Using TOPSIS for assessing the sustainability of government bond funds ☆

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ABSTRACT

The aim of this paper is to provide a methodology to assess the sustainability of investments in sovereign bonds using a technique for order preference by similarity to the ideal solution (TOPSIS). TOPSIS is a multi-criteria decision making technique used to rank a finite set of alternatives based on the minimization of distance from an ideal point and the maximization of distance from an anti-ideal point. The proposal presented herein can be a potential solution to the research works raised with respect to the difficulty of finding a unified measurement of the sustainability performance of investments in order to support investor decision-making process. The assessment presented is according to both the most frequently used sustainability indicators and the most interesting concerns for a particular investor. The Adjusted Net Saving (*ANS*), the Ecological Footprint (*ECF*), the Environmental Performance Index (*EPI*) and the Human Development Index (*HDI*) have been used in this paper. Our approach has been applied for evaluating government fixed income funds domiciled in three European countries: France, Italy and the Netherlands. In addition, the developed approach is incorporated in a compromise model for portfolio selection of government bond funds.

1. Introduction

Socially Responsible Investment (SRI) (now known as Sustainable and Responsible Investment [1]) is defined 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" by the European Social Investment Forum (Eurosif) [2].

Over the last few decades, SRIs have experienced significant worldwide growth. According to the European SRI Study 2012 [1], the European SRI market has reached approximately €8,75 billion and in the United States the overall total of SRI assets under management is $3,74 trillion (Report on Sustainable and Responsible Investing Trends 2012 [3]).

The growing interest in the concept of responsible investment in general, both among individuals and institutional investors, has led

to an increasing volume of academic literature. Several SRI topics have been extensively investigated, with most of the existing empirical studies focusing on the financial performance of SRI assets, mostly in equity investment domain (see [4–10]), the theoretical background of SRI (see [11–14]) and flow-performance relation for SRI funds (see [15–17]). However, there is a dearth of academic literature on the SR issues for fixed-income assets, despite the fact that the corporate bonds market is considerably larger than the equities one. Remarkable exceptions are discussed below.

Scholtens [18] analyzes the performance in financial and Corporate Social Responsibility (CSR) in terms of the socially responsible savings and investment funds in the Netherlands and looks at that of the so-called Green Project Facility (GPF). Connolly [19] puts forward a link between sovereign credit ratings and the corruption index measured by the Corruption Perceptions Index [112]. Derwall and Koedijk [20] evaluate the performance of socially responsible bond and balanced funds relative to matched samples of conventional funds, over the period 1987–2003. Using multi-index performance evaluation models, they show that the average SRI bond fund performed similar to conventional funds. Drut [21] investigates how the mean-variance efficient frontier defined by sovereign bonds of 20 developed countries is affected by the consideration of socially responsible indicators for countries

in investment decision-making. His results suggest that socially responsible portfolios of sovereign bonds can be built without a significant loss of mean-variance efficiency. Scholtens [22] studies the implications of using different indicators to assess the sustainability performance of investment funds. In particular, Scholtens looks into the environmental performance of Dutch government bond funds and shows that they differ according to the environmental indicator. Therefore, he suggests that funds should be very transparent and straightforward about their non-financial performance and proposes three options. First, the industry comes up with a benchmark against which the responsibility of their investments should be measured and reported by all funds. Second, the funds should make very clear and transparent which particular aspects of sustainability they specifically target and how they keep score. Third, the dashboard approach where the funds should report their performance on a well-defined set of indicators. Preu and Richardson [23] identify a variety of legal, institutional and attitudinal factors which hinder the growth of the German SRI market.

As has been commented above, despite the scarce literature for the SRI fixed-income market, the interest in such products has grown substantially for both individual and large institutional investors around the world. Thus, Bauer and Hann [24] show that the relevance of environmental management issues has increased for bond investors over the recent decade, consistent with the view that widespread climate change concerns have heightened investors' awareness of potential regulatory changes and other associated financial risks. According to Derwall and Koedijk [20] SRI has attracted the attention of investors in sovereign bond markets. Sovereign states represent an overwhelming portion of debt issuers, perhaps because the case for SRI in this segment is the most straightforward (see [25]). Bond rating agencies seem to agree that sovereign credit risk is significantly driven by quantifiable and non-quantifiable instruments related to social, political and economic factors [26]. Here, socially responsible investors make a case for integrating environmental and social factors into investment decisions, because these factors influence countries long-term economic development and political stability.

The growing climate change concerns and recent environmental disasters fuel the ongoing controversy over both the social responsibility of firms and the role of governments in regulating corporate behavior. In this work, we are assuming, according to Drut [21] and Scholtens [22], among others, that it is primarily the government which is to be held responsible for the environmental and social performance of a country since governments have the power to improve regulations related to ESG criteria. We think that this argument is valid for other constituents of social responsibility as the fulfillment and surveillance of human rights and labor conditions.

The need of indicators to evaluate and to guide the sustainable development process was suggested at the 1992 UN Conference on Environment and Development. The "Brundtland Report" [27,28] defined sustainable developments as those that "meet present needs without compromising the ability of future generations to meet their needs". Although the scientific community has worked extensively in order to provide adequate indicators to measure sustainable development, it is nowadays an open problem with many aspects unsolved (see [28–32]). However, the purpose of this article is not to delve deeply into the debates about what methodologies, approaches etc. for constructing such indicators or which should be used, and the goodness, fairness or weakness of them. Rather we work with four indexes: the Adjusted Net Saving, ANS [33]; the Ecological Footprint, ECF [34–36]; the Environmental Performance Index, EPI [37,38] and the Human Development Index HDI [39]. These indexes are commonly used in the scientific community and government officials and also are available for a large number of countries. Furthermore their methodology and data are publicly

available. Of course, our approach would benefit from any improvement in the construction of the sustainability indicators that can be presented in the future.

In this work, we have extended Scholtens' research [22] in several directions. We evaluate the sustainability performance of a particular government bond investment fund using the sustainability performance of all the countries it invests in. To do this, we use the most accepted indicators of sustainability mentioned above. First, we propose using multi-criteria methods for assessing the sustainability of all countries for which the indexes are publicly available (ANS is available for 134 countries in 2009; ECF for 148 in 2008; EPI for 132 in 2012 and HDI for 187 in 2011). Approaches from multi-criteria decision making (MCDM) can help to take into account various incommensurable aspects and subjective preferences of the decision makers (DMs) and thus contribute to transparency and traceability of decision-making processes [40,41]. The application of multi-criteria technologies for constructing indicators of sustainable development has been suggested in several papers [31,42–44]. Using TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) presented in Chen and Hwang [45], with reference to Hwang and Yoon [46], we achieve a score for each country based on both the closeness to the best values that reach the indexes over the universe of countries and the remoteness to the worst ones. The idea behind our application of TOPSIS method is, indeed, that a country with good values in many and important indicators is sustainable and one with many bad values is unsustainable. Our proposal evaluates all countries in order to avoid the rank reversal problem [47] that can arise in the application of TOPSIS when the ideal and anti-ideal points are relative to the domain of the set of alternatives under consideration. In this way, the ranking and score of the countries are invariant and, in consequence, the ones of the investment funds are too. We differ from Scholtens' work [22] because he runs only with the countries involved in his universe of investment funds. Second, the evaluation obtained for countries and investment funds is sensible to the experts' opinions and to that of the investors themselves about the most suitable or important indexes. Third, we propose a portfolio selection model based on Compromise Programming (CP) [48,49] considering the sustainability of the portfolio as an objective in the process of portfolio constructing. CP is a mathematical programming technique with the capability of handling multiple objectives in those situations where the existence of a high level of conflict between criteria does not allow the simultaneous optimization of all the considered objectives. In those situations it seems rational to find compromise solutions among the level of achievement of the objectives. We owe to Ballestero and Romero [50] one of the pioneering applications of CP for portfolio selection, and since then several interesting papers can be found in the literature (see [51–55], among others).

The rest of this paper is organized as follows. Section 2 is devoted to a brief introduction to the various sustainability indexes used here. Section 3 provides the necessary MCDM tools for this proposal: an overview of TOPSIS and a method for assigning weights to indexes are presented. Section 4 displays the application of TOPSIS method for evaluating the sustainability of countries and as a by-product the sustainability of the government bond investment funds is obtained. A portfolio selection model taking into account the sustainability of the investment funds is introduced in Section 5 and the conclusions are presented in Section 6.

2. Sustainability indexes

Nowadays, there is no consensual definition of "sustainable development" although this concept is a shared principle. Therefore, there is a need to make progress which will lead to a