

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

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The determinants of sovereign bond spreads (SBS)

- Vast literature on the relationships between SBS and macroeconomic performance
- Quantitative factors as the main focus
 - fiscal accounts and fiscal space (Ardagna et al. 2007, Attinasi et al. 2009, Baldacci & Kumar 2010, Aizenman & Hutchinson 2013, Beirne & Fratscher 2012, Ghosh et al. 2013)
 - public deficits signal higher risk (default, monetization driven depreciation, inflation) and increase SBS

The determinants of sovereign bond spreads (SBS)

- Since the global financial crisis, the relationship between SBS and macroeconomic fundamentals has broken down
 - During the euro area debt crisis, a large part of SBS is left unexplained
 - and is higher than what could be justified on the basis of fundamentals
(De Grauwe & Ji 2013, Poghosyan 2012, IMF 2012)
- Renewed interest in the determinants of SBS, in particular 'qualitative factors'

Qualitative factors as potential determinants of SBS

- capture the the 'soft' aspects of a country's ability to adequately service its obligations
 - willingness (vs ability) of a country to pay interest
 - flexibility of an economy and growth capacity
 - transparency of data
 - fiscal credibility and commitment to responsible borrowing
- government reputation and political issues already considered for debt sustainability (Nelson 2013, Papanikos 2014)

Qualitative factors as potential determinants of SBS

- underlying arguments can be categorised in two groups
 - investors' preferences for ESG factors (ethical/moral reasons) (Benabou & Tirole 2010, Kitzmueller & Shimshack 2012)
 - sustainability can enhance financial performance (Bauer et al. 2009, Hoepner et al. 2016, Calvert 2015)
- ESG indicators as extra-guard against losses (reputational wealth , quality of institutions, Icaza 2016)

ESG factors and SBS

- most of the literature focuses on ESG factors and cost of corporate bonds
(Godfrey et al. 2009, Bauer et al. 2009, El Ghouli et al. 2011, Bauer & Hann 2011, Hoepner et al. 2016)
 - lack of reliable data on ESG criteria
 - absence of a clear definition of the methodology applied to assess country ESG performance
- our goal: address the data gap and investigate the relationship between ESG indicators and SBS

Our contribution

- explore the link between overall ESG performance and SBS
- decompose the financial impacts of ESG factors
- disentangle European from other advanced countries
- examine the role of the global financial crisis in the ESG performance-sovereign risk link

Preview of results

- country ESG performance is significantly and negatively related to SBS
- the impact is stronger
 - in the long run
 - in the Eurozone
 - during the crisis period
 - $G > S > E = 0$

ESG and SBS

- environmental performance (EPI, petroleum consumption, CO2 em./capita, GDP/CO2 em.)
(Berg et al. 2016, Gervich 2011)
- social performance (HDI, unemployment)
(Bundala 2013, Hoepner et al. 2016, Maplecroft 2012)
- governance performance (quality of legal institutions, ICRG)
(Erb et al. 1996, Haque et al. 1998, Ciocchini et al. 2003, Buter et al. 2009)

- H1: there is a negative relationship between ESG performance and SBS
- H2: the impact is stronger in the long run (Poghosyan 2012, Lydenberg 2009)
- H3: the impact is stronger for governance factors (Hoepner et al. 2016)
- H4: the impact is stronger in the euro area (Beirne & Fratzscher 2013)
- H5: the impact is stronger after the financial crisis (Ebner 2009, Dailami et al. 2008, Bernoth et al. 2012)

- Dataset: 20 countries from 1996-2012
- Sources:
 - World bank database (WDI, WGI): country ESG index (PCA)
 - Bloomberg database: bond yield spreads
 - World bank and datastream: contro variables (GDP, debt, X, M etc.)

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

SBS

- Definition: SBS= 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).
- 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

- GDP growth rate
- Inflation
- Fiscal conditions: gross country debt and primary balance
- Current account balance
- Liquidity ratio
- Country openness
- Sovereign credit ratings

ESG indicators: PCA

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

Indexes	ESGGI		GOVI		SODI		ENVI	
	Score	Rank	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	

Model specification

We estimate the relationship between ESG indicators and SBS using a standard panel model with country fixed effects based on the following equation (Afonso et al. 2012, Beirne & Frasccher 2013)

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 ESGGI_{i,t-1} + \beta_3 \left(\frac{\Delta GDP}{GDP} \right)_{i,t} + \beta_4 \left(\frac{\Delta P}{P} \right)_{i,t} \\ + \beta_5 \left(\frac{Debt}{GDP} \right)_{i,t} + \beta_6 \left(\frac{Pri.Fis}{GDP} \right)_{i,t} + \beta_7 \left(\frac{D.account}{GDP} \right)_{i,t} + \beta_8 \left(\frac{Res}{Imp} \right)_{i,t} \\ + \beta_9 \left(\frac{X+M}{GDP} \right)_{i,t} + \beta_{10}(SPscale)_{i,t} + \alpha_i + \epsilon_{i,t}$$

Table: Descriptive statistics

Variable	N	Mean	Std Dev	Min	Max
<i>Spread (12M)</i>	340	0.17	1.97	-4.28	20.69
<i>Spread (10YR)</i>	340	0.20	2.09	-4.30	21.67
<i>L.ESGGI</i>	320	68.92	6.73	52.27	83.09
<i>$\Delta GDP/GDP$</i>	340	2.05	2.58	-8.86	10.77
<i>$\Delta P/P$</i>	340	1.98	1.25	-1.70	8.20
<i>G.Debt/GDP</i>	340	66.82	37.47	9.67	236.75
<i>Pri.Fis/GDP</i>	340	0.55	4.39	-29.95	15.88
<i>C.Account/GDP</i>	340	0.93	5.68	-14.46	16.23
<i>Reserves/Import</i>	340	0.21	0.27	0.02	1.64
<i>$(X + M)/GDP$</i>	340	74.91	33.16	16.75	178.25
<i>S&Pratings</i>	340	11.83	2.05	1	13

ESG and SBS

Table: Sovereign Bond Spreads: Coefficient Estimates, effect of global and separate dimensions of ESG performance

	Sovereign Bond Spreads			
	(1)	(2)	(3)	(4)
		12M		10YR
<i>L.Spread</i>	1.126***	1.115***	0.934***	0.952***
<i>L.ESGGI</i>	-0.109***		-0.163***	
<i>L.ENVI</i>		0.018		0.023
<i>L.SODI</i>		-0.033***		-0.080*
<i>L.GOQI</i>		-0.096***		-0.083**
$\Delta GDP / GDP$	-0.089***	-0.082***	-0.162***	-0.152***
$\Delta P / P$	-0.032	-0.032	-0.100	-0.096
<i>G.Debt / GDP</i>	-0.002	-0.000	0.007	0.010
<i>Pri.Fis / GDP</i>	0.021	0.019	0.038	0.035
<i>C.Account / GDP</i>	-0.028*	-0.034*	-0.045*	-0.041
<i>X + M / GDP</i>	0.005	0.008	0.012	0.010
<i>Reserves / import</i>	-0.628	-0.443	-0.875	-0.751
<i>SPscale</i>	-0.283***	-0.240***	-0.216***	-0.168**
Time effects	yes	yes	yes	yes
Observation	320	320	320	320

Table: Sovereign Bond Spreads: Coefficient Estimates, Euro-area and Non Euro-area economies

	Sovereign Bond Spreads			
	12M		10YR	
	(1) Euro-Area	(2) Non Euro-Area	(3) Euro-Area	(4) Non Euro-Area
<i>L.Spread</i>	1.083***	0.802***	1.003***	0.747***
<i>L.ESGGI</i>	-0.109*	-0.005	-0.166***	-0.086*
$\Delta GDP/GDP$	-0.110***	0.000	-0.205***	-0.019
$\Delta P/P$	0.242***	0.058	-0.156	-0.052
<i>G.Debt/GDP</i>	0.002	0.003	0.007	0.003
<i>Pri.Fis/GDP</i>	0.005	-0.001	0.037	0.001
<i>C.Account/GDP</i>	-0.036	-0.023*	-0.020	-0.023*
$X + M/GDP$	0.001	0.004	0.004	0.012*
<i>Reserves/import</i>	-0.493***	-0.049	-0.531***	-0.297
<i>SPscale</i>	-0.349***	-0.012	-0.204**	-0.068
Time effects	yes	yes	yes	yes
Observation	187	153	187	153

Table: Sovereign Bond Spreads: Coefficient Estimates, accounting for crisis

	Sovereign Bond Spreads			
		12M		10YR
	(1)	(2)	(3)	(4)
<i>L.Spread</i>	1.15***	1.12***	0.980***	0.921***
<i>L.ESGGI</i>	-0.038*		-0.054*	
<i>L.ESGGI * D.2007</i>	-0.009***	-0.012***	-0.006***	-0.010***
$\Delta GDP / GDP$	-0.109***	-0.106***	-0.131***	-0.135***
$\Delta P / P$	-0.000	0.003	-0.026	-0.032
<i>G.Debt / GDP</i>	-0.001	-0.002	0.007	0.007
<i>Pri.Fis / GDP</i>	0.016	0.026	0.038*	0.043***
<i>C.Account / GDP</i>	-0.031*	-0.033*	-0.046***	-0.051***
$X + M / GDP$	0.003	0.000	0.014*	0.011
<i>Reserves / import</i>	-1.015***	-1.001***	-0.873*	-0.960***
<i>SPscale</i>	-0.290***	-0.327***	-0.257***	-0.283***
Time effects	yes	yes	yes	yes
Observation	320	320	320	320

Table: Sovereign Bond Spreads: Coefficient Estimates, Robustness Checks

	Sovereign Bond Spreads					
	(1) Baseline	12M (2) Excluding S&P	(3) Excluding Greece	(4) Baseline	10YR (5) Excluding S&P	(6) Excluding Greece
<i>L.Spread</i>	1.126***	1.231***	0.879***	0.934***	1.027***	0.909***
<i>L.ESGGI</i>	-0.109***	-0.156***	-0.139***	-0.163***	-0.222***	-0.139***
$\Delta GDP / GDP$	-0.089***	-0.098***	-0.058	-0.162***	-0.175***	-0.052
$\Delta P / P$	-0.032	-0.020	-0.034	-0.100	-0.107	-0.037
<i>G.Debt / GDP</i>	-0.002	0.007***	0.009*	0.007	0.014***	0.008**
<i>Pri.Fis / GDP</i>	0.021	0.010	-0.019	0.038	0.028	-0.020
<i>C.Account / GDP</i>	-0.028*	-0.017	-0.008	-0.045*	-0.038	-0.009
<i>X + M / GDP</i>	0.005	0.009	0.007	0.012	0.015	0.006
<i>Reserves / import</i>	-0.628*	-0.373	-0.475	-0.875	-0.818	-0.444
<i>SPscale</i>	-0.283***			-0.216***		
Time effects	yes	yes	yes	yes	yes	yes
Observation	320	320	303	320	320	303

- High country ESGGI scores reduces spreads: H1 validated.
- An increase in 10% unit of ESGGI reduces 12M SBS by 11%, and 10YR SBS by 16%: H2 confirmed.
- An increase in 10% unit of GOV reduces 12M SBS by 9.6% and an increase in 10% unit of SOC reduces 12M SBS by 3.3%: H3 validated
- ESGGI has a stronger impact in european countries : H4 confirmed
- An increase in 10% unit of ESGGI*2007 reduces 12M SBS by 9%, and 10YR SBS by 6%: H5 confirmed.

- country ESG performance is significantly and negatively related to SBS
- the impact is stronger for governance, in the long run, in the Eurozone, during the crisis period
- future research: include developing and emerging countries

Table A.1.1: ESG analysis dimensions.

Dimensions of ESG included in reports		VIGEO	HBC AM	Natexis 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	Healthpercapita	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 ctiveness	WGI
	Political Stability	Stability	WGI
	Regulatory Quality	Regulatory	WGI

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 first 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: $ESGGI = 0.44 * GOVI + 0.32 * SODI + 0.24 * ENVI$.