



A new rating of sustainability based on the Morningstar Sustainability Rating

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ABSTRACT

Nowadays, investors seek beyond the financial performance of their investments, including Environmental, Social, and Governance (ESG) criteria in the decision-making process. To this effect, there are currently suppliers who offer different methodologies to evaluate the ESG factors that companies apply in their businesses. In 2016, Morningstar launched the Morningstar Sustainability Rating for mutual funds, which provides information on how well mutual funds incorporate sustainable assets. This rating is obtained from the Morningstar Portfolio Sustainability Score, the calculation system of which was modified and improved in 2018. However, an important drawback remains to be overcome because the score is only calculated if at least 67% of the portfolio assets have an ESG score and it does not take assets without an ESG score into account. This paper aims to provide a more reliable rating for investors because it proposes the inclusion of all the assets in the fund valuation, regardless of whether they have an ESG score, using fuzzy set theory and specifically triangular fuzzy numbers.

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1. Introduction

Nowadays, there is an increasing need for sustainable investments worldwide (Barua & Chiesa, 2019). Investments of this kind aim to achieve an environmentally friendly and greener world. Some authors consider that financial resources should be transferred to a low-carbon economy and to activities that have a less negative impact on the climate (Clark, 2013). Sustainable investing has attracted special interest among researchers, investors and institutions, generating a new financial and business reality and highlighting the need for in-depth analysis of the environmental and social consequences of the economy (Bak, Bhattacharya, Edenhofer & Knopf, 2017; Dörry & Schulz, 2018; Khemir, 2019).

Sustainable investing considers Environmental, Social, and Governance criteria (ESG) when evaluating and selecting investments. Environmental criteria are applied by companies that actively strive to reduce the negative impact of their business operations on the environment. The factors analysed include the company's likely

impact on climate change, natural resource use, pollution and the use of clean technology, among others. Regarding the social perspective, this is defined as how companies consider both the internal and the external social impact of the business. To this effect, social criteria include considerations such as worker safety, product safety and integrity, healthier products, impact on the community and human rights. Last, governance criteria are concerned with how companies embrace corporate governance principles (board diversity, shareholder rights, executive compensation, business ethics, etc.).

The focus of sustainable investing is long term, considering the interests of an extended sphere of stakeholders and the environment. According to Global Sustainable Investment Alliance (2018), at the start of 2018, sustainable investing reached 12.3 trillion euros in Europe and 30.6 trillion dollars globally. This increasing social awareness coincides with international initiatives aimed at developing environmental and social policies on sustainable financial issues. In this regard, in 2018 the European Commission (EC) adopted an Action Plan on sustainable finance, whereby the European Union (EU) aims to improve the financial contribution to sustainable growth and strengthen financial stability by incorporating the ESG criteria into investment decision making.

In a global sense, mutual funds are one of the most important instruments for investing savings. At the end of 2019, total net assets

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(TNA) recorded 48.8 billion euros worldwide, a significant growth compared to 2008 when TNA recorded 13.65 billion euros (INVERCO, 2018). Moreover, according to the International Monetary Fund (IMF), the volume of mutual fund and pension fund assets involves 101.7% of world gross domestic product.

A socially responsible mutual fund is one that integrates ESG criteria in the selection of stocks, rather than just basing decisions on financial considerations (Fabregat-Aibar, Barberà-Mariné, Terceño & Pié, 2019).

There is currently a large amount of data from information suppliers who offer different analyses and methodologies to evaluate the ESG factors applied by companies in their activity (Sustainalytics, RobecoSAM, MSCI, Vigeo Eiris, etc.). However, a survey conducted among ESG experts highlighted the need to offer more consistency and comparability among methodologies, and the requirement to improve quality in terms of transparency and coherence of the evaluation method (ERM, 2019).

Regarding the assessment of ESG factors applied to mutual funds, Sustainalytics, global leader in ESG scores and corporate governance research, provides Morningstar with information on corporate ESG and controversy scores, from which Morningstar obtains the Morningstar Sustainability Rating. This rating can be considered one of the newest systems for decision making in sustainability investment (Steen, Moussawi & Gjolberg, 2019) and its information has an impact (positive or negative) on mutual fund inflows and outflows (Ammann, Bauer, Fischer & Müller, 2019). Nowadays, the rating of “social” and “green” funds is a key element that investors consider in their investment decisions.

The Morningstar Sustainability Rating is expressed using a five-globe system indicating whether the fund is at the bottom end of the rating for its industry group (one globe), below average (two globes), average (three globes), above average (four globes) or at the high end (five globes). This system is applied to all funds with at least 67% of their assets with an ESG score and is calculated ignoring the assets that have not been scored.

The methodology used for the Morningstar Sustainability Rating is a crucial issue for investors concerned about ESG factors, since the categorization of a fund in terms of sustainability depends on it. Therefore, it constitutes the research subject of this paper.

The motivation for this work is to improve the aforementioned methodology by proposing a new one that considers all the assets of the portfolio, including both the scored and the non-scored ones. Given that the non-scored assets can represent up to 33% of the portfolio, their omission can imply a distortion between assessment and reality. The instruments used to develop this new approach are the Triangular Fuzzy Numbers. The capability of this tool to manage uncertainty makes it extremely useful for incorporating the missing information of non-scored assets into the analysis.

This paper provides new insights into investors' decision making and contributes to the existing mutual fund literature. It provides a more reliable rating for investors because the inclusion of all assets in the fund valuation means the possibility of obtaining a different score, which could vary the result of applying the five-globe Morningstar system.

The paper is structured as follows. Section 2 is a review of the literature. Section 3 provides details of Morningstar's Portfolio Sustainability Score methodology in 2016 and 2018. In Section 4, the proposed model to improve the current score is outlined, and the conclusions are presented in the last section.

2. Literature review of sustainability rating

Most investment funds are conventionally rated financially by independent agencies according to risk-adjusted returns. However, these return/risk-based rating criteria have some critical aspects. Standard and Poor's Fund Management Rating was designed to assess

the quality of the management process and fund managers' experience, aiming to reflect these aspects in the rating criteria. (Cook & Hebner, 1993) undertook an empirical study, proposing a multi-criterion approach to fund rating that included factors (both financial and non-financial) such as volatility, degree of diversification, quality of service and fees.

The matter of the sustainability rating is becoming increasingly important because more investors are seeking beyond the financial performance of their investments to also consider ecological and socio-economic aspects (Koellner, Weber, Fenchel & Scholz, 2005). Sustainability criteria were adopted by pension funds decades ago in the US and continental Europe (Kasemir, Süess & Zehnder, 2001), since when the corporate sustainability rating has become essential in terms of rating sustainability in funds. Some researchers (Figge, Hahn, Schaltegger & Wagner, 2002; Johnson, 1998) further developed the balanced scorecard model (Kaplan & Norton, 1996) so as to apply criteria for corporate sustainability. According to (Lozano, 2015), corporate sustainability is defined as “corporate activities that proactively seek to contribute to sustainability equilibria, including today's economic, environmental and social dimensions and their interrelations within and throughout the time dimension (i.e., the short, long and longer terms), while addressing the company's systems, i.e., operations and production, management and strategy, organizational systems, procurement and marketing, and assessment and communication, as well as its stakeholders' [systems]”. Hence, corporate sustainability needs to fulfill the commitment made in terms of the current environmental, social and economic requirements of firms' stakeholders (Escrig-Olmedo, Fernández-Izquierdo, Ferrero-Ferrero, Rivera-Lirio & Muñoz-Torres, 2019).

Therefore, how to assess corporate sustainability is becoming a crucial issue (Escrig-Olmedo et al., 2019; Windolph, 2011) given that the existing frameworks and tools are not yet sufficient to measure corporate sustainability (Ben-Eli, 2018). ESG rating agencies (the so-called corporate social responsibility (CSR) ratings, social ratings, sustainability ratings or SRI rating agencies), which evaluate and analyze environmental, social and corporate governance-related business practices of firms all over the world (García, González-Bueno, Oliver & Riley, 2019), appeared to meet this demand for information from investors who were seeking to invest in sustainability companies. Examples of the most important ESG scoring systems are the Sustainalytics ESG, the Bloomberg ESG Disclosure Score, the Thomson Reuters ESG Score, and the MSCI ESG Score, among others. Some rating scores are obtained using exclusively extra-financial information, while others apply financial and extra-financial data to assess long-term value and sustainability (Scalet & Kelly, 2010). Triple Bottom Line (TBL), which are principles for rating sustainability, linked the three dimensions: economic-financial, environmental and social, aiming to achieve a balanced performance measurement (Elkington, 1994, 1997). These three dimensions were further extended by other researchers (Escrig-Olmedo, Muñoz-Torres, Fernández-Izquierdo & Rivera-Lirio, 2014, 2017; Ferrero-Ferrero, Fernández-Izquierdo & Muñoz-Torres, 2016). Combining the TBL concept with the inter-generational perspective, Lozano (2008) proposed the holistic approach, which sought a balance among economic, environmental and social dimensions in various time spans (short-, long- and longer-future term). This approach is also referred to as the intergenerational perspective by Muñoz-Torres et al. (2018). In practice, each rating agency applies its own social performance criteria and has its particular evaluation methodology, which can lead to certain controversy due to uncertainty, ambiguity or imprecision (Lien & Pérez-Gladish, 2018), as is the case with the Morningstar Sustainability Rating. The existing literature mainly sheds light on the discussion regarding the heterogeneity in rating criteria and different factors or indicators that contribute to the definition of the E, S and G components (Billio, Costola, Hristova, Latino & Pelizzon, 2021; Diez-Cañamero, Bishara, Otegi-Olaso, Minguez & Fernández, 2020; Escrig-Olmedo et al., 2019). As stated by Popescu, Hitaj and Benetto (2021), ESG scores from

different agencies diverge enormously (Berg, Kölbel & Rigobon, 2022), which may send inconsistent signals to investors. Singh, Murty, Gupta and Dikshit (2012) considered that the calculation of aggregate values is commonly applied for constructing sustainability indices, where the composite indices can be formed with or without weights. However, no particular attention has been paid to the methodology approach in dealing with the assignment of sustainability scores in portfolios where certain assets do not have available rating scores. As noted by Singh et al. (2012), it is crucial to have a suitable method that can lead to a reliable result and this study aims to fill the gap in this direction.

3. Methodology: Morningstar portfolio sustainability score

In 2016, Morningstar developed a new rating, the Morningstar Sustainability Rating, which evaluates funds according to their ESG factors. The main aim of this rating is to help investors to choose between the best managed portfolios in terms of sustainability. The Morningstar Sustainability Rating is obtained from the Morningstar Portfolio Sustainability Score (PSS).

This score is calculated as the difference between the Morningstar Portfolio ESG Score (ESG) and the Morningstar Portfolio Controversy Deduction (PCD). Notably, the ESG score and the controversy score of each company is provided by a third-party research firm named Sustainalytics and both values are on a scale of 0–100. Sustainalytics analyses and measures the environmental, social and corporate governance risks to which a company is exposed and how well it can manage them.

Thus, the Morningstar Portfolio Sustainability Score for a portfolio p is:

$$PSS_p = ESG_p - PCD_p \tag{1}$$

The portfolio ESG Score is obtained as follows:

$$ESG_p = \sum_{i=1}^n w_i \cdot ESG_i^N \tag{2}$$

where:

n is the number of securities in the portfolio that have an ESG score. w_i is the weight on security i in the portfolio p , so $\omega_i = \frac{V_i}{V_p}$, V_i being the value of the asset i in the portfolio and V_p the value of the portfolio considering only the securities that have an ESG score.

Importantly, $\sum_{i=1}^n w_i = 1$.

ESG_i^N is the normalized ESG score of the company that has issued security i .

Morningstar normalizes the ESG_i score using a z-score transformation to obtain comparable scores between companies that belong to different peer groups (PG). Subsequently, this value is rescaled between 0 and 100, obtaining the ESG_i^N value, as follows:

$$ESG_i^N = \left(50 + 10 \cdot \frac{ESG_i - \mu_{PG(i)}}{\sigma_{PG(i)}} \right) \tag{3}$$

where:

ESG_i is the ESG score of the company that has issued security i . $\mu_{PG(i)}$ and $\sigma_{PG(i)}$ are the mean and standard deviations, respectively, of the ESG scores of the companies in the peer group of security i , $PG(i)$.

A value of $ESG_i^N=50$ indicates that the company scores are at the PG average. Other values can be interpreted as follows:

- >70 → company scores at least two standard deviations above average in its PG

- 60 → company scores one standard deviation above average in its PG
- 40 → company scores one standard deviation below average in its PG
- <30 → company scores at least two standard deviations below average in its PG.

For its part, the Morningstar Portfolio Controversy Deduction (PCD) is calculated as follows:

$$PCD_p = \sum_{i=1}^n w_i \cdot CD_i \tag{4}$$

where:

n is the number of securities in the portfolio that have an ESG score. w_i is the weight on security i in the portfolio p , so $\omega_i = \frac{V_i}{V_p}$, V_i being the value of the asset i in the portfolio and V_p the value of the portfolio considering only the securities that have a controversy score. Importantly, $\sum_{i=1}^n w_i = 1$.

CD_i is the Morningstar Controversy Deduction for the company that has issued security i .

If CD_i is 0, it signifies no evidence of controversy, and if it is 20 it indicates the most serious risk for a company. This value is obtained by rescaling the controversy score provided by Sustainalytics on a scale of 0–100.

Notably, the Morningstar Portfolio Sustainability Score (PSS) is only obtained if at least half the portfolio assets have an ESG score.

Using the value obtained in Eq. (1), Morningstar classifies the funds in five groups using a five-globe system, thus obtaining the Morningstar Sustainability Rating. It assigns the score of 5 (five globes) to the highest 10%, the score of 4 (four globes) to the next 22.5%, the score of 3 (three globes) to the next 35%, the score of 2 (two globes) to the next 22.5% and the score of 1 (one globe) to the lowest 10%. This rating is only applied if the fund's Morningstar category has at least 10 funds with a Portfolio Sustainability Score.

Morningstar has maintained the five-globe system, but as from 2018 it has not applied it using the PSS values, but rather calculates a new PSS value considering historical data from the previous 12 months: the Historical Portfolio Sustainability Score. It is formulated as follows:

$$HPSS_p = \frac{\sum_{t=0}^{11} (12 - t) \cdot PSS_{p,t}}{\sum_{t=0}^{11} t + 1} \tag{5}$$

where:

$HPSS_p$ is the Historical Portfolio Sustainability Score for the portfolio p .

t is the number of months from the present, $t = 0, \dots, 11$.

$PSS_{p,t}$ is the Portfolio Sustainability Score for the portfolio p on the t month from the present.

Obviously, as it can be deduced from the Eq. (5), the most recent PSS_p is the value that is the most weighted when the $HPSS_p$ is calculated.

Moreover, Morningstar has enhanced the methodology to calculate the PSS_p , increasing the score threshold of portfolios from 50% to 67% and assigning 30 as the minimum number of scored portfolios in a Morningstar category to obtain a rating in terms of globes. Despite the changes made to the Morningstar Sustainability Rating in 2018, there is still an important drawback that hinders its interpretation, because the portfolio score is only calculated if 67% of the portfolio's assets have an ESG score. This means that the other 33% of the portfolio is disregarded and there is no way of assessing how good its sustainability management is.

4. New sustainability rating proposal: fuzzy portfolio sustainability score

A new Portfolio Sustainability Score is proposed based on the concept of fuzzy sets¹ to incorporate information about 100% of the portfolio assets. This proposal resolves the problem of the lack of information within the Morningstar Portfolio Sustainability Score.

Hence, the Fuzzy Portfolio Sustainability Score (FPSS) for a portfolio *p* can be defined through a Triangular Fuzzy Number (TFN) obtained as the difference between two TFN, following the expression:

$$FPSS_p = FESG_p - FPCD_p \tag{6}$$

where:

FESG_p is the Fuzzy Portfolio ESG score for the portfolio *p*.
FPCD_p is the Fuzzy Portfolio Controversy Deduction for the portfolio *p*.

The Fuzzy Portfolio ESG score is built in the following way:

$$FESG_p = \left(\sum_{i=1}^n w'_i \cdot ESG_i^N + \sum_{i=n+1}^{n+m} w'_i \cdot \min(ESG_{PG(i)}^N), \quad ESG_p, \right. \\ \left. \sum_{i=1}^n w'_i \cdot ESG_i^N + \sum_{i=n+1}^{n+m} w'_i \cdot \max(ESG_{PG(i)}^N) \right) \tag{7}$$

where:

n is the number of securities in the portfolio that have an ESG score.
m is the number of securities in the portfolio that have no ESG score.
w'_i is the weight on security *i* considering all the securities, the ones

with an ESG score and the non-scored ones, so $\sum_{i=1}^{n+m} w'_i = 1$.

ESG_i^N is the normalized ESG of the company that has issued security *i* and has been scored.

PG(i) identifies the peer group to which the company that has issued security *i* belongs.

$\min(ESG_{PG(i)}^N)$ is the minimum of the normalized ESG score of the *PG(i)*.

$\max(ESG_{PG(i)}^N)$ is the maximum of the normalized ESG score of the *PG(i)*.

ESG_p is the Morningstar Portfolio ESG Score of the portfolio *p*.

As can be deduced from its expression, the lower limit of *FESG_p* is the smallest likely resulting value, considering that all the securities that have not been scored will have a score which equals the minimum of their peer group. The largest likely value represents the case where all the non-scored securities will be scored with the maximum value of their peer group, and the most possible value coincides with the Morningstar *ESG_p*.

To simplify the notation of Eq. (8), it can be expressed as:

$$FESG_p = (a_{ESG}, ESG_p, c_{ESG}) \tag{8}$$

Similarly, the Morningstar Portfolio Controversy Deduction can also be considered as another TFN (*FPCD*):

$$FPCD_p = \left(\sum_{i=1}^n w'_i \cdot CD_i + \sum_{i=n+1}^{n+m} w'_i \cdot \min(CD_{PG(i)}), \quad PCD_p, \right. \\ \left. \sum_{i=1}^n w'_i \cdot CD_i + \sum_{i=n+1}^{n+m} w'_i \cdot \max(CD_{PG(i)}) \right) \tag{9}$$

where:

n is the number of securities in the portfolio that have a controversy score.

m is the number of securities in the portfolio that do not have a controversy score.

w'_i is the weight on security *i* considering all the securities, the ones with an ESG score and the non-scored ones, so $\sum_{i=1}^{n+m} w'_i = 1$.

$\min(CD_{PG(i)})$ and $\max(CD_{PG(i)})$ represent the minimum and maximum Morningstar Controversy Deduction, respectively, of the peer group to which the company that has issued security *i* belongs.

PCD_p is the Morningstar Portfolio Controversy Deduction.

To simplify the notation of Eq. (10), it can be defined as:

$$FPCD_p = (a_{CD}, PCD_p, c_{CD}) \tag{10}$$

Then, the Fuzzy Portfolio Sustainability Score (*FPSS*) is calculated using the difference between these two TFN, as follows:

$$FPSS_p = (a_{ESG} - c_{CD}, ESG_p - PCD_p, c_{ESG} - a_{CD}) \\ = (FPSS_p^{min}, PSS_p, FPSS_p^{max}) \tag{11}$$

Last, to apply the five-globe system and assign the Sustainability Rating to each portfolio, a total order of the *FPSS* of the different portfolios evaluated must be established. There is wide literature on methods for ordering TFN based on different criteria, but they all associate a crisp number with each TFN to obtain the total order (Chen, 1985; Rao & Shankar, 2013; Yager, 1978, 1981).

Conclusions

The growing importance of aspects related to ESG has led rating agencies to create and provide sustainability ratings at the company level and at the level of financial investments. Nowadays, there is greater social pressure around the behavior of companies because of the scandals involving large corporations, linked to a lack of transparency and ethical issues. To this effect, the market has started to consider companies' intangible assets such as good reputation, governance, and environmental aspects, among others.

In 2016, Morningstar launched the Morningstar Sustainability Rating, a five-globe system to help investors and managers use ESG information to evaluate mutual funds. This rating is obtained from the corporate ESG and controversy scores for each company provided by Sustainability, a leading provider of ESG research. In 2018, Morningstar improved this rating.

Nonetheless, this rating still has one important drawback. The Morningstar Portfolio Sustainability Score does not incorporate all the data because it is calculated without taking the characteristics of the portfolio assets that do not have an ESG score into account. Therefore, this theoretical paper contributes by proposing a new rating method which includes 100% of the portfolio assets, independently of the number of assets that have an ESG score. The lack of information is resolved using the Fuzzy Sets theory and, more specifically, Triangular Fuzzy Numbers (TFN). The inclusion of all assets in the fund valuation can produce more precise results compared to the Morningstar Portfolio Sustainability Score. Notably, the determination of TFN adopted in the *FPSS* improves the crisp approach.

This paper has both academic contributions and practical applications. In a theoretical sense, a novel way for rating the sustainability of a portfolio is proposed, the Fuzzy Portfolio Sustainability Score (*FPSS*), which essentially improves the existing methodologies by dealing with the drawbacks of rating expressed in the current academic literature. From a practical standpoint, this research adds value by providing a new method for investors to better understand the formation of portfolio rating scores to be considered in their decision-making. Furthermore, sustainability rating agencies can adopt the approach raised in this study to achieve more precise rating scores, particularly given the condition that the ESG and controversy scores may not be available for all assets in the portfolio.

¹ See Appendix.

The findings of this study can offer important insights in this field, but some limitations should be addressed. First, in proposing a theoretical rating model, this paper lacks empirical analysis. Hence, a future research line is to apply this method with empirical fund data to compare the ESG scores yielded. Second, since heterogeneity in rating criteria is observed among different rating agencies, a limitation of FPSS is that it was particularly derived based on the Morningstar Sustainability Rating for mutual funds. Future research may shed light on the matter by proposing other rating models for diverse rating agencies such as Refinitiv, Bloomberg, etc..

Last, the existing literature mainly focuses on the discussion of what factors or indicators contribute to the construction of ESG criteria. However, it is crucial to further study the methodological approach of score assignment based on the constructed ESG indicators of a portfolio.

Appendix

The concept of Fuzzy Sets was introduced by Zadeh in 1965. He developed a new theory capable of managing with uncertain information, which means adding more complexity but also has the advantage of obtaining more realistic results.

Definition 1. Fuzzy sets

Let X be a space of points (objects) formed by the elements x . A fuzzy set A in X is characterized by a membership function, $\mu(x)$, which associates a real number with each point in X in the interval $[0,1]$, with the value of $\mu(x)$ at x , representing the grade of membership of x in A .

Definition 2. Fuzzy number

A fuzzy number is a fuzzy set whose membership function, $\mu(x)$, is convex and normalized, and $x \in \mathbb{R}$.

Definition 3. Triangular Fuzzy Number

A Triangular Fuzzy Number (TFN) is a fuzzy number with the following membership function:

$$\mu(x) = \begin{cases} 0, & x < a \\ \frac{x-a}{b-a}, & a \leq x \leq b \\ \frac{b-x}{c-b}, & b \leq x \leq c \\ 0, & x > c \end{cases}$$

So, a TFN (Fig. 1) can be represented as $A = (a, b, c)$.

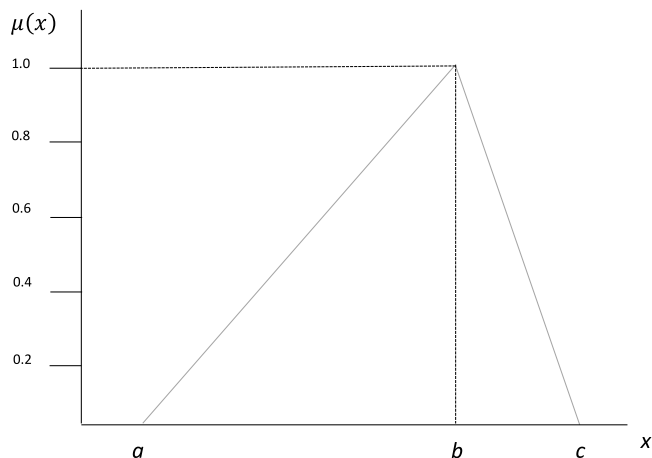


Fig. 1. A Triangular Fuzzy Number (TFN).

References

Alliance, G.S.I. (2018). *Global sustainable investment review* (Vol. 53). <https://doi.org/10.1017/CBO9781107415324.004>

Ammann, M., Bauer, C., Fischer, S., & Müller, P. (2019). The impact of the Morningstar Sustainability Rating on mutual fund flows. *European Financial Management*, 25(3), 520–553. doi:10.1111/eufm.12181.

Bak, C., Bhattacharya, A., Edenhofer, O., & Knopf, B. (2017). Towards a comprehensive approach to climate policy, sustainable infrastructure, and finance. *Economics*, 11(1), 1–13. doi:10.5018/economics-ejournal.ja.2017-33.

Barua, S., & Chiesa, M. (2019). Sustainable financing practices through green bonds: What affects the funding size? *Business Strategy and the Environment*, 28(6), 1131–1147. doi:10.1002/bse.2307.

Ben-Eli, M. U. (2018). Sustainability: Definition and five core principles, a systems perspective. *Sustainability Science*, 13(5), 1337–1343. doi:10.1007/s11625-018-0564-3.

Berg, F., Kölbl, J. F., & Rigobon, R. (2022). Aggregate confusion: The divergence of ESG ratings. *Review of Finance*, 1–30. doi:10.1093/rof/rfac033.

Billio, M., Costola, M., Hristova, I., Latino, C., & Pelizzon, L. (2021). Inside the ESG ratings: (Dis)agreement and performance. *Corporate Social Responsibility and Environmental Management*, 28(5), 1426–1445. doi:10.1002/csr.2177.

Chen, S. H. (1985). Ranking fuzzy numbers with maximizing set and minimizing set. *Fuzzy Sets and Systems*, 17, 113–129.

Clark, G. L. (2013). Mapping Financial Literacy : Cognition and the environment. *Geografiska Annaler*, 95(2), 131–145.

Cook, W., & Heibner, K. J. (1993). A multicriteria approach to mutual fund selection. *Financial Services Review*, 2(1), 1–20. doi:10.1016/1057-0810(92)90012-2.

Diez-Cañamero, B., Bishara, T., Otegi-Olaso, J. R., Minguez, R., & Fernández, J. M. (2020). Measurement of corporate social responsibility: A review of corporate sustainability indexes, rankings and ratings. *Sustainability (Switzerland)*, (5), 12. doi:10.3390/su12052153.

Dörny, S., & Schulz, C. (2018). Green financing, interrupted. Potential directions for sustainable finance in Luxembourg. *Local Environment*, 23(7), 717–733. doi:10.1080/13549839.2018.1428792.

Elkington, J. (1994). Towards the sustainable corporation: Win-Win-Win business strategies for sustainable development. *California Management Review*, 36(2), 90–100. doi:10.2307/41165746.

Elkington, J. (1997). *Cannibals with forks: The triple bottom line of 21st century business*. Oxford, UK: Capstone Publishing Ltd.

ERM. (2019). *Rate the raters 2019: Experts views on ESG ratings*. Retrieved from <https://sustainability.com/our-work/reports/rate-raters-2019/>

Escrig-Olmedo, E., Fernández-Izquierdo, M.Á., Ferrero-Ferrero, I., Rivera-Lirio, J. M., & Muñoz-Torres, M. J. (2019). Rating the raters: Evaluating how ESG rating agencies integrate sustainability principles. *Sustainability*, 11(3), 915. doi:10.3390/su11030915.

Escrig-Olmedo, E., Muñoz-Torres, M. J., Fernández-Izquierdo, M.Á., & Rivera-Lirio, J. M. (2014). Lights and shadows on sustainability rating scoring. *Review of Managerial Science*, 8(4), 559–574. doi:10.1007/s11846-013-0118-0.

Escrig-Olmedo, E., Muñoz-Torres, M. J., Fernández-Izquierdo, M.Á., & Rivera-Lirio, J. M. (2017). Measuring corporate environmental performance: A methodology for sustainable development. *Business Strategy and the Environment*, 26(2), 142–162. doi:10.1002/bse.1904.

Fabregat-Aibar, L., Barberà-Mariné, M. G., Terceño, A., & Pié, L. (2019). A bibliometric and visualization analysis of socially responsible funds. *Sustainability (Switzerland)*, 11(9), 1–17. doi:10.3390/su11092526.

Ferrero-Ferrero, I., Fernández-Izquierdo, M.Á., & Muñoz-Torres, M. J. (2016). The effect of environmental, social and governance consistency on economic results. *Sustainability*, 8(10), 1005. doi:10.3390/su8101005.

Figge, F., Hahn, T., Schaltegger, S., & Wagner, M. (2002). The Sustainability Balanced Scorecard - linking sustainability management to business strategy. *Business Strategy and the Environment*, 11(5), 269–284. doi:10.1002/bse.339.

García, González-Bueno, Oliver, & Riley (2019). Selecting socially responsible portfolios: A fuzzy multicriteria approach. *Sustainability*, 11(9), 2496. doi:10.3390/su11092496.

INVERCO. (2018). *Las instituciones de inversión colectiva y los fondos de pensiones*. Retrieved from <http://www.inverco.es/archivosdb/c87-ahorro-financiero-de-las-familias-iics-y-fp-2017.pdf>

Johnson, S. D. (1998). Application of the balanced scorecard approach application of the balanced scorecard approach. *Corporate Environmental Strategy*, 5(4), 34–41.

Kaplan, R. S., & Norton, D. P. (1996). *Translating strategy into action. The balanced scorecard*. Boston: Harvard Business School Press.

Kasemir, B., Süess, A., & Zehnder, A. J. B. (2001). The next unseen revolution pension fund investment and sustainability. *Environment: Science and Policy for Sustainable Development*, 43(9), 8–19. doi:10.1080/00139150109604511.

Khemir, S. (2019). Perception of ESG criteria by mainstream investors: Evidence from Tunisia. *International Journal of Emerging Markets*, 14(5), 752–768. doi:10.1108/IJOEM-05-2017-0172.

Koellner, T., Weber, O., Fenchel, M., & Scholz, R. (2005). Principles for sustainability rating of investment funds. *Business Strategy and the Environment*, 14(1), 54–70. doi:10.1002/bse.423.

Liern, V., & Pérez-Gladish, B. (2018). Ranking corporate sustainability: A flexible multi-dimensional approach based on linguistic variables. *International Transactions in Operational Research*, 25(3), 1081–1100. doi:10.1111/itor.12469.

Lozano, R. (2008). Envisioning sustainability three-dimensionally. *Journal of Cleaner Production*, 16(17), 1838–1846. doi:10.1016/j.jclepro.2008.02.008.

Lozano, R. (2015). A holistic perspective on corporate sustainability drivers. *Corporate Social Responsibility and Environmental Management*, 22(1), 32–44. doi:10.1002/csr.1325.

Muñoz-Torres, M. J., Fernández-Izquierdo, M.Á., Rivera-Lirio, J. M., Ferrero-Ferrero, I., Escrig-Olmedo, E., Gisbert-Navarro, J. V., et al. (2018). An assessment tool to

- integrate sustainability principles into the global supply chain. *Sustainability*, 10(2). doi:10.3390/su10020535.
- Popescu, I. S., Hitaj, C., & Benetto, E. (2021). Measuring the sustainability of investment funds: A critical review of methods and frameworks in sustainable finance. *Journal of Cleaner Production*, 314,(May) 128016. doi:10.1016/j.jclepro.2021.128016.
- Rao, P. P. B., & Shankar, N. R. (2013). Ranking fuzzy numbers with an area method using circumcenter of centroids. *Fuzzy Information and Engineering*, 5, 3–18.
- Scalet, S., & Kelly, T. F. (2010). CSR rating agencies: What is their global impact? *Journal of Business Ethics*, 94(1), 69–88. doi:10.1007/s10551-009-0250-6.
- Singh, R. K., Murty, H. R., Gupta, S. K., & Dikshit, A. K. (2012). An overview of sustainability assessment methodologies. *Ecological Indicators*, 15(1), 281–299. doi:10.1016/j.ecolind.2011.01.007.
- Steen, M., Moussawi, J. T., & Gjolberg, O. (2019). Is there a relationship between Morningstar's ESG ratings and mutual fund performance? *Journal of Sustainable Finance and Investment*, 0(0), 1–22. doi:10.1080/20430795.2019.1700065.
- Windolph, S. E. (2011). Assessing corporate sustainability through ratings: Challenges and their causes. *Journal of Environmental Sustainability*, 1(1), 1–22. doi:10.14448/jes.01.0005.
- Yager, R. R. (1978). Ranking fuzzy subsets over the unit interval. *IEEE Conference on Decision and Control*, 1435–1437. doi:10.1109/cdc.1978.268154.
- Yager, R. R. (1981). A procedure for ordering fuzzy subsets of the unit interval. *Information Sciences*, 24, 143–161.
- Zadeh, L. A. (1965). Fuzzy sets. *Information and Control*, 8, 338–353.