the framework of this study:

H3: The financial impact of the governance side of country ESG performance will be more pronounced compared to the social and environmental one.

Taking into consideration the recent global financial crisis, Beirne and Fratzscher (2013) argue that sovereign risk is substantially underpriced during the pre-crisis period 2000-2007 among the euro area periphery economies (Greece, Ireland, Portugal, Spain and Italy). They further observe that it is striking that the fundamentals one would expect to be the most important determinants for the price of sovereign risk - the public debt level, fiscal deficit and the current account – actually do explain very little of the pricing of risk in euro area countries before the crisis, but have much more explanatory power for sovereign risk in other advanced economies. In turn, they argue that the small spreads and very high co-movements of sovereign yields within the euro area suggest that other factors than fundamentals may have been the key determinants of sovereign debt in Europe (compared to other advanced economies). High spread volatility and market overshooting in Euro zone has been investigated for example, by Di Cesare et al. (2012) and Hochestein (2013), who observe that spreads for some countries during the euro area debt crisis have been much higher than what could be justified on the basis of economic fundamentals. Additionally, over the course of the crisis, Blundell-Wignall (2012) notes that the European Monetary Union was exposed to asymmetric real shocks through external competitiveness and trade. With the inability to adjust exchange rates, Blundell-Wignall (2012) stresses that these pressures were forced into the labor market and unemployment and have led some euro area countries to try to alleviate pressures with fiscal slippage, contributing to underlying financial instability. In this context- of financial instability- several observers have become more interested in factors like corruption, political instability and global stakes that may impact sovereign bonds conditions (Connelly, 2007; Bernoth and Erdogan, 2012; Arghyrou and Kontonikas, 2012). Others stress the increased importance of market-wide illiquidity (Rubia et al., 2016) or uncertainty and investment confidence conditions and perceptions (Gerogoutsos and Migiakis, 2013). Drawing upon this literature on the drivers of the Eurozone sovereign risk, we hypothesize that:

H4: The effect of country ESG performance on sovereign bond spreads is stronger in

the euro area than in the other advanced economies.

Our fifth and last hypothesis focuses on the different development paths before and after the global financial crisis. Ebner (2009) studied the Eastern and Central European government bond spreads in crisis and non-crisis periods. He argues that there is a significant difference in government bond spread determinants during both periods. More precisely, he finds that during a crisis period, macroeconomic factors become less significant explanatory variables, while other factors like political uncertainty, market instability, and global factors play a more important role in explaining the rise in spreads. Similarly, Dailami et al. (2008) propose a framework in which the probability of default is a nonlinear function of the risk-free rate (U.S.A. Treasuries), implying that the U.S.A. interest rate alone is not a sufficient explanation of the spread level. Interactions with the severity of the debt dynamics, global liquidity conditions, the appetite for risk, and shock indicators are also important, and a distinction has to be made between crisis and non crisis periods. Bernoth et al (2012) also observe that the general pricing of risk has increased over time in the EMU. Therefore, we hypothesise that:

H5: The effect of country ESG performance on sovereign bond spreads is higher in the years after the financial crisis than before the crisis.

2. DATA AND DESCRIPTIVE STATISTICS

In this section we introduce and discuss the data employed in our study. We also explain how we include environmental, social and governance performance in the empirical analysis.

2.1. Data

Country ESG performance: ESG index

In order to construct the composite ESG index, we account for recommendations made in ESG analysis reports published by rating agencies and asset managers. These reports developed recently include: VIGEO (2013), HSBC AM (2013), Natexis AM (2013), MSCI ESG Country Ratings (2013), Neuberger Berman's emerging market debt team (2014)[1]. For each dimension, we select several observable items relying on the literature. To measure a country's environmental performance, we use the World Development Indicators (WDI) proposed by the World Bank Group which contains information on air quality, water and sanitation, forests, biodiversity and climate and energy. We also used the WDI dataset to get information on human capital, demography, technology and R&D, health and gender equality. The data on democratic institutions and safety policy are based upon the work of Kaufmann et al. (2005). This dataset presents estimates of six dimensions of governance. The dimensions are voice and accountability, political stability and absence of biolence, country effectiveness, regulatory quality, rule of law, and control of corruption[2].

To construct our ESG index, we follow the method of Nicoletti et al. (2000) which is based on Principal Component Analysis (PCA). This method differs from other standard methods found in the literature to weight composite indexes. In particular, it does not only consider the first principal component to weight the index, but also the factor loadings of the consecutively extracted components. The advantage of this method is that a bigger proportion of the variance in the data set is explained (Tabachnick and Fidell, 2007). According to this method, the estimates of the rotated factor loadings provide the key for aggregating the detailed indicators into factor-specific scores[3]. Summary indicators of the sub-domains unveiled can be obtained by aggregating

[1] The ESG dimensions highlighted in the recommendations of the reports are presented in appendix (Table A.1.1).
[2] The description of all these items is in appendix (Table A.1.2).
[3] See Tables A.1.3. A.1.4 and A.1.5 in appendix.

the detailed indicators using the weights estimated by means of factor analysis[4].

The interpretation of these weights, which are obtained by squaring and normalising the estimated factor loadings, is as follows: the squared factor loadings represent the proportion of the total unit variance of the indicator which is explained by the factor. These summary indicators are then aggregated into a global index: the ESG index (ESGGI). The ESGGI is obtained by means of factor analysis, in which each component of the ESG framework is weighted according to its contribution to the overall variance in the data. The ESGGI can, hence, be interpreted as an index that measures the extra-financial performance of a given country.

The sub-domain indicators used to build the ESGGI are the *governance quality index* (GOVI), the *social development index* (SODI) and the *environmental quality index* (ENVI).

- The governance quality index (GOVI) assesses regulatory effectiveness by including six sub-components: rule of law, political stability, voice of the people, corruption control, country effectiveness and regulatory quality. High scores signal a high degree of legal quality.
- The social development index (SODI) captures the country's effort in terms of human development and includes six sub-components: gross national income per capita growth (GNI), human development index (HDI), life expectancy, health expenditure per capita, female to male labour participation and internet users. The SODI can be interpreted as a measure of the degree of social welfare of a given country, with high scores signalling a high degree of social development.
- The environmental quality index (ENVI) measures how well countries manage their natural resources. The ENVI is inspired from the Environmental Performance Index (EPI) developed by Yale University. It includes six sub-components: air quality, water and sanitation,

[4] See Table A.1.6 in appendix.

biodiversity and forest, control to climate energy and climate quality. High scores signal strong environmental performance.

Sovereign bond yield spreads

The data on government bond yields is taken from Bloomberg. Sovereign bond spreads are defined as the difference between the interest rate the country pays on its external US dollar denominated debt and the rate offered by US Treasury on debt of comparable maturity (Hilscher and Nosbusch, 2010). Typically, we consider yield on sovereign bonds of the considered country minus yield on US sovereign bonds, both values are taken at the end of year, from the yield curve for a fixed maturity. The yield on the benchmark US Bond is, then, treated as the "risk-free" rate or the numeraire over which each country's spreads are computed. We use both 12-month and 10-year benchmark country bond yields from monthly data on secondary market bond yields.

Control variables

In line with the literature on the determinants of sovereign risk (Attinasi et al., 2009; Barbosa and Costa, 2010; Afonso et al., 2012; D'Agostino and Ehrmann, 2013), we include eight country specific macroeconomics controls in our model.[5]

(1) *GDP growth rate* is an indicator of the evolution of the country's wealth, and relatively high values can point to the debt burden becoming easier to bear in the future. Eichengreen and Mody (2000) and Cantor and Packer (1996) find that high country growth rates enhance the ability to repay debt and thus reduce spreads.

(2) *Inflation* reveals sustainable monetary and exchange rate policies. According to Nickel et al., (2009) the impact of inflation on sovereign risk reflects two opposing effects. On the one

[5] The description of these variables is provided in appendix (Tables A.2.1; A.2.2 and A.2.3).

hand, higher inflation rates raise the country tax base and reduce the real value of outstanding debt denominated in domestic currency. This should overall relax the country's financing constraints and result in a reduction of bond spreads also on the foreign currency borrowing. On the other hand, higher expected inflation rates, in particular if in excess of certain thresholds, are associated with increased macroeconomic instability and would thus be harmful to a country's creditworthiness. The overall expected impact of inflation on yield spread hence is ambiguous.

(3) and (4) *Country fiscal condition* is expected to affect sovereign risk. We use the ratios of two fiscal variables to GDP: gross country debt and primary balance. According to the standard theory, countries with higher levels of debt and/or larger fiscal deficits would be considered less credit worthy and thus this would amplify the default risk (Attinasi et al., 2009; Sgherri and Zoli, 2009; Gruber and Kamin, 2012). The expected impact of both variabe on yield spreads hence is positive.

(5) *Current account balance* is expected to affect negatively country bond yields, as an indicator of competitiveness and ability to raise funds for debt servicing; therefore as it improves, the sovereign spreads should decline and sovereign ratings rise. . The expected impact of current account balance hence is negative.

(6) *Liquidity ratio* measures the access to credit relative to national reserves. We use the ratio of international reserves to GDP. The lower the ratio of international reserves to GDP, the greater will be the threat of a sudden liquidity crisis, and the lower a country's risk rating (Edwards, 1983). The expected impact of liquidity ration hence is negative.

(7) *Country openness* plays an important role in explaining economies' cost of borrowing as the penalty for sovereign default is higher in terms of capital reversion in an open rather than a closed economy. The higher this ratio, the greater is the ability of country to generate the required

trade surpluses in order to refinance the present stock of debt or to finance new debt. The expected sign of the coefficient hence is positive.

(8) *Sovereign credit ratings* are an evaluation of country's credit worthiness, and relatively high values are intended to represent a lower probability of default. Afonso et al. (2012) find that sovereign credit ratings and outlook announcements have had a statistically significant negative impact on spreads. Similarly a number of European policy makers have suggested that sovereign downgrades by the credit rating agencies have been a significant factor in the crisis' initiation and escalation. The expected sign of the coefficient hence is negative

2.2. Descriptive statistics

Our sample comprises yearly observations of 20 countries from 1996 to 2012, resulting in 340 observations. More precisely, our benchmark sample is Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New-Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom[6] .

Table 1 gives the average ESG global index (ESGGI) as well as the average of the three detailed indexes for the 20 countries over the period of 1996 to 2012. Furthermore, it ranks these countries from the best performers (rank 1) to the worst one.

[INSERT TABLE 1 ABOUT HERE]

These twenty countries have relatively high ratings for the the GOVI and SODI but obtain relatively poor ratings for ENVI. The dispersion of the ratings score is much larger for social and environmental than for governance. The dispersion of the ratings score shows that even if the sample countries are developed and homogeneous from a wealth point of view, there are clear

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[6] In the analysis, the US do not appear as the yield on the benchmark US Bond is treated as the "risk-free" rate or the numeraire over which each country's spreads are computed.

differences regarding the three ESG criteria. The analysis of the ESGGI shows that it is possible to distinguish several subgroups of countries: Nordic countries and Canada are at the top with an average score about 65, followed by Netherlands, Denmark, Anglo-Saxon countries, and Switzerland, Germany, Austria, Japan and Latin countries are at the bottom. As reflected in the ranking of the ESGGI, the four economies with the best overall performance in the period under review are Finland, Norway and Sweden. Finland tops the global ranking. For GOVI, SODI and ENVI countries are ranked from the highest performing respectively to institutional, social policy and environmental quality to the lowest performing.

The Spearman's rank correlation of the aggregate index and its components is shown in Table 2. The three intermediate composite indexes, governance quality, social quality and environmental quality, are all positively correlated. That is, higher values of environmental quality are associated with better governance and/or more favorable social conditions. However, the correlation is not perfect: it goes from 35% between ENVI and GOVI to 47% between SOD and GOVI. This suggests that we need not be very much concerned about including them at the same time in the regressions.

[INSERT TABLE 2 ABOUT HERE]

3. METHODOLOGY

In this section, we introduce the model, explain and motivate the way in which we will estimate it. Furthermore, we discuss the ways in which we will account for the robustness of our analysis.

3.1. Model specifications

In line with our hypotheses, we model the link between ESG performance and sovereign risk using a standard panel model with country fixed effects[7] (building on a common approach in the literature, e.g. Afonso et al., 2012; Beirne and Fratzscher, 2013). In its most simple form the approach is based on the following equation:

$$Y_{i,t} = \beta_0 + \beta_i Y_{i,t-1} + \beta_2 ESGGI_{i,t-1} + \beta_3 \left(\frac{\Delta GDP}{GDP}\right)_{i,t} + \beta_4 \left(\frac{\Delta P}{P}\right)_{i,t} + \beta_5 \left(\frac{Debt}{GDP}\right)_{i,t} + \beta_6 \left(\frac{Pri.Fis}{GDP}\right)_{i,t} + \beta_7 \left(\frac{D.account}{GDP}\right)_{i,t} + \beta_8 \left(\frac{Reserves}{Import}\right)_{i,t} + \beta_9 \left(\frac{X+M}{GDP}\right)_{i,t} + \beta_{10} (S\&PScale)_{i,t} + \alpha_i + \varepsilon_{i,t}$$

where i = 1 to n (the number of countries) and t = 1 to T (the number of periods).

Equation (1) models the sovereign bond spreads (Y), which can either be 12-month bond spreads or 10 year bond spreads, on a number of control variables incorporating country specific fixed effects α_i[8]. We have included on the right-hand side lagged sovereign bond spreads, since one has to account for the persistence that is inherent to spreads (Afonso et al., 2012; Gerlach et al., 2010; Hallerberg and Wolff, 2008). Indeed, the persistent nature of spreads implies that the exclusion of the lagged spread term from the model will generate omitted variable bias.

ESGGI denotes the ESG indicator and is our variable of interest, $\left(\frac{\Delta \text{GDP}}{\text{GDP}}\right)$ denotes the GDP growth, $\left(\frac{\Delta \text{P}}{\text{P}}\right)$ denotes the inflation rate, $\left(\frac{\text{Debt}}{\text{GDP}}\right)$ denotes the gross country debt to GDP ratio, $\left(\frac{\text{Pri.Fis}}{\text{GDP}}\right)$ denotes the country's primary balance to GDP ratio, $\left(\frac{\text{C.account}}{\text{GDP}}\right)$ denotes the current account to GDP ratio, $\frac{\text{Reserves}}{\text{Import}}$ denotes the ratio of reserves to imports, $\frac{\text{X+M}}{\text{GDP}}$ denotes the trade openness ratio, (S&PScale) denotes the Standard and Poor's sovereign ratings: numerical variable

[7] We performed a Hausman test, which clearly indicates that a fixed effects model needs to be estimated instead of a random effects model. The results are available upon request.
[8] The country specific effect α_i permits us to take into account unobservable variables that are specific to the country *i* and time-invariant.

assigning 1 to BB, 2 to BB+ and so to AAA.

After estimating the baseline model given by equation (1) we extend it by adding variables aiming to capture further insights relating to the drivers of sovereign bond spreads.

- First, an important issue is to account for the role of each ESG dimension individually. This allows us to look into the potential differences in the financial impact of separate ESG dimensions on sovereign bond spreads. More precisely, we estimate equation (1) but replace (*ESGGI*) with $(GOVI)$, $(SODI)$ and $(ENVI)$, which are the governance quality index, social development index and environmental quality index respectively.
- Second, we allow a structural break in the relationship between spreads and their aforementioned potential determinants, using dummy variable. The dummy variable (D2007) aims to capture the effects of the global financial crisis specified to begin in August 2007. This date is widely acknowledged in the literature to be the starting point of the global credit crunch given that the first large emergency loan that the ECB provided to European banks in response to increasing pressures in the interbank market took place on 9/8/2007 (Arghyrou and Kontonikas, 2012; Attinasi et al., 2009).

The ESG (*ESGGI*, *GOVI*, *SODI*, *ENVI*) indicators are lagged in all models. This is done for several reasons. First, the primary scope of this study is the examination of the relationship between ESG issues and sovereign risk where ESG indicators are seen as the cause and sovereign bond spreads are regarded as being an effect. Furthermore, lagging the ESG measures helps to escape the alleged endogeneity problems and simultaneity bias that may arise due to a contemporaneous bidirectional causality existing between ESG issues and sovereign risk. Also, the common practice in ratings agencies and international organizations (that provide the data) is actually to assemble the various environmental, social and governance data at the end of each year. So lagging the ESG indicators helps to ensure that the ESG index for each country is public knowledge at time *t* and has already become incorporated by the financial market participants in their price formation.

3.2. Econometric strategy

A major concern is that the lagged dependent variable on the right-hand side of the model might be serially correlated and hence correlated with the error term, which makes the LSDV (Least Squares Dummy Variable) and OLS (Ordinary Least Squares) estimators biased and inconsistent (Baltagi and Chang, 1994). More specifically, it can be shown that the OLS coefficient on the lagged dependent variable is biased upwards, while the LSDV estimator is biased downwards[9]. Therefore, a consistent estimate should lie between the two estimators (LSDV and OLS).

Kiviet (1995) derives an approximation for the bias of the LSDV estimator when the errors are serially uncorrelated and the regressors are strongly exogenous, and proposes an estimator that is derived by subtracting a consistent estimate of this bias from the LSDV estimator. Using Monte Carlo simulations, Judson and Owen (1999) show that with balanced dynamic panels characterized by $N < 20$ and $T < 50$ as is the case here, the Kiviet corrected LSDV (LSDVC) estimator of β_1 (the coefficient on the lagged dependent variable) is better behaved than the Anderson-Hsiao and the Arellano-Bond estimators[10]. The idea behind LSDVC is to derive an accurate approximation of the LSDV bias and then remove it from the LSDV estimator. Kiviet (1995) obtains LSDVC by purging LSDV of bias approximations containing terms of at most order $N^{-1} T^{-1}$. Kiviet (1999) provides a further refinement with approximations of at most

[9] For a discussion on this issue see Nickell (1981).

[10] With unbalanced panels, by the time T reaches 30, Judson and Owen found the LSDV estimator without bias correction is superior to the Arellano-Bond estimators. Bruno (2005) develops the LSDVC estimator for unbalanced panel.

order $N^{-1}T^{-2}$. Bun and Kiviet (2003) obtain formulas that are as accurate as Kiviet's (1999) but easier to implement. LSDVC has been increasingly used as a suitable tool of inference in dynamic panel models with a small number of cross-sectional units. Bruno (2005) computes the bias correction for unbalanced dynamic panels, making it possible to have missing values in the dataset. However, unlike previous estimators that allow effective estimation in the presence of endogenous regressors (GMM estimtor, System GMM estimtor), the LSDVC estimators assume a weak exogeneity (Kiviet, 1999).

Of course, all potential estimators have advantages and disadvantages given the size of our panel and our study object. However, to eliminate inefficient estimators, we performed the OLS and the LSDV (fixed effect) regression. The estimated results will display bounds on the coefficient of lagged dependent variables. Then, we estimated the model (1) with the estimators of Anderson and Hsiao (1982) in difference and in level, the GMM estimators of Arellano-Bond (1991) and of Bundell and Bond (1998) and the estimator LSDVC of Bruno (2005), we also used auto-correlation tests, over-identification tests, as well as tests of endogeneity for each explanatory variable[11]. Of the five candidate estimators, only one provides the coefficient on lagged dependent variable in the bounds of its OLS and FE counterparts, namely the LSDVC estimator of Bruno (2005)[12] . The endogeneity tests confirm the efficiency of this estimator as all explanatory variables, except the lagged dependent variable, are exogenous.

3.3. Robustness

We perform a number of robustness checks. First, we assess the extent to which the coefficients change if the dimensions of the panel of countries change. To this extent, we exclude

11 The results are available upon request

12 Bloom et al. (2007), Potrafke (2010), Celasun and Harms (2010), de Rassenfosse and van Pottelsberghe de la Potterie (2012) are notable examples of applications of LSDVC to panels with a small number of countries.

the sovereign ratings as potential input factor from our statistical analysis. Altman and Saunders (2001) have argued that the ability of ratings to predict default is poor and, hence, that their usefulness as a basis for the calculation of risk weights is limited. Their arguments suggest that rating agencies provide little if any new information to the market, but rather reflect information already incorporated in market prices. Yet, according to Hochstein (2013) adding sovereign ratings may improve the explanatory power of sovereign spread models. Further, we remove Greece, from the list of the countries in the panel. We suspect that Greece may be an outlier and try to test the sensitivity of the baseline results to this outlier.

Second, we back-test our models by generating in-sample predictions for bond spreads, which will be compared with the actual bond spreads. We follow the idea developed in Berg and Pattillo (1998), Kumar et al. (2003) and Comelli (2012) among others. We proceed as follows. The time dimension of our panel consists of T observations. We re-estimate the model using the data in a sub sample made of $t < T$ observations (the estimation sample) to generate bond spreads forecasts in the remaining part ($T – t$) of the whole sample (the forecasting sample). In terms of our study, we re-estimate bond spreads for the periods 1996-2006, 1996-2007 and 1996-2008 (the estimation samples) in order to forecast bond spreads in the periods 2007-2012, 2008-2012 and 2009-2012, respectively (the forecasting samples). The purpose of this exercise is to ask whether the model can predict accurately bond spreads in periods that are not included in the estimation sample. We use different estimation samples because we are interested to assess whether the in-sample forecasting ability of the model changes with the beginning of the global financial crisis. We use linear prediction (LP) method to generate in sample predictions for bond spreads. With this method, we re-estimate the model in the estimation sample and obtain the coefficients estimates.[13] Then, in the forecasting sample we multiply the explanatory variables by the estimated coefficients to generate bond spread forecasts for all the OECD economies included in the panel. To assess the model ability to generate informative in-sample bond spread predictions, we proceed as follows. In each year of the forecasting sample, we assign a value of one if actual and predicted bond spreads change in the same direction (e.g. they both increase or decrease). Otherwise, if actual and predicted spreads change in opposite directions, we assign a value of zero. We then calculate the probability that the LP forecasting method correctly predicts the direction of yearly changes in actual bond spreads.

4. EMPIRICAL RESULTS

We start our econometric investigation by estimating benchmark models for equation (1) (basic and extended with individual ESG dimensions) for the full sample period. The results from our LSDVC estimations are reported in Table 3.

In all specifications, the yield spreads appear to be highly persistent. We also obtain statistically significant coefficients with the theoretically expected signs throughout for growth conditions (GDP growth rate) and financial ratings (S&P ratings). The credit quality indicator (current account balance) is significant with the appropriate sign in three out of six specifications. The estimated coefficients of ESGGI are negative and statistically significant at the 1% level, in 12M and 10YR regression models (Columns, 1 and 3), suggesting that a high country ESG scores reduces the spreads. Thus, Hypothesis 1 receives strong support.

[13] We calculate the linear prediction from the fitted model. The model can be thought of as estimating a set of parameters $b_1, b_2, \ldots, b_k$, and the linear prediction is $ypj = b1x1j + b2x2j + \cdots + bkxkj$ where $j = t + 1, t + 2, \ldots T$. The values ypj are the out-of-sample predictions; $x1j, x2j, \ldots xkj$are the values of the explanatory variables in the forecasting period and have not been used to fit the model (hence to obtain $b_1, b_2, \ldots, b_k$).

These results clearly show that there is value in incorporating ESG factors into sovereign risk analysis. Indeed, apart from fundamental factors (growth condition and credit risk factor), there is also a discernable financial effect of sustainability related information on sovereign spreads. This is supportive of the claims in professional analysts reports (MSCI, 2011; Novethic, 2010; Union Investment, 2012; PRI, 2013; AXA IM, 2013) regarding the relevance of ESG issues on sovereign risk analysis.

While prior literature has argued that there are three types of potential determinants that may affect spreads (Attinasi et al. 2009; Afonso et al., 2012), namely credit risk (i.e. a country's creditworthiness as reflected by its fiscal and macroeconomic position), liquidity risk, (i.e. the size and depth of the government's bond market) and international risk aversion (i.e. investor sentiment towards this class of assets for each country), we argue that ESG issues also matter for the evolution of government bond spreads and we prove the predictability of ESG issues as a driver of sovereign spreads.

[INSERT TABLE 3 ABOUT HERE]

The coefficients of ESGGI, estimated at 0.109 for 12M sovereign bond spreads and at 0.163 for 10YR sovereign bond spreads, suggest that the relationship between country ESG performance and long-term sovereign bond spreads is stronger compared to that between ESG performance and short-term sovereign bond spreads. Specifically, in terms of magnitude, an increase of 10 percent unit of ESGGI reduces 12M sovereign spreads by approximately 11% compared to 16% for the same increase in the 10YR sovereign spreads. Hence, Hypothesis 2 is confirmed. This is consistent with the observations of Hoepner et al. (2016). In fact, it's often difficult to find a link to the materiality of a particular ESG factor over the short term. However, over longer time horizons large scale issues, such as resource scarcity and climate change, could have a significant impact on a country's stability; and therefore, should be considered as potential risk factors.

Table 3 also allows us to examine the nature of the effects of ESG on spreads by separately looking at the environmental, social and governance components for both 12M and 10Y sovereign spreads. The interest-reducing effects of country sustainability are verified and appear to be coming from social and governance dimensions. This is in line with the findings of Hoepner et al. (2016) for the private sector. Indeed, as it can be seen in columns (2) and (4) that the effect of environmental factors appears to be limited, while the negative significant coefficients associated with SODI and GOVI, at 1% level, suggest that good social and governance performance tend to be associated with lower sovereign bond spreads. The economic magnitude of a change in the country governance scores on sovereign spreads are larger than the impact of an equal change in country social scores: a ten percent unit increase in the governance dimension decreases 12M sovereign bond spreads by approximately 9.6% compared to 3.3% for the same increase in social dimension. When considering 10Y sovereign spreads model, the impact of an equal change in social and governance scores on spreads is getting lower. These findings are in line with Hypothesis 3 and suggest that governance concerns are the most relevant ESG issues for sovereign risk analysis, social concerns are in second place, and environmental indicators do not appear to play a role here. The way we read this finding is twofold. On one hand, it suggests that governance information and, to a lesser extent, social information play a crucial role in evaluating the default risk of a country. On the other hand, the non-significance of environmental indicator in the government bond spread estimation indicates that environmental issues do not appear to affect default risk as perceived by financial markets.

Table 4 depicts the influence of overall country ESG scores on 12M and 10YR sovereign spreads by distinguishing between euro area and non euro area countries as considered in Hypothesis 4. This hypothesis was based on the assumption that country ESG performance is an increasingly important phenomenon in euro area countries due to high spread volatility and market overshooting that faced Eurozone governments.

[INSERT TABLE 4 ABOUT HERE]

As it can be seen in the second row of Table 4, the significance level of the relationship between government bond spreads and ESG performance is increasing when one moves from non euro area to the euro area countries. For example, regarding the 12M spread regression, ESG performance appears to have a limited effect on spreads in non euro area countries, while results clearly show that ESG performance has a negative impact, statistically significant at the 1% level in euro area economies. In addition, though the interest-reducing effect of country ESG performance on 10YR spreads are verified in both areas, the coefficient of ESGGI, estimated at 0.086 in non euro area and at 0.166 in euro area countries suggests that the relationship between country ESG performance and sovereign bond spreads is stronger in the Eurozone. An interesting finding is that country sustainability seems to be more significant and to have stronger impact on spreads in euro area countries, thus hypothesis 4 is confirmed.

As discussed in literature (Di Cesare et al., 2012; Hochestein, 2013; Nelson, 2013 and Papanikos, 2014; Gerogoutsos and Migiakis, 2013), there are essentially two reasons which could explain why euro area economies seem to be more sensitive to ESG issues compared to the other advanced economies. The first reason is that interest rates of Eurozone government bonds, which have experienced periods of high volatility and market overshooting, insufficiently reflected the credit risk of individual countries. The prevailing working assumption of financial markets, that a sovereign default within the currency union was almost impossible, explains why the price of sovereign risk in Eurozone was not determined by fundamentals (Di Cesare et al., 2012; Hochestein, 2013; Nelson, 2013 and Papanikos, 2014). The second reason accepts that non-fundamental factors matter, but on top of that it is the increased importance of uncertainty and of variables reflecting investment confidence conditions and perceptions for the upcoming economic activity that have an impact (Gerogoutsos and Migiakis, 2013).

We now seek to examine the extent to which the determinants of spreads may have changed between the pre- and post-crisis periods. To that end, we repeat our estimations (baseline model described by equation (1)) accounting for slope dummies differentiating between two periods, namely the period preceding the global financial crisis (1996-2006) and the crisis period (2007-2012). The results produced by these analyses are captured in Table 5 and provide us with a very clear picture.

Since 2007, the significance level of the relationship between government ESG performance and sovereign bond spreads (for the both maturities: 12M and 10YR) is getting higher. This confirms the assumption that during crisis periods, ESG sustainability indicators have a key role in enhancing investor understanding of country risk. Hence, Hypothesis 5 can be confirmed on the basis of Table 5.

[INSERT TABLE 5 ABOUT HERE]

Moreover, the economic importance of the ESG performance crisis factor ($ESGGI_{i,t-1}$ * $D.2007$) is significantly greater in 12M spread regressions than that of the 10YR, judging from the size of the related coefficients. A ten percent unit increase in ($ESGGI_{i,t-1}$ * $D.2007$) can be associated with a reduction of the average 12M sovereign spreads by approximately 9%. The equivalent effect of 10YR spreads amounts to approximately to 6%. These interesting findings suggest that during crisis periods, the effect of ESG performance is more pronounced in short-term (12M) than long-term (10YR) maturity. This is in line with the works of Zoli (2005) and Bellas et al. (2010) suggesting that the financial effects of qualitative factors are more prone to arise in the short run.

5. ROBUSTNESS ANALYSIS

We have conducted several robustness checks to investigate the sensitivity of our results to our modelling choices. For instance, we changed our panel's dimensions, first, by skipping Greece from our sample countries and second, by excluding Standard and Poor's sovereign ratings from our control variables. Further, we back-tested our model by generating in sample prediction which will be compared with the actual bond spreads.

[INSERT TABLE 6 ABOUT HERE]

Table 6 shows that all the coefficient estimates of ESGGI have the same sign and statistical significance whatever the dimensions of the panel. The coefficients of ESGGI are getting higher when the S&P credit ratings indicator is excluded from the explanatory variables. Those coefficients become more important accounting for sovereign bond yield spreads. The way we read this finding is is that sovereign credit ratings may capture some of the effects measured by ESGGI. The results of the exclusion of Greece from the list of the countries in the panel are comparable. This suggests that the impact of having good ESG indicators on bond yield spreads remains statistically significant even if the dimensions of panel change. It should be noted that after excluding Greece from regression, the absolute value of coefficient of ESGGI goes down compared with the value of the initial panel.

Table 7 shows for each OECD economy the probability that the linear prediction (LP) method correctly predicts the direction of the yearly change in actual bond spreads. We consider

LP to perform well in predicting the direction of the yearly change in bond spreads if for a given country the probability is above 0.7 in every forecasting period. The countries having a probability above 0.7 in all the forecasting periods are Greece and Portugal. By contrast, the model is considered to perform poorly if for a given country the probability is below 0.6 in any of the forecasting periods. On the basis of this criterion, the 12M spread's model performs poorly over the 2007-2012 forecasting period, for Canada, Denmark, Finland, Norway, Sweden and UK. However, if the estimation sample cover the 1996 - 2007 and 1996 -2008 periods, the 12M model's ability to forecast movement in bond spreads clearly improves (for all country the probability is above 0.6).

Table 7 also shows that the 10YR model appears on average to successed in predicting movements in bond spreads. Indeed, in two of the three forecasting samples (2007-2012 and 2009-2012), the average of the probability that the linear prediction (LP) method correctly predicts the direction of the yearly change in actual bond spreads is higher in the 10YR model. However, if the forecasting sample is restricted to the period 2008-2012, results show that on average the 12M and 10YR models predict movements in sovereign bond spreads equally well. Hence, this segment of our investigation provides additional support for Hypothesis 2, which holds that the relationship between ESG performance and long-term sovereign bond spreads, is stronger than the relationship between ESG performance and short-term sovereign bond spreads.

[INSERT TABLE 7 ABOUT HERE]

Summing up, judging by the probability to correctly predict the direction of the yearly changes in bond spreads as shown in Table 7, the linear prediction forecasting methods (LP) used show that 10YR model performs better regarding the prediction of bond spread changes. In all, we can conclude that the results from the estimations of our model are robust to changes in the model and to adjustments of the sample.

6. CONCLUSION

Especially since the European debt crisis that started in 2010, many policymakers and investors have sought a better understanding of sovereign risk and the related effects on overall fixed income investment returns. As a part of this trend towards a broader analysis of risk, some observers have argued that Environmental, Social and Governance metrics could have a significant impact on a country's creditworthiness; and therefore should be considered as potential risk factors too, next to traditional sovereign risk factors such as credit risk, liquidity risk and international risk aversion.

In this paper, we try to find out what is the value added of including ESG performance in conventional sovereign risk analysis. To this extent, we construct an ESG index which is based onseveral indicators relating to different subdimensions, namely governance, social, and environmental. We include ESG in the risk model and rely on dynamic panel regressions with data for 20 developed countries from 1996 to 2012. This allows us to illustrate the complexity and variability of the economic impact of the ESG performance on sovereign risk.

The paper examines five hypotheses. Our estimation results provide support for these hypotheses. First, we find that there is a strong negative relationship between ESG performance and sovereign bond spreads. Hence, country ESG factors are priced by sovereign bond markets. It shows that above average ESG performance is to be associated with less default risk and thus with lower sovereign bond spreads. This finding is in line with evidence from the private sector (see Hoepner et al., 2016) and seems very useful to take into consideration when designing strategic asset allocations across countries. Second, the relationship between ESG indicators and long-term government bond yield spreads turns out to be stronger than between short-term government bond yield spreads. This result is intuitive when keeping in mind that country ESG factors are long-lasting phenomenons. Third, the financial impact of governance performance is more pronounced compared to that of social and environmental performance. Fourth, the relationship between ESG factors and sovereign spreads in euro area countries is stronger than in other developing countries. Fifth, the relationship between ESG performance and sovereign spreads is stronger after the financial crisis in 2008 than it is before. Our results are supported by robustness checks regarding model specification, sampling, and estimation method.

We feel that our in-depth assessment of the relationship between country risk and ESG is highly interesting and is relevant from several perspectives. For the research field, we provide a more complete understanding of the relationship between country risk and sustainable performance. For investors, the results focus on the importance of the consideration of sustainability criteria at the macro-level when assessing risk. It must be pointed out that the process by which we assess country sustainability characteristics leads to the creation of a single rating and corresponding score. Although this is highly useful for empiricists, some suggest that ESG issues (or sustainability) should always be distinguished into those that are related to positive and those that are related to negative social/environmental performance as these are conceptually and practically different and so are their financial outcomes (Chatterji et al., 2009). As prospects for future research, it would also be worthwhile to include more countries, especially developing countries, in the analysis as well as to estimate the model over a much longer time span.

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TABLES

Table 1: ESGGI, GOVI, SODI and ENVI: scores and rank

ESG score	ESGGI		GOVI		SODI		ENVI	
	Score	Rank[a]	Score	Rank	Score	Rank	Score	Rank
Finland	65.20	1	98.63	1	57.89	6	64.89	2
Norway	64.98	2	96.36	6	61.32	1	56.34	4
Sweden	64.95	3	96.90	3	60.82	2	68.24	1
Canada	64.92	4	94.23	8	57.94	5	51.90	5
Netherlands	63.55	5	96.28	7	58.29	3	40.06	13
Denmark	63.47	6	97.86	2	58.14	4	40.19	12
New Zealand	62.93	7	96.86	4	56.95	8	58.09	3
Switzerland	62.67	8	96.63	5	57.44	7	50.36	7
Australia	62.44	9	93.28	9	56.72	13	42.69	11
Germany	61.33	10	91.61	12	55.20	10	45.14	10
Austria	60.60	11	94.11	10	53.82	9	51.39	6
United Kingdom	60.25	12	91.06	13	54.99	11	38.99	15
Belgium	59.01	13	88.94	14	53.22	14	38.60	16
Ireland	58.84	14	92.71	11	51.17	16	32.22	20
Japan	58.70	15	84.24	17	54.80	12	46.80	9
France	57.63	16	86.30	15	52.38	15	48.27	8
Spain	54.17	17	82.45	18	49.81	17	37.97	17
Portugal	53.60	18	84.79	16	47.13	19	39.18	14
Italy	49.29	19	72.35	19	47.90	18	38.05	18
Greece	47.38	20	71.41	20	45.64	20	34.97	19
Mean	59.80		90.35		54.58		45.76	
St. Dev	5.53		8.03		8.96		9.05	

[a] We rank countries from the highest performing respectively to governance, social policy and environmental quality to the lowest performing. The score are averaged over the period 1996-2012.

Table 2: Spearman's rank correlation of the ESG scores

	ESGGI	GOVI	SODI	ENVI
ESGGI	1.00			
GOVI	0.85***	1.00		
SODI	0.71***	0.35***	1.00	
ENPI	0.61***	0.47***	0.46***	1.00

* significant at 10 %, ** significant at 5 %, *** significant at 1 %.

Table 3: Sovereign bond spreads: coefficient estimates, effect of global and separate dimensions of ESG performance

	Sovereign bond spread ($Y_{i,t}$)			
	12 M		10YR	
	(basic)	(extended)	(basic)	(extended)
Y (lagged)	1.126***	1.115***	0.934***	0.952***
	(0.014)	(0.015)	(0.063)	(0.065)
ESGGI (lagged)	-0.109***		-0.163***	
	(0.054)		(0.083)	
ENVI (lagged)		0.018		0.023
		(0.029)		(0.045)
SODI (lagged)		-0.033***		-0.080*
		(0.013)		(0.049)
GOVI (lagged)		-0.096***		-0.083**
		(0.029)		(0.042)
ΔGDP/GDP	-0.089***	-0.082***	-0.162***	-0.152***
	(0.029)	(0.029)	(0.043)	(0.041)
ΔP/P	-0.032	-0.032	-0.100	-0.096
	(0.053)	(0.053)	(0.084)	(0.081)
Debt/GDP	-0.002	-0.000	0.007	0.010
	(0.004)	(0.004)	(0.007)	(0.006)
PB/GDP	0.021	0.019	0.038	0.035
	(0.016)	(0.016)	(0.026)	(0.025)
CA/GDP	-0.028*	-0.034*	-0.045*	-0.041
	(0.016)	(0.018)	(0.028)	(0.028)
(X+M)/GDP	0.005	0.008	0.012	0.010
	(0.007)	(0.007)	(0.012)	(0.012)
Reserves/import	-0.628	-0.443	-0.875	-0.751
	(0.470)	(0.379)	(0.617)	(0.568)
S&P	-0.283***	-0.240***	-0.216***	-0.168**
	(0.053)	(0.057)	(0.088)	(0.093)
Time effects	Yes	Yes	Yes	Yes
Observations	320	320	320	320
R-squared	0.74	0.76	0.67	0.70

Notes: Bootstrap standard errors based on 500 replications are reported in parentheses under the coefficient value:

* significant at 10 %, ** significant at 5 %, *** significant at 1 %.

Table 4: Sovereign bond spreads: coefficient estimates,

Euro-area and Non Euro-area economies

	Sovereign Bond Spreads			
	12M		**10YR**	
	Euro-Area	**Non Euro-Area**	**Euro-Area**	**Non Euro-Area**
Y (lagged)	1.083***	0.802***	1.003***	0.747***
	(0.045)	(0.091)	(0.064)	(0.078)
ESGGI (lagged)	-0.109*	-0.005	-0.166***	-0.086*
	(0.065)	(0.058)	(0.054)	(0.047)
ΔGDP/GDP	-0.110***	0.000	-0.205***	-0.019
	(0.042)	(0.025)	(0.044)	(0.026)
ΔP/P	0.242***	0.058	-0.156	-0.052
	(0.103)	(0.043)	(0.116)	(0.044)
Debt/GDP	0.002	0.003	0.007	0.003
	(0.011)	(0.003)	(0.010)	(0.002)
PB/GDP	0.005	-0.001	0.037	0.001
	(0.036)	(0.017)	(0.030)	(0.016)
CA/GDP	-0.036	-0.023*	-0.020	-0.023*
	(0.042)	(0.013)	(0.036)	(0.013)
(X+M)/GDP	0.001	0.004	0.004	0.012*
	(0.014)	(0.006)	(0.013)	(0.006)
Reserves/import	-0.493***	-0.049	-0.531***	-0.297
	(0.160)	(0.284)	(0.148)	(0.279)
S&P	-0.349***	-0.012	-0.204**	-0.068
	(0.104)	(0.081)	(0.104)	(0.079)
Time effects	Yes	Yes	Yes	Yes
Observations	187	153	187	153
R-squared	0.87	0.93	0.81	0.94

Notes: Bootstrap standard errors based on 500 replications are reported in parentheses under the coefficient value:

* significant at 10 %, ** significant at 5 %, *** significant at 1 %.

Table 5: Sovereign bond spreads: coefficient estimates, accounting for structural change.

	Sovereign Bond Spreads			
	12M		10YR	
Y (lagged)	1.15***	1.12***	0.980***	0.921***
	(0.010)	(0.013)	(0.061)	(0.062)
ESGGI (lagged)	-0.038*		-0.054*	
	(0.023)		(0.032)	
*ESGGI (lagged) * D.2007*	-0.009***	-0.012***	-0.006***	-0.010***
	(0.003)	(0.002)	(0.003)	(0.003)
ΔGDP/GDP	-0.109***	-0.106***	-0.131***	-0.135***
	(0.027)	(0.027)	(0.031)	(0.029)
ΔP/P	-0.000	0.003	-0.026	-0.032
	(0.054)	(0.054)	(0.059)	(0.061)
Debt/GDP	-0.001	-0.002	0.007	0.007
	(0.004)	(0.004)	(0.005)	(0.005)
PB/GDP	0.016	0.026	0.038*	0.043***
	(0.017)	(0.017)	(0.020)	(0.021)
CA/GDP	-0.031*	-0.033*	-0.046***	-0.051***
	(0.018)	(0.018)	(0.021)	(0.021)
(X+M)/GDP	0.003	0.000	0.014*	0.011
	(0.007)	(0.007)	(0.008)	(0.009)
Reserves/import	-1.015***	-1.001***	0.873*	-0.960***
	(0.393)	(0.401)	(0.467)	(0.465)
S&P	-0.290***	-0.327***	-0.257***	-0.283***
	(0.053)	(0.053)	(0.065)	(0.065)
Time effects	Yes	Yes	Yes	Yes
Observations	320	320	320	320
R-squared	0.78	0.88	0.72	0.86

Notes: The dummy variables *D.2007* is equal to one from 2007 onwards, and zero otherwise, was also included as intercept dummies. Bootstrap standard errors based on 500 replications are reported in parentheses under the coefficient value:

* significant at 10 %, ** significant at 5 %, *** significant at 1 %.

Table 6: Sovereign bond spreads: coefficient estimates, robustness checks.

	Sovereign Bond Spreads					
	12M			10YR		
	Baseline	Excluding S&P	Excluding Greece	Baseline	Excluding S&P	Excluding Greece
Y (lagged)	1.126***	1.231***	0.879***	0.934***	1.027***	0.909***
	(0.014)	(0.005)	(0.065)	(0.063)	(0.048)	(0.065)
ESGGI (lagged)	-0.109***	-0.156***	-0.139***	-0.163***	-0.222***	-0.139***
	(0.054)	(0.055)	(0.064)	(0.083)	(0.077)	(0.063)
ΔGDP/GDP	-0.089***	-0.098***	-0.058	-0.162***	-0.175***	-0.052
	(0.029)	(0.030)	(0.038)	(0.043)	(0.040)	(0.037)
ΔP/P	-0.032	-0.020	-0.034	-0.100	-0.107	-0.037
	(0.053)	(0.057)	(0.070)	(0.084)	(0.081)	(0.068)
Debt/GDP	-0.002	0.007***	0.009*	0.007	0.014***	0.008**
	(0.004)	(0.003)	(0.004)	(0.007)	(0.005)	(0.004)
PB/GDP	0.021	0.010	-0.019	0.038	0.028	-0.020
	(0.016)	(0.017)	(0.022)	(0.026)	(0.026)	(0.022)
CA/GDP	-0.028*	-0.017	-0.008	-0.045*	-0.038	-0.009
	(0.017)	(0.018)	(0.023)	(0.028)	(0.026)	(0.022)
(X+M)/GDP	0.005	0.009	0.007	0.012	0.015	0.006
	(0.007)	(0.007)	(0.009)	(0.012)	(0.011)	(0.009)
Reserves/import	-0.628*	-0.373	-0.475	-0.875	-0.818	-0.444
	(0.379)	(0.405)	(0.475)	(0.617)	(0.589)	(0.462)
S&P	-0.283***			-0.216***		
	(0.053)			(0.088)		
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	320	320	303	320	320	303
R-squared	0.74	0.64	0.51	0.67	0.59	0.53

Notes: Bootstrap standard errors based on 500 replications are reported in parentheses under the coefficient value:

* significant at 10 %, ** significant at 5 %, *** significant at 1 %.

Table 7: Probabilities that the linear prediction (LP) method correctly predicts (i) the direction of yearly changes in bond spreads Probabilities

	Sovereign Bond Spreads					
	12M			10YR		
	Forecasting period			Forecasting period		
	2007-2012	**2008-2012**	**2009-2012**	**2007-2012**	**2008-2012**	**2009-2012**
Australia	0.60	0.66	0.66	0.68	0.67	0.66
Austria	0.61	0.66	0.66	0.67	0.66	0.66
Belgium	0.62	0.66	0.66	0.67	0.66	0.66
Canada	0.59	0.66	0.66	0.68	0.67	0.67
Denmark	0.58	0.65	0.65	0.66	0.65	0.65
Finland	0.59	0.66	0.65	0.67	0.66	0.65
France	0.61	0.66	0.66	0.68	0.67	0.66
Germany	0.60	0.65	0.65	0.67	0.66	0.65
Greece	0.74	0.71	0.71	0.73	0.72	0.72
Ireland	0.63	0.66	0.65	0.67	0.66	0.65
Italy	0.62	0.68	0.67	0.69	0.68	0.68
Japan	0.64	0.68	0.67	0.68	0.68	0.68
Netherlands	0.60	0.66	0.65	0.67	0.66	0.66
New Zealand	0.60	0.66	0.66	0.68	0.67	0.67
Norway	0.59	0.66	0.66	0.68	0.67	0.67
Portugal	0.69	0.70	0.71	0.70	0.70	0.71
Spain	0.64	0.68	0.68	0.70	0.69	0.69
Sweden	0.58	0.65	0.65	0.67	0.66	0.66
Switzerland	0.62	0.66	0.66	0.67	0.66	0.66
United Kingdom	0.58	0.65	0.64	0.67	0.66	0.65
Average	0.61	0.67	0.66	0.68	0.67	0.67

Notes: The probabilities are obtained as follows: In each year of the forecasting sample, we assign a value of one if actual and predicted bond spreads change in the same direction (e.g. they both increase or decrease). Otherwise, if actual and predicted spreads change in opposite directions, we assign a value of zero. We then calculate the probability that the LP forecasting method correctly predicts the direction of yearly changes in actual bond spreads.

APPENDIX

A.1: Principal Component analysis

PCA is a multivariate statistical technique that, when applied to a data set, reveals which variables in the set form coherent subsets that are relatively independent of one another. The variables that are highly correlated are combined into components. The components are expected to reveal the underlying processes that have created the correlation among the variables (Tabachnick and Fidell, 2007).

PCA aims to extract the maximum variance from a data set with each component (Tabachnick and Fidell, 2007). "The first principal component is the linear combination of observed variables that maximally separate subjects by maximising the variance of their components scores" (Tabachnick and Fidel, 2007). The second component is computed from the residual correlations. It is the linear combination of observed variables that extracts maximum variability. This variability is uncorrelated to the rst component. The subsequent components also extract maximum variability from the residual correlations and are independent from all the other components (Tabachnick and Fidell, 2007). The extracted components represent most of the variance of the original data set and can be used in further analysis.

In mathematical terms, PCA can be explained as follows: From a set of variables X1, X2 to Xn, the principal components PC1 to PCm are extracted:

$$PC\mathbf{1} = a\mathbf{11}X\mathbf{1} + a\mathbf{12}X\mathbf{2} + \dots a\mathbf{1}nXn \dots$$

$$PCm = am\mathbf{1}X\mathbf{1} + am\mathbf{2}X\mathbf{2} + \cdots amnXn$$

where a_{mn} represents the weight for the m^{th} principal component and the nth variable. The weights of each principal component are given by the eigenvectors of the correlation matrix or the co-variance matrix. The variance ( ) for each principal component is given by the eigenvalue of the corresponding eigenvector.

The PCA conducted in this paper involves several steps:

1. For the factor analysis to yield meaningful results, the variables in the data set have to be related to each other: if the correlations between variables are small, it is unlikely that they share common factors. This paper relies on the Kaiser-Meyer-Olkin (KMO) measure to test the correlation of the basic indicators. The KMO statistic is a ratio of the sum of squared correlations to the sum of squared correlations plus the sum of squared partial correlations

(Tabachnick and Fidell, 2007). The KMO statistic should be at least 0.6 in order to proceed with factor analysis (Kaiser and Rice, 1974).

2. The second step involves factor extraction, i.e. the identification of the number of factors necessary to represent the data and the method for calculating them. Each factor is defined as a set of coefficients (so-called loadings), each measuring the correlation be-tween the individual indicators and the latent factor. Principal component analysis was used to extract the factors. In principal component analysis, linear combinations of the basic indicators are formed as follows: the first principal component is the combination that accounts for the largest amount of variability in the sample. The second principal component accounts for the next largest amount of variance and is uncorrelated with the first. Successive components explain smaller and smaller portions of the sample variance and are all uncorrelated with each other.

3. The third step involves the rotation of factors. Rotation is a standard step in factor analysis. It provides a criterion for eliminating the indeterminacy implicit in factor analysis results. The rotation changes the factor loadings and consequently the interpretation of the factors, but the different factor analytical solutions are mathematically equivalent in that they explain the same portion of the sample variance. Factor rotation was obtained using the varimax method, which attempts to minimise the number of variables that have high loadings (so-called salient loadings) on the same factor. It is a transformation of factorial axes which makes it possible to approximate a "simple structure" of the factors, in which each indicator is "loaded" exclusively on one of the retained factors. This enhances the interpretability of these factors.

4. The final step involves the construction of the weights used to construct the summary indicators. The approach followed in this paper was to weight each detailed indicator according to the proportion of its variance that is explained by the factor it is associated to (i.e. the normalised squared loading), while each factor was weighted according to its contribution to the portion of the explained variance in the dataset (i.e. the normalised sum of squared loadings).

Table A.1.1: ESG analysis dimensions.

Dimensions of ESG included in reports		VIGEO	HBC AM	Natexix AM	MSCI ESG	Neuberger Bermans
Environmental	Air Quality	X	X	X	X	
	Water and Sanitation	X	X	X	X	
	Forests	X	X	X	X	X
	Biodiversity	X				
	Climate and Energy	X	X	X	X	X
Social	Human development	X		X		X
	Demography		X	X		
	Health	X	X	X	X	
	Gender equality	X				
	Technology and R&D	X	X	X		
Governance	Democratic institution	X	X		X	
	Safety policy	X				X

Table A.1.2: Items used to assess ESG performance.

Dimension	Measuring items	Code	*Source*
Environmental			
Air Quality	Air pollution	Air	WDI
Water and sanitation	Waste water treatment	Waste	WDI
Forests	Forest area (% of land area)	Forest	WDI
Biodiversity	Terrestrial protected areas (% of total land area)	Terrest	WDI
Climate and Energy	Renewable electricity output(% of total)	Electricity	WDI
	Renewable energy consumption(% of total)	Energy	WDI
Social			
Human capital	Gross national income per capita growth rate	Gnicapita	WDI
	Human development index	IDH	WDI
Demography	Life expectancy	Life	WDI
Health	Health per capita	Healthepercapita	WDI
Gender equality	Female to male labour force participation rate	Femaletomale	WDI
Technology and R&D	Internet users	Internetusers	WDI
Governance			
Democratic-institution	Control of Corruption	Corruption	WGI
	Rule of Law	rule	WGI
	Voice and Accountability	voice	WGI
Safety policy	Country Effectiveness	E ectiveness	WGI
	Political Stability	Stability	WGI
	Regulatory Quality	Regulatory	WGI

Table A.1.3: Descriptive statistics of ESG data set

Variable	N	Mean	Std Dev	Minimum	Maximum
Air	340	25.02	16.97	1.47	69.00
Water	340	78.91	14.56	30.00	99.00
Forest	340	32.79	18.21	8.23	73.73
Terrest	340	14.53	9.80	0.63	48.03
Electricity	340	30.40	27.24	0.74	99.71
Energy	340	16.35	14.74	0.873	60.18
Gnicapita	340	1.49	2.66	-11.10	9.63
IDH	340	86.68	4.76	71.40	95.50
Lifeexpectancy	340	79.45	1.61	75.26	83.09
Heathpercapita	340	6.80	1.18	4.55	10.09
Femaletomale	340	77.22	9.10	54.32	93.22
Interenetusers	340	50.67	27.87	1.02	94.65
Effectiveness	340	91.33	7.95	62.13	100.00
Stability	340	81.60	15.63	30.14	100.00
Regulatory	340	90.33	7.77	66.17	100.00
Corruption	340	90.97	9.54	51.19	100.00
Rule	340	91.83	8.52	60.28	100.00
Voice	340	92.08	7.07	67.29	100.00
			MSA[a)] = 0.77		

Notes: a) The Kaiser-Meyer-Olkin (KMO) of Sampling Adequacy Overall MSA , the KMO statistic is a ratio of the sum of squared correlations to the sum of squared correlations plus the sum of squared partial correlations. The KMO statistic should be at least 0.6 in order to proceed with factor analysis.

Table A.1.4: Total variance explained by the eigenvalue of the extracted components.

Component	Eigenvalue	Difference	Proportion	Cumulative
1	7.34	4.09	0.41	0.41
2	3.24	1.00	0.18	0.59
3	2.24	0.90	0.12	0.71

Notes: The eigenvalue (variance) for each principal component indicates the percentage of variation explained in the total data set. Using the Kaiser's criterion or the eigenvalue rule components with an eigenvalue of 1.0 or more are extracted.

Lecture: According to these criteria, the indicators are correlated with three main factors, which account for 76 per cent of the total variance.

Table A.1.5: Principal component analysis (PCA) results.

Variables	Component 1	Component 2	Component 3
Air	0.27	0.14	0.84[b]
Water	-0.37	-0.57	0.10
Forest	-0.13	-0.05	0.75
Terrest	-0.06	0.16	0.24
Electricity	0.32	0.15	0.69
Energy	0.34	0.13	0.81
GNIpercapita	0.23	0.85	0.10
IDH	0.18	0.88	0.02
Lifeexpectancy	-0.37	0.78	0.23
Heathpercapita	0.06	0.64	0.19
Femaletomale	0.42	0.42	0.42
Internet users	0.18	0.89	0.17
Effectiveness	0.90	0.16	0.12
Stability	0.72	-0.15	0.22
Regulatory	0.88	0.21	-0.13
Corruption	0.92	0.14	0.12
Rule	0.90	0.13	0.17
Voice	0.90	0.14	0.11
Total variance explained by factors (%)	40.80	18.04	12.46
Eigenvalue	5.75	4.10	2.99

(a) = Based on rotated component matrix

(b) = 0.84 is the factor loading on the Air Quality variable on the third component

Lecture: According to this table, three principal components extract the most of the variance of the original data set and can be used in the analysis. The effectiveness (0.90), political stability (0.72), security and regulatory quality (0.88), corruption (0.92), rule of law (0.90) and Voice and accountability (0.90) have the highest factor loading on the rst component. This component was labelled "governance quality index" (GOVI). This dimension explains the most variance in the data set, 40.80%.

Table A.1.6: The construction of the ESG index.

Variables	Component 1	Component 2	Component 3
Air	0.00	0.00	0.29[b]
Water	0.00	0.00	0.01
Forest	0.00	0.00	0.23
Terrest	0.00	0.00	0.02
Electricity	0.00	0.00	0.19
Energy	0.00	0.00	0.27
Gnicapita	0.00	0.21	0.00
IDH	0.00	0.22	0.00
Lifeexpectancy	0.00	0.17	0.00
Heathpercapita	0.00	0.12	0.00
Femaletomale	0.00	0.05	0.00
Interenetusers	0.00	0.23	0.00
Effectiveness	0.18	0.00	0.00
Stability	0.11	0.00	0.00
Regulatory	0.17	0.00	0.00
Corruption	0.18	0.00	0.00
Rule	0.18	0.00	0.00
Voice	0.18	0.00	0.00
Weight of factors in summary indicator	0.44[c]	0.32	0.24
Eigenvalue	5.78	4.20	3.17
Total variance explained by factors (%)	40.59	20.53	13.88

(a) = Based on rotated component matrix
(b) = Normalised squared factor loadings
(c) = The weighting of the intermediate composite index expressed as the total percentage of explained variance of each component

The approach followed in this paper was to weight each detailed indicator according to the proportion of its variance that is explained by the factor it is associated to (i.e. the normalized squared loading), while each factor was weighted according to its contribution to the portion of the explained variance in the data set (i.e. the normalized sum of squared loading. More precisely, at first, we identify the intermediate composite indexes (which refer to the extracted components). Then, each intermediate composite index is loaded by using the variables with the highest factor on corresponding component. The weighting of each of the variables was derived by squaring the factor loading of the variables. The squared factor loading represented the proportion of the total unit variance of the indicator, which was explained by the component. Specifically, the first component which represent the first composite index: "governance quality index" (GOVI) is computed as follows:
GOVI = 0.18*effectiveness + 0.11*Stability + 0.17*regulatory + 0.18*corruption + 0.18*rule + 0.18*voice.

Once the three intermediate composite indexes had been constructed, they were aggregated by allocating a weight to each one of them equal to the proportion of the explained variance in the data set. For example, the weighting of the first intermediate composite index was 0.44 (44%), calculated as follows: 5.75/(5.75 + 4.10 + 2.99). In the same manner the weights of each intermediate composite index in the total composite index are calculated. Note that the weighting of each consecutive intermediate composite index contributed less to explaining the variance in the data set, decreasing from 40.80% to 12.46%. The ESG global index is then obtained as follows: ESGGI= 0.44*GOVI+ 0.32*SODI + 0.24*ENVI.

Table A.2.1: Description of variables

Variable Name	Code	Description	Source
Dependent variable			
12-month sovereign Spread	Spread(12M)	Spreads are yield on sovereign bonds of the considered country minus yield on US sovereign bonds	Bloomberg
10-year sovereign Spread	Spread(10YR)		
Independent variable			
GDP growth	ΔGDP/GDP	Annual percentages of constant price GDP changes	IMF
Inflation	ΔP/P	Annual percentages of average consumer prices changes	
Fiscal Condition	Debt/GDP	All liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future	IMF
	PB/GDP	Primary net lending/borrowing plus net interest payable /paid	IMF
Current Account	CA/GDP	All transactions other than those in financial and capital Items	IMF
Liquidity ratio	Reserves/ Import	Total reserves comprise holdings of monetary gold special drawing rights, and holdings of foreign exchange under the control of monetary authorities	WB
Trade openness	(X + M)/GDP	The sum of exports and imports of goods and services measured as a share of gross domestic product	WB
S&P sovereign ratings	S&P	Numerical variable assigning 1 to BB, 2 to BB+ and so on through 13 to AAA	Reuters
ESG	L.ESGindex	Our variable of interest	

Table A.2.2: Descriptive Statistics

Variable	N	Mean	Std Dev	Min	Max
Spread(12M)	340	0.17	1.97	-4.28	20.69
Spread(10Y R)	340	0.20	2.09	-4.30	21.67
L.ESGindex	320	68.92	6.73	52.27	83.09
ΔGDP/GDP	340	2.05	2.58	-8.86	10.77
ΔP/P	340	1.98	1.25	-1.70	8.20
Debt/GDP	340	66.82	37.47	9.67	236.75
PB/GDP	340	0.55	4.39	-29.95	15.88
CA/GDP	340	0.93	5.68	-14.46	16.23
Reserves/Import	340	0.21	0.27	0.02	1.64
(X + M)/GDP	340	74.91	33.16	16.75	178.25
S&P	340	11.83	2.05	1	13

Table A.2.3: Pearson Correlation Matrix of independent variables: Sovereign bond spreads

	Variable	1	2	3	4	5	6	7	8	9	10	11
1	Spread*(12*M*)*	1.00										
2	Spread*(10*Y R*)*	0.99***	1.00									
3	L:ESGindex	-0.13***	-0.13***	1.00								
4	ΔGDP/GDP	-0.33***	-0.33***	-0.02	1.00							
5	ΔP/P	0.32***	0.34***	-0.19***	0.14***	1.00						
6	Debt/GDP	-0.00	0.01	-0.41***	-0.29***	-0.23***	1.00					
7	PB/GDP	-0.08	-0.08	0.15***	0.41***	0.24***	-0.35***	1.00				
8	CA/GDP	-0.30***	-0.29***	0.56***	0.03	-0.34***	-0.02	0.38***	1.00			
9	Reserves/Import	-0.29***	-0.27***	0.10***	-0.04	-0.35***	0.40***	-0.08	0.25***	1.00		
10	*(*X + M*)*/GDP	0.02	0.00	0.23***	0.07	0.03	-0.17***	0.12***	0.31***	-0.33***	1.00	
11	S&P ratings	- 0.61***	-0.63***	0.57***	0.24***	-0.20***	-0.50***	0.25***	0.41***	-0.02	0.16***	1.00

***,**,* significant respectively at 1%, 5%, 10%

Figure 1. Heterogoneity accros countries and over time