Planetary boundaries and sustainability indicators: a survey of corporate reporting boundaries

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Abstract

The aim of this research is twofold: (a) to inquire into the methodological foundations of boundary setting for improved sustainability reporting and (b) to explore current corporate practice in this area, with a particular emphasis on environmental indicators. The paper contends that the boundaries of significant sustainability indicators should encompass all entities over which there is sustainability control together with indirect impacts arising from activities across the supply chain, and not merely direct impacts caused by entities within boundaries based on financial control. The paper explores, through an empirical study of the sustainability reports disclosed by some of the top FT500 companies, how corporations are setting environmental boundaries in practice. Results show a lack of ambition in the practice of setting organizational and operational boundaries. Most reporting entities define organisational boundaries restricted to financial control and most of the indirect environmental impacts sought remain undisclosed.

Keywords: Boundary setting, sustainability reporting; environmental indicators; environmental accounting; indirect environmental impacts**.**

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1. Introduction

In recent years, an increasing number of organisations started to produce reports attempting

to account for their social and environmental responsibility. The percentage of organisations among the 500 largest companies claiming to produce this kind of reports has attained 82% in 2011 (KPMG, 2013). Nevertheless, the design and implementation of systems providing such information has often proved difficult on both methodological and institutional levels, leading to question the relevance of such information (Gray and Milne, 2004).

On the institutional side, it is argued that the voluntary nature of sustainability reporting erodes its reliability and quality (Dingwerth and Eichinger, 2010), with corporations motivated by reputational concerns, rather than by discharging their accountability with stakeholders. The increasing complexity of sustainability reporting has not been matched with a comparable level of methodological sophistication. We would argue that the domination of studies focusing on the institutional explanation of sustainability reporting's lack of quality (e.g. Boiral, 2013), leaves little room to methodological discussions of sustainability reporting and that it is urgent to create spaces for reflection and experimentation (Mitchell et al., 2012) through which organizations and stakeholders can learn how to make corporate accountability operational in a sustainability context.

One specific methodological topic that has not received the attention it deserves is reporting boundary setting. It has been argued that the triple bottom line heuristic, pervasive in sustainability reporting, is actually obscuring the links between the economy, the environment and society as well as the interplay between the micro-organizational and the macro-systemic aspects of sustainable development (Gray and Milne, 2004). Sustainability and environmental concerns transcend the boundaries of the organization and it is uncertain how to define the boundaries of indicators and reports to assess corporate contribution to sustainability. For example, Gray and Milne (2004) argue that there is a mismatch between

the actual boundaries of ecosystems sustainability and sustainability reporting boundaries (see also Gray 2006). According to such explanation, sustainability reports would be problematic since the analysis of sustainable development is only feasible at the ecosystem level of resolution and not within individual organisations (Gray, 2006).

Baker and Schaltegger (2015) contend that this critique of sustainability accounting is important, but critique needs to lead to opening new spaces, new institutional and technical possibilities to address sustainability. In this regard the motivation of this paper is to engage in the development of improved methodologies for sustainability reporting, in the understanding that accounting, corporate reporting and indicators are necessary to measure corporate sustainability, which is the purpose of this special issue. Improved sustainability accounting and reporting is ultimately necessary for making organizations more accountable of their social and environmental impacts. Therefore, the aim of this research is twofold: (a) to inquire into the methodological foundations of boundary setting for improved sustainability reporting and (b) to explore current corporate practice in this area. On the one hand, the study seeks to contribute to the theoretical discussion about the methodological issues raised by boundaries setting in the context of sustainability reporting. The paper contends that the boundaries of significant sustainability indicators should encompass all entities over which there is sustainability control together with indirect impacts arising from activities across the supply chain, and not merely direct impacts caused by entities within boundaries based on financial control. On the other hand, the paper also explores, through an empirical study of the sustainability reports disclosed by some of the top FT500 companies, how corporations are setting boundaries in practice, with a particular emphasis on a set of indirect environmental indicators that have received more attention in both reporting guidelines and practice.

Accordingly, this paper is structured as follows. The second section reviews the literature and examines the main issues arising from reporting boundaries. Key to this paper is the interaction between organizations and planetary ecological processes and the importance of rising awareness about corporate environmental impacts through the notion of sustainability boundaries. Section two finishes by outlining the potential and limitations of a boundary heuristic consisting in organizational and operational boundaries. The third section describes an empirical study using this heuristic to investigate how the worldwide largest corporations are considering environmental boundaries in their sustainability reports. The study involves the content analysis of a sample of 92 sustainability reports published by companies included in the 2012 Financial Times Global 500 (FT 500 thereafter) (Financial Times, 2012). Section four presents the results, which suggest that the quality of boundary disclosure is low. Most reporting entities restrict their definition of organisational boundaries to the criterion of financial control and most indirect environmental impacts are not reported. Finally, section five presents some concluding comments.

2. From planetary boundaries to corporate sustainability reporting

The purpose of sustainability reports and indicators is, arguably, to provide information about the contribution to sustainability of a particular reporting entity. The notion of "entity" draws on conventional financial reporting, where the reporting/accounting entity is defined following the principle of financial control (IFRS 10, 2014). Accordingly, an entity (called "parent or investor") has the obligation of consolidating information when it controls other entities (called "investees"), understanding by control the ability to affect their returns. The rationale being that consolidated financial statements provide more useful, comparable and reliable information to financial stakeholders, because they represent all the transactions made under the control of a single decision maker. In contrast,

the financial information of only a part of the same entity (whatever its legal form) is not financially significant. As an infamous example, Enron deceitfully failed to consolidate some dependent firms that were used to conceal losses. When Enron was forced to retroactively consolidate those entities, the reported losses and debt lead Enron to file for bankruptcy (see Baker, 2003 for more details). As a result, financial stakeholders who trusted Enron financial statements lost their investments. In Enron the reporting entity should have included the financial operations of the dependent firms.

Analogously to the case of financial reporting, boundary setting is a crucial methodological step in the definition of the reporting entity whose performance is described in the sustainability indicator or report. Accurate sustainability boundaries improve the comparability, completeness and relevance of sustainability indicators. For example, in carbon emissions it is necessary to consider *all* the emissions generated by the activity carried out by the company and, consequently, over which it has some control. In this regard, the comparability of sustainability performance among companies with different outsourcing policies or with different energy mixes would demand the inclusion into those sustainability boundaries of supply chain carbon emissions and the emissions produced by the generation of electricity. Otherwise, the carbon indicator would not inform about corporate contribution to sustainability. Just as in the case of Enron its financial reports were not informing about its debts and losses.

Unlike financial reporting boundaries –based on one dimension (financial control) and mandatory through financial reporting standards–, sustainability reporting boundaries are specific for each environmental/social indicator. Furthermore, any attempt to define sustainability reporting boundaries needs to relax the principle of financial control to allow the inclusion of environmental impacts that are produced beyond the boundaries of

financial reporting, but over which the entity has some degree of control/responsibility. Let us call this *sustainability control*.

Among the economic, environmental and social dimensions of the triple bottom line heuristic this paper is emphasizing ecological issues that, arguably, lie at the core of the notion of sustainable development (e.g. greenhouse gas emissions; GHG thereafter). This is not to downplay the importance of the social and economic dimensions of sustainability. For example, despite its sustainability significance, labour practices in the supply chain are not the focus of this study.

Gray (2010) contends that "accounting for sustainability takes the planet as its accounting entity" (p. 55). However, how can the planet be translated into specific boundaries for sustainability indicators at the corporate level is a problematic question that requires a look at the science of sustainable development (Bebbington and Larrinaga, 2014; Schaltegger et al., 2013).

The notion of ecological/planetary boundaries lies at the core of discussions about sustainable development. In the Brundtland Commission's definition of sustainable development (UNWCED, 1987) it was already stated that "growth has no set limits in terms of population or resource use beyond which lies ecological disaster. Different limits hold for the use of energy, materials, water, and land." (p. 42). Such notion of sustainable development is based on two main tenets that illustrate the importance of boundaries: the limits imposed by "the ecological possible" (UNWCED, 1987) and the absence of limits to economic growth. Both tenets are discussed in the following paragraphs.

Scientific research provides evidence that helps to identify some of the limits imposed by "the ecological possible". Rockström et al. (2009) define a set of planetary boundaries that, according to the authors, "define the safe operating space for humanity with respect to the

Earth system" (p. 472), in such a way that crossing these thresholds could cause important subsystems to shift into a new state, where the survival of humanity could be jeopardized. Rockström et al. (2009) found nine processes that demand the definition of planetary boundaries, the first of them being climate change. Certain levels of climate change increase ecological risks, including the loss of mass from Antarctic ice sheets (Cazenave, 2006), the rise of sea-level (Church and White, 2006) or the rise in the number of large floods (MEA, 2005). The boundary proposed by Rockström et al. (2009) is an atmospheric concentration of carbon dioxide of 350 (in parts per million), with current levels beyond this proposed boundary. The rate of biodiversity loss is probably the most unrestrained planetary boundary. Species loss affects both the functioning of ecosystems and their potential to respond and to adapt to changes in physical and biotic conditions (Suding et al., 2008). The boundary proposed by Rockström et al. (2009) is the loss of 10 species per million species per year, with current levels unknown, but well above 100. The anthropogenic interference in the nitrogen cycle with the activation of growing amounts of nitrogen and phosphorus, transforming for example clear-water in oligotrophic state into a turbid-water eutrophic state (Carpenter et al., 2001), is the third process that Rockström et al. (2009) consider that has exceeded the proposed planetary boundary. The proposed boundary in this case is 35 million tonnes of N_2 removed from the atmosphere per year for human use, while the actual figure is 121. The remaining planetary boundaries identified by these authors are ocean acidification, stratospheric ozone depletion, global freshwater use, land-system change, aerosol loading and chemical pollution.

While the planet is characterized by the ecological limits (planetary boundaries) described in the previous paragraph, economic growth (narrowly defined) has no limits. The objective of sustainable development is, therefore, to make economic development compatible with

those ecological limits. As regards measuring corporate sustainability, the focus of this special issue, there is evidence that corporations determine a great deal of, for example, global biodiversity (Chaplin-Kramer et al., 2015) and global climate change (Levy and Egan, 2003), through their decisions about the design, sourcing, production and marketing of their products and services. Whiteman et al. (2013) contend that corporations are central within contemporary economies and societies and conceptualize them as playing an important role in some of the planetary processes identified by Rockström et al. (2009). In this regard, it can be argued that keeping the Earth system in the limits of the "safe operating space for humanity" requires developing appropriate sustainability indicators at the corporate level to understand how companies contribute to global ecological processes.

Significant indicators about the corporate contribution to global ecological processes require a precise definition of corporate boundaries, reflecting the degree of corporate responsibility and control over each ecological issue. Reporting boundaries need to be defined in such a way that the indicator reflects the degree of control (and responsibility) a corporation has over the sustainability issue the indicator is providing information about, allowing managers and stakeholders making decisions about the underlying sustainability issues. However, as the Brutland report states, ecological interactions do not respect the boundaries of individual ownership or political jurisdiction (UNWCED, 1987).

This is the reason why sustainability boundary setting needs to refer to the notion of sustainability, in addition to financial, control; while the latter is amenable to the ideas of financial reporting, the former has to consider supply chain and lifecycle perspectives, characteristic of environmental analysis, i.e. *sustainability control*. Such notion of sustainability control for boundary setting has been articulated around two different boundaries: organizational and operational boundaries (Archel et al., 2008). Organizational

boundaries refer to how boundaries are horizontally set along the continuum of corporate ownership/control to include subsidiaries, concessions or franchises, among other organizations, linked to the reporting entity. Operational boundaries refer to how reporting boundaries are vertically set along the supply chain and/or the life cycle of products and services to include the direct and indirect impact of energy and material inputs, outsourced activities and products and services (see also Matthews et al., 2008).

Organizational boundaries

The notion of organizational boundaries helps to decide which organizations are to be included in the reporting entity and whose environmental performance is portrayed in the sustainability indicator or report (GRI, 2002, US EPA, 2014). As previously discussed, the notion of entity draws on the principle of financial control (IFRS 10, 2014), where an entity (called "parent or investor") has the obligation of consolidating information when it controls other entities (called "investees"), understanding by control the ability to affect their returns. However, in a sustainability context, the ability to affect returns is not the appropriate benchmark for the definition of organizational boundaries. Instead, it has been proposed (e.g. GRI, 2005) that it is the influence over other entities´ sustainability performance the relevant hallmark of organizational boundaries in this context. In this regard, organizational boundaries should incorporate not only entities wholly or partially owned by the reporting entity (CDP, 2011), but also other organisations over whose sustainability the reporting entity has significant influence, i.e. does not have financial but sustainability control. For example, provided that an entity has significant influence over the energy consumption of its contractors, failing to include this information in the indicators and reports of that entity might misrepresent its sustainability performance. The current trend of outsourcing different corporate activities makes accurate organizational

boundaries more significant than ever.

Operational boundaries

While the organizational boundary refers to the entities considered for the elaboration of sustainability indicators and reports, the operational boundary refers to the notion that sustainability indicators and reports need to embrace two classes of impacts: direct and indirect environmental impacts (US EPA, 1970, title 40). Direct environmental impacts are those directly produced by the operations of the entity (US EPA, 2014; WBCSD, 2004). These impacts are easily noticeable and are more likely to be included in sustainability indicators and reports. For example, most sustainability reports include estimations of energy directly consumed and carbon directly emitted by the entity's operations. In contrast, indirect environmental impacts are produced by the activities that third parties (e.g. suppliers) perform as a consequence of the activities of the reporting organization (WBCSD, 2004). Indirect environmental impacts stem from upstream and downstream activities along the supply chain and/or the life cycle of products and services (GRI, 2002; Soderman, 2003). The greenhouse gases protocol (WBCSD, 2004) provides a well-known set of guidelines for setting the operational boundaries of a particular sustainability indicator: greenhouse gases emissions. The GHG protocol suggests three different operational boundaries for the elaboration of GHG emissions indicators using the term "scope" instead of boundary. In such framework scope 1 covers direct GHG emissions, i.e. stemming from combustion in the operations of the reporting entity. Scope 2 would also consider the GHG emissions produced by the generation of electricity/steam consumed by the reporting entity. Finally, scope 3 would include all other indirect emissions. The importance of indirect GHG emissions is illustrated by the findings of Matthews et al. (2008), who estimate that scope 3 would amount to more than 75% of the carbon footprint

for two thirds of the economic sectors.

Extended operational boundaries allow, if not to translate “the ecological possible” to specific corporate sustainability indicators, at least to open new possibilities for the conceptualization of corporate performance with regard to planetary ecological processes. For example, the service sector is at the final end of the supply chain and, although its direct environmental impact is often limited, it causes significant environmental impacts produced by the operations of third parties, often in the primary or secondary sectors (Wiedmann et al., 2006), that provide the service sector with resources for their activities (e.g. energy). Disregarding upstream and downstream ecological impacts would leave out of analysis much of the environmental burden of the service industry. For example, according to Matthews et al. (2008) direct carbon emissions amount to 14% of the carbon footprint for the average industry, with vast variation between the power generation industry (92%) and most service industries. Along the same lines, different studies show that the service industry (Rosenblum et al., 2000) and the information and communication technology industry (Malmodin et al., 2010) have significant environmental impacts, even though their direct impacts might be insignificant.

In summary, sustainability indicators are necessary to assess and make decisions in an organizational context, because organizations have a notable influence over sustainability challenges. Boundary setting is an important issue in the elaboration of sustainability indicators because (i) it connects the micro perspective of organizations and the macro systemic perspective of sustainability and (ii) different boundaries provide completely different pictures about the sustainability performance of whole sectors. The next section reports a study that looks at how corporations are considering environmental boundaries in their sustainability reports.

3. Methods

To study how corporations are considering environmental boundaries in their sustainability reports, a content analysis was performed to the sustainability reports published by some of the 2012 FT top 500 companies.

Sample

The sample includes the 2012/2013 sustainability reports included in the GRI benchmark database[1], submitted by companies included in the 2012 FT 500 ranking (Financial Times, 2012). The GRI benchmark database includes reports applying the G3 sustainability reporting guidelines (GRI, 2011) that went through a GRI application level check between 2012 and 2013 to obtain a certified level of compliance. 105 sustainability reports were initially identified, but thirteen reports were excluded for two reasons: seven reports were in html, which does not allow access to a full version of the report in a single document and six reports were in languages with which the authors are not familiar (German, Korean and Turkish). The final sample was, thus, reduced to 92 sustainability reports for the year ending in 2012 or 2013, representing all six G3 application levels. In terms of industry, the basic materials, the financial, the cyclical good and the energy sectors account for 65% of the sample. Additionally, in terms of geographical distribution (not reported in this table), 26 countries were represented in this sample, but five countries accounted to 54% of the sample: 16 reports were published by US companies, 15 by German companies, seven by French companies and six by Brazilian and by Spanish firms[2].

As explained in the introduction, previous research has expressed concerns about the relationship between sustainability reporting and sustainable development. These concerns

1 Available online at http://database.globalreporting.org/benchmark.

[2] A complete list of the corporate reports analyzed is available upon request to the authors.

have often focused on GRI (Milne, Tregidga and Walton, 2009). However, it is important to make clear that the purpose of this study is not to judge GRI as such, but to inquire into the methodological foundations of boundary setting and to explore current corporate practice in this regard (see above). The GRI database and GRI indicators are used instrumentally, as a way to identify the sustainability reports under study and to locate those specific disclosures that are more likely to be found in sustainability reports.

An additional critique to this sample could be that it is skewed towards specific countries, industries or large companies. Although this critique has some ground, it is also the case that those countries, industries and companies present the best sustainability reporting practice, strengthening the conclusions of this investigation, i.e. including second-tier sustainability reports will not improve the results of this analysis.

Content analysis

A content analysis (Krippendorff, 1989) was performed to the sample sustainability reports to study how organizational boundaries are set for the whole report and how operational boundaries are set for specific environmental indicators. More specifically, a thematic content analysis approach was followed, where the unit of analysis is the “themes” (Beattie et al., 2004), which are usually derived from theory and investigated in the corporate reports. Thematic content analysis has been widely used in environmental accounting research (e.g. Clarkson et al., 2008).

Content analysis reliability can be enhanced using well-specified decision categories, well-specified rules and multiple coders (Milne and Adler, 1999). In this regard, categories and rules specification lies on the well-defined design of the specific disclosure items that are sought in the sustainability reports. The development of variables for the content analysis (table 1) is based on the GRI guidelines, which convey a commonly accepted language

about sustainability reporting and reporting boundaries, minimizing the likelihood of disparate interpretations. Furthermore, a key factor in reliability is the agreement among independent observers (Hayes and Krippendorff, 2007): 27% of the sustainability reports were analysed by the authors separately to test the research instrument, with any discrepancy about the coding procedure being discussed and agreed.

The first column in table 1 shows the fourteen G3 disclosure items considered for this study. Two of them (2.2 and 2.3) disclose information about the reporting organizational profile, four (3.6, 3.7, 3.8 and 3.11) reveal specific boundary issues. Those six indicators reveal different features of organizational boundaries. Eight more disclosure items allow analysing disclosures about indirect environmental impacts. Five of them are G3 core indicators and three are additional indicators.

[Table 1: to be inserted about here]

Content analysis requires developing a set of rules for coding, measuring and recording the analysed data (Milne and Adler, 1999). The research instrument developed (table 1) was adapted for that purpose to include G3 disclosure (GRI, 2011), rather than the G2 guidelines used by Archel et al's (2008). A quantitative scoring method (Krippendorff, 1989) was used to reduce disclosure to numbers that are considered as commensurate. This method consists in assigning either 1 for the presence or 0 for the absence of each disclosure item in each report. Additionally, an intermediate score (0.5) was used, as explained in table 1, when the report provides general descriptions in disclosure items where a precise measurement is required.

As the first row of table 1 describes, seven variables were developed to encapsulate the information about organizational and operational boundaries. Two variables account for organizational boundaries and five variables for operational boundaries. First, *ORGB*

analyses whether, according to disclosures items 3.6, 3.7 and 3.8, the organizational boundary includes not only entities wholly or partially owned by the reporting entity, but also other organizations over which the reporting entity exerts significant sustainability control. *ORGB* takes the value of 1 if the information about organizations whose sustainability performance is controlled by the reporting company is consolidated in the sustainability report. *ORGB* takes the value of 0 if, according to these disclosure items, the organizational boundary of the sustainability report is restricted to the financial control of other companies, as practised in conventional financial reporting.

The second organizational boundaries variable, *DISB*, focuses on two boundary topics. On the one hand, *DISB* measures whether the report discloses those organizations that make up the sustainability reporting entity, considering just a financially restricted boundary. According to their definition, G3 disclosure items 3.6, 3.7 and 3.8 can provide such information. Additionally, disclosure item 2.3 can also provide information about the participation of the reporting entity in subsidiaries and 3.11 can provide information about changes. On the other hand, item 2.2 asks companies to disclose the degree to which they rely on outsourcing, which is a key boundary issue, as was previously discussed. A value of 1 is given if such items are disclosed in the sustainability report and 0 otherwise. Those scores are added and finally standardized in a 0–1 scale ($0 \leq DISB \leq 1$).

Five variables explore operational boundaries. First, *INDI* captures all the information about indirect environmental impacts that can be usually found in a G3 sustainability report: five core indicators (EN4; EN16; EN17; EN26; EN27) and three additional indicators (EN6; EN7, EN29). Most of them focus on climate change (EN16 and EN17) and energy (EN4, EN6, EN7). The rest provide information about indirect impacts arising

from packaging (EN27), transport (EN29) and products (EN26). As for the coding rules, disclosures were only coded when they provided information about indirect environmental impacts (ignoring additional disclosures included in the definition of the G3 indicator). For example, in EN26 this analysis focuses on the initiatives to mitigate environmental impact in the use phase of products and services, while the G3 definition of such indicator includes environmental impacts *in the production* and/or use phases (GRI, 2011). As previously stated, the aim of this analysis is not to assess GRI, but to explore how boundaries are considered in sustainability reports. Each indicator is given a score of 1 if the reporting organisation fully discloses indirect impacts, 0.5 in case of general disclosures lacking detail and 0 for non-disclosure. The addition of the scores given to the eight indicators is standardized to a 0–1 scale ($0 \leq INDI \leq 1$). Subsequently, *INDI* is split into two variables: the first measuring core indicators (*INDC)* and the second additional indicators (*INDA)*. Those two variables are also expressed in a 0–1 scale (see table 1).

The last two variables, *MSIC* and *MSIA* measure in a 0-1 scale inaccurate disclosures for core and additional indicators respectively. They account for disclosures of direct impacts as if they were indirect impacts as well as for denials of indirect environmental impact (when a reporting company unsoundly claims that a particular indicator under analysis is irrelevant or not applicable). Finally, scores are distributed across industries using the Thomson Reuters 10 sectors business classification scheme.

4. Results and Discussion

Descriptive statistics are presented in table 2. In essence, the analysis of the sustainability reports submitted to the GRI benchmark database by FT 500 companies shows that, like financial reports, sustainability reports are based on a notion of the entity defined by

financial control, not consolidating information about those organizations over which the reporting entity has sustainability control. Along the same lines, the disclosure of indirect environmental impact indicators is far from the disclosure levels required by GRI, even in the case of core indicators.

[Table 2: to be inserted about here]

As regards the definition of organisational boundaries beyond financial control (*ORGB)*, 92 out of 92 reports are assigned a 0 score. Despite the previous discussion in GRI (2005) and the possibility of making disclosures in some GRI items, the analysis could not identify in any report a discussion about the consolidation of a single organization on the grounds of influence over their sustainability performance. This seems to confirm that organizational boundaries are, as expected, limited to financial control and, thus, subject to a lack of systemic view as argued in the reviewed literature and in the GRI boundary protocol itself (GRI, 2005). This approach to the definition of the reporting entity, arguably, limits the usefulness of the sustainability report/indicator as a valid instrument for making decisions concerning broader sustainability.

Disclosing the participation on subsidiaries and the degree of dependence on outsourcing (*DISB*) attains a mean value of 0.37, suggesting that in more than 60% of the cases not even the entities included in the report (within a financial control perspective) are disclosed. Therefore, as it comes to organizational boundaries, the reporting entity seems to be generally defined according to the principle of financial control. But unlike financial reporting, a substantial part of the sustainability reports fail to disclose enough information for a stakeholder to discern the composition of the reporting entity. Archel et al. (2008) analysed the 2005 reports produced in accordance with G2 and, as organizational boundaries concerns, found similar results (mean *ORGB* = 0.000; mean *DISB* = 0.304).

These results suggest that the development of sustainability reporting that has taken place since 2005 has not changed the definition of sustainability boundaries and that, arguably, defining them on sustainability control grounds could be seen as a radical change for corporations. Further, these results show little improvement in disclosing the composition of the reporting entity within a financial control perspective.

It is worth analysing separately disclosure item 2.2 (*DISB* (2.2)), given the importance of outsourcing and the fact that it performs remarkably lower (0.011) than the rest of items included in *DISB* (mean=0.370). According to the GRI definition, companies are requested to disclose in item 2.2 major products and/or services and the degree to which the company relies on outsourcing. However, what *DISB* (2.2) measures is only the disclosure of any information about the degree to which the company relies on outsourcing. Mean *DISB* (2.2) = 0.011 suggests that companies are ignoring environmental impacts produced by outsourced activities. Only one report (Unilever Brazil) briefly states that the company works with 3,755 outsourced providers. Sustainability reports and indicators ignoring outsourcing can convey a misleading assessment of corporate sustainability performance and hinder sound decisions. Sustainability indicators of companies with and without outsourced activities are not be comparable. In this regard, without sound sustainability boundaries, showing nicer environmental indicators could be an incentive to outsource the activities with a poorer environmental performance.

Regarding the disclosure of indirect environmental impacts, mean *INDI*=0.378 suggests that, overall, two thirds of such information is missing in some of the, arguably, best sustainability reports worldwide (FT 500 reports submitted to the GRI benchmark database). Archel et al.'s (2008) results for this variable was lower (0.257). This increase can be explained because, unlike Archel et al., the present study focuses on those indirect

indicators that show higher reporting levels (environmental), particularly those on energy and GHG emissions. It can be argued that the situation has not improved substantially since 2005, when sustainability reporting was still as its inception.

Table 3 displays average *INDI*, *INDC*, *INDA* as well as indirect environmental impact indicators, per industry. The first observation that emerges is that disclosure scores vary significantly across industries. The sector with the best scores is non-cyclical goods (mean *INDI*=0.527, mean *INDC*=0.600 and mean *INDA*=0.405), followed by technology (mean *INDI*=0.484, mean *INDC*=0.525 and mean *INDA*=0.417). In contrast, the energy industry achieves the lowest scores of all sectors (mean *INDI*=0.227, mean *INDC*=0.309 and mean *INDA*=0.091). These low scores in energy could be caused by the fact that direct impacts tend to be the share of the lion of this sector's environmental burden in issues such as energy or GHG emissions. However, it is worth noting that service providers, where indirect impacts entail a particular importance, attain mediocre results. Such is the case of financials (mean *INDI*=0.324, mean *INDC*=0.382 and mean *INDA*=0.225) and telecommunications industries (mean *INDI*=0.363, mean *INDC*=0.400 and mean *INDA*=0.300).

[Table 3: to be inserted about here]

Table 3 also shows the mean scores for the different indicators that constitute the variables. Those results indicate that some indicators are disclosed more often than others: means ranging from 0.158 to 0.799. Only two indicators, both core indicators, attain mean scores exceeding 0.5. They are indirect greenhouse gas emissions (EN16) and information about other relevant greenhouse gas emissions (EN17) (0.799 and 0.641, respectively). All the remaining scores are below 0.5: disclosure of initiatives to mitigate environmental impacts of products and services (EN26) achieves a mean of 0.402; disclosure of significant

environmental impact of transporting goods, material and staff (EN29) scores a mean of 0.353; indirect energy consumption by primary source (EN4), information about companies initiatives to provide energy efficient products and services (EN6) and reporting the percentage of products sold and their packaging material that are reclaimed by category (EN27) attain means slightly above 20% (0.228, 0.228 and 0.212 respectively); finally, the lowest score is for initiatives to reduce indirect energy consumption and reductions achieved (EN7) with an average of 0.158.

In general, mean *INDC*=0.457 and mean *INDA*=0.246 suggest that companies are focusing on core indicators, something which might be expected. But, more interestingly, the results also show that those indirect impacts over which there is a developed and generally accepted guidance (GHG emissions and the GHG Protocol) are disclosed disproportionately more than those indicators that are more ambiguous and/or poorly defined. The nature of this study does not allow inferring the reasons for a higher level of disclosure in certain indicators rather than others. However, a higher level of disclosure could be due to the existence of official guidelines (e.g GHG protocol; CDP, 2011) perceived as rational and legitimate by reporters or to the existence of compelling norms to disclose.

Finally, table 3 also shows a high dispersion as regards individual indirect impact indicators across industries. In the case of greenhouse gas emissions, EN16 ranges from 0.600 in healthcare and telecommunication services companies to 1.000 in industrial companies, while EN17 disclosure ranged from 0.364 for the energy sector to 0.875 for the technology sector. Sullivan (2009) explains those differences in terms of the existence of differences across sectors in the governance of climate change.

The disclosure of initiatives to mitigate environmental impacts of products and services

(EN26) ranged from 0.182 in energy to 0.667 in cyclical goods and industrials. Three indicators ranged from nondisclosure to about 50% of disclosure depending on the sector. Indirect energy consumption by primary source (EN4), initiatives to provide energy efficient products and services (EN6) and initiatives to reduce indirect energy consumption (EN7) were not disclosed at all in non-cyclical goods, telecommunication and utilities; health care sector and industrials. However some of those indicators achieved 50% disclosure in cyclical goods (EN4) and technology (EN6) and 40% in utilities sector (EN7). The sharpest variation occurred in EN29 (transportation impacts) which, on average, ranged from 0.045 in energy providers to 0.917 in companies providing non-cyclical goods. EN27 differences across industries can be explained since this indicator (packaging material reclaimed and/or recycled) could be considered not material for certain industries (in the energy and financial sectors its mean is 0.000).

This study also considers the possibility of misleading disclosure within the reports, i.e. companies could pretend to disclose indirect information when they are really providing direct impact information. Misleading disclosures on core indicators (mean *MSIC*=0.107) and on additional indicators (mean *MSIA*=0.217) suggest that companies are putting more effort in disclosing core indicators accurately. It is interesting to note that these results contrast with Archel et al. (2008), since in the latter study misleading disclosure was more frequent for core indicators. These authors contended that this behaviour could be due to the requirement to disclose core indicators for the “in accordance” label that received all the G2 reports that composed their sample. According to their results, companies could conceal their non-disclosure by disclosing direct impacts in the place of indirect impacts and, thus, fit into the “in accordance” requirements.

Alternative explanations of misleading disclosure would include lack of knowledge, lack of

interest or the intention to conceal poor performance. An additional analysis suggests that sustainability illiteracy (which is of course coupled with lack of interest) could play an important role in explaining misleading disclosures. In 4 reports out of the 92 reports we identified cases in which companies openly deny their indirect environmental impacts. In these four reports, companies briefly state that they do not have any indirect energy consumption or impact due to the kind of activities they perform. Considering the previous discussion about the indirect environmental impacts produced by the service industries through the activities of the primary and/or secondary sectors, it is surprising to find such statements in two reports: Ace Seguros (financials) and Celgene (medical research). ACE Seguros states in its sustainability report (p. 93) that EN16 and EN17 are not applicable because their activities do not produce greenhouse gases. Along the same lines, Celgene states for EN16 that Celgene Spain does not have an industrial plant but only commercialise products and therefore this indicator is irrelevant (p. 53). The two remaining reports are published by two Latin America mining corporations, Peñoles and Xstrata Cooper Peru. Peñoles introduces itself as the major world producer of silver, the biggest producer of bismuth in the Western world and the most important producer of gold and lead in Latin America. In page 42 they declare that, as per their knowledge, transport of staff, products and goods did not cause any significant environmental impact. Similarly, Xstrata, states that EN17, EN26, EN27 are not applicable and, finally, in EN29 they state that there are not significant environmental impacts from transportation because this is appropriately managed.

To confirm results some sensibility analysis were performed: variables measuring core indirect impacts (*INDI; INDC* and *MSIC)* were recalculated considering that EN27, due to its nature, is not applicable to energy, financial and telecommunication sectors. Means

calculated along these lines increased from to 0.378 to 0.393 for *INDI* and from 0.457 to 0.481 for *INDC*. Excluding those sectors also produced an increase of misleading disclosure in core indicators (*MSIC)* (from 0.107 to 0.159). The overall conclusions are not affected.

5. Concluding comments

This study has explored, at a theoretical level, the importance of boundaries in the definition of sustainability indicators and reports and, at an applied level, how corporations are considering organizational and operational boundaries in their sustainability reports. A review of the literature suggests that the evaluation of the sustainability performance of organizations requires the integration in the reporting entity of organizations over whose sustainability performance the parent company has control or influence. Such is the case of outsourced activities. Along the same lines, previous studies suggest that for most industries, the lion's share of their environmental impact is indirect, taking place upstream in their supply chain or downstream in the lifecycle of their products and services. Addressing planetary boundaries and providing an accurate picture of corporate sustainability performance requires paying attention to indirect environmental impacts.

To ascertain how reporting boundaries are considered in practice in environmental indicators and sustainability reports, the paper reports a content analysis of a sample of 92 sustainability reports published by FT 500 companies and submitted to the GRI benchmark database. The findings are that reporting boundaries are, as expected, limited to the consideration of financial control (characteristic of financial reporting) and, therefore, not aligned with the required systemic view to approach a sustainable use of natural resources.

More in detail, according to our analysis, organizational boundaries are restricted to organizations under financial control and not encompassing all organizations over which

the reporting entity generates significant sustainability impacts. Furthermore, in most cases reports do not include environmental impacts from outsourced goods and services. The use of this information for sustainability appraisal and decision making could provide incentives to make unsound decisions from a sustainability perspective, e.g. outsourcing activities with poor sustainability performance in order to disclose a better sustainability performance of the reporting entity.

The analysis of operational boundaries reveals that up to two thirds of the information sought in the examined indirect impact indicators is missing in the sustainability reports of some of the largest companies in the world. Considering the importance of indirect environmental impacts and the influence of corporations (especially large corporations) in the major sustainability challenges, the invisibility of this information can again lead to inaccurate sustainability appraisals and to make sustainability-unsound decisions. On a more positive side, certain indicators show a higher level of disclosure than others. This is the case of indirect greenhouse gas emissions, where accepted boundary guidelines exist. This suggests that notable progress on indirect environmental indicators can be made when institutions demand disclosure and reporting guidance is developed and generally accepted.

Additionally, the analysis of misleading disclosure suggests that, despite the development of reporting guidelines, there is room for improvement in terms of raising awareness about corporate responsibility in the current sustainability challenges. Engaging in the design of new accounting methods for environmental disclosure might help to develop more effective disclosure methodologies that should be based on a scientific understanding of the interrelation between organisations and the environment.

The results of this study are relevant for companies, policy makers and researchers alike. To achieve improved disclosure of its environmental impacts, companies and policy makers

should take a long-term approach to analyse, align and integrate ecosystems knowledge into reporting boundary setting. More specifically, companies and policy makers need to envisage new approaches to integrate indirect impacts, outsourced activities and entities beyond financial control in their sustainability reports. Although this study cannot conclude about the regulation of sustainability reporting, one of the implications of this study is that more sophisticated guidance on sustainability boundaries is required not only to ensure the quality and quantity of sustainability reporting but also to provide managers and stakeholders with a clear understanding of corporate environmental performance.

This study has focused on GRI sustainability reports published by some of the largest companies in the world and on a selection of a reduced number of indirect environmental impact indicators. In this regard, the disclosure results presented in this paper are positively skewed, as they are gathered from best sustainability reporting practice and from the indirect impact indicators that draw more attention. Although the non-generalizability of the results is a limitation, this approach strengthens the results of the investigation. Nevertheless, future research should focus on other types of organizations and reports, following different guidelines. The focus on a reduced set of environmental indicators is a further limitation of this study. Further research should also look at the disclosure of indirect social and economic impacts.

This paper opens avenues for further research in the alignment of reporting with planetary boundaries in order to achieve meaningful sustainability disclosure. There is evidence that indirect impacts are a big share of the environmental burden of companies. However, there is little empirical research on the different shares of indirect environmental impacts in different countries, economic sectors and environmental issues.

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TABLE 1

Development of variables for content analysis (adapted from Archel et al 2008)

	Variables						
G3 Disclosures and indicators (GRI 2011)	***ORGB***	***DISB***	***INDI***	***INDC***	***INDA***	***MSIC***	***MSIA***
(3.6) Boundary of the report (e.g., countries, divisions, subsidiaries, leased facilities, etc). See GRI boundary protocol for guidance.	Extended (1) financially-restricted (0) boundaries for report	Mentioning companies inside financially restricted boundaries (1)					
(3.7) State any specific limitations on the scope[1] of boundary of the report.							
(3.8) Basis for reporting on joint ventures, subsidiaries, leased facilities, outsourced operations, and other entities that can significantly affect comparability from period and/or between organization.							
(2.3) Operational structure of the organisation, including main divisions, operating companies, and joint ventures.		Disclosure on participation in subsidiaries (1)					
(3.11) Significant changes from previous reporting periods in the scope[1], boundary, or measurement methods applied in the report.		Changes in the definition of boundaries (1)					
(2.2) Major products and/or services (…) degree to which the organisation relies on outsourcing.		Outsourcing information (1)					
Core Indicators							
(EN4) Indirect energy consumption by primary source			For each indicator, nondisclosure (0); general description (0.5); description and quantification or detailed information (1)	For each indicator same rule as INDIRECT variable		For each core indicator, direct impact disclosure (1); otherwise (0)	
(EN16) Total direct and indirect greenhouse gas emissions by weight.							
(EN17) Other relevant indirect greenhouse gas emissions by weight.							
(EN26) Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation							
(EN27) Percentage of products sold and their packaging materials that are reclaimed by category							
Additional Indicators							
(EN6) Initiatives to provide energy-efficient or renewable energy-based products and services, and reductions in energy requirements as a result of these initiatives.					For each indicator same rule as INDIRECT variable		For each additional indicator, direct impact disclosure (1); otherwise (0)
(EN 7) Initiatives to reduce indirect energy consumption and reductions achieved							
(EN29) Significant environmental impacts of transporting products and other goods and materials used for the organization's operations, and transporting members of the workforce.							
Max. derived from content analysis (min. = 0)	1	4	8	5	3	5	3
Standardized max. For each variable (min. = 0)	1	1	1	1	1	1	1

Notes: [1]Scope meaning disambiguation. In this table "scope" refers to issues in sustainability, also denominated aspects in the context of GRI such as energy use, greenhouse gas emissions, etc., covered in a report (GRI, 2011).

TABLE 2

Descriptive statistics

Variables	Mean	Max	Min	Std. Dev.
ORGB	0.000	0.000	0.000	0.000
DISB	0.370	0.750	0.000	0.263
DISB (2.2)	0.011	1.000	0.000	0.104
INDI	0.378	0.938	0.000	0.204
INDC	0.457	1.000	0.000	0.240
INDA	0.246	0.833	0.000	0.250
MSIC	0.107	0.800	0.000	0.171
MSIA	0.217	1.000	0.000	0.268

Notes: Mean estimations excluding energy, financials and telecommunication sectors: *INDI*= 0.393; *INDC*= 0.481; *MSIC*= 0.159

TABLE 3

Average indirect environmental indicators, by industry

Industry	*INDI*	*INDC*	*EN4*	*EN16*	*EN17*	*EN26*	*EN27*	*INDA*	*EN6*	*EN7*	*EN29*
Basic Materials	**0.403**	**0.505**	0.350	0.850	0.700	0.325	0.300	**0.233**	0.250	0.150	0.300
Cyclical Goods	**0.464**	**0.567**	0.500	0.833	0.667	0.667	0.167	**0.292**	0.208	0.167	0.500
Energy	**0.227**	**0.309**	0.182	0.818	0.364	0.182	0.000	**0.091**	0.182	0.045	0.045
Financials	**0.324**	**0.382**	0.176	0.706	0.706	0.324	0.000	**0.225**	0.265	0.206	0.206
Health Care	**0.350**	**0.420**	0.200	0.600	0.600	0.400	0.300	**0.233**	0.000	0.200	0.500
Industrials	**0.385**	**0.500**	0.167	1.000	0.583	0.667	0.083	**0.194**	0.333	0.000	0.250
Non-Cyclical Goods	**0.527**	**0.600**	0.000	1.000	0.833	0.583	0.917	**0.405**	0.167	0.167	0.917
Technology	**0.484**	**0.525**	0.250	0.750	0.875	0.375	0.375	**0.417**	0.500	0.000	0.750
Telecommunication	**0.363**	**0.400**	0.000	0.600	0.600	0.500	0.300	**0.300**	0.200	0.300	0.400
Utilities	**0.325**	**0.360**	0.000	0.900	0.600	0.300	0.000	**0.267**	0.200	0.400	0.200
Total	**0.378**	**0.457**	0.228	0.799	0.641	0.402	0.212	**0.246**	0.228	0.158	0.353

Notes: Thomson Reuters business classification scheme available at: http://thomsonreuters.com/content/dam/openweb/documents/pdf/tr-com-financial/methodology/trbc-methodology.pdf