# 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 Ghoul 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 long run
  - in the Eurozone
  - during the crisis period
  - G>S>E=0

# Hypotheses

## ESG and SBS

- environmental performance (EPI, petroleum conusmption, 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)

# Hyptoheses

- 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)

# Data

- 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.)

# Data

- 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

- 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

- 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: PCA

See Tables A.1.. and 1 &2

# Methodology

## Model specification

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

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

# Results

## ESG and SBS

See Tables 3, 4 and 5

# Results

- 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.

# Conclusion and future research

- 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 | 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.1.5: 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.

**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.