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Sovereign Bonds and Socially Responsible Investment

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Abstract

While the literature on Socially Responsible Investment (SRI) is mainly focused on the stock market, little attention has been paid to SRI in sovereign bonds. This paper investigates the effect of taking into account socially responsible indicators for countries, the Vigeo Sustainability Ratings (VSR), on the efficient frontier formed with the sovereign bonds of twenty developed countries. It shows that it is possible to increase the portfolios' VSR rating without significantly harming the risk/return relationship. The analysis then focuses on specific ratings relating to a) the environment, b) social concerns, and c) public governance. The results suggest that socially responsible portfolios of sovereign bonds can be built without a significant diversification cost.

Keywords: Socially Responsible Investment, Sovereign Bonds, Portfolio Selection, Rating, Spanning Tests, Mean-variance efficiency, Portfolio Choice.

JEL: G11, G15

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1. Introduction

Research on Socially Responsible Investment (SRI) focuses on the stock market mainly. Little attention has been paid to the link between sovereign bonds returns and the performances of countries in terms of Environmental, Social and Governance (ESG) issues. However, there is a crucial need to investigate the link between financial performances of sovereign bonds and extra-financial SRI factors. Indeed, many asset managers have declared adhering to the Principles for Responsible Investment (PRI)[1] and therefore should "incorporate ESG issues into investment analysis and decision-making process". According to the PRI, managers of SRI funds specialized in sovereign bonds should integrate ESG performances of countries into their portfolio process.

SRI is defined by the European Social Investment Forum (2008) as "a generic term covering ethical investments, responsible investments, sustainable investments, and any other investment process that combines investors' financial objectives with their concerns about environmental, social and governance (ESG) issues". In practice, SRI has taken place in various forms (European Social Investment Forum, 2008): negative screening, positive screening, shareholders' activism. In negative screening investors exclude certain companies from their investment universe because of their involvement in activities[2] that do not fit into the investor's ethics. Positive screening consists in overweighting companies within industries fulfilling ESG criteria. Recently, SRI concerns have considerably grown and have been transposed by asset managers (United Kingdom Social Investment Forum, 2006) to the sovereign bonds portfolio management.

This being said, there is still an ongoing debate about the financial characteristics of SRI. Do SRI significantly differ from conventional investments? Do investors pay an additional price for SRI? Bauer *et al.* (2005) find that ethical funds do not under-perform relative to conventional funds while Renneboog *et al.* (2008) show that SRI funds strongly under-perform their domestic benchmarks. In summary, these studies lead to mixed results, leaving the basic question unsolved.

[1] PRI is a joint initiative of the United Nations Environment Programme Finance Initiative (UNEPFI) and the United Nations Global Compact (2005). According to the PRI, investors "will incorporate ESG issues into investment analysis and decision-making process", "support development of ESG-related tools, metrics and analyses", and "encourage academic and other research on this theme".

[2] The most frequent negative criteria are: involvement in alcohol, animal testing, armaments, gambling, nuclear power, pornography, tobacco.

Other papers investigate whether stocks of companies well-rated in terms of ESG issues perform better than companies with a worse record. Derwall *et al.* (2005) link stock returns to environmental performances based on scores produced by Innovest Strategic Value Advisors[3], an extra-financial rating agency. They show that companies with good environmental performances have significantly higher returns. Kempf and Osthoff (2007) and Statman and Glushkov (2008) extend this analysis to social concerns and to more global socially responsible indicators, using the KLD Research & Analytics, Inc.[4] ratings. They find that socially responsible portfolios obtain significantly higher returns than conventional portfolios. However, to our best knowledge, this type of analysis has not been applied yet to sovereign bonds portfolios.

Few papers explore the link between sovereign bonds returns and qualitative factors. Erb *et al.* (1996) exhibit a link between sovereign bond returns and country risk measured according to the International Country Risk Guide (ICRG)[5]. Portfolios invested in highly ICRG graded countries perform significantly better. Unfortunately, the study by Erb *et al.* (1996) suffers from a lack of data for several countries, due to heterogeneous starting dates of the ICRG ratings, making it impossible to draw firm conclusion. Connolly (2007) puts forward a link between sovereign bond ratings and the corruption index measured by the *Transparency International's Corruption Perceptions Index*[6]. These two studies while limited to governance characteristics testify to the interest of investigating SRI issues on the sovereign bond market.

For several years now, extra-financial agencies, initially specialised in the ratings of companies, produce country ratings according to the ESG factors. These ratings are used by practitioners to build SRI strategies for sovereign bonds portfolio management. However, no academic research has assessed yet the SRI and financial characteristics of sovereign bonds investments. Our paper aims at filling this gap. In order to do so, we consider the

[3] Innovest Strategic Value Advisors is an extra-financial rating agency. Among other things, it evaluates companies' environmental performances along 60 variables and gives them a score between 1 and 10.
[4] KLD Research & Analytics, Inc. is an extra-financial rating agency. It rates companies on different themes: corporate governance, community, diversity, employee relations, environment, human rights, products.
[5] The ICRG rating is published by the PRS Group. It rates more than 140 countries and comprises 22 variables in three subcategories of risk: political, financial and economic.
[6] Transparency International is an international non-governmental organization addressing corruption. Each year, it publishes the Corruption Perceptions Index that uses different surveys to evaluate perceptions of the degree of corruption in 180 countries.

Sustainability Country Ratings, produced by Vigeo[7], which are indexes meant to represent the countries' socially responsible performances and we investigate the impact of taking it into account into a portfolio process.

This paper bridges two blocks of portfolio management research: those about the SRI and those about sovereign bonds diversification within the group of developed countries. The benefits of diversification in the government bonds market is discussed, for example, by Levy and Lerman (1988) who find very high correlations between developed countries government bonds returns, with the notable exception of Japan. Hunter and Simon (2004) show that the diversification benefits to US investors from investing in international government bonds are significant on a currency-hedged basis, even during periods of weakness of the markets. Though, Hanson *et al.* (2008) bring new evidence contradicting these observations, both papers share the spanning test methodology proposed by DeRoon and Nijman (2001).

In this paper, we first compute the efficient frontier made of portfolios including sovereign bonds from twenty developed countries[8] over the period 1995-2008. We then add constraints on portfolio's VSR by imposing successively growing minimum thresholds and observe the efficient frontier deformations due to these increasing constraints. In theory, the stronger the constraint, the weaker the diversification potential becomes. However, in practice, the mean-variance efficiency loss might be insignificant. In order to test whether SRI leads to significant losses we use the test proposed by Basak *et al.* (2002). The results show that high standard sovereign bonds portfolios are reachable without any significant loss of diversification. It thus brings good news to socially responsible bond market investors.

Our contribution is twofold. First, this paper opens the way to analysing sovereign bonds market in the SRI framework. Second, it explore an original dataset as, to our knowledge, the Vigeo Sustainability Rating (VSR) is used for the first time in a financial perspective.

The rest of the paper is organised as follows. Section 2 presents the data and describes the VSR construction. In Section 3, we present the methodology used to determine the impact

[7] Vigeo is an extra-financial agency that evaluates the ESG performances of companies and countries.
[8] The same sample as Erb et al. (1996), that is to say : Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.

of successive VSR constraints on the bond efficient frontier. The results are exposed in Section 4. Section 5 concludes.

2. Data

The data on sovereign bonds monthly returns come from Datastream World Government Bond Index (WGBI) "All maturities"[9] from Citigroup[10], from the 31st December 1994 to the 31st December 2008. We use total returns in US dollars hedged for exchange rate risk.

The VSR data were taken at the end of 2008. The rating system is based on universally opposable criteria of social responsibility. Vigeo selected criteria approved by the international community including: the Millenium Development Goals[11], the Agenda 21[12], the International Labour Organisation (ILO) conventions, the United Nations Charters and Treaties, the OECD Guiding Principles.

For transparency reasons, Vigeo only gathers official data from international institutions and non-governmental organisations: the World Bank, the United Nations Development Program, the United Nations Environment Program, the United Nations Office on Drugs and Crime, the United Nations Children's Emergency Fund, the Food and Agriculture Organization, the United Nations Conference on Trade and Development, the United Nations Department for Disarmament Affairs, the International Labour Institute, the Organisation for Economic Co-operation and Development, the Office of the High Commissioner for Human Rights, Coface, Amnesty International, Transparency International, Freedom House and Reporters Without Borders.

Three separate ratings are available as well as a composite index. The specific indexes are concerned, respectively, with Environmental Responsibility Rating (ERR), Social

[9] We use the "All Maturities" indexes rather than comparable maturity indexes because there was no common maturity with sufficiently long series of observations.
[10] Formerly from Salomon Brothers
[11] These eight goals were established in 2000 by 189 countries as targets to be achieved by 2015.
[12] The Agenda 21 on sustainable development was adopted by 179 countries in 1992 at the UN Earth Summit in Rio de Janeiro.

Responsibility and Solidarity Rating (SRSR), and the Institutional Responsibility Rating (IRR) and correspond to the three SRI classical dimensions (see Appendix 1 for a comprehensive list). For each rating, Vigeo has selected several criteria representing either commitments or quantitative realisations. For each criterion, the countries are rated on a scale ranging from 0 to 100 (being the best grade).

For the commitment criteria, i.e. the signature and ratification of treaties and conventions, the grade is: 0 if the country did not sign, 50 if the country signed but did not ratify, and 100 if the country signed and ratified. For the quantitative criteria, a score is computed following the decile method: the 10 percent of worst-performing countries obtain a score of 10, and so on. Vigeo ranks not only levels but also trends computed as variation rates between the first and the last available value. More precisely, if a country's trend lies in the top 20 percent, then the country benefits from a premium of ten points for the criterion at stake; if the country exhibits a negative trend, then it gets ten-point penalty.

The three specific ratings (ERR, SRSR, IRR) are weighted averages of scores. The VSR global index is an equally-weighted average of these three ratings. The advantage to use these Vigeo ratings comes from the large spectrum of criteria taken into account. The main drawback is that, contrary to credit ratings, no historical data are available making it impossible to run any dynamic analysis.

3. Methodology

Our purpose is to determine to which extent constraints on country ratings lead to a loss of diversification in sovereign bonds portfolios. To do so, we first introduce the rating of a portfolio as a function of its components.

Consider a financial market including n sovereign bonds, each from a different country ($i = 1, \ldots, n$). Country i is associated to its rating value, denoted $rating_i$. A portfolio is characterised by its composition $w_i, i = 1, \ldots, n$, where[13] $\sum_i w_i = 1$ $w_i \geq 0$ and consequently by the weighted average rating of the corresponding countries:

[13] As most investors in sovereign bonds are long-only, we exclude short positions.

$$Portfolio\ rating = \sum_i w_i\ rating_i\ .$$

The same computation applies for all indexes at stake (specific ratings EER, SRSR, IRR, or global index, VSR).

The portfolio ratings are thus directly linked to its shares in well-rated countries. Opting for SRI highly rated portfolio restricts the set of possible combinations of sovereign bonds. In order to measure the strength of such constraint, we will use the test proposed by Basak, Jagannathan and Sun (2002), referred to as the BJS test.

The BJS test is meant for testing the mean-variance efficiency of a given benchmark portfolio. It is based on an efficiency measure λ defined as the difference between the variance of the efficient portfolio that has the same expected return as the benchmark and the variance of the benchmark. Under the null, the benchmark is mean-variance efficient and $\lambda = 0$. BJS (2002) derive the asymptotic distribution that the sample measure of efficiency λ_T :

$$\sqrt{T}(\lambda_T - \lambda) \to N(0, \sigma^2)$$

where σ^2 is the variance of the efficiency measure and T is the sample size.

Ehling & Ramos (2006) have implemented the BJS test for comparing the efficient frontiers resulting from geographic diversification versus industry diversification for the European stock market. In order to compare the two curves, they use one of them as the reference efficient frontier and take points of the other one as benchmarks. Actually, these authors did consider only two benchmarks, namely the minimum variance portfolio and the tangency portfolio. We follow the same procedure here.

The WGBI index returns hedged for FX variations are used as proxies for the sovereign bonds returns. At each date, the reference efficient frontier is built from portfolios that are fully invested in the twenty WGBI indexes, excluding short sales. Next, we add a constraint of the type "portfolio rating superior to a given threshold" and compute the corresponding constrained frontier. We successively consider increasing thresholds, starting

from the lowest rating[14]. For each of these constraints frontiers, we run the BJS test for the two portfolios suggested by Ehling & Ramos (2006). In this way, we sequentially obtain the rating thresholds leading to the rejection of the null hypothesis of mean-variance efficiency at the respective probability levels of 10%, 5%, and 1%.

4. Empirical results

4.1. Descriptive statistics of the WGBI indexes

Table 1 reports the descriptive statistics of the WGBI indexes in US dollars hedged for FX variations for the period January 1995-December 2008 for the twenty countries under study.

Table 1 Descriptive statistics of the WGBI indexes in US dollars hedged for FX variations, period January 1995-December 2008

	Ann. Mean	Ann. Std. Dev.	Max.	Min.	Skewness	Kurtosis
AUS	6.67%	4.38%	4.84%	-2.11%	0.50	3.39
AUT	7.09%	3.47%	4.61%	-2.05%	-0.03	3.74
BEL	7.53%	3.48%	3.50%	-1.76%	-0.16	2.92
CAN	8.16%	4.35%	4.45%	-2.15%	0.43	3.59
DNK	7.45%	3.44%	4.33%	-1.46%	0.07	3.42
FIN	7.68%	3.37%	3.62%	-1.69%	-0.05	3.08
FRA	7.47%	3.59%	4.28%	-1.75%	-0.01	3.05
DEU	7.20%	3.35%	3.83%	-1.60%	-0.14	3.00
IRL	7.32%	4.27%	4.97%	-2.03%	0.21	3.46
ITA	7.29%	3.72%	3.72%	-1.78%	0.07	2.83
JPN	7.39%	3.50%	4.80%	-4.65%	-0.18	8.97
NLD	7.42%	3.51%	4.40%	-2.00%	-0.02	3.48
NZL	5.07%	3.84%	4.54%	-2.84%	0.55	4.46
NOR	6.06%	3.61%	3.84%	-3.03%	0.03	4.01
PRT	7.48%	3.36%	3.97%	-1.86%	-0.05	3.28
ESP	7.70%	3.63%	4.04%	-1.66%	0.14	3.23
SWE	8.11%	3.91%	3.81%	-2.27%	0.03	3.10
CHE	7.46%	3.48%	3.19%	-1.68%	-0.11	2.72
GBR	6.64%	4.77%	5.10%	-2.56%	0.11	3.20
USA	7.21%	4.65%	5.41%	-4.38%	-0.15	4.48

AUS stands for Australia, AUT Austria, BEL Belgium, CAN Canada, DNK Denmark, FIN Finland, FRA France, DEU Germany, IRL Ireland, ITA Italy, JPN Japan, NLD Netherlands, NZL New Zealand, NOR Norway, PRT Portugal, ESP Spain, CHE Switzerland, GBR United Kingdom, USA United States.

Table 1 shows that the WGBI indexes offer similar annualized returns and volatilities for the period January 1995 - December 2008. We notice that the distribution of the returns is

[14] The lowest threshold corresponds to the reference efficient frontier.

close to those of a normal distribution: the skewness is close to 0 (except for the Australian and New Zealander indexes with a skewness superior to 0.5) and that the kurtosis is close to 3 (except for Japan with a kurtosis of 8.97). In addition, the descriptive statistics of the returns are very close for the Eurozone[15] countries, due to common monetary policy. For the European countries, the annualised volatility of the WGBI indexes is very low, around 3.5%/year. The annualized volatility of the US and UK WGBI indexes is much higher than those of the other indexes. This has to be related to maximal monthly gains that are the highest for these two countries and should be interpreted as a particularly strong fly-to-quality phenomenon.

Table 2 Correlation matrix of the monthly returns of the WGBI indexes in US dollars hedged for FX variations, period January 1995-December 2008

	AUS	AUT	BEL	CAN	DNK	FIN	FRA	DEU	IRL	ITA	JPN	NLD	NZL	NOR	PRT	ESP	SWE	CHE	GBR	USA
AUS	1.00	0.65	0.66	0.75	0.66	0.66	0.63	0.66	0.62	0.58	0.36	0.65	0.73	0.59	0.63	0.61	0.65	0.53	0.65	0.68
AUT		1.00	0.97	0.62	0.90	0.91	0.96	0.97	0.91	0.85	0.28	0.97	0.59	0.72	0.91	0.88	0.79	0.74	0.77	0.74
BEL			1.00	0.64	0.91	0.93	0.97	0.98	0.92	0.87	0.31	0.98	0.58	0.71	0.91	0.90	0.82	0.72	0.79	0.74
CAN				1.00	0.65	0.65	0.63	0.63	0.60	0.57	0.29	0.63	0.64	0.55	0.60	0.60	0.58	0.47	0.65	0.78
DNK					1.00	0.90	0.91	0.90	0.87	0.84	0.22	0.91	0.56	0.73	0.86	0.86	0.86	0.71	0.80	0.72
FIN						1.00	0.90	0.91	0.89	0.82	0.28	0.93	0.54	0.72	0.87	0.87	0.83	0.70	0.75	0.69
FRA							1.00	0.97	0.91	0.87	0.22	0.97	0.56	0.69	0.91	0.90	0.81	0.71	0.80	0.75
DEU								1.00	0.89	0.83	0.30	0.99	0.59	0.71	0.89	0.88	0.80	0.73	0.81	0.76
IRL									1.00	0.90	0.17	0.92	0.51	0.71	0.90	0.91	0.80	0.68	0.77	0.70
ITA										1.00	0.12	0.84	0.48	0.65	0.92	0.94	0.78	0.60	0.73	0.66
JPN											1.00	0.30	0.32	0.22	0.16	0.13	0.19	0.24	0.19	0.28
NLD												1.00	0.59	0.71	0.89	0.88	0.80	0.72	0.81	0.75
NZL													1.00	0.49	0.53	0.49	0.51	0.52	0.57	0.67
NOR														1.00	0.68	0.68	0.69	0.56	0.62	0.52
PRT															1.00	0.97	0.81	0.67	0.74	0.69
ESP																1.00	0.83	0.66	0.76	0.68
SWE																	1.00	0.62	0.71	0.60
CHE																		1.00	0.58	0.56
GBR																			1.00	0.71
USA																				1.00

Table 2 reports the correlation matrix of the monthly returns. All correlation pairs are positive. We notice that correlations are higher between geographically or culturally close countries. We roughly distinguish three zones: European countries, Dollar Zone[16] countries and Japan. For example, the correlations are very high within the ten countries of the Eurozone.

[15] Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal and Spain belong to the Eurozone since the 1st of January 1999.
[16] That is to say: Australia, Canada, New Zealand and United States.

Even within this set of similar assets, good diversification possibilities emerge. For example, the Japanese index return exhibits low correlations with all other indexes (the highest correlation of the Japanese index is 0.36 with Australia). Except with the Australian index, the New Zealander index is quite low correlated with others (correlation of 0.67 at most). In Europe, Norway and Switzerland also offers diversification possibilities: their correlations with the other WGBI indexes do not exceed 0.73.

4.2. Descriptive statistics of the Sustainability Country Ratings

For the twenty countries under study, the ratings by Vigeo as available at the end of December 2008 appear in the Table 3.

Table 3 Vigeo ratings at the end of December 2008

	Environmental Responsibility Rating (ERR)	Social Responsibility and Solidarity Rating (SRSR)	Institutional Responsibility Rating (IRR)	Vigeo Sustainability Rating (VSR)
AUS	57.74	72.93	91.67	74.11
AUT	67.14	77.6	97.4	80.71
BEL	52.44	85.54	89.39	75.79
CAN	48.91	78.95	83.92	70.60
DNK	60.94	84.86	97.8	81.20
FIN	65.18	84.68	97.67	82.51
FRA	60.29	80.27	91.58	77.38
DEU	61.71	76.65	94.56	77.64
IRL	51.25	82.84	92.89	75.66
ITA	54.14	77.09	85.76	72.33
JPN	52.69	72.2	77.34	67.41
NLD	56.8	87.71	97.18	80.56
NZL	54.2	80.46	86	73.55
NOR	68.3	92.89	97.64	86.27
PRT	51.67	68.54	93.6	71.27
ESP	52.84	77.91	92.95	74.57
SWE	71.05	91.18	98.45	86.89
CHE	74.24	79.48	91.58	81.77
GBR	64.94	81.98	94.98	80.63
USA	47.75	67.89	62.83	59.46
Average	58.71	80.08	90.76	76.52
Std. Dev.	7.71	6.72	8.58	6.55

Globally, the twenty countries are well-rated for the SRSR and for IRR but obtain poor ratings for ERR. The dispersion of the ratings score is quite similar among the three components of VSR, except for the IRR for which Japan and United States are well below the other countries. This dispersion shows that even if the countries of the sample are developed

and homogeneous from a wealth point of view, there is discrimination between good and bad performers regarding the ESG criteria. The Spearman's rank correlation in the Appendix 2 indicates that the three components of the VSR are certainly not perfectly correlated (rank correlation of 43.3% between the ERR and the SRSR).

The analysis of the VSR confirms certain popular views: the Scandinavian countries (Denmark, Finland, Norway, Sweden) obtain the best scores for each area with Norway and Sweden far above the other countries for the global rating (the only countries with a rating superior to the mean of the rating plus one standard deviation). The VSR also puts Japan and the United States at the bottom of the ranking. In particular, the United States is the worst-rated for each area. This position is due to the non signature of several international conventions, to a highly energy-consuming economy and also to a weak development aid. We also notice that South European countries (Italy, Portugal, Spain) globally obtain poor performances, especially for the ERR.

Some of the ratings go against popular views. Canada is often cited as an example of a sustainable country but is only ranked 18th with the VSR. Actually, Canada is badly rated for the same reasons than the United States: non signature of international conventions, highly energy-consumption economy and a weak development aid. The IRR is also diminished by the inexistence of a minimum age for employment, as for the United States. Another surprising rating is the poor ERR of The Netherlands, which is often presented as a green country. This could be explained by the fact that the agriculture in The Netherlands intensively uses pesticide, fertilizer and water.

The dispersion of the VSR makes the question of the effect of a constraint on the ratings on the diversification power obviously relevant.

4.3. BJS test on SRI constraints portfolios

We first compute the efficient frontier given by the twenty WGBI indexes currency-hedged without restriction on the portfolio rating. Then, we compute efficient frontiers given by portfolios of WGBI indexes with a constraint of the type "portfolio ratings superior to a threshold". For each threshold, we run the BJS (2002) test by considering the unconstrained

efficient frontier as the reference efficient frontier and two points (minimum variance and tangency portfolios) of the constrained efficient frontier as benchmarks. The null hypothesis is the following:

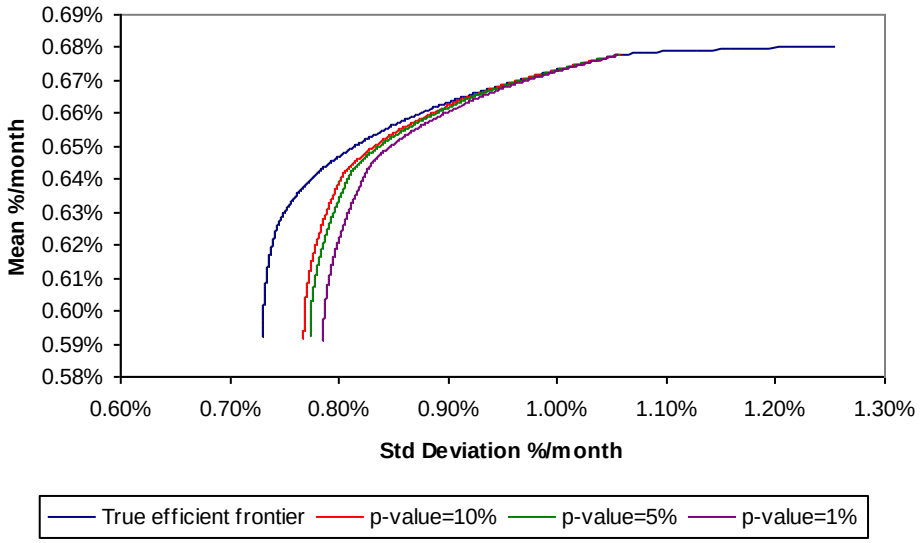
H0: *"The portfolio constrained on the VSR is mean-variance efficient with reference to the unconstrained efficient frontier"*

The rejection of H0 means that the constrained portfolio is not mean-variance efficient and that the constraint on the rating implies a significant loss of diversification. If H0 is not significantly rejected, it means that the mean-variance efficiency is not rejected and that it is possible to build socially responsible portfolios without a significant diversification cost. In Table 4, we report the thresholds on portfolio ratings for which the mean variance efficiency of the portfolios is rejected with a probability level of 10%, 5% and 1%. For the VSR, we plot in Figure 1 the constrained efficient frontiers corresponding to these rejections of mean variance efficiency against the unconstrained efficient frontier.

Table 4 Thresholds of the constraint "portfolio SRI rating superior to a threshold" corresponding to the rejection of the null hypothesis of mean variance efficiency against unconstrained portfolios at the probabilities 10%, 5% and 10%

	Portfolio rating		
Minimum variance portfolio			
	Probability of rejection of the null hypothesis		
	10%	*5%*	*1%*
Vigeo Sustainable Rating (VSR)	79.56	80.01	80.73
Environmental Responsability Rating (ERR)	66.51	67.08	68.01
Social Responsability and Solidarity Rating (SRSR)	83.35	83.92	84.82
Institutional Responsability Rating (IRR)	90.84	91.23	91.95
Tangency portfolio			
	Probability of rejection of the null hypothesis		
	10%	*5%*	*1%*
Vigeo Sustainable Rating (VSR)	79.47	79.86	80.55
Environmental Responsability Rating (ERR)	67.08	67.65	68.58
Social Responsability and Solidarity Rating (SRSR)	82.72	83.23	84.10
Institutional Responsability Rating (IRR)	90.99	91.38	92.10

Figure 1 The efficient frontiers defined by the WGBI indexes hedged for FX in US dollars with restrictions on the Vigeo Sustainability Ratings, period January 1995-December 2008



For each rating type, we notice that the thresholds of the portfolio rating corresponding to the rejection at 10%, 5% and 1% of the mean-variance efficiency are very close. The efficiency measures have all a negative sign, which is expected by construction: by imposing a linear constraint on the weights of the WGBI indexes, the efficient frontier moves to the south east in accordance with the modern portfolio theory.

For each rating, we report in the Figures 1 to 4 of the Appendix 3 the Vigeo ratings and the threshold on the portfolio rating corresponding to the rejection of the mean-variance efficiency at the 5% significance level. We notice that the portfolio ratings' thresholds corresponding to the rejection of the null hypothesis of mean-variance efficiency are all above the mean of the Ratings of the twenty countries. Concerning the VSR, that is to say our global proxy of the socially responsible behaviour of countries, only portfolios with a portfolio rating superior to 79.86 (which corresponds to the mean of the VSR of the study's countries plus 0.51 standard deviation) significantly displace the efficient frontier with a probability of 5%. This means that one can sensibly improve the average rating of the portfolio without significantly losing diversification power. It is thus possible to create socially responsible portfolios of sovereign bonds without significant diversification cost.

This being said, the possibility to improve the portfolio rating differs depending on the rating types: while it is possible to sensibly increase the portfolio rating without significantly

moving away from the efficient frontier for the VSR, the ERR and the SRSR, this is not the case for the IRR. Indeed, for the IRR, the portfolio rating corresponding to a rejection at a probability of 5% of the mean-variance efficiency is very close to the mean of the ratings of the sample countries. Actually, the ability to improve the average rating of the portfolio without losing diversification power depends a lot on the ratings of the countries whose sovereign bonds are the least correlated with others, that is to say Japan or New Zealand for our sample.

For the global VSR, we report in the Appendix 4 the composition of the minimum variance and tangency portfolios corresponding to the rejection of mean-variance efficiency at the 10%, 5% and 1% probability level. We observe that the limit portfolios exclude a lot of countries including the United States. Furthermore, investment is concentrated in countries (Japan, Norway, Switzerland, Sweden) whose WGBI index has a low correlation with others. The proportion of highly rated countries is closely linked to the constraint on the portfolio's VSR: the stronger the constraint, the higher the proportion of well-rated countries is (mainly Sweden and Switzerland) and the lower the proportion of badly rated countries. This illustrates the importance of taking into account the link between the socially responsible indicators and the sovereign bonds' correlations when building a socially responsible portfolio.

In the case of the IRR, the difficulty to sensibly improve the rating of the portfolio without significantly losing diversification power could be explained by the particularly poor performance of Japan (more than one standard deviation below the average of the countries of the sample) and the weak performance of other countries whose sovereign bonds are not very correlated with the others: New Zealand, Canada.

As far as the ERR is concerned, the possibility to widely increase the average SRI rating of the sovereign bonds portfolio compared to the average rating of the countries of the sample without significantly losing diversification benefits likely comes from the not so bad rating of Japan (15^{th} country) and New Zealand (12^{th}) and also from the particularly good performance of Switzerland (more than one standard deviation above the average rating of the countries of the sample) whose sovereign bonds returns are moderately correlated with the others.

The case of the SRSR and VSR are intermediary with notably the very high ratings of Norway and Sweden (more than one standard deviation above the mean rating of the study's countries in both cases) and the very low ratings of Japan. The rejection of H0 at the 5% probability level occurs for portfolio ratings respectively equal to 83.23 (corresponding to the mean plus 0.47 standard deviation) and 79.86 (corresponding to the mean plus 0.51 standard deviation), that is sizeable.

5. Conclusion

In the current context of financial turmoil, the sovereign bond market is in the spotlight, notably because of a large flight-to-quality movement. This revival of interest is nevertheless accompanied by the rise of government deficits and the subsequent necessity for the investor to diversify even within this category of safe assets. The importance of the sovereign bond markets and the growing interest for SRI represent strong argument in favour of the development of financial research joining the two themes. Indeed, it is most likely that investors searching for SRI in the stock market would act likewise in the sovereign bond market. However, countries and companies are obviously not judged on the same criteria. For this reason, the first challenge of our study was to find appropriate country rating that allows defining SRI in sovereign bonds. We have chosen the Vigeo Sustainable Country Ratings because it takes into account a large set of criteria referring to the environmental, social and governance issues and we find it a good indicator of the socially responsible performances of countries. It is also highly reliable because it only uses data from international organisations like the World Bank and the different bodies of the United Nations.

Restricting the set of possible investments reduces the diversification possibilities and displaces the efficient frontier to the south east. Thus, in principle, requiring higher global socially responsible performances reduces the diversification possibilities. However, as shown here, portfolio ratings may be improved at a vey low price, that is, without significantly displacing the efficient frontier.

This positive result is however different across the three sub-ratings of the Sustainability Country Ratings: requiring better average ratings costs more in terms of diversification for the Institutional Responsibility rating than for the Environmental Responsibility and Social Responsibility and Solidarity ratings. Actually, the country rankings

differ across the three Vigeo scores. It shows that the investors' decisions to favour some ESG criteria may have dramatic consequences for his/her portfolio composition and diversification. This point is particularly important in an industry with heavily tailored products. Our results show that asset managers can create sovereign bonds' portfolios with higher than the average socially responsible rating without significantly losing diversification possibilities. The key point here is to study the link between socially responsible indicators and the sovereign bonds in terms of risk/return and correlation properties.

This work is in line with existing literature focusing on the potential cost associated to SRI (Adler and Kritzman (2008), Renneboog *et al.* (2008)) but brings this discussion into the sovereign bond market. However, our findings only concern developed countries. An interesting direction for further research would be to focus on emerging and developing countries. Indeed, the building process of sovereign bonds' portfolios is very different for the emerging market. We should expect that the socially responsible indicators for emerging countries should be much more scattered than for developed countries and also that the ESG criteria play a very different role. Another topic should be to study how to build a socially responsible portfolio containing sovereign bonds and other asset classes, for example corporate bonds, and the financial consequences of this mixing. Finally, because of the relativity of the individual ethics, we also think further research could investigate the investors' weighting of the different criteria and its implications.

References

Adler T. and Kritzman M. (2008), "The Cost of Socially Responsible Investing", *Journal of Portfolio Management*, 35(1), 52-56.

Basak G., Jagannathan R., and Sun G. (2002), "A direct test for the mean variance efficiency of a portfolio*", Journal of Economic Dynamics & Control*, 26(7-8), 1195-1215.

Bauer R., Koedijk K. and Otten R. (2005), "International evidence on ethical mutual fund performance and investment style", *Journal of Banking & Finance*, 29(7), 1751-1767.

Connolly M. (2007), "Measuring the Effect of Corruption on Sovereign Bond Ratings", *Journal of Economic Policy Reform*, 10(4), 309-323.

De Roon F. and Nijman T. (2001), "Testing for Mean-Variance Spanning: a Survey", *Journal of Empirical Finance*, 8(2), 111-155.

Derwall J., Guenster N., Bauer R., and Koedijk K. (2005), "The Eco-Efficiency Premium Puzzle", *Financial Analysts Journal*, 61(2), 51-63.

Ehling P. and Ramos S. (2006), "Geographic versus industry diversification: Constraints matter" *Journal of Empirical Finance*, 13(4-5), 396-416.

Erb C., Harvey C. and Viskanta T. (1996), "The Influence of Political, Economic and Financial Risk on Expectd Fixed Income Returns", *Journal of Fixed Income*, 6(1), 84-95.

European Social Investment Forum (2008), "European SRI Study", available at http://www.eurosif.org/publications/sri_studies

Hanson M., Liljeblom E. and Löflund A. (2008), "International Bond Diversification Strategies ; The Impact of Currency, Country, and Credit Risk", available at SSRN: http://ssrn.com/abstract=1082789

Hunter D. and Simon D. (2004), "Benefits of International Bond Diversification", *Journal of Fixed Income*, 13(4), 57-72.

Kempf A. and Osthoff P. (2007), "The Effect of Socially Responsible Investing on Portfolio Performance", *European Financial Management*, 13(5), 908-922.

Levy H. and Lerman Z. (1988), "The Benefits of International Diversification in Bonds", *Financial Analysts Journal*, 44(5), 56-64.

Renneboog L., Horst J.T. and Zhang C. (2008), "The price of ethics and stakeholder governance: The performance of socially responsible mutual funds", *Journal of Corporate Finance*, 14(3), 302-322.

Statman M. and Glushkov D. (2008), "The Wages of Social Responsibility", available on http://www.socialinvest.org/resources/research/documents/2008WinningPrize-Moskowitz.pdf

United Kingdom Social Investment Forum (2006), "Discovering New SRI Institutional Investment Opportunities", available on http://www.uksif.org/cmsfiles/uksif/uksif-new_SRI_Instit_Opps.pdf

United Nations Environment Programme Finance Initiative and United Nations Global Compact (2005) "Principles for Responsible Investment", available on http://www.unpri.org/

Appendix 1 Themes taken into account in the Vigeo Sustainability Country Ratings and their weights

Environmental Responsability	
Participation in International environmental conventions	Air Biodiversity Water Land Information systems
Air emissions	Climate change Ozone layer protection Local and regional air quality
Water	Water
Biodiversity	Threatened species Sensitive areas
Land use	Land use
Environmental pressures	Waste Energy consumption
Institutional responsability	
Respect, protection and promotion of civil rights	Respect, protection and promotion of human rights Respect, protection and promotion of labour rights
Democratic institutions	Political freedom and stability Control of corruption Independance of justice Market regulation Press freedom
Society Responsability and Solidarity	
Social protection	Poverty Employment
Education	Educational policy Primary school education Secundary school education
Health	Health policy Mortality HIV/Aids Tuberculosis
Gender equality	Gender equality
Development aid	Development aid
Safety	Safety policy

Appendix 2 Spearman's rank correlation of the Vigeo scores

	SRI	Environmental responsibility	Institutional responsibility	Social responsibility and solidarity
SRI	100.0%	88.3%	84.6%	72.9%
Environmental responsibility		100.0%	68.9%	43.3%
Institutional responsibility			100.0%	58.1%
Social responsibility and solidarity				100.0%

Appendix 3 Vigeo Ratings and threshold on the SRI portfolio rating for the rejection of the BJS (2002) test at 5%

Figure 1 Sustainability country ratings

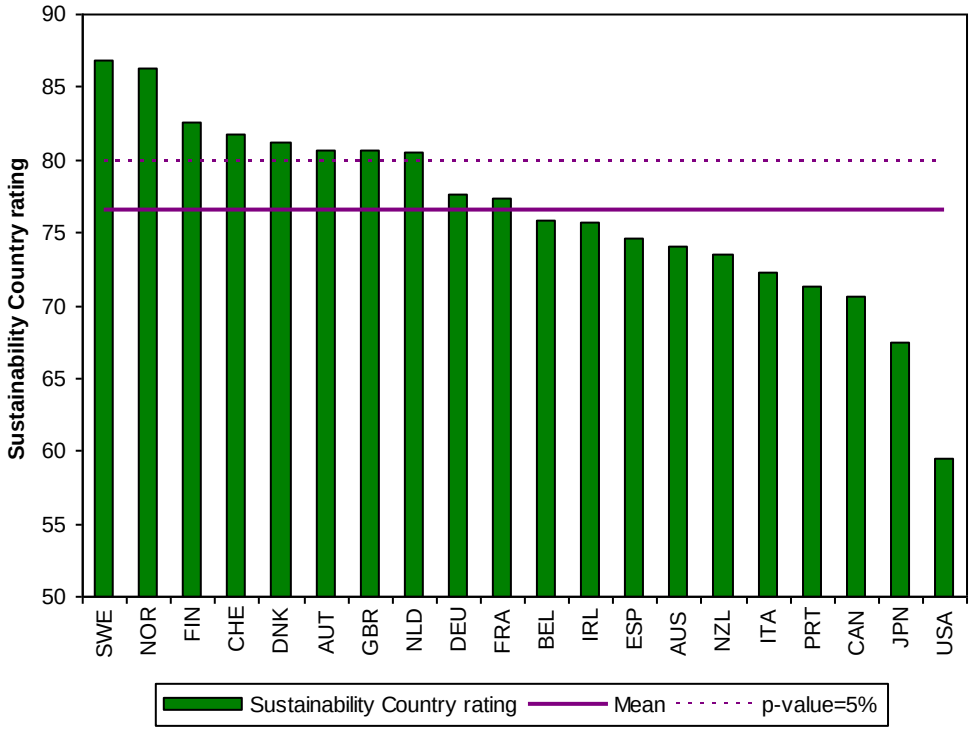


Figure 2 Environmental ratings

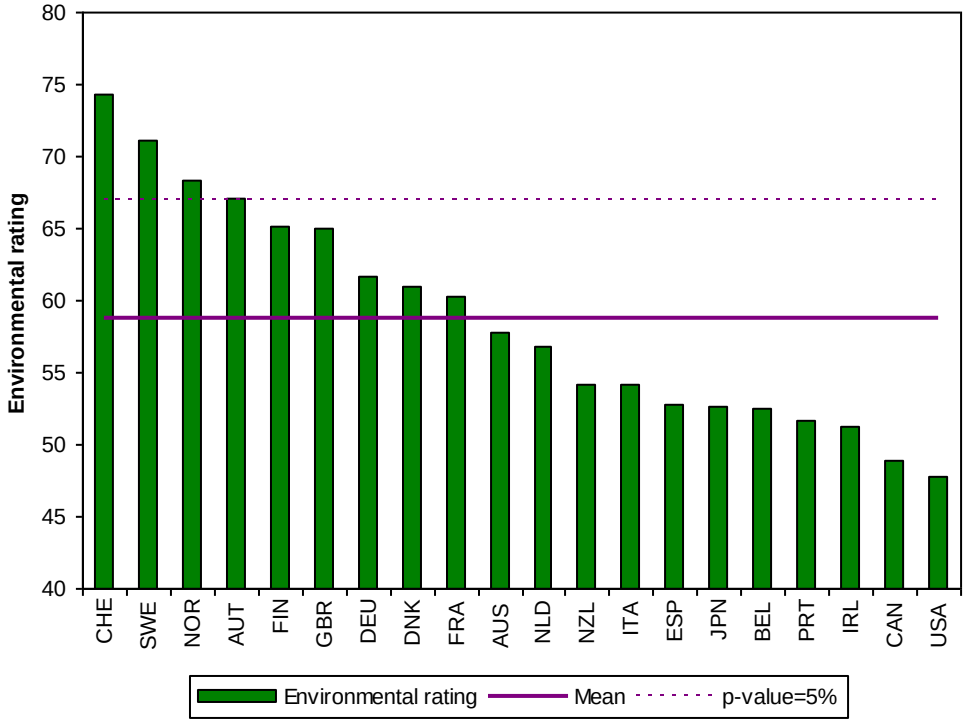
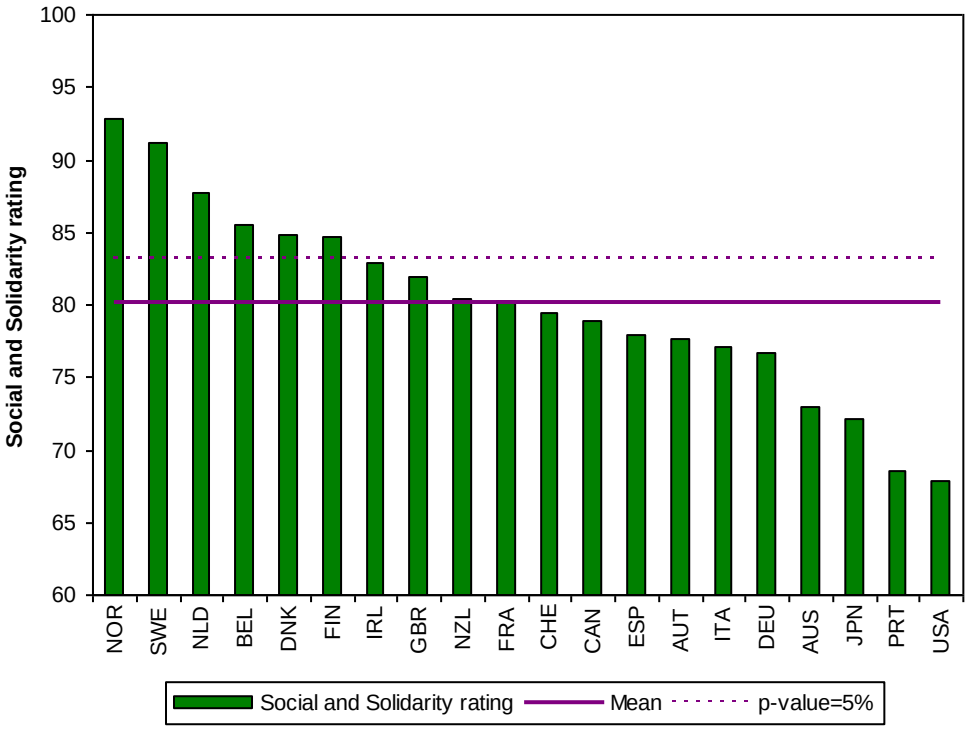


Figure 3 Institutional ratings

Figure 4 Social and solidarity ratings



Appendix 4 Weights of the WGBI indexes in the minimum variance and tangency portfolios corresponding to the rejection of the BJS (2002) test at a probability level of 10%, 5% and 1%

Minimum variance portfolio				Tangency portfolio			
	Null hypothesis rejection probability				Null hypothesis rejection probability		
	10%	**5%**	**1%**		**10%**	**5%**	**1%**
AUS	0.00%	0.00%	0.00%	**AUS**	0.00%	0.00%	0.00%
AUT	0.00%	0.00%	0.00%	**AUT**	0.00%	0.00%	0.00%
BEL	0.00%	0.00%	0.00%	**BEL**	0.00%	0.00%	0.00%
CAN	0.00%	0.00%	0.00%	**CAN**	0.00%	0.00%	0.00%
DNK	0.00%	0.00%	0.00%	**DNK**	0.00%	0.00%	0.00%
FIN	5.96%	5.09%	3.82%	**FIN**	12.91%	12.23%	11.02%
FRA	0.00%	0.00%	0.00%	**FRA**	0.00%	0.00%	0.00%
DEU	0.00%	0.00%	0.00%	**DEU**	0.00%	0.00%	0.00%
IRL	0.00%	0.00%	0.00%	**IRL**	0.00%	0.00%	0.00%
ITA	0.00%	0.00%	0.00%	**ITA**	0.00%	0.00%	0.00%
JPN	28.29%	26.50%	22.98%	**JPN**	28.24%	26.33%	22.95%
NLD	0.00%	0.00%	0.00%	**NLD**	0.00%	0.00%	0.00%
NZL	0.68%	0.00%	0.00%	**NZL**	0.00%	0.00%	0.00%
NOR	29.03%	30.75%	32.17%	**NOR**	7.84%	8.61%	9.97%
PRT	0.00%	0.00%	0.00%	**PRT**	0.00%	0.00%	0.00%
ESP	0.00%	0.00%	0.00%	**ESP**	0.00%	0.00%	0.00%
SWE	10.90%	12.20%	15.31%	**SWE**	25.52%	27.20%	30.18%
CHE	25.14%	25.46%	25.72%	**CHE**	25.49%	25.63%	25.88%
GBR	0.00%	0.00%	0.00%	**GBR**	0.00%	0.00%	0.00%
USA	0.00%	0.00%	0.00%	**USA**	0.00%	0.00%	0.00%