

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

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# Introduction

## 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

# Introduction

## 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'

# Introduction

## 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)

# Introduction

## 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)

# Introduction

## 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

# Introduction

## 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

# Introduction

## Preview of results

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



# Hypotheses

## 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)

# Hypotheses

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

# Data

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

## Data : ESG index with PCA

- 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

## Data : ESG index with PCA

- 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

## Data : ESG index with PCA

- 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

# Data

## 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.

# Data

## Control variables

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



# Data

## ESG indicators and PCA

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

<b>Dimension</b>	<b>Measuring items</b>	<b>Code</b>	<b>Source</b>
<b><i>Environmental</i></b>			
Air Quality	Control Air pollution	Air	WDI
Water and sanitation	Waste water treatment	Waste	WDI
Forests	Forest area (% of land area)	Forest	WDI
Renewable Energy	Combustible renewable and waste (%of total energy)	Combust	WDI
	Renewable electricity output (% of total electricity)	Electricity	WDI
	Renewable energy consumption (% of total energy)	Energy	WDI
<b><i>Social</i></b>			
Human capital	School enrollment secondary (% gross)	Enroll	WDI
Demography	Life expectancy	Life	WDI
Health	Health expenditure, public (% of total health expenditure)	Health	WDI
Gender equality	Ratio of female to male labor force participation rate (%)	Femaletomale	WDI
	Gender Parity Index	GPI	WDI
Employment	Non-Vulnerable employment (% of total employment)	Nonvulnerable	WDI
<b><i>Governance</i></b>			
Democratic-institution	Control of Corruption	Corruption	WGI
	Rule of Law	rule	WGI
	Voice and Accountability	voice	WGI
Safety policy	Country Effectiveness	Effectiveness	WGI
	Political Stability	Stability	WGI
	Regulatory Quality	Regulatory	WGI

**Table A.1.3: Descriptive statistics of ESG data set.**

Variable	Mean	St. dev	Min	Max
Air	74.22	19.43	10.26	98.53
Waste	72.35	20.79	4.00	100.00
Forest	33.63	18.27	0.23	73.70
Combust	70.19	25.86	3.14	100.00
Electricity	27.76	27.59	0.04	99.99
Energy	16.71	15.59	0.61	77.36
Enroll	105.02	15.64	59.40	164.81
Health	71.59	11.84	36.62	92.81
Life	79.94	11.36	37.42	99.41
Nonvulnerable	86.49	9.01	42.82	97.21
Femaletomale	74.89	11.40	30.55	94.06
GPI	1.00	0.04	0.80	1.15
Corruption	83.61	15.23	23.90	100.00
Rule	84.60	15.01	24.88	100.48
Voice	84.92	13.79	23.56	100.96
Effectiveness	86.04	11.21	45.85	100.49
Stability	72.56	22.59	7.11	100.00
Regulatory	86.33	10.31	54.90	101.47

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	8.39	5.71	0.47	0.47
2	2.69	1.36	0.15	0.62
3	1.33	0.33	0.08	0.70

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 70 per cent of the total variance.

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

Variables	Component1	Component2	Component3
Air	-0.01	0.45	<b>0.71</b>
Waste	-0.67	-0.25	<b>0.24</b>
Forest	0.15	0.31	<b>0.35</b>
Combust	0.17	-0.21	<b>0.70</b>
Electricity	0.14	0.02	<b>0.93</b>
Energy	0.00	0.23	<b>0.90</b>
Enroll	0.49	<b>0.48</b>	-0.03
Life	0.38	<b>0.80</b>	0.24
Health	0.25	<b>0.47</b>	0.09
Femaletomale	0.39	<b>0.81</b>	0.23
GPI	0.17	<b>0.59</b>	-0.05
nonvulnerable	0.51	<b>0.67</b>	0.07
Corruption	<b>0.90</b>	0.24	0.17
Rule	<b>0.91</b>	0.26	0.18
Voice	<b>0.83</b>	0.40	0.19
Effectiveness	<b>0.90</b>	0.27	0.17
Stability	<b>0.60</b>	0.30	0.33
Regulatory	<b>0.86</b>	0.28	0.10
Total variance explained by factors (%)	46.69	14.93	7.86
Eigenvalue	8.38	2.69	1.33

<sup>(a)</sup> = Based on rotated component matrix

<sup>(b)</sup> = 0.71 is the factor loading on the Air Quality variable on the third component

Three principal components extract most of the variance from the original dataset. The control corruption (0.90), rule of law (0.91), voice (0.83), effectiveness (0.90), political stability (0.60) and security and regulatory quality (0.86) have the highest factor loading on the first component. This component is labelled "governance quality Index" (GOVI). This GOVI dimension explains the most the variance from the dataset: 46.69%. In the second component, enrollsec (0.48) health (0.47), life (0.80), non vulnerable (0.67), female to male labour participation (0.81) and gpisecprim (0.59) loaded the highest on the component (which is component was labelled "Social Development Index"-SODI). This SODI dimension explains 14.93%of the total variance. Finally, air quality (0.71), water (0.24), forest (0.35), combust (0.70), electricity (0.90) and energy (0.93) were the variables with the highest factor loading on the third component (labelled as "Environmental Quality Index"-ENVI). This component is related to the environmental indicators. It explained 7.86% of the total variance.

**Table A.1.6: The construction of the ESG index<sup>a</sup>.**

Variables	Component1	Component2	Component3
Air	0.00	0.00	<b>0.17<sup>b</sup></b>
Waste	0.00	0.00	<b>0.02</b>
Forest	0.00	0.00	<b>0.04</b>
Combust	0.00	0.00	<b>0.17</b>
Electricity	0.00	0.00	<b>0.30</b>
Energy	0.00	0.00	<b>0.30</b>
Enroll	0.00	<b>0.09</b>	0.00
Life	0.00	<b>0.08</b>	0.00
Health	0.00	<b>0.25</b>	0.00
Femaletomale	0.00	<b>0.18</b>	0.00
GPI	0.00	<b>0.27</b>	0.00
nonvulnerable	0.00	<b>0.13</b>	0.00
Corruption	<b>0.19</b>	0.00	0.00
Rule	<b>0.20</b>	0.00	0.00
Voice	<b>0.16</b>	0.00	0.00
Effectiveness	<b>0.19</b>	0.00	0.00
Stability	<b>0.08</b>	0.00	0.00
Regulatory	<b>0.18</b>	0.00	0.00
Total variance explained by factors (%)	0.45 <sup>c</sup>	0.30	0.25
Eigenvalue	5.65	3.52	3.27
Total variance explained by factors (%)	46.69	14.93	7.86

<sup>(a)</sup>=Based on rotated component matrix

<sup>(b)</sup>=Normalised squared factor loadings

<sup>(c)</sup>=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:  $GOVI = 0.19 \cdot \text{corruption} + 0.20 \cdot \text{rule} + 0.16 \cdot \text{voice} + 0.19 \cdot \text{effectiveness} + 0.08 \cdot \text{stability} + 0.18 \cdot \text{regulatory}$ . 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 0.45 (45%), calculated as follows:  $5.65 / (5.65 + 3.52 + 3.27)$ . 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 46.69% to 7.86%. The ESG global index is then obtained as follows:  $ESGGI = 0.45 \cdot GOVI + 0.30 \cdot SODI + 0.25 \cdot ENVI$ .

## Descriptive statistics

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

Indexes	ESGGI		GOVI		SODI		ENVI	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Norway	87.95	1	96.31	6	82.53	1	76.57	1
New Zealand	82.95	2	97.20	3	76.40	6	60.36	2
Sweden	82.13	3	96.89	4	81.95	2	54.66	5
Finland	79.95	4	98.58	1	79.32	4	45.12	8
Canada	79.71	5	94.46	8	76.30	7	55.09	4
Austria	79.61	6	94.101	9	72.45	13	60.36	2
Switzerland	78.20	7	96.45	5	71.56	15	50.02	6
Denmark	77.55	8	97.78	2	80.65	3	37.63	11
Netherlands	74.31	9	96.31	6	75.67	9	43.43	9
Australia	71.78	10	93.61	10	76.44	5	27.74	19
Japan	71.27	11	84.41	16	71.61	14	46.59	7
United Kingdom	71.17	12	91.57	11	74.50	10	30.97	18
Germany	71.00	13	91.50	12	73.42	12	33.61	14
France	70.50	14	86.69	14	76.29	8	34.66	13
Belgium	70.04	15	88.90	13	73.71	11	32.06	16
Portugal	67.26	16	85.28	165	66.72	18	35.31	12
Spain	67.77	17	82.41	18	69.03	17	39.48	10
Italy	61.65	18	71.90	19	62.75	19	31.09	17
Ireland	60.91	19	82.64	17	70.64	16	32.84	15
Greece	58.19	20	70.93	20	61.15	20	30.06	20
Mean (st.d)	73.63 (7.18)		90.38 (8.13)		73.63 (6.11)		42.96 (13.06)	

# Methodology

## 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 & Frascher 2013)

$$\begin{aligned}
 Y_{i,t} = & \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 ESG_{i,t-1} + \beta_3 \left( \frac{\Delta GDP}{GDP} \right)_{i,t} + \beta_4 \left( \frac{\Delta P}{P} \right)_{i,t} \\
 & + \beta_5 \left( \frac{Debt}{GDP} \right)_{i,t} + \beta_6 \left( \frac{P.B}{GDP} \right)_{i,t} + \beta_7 \left( \frac{C.account}{GDP} \right)_{i,t} + \beta_8 \left( \frac{Res}{Imp} \right)_{i,t} \\
 & + \beta_9 \left( \frac{X+M}{GDP} \right)_{i,t} + \beta_{10}(SPscale)_{i,t} + \alpha_i + \epsilon_{i,t}
 \end{aligned}$$

## Distribution of Model Variables

**Table:** Descriptive statistics

<b>Variable</b>	<b>N</b>	<b>Mean</b>	<b>Std Dev</b>	<b>Min</b>	<b>Max</b>
<i>ESG</i>	380	73.63	7.18	56.28	89.23
<i>Spread (10YR)</i>	380	0.20	2.06	-4.30	21.59
$\Delta GDP / GDP$	380	1.98	2.54	-9.13	10.83
$\Delta P / P$	380	1.83	1.26	-2.53	6.95
<i>Debt / GDP</i>	380	68.79	40.00	9.67	242.11
<i>P.B / GDP</i>	380	0.40	4.22	-29.81	15.88
<i>C.account / GDP</i>	380	0.95	5.62	-15.18	16.23
<i>Reserves / Import</i>	380	0.26	0.86	0.04	1.67
$(X + M) / GDP$	380	77.25	35.59	18.34	209.65
<i>S&amp;Pratings</i>	380	12.67	2.335	1	14



# Results

## ESG and SBS: TABLES

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

Sovereign bond spread ( $Y_{i,t}$ )		
10YR		
	Basic	Extended
$Y$ (lagged)	0.560*** (0.049)	0.558*** (0.049)
$ESGGI$ (lagged)	-0.153*** (0.072)	
$GOVI$ (lagged)		-0.074*** (0.033)
$SODI$ (lagged)		-0.049*** (0.024)
$ENVI$ (lagged)		-0.030 (0.040)
$\Delta GDP/GDP$	0.040 (0.037)	0.052 (0.038)
$\Delta P/P$	-0.062 (0.063)	-0.056 (0.063)
$Debt/GDP$	0.005 (0.004)	0.007* (0.004)
$PB/GDP$	0.029 (0.026)	0.033 (0.025)
$CA/GDP$	-0.046* (0.023)	-0.054*** (0.025)
$(X+M)/GDP$	-0.011 (0.009)	-0.010 (0.009)
$Reserves/import$	-0.570 (0.460)	-0.666 (0.471)
$S\&P$	-0.336*** (0.056)	-0.382*** (0.065)
Time effects	Yes	Yes
Observations	360	360
R-squared	0.70	0.43

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 spread ( $Y_{i,t}$ )	
	10YR	
	EURO	NON-EURO
<i>Y (lagged)</i>	0.552*** (0.071)	0.877*** (0.067)
<i>ESGGI(lagged)</i>	-0.212* (0.124)	-0.122*** (0.037)
<i>ΔGDP/GDP</i>	0.053 (0.051)	0.021 (0.031)
<i>ΔP/P</i>	-0.169* (0.100)	0.037 (0.036)
<i>Debt/GDP</i>	0.001 (0.007)	-0.000 (0.003)
<i>PB/GDP</i>	0.004 (0.042)	0.030 (0.016)
<i>CA/GDP</i>	-0.069* (0.042)	-0.020 (0.014)
<i>(X+M)/GDP</i>	-0.011 (0.019)	0.006 (0.005)
<i>Reserves/import</i>	-0.508 (0.180)	-0.264 (0.210)
<i>S&amp;P</i>	-0.334*** (0.084)	-0.011 (0.062)
Time effects	Yes	Yes
Observations	198	162
R-squared	0.72	0.92

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 Crisis.**

	Sovereign bond spread ( $Y_{i,t}$ )	
	10YR	
	1996-2006	2007-2014
<i>Y (lagged)</i>	0.624*** (0.039)	0.521*** (0.099)
<i>ESGGI(lagged)</i>	-0.037 (0.026)	-0.516*** (0.277)
$\Delta GDP/GDP$	0.035* (0.019)	-0.038 (0.095)
$\Delta P/P$	0.022 (0.024)	-0.323* (0.168)
<i>Debt/GDP</i>	0.005* (0.003)	-0.015 (0.015)
<i>PB/GDP</i>	-0.004 (0.013)	0.023 (0.068)
<i>CA/GDP</i>	-0.006 (0.010)	-0.030 (0.077)
$(X+M)/GDP$	-0.004 (0.004)	-0.056* (0.031)
<i>Reserves/import</i>	0.074 (0.211)	-0.100 (1.486)
<i>S&amp;P</i>	-0.048 (0.046)	-0.420*** (0.122)
Time effects	Yes	Yes
Observations	200	160
R-squared	0.70	0.60

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 6: Sovereign bond spreads:  
coefficient estimates, robustness checks**

Sovereign bond spread ( $Y_{i,t}$ )			
10YR			
	Basic	Excluding Greece	Excluding S&P
<i>Y (lagged)</i>	0.560*** (0.049)	0.584*** (0.053)	0.786*** (0.048)
<i>ESGGI(lagged)</i>	-0.153*** (0.072)	-0.113*** (0.041)	-0.207*** (0.075)
<i>ΔGDP/GDP</i>	0.040 (0.037)	0.001 (0.022)	0.065* (0.038)
<i>ΔP/P</i>	-0.062 (0.063)	-0.017 (0.037)	-0.012* (0.067)
<i>Debt/GDP</i>	0.005 (0.004)	-0.006*** (0.003)	0.002 (0.004)
<i>PB/GDP</i>	0.029 (0.026)	0.028*** (0.014)	0.040 (0.028)
<i>CA/GDP</i>	-0.046* (0.023)	-0.011 (0.015)	-0.029 (0.025)
<i>(X+M)/GDP</i>	-0.011 (0.009)	-0.001 (0.006)	-0.001 (0.010)
<i>Reserves/import</i>	-0.570 (0.460)	-0.280 (0.278)	-0.760*** (0.503)
<i>S&amp;P</i>	-0.336*** (0.056)	-0.161*** (0.035)	
Time effects	Yes	Yes	Yes
Observations	360	324	360
R-squared	0.70	0.75	0.67

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 %.

## Summary of results

- High country ESGGI scores reduces spreads: an increase in 10% unit of ESG reduces 10YR SBS by 16%: H1 confirmed.
- An increase in 10% unit of GOV reduces 10YR SBS by 7.4% and an increase in 10% unit of SOC reduces 10YR SBS by 4.9%: H2 validated
- ESG has a stronger impact in european countries (coeff 0.212 euro vs 0.122 non euro) : H3 confirmed
- ESG has a stronger impact after the financial crisis (coeff 0.624 pre vs 0.521 post crisis) : H34 validated

## Conclusion and future research

- country ESG performance is significantly and negatively related to SBS
- the impact is stronger for governance, in the Eurozone, and after the crisis period
- future research: include developing and emerging countries, distinguish good/bad ESG performance