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ORIGINAL PAPER

The Influence of Firm Size on the ESG Score: Corporate Sustainability Ratings Under Review

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Abstract
The concept of sustainable and responsible (SR) investments expresses that every investment should be based on the SR investor's code of ethics. To a large extent the allocation of SR investments to more sustainable companies and ethical practices is based on the environmental, social, and corporate governance (ESG) scores provided by rating agencies. However, a thorough investigation of ESG scores is a neglected topic in the literature. This paper uses Thomson Reuters ASSET4 ESG ratings to analyze the influence of firm size, a company's available resources for providing ESG data, and the availability of a company's ESG data on the company's sustainability performance. We find a significant positive correlation between the stated variables, which can be explained by organizational legitimacy. The results raise the question of whether the way the ESG score measures corporate sustainability gives an advantage to larger firms with more resources while not providing SR investors with the information needed to make decisions based on their beliefs. Due to our results, SR investors and scholars should reopen the discussion about: what sustainability rating agencies measure with ESG scores, what exactly needs to be measured, and if the sustainable finance community can reach their self-imposed objectives with this measurement.

Keywords Data availability · ESG rating · Firm size bias · Measurement of corporate sustainability · Organizational legitimacy · Sustainable and responsible investment (SRI)

JEL Classification C33 · M14 · L25

Introduction

Sustainable finance has gained more and more attention: for investors worldwide (Global Sustainable Investment Alliance (GSIA) 2017), in European (European Commission 2018) and international politics (G20 Green Finance Study Group 2017)[1] as well as in the research community. A core question in sustainable finance research has been the relationship between corporate sustainability performance (CSP) and corporate financial performance (CFP). More than 2200 empirical studies have examined the relationship between CFP and environmental, social, and corporate governance (ESG) criteria, as a proxy for CSP (Friede et al. 2015). Virtually all of these studies use data from sustainability rating agencies to quantify sustainability. Less often discussed is what these agencies really measure with ESG scores, and what sustainable and responsible (SR) investors and researchers want the scores to measure. This paper suggests that some ESG scores do not provide the information researchers and SR investors need for their analyses.

To understand the idea of sustainable finance, it is important to know what an ESG score, as a proxy for CSP, should measure for the user. For this reason, it is necessary to define the aim of sustainable finance. Soppe (2004)

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[1] For the development and the growing attention, it is irrelevant that some of the political initiatives are not really 'sustainable finance', because the focus is often only on the environment and so it should actually be considered green finance.

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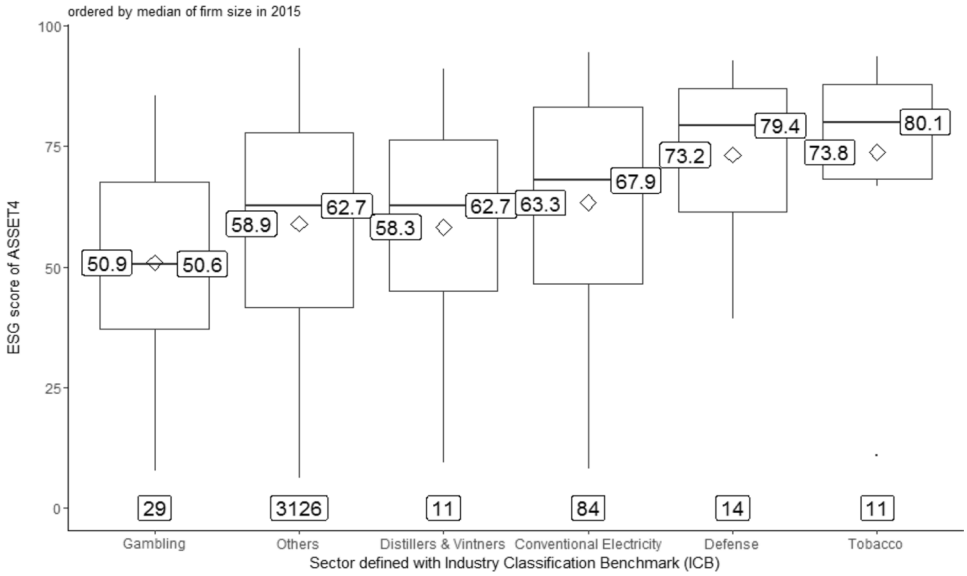

Fig. 1 ESG Scores for controversial branches. Figure shows boxplots of five as controversial identified branches and compares this with the remaining companies in the ASSET4 universe (Others). The sectors are aggregated by the Industry Classification Benchmark (ICB). Nuclear power is included in conventional electricity and adult entertainment is not presented. The subsets are ordered by the median of market capitalization in the subset. The *y*-axis provides the mean of the three ESG-pillars (environmental, social and corporate governance) from ASSET4. The diamond and the number on the left give the mean of the ESG score in the subset. The number on the right provides the median in the subset. The number on the bottom gives the number of companies in the subset

views sustainable finance as a "virtue-ethical approach" and claims that intergenerational justice is an aim of sustainable finance. This definition agrees with various international commitments, e.g., the sustainable development goals (SDGs). One way to reach this goal should be by channeling capital towards more sustainable companies. The growing market and the "mainstream" process of sustainable finance (Revelli 2017; Erragragui and Lagoarde-Segot 2016), can be explained by the neo-institutional theory. This theory claims that in the approach of organizational legitimacy, the survival of a company depends on their acceptance by society (DiMaggio and Powell 1983; Meyer and Rowan 1977).

Independent of the different approaches that are available, the question of what is a (more) sustainable corporation is important in order to fulfill the objectives to foster sustainability within the economy. Most SR investors are unable to assess the sustainability of companies on their own, and therefore, rely heavily on the ESG scores provided by sustainability rating agencies which have been established within the market as intermediaries. Sustainability rating agencies collect information from the public as well as directly from companies to calculate ESG scores with thorough and sophisticated methods. According to the neo-institutional theory, sustainability rating agencies assess the legitimacy of the company with an ESG score. SR investors pay rating agencies for ESG scores—among other reasons—to reduce the information asymmetry (Cho et al. 2013; Cui et al. 2016). This information is then used, alongside financial criteria, as the basis for an investment decision (e.g., ESG data are necessary for best-in-class or ESG integration strategies).

Because morals and ethics are different between SR investors, the definition of a SR investment as well as a sustainable company tends to differ as well. However, it looks like there is a predominant consensus for the exclusion criteria. Lobe and Walkshäusl (2016, p. 303) wrote of a "Sextet of Sin: adult entertainment, alcohol, gambling, nuclear power, tobacco, and weapons." These business fields are generally excluded in SR investment indices. This result is similar to the study from Eurosif (2018) which identifies the following top exclusion criteria for investors: weapons, tobacco, gambling, pornography, nuclear energy, alcohol, genetically modified organism (GMO), and animal testing. These business fields are considered unethical by most SR investors. In our initial idea, these business fields were less sustainable than other sectors and with this background we were surprised by Fig. 1, which compares CSP measured by the ESG score from the ASSET4 database.

Figure 1 shows the four quartiles and the mean of ESG scores based on the three pillars (environmental, social, and corporate governance) of the ASSET4 database provided by Thomson Reuters. The abscissa presents the most often excluded sectors by SR investors (Lobe and Walkshäusl 2016; Eurosif 2018) as well as the remaining companies in the coverage ("Others"). It looks as if the sectors were arranged according to the median of the ESG score;

however, this is not the case. The sectors were sorted according to the median firm size, measured by the market capitalization. This observation cannot be considered evidence, but it is a curious find. Nonetheless, why do most of these sectors, which are shunned by SR investors, and which are thought to not be 'sustainable' business fields, have better scores than the remaining companies in the ASSET4 universe?

Based on this background, the research question in this paper is as follows: Does the size of a company have an influence on the assessment of the sustainability, the ESG score, and why? This study hypothesizes that larger firms often use more resources for providing ESG data, and consequently, larger companies also provide more data for the ESG databases of the rating agencies. This correlates positively with the ESG score provided by ESG raters. So then, does this also mean that larger firms are more sustainable than smaller firms, or do larger firms only have a better sustainability reporting, which supports a better ESG score/rating?

Assuming that SR investors want to contribute to global development and support climate change mitigation, this research focuses on greenhouse gases (GHG) as a proxy for the environmental score. We use GHG emissions as a variable that does not measure ESG activities but is an actual objective ESG outcome that is rather independent of the resources a firm has to engage in reporting.[2] We discuss two reasons to justify using GHG as a suitable proxy. First, the political and practical development focuses on the realization of the SDG and the Paris Commitment with a focus on climate mitigation (High-Level Expert Group on Sustainable Finance 2018; European Commission 2018), and supports the discussion about the carbon risk of portfolios. These movements concentrate on the reduction of the GHG emission. Second, GHG measured by carbon dioxide emission equivalents are an accepted and well used operationalization in business research (Qian and Schaltegger 2017; Jung et al. 2018). If larger firms are more sustainable than smaller firms, then they should have less GHG emission scaled by firm size (GHG intensity). One reason could be that larger firms can use scale effects to reduce GHG intensity. However, this research postulates that larger firms do not use the scale effects of their firm size to produce less GHG intensity than smaller firms.

To shed light on our research questions, we used the ASSET4 database of Thomson Reuters, which contains over 6000 companies. Our results from the linear mixed-effects model (LMM) demonstrate that firm size variables (along with a 1-year lag) as well as the other independent variables have a highly significant influence on the ESG score. Furthermore, all firm size variables correlate positively and significantly with the data availability (DA) and the resources for providing ESG data (RPD). The general structural equation model (SEM) indicates direct and indirect effects on the ESG score in agreement with the LMM. This implies that larger companies more often have the resources for ESG data disclosure. More resources lead to more available data in the ESG database, and more available data, regardless of whether it is directly positive or negative, raises the overall sustainability assessment of the company made by Thomson Reuters. So the SEM gives one explanation for why larger firms have a better ESG score. However, the regression results for firm size, RPD and DA on GHG intensity are not as clear cut and depend on the scope of GHG. Considering GHG scopes 1, 2, and 3 shows that larger companies do not have less GHG intensity. This suggests that larger companies are not, in principle, more sustainable than smaller corporations, regarding the Paris Agreement on climate change mitigation targets despite their higher environmental and ESG scores.

Summarized, our results indicate that the current ESG scores do not realistically measure the sustainability performance of a company: They depend on firm size, which mainly determines the data availability and resources for providing ESG data. When provocatively formulated, we could propose that it may be better for companies to invest in sustainability reporting, rather than in sustainability activities or impact. But this is most likely not the incentive which ESG rating agencies want to support and the same can be said about the SR investors. In this case, the rating agencies only provide as much information as a company reports, but do not reduce the asymmetrical distribution of CSR information for the SR investors.

The contributions of this paper are manifold. Firstly, this paper discusses the triangular relationship between sustainability reporting, corporate sustainability measurement and ESG scoring. Compared with the amount of agencies and the importance of ESG data for research, the efforts to compare ESG score results (Chatterji et al. 2014; Hedesström et al. 2011) or to analyze the transparency of ESG agencies (Chatterji et al. 2009; SustainAbility and GlobeScan Inc. 2013; Windolph 2011) is sparse and insufficient (Hoepner et al. 2016; Windolph 2011). We will not completely answer the question if larger companies are more sustainable than smaller companies, but we contribute one crucial piece to the puzzle. The results indicate that the ESG score is distorted in favor of larger companies, because ESG scores are dependent on resources for providing ESG data and data availability of the ESG score. That explains why sin stocks with above average firm size have a better ESG score than the remaining companies (see Fig. 1). Secondly, this paper

[2] Obviously, there are many more possible variables that could be used in this respect, but it is beyond the scope of this paper to look at them.

seeks to contribute to the development of the measurement of CSP thereby supporting the aim of sustainable finance to reallocate funds towards more sustainable companies. Due to our results, ethical investors must be cautious when using ESG scores since they may lead to a misallocation of funds with respect to the sustainability goals of the investor. This also means that the first main objective of the *Action Plan of the European Commission* (2018) is not solvable with only ESG integration and/or a best-in-class approach. In addition, exclusion criteria are necessary to reallocate capital to more sustainable companies. Thirdly, this paper seeks to contribute to helping rating agencies and SR investors in optimizing the rating criteria while focusing more on the core business of the company; which has already been stipulated by other scholars in this field, e.g., Windolph (2011). The further development of ESG scores is necessary in order to not undermine the idea of sustainable finance as part of the mainstreaming process.

The following section reviews the existing literature. We start by embedding sustainable finance in the neo-institutional theory and we review why companies invest in sustainability reporting. Further, we discuss the existing results and deduce the hypothesis in section two. For the testing of the hypotheses, we explain in the third section the LMM and the SEM as well as the implemented variables. The results as well as further analysis and robustness checks are presented in section four. In the fifth section, we discuss the results and implications for both research and practice. The last section, the conclusion, presents the main contributions and consequences of the findings of this paper.

Related Literature and Hypotheses

The definition of sustainable finance and the associated terms are often defined by the process of SR investment: a consideration of ESG criteria in the selection process beyond financial criteria (Hoepner et al. 2016). 'Sustainable finance' is an umbrella term for many mostly equivalently used terms: social finance; ethical-sustainable investment; socially responsible investment; sustainable responsible investment; etc. (Rizzi et al. 2018; Busch et al. 2016). Independent of the wording, the approach differs fundamentally from the concept of traditional finance (the maximization of the shareholder value without considering the externalities, e.g., consequences for the environment and society) (Soppe 2004). Managerial responsibility in one single company for global problems (global warming, loss of biodiversity, poverty, hunger, inequalities in income, etc.) is, in the traditional view, not entirely explainable (Schaltegger and Hörisch 2017).

Soppe (2004, p. 221) describes "sustainable finance as 'a financial policy that strives for triple bottom-line performance measurement with human actors that opt for maximizing multi-dimensional preference functions'". This definition focuses on the inherent idea of sustainability: intergenerational justice—caring about present and future generations at the same time. Sustainable finance also involves the first idea of ethical investment: the investment should adhere to the same ethical principles as the investor (Sparkes and Cowton 2004; Boatright 2014). Accordingly, funding should not support companies that do not comply with the ethical preferences of the investor. This look at the past explains one reason why the more predominantly used approach in sustainable finance is the adaption of exclusion criteria (Eurosif 2018) and in the majority of cases, the ethical approach conforms with the path of sustainable development, which is then mostly operationalized with the sustainable development goals (SDG). Furthermore, the idea exists to "shift corporate behaviour towards more sustainable patterns of production and consumption" (O'Rourke 2003, p. 684) by steering the flow of capital towards more sustainable companies. This idea is also one of the main aims of the European Commission (2018) described in its action plan.

The idea of sustainable finance is connected with the theory of firms (Boatright 2014; Soppe 2004). Different theories argue that the responsibility of corporations for society goes beyond the creation of shareholder value and, for example, includes caring for the environment, explaining why companies invest in sustainability (Hahn 2005; Baldini et al. 2016; Schaltegger and Hörisch 2017). The neo-institutional theory[3] agrees with this reasoning. It claims that the survival of companies depends on their legitimacy by the society: conformity with the expectations by (near and far) environment (Hasse and Krücken 2009; Meyer and Rowan 1977; DiMaggio and Powell 1983). This theory is empirically supported in a lot of other research, for example Singh et al. (1986, p. 171) found support for the thesis that environmental legitimacy can explain the "higher propensity of younger organisation to die". Many other studies explain the incorporation of sustainability management, as well as the disclosure of sustainable reports, etc. in gaining and securing legitimacy (Schaltegger and Hörisch 2017; Hahn and Kühnen 2013; Baldini et al. 2016).

The transfer of neo-institutional theory to an investment trust could possibly be interpreted as an observation of the second order. That means that the investment company also

[3] Some authors combine the institutional and legitimacy theories and comment that they "tend to overlap and cannot be considered mutually exclusive" (Baldini et al. 2016, p. 2). Suchman (1995, p. 571) views "organizational legitimacy" as the core concept of the "intellectual transformation" of the institutional theory. But it is also used in other theories (Reast et al. 2013; Meyer and Rowan 1977). This paper sees (organizational) legitimacy and legitimacy 'theory' as a part of the neo-institutional theory like Schaltegger and Hörisch (2017).

has the commitment to earn its legitimacy from society by adhering to a society's beliefs and norms, while executing its core business of investing. The legitimacy of an investment company with the society is earned once that investment itself has the approval, or legitimacy, of that society. Sustainability ratings are used by investment companies to demonstrate the legitimacy and an ethical business practice of the company for (SR) investors. Sustainable development[4] can be one orientation for the financial industry to receive legitimacy and at the same time is a core element of the definition of sustainable finance (Busch et al. 2016). This argumentation explains the "mainstreaming of ethical investment" (Revelli 2017; Erragragui and Lagoarde-Segot 2016) by the financial industry. With knowledge of the financial industry's perspective, we are able to focus on the investment object, the company.

Information is crucial in evaluating the sustainability of a company, in the same way as it is when evaluating company risk. The demand for transparency is comprehensible and as such, more and more companies publish (voluntary) sustainability reports (Döpfner 2016; King and Bartels 2015). Additionally, regulators require more and more transparency from companies (European Parliament and Council of the European Union 2014). Different types of reporting instruments exist in a country and they target various types of companies.[5] 65% of the 381 identified reporting instruments in 71 countries are mandatory (Bartels et al. 2016). ESG rating agencies and the rating object (the stock company) are in an interesting relationship: Schäfer (2011) describes this relationship as unilateral and contractual. Compared to conventional credit ratings, sustainability ratings are mostly 'unsolicited ratings' (Schäfer 2005) or 'co-operative ratings', when the company supports the rater with further information (e.g., filling in a questionnaire). The company does not request the rating and does not pay for the ESG rating. The ESG rating is charged to and paid by the investors (Kopp 2016). The important difference and advantage of unsolicited ratings is the independency of the rating subject (rater) from the rating object (company) and the commitment to the client (investor) (Döpfner 2016).[6] However, the rating agency relies on ESG information from the rating object and other external sources. This reliance can lead to reduced data quality when compared with solicited ratings. The company receives no financial compensation for its data provision efforts from the rating agency. So why does a company use its own resources to provide information, for example, by producing sustainability reports beyond legal regulations? Schaltegger and Hörisch (2017) provide two directions of argumentation: the organizational legitimacy and the profit-oriented. The latter can be described as follows: The provision of CSR information is a strategic investment to promote the reputation of the company, which is an intangible asset (Lewis 2003; Schwaiger et al. 2016; Parguel et al. 2011; Gardberg and Fombrun 2006; Chen et al. 2017). If CSR reporting is helpful in increasing corporate reputation, as illustrated previously, we can conclude that corporations anticipate better financial performance with an increase in reputation (Wang et al. 2016). Empirical evidence to this effect is readily available, for example, Schadewitz and Niskala (2010, 104) concluded that "communication via Global Reporting Initiative (GRI) standard is an important explanatory factor for a firm's market value". Searcy and Elkhawas (2012) provide insights through a survey, that Canadian corporations use signaling with the Dow Jones Sustainability Index (DJSI) also for reputable reasons. Schwaiger et al. (2016) found that an improved reputation bolsters the confidence of clients, supports the acquisition of new and long-term commitment from current employees, and reduces the cost of raising capital. Capelle-Blancard and Petit (2017a) found that positive ESG news, which includes green-washing, reduces the financial penalties of the market from negative ESG news. So good ESG reputation is not only helpful for better financial performance, it additionally protects against risks stemming from negative news. However, Schaltegger and Hörisch (2017) show with an online survey that the ESG disclosure by corporations was primarily "legitimacy-seeking" and not profit-oriented. The company strives to fulfill the expectation of society regardless of its profitability. This realization conforms to the idea of the "license to operate" from the stakeholder theory (Deegan 2002) and the risk of "blaming and shaming" in front of the stakeholders (Schäfer 2011). Further, it supports the neo-institutional theory with the organizational legitimacy that organizations have a need to explain that they are operating in a responsible way (Hahn and Kühnen 2013). Besides the neo-institutional theory, other approaches are stated to explain the provision of corporate sustainability information (Pérez 2015).

The stakeholder theory (Freeman 1984), a concept which was developed primarily for large firms but is also suitable for small companies (Blombäck and Wigren 2009, p. 261; Jenkins 2006), uses similar arguments to the neo-institutional theory: Companies communicate by disclosing information to their stakeholders to retain a "license to operate"

[4] Sustainable development is mostly defined as a "development which meets the needs of current generations without compromising the ability of future generations to meet their own needs" (Brundtland and Khalid 1987).

[5] 30% of all instruments apply to large listed companies, 40% to all company sizes and around 20% to specific industry sectors (Bartels et al. 2016).

[6] Sustainability ratings paid for by companies are rather unusual but getting more attention with the growing green bond market (Eurosif 2018) and second party opinions, paid by the issuer of the bond (Schneeweiß 2016).

(Gangi and D'Angelo 2016). The argument in this case is that larger firms have higher public pressure (Udayasankar 2008) and they use the CSR reporting as a form of justification to stakeholders in a broader sense. Moreover, Adams et al. (1998) found that CSR reporting differs, among other factors, based on company size: Larger companies disclose more information than smaller companies. They explain this result with the perspective of legitimacy view. Vormedal and Ruud (2009) disagreed with these findings for the Norwegian private sector, measuring size by turnover.

Another line of argumentation is used by Graafland et al. (2003). They note that larger firms use more instruments to analyze and report ethical and sustainable behavior. They also argue that competitiveness as well as cost pressure between smaller firms is higher. Furthermore, the provision of sustainability data is costly. Hutton et al. (2001) identified the communication spending for social responsibility as the third-largest budget item for corporate communication departments in the Fortune 500 companies. Apart from this, it is unknown how much a company spends only on CSR reporting. In any event, the number of CSR reports has grown in the last years (Pérez 2015; King and Bartels 2015) and the results from Chauhan (2014) indicate that the CSR expenditure grows with firm size. The crucial finding of the research in this field is that small and large firms differ in the structuring and formalization of ESG reporting. Hörisch et al. (2015) found that larger firms have more knowledge of sustainability management tools (e.g., environmental management systems or sustainability balanced scorecards) compared to small firms. Additionally, they show that the application rate of sustainability management tools depends more on the knowledge of the company than on company size, but that the knowledge is greater for larger companies. Hörisch et al. (2015) using the knowledge based view for their argumentation, suggest that human and financial resources are needed for the advancement of knowledge within smaller firms. These findings support the theory that larger firms have more (slack) resources for sustainability management tools (Gallo and Christensen 2011), and by having sustainability management tools, larger firms have a more formal reporting structure than smaller firms. However, smaller firms tend to use more informal communication regarding CSR activities (Baumann-Pauly et al. 2013). Other authors suggest a correlation between company size and information disclosure (Gray et al. 1995; Gao et al. 2005; Naser et al. 2006; Hou and Reber 2011; Prado-Lorenzo and Garcia-Sanchez 2010; Veronica Siregar and Bachtiar 2010; Hahn and Kühnen 2013). Furthermore a literature review by Hahn and Kühnen (2013) verifies that the firm size is the only internal determinant which consistently and positively affects sustainability reporting. This verification supports the observations of the SAM ranking by Fowler and Hope (2007), which suggest that the DJSI process favors larger companies among others because of the resources for interaction with SAM and completing the questionnaires of the rating agency.

In summary, it seems that larger firms have more resources and more often use reporting tools to provide ESG data. Further, the research hypothesizes that the resources for providing ESG data have an influence on the data availability in the ESG database of the rating agency. That hypothesis is based on the fact, that Thomson Reuters uses only public information for the ASSET4 database. The provision of more information by the company leads to more available data in the database. Accordingly, we formulate the following two hypotheses:

H1 Company size (SIZE) positively influences the resources for providing ESG data (RPD).

H2 RPD positively influences the data availability (DA) in the ESG database of the rating agency.

Furthermore, we consider the results of Baumann-Pauly et al. (2013, p. 700), who found in a qualitative, empirical study that multi-national companies are better in CSR communication "often without substantial implementation in organizational practices", compared to small and medium-sized enterprises (SMEs), which poorly communicate their superior implementation of CSR activities. This discrepancy in larger companies between reporting and implementing, mentioned by Baumann-Pauly et al. (2013), can also be explained by the neo-institutional theory. Meyer and Rowan (1977, p. 360) already described the decoupling phenomenon of the legitimacy-seeking organization, in which sustainability standards or policies can be decoupled from the implementation to maintain legitimacy without changing the structure. Gallo and Christensen (2011), in an exploratory study, found that the production of more complex sustainability reports (compared with the one-dimensional social or environmental reports) increases with the size of the company. These complex reports fit to the ESG data requirements of rating agencies, which use a multi-dimensional data tool. We presume that larger companies have more structured, institutionalized, and complex reporting, which supports data availability. This idea is supported by Baldini et al. (2016), who stated that the availability of data (CSR disclosure) in the Bloomberg database depends on the firm visibility measured, among other variables, by market value of the company. In this case, we hypothesize that data availability correlates positively with the company size.

H3 SIZE influences DA.

The non-availability of information will be interpreted as "bad news" (Schreck and Raithel 2015; Verrecchia 2001). So the punishment of non-availability is inherent in the measurement system of sustainable rating agencies. Basically, this is a non-trust-system. This punishment is documented by Hughey and Sulkoski (2012). They observe, based on 45 companies in the oil and gas sector, that CSR reputation is higher when there are more available data points. They also found that the availability of data rises with the size and the age of the company. Gangi and D'Angelo (2016) demonstrate that the CSP drives the information disclosure and the information disclosure drives the CSP in a reciprocal cycle.

H4 DA positively influences the ESG score.

With a focus on environment, one pillar of sustainability, Clarkson et al. (2008) and Clarkson et al. (2011) verified a positive association between disclosure in environmental and social responsibility reports with environmental performance. We go one step further and analyze the environmental as well as the social and corporate governance dimensions. We also interpret the existence of environmental, social, or sustainability reports as the existence of resources for providing ESG data. So the results of Clarkson et al. (2008) support our model. We suggest that the resources for providing ESG data (e.g., sustainability reports) have an influence over the data availability (see H2) on the ESG score.

H5 Increased RPD positively influence the ES(G) score.

Blombäck and Wigren (2009) claim that the understanding of the concept of CSR does not differ by company size and suggest not treating small and large firms differently when comparing CSR activities. However, Russo and Perrini (2010, p. 207) argue that "the idiosyncrasies of large firms and SMEs explains the different approaches to CSR". The empirical results make it clear that company size exerts some type of influence on CSR activities (Hörisch et al. 2015). For example, Darnall et al. (2010, p. 1088) found "smaller firms adopt fewer proactive environmental practices than their larger counterparts". That larger firms have more CSR activities is often explained by the visibility of larger firms. The greater publicity and the more exposed position lead to higher public pressure and more CSR activities (Udayasankar 2008; Hörisch et al. 2015). Remembering the results of Baumann-Pauly et al. (2013), that larger companies are better in CSR communication and considering that reputation is, for every company, one of the greatest immeasurable and well-kept resources (Gardberg and Fombrun 2006), in particular amongst larger firms (Lewis 2003), it is obvious that companies provide ESG rating agencies with data without financial compensation. In empirical studies the influence of the company size on the ESG score is generally taken into consideration and for that reason firm size is often used as a control variable, with differing results (Waddock and Graves 1997; Wagner et al. 2002). In accordance with the above, we hypothesize that:

H6 SIZE from the previous year positively influence the ES(G) score.

The different hypotheses yield the following model: SIZE as well as DA and RPD influence directly and positively the ESG score. Both company size and RPD also indirectly influence the ESG score through DA. We further postulate with H1–H3 and H6 that DA and RPD have a mediator effect on the ESG score.

H7 SIZE directly and indirectly influences the ES(G) score by means of RPD and/or DA.

A correlation between the stated variables can be supported or disproved by testing the stated hypotheses with a LMM. If we find a significant coefficient, then statistically speaking the independent variables have an influence on the dependent variable. H1–H7 can answer our first research question: if firm size, DA and RPD have an influence on the ESG score. Furthermore, the mediator effect (H7) can be one explanation for an influence of the company size on the ESG score. This does not, however, answer the second question: if larger firms have an advantage in the rating process due to RPD and/or DA. A holistic answer to this question goes beyond the scope of this paper and more research is necessary. However, we make a first attempt to shed light on this question by using GHG emissions as a variable that does not measure ESG activities (e.g., sustainability reporting) but is an actual objective ESG outcome that is rather independent of the resources a firm has to engage in reporting. Through the Greenhouse Gas (GHG) and Kyoto protocols as well as the EU Trading Scheme and further initiatives [e.g., Carbon Disclosure Project (CDP)], a comparable measurement of GHG exists. Carbon dioxide and further GHGs are converted into a carbon dioxide equivalent (CO_2-eq) (Boone et al. 2012a). In order to compare smaller and larger companies the GHG emission is divided by company size, also called GHG intensity.

By comparing the ESG score (or the separated pillars of the score like the environmental pillar) with GHG intensity it is only possible to show if the two proxies do or do not converge. Analyzing the different methods and results of the six major ESG raters reveals a "fairly low correlation" (Chatterji et al. 2014), but this does not prove which company is more sustainable than the other. Further, Delmas and Blass (2010, p. 245) analyzed 15 companies in the chemical sector with the result that "firms that have the most advanced reporting

and environmental management practices tend also to have higher levels of toxic releases and lower environmental compliance". In our research, we assume that GHG intensity is a proxy for the environmental score. Because GHG is a central part of the Paris Agreement on climate change mitigation. We analyze if our stated independent variables (firm size, DA, RPD) have negative influence on the environmental score. The interpretation reads as follows: larger companies are producing less GHG per unit e.g., Euro of market capitalization or heads of employee. If this is the case, we can assume that larger firms are more sustainable than smaller companies. If firm size has no consistent or positive influence on the GHG intensity, it will support our hypothesis that larger firms tend to have a better ESG score but not a better ESG—in this example environmental—performance.

Scopes 1 and 2 of GHG are generally used in research by discussing the influence of the company on the emission (Doda et al. 2016) and the comparability of the emission results (Busch et al. 2018). So first the GHG intensity is measured with scopes 1 and 2.

H8a SIZE, DA and RPD have no or positive influence on the GHG intensity (scopes 1 and 2).

Measuring scope 3 is difficult and often not under the control of the company (Boone et al. 2012b). But also, even if scope 3 is less used in research, it is recommended to monitor all three scopes in business (King and Bartels 2015; Task Force on Climate-related Financial Disclosures 2017). Further scopes 1 and 2 exclude mostly outsourced activities (World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) 2004), which gives an advantage to companies with a large supply chain and more outsourced activities. So in a second step we compare the influence of firm size on the GHG intensity including scope 3.

H8b SIZE, DA and RPD have no or positive influence on the GHG intensity (scopes 1, 2 and 3).

Data and Methods

Sample Overview and Data Description

The ASSET4 database from Thomson Reuters is utilized in our research because it is readily available for many investors and scholars. The ASSET4 database contains over 6000 companies[7] and serves as a database for many research articles (Aouadi and Marsat 2016; Stellner et al. 2015; Tarmuji et al. 2016; Hawn and Ioannou 2016; Esteban-Sanchez et al. 2017; Gonenc and Scholtens 2017; Al-Shaer and Zaman 2017; Benlemlih et al. 2016). ASSET4 enjoys a high, but not the best (rank 14), level of credibility by experts identified by the project Rate the Raters (Rahdari and Anvary Rostamy 2015; SustainAbility and GlobeScan Inc. 2013). ASSET4 has a big advantage over other ESG databases in regards to research: All data points, the questions to each data point, and also the metric is public and transparent, which allows for a more transparent and deeper insight for scholars.

Our data set contains 3828 different companies in the period between 2004 and 2015 because the database does not have all ESG score data for every company and some other data points were unavailable (NA). More than half of these companies are located in four countries: the USA (26.54%), Japan (10.27%), Great Britain (8.31%) and Canada (6.58%). If we classify the companies with the industry classification benchmark (ICB) (based on the Datastream industry level 2), then more than 50% of the companies are assigned to the following three sectors: Financials (20.40%), Industrials (18.81%) and Consumer Services (13.43%). Because the ASSET4 database has missing data points, we analyzed an unbalanced data set from 2004 to 2015. The sample of model 1 and 2 for 2004 contains 719 companies with data points and 3275 companies for 2015.[8] There is not any year in which we have data points for all the companies in our sample. In total, we have 27,545 (N) data points for model 1 and 2, as can be seen in Table 1.

The summary statistic gives an overview of the variables used. The number of observations indicate the model used [without GHG (model 1 and 2, $N=27{,}545$), with GHG scopes 1 and 2 (model 3, $N=9640$) as well as with GHG scopes 1, 2 and 3 (model 4, $N=6594$)]. The minimum and maximum values were verified by manual research. Definitions of the variables are provided in Table 2.

In line with Gallo and Christensen (2011), we use the multi-dimensional definition of corporate sustainable responsibility and concentrate on the three pillars: environmental, social, and corporate governance (ESG). Accordingly, we do not use the equal weighted rating, the total score from ASSET4, since it includes an additional fourth pillar: economics. This paper is focused on the ESG-Pillars: we calculate the mean of the environmental, the social, and the governance scores. We also provide regression results for only the environmental (ENV) pillar as a dependent variable to make the results for H8a and H8b more comparable.

The independent variable, company size, is measured in different ways referring to the literature (Perez and Sanchez 2009; Orlitzky 2001; Hahn and Kühnen 2013): number of employees (Gallo and Christensen 2011), total assets

[7] In the number of rated companies, ASSET4 is comparable with the MSCI ESG Rating (Klug and Sailer 2017).

[8] The table with the distributions over the years is available on request.

Table 1 Summary statistics for model 1 and partly for models 2, 3 and 4

Variable	*N*	Mean	SD	Min	Max
ESG	27,545	54.7	24.2	4.6	97.8
ESG	9640	73.5	15.7	7.0	97.6
ESG	6594	74.7	14.9	6.6	96.2
ENV	27,545	54.7	31.9	8.3	97.5
GHG scopes 1 + 2	9640	4,367,665.0	14,901,898.0	4	412,400,000
GHG scopes 1 + 2	6594	4,444,571.0	16,205,148.0	10	412,400,000
GHG scopes 1,2 + 3	6594	17,656,425.0	85,508,452.0	97	3,514,273,120
EMP lag1	27,545	31,179.5	71,224.1	2	2,200,000
TA lag1	27,545	34,904,764.0	144,202,682.0	3312	3,071,733,865
MCAP lag1	27,545	10,347,457.0	22,772,700.0	3393	521,586,864
MCAP lag1	9640	16,167,558.0	29,802,947.0	26,299	521,586,864
MCAP lag1	6594	17,276,318.0	30,392,139.0	30,062	521,586,864
REV lag1	27,545	8,587,415.0	15,357,123.0	227	93,539,354
DA	27,545	77.5	4.4	0.0	89.8
CSR_Comm	27,545	0.5	0.5	0	1
SusRep_NoGRI	27,545	0.2	0.4	0	1
GRI	27,545	0.3	0.5	0	1
EPS/P	27,545	0.1	0.4	0.0	58.2
ROIC	27,545	9.3	43.4	− 5820.9	2413.1
OPM	27,545	5.3	453.4	− 49,686.9	4183.3
Leverage	27,545	137.1	2228.4	− 77,921.7	223,758.5
ISO_EMS	27,545	0.5	0.6	0	2

Table provides summary statistics (mean, standard deviation, minimum and maximum) for used variables in model 1 as well as selected variables for models 2, 3 and 4. The number of observations (company-years) indicates the model. Models 1 and 2 have 27,545 observations without GHG data. Model 3 has 9640 observations without scope 3 of GHG emission data and model 4 has 6594 observations with scope 3 GHG emission data

(Aouadi and Marsat 2016; Brammer and Millington 2006; Chen et al. 2017), market capitalization (Perez and Sanchez 2009), and revenue (Gallo and Christensen 2011; Orlitzky 2001). Because the resources of the preceding year should influence the ESG score of the present year, we use a time lag of 1 year for each company size proxy. For a better comparison (e.g., a reduction in the influence of outliers on estimation results), we also use a logarithm.

Information disclosure is also measured in several ways. For example, Gangi and D'Angelo (2016) use the CSR report as the data source and analyze the presence of predetermined categories in the CSR reports. We similarly measured the data availability (DA) of the companies. We used the 157 active[9] indicators of the three ESG-pillars. We controlled if each key performance indicator had a value or not (NA) and calculated the percentage of availability.[10] An index of 0.8 means that 80% of the data points for the respective company are available in the ASSET4 database. If we assume that Thomson Reuters has collected all information that is available, then we can also assume that an indicator which is not-available (NA) is information not reported by the company. Companies that are no longer on the market ("DEAD"), do not publish information for the three ESG-pillars, so there is a NA (not-available) for these years and these (NA) data points were eliminated prior to the regression. We are not eliminating the company entirely, only the year(s) with missing values, because survivorship bias must be taken into consideration for this research.

We tested resources for providing ESG data (RPD) in the LMM with two dummy-variables: CSR committee and sustainability reporting. Sustainability reporting was separated into sustainability reports not in accordance with GRI guidelines and those in accordance with GRI guidelines.

[9] ASSET4 screened the database for strategic KPI. After this process, they decided to inactivate some indicators. In total, they identified strategic KPI that they nowadays employ for their ratings (active KPIs). The rest were deactivated after 2014, yet they are still available in its database. We only concentrated on the active KPIs. The database includes 184 indicators scored over all four pillars. Removing the indicators of the economic pillar leaves 157 active indicators. Now there is a new calculation resulting from the old data points.

[10] This is comparable to the disclosure index of Bloomberg used by Fatemi et al. (2017).

Table 2 Overview of variables

Variable	Description	Unit	Source
Corporate sustainability/environmental performance			
ESG	Computed: Mean of the 3 ASSET4-Pillars: Social (SOC), Environmental (ENV), Corporate Governance (GOV)	None	ASSET4
GHG	Greenhouse Gas Emission Intensity; Total (direct (scope 1) and indirect (scope 2)) carbon dioxide (CO_2) emission and CO_2 equivalents (CO_2e) in tonnes scaled by revenue, market capitalization, total asset or number of employees. Observations with zero emission in one of the three scopes were deleted	CO_2e tonnes divided by firm size	ASSET4; ENERDP023
GHG	Greenhouse Gas Emission Intensity; Sum of scope 1, scope 2 and scope 3 carbon dioxide (CO_2) emission and CO_2 equivalents (CO_2e) in tonnes scaled by revenue, market capitalization, total assets or number of employees. Data points with zero emissions were deleted		ASSET4; ENERDP023 + ENERDP096
Company size			
EMP	Number of Employees, represents the number of both full and part time employees of the company; modification: 1-year lag and log	None	Worldscope; WC07011
TA	Total Assets; modification: 1-year lag and log	1000 Euro	Worldscope; WC02999
MCAP	Market capitalization: Market Price (Year End) * Common Shares Outstanding; modification: 1-year lag and log	1000 Euro	Worldscope; WC08001
REV	Revenue; modification: winsorized with 0.001 because of tremendous outliers, 1-year lag and log	1000 Euro	Worldscope; WC01001
Data availability in the ASSET4 database			
DA	Data Availability Index; Computed Index, percent of available data, active indicators (score) of the three pillars SOC, ENV and GOV for a company out of a maximum of 157 (with ECON there are 184 indicators)	Percent	ASSET4
Resources for providing ESG data			
CSR_Comm	CSR Committee; Dummy Variable: "Does the company have a CSR committee or team?"	Y/N	ASSET4, CGVSDP005
SusRep_NoGRI	Sustainability Reporting not in accordance with the GRI guidelines; Computed: It is the dummy variable CGVSDP026 ("Does the company publish a separate sustainability report or [does it] publish a section in its annual report on sustainability?" Yes, if one or both questions can be answered with yes.) minus the dummy variable GRI	Y/N	ASSET4; CGVSDP026, CGVSDP028
GRI	Global Reporting Initiative; Dummy Variable; "Is the company's sustainability report published in accordance with the GRI guidelines?"	Y/N	ASSET4; CGVSDP028
Control variable			
EPS/P	Computed: Earnings per share (Euro) divided by Stock price (Euro)	None	Worldscope; EPS, P
ROIC	Return on Invested Capital	None	Worldscope; WC08376
OPM	Operating Profit Margin; rescaled through divided by 10	None	Worldscope; WC08316
Leverage	Total debt/total equity; proxy for capital structure; rescaled through divided by 100	None	Worldscope; WC08231
ISO_EMS	ISO 14000 or EMS Certification: "Does the company claim to have a certified Environmental Management System?", if the company has ISO 14000 or EMS, then 1; if the company has both, then 2	Both/Y/N	ASSET4; ENERDP073

Table gives the definition and operationalization of the variables and the sources. ASSET4 and Worldscope are databases from Thomson Reuters

Why should this variable stand for the resources needed to provide ESG data? Thomson Reuters only collects publicly available data for the ASSET4 database, which means that the company (or a third party like a NGO) has to provide ESG data.

Greenhouse Gas (GHG) is measured with carbon dioxide (CO_2) equivalent emissions and includes CO_2, Methane (CH4), Nitrous oxide (N2O), Hydro fluorocarbons (HFCs), perfluorocarbons (PFCs), Sulfur hexafluoride (SF6) and Nitrogen trifluoride (NF3) in accordance with the GHG and Kyoto protocol (World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) 2004, 2013). Of course, the absolute carbon emission in tonnes grows with the firm size and depends, to a great extent, on the sector. Therefore, we use the company GHG emission divided by firm size, which gives us the GHG intensity (GHG/firm size). Proxies that we use for firm size to scale GHG are revenue, market capitalization, number of employees and total assets. Most studies concentrate on total emission, the sum of scope 1 (direct emission) and scope 2 (indirect emission).[11] The inclusion of the total emission in the regression model remarkably reduces the number of companies and company-years (observations) (without GHG: $n=3828$; $N=27{,}545$; with GHG: $n=1931$, $N=9640$). The disclosure of scope 3 is even more rare and reduces the number of companies and company-years ($n=1486$, $N=6594$) even further. Still, we use scope 3 as an additional environmental score. The reason is that scope 2 is not really comparable, e.g., if a company has an external server provider, or outsources one production unit, this does not count any more in the "total" emission (World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) 2004). This shows that the expression 'total emission' needs to be interpreted carefully. All in all, we use eight variables: GHG emission (scopes 1 and 2) scaled by revenue, market capitalization, number of employees and total assets and GHG emission including scope 3 (scopes 1, 2 and 3) scaled by revenue, market capitalization, number of employees and total assets. Thomson Reuters only uses public information direct from the companies for GHG data. We assume that the amount of GHG emission is reported lower than when provided by other sources like Carbon Disclosure Project (CDP). This is supported by Depoers et al. (2016) in the case of French companies. Results with GHG data should be interpreted carefully, because the lack of consistency in GHG data is known (King and Bartels 2015). But by removing outliers the level of consistency between different GHG data providers is higher (Busch et al. 2018). For this reason, winsorized GHG intensity is used.

We included the following control variables (see Table 2) in the mixed model: The environment of companies, e.g., company's stated country of origin, can have an influence on ESG performance (Mackenzie et al. 2013; Maignan and Ralston 2002). The literature further suggests a higher CSR communication in companies based in countries with higher gross domestic product (Li et al. 2010). For this reason, the company's stated country of origin is included as a by-size random slope in the mixed-effects model. Also, industry sectors are considered as by-size random slopes to control industry sector specific effects (Tuppura et al. 2016).

Further, we used earnings per share divided by the stock price (EPS/P), leverage ratio, Return on Invested Capital (ROIC) and Operating Profit Margin (OPM) as control variables for a company's financial performance.

The correlation between the ESG score and leverage is not immediately obvious. With more debt, the influence of stakeholders rises. Researchers have examined the efforts of stakeholders to improve the CSR activities of companies (Yu and Choi 2016) and positive links between leverage and environmental disclosure have been found by Sulaiman et al. (2014) and Clarkson et al. (2008). However, Barnea and Rubin (2010) found a negative relationship between leverage and ESG, and argue employing the overinvestment theory.

The correlation between ESG and the financial success of a company is one of the main research issues in the subject of sustainable investment and is also controversial. For Example, Clarkson et al. (2008) found no correlation between financial success and environmental disclosure, Rodriguez-Fernandez (2016) see a bidirectional relationship between social and financial performance. This research suggests a positive correlation between EPS/P, ROIC, OPM and the ESG score. This suggestion would agree with the slack resources theory.

Furthermore, environmental management system (ISO 14000 and EMS, see Table 2) is used as a control variable. The year as a trend variable is included as a random intercept to control trend effects (this is not shown in Table 2) as well as a company's identification (id). Table 3 provides the correlation between the variables used in the mixed model (model 1, $N=27{,}545$) and the structural equation modeling (model 2) without GHG data.

Methodology

To test the hypotheses, we use a linear mixed-effects model (LMM; model 1, 3 and 4 for H4–H6, H8a and H8b) and structural equation modeling (SEM; model 2 for H1–H3 and H7). The SEM was used due to two reasons. Firstly, the results of model 1 can be verified with it. Secondly, it is possible to analyze one explanation of the firm size influence on the ESG score by testing all causal paths simultaneously (Thogersen and Ölander 2002). Thereby, a mediator effect between the stated variables can be verified.

[11] Scope 1: "A reporting organization's direct GHG emissions"; scope 2: "A reporting organization's emissions associated with the generation of electricity, heating/cooling, or steam purchased for own consumption"; scope 3: "A reporting organization's indirect emissions other than those covered in scope 2" (World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) 2004, p. 103).

Table 3 Correlation table for model 1

	ESG	ENV	EMP	MCAP	TA	REV	DA	CSR_Comm	SusRep_NoGRI	GRI	EPS/P	ROIC	Leverage	OPM	ISO_EMS
ESG	1														
ENV	0.842	1													
EMP	0.404	0.420	1												
MCAP	0.391	0.364	0.580	1											
TA	0.329	0.360	0.550	0.744	1										
REV	0.436	0.477	0.800	0.724	0.763	1									
DA	0.701	0.577	0.291	0.244	0.112	0.267	1								
CSR_Comm	0.564	0.566	0.226	0.203	0.235	0.280	0.438	1							
SusRep_NoGRI	0.121	0.146	0.020	−0.052	−0.039	−0.003	0.062	0.118	1						
GRI	0.569	0.594	0.288	0.305	0.312	0.347	0.541	0.492	−0.348	1					
EPS/P	−0.010	−0.002	0.005	0.013	0.029	0.018	−0.011	−0.009	−0.011	0.005	1				
ROIC	0.014	−0.0001	0.011	0.067	−0.051	0.005	0.034	−0.014	0.017	−0.009	0.003	1			
Leverage	0.008	0.008	0.015	−0.003	0.033	0.017	−0.004	0.005	−0.003	0.005	0.0001	−0.005	1		
OPM	0.018	0.016	0.044	0.056	0.043	0.090	0.014	0.004	0.008	0.010	0.004	0.038	0.0004	1	
ISO_EMS	0.407	0.546	0.281	0.125	0.122	0.279	0.375	0.319	0.071	0.372	−0.003	−0.013	0.007	0.010	1

Table shows the correlation between the variables used in model 1

But first we focus our attention on the LMM used for model 1, 3 and 4. The influence of different variables on Corporate Sustainability (ESG score, Environmental score and GHG intensity; dependent variables) is analyzed with a linear mixed-effects model. The following model is applied:

$$\begin{aligned}\text{Corporate Sustainability}_{i,t} &= \alpha + \text{id}_i + \text{Year}_t \\ &+ (\text{Sector}_i + \text{Country}_i + \beta_1)\text{Size}_{i,t-1} \\ &+ \beta_2 DA_{i,t} + \beta_3 RPD_{i,t} + \beta_4 \text{Control Variable}_{i,t} \\ &+ \varepsilon_{i,t}\end{aligned}$$

where the Corporate Sustainability (measured by ESG, ENV and GHG intensity, for corporation i at time t) depends on the random effects corporations (id) i, time (Year) t, business field of the corporation (sector) and company's stated country of origin as well as on the fixed effects the prior year's company size, the same year's data availability in the ASSET4 database represented by $DA_{i,t}$ and resources for providing ESG data for corporation represented by $RPD_{i,t}$, and a set of company-specific, time-varying control variables. The definitions of the variables are presented in Table 2.

LMM is more common in other fields, for example, psychology or linguistics (Barr et al. 2013) or ecology (Bolker et al. 2009), but is also used in business research (Baird et al. 2012). A principal benefit from a LMM is to consider time-invariant variables of interest by estimating fixed effects in a panel dataset. Fixed effects are "analogous to linear predictors from standard OLS" (Baird et al. 2012, p. 374), that allow a known interpretation of the results like from an Ordinary Least Square (OLS) regression. The random effects in a mixed-effects model can be interpreted as a grouping factor. P-values are evaluated and presented by using the normal distribution. This is anti-conservative for smaller sample sizes (Luke 2017). To be sure, we controlled the p-values with Satterthwaite approximation with similar results.

To verify that we can handle multicollinearity, we used the variance inflation factor (VIF) (Aouadi and Marsat 2016).The results are below 2.0 for all variables indicating that there are no problems with respect to multicollinearity. The results in Table 5 are presented with restricted maximum likelihood estimation (REML). The maximum likelihood estimation (ML) had similar results but is not presented.

Secondly, we analyze the indirect influence of the independent variables on the ES score with a co-variance based SEM.[12] The advantage is to be able to control all the influences of the three independent variables on the ES score and between the independent variables simultaneously. In our

[12] With respect to the discussion about the Partial Least Square Path Model (PLS-PM) and the co-variance based Structural Equation Model (SEM) (Sarstedt et al. 2016; Reinartz et al. 2009; Rönkkö et al. 2015; Edwards 2011), we decided also in accordance to Hair et al. (2011) for the co-variance based SEM.

SEM, we use the maximum likelihood estimator with robust standard error terms and a Sattora-Bentler scaled test statistic (Rosseel 2012). The reflective latent variable[13] is specified as follows: for sustainability performance we only use the ES score, measured by the average of the environmental and social pillars instead of ESG. The reason for this is the weak internal consistency of the latent variable ESG (Cronbach's alpha of 0.69) caused by the corporate governance pillar. ES provides a Cronbach's alpha of 0.88 and is used as a latent variable in our SEM. Further, RPD was measured by CSR committee and sustainable reports (no differentiation between those in accordance with GRI and those which are not), and SIZE is measured with market capitalization and number of employees, both logarithmized and with a 1 year lag as seen in Table 2. Data availability is included as a manifest variable because it is a measured variable itself. Two different models are provided: Model 2a is a pooled version and does not consider the years. However, in Model 2b the years are grouped, but with constant loadings and intercepts over the years. This makes it possible to display the results more clearly and understandably. While a lot of different models are possible and have been tested, the selection was based on the fitness of the model, e.g., Comparative Fit Index, Tucker-Lewis Index, etc. (Steyer et al. 2009; Dion 2008; Byrne 2001).

The calculation was performed with r from R Core Team (2018) in *rstudio* and the following packages were used among others: Linear mixed-effects models were done with *lme4* from Bates et al. (2015). Most of the statistic tables are well formatted with *stargazer* from Hlavac (2015) and *rmarkdown*. The boxplot was plotted by *ggplot2* from Wickham (2009). The SEM was done with *lavaan* from Rosseel (2012). The panel regression for robustness checks was done with *plm* from Croissant and Millo (2008).

Results

Model 1: Linear Mixed-Effects Model

Because we can verify the results of the mixed model with SEM, we start with the linear mixed-effects models (LMM) and first look at hypotheses H4 to H6. As described in the section on methodology, we performed LMM to examine whether resources for providing ESG data (RPD), data availability in the ASSET4 database (DA) and company size lead to a superior ESG score. Table 4 shows the results for six different models with different proxies for the independent variable for the company size: number of employees, market capitalization, revenue, and total asset. The dependent variable in column 1 to 4 is the mean of the environmental, the social, and the corporate governance pillars. In column 5 and 6, the dependent variable is the environmental pillar only with market capitalization and revenue as a company size proxy. For employees and total assets, the results are similar and are not provided because of space limitations.

Hypothesis H4 suggests that the dependent variable (ESG score) correlates with the data availability index. We find that the data availability is significant for all models in Table 4 and influences the ESG score positively. Thus, hypothesis H4 is supported.

Hypothesis H5 suggests that the dependent variable (ESG score) correlates with the resources for providing ESG data. This is measured by the existence of a CSR committee, a sustainability report (not in accordance with GRI guidelines) and a sustainability report in line with GRI guidelines. As seen in Table 4 all three variables are significant in all columns. Thus, hypothesis H5 is supported.

Hypothesis H6 suggests that the dependent variable (ESG score) correlates with company size from the previous year (EMP, MCAP, REV, TA). We find that all four proxies for company size in all models in Table 4 are highly significant. Thus, hypothesis H6 is supported.

Aside from the existence of an environmental certification (ISO_EMS) which is highly significant for all models in Table 4, other variables are not significant. This supports the idea that standardized management systems have a positive influence on the assessment of sustainability performance.

Model 2: Structural Equation Modeling (SEM)

Secondly, we verify the results from the panel regression and test H1 to H3 with a SEM. As seen in Table 5, company size (SIZE) measured by the prior year's logarithmized number of employees and market capitalization positively influences the ES score (mean of the sum of the environmental and the social pillar). This evidence and the panel regression both support H6. In our SEM, the latent variable RPD is measured by the existence of a CSR committee and a sustainability report. As seen in Table 5, RPD has a significant influence on ES score and supports H5 too. Additionally, H4, the influence of DA on the ES score, can be supported with the SEM.

Hypothesis H1 suggests an influence from company size on resources to provide ESG data (RPD). The company size measurement is positively correlated as seen in Table 5. Thus, hypothesis H1 is supported. Finally, we can identify the different indirect effects of company size on the ES score, as provided in Table 5 and support our general thesis of an influence of company size on the ESG score.

[13] For further information on differences between formative and reflective specifications of the latent variables see Jarvis et al. (2003).

Table 4 Model 1: Linear mixed-effects model with random slope

	ESG score				ENV score	
	(1)	(2)	(3)	(4)	(5)	(6)
EMP	3.230***					
	(0.304)					
MCAP		2.823***			3.493***	
		(0.335)			(0.393)	
REV			3.747***			4.578***
			(0.395)			(0.561)
TA				4.283***		
				(0.289)		
DA	0.737***	0.744***	0.737***	0.745***	0.722***	0.710***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.036)	(0.036)
CSR_Comm	6.298***	6.409***	6.262***	6.201***	8.978***	8.644***
	(0.174)	(0.175)	(0.174)	(0.174)	(0.266)	(0.264)
SusRep_NoGRI	9.139***	9.096***	9.085***	9.071***	12.470***	12.334***
	(0.192)	(0.193)	(0.192)	(0.192)	(0.294)	(0.292)
GRI	13.206***	13.091***	13.095***	12.989***	16.569***	16.394***
	(0.224)	(0.226)	(0.224)	(0.224)	(0.344)	(0.341)
ISO_EMS	5.460***	5.789***	5.517***	5.543***	8.853***	8.469***
	(0.184)	(0.184)	(0.183)	(0.183)	(0.277)	(0.275)
EPS/P	0.039	−0.018	0.033	0.063	0.060	0.106
	(0.135)	(0.135)	(0.134)	(0.134)	(0.207)	(0.206)
Leverage	0.002	0.002	0.002	0.002	0.004	0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
OPM	0.0004	−0.0003	−0.001	0.00004	−0.002	−0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
ROIC	−0.002	−0.004***	−0.002*	−0.0004	−0.003	−0.0004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Constant	−49.175***	−63.457***	−74.597***	−85.893***	−73.676***	−86.344***
	(3.599)	(5.926)	(6.232)	(5.074)	(7.310)	(9.092)
Observations	27,545	27,545	27,545	27,545	27,545	27,545
Log Likelihood	−100,620.000	−100,832.000	−100,567.900	−100,564.400	−112,153.000	−111,869.100
Akaike Inf. Crit.	201,280.000	201,704.000	201,175.900	201,168.800	224,346.000	223,778.200
Bayesian Inf. Crit.	201,444.500	201,868.500	201,340.400	201,333.300	224,510.400	223,942.700

Table presents coefficients and standard errors from the linear mixed-effects regression of yearly ESG scores (1–4) and of yearly ENV scores (5–6) from ASSET4 database on the prior year's logarithmized company size number of employees (1, EMP), market capitalization (2 + 5, MCAP), revenue (3 + 6, REV) and total assets (4, TA), the data availability of the corporation in ASSET4 (DA), the resources for providing ESG data measured by the existence of a sustainability report (SusRep_NoGRI), a GRI report (GRI) and a CSR Committee in the company and control variables. As random intercept the ISIN, the year and as random slope depending on firm size the business field of the corporation (sector) and company's stated country of origin is used

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Hypothesis H2 suggests a positive correlation between resources for providing ESG data (RPD) and data availability (DA). The latent variable RPD is measured by the existence of a CSR committee in the company and a sustainability report. Both models confirm a positive influence. Thus, hypothesis H2 is supported.

Hypothesis H3 suggests an influence of company size on data availability (DA). As seen in Table 5, our latent variable, company size, positively influences the data availability and the coefficient in both models remains highly significant. Thus, hypothesis H3 is supported.

Hypothesis H7 suggests a total influence from company size on the ES score (ES) by means of RPD and DA. As seen in Table 5, the direct effect of the latent variable, firm size, on ES, as well as the indirect effects of firm size on the ES score, is positive and highly significant. Consequently, the total effect of firm size on the ES score is also positive as seen in Table 5. Thus, hypothesis H7 is supported.

Table 5 Model 2: SEM in two variations

	Model 2a: pooled	Model 2b: year grouped; loading and intercept constant over the years
Direct effects		
RPD → ES	5.029*** (0.086)	6.063*** (0.089)
SIZE → ES	0.745*** (0.019)	0.498*** (0.018)
DA → ES	0.066*** (0.007)	0.046*** (0.007)
SIZE → RPD	0.179*** (0.003)	0.187*** (0.003)
SIZE → DA	0.388*** (0.031)	0.426*** (0.027)
RPD → DA	6.759*** (0.084)	6.786*** (0.071)
Indirect effects		
SIZE → DA → ES	0.026*** (0.003)	0.020*** (0.003)
SIZE → RPD → ES	0.902*** (0.023)	1.134*** (0.025)
SIZE → RPD → DA → ES	0.080*** (0.009)	0.058*** (0.008)
Total effect	1.753*** (0.023)	1.690*** (0.022)
Fitness of the model		
χ^2 (df)	723 (9)	3664 (251)
Comparative fit index (CFI)	0.99	0.97
Tucker–Lewis index (TLI)	0.98	0.97
RMSEA (p value)	0.054 (0.028)	0.077 (0.000)

Table shows the SEM results (coefficients and standard errors) with environmental and social score of ASSET4 (ES), the prior year's logarithmized number of employees and market capitalization (SIZE), the data availability of the corporation in ASSET4 (DA), the resources for providing ESG data (RPD) measured by the existence of a CSR committee and a sustainability report by the company

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

The rule of thumb suggests a Comparative Fit Index (CFI) of 0.95, a Tucker-Lewis Index (TLI) of around 1 and significant RMSEA of 0.05 for a perfect fit of the model (Dion 2008; Byrne 2001; Steyer et al. 2009). As seen in Table 5 CFI, TLI and RMSEA indicate a good fit for both models.

Model 3 and 4: LMM

To compare the statistical influence of company size on the ESG score and GHG, we provided two additional tables.

Hypothesis H8a suggests no or a positive influence from company size, RPD and DA on GHG intensity (scopes 1 and 2). As seen in Table 6, nine from sixteen firm size coefficients are not significant and/or positive. Even if this is the majority, in most cases the results have a negative sign, also if the coefficient is not significant. Furthermore, seven coefficients are significant and negative. This implies that with growing firm size the GHG intensity has the tendency to go down. In these cases, larger firms seem to be able to use the scale effects. In total these sixteen coefficients only partly support the hypothesis for firm size. Further as seen in Table 6 CSR_Comm, SusRep_NoGRI and GRI are mostly not significant and if so then with positive coefficients. That signals, that RPD do not reduce the GHG intensity. Quite the contrary it raises the GHG intensity. The same can be seen for the control variable ISO_EMS. The meaning is that an environmental management system does not reduce the GHG intensity. However, DA has mostly a negative and significant influence on GHG intensity as seen in Table 6. So it seems that transparent companies are the ones who also try to reduce their GHG intensity. Thus, hypothesis H8a is only partially supported.

Hypothesis H8b suggests no or a positive influence from company size, RPD and DA on GHG intensity (scopes 1, 2 and 3). As seen in Table 7 one from sixteen results is significantly negative. That supports the hypothesis for company size. For the RPD variables as well as for DA almost no coefficient is significant and if so, then it is a positive sign. With this result almost no influence from DA and RPD on GHG (scopes 1, 2 and 3) intensity is shown. Thus hypothesis H8b is supported.

Robustness Checks

Using more than one proxy for company size is a robustness check which we already provided in Table 4. For DA, we used an additional transparency index provided by Thomson Reuters on request and we received similar results to those provided in Table 4 and Table 5. Furthermore, we checked the hypotheses with the ESG score from RobecoSAM with similar results. Unlike the ASSET4 rating, RobecoSAM does not focus on publicly available information only and

completes the rating with questionnaires (novethic research 2013). The subsequent verification and assessment of the questionnaires can conduce to a higher data quality than solely collecting public information. Compared to individual questionnaires, the use of publicly available information requires less effort for the companies (Windolph 2011). However large companies have special units only for answering the ESG agencies' questionnaires. Only using information directly from the companies as a data source for the measurement is controversial due to reliability issues (Windolph 2011; Dando 2003).

We want to ensure that the correlation is not dependent on outliers as seen in the descriptive statistic in Table 1. For that reason, we also tested a winsorized database without having any changes to the main results. Only some control variables became significant. In an additional step, we used the mean of the environmental and social score (ES) without the corporate governance score as well as each pillar (environmental, social, and corporate governance) separately, and also the total score of ASSET4, the equal weighted rating. We received similar results for all dependent variables in the LMMs.

For the LMM different models were tested (e.g., random intercept without random slope). Also, a panel regression (OLS, random effects, fixed effects) was calculated for the whole dataset as well as for subsamples (Industry sectors, countries, etc.). The results were similar.

We also carried out several robustness tests for the SEM, e.g., we used different combinations for the latent variables. Apart from the *lavaan* package from Rosseel (2012), we also tested a partial least square SEM with the *plspm* package from Sanchez (2013). The results were similar, agreeing with the rule of thumb from Hair et al. (2011).

Discussion

Our results confirmed our hypotheses and are in line with results from other scholars. For example, Gavana et al. (2017) found—as verified with H3—a significant correlation between company size (number of employees) and CSR disclosure (comparable to our measurement of data availability). These findings are consistent with the theory of slack resources as well as with the assumption that larger companies are under more pressure to disclose more information in order to gain legitimacy.

Furthermore, this paper can confirm the highly significant relationship between data availability and ESG scores in all sectors. This finding fits with the results from Hughey and Sulkoski (2012) who concluded that more disclosure, independent from the quality and content of the information, implicates a better CSR reputation in the Oil and Gas industry. One interpretation of this connection between data availability and the ESG score could be that what is reported is essentially irrelevant: the main point is that the company reports. One reason for this phenomenon is that non-availability is interpreted as bad news in the system. The non-trust system and the punishment of non-transparency contradict the description of the "human nature of economic actors" in the sustainable finance field by Soppe (2004). He wrote of a "moral economic man", an actor, who "acts rationally, but aims at cooperation and trust because of the higher expected utility in terms of the multi-dimensional goal function of the company". One interpretation can be that some rating agencies have their own rules and are not a part of the sustainable finance community in the narrower sense since they only provide data and do not do any investing. On the other hand, transparency is supposed to be one essential part of sustainability (Dubbink et al. 2008; Mena and Palazzo 2012) and this idea is also supported by our results in Table 7. Some studies have shown a positive effect between environmental performance and environmental disclosure (Dawkins and Fraas 2011; Qian and Schaltegger 2017). However, it has also been claimed that more transparency does not automatically lead to more sustainability (Gold and Heikkurinen 2017). A discussion in the community regarding the emphasis of transparency should have in measuring the sustainability performance of a company is currently lacking.

Unfortunately, how national and company type specific reporting instruments affect ESG ratings is beyond the scope of this paper. The often confusing coexistence of different reporting instruments makes an empirical, worldwide analysis of the influence of the instruments on the ESG reporting and/or activities difficult. It would be interesting for regulators and SR investors to know which instruments lead to a better ESG reporting or more importantly: better and sustainable activity. It is highly probable that existing reporting instruments lead to more transparency for large listed companies. However, this does not mean these companies are consequently more sustainable. Further research is needed in order to evaluate the influence of the different reporting instruments on the sustainability rating and to see how organizational legitimacy is addressed in different cultures and countries.

Interestingly, the financial success control variables are predominantly not significant. This is an indication that the firm size bias cannot be predominantly explained by the theory of slack resources. Also, our sample does not contain really small companies that do not have the possibility to produce a sustainability report. Organizational legitimacy found in the neo-institutional theory can help to explain our results: companies seek legitimacy profit by fulfilling society's expectations. Larger companies are more exposed and feel more pressure from society and civil organizations. In this social construct, sustainability rating agencies can be used to assess the legitimacy of the firms (including banks

Table 6 LMM with random slope and the dependent variable GHG with scopes 1 and 2

	Dependent variable							
	GHG/MCAP				GHG/EMP			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
REV	0.070				−11.598			
	(0.045)				(12.431)			
MCAP		−0.152***				−17.268**		
		(0.056)				(7.890)		
EMP			0.055				−56.533**	
			(0.040)				(24.923)	
TA				0.069**				−12.267
				(0.032)				(9.900)
DA	−0.006**	0.002	−0.006**	−0.007**	0.039	0.214	0.911	−0.126
	(0.003)	(0.003)	(0.003)	(0.003)	(0.937)	(0.937)	(0.911)	(0.942)
CSR_Comm	0.008	0.003	0.009	0.009	10.870**	10.995**	9.087*	10.601**
	(0.015)	(0.014)	(0.015)	(0.015)	(5.100)	(5.130)	(4.988)	(5.093)
SusRep_NoGRI	0.002	−0.001	−0.002	0.004	−0.767	−1.173	−1.222	−2.226
	(0.017)	(0.017)	(0.017)	(0.017)	(6.088)	(6.104)	(5.943)	(6.111)
GRI	0.011	0.014	0.006	0.013	2.076	0.960	2.226	0.105
	(0.018)	(0.017)	(0.018)	(0.018)	(6.207)	(6.228)	(6.058)	(6.220)
ISO_EMS	0.047***	0.049***	0.048***	0.047***	4.913	4.291	8.398*	4.767
	(0.013)	(0.013)	(0.013)	(0.013)	(4.749)	(4.763)	(4.659)	(4.771)
EPS/P	0.077	0.111	0.098	0.090	28.979	38.009	28.196	38.348
	(0.079)	(0.077)	(0.078)	(0.078)	(27.421)	(27.474)	(26.736)	(27.404)
Leverage	0.0004***	0.0003**	0.0004***	0.0004***	−0.018	−0.016	−0.019	−0.018
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.048)	(0.048)	(0.047)	(0.048)
OPM	−0.002***	−0.002***	−0.002***	−0.002***	−0.161	−0.114	−0.173	−0.128
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.143)	(0.143)	(0.139)	(0.143)
ROIC	−0.002***	−0.001***	−0.002***	−0.001***	0.049	0.070	−0.004	0.037
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.079)	(0.080)	(0.077)	(0.080)
Constant	−0.067	2.714***	0.460	−0.055	455.628*	534.558**	712.455**	489.205*
	(0.589)	(1.035)	(0.307)	(0.429)	(236.166)	(241.046)	(305.450)	(254.269)
Observations	9640	9640	9640	9640	9640	9640	9640	9640
Log Likelihood	−5868.0	−5691.0	−5861.1	−5874.5	−62880.5	−62904.1	−62658.0	−62903.5
Akaike Inf. Crit.	11,776.0	11,422.1	11,762.2	11,789.0	125,801.0	125,848.1	125,356.0	125,847.0
Bayesian Inf. Crit.	11,919.5	11,565.6	11,905.7	11,932.4	125,944.5	125,991.6	125,499.5	125,990.5

Table 6 (continued)

	Dependent variable							
	GHG/REV				GHG/TA			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
REV	−0.056**				−0.009			
	(0.024)				(0.009)			
MCAP		−0.042*				−0.022**		
		(0.022)				(0.010)		
EMP			−0.017				0.0002	
			(0.028)				(0.009)	
TA				−0.043				−0.033*
				(0.027)				(0.019)
DA	−0.004**	−0.004**	−0.004***	−0.004**	−0.002**	−0.002**	−0.002***	−0.001
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
CSR_Comm	0.009	0.007	0.009	0.006	0.013***	0.012***	0.013***	0.010**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)	(0.004)
SusRep_NoGRI	0.010	0.014	0.013	0.009	0.013**	0.015***	0.013**	0.011**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.005)	(0.005)	(0.005)	(0.005)
GRI	0.021**	0.024**	0.024**	0.018*	0.015***	0.018***	0.016***	0.014***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.005)	(0.005)	(0.005)	(0.005)
ISO_EMS	0.025***	0.022***	0.026***	0.024***	0.013***	0.012***	0.014***	0.013***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)	(0.004)
EPS/P	0.044	0.056	0.040	0.053	0.030	0.031	0.024	0.026
	(0.044)	(0.044)	(0.044)	(0.043)	(0.023)	(0.023)	(0.023)	(0.022)
Leverage	0.00003	0.00001	0.00002	0.00003	−0.0001	−0.0001*	−0.0001	−0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.00004)	(0.00004)	(0.00004)	(0.00004)
OPM	−0.001**	−0.001**	−0.001**	−0.001***	−0.0002*	−0.0002**	−0.0003**	−0.0003***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ROIC	−0.0002	−0.0001	−0.0002	−0.0003**	0.0001	0.0001*	0.0001	−0.00003
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant	1.569***	1.394***	0.951***	1.425**	0.539***	0.712***	0.427***	0.843**
	(0.468)	(0.467)	(0.299)	(0.560)	(0.173)	(0.225)	(0.105)	(0.369)
Observations	9640	9640	9640	9640	9640	9640	9640	9640
Log Likelihood	−857.9	−858.8	−881.0	−859.1	5450.1	5516.5	5446.4	5601.4
Akaike Inf. Crit.	1755.8	1757.7	1802.1	1758.1	−10,860.2	−10,993.0	−10,852.9	−11,162.7
Bayesian Inf. Crit.	1899.2	1901.2	1945.5	1901.6	−10,716.7	−10,849.6	−10,709.4	−11,019.3

Table presents coefficients and standard errors from the linear mixed-effects regression of yearly GHG (scopes 1 and 2) intensity scaled by market capitalization (1–4), number of employees (5–8), revenue (9–12) and total assets (13–16) on the prior year's logarithmized company size revenue (1, 5, 9 and 13), market capitalization (2, 6, 10 and 14), number employees (3, 7, 11 and 15), and total assets (4, 8, 12 and 16), the data availability of the corporation in ASSET4 database (DA), the resources for providing ESG data measured by the existence of a sustainability report (SusRep_NoGRI), a GRI report (GRI) and a CSR Committee in the company and control variables. As random intercept the company's identification (ISIN), the year and as random slope depending on firm size the business field of the corporation (sector) and company's stated country of origin is used

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 7 LMM with random slope and the dependent variable GHG with scopes 1, 2 and 3

	Dependent variable							
	GHG/MCAP				GHG/EMP			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
REV	0.244***				186.701*			
	(0.056)				(101.550)			
MCAP		−0.178***				102.406		
		(0.050)				(73.753)		
EMP			0.143***				19.444	
			(0.035)				(61.449)	
TA				0.177***				202.423*
				(0.048)				(108.824)
DA	0.008*	0.010**	0.007	0.007	2.916	3.920*	4.349*	2.564
	(0.005)	(0.005)	(0.005)	(0.005)	(2.233)	(2.252)	(2.242)	(2.233)
CSR_Comm	−0.008	−0.006	−0.0001	−0.004	19.230	26.994	32.012	11.459
	(0.054)	(0.054)	(0.055)	(0.054)	(25.625)	(26.147)	(26.190)	(25.271)
SusRep_NoGRI	0.024	0.051	0.021	0.025	9.652	7.546	21.299	13.193
	(0.065)	(0.065)	(0.066)	(0.065)	(31.382)	(31.674)	(31.549)	(31.388)
GRI	−0.037	0.018	−0.044	−0.033	−7.585	−7.632	12.404	−1.531
	(0.065)	(0.065)	(0.066)	(0.065)	(31.367)	(31.738)	(31.646)	(31.330)
ISO_EMS	0.054	0.117***	0.069	0.064	17.256	34.809	37.232	24.064
	(0.046)	(0.045)	(0.046)	(0.046)	(22.392)	(22.589)	(22.658)	(22.371)
EPS/P	0.345	0.460**	0.389*	0.369*	174.722*	167.224	220.458**	193.326*
	(0.212)	(0.211)	(0.213)	(0.212)	(101.031)	(102.424)	(101.835)	(100.276)
Leverage	0.002*	0.004***	0.002*	0.002*	0.058	0.190	0.117	0.013
	(0.001)	(0.001)	(0.001)	(0.001)	(0.582)	(0.588)	(0.584)	(0.584)
OPM	−0.016***	−0.012**	−0.014***	−0.014***	−1.411	−2.133	−1.987	−1.139
	(0.005)	(0.005)	(0.005)	(0.005)	(2.420)	(2.437)	(2.426)	(2.420)
ROIC	−0.002***	−0.002***	−0.002***	−0.002***	−0.148	−0.250	−0.252	−0.018
	(0.001)	(0.001)	(0.001)	(0.001)	(0.292)	(0.297)	(0.299)	(0.295)
Constant	−3.483***	2.750***	−0.985**	−2.458***	−2494.013*	−1320.818	64.723	−2838.936*
	(0.860)	(0.894)	(0.441)	(0.759)	(1304.939)	(943.922)	(477.385)	(1487.712)
Observations	6594	6594	6594	6594	6594	6594	6594	6594
Log Likelihood	−10,371.1	−10,351.7	−10,416.9	−10,392.6	−51,180.3	−51,265.6	−51,284.3	−51,190.3
Akaike Inf. Crit.	20,782.2	20,743.4	20,873.9	20,825.2	102,400.6	102,571.1	102,608.6	102,420.7
Bayesian Inf. Crit.	20,918.0	20,879.2	21,009.7	20,961.0	102,536.5	102,707.0	102,744.5	102,556.5

Table 7 (continued)

	Dependent variable							
	GHG/REV				GHG/TA			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
REV	0.081				0.105**			
	(0.072)				(0.049)			
MCAP		0.048				0.037		
		(0.046)				(0.030)		
EMP			0.065				0.064	
			(0.064)				(0.041)	
TA				0.128				0.067
				(0.083)				(0.042)
DA	0.002	0.004	0.003	0.002	0.002	0.003*	0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
CSR_Comm	−0.001	0.001	0.006	−0.005	−0.012	−0.007	−0.004	−0.011
	(0.031)	(0.031)	(0.031)	(0.031)	(0.020)	(0.021)	(0.021)	(0.021)
SusRep_NoGRI	0.031	0.030	0.036	0.030	−0.003	0.002	0.006	0.004
	(0.037)	(0.037)	(0.037)	(0.037)	(0.025)	(0.025)	(0.025)	(0.025)
GRI	0.033	0.031	0.038	0.029	0.003	0.011	0.014	0.012
	(0.037)	(0.037)	(0.037)	(0.037)	(0.025)	(0.025)	(0.025)	(0.025)
ISO_EMS	0.034	0.044*	0.039	0.037	0.027	0.040**	0.031*	0.035**
	(0.026)	(0.026)	(0.026)	(0.026)	(0.018)	(0.018)	(0.018)	(0.018)
EPS/P	0.046	0.057	0.094	0.051	0.103	0.125	0.139*	0.120
	(0.119)	(0.120)	(0.119)	(0.119)	(0.080)	(0.081)	(0.081)	(0.081)
Leverage	0.00002	0.0001	0.0001	0.00000	0.0001	0.0001	0.0001	0.0001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
OPM	−0.003	−0.004	−0.003	−0.003	−0.001	−0.001	−0.001	−0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
ROIC	−0.0003	−0.0004	−0.0003	−0.0002	0.0001	0.00004	0.0001	0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Constant	−0.681	−0.313	−0.118	−1.461	−1.314**	−0.364	−0.325	−0.785
	(0.926)	(0.593)	(0.509)	(1.096)	(0.647)	(0.374)	(0.312)	(0.574)
Observations	6594	6594	6594	6594	6594	6594	6594	6594
Log Likelihood	−6784.8	−6814.2	−6803.3	−6773.0	−4034.1	−4137.3	−4126.0	−4122.3
Akaike Inf. Crit.	13,609.6	13,668.5	13,646.5	13,586.0	8108.3	8314.7	8291.9	8284.7
Bayesian Inf. Crit.	13,745.5	13,804.3	13,782.4	13,721.9	8244.2	8450.6	8427.8	8420.6

Table presents coefficients and standard errors from linear mixed-effects regression of yearly GHG (scopes 1, 2 and 3) intensity scaled by market capitalization (1–4), number of employees (5–8), revenue (9–12) and total assets (13–16) on the prior year's logarithmized company size revenue (1, 5, 9 and 13), market capitalization (2, 6, 10 and 14), number employees (3, 7, 11 and 15), and total assets (4, 8, 12 and 16), the data availability of the corporation in ASSET4 database (DA), the resources for providing ESG data measured by the existence of a sustainability report (SusRep_NoGRI), a GRI report (GRI) and a CSR Committee in the company and control variables. As random intercept the company's identification (ISIN), the year and as random slope depending on firm size the business field of the corporation (sector) and company's stated country of origin is used

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

and investment companies) for the society in general and (SR) investors specifically.

Different possible interpretations exist for the statistical influence of the firm size on the ESG score. On the one hand, it could be suggested that larger firms are more sustainable than smaller firms, on the other hand our results could support the thesis that larger firms have an advantage with this method of measuring sustainability. If the first interpretation is correct, the consequences for SR investors should be a predominate investment in larger companies. But this conclusion should be doubted. What could confirm the second interpretation? Firstly, larger companies do not have a lower GHG intensity if we focus on scopes 1, 2 and 3. For scopes 1 and 2, we cannot verify our hypothesis with a significant majority of presented models as seen in Table 6. The discrepancy is also explainable with the legitimacy approach of the neo-institutional theory. Scopes 1 and 2 are more common, and more often reviewed by scholars and society. Doda et al. (2016) explain the use of scopes 1 and 2 with the argument that companies have more influence on this emission. It is correct that the management can more easily influence scopes 1 and 2, but the influence from the company on scope 3 is existent too. Further, only measuring a company without the supply chain gives an advantage to all companies with outsourced activities. Companies which only monitor and control scopes 1 and 2 (ignoring scope 3), have the possibility to transfer the GHG emission to the supply chain without taking the responsibility. Of course, only one environmental criterion does not decide if a company is sustainable or not sustainable. But the GHG emission which is one important indicator for SDGs and the Paris Agreement on climate change mitigation cannot be left unattended. Second the literature review (section two) supports our results: larger companies use more structured management and reporting tools which are resource intensive, provide a higher data availability and the resources fit better to the measurement system of the ESG rating agencies. Thirdly, this literature-based indication is supported with our analysis of the considerable influence of the data availability on the sustainability performance. Thus, a positive sustainability performance can simply be created through reporting. Fourthly, if we consider the results of our panel regressions and SEM, we can see that company size has a direct and indirect influence on the ESG score. These results support the influence of firm size. This brings us to the conclusion that the ESG score in the ASSET4 database has a firm size bias.

The concentration on the ASSET4 database is an advantage, but also a limitation. To verify that it is not only a problem with the ASSET4 database, we checked our results against the ESG score from RobecoSAM. We cannot and do not want to generalize our results to include all ESG scores. However, studies with other ESG databases use firm size as a control variable and find firm size has a significant influence on the respective ESG score, for example, Oh et al. (2017) report that firm size has a significant influence on the KLD score. This firm size bias is neglected in the research community but it is discussed in practice. For example, RobecoSAM shows in several documents how they work on a (size) unbiased score (Bacon and Ossen 2015; Feldman 2017). Or: Klug and Sailer (2017) supplement the MSCI ESG Rating to avoid the firm size bias by not only using information from the company. This could be one step in the right direction, but it does not entirely prevent the bias, since third party information (e.g., from Non-Governmental Organizations) is dependent on firm visibility and visibility depends on the size of the corporation (Schreck and Raithel 2015). The correlation between firm size and firm visibility goes so far that Baldini et al. (2016) consequently use market value, normally a proxy for firm size, as a proxy for non-investors' firm visibility. In this case, we can also postulate a firm visibility bias which also conforms to the idea of legitimacy-seeking companies. Our results are in line with Gamerschlag et al. (2011) and suggest that with higher firm visibility, the pressure to disclose social and ecological aspects of the company increases.

The paper raises a major question for scholars: how can we verify whether ESG scores really measure the sustainability of corporations?[14] In future research, we want to question how useful an ESG score is if it depends largely on the size (or on visibility), the resources for institutionalized reporting and the transparency of the company. Basically, sustainability measurement with ESG scores should be supported. But to achieve the aims of sustainable finance the measurement system of corporate sustainability needs an update (Busch et al. 2016). A bias does not help SR investors act according to their code of ethics and furthermore does not support the assessment of how ethical a company is. One explanation for the bias can be found in Avetisyan and Hockerts (2017). They conclude, that the consolidation process of ESG ratings can reduce "their institutional change intentions" (Avetisyan and Hockerts 2017, p. 328). A firm size bias and the risk of a misallocation of capital is not in the original spirit of the sustainability rating agencies and the sustainable finance movement, because it does not support the transformation to more sustainability. The firm size bias is especially relevant for relative best-in-class and ESG integration investment strategies. The latter was the "fastest growing strategy" of the last years (Eurosif 2018). Furthermore, Hartzmark and Sussman (2018) show how investors focus on sustainability rankings. They found that mutual funds with five of five Morningstar globes (the sustainability

[14] A discussion of the overall score is missing. But it exists approaches for subscores. For example, Schultze and Trommer (2012) discuss the measurement of environmental performance.

Morningstar ranking is based on sustainalytics' ESG rating) have significantly more net inflow than mutual funds with fewer globes (lower sustainability). This exemplifies how ratings can aid the transfer of capital to more sustainable companies (by means of sustainable funds): Better rated companies gain legitimacy from ESG raters and are consequently picked by sustainability funds. In the long-term, a firm size bias, essentially a biased legitimacy, could destroy the idea of sustainable finance and confidence in ESG raters, because the ESG raters do not properly support the SR investors in their ethical investment approach. And if industry sectors or 'sin stocks', which have a doubtful long-term contribution to the sustainability development, have a higher sustainability score than other companies (see Fig. 1), we only have the pretense of legitimacy. Consequentially, different topics should be discussed regarding this measurement system. How can sustainable finance support business ethics if the measurement system of SR investors has a bias? Should the measurement system focus on input, output, outcome or impact measurement? Is it necessary to adapt all sustainability measurement systems to the SDGs? Should smaller companies meet the same requirements for sustainability assessments as larger companies? Furthermore, whether or not it makes sense to measure a complex construct like sustainability with a single number should be discussed (Capelle-Blancard and Petit 2017b), because investors might only focus on a number and not on sustainability details (Hartzmark and Sussman 2018). Perhaps a separate transparency index and/or controversy score besides a content related ESG score would also be reasonable. Thomson Reuters was well advised and recently updated their ASSET4 Rating with a new Thomson Reuters ESG score which places particular emphasis on including a controversy score in the new combined score. This however, does not remedy the problems from which all papers suffer that have used the ASSET4 ESG ratings which we analyzed in this study. Instead new additional questions have been raised for further research. Do the changes that Thomson Reuters made, reduce firm size or visibility bias? How do the modifications in the new Thomson Reuters ESG score change the results of papers that have used the ASSET4 score analyzed in our paper?

Implication and Conclusion

Our results indicate that there is a firm size bias in the measurement of the corporate sustainability performance by the ASSET4 database. We see the following consequences from our results:

(1) Organizational legitimacy in the neo-institutional theory can explain our results. However, there is less support for the theory of slack resources. The topics of the Brundtland report which aim to protect the rights of future generations by "elevating sustainable development to a global ethic" have become more important in our society (Brundtland and Khalid 1987, Chap.: 12: 2). The development is not only relevant for SR investors but also for other stakeholders. Companies take this development into account by investing in sustainability reporting in order to improve their legitimacy. To reach the transformation, the core business also has to change with implications for the society. The decoupling of external appearance from the core activity of the company is a fundamental issue in organizational legitimacy (Meyer and Rowan 1977; Snelson-Powell et al. 2016). Further research is necessary to investigate under which conditions companies couple or decouple their sustainability reporting from their business practices. If organizational legitimacy brings companies to invest in reporting to "increase their reputation as ethical enterprises" (Long and Driscoll 2007, p. 173), the question for business ethics and sustainable finance should be how to transform this into sustainable development.

(2) If ESG scores do not measure CSP correctly, they do not channel capital to more sustainable companies. Thus, the ethical approach of the SR investors cannot be fulfilled with best-in-class or ESG integration alone. Additionally, actual exclusion criteria and output variables like GHG intensity are necessary to support the reallocation to more sustainable companies and sectors. But this result is not only pertinent for SR investors, it is also important for political decisions since the first of the three main objectives is to "reorient capital flows towards sustainable investment in order to achieve sustainable and inclusive growth" as described in the Action Plan of the European Commission (2018, p. 2).

(3) ESG scores and rating agencies did a good job in bringing transparency to companies regarding their sustainability efforts and condensing it in one number (the ESG score). The ESG raters got the role to assess the legitimacy of the companies. This made it possible for many investors from mainstream finance to include sustainability in their investment processes. Now, we see the time for revision to check if ESG scores really help SR investors' ethical obligation to reallocate funds towards more sustainable companies, which also support the climate change mitigation path and the SDGs. Also, the core business and/or the product of the company should have more relevance than the presentation of the company. We are not saying to abandon the tool, but we do require an update in order to better support the core idea of sustainable finance represented in the

SDGs. This is also necessary with respect to the signaling effect of ESG scores for society and investors.

(4) For researchers, it is necessary to challenge the ESG databases/ratings more. The field of sustainable finance is a relatively young branch in the research community. But interestingly there is more discussion about how profitable sustainability is rather than on how reliable the measurements of sustainability are. Mostly it is unknown if the underlying score measures input, output, outcome or impact. One reason can be that not every question behind each data point in ESG databases is transparent for scholars. One notable exception is the ASSET4 database, where all questions are accessible. The scientific community is well advised not to leave the SR measurement of corporations only to private rating agencies. Another step could be a broader discussion on the definition of corporate sustainability performance, as a fundamental concept of ESG measurement and also as a categorization of the different measurement systems (Schäfer et al. 2004). The latter could help investment companies and investors alike to find the rating scheme and agency that best fits to their ethical investment approach. Malik (2005) indicates that one characteristic of a highly developed discipline is a clear and accurate terminology. Under this perspective it is sad to see, that the science community has waited until a High-Level Expert Group on Sustainable Finance (2018), a group with almost no scholars, proposes a sustainability taxonomy and that the scholars did not do it themselves. Of course, proposals do exist (Dyllick and Hockerts 2002; Soppe 2004; Haigh 2012), but they are not broadly used and so the acceptance is questioned.

(5) Hartzmark and Sussman (2018) show that capital inflow to mutual funds increases with high categorized sustainability (five globes from Morningstar). Thereby they demonstrate that sustainability ratings can positively influence investor's behavior. But does the capital really flow to sustainable businesses? If an ESG score depends mostly on the firm's size and resources, it challenges how comparable the sustainability is between different sectors and portfolios. For example, if we compare the ESG score of sustainable mutual funds with non-sustainable funds (Bauckloh et al. 2017), can we be sure, that the exclusion criteria for controversial business fields used by the sustainable mutual funds really lead to a better ESG score since we have seen in Fig. 1 that excluding sin stocks actually excludes many companies with high ESG scores? Consequently, can the investors be sure that they support companies that are really making business more sustainable by investing in mutual funds with high sustainability performance?

In conclusion, we raised and discussed the question of whether the way the ASSET4 database of Thomson Reuters measures sustainability gives an advantage to larger firms with more or better resources for providing ESG data. Due to our results SR investors and scholars should reopen the discussion about what sustainability rating agencies measure with ESG scores and what exactly we, the scholars, but also the SR investors and politicians, want to have measured. First it should be clear how the instrument works and then it should be used wisely.

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Compliance with Ethical Standards

Conflict of interest There are no conflicts of interest to disclose.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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