



HAL
open science

The impact of international sustainability initiatives on Life Cycle Assessment voluntary disclosures: The case of France's CAC40 listed companies

Ismail N.B., Sébastien Alcouffe, Galy N, Ceulemans K

► To cite this version:

Ismail N.B., Sébastien Alcouffe, Galy N, Ceulemans K. The impact of international sustainability initiatives on Life Cycle Assessment voluntary disclosures: The case of France's CAC40 listed companies. *Journal of Cleaner Production*, 2020. hal-03082800

HAL Id: hal-03082800

<https://hal.science/hal-03082800>

Submitted on 2 Jan 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial 4.0 International License

The impact of international sustainability initiatives on Life Cycle Assessment voluntary disclosures: the case of France's CAC40 listed companies

Nesrine Ben Ismail ^{a, *}, Simon Alcouffe ^b, Nadine Galy ^c, Kim Ceulemans ^d

^a*Aix Marseille University, CERGAM, Faculté d'Économie et de Gestion, Aix-en-Provence, France*

^{b,c,d}*TBS Business School, Toulouse, France*

Abstract

Based on an institutional approach to legitimacy theory, this paper aims to study the individual and cumulative influence of three international sustainability initiatives on the decision to disclose information on Life Cycle Assessment (LCA) and on the quantity of information disclosed. A total sample of 433 firm-year observations has been collected from the content analysis of registration documents and sustainability standalone reports published by 36 companies listed on the French CAC40 index over a longitudinal period of 13 years. Results show that the adoption of the Global Reporting Initiative (GRI) sustainability guidelines, of the United Nations Global Compact (GC) principles, and of the Carbon Disclosure Project (CDP) are positively and significantly associated with the tendency of CAC40 companies to disclose LCA information. In addition, the GRI is the only initiative significantly associated with the quantity of LCA information disclosed. Moreover, the results reveal a positive and significant relationship between the cumulative number of initiatives adopted and both the decision to disclose and the quantity of LCA information disclosed. Finally, in comparison to the GRI, the GC and the CDP do not encourage companies to disclose much information on LCA. The contributions of this study are manifold. It provides evidence that voluntary environmental frameworks can exert different normative pressures towards environmental reporting and suggests that companies decide to disclose LCA information to emphasize their superior environmental performance and to manage their legitimacy. It contributes to a more nuanced understanding of environmental disclosure by making a distinction between the decision to disclose and the quantity of information disclosed. From a managerial perspective, this paper demonstrates the usefulness of having multiple initiatives promoting sustainability, since their combined use leads to an increase in disclosure. Moreover, the results are likely to encourage international initiatives, particularly the GRI, to pay greater attention to LCA.

Keywords: Life Cycle Assessment; environmental information; voluntary disclosure; legitimacy theory; Global Reporting Initiative; sustainability assessment

Paper type Research paper

* Corresponding author.

E-mail addresses: nesrine.BEN-ISMAIL@univ-amu.fr (N. Ben Ismail), s.alcouffe@tbs-education.fr (S. Alcouffe), n.galy@tbs-education.fr (N. Galy), k.ceulemans@tbs-education.fr (K. Ceulemans).

Abstract

Based on an institutional approach to legitimacy theory, this paper aims to study the individual and cumulative influence of three international sustainability initiatives on the decision to disclose information on Life Cycle Assessment (LCA) and on the quantity of information disclosed. A total sample of 433 firm-year observations has been collected from the content analysis of registration documents and sustainability standalone reports published by 36 companies listed on the French CAC40 index over a longitudinal period of 13 years. Results show that the adoption of the Global Reporting Initiative (GRI) sustainability guidelines, of the United Nations Global Compact (GC) principles, and of the Carbon Disclosure Project (CDP) are positively and significantly associated with the tendency of CAC40 companies to disclose LCA information. In addition, the GRI is the only initiative significantly associated with the quantity of LCA information disclosed. Moreover, the results reveal a positive and significant relationship between the cumulative number of initiatives adopted and both the decision to disclose and the quantity of LCA information disclosed. Finally, in comparison to the GRI, the GC and the CDP do not encourage companies to disclose much information on LCA. The contributions of this study are manifold. It provides evidence that voluntary environmental frameworks can exert different normative pressures towards environmental reporting and suggests that companies decide to disclose LCA information to emphasize their superior environmental performance and to manage their legitimacy. It contributes to a more nuanced understanding of environmental disclosure by making a distinction between the decision to disclose and the quantity of information disclosed. From a managerial perspective, this paper demonstrates the usefulness of having multiple initiatives promoting sustainability, since their combined use leads to an increase in disclosure. Moreover, the results are likely to encourage international initiatives, particularly the GRI, to pay greater attention to LCA.

Keywords: Life Cycle Assessment; environmental information; voluntary disclosure; legitimacy theory; Global Reporting Initiative; sustainability assessment

Paper type Research paper

1. Introduction

Over the last decades, there has been growing interest from the general public in the impacts that companies have on the natural environment (Buniamin, 2010; Dienes et al., 2016; ISO, 2006). As a result of this evolution, and due to increasingly stringent governmental regulations and growing stakeholder pressures around corporate environmental disclosure (Ben-Amar and McIlkenny, 2015; Hartmann et al., 2013), companies are publishing increasing quantities of environmental information, including data on greenhouse gas (GHG) emissions, water consumption, volumes of waste generated, and the company's impact on biodiversity (Gibson and O'Donovan, 2007; Jose and Lee, 2007; Michelon et al., 2015). Parallel to this, a growing body of research is concerned with identifying the reasons and conditions that encourage companies to disclose information on their environmental impacts (Bouten et al., 2012; Peters and Romi, 2014). However, while the levels of environmental disclosure of companies have increased over the years, there is still unclarity about the factors that contribute to the decision for corporations to disclose information on their environmental impacts (Dienes et al., 2016; Hahn and Kühnen, 2013).

Life Cycle Assessment (LCA) is one of the most widely used methods to measure the environmental impacts of products or services holistically (Gibassier and Schaltegger, 2015; Guérin-Schneider et al., 2018; Pell et al., 2019; Zanghelini et al., 2018). Nevertheless, as performing a LCA study is relatively costly and time consuming (Gonzales et al., 2002; Hur et al., 2005), only a certain number of companies disclose LCA information and the factors contributing to their decision to disclose remain largely unknown (Ben Ismail, 2018). Several international sustainability initiatives indirectly encourage companies to disclose LCA information. These include the Global Reporting Initiative (GRI) guidelines, the Global Compact (GC) principles, and the Carbon Disclosure Project (CDP). These three international initiatives are widely recognized in the sustainability field (Gallego-Alvarez et al., 2018; Jastram and Klingenberg, 2018; Mori Junior and Best, 2017; Patchell, 2018). They have a dual objective: to encourage companies to adopt responsible behavior and to improve the comparability of companies' sustainability activities by harmonizing reporting on these activities (Fortanier et al., 2011). Therefore, a company adopting such initiatives should be more likely to disclose environmental information than a firm that does not adopt them. This may have a significant impact on its reputation and the credibility of its commitment to protecting the environment. In addition, by disclosing information on LCA, companies can improve their image and position themselves as being part of the club of environmentally responsible companies.

The objective of this article is, therefore, to study the individual and cumulative influence of the three international sustainability initiatives mentioned above on the decision to disclose LCA information and on the quantity of information disclosed. The quantitative analysis is based on a sample of 433 observations gathered from the registration documents and sustainability standalone reports of companies listed on the French CAC40 over the period 2002-2014. For this study, an institutional approach to legitimacy theory is employed (Suchman, 1995). The institutional legitimacy model is based on neo-institutional theory, which seeks to highlight managers' strategies in order to legitimize their actions and manage their company's image in relation to its stakeholders. According to this approach, legitimate companies are those that respect organizational laws, rules, and standards (Beck et al., 2017; Chelli et al., 2018; Chen and Roberts, 2010). Based on this logic, the disclosure of social and environmental information is a way of responding both to coercive institutional pressures, exerted through legal regimes, and to normative pressures, exercised via "non-legal", or voluntary, regimes (Beck et al., 2017; Chelli et al., 2018).

This research makes several contributions to the literature and practice on corporate environmental disclosure. From an academic point of view, three contributions are provided.

First, this study provides evidence that non-legal, or voluntary, environmental frameworks can exert different normative pressures towards environmental reporting. This extends the work of Chelli et al. (2018), who studied the influence of legal and non-legal regimes on the voluntary disclosure of social and environmental information in France and Canada. The results of the present study show that adhering to voluntary sustainability initiatives positively influences the decision to disclose environmental information (i.e., LCA information), but that a distinction can be made in terms of the influence of each individual initiative on the quantity of the disclosed information. Second, the study suggests that companies decide to disclose LCA information to emphasize their superior environmental performance and to manage their legitimacy. This result contradicts the majority of studies using legitimacy theory who find that firms with a poorer environmental performance tend to increase their levels social and environmental disclosures (e.g., Cho and Patten, 2007; Cho et al., 2010). Third, in terms of the methodology used, the study contributes to a more nuanced understanding of environmental disclosure by responding to the call of Bouten et al. (2012) in three different ways: (1) by making a distinction between the decision to disclose and the quantity of information disclosed because the determinants for such decisions may differ; (2) by focusing on a single context (i.e., France) to avoid effects due to country heterogeneity; and (3) by providing a longitudinal analysis, allowing to shed light on evolving patterns in environmental disclosures.

This study provides three managerial implications. First, it was found that, contrary to the GC and CDP, adhering to the GRI guidelines positively influences the quantity of LCA information disclosed by companies, while each of the initiatives positively influence the decision to disclose LCA information. This notion can help external stakeholders to prioritize when encouraging companies to adhere to one or more of these three sustainability initiatives. Second, this research is the first to examine the cumulative influence of GRI, CDP and GC, since previous studies have focused on only one of them individually (Chelli et al., 2018; Mahoney et al., 2013; Michelon et al., 2015). Shedding light on this complementary role is important: it demonstrates the usefulness of having multiple voluntary initiatives promoting sustainability, since their combined use leads to an increase in disclosure. Third, the results of this research are likely to encourage international initiatives, particularly the GRI, to pay greater attention to LCA information by officially including it in their list of indicators to be published. The study also provides evidence of the emerging debate on the harmonization and standardization of reporting practices (e.g. Russo-Spena et al., 2018) and discusses this aspect by identifying the initiatives as exerting some normative pressures.

The remainder of the article is structured as follows. Section 2 presents the relevant literature and theoretical framework, the context of the study and the hypotheses. Section 3 describes the research method. The results are presented in section 4, followed by a discussion in section 5 and a conclusion in section 6.

2. Literature review and hypotheses development

In this section, recent advances in the field of social and environmental disclosure are discussed (section 2.1), as well as the broader context on LCA disclosure in France (section 2.1.1). Afterwards, the theoretical framework of the paper is presented, i.e. the institutional approach to legitimacy theory (section 2.2). Finally, the hypotheses are developed (section 2.3) by presenting the recent literature on the relationships between the adherence to international sustainability initiatives and LCA disclosure.

2.1. Social and environmental disclosure

The decision to disclose social and environmental information and the quantity of information disclosed have been the subject of extensive research and several literature reviews (Dienes et

al., 2016; Fifka, 2013; Guidry and Patten, 2012; Hahn and Kühnen, 2013). Such reviews show that previous research has pointed to some major gaps and shortcomings that have led to the current study. These entail (1) the choice of the independent variable; (2) the determinants to focus on; and (3) the importance of the institutional context.

First, most studies in the field of social and environmental accounting examine environmental and social information as a whole, without investigating further single categories of information (e.g., Chauvey et al., 2015; Chelli et al., 2018; Chelli et al., 2014). This contradicts the work of Unerman (2000), who advocates for studying specific categories of environmental information separately. As opposed to studying environmental information as a whole, focusing on a single environmental disclosure category helps to nuance and fine-tune the analysis of the disclosure strategies of companies (Delmas and Blass, 2010; Depoers and Jérôme, 2017).

As a response to Unerman's (2000) call, some recent papers have focused on information relating solely to GHG emissions (Chu et al., 2013; Depoers et al., 2016; Liesen et al., 2015; Peters and Romi, 2014), climate change (Prado-Lorenzo et al., 2009; Reid and Toffel, 2009), biodiversity (Rimmel and Jonäll, 2013; van Liempd and Busch, 2013), water (Burritt et al., 2016), or environmental expenditure (Depoers and Jérôme 2017). These studies can allow stakeholders to judge the actual efforts made by firms to limit the impact of their activities on the environment. Moreover, based on the results of such studies, legislators can decide to make some categories of environmental information mandatory for certain types of organizations (Jérôme, 2013).

LCA information is among the categories that can be researched separately when investigating environmental and social disclosure. LCA is one of the most established and widely applied tools for assessing and monitoring companies' environmental performance (Guérin-Schneider et al., 2018; Riot, 2013, 2014), therefore holding an important place in the field of environmental accounting (Antheaume, 2018; Gibassier, 2017). While LCA is attracting growing interest from researchers in the engineering sciences, particularly in terms of its technical aspects (e.g., Danilecki et al., 2017; Dossche et al., 2018; Farjana et al., 2019), only a few management or accounting studies have examined the topic in depth (e.g., Antheaume, 2018; Bicalho et al., 2012; Gibassier, 2017). The few existing accounting studies examine the limitations of LCA in environmental accounting for biofuels (Bicalho et al., 2012), the use of LCA to communicate with the general public (Riot et al., 2011), the conditions in which LCA can trigger the dynamics of collective action (Riot, 2013), or the process of creating and institutionalizing LCA (Gibassier, 2014; 2017). No study to date has examined LCA disclosures in company reports.

Second, the literature has shown that firm size and media exposure are important drivers of social and environmental disclosure, while the effect of other determinants, such as profitability and capital structure, is inconclusive (Dienes et al., 2016; Hahn and Kühnen, 2013). In addition, there is a lack of attention in the literature to other types of internal and external determinants of environmental and social disclosure, such as gender diversity or stakeholder pressure (Dienes et al., 2016; Hahn and Kühnen, 2013; Liesen et al., 2015). Some authors have also questioned the role of international sustainability initiatives in encouraging and increasing environmental and social disclosure (Brown et al., 2018; Joseph, 2012; Michelon et al., 2015) and in satisfying the informational needs of stakeholders (Hahn and Kühnen, 2013; Levy et al., 2010). Therefore, the present study examines the role of three of the world's most important international sustainability initiatives on environmental disclosure.

The sustainability initiatives studied in this paper are the GRI sustainability guidelines, the Global Compact (GC) principles and the Carbon Disclosure Project (CDP). Until today, some researchers have analysed the role of one of these three sustainability initiatives in the

disclosure of social and environmental information: GRI (e.g. Chelli et al., 2018; Mahoney et al., 2013), GC (Liesen et al., 2015), CDP (Rankin et al., 2011). Globally, these studies demonstrate that adherence to one initiative has a significant impact on the disclosure of social and environmental information. However, the focus on the influence of a single initiative in isolation only gives a partial idea of the institutional context in which firms operate. The cumulative influence provides a global picture about the response of companies to the influence of a set of international sustainability initiatives that play complementary roles in promoting organizational accountability and improved social and environmental disclosure (Zinenko et al., 2015). However, no study has specifically examined the cumulative influence of sustainability initiatives. Therefore, the present study is focused on the individual and cumulative influences of the most widely used sustainability initiatives on the disclosure of LCA information.

Third, institutional effects specific to one country are an important reason why divergence exists between different studies of social and environmental disclosure (Bouten et al., 2012; Gray et al., 2001; Wanderley et al., 2008). While Chelli et al. (2018) studied environmental disclosure in France and Canada, and Liesen et al. (2015) focused on different European companies, other studies discussing voluntary disclosure through sustainability initiatives have investigated only one country, e.g., the United Kingdom (Michelon et al., 2015) and Australia (Rankin et al., 2011). The current study is focused on a single context (i.e., France), as to avoid such institutional effects specific to multiple countries. The following section discusses the specific institutional context of LCA disclosure in France.

2.1.1. LCA disclosure in the French context

France has built a comprehensive legal framework around corporate environmental disclosure, the main objective of which is to encourage companies to reduce the environmental impact of their products and services (Grisel and Osset, 2008). The use of LCA by companies has been promoted in France since the mid 1990s, but disclosure on such practice has not yet been made mandatory. In 1994, France was the first country to publish a national standard related to packaging for the use of LCA (Antheaume, 2018). In 1997, this standard became the ISO standard for LCA (Gibassier, 2017). Moreover, regulations such as Directive 94/62/EC of 20 December 1994 on packaging and packaging of waste obliged French companies to use LCA to measure and evaluate the environmental impacts of their building materials, electrical and electronic products, packaging and buildings.

France has been among pioneer countries to legislate in the domain of extra-financial reporting, by enacting the New Economic Regulations Act (Loi NRE) in 2001 (Camilleri, 2015) and the Article 225 of the Grenelle II Act in 2010 (applicable in 2012). However, neither the implementing decree of Loi NRE nor the Grenelle II Act (Article 225) include LCA in the list of social and environmental impact indicators that all listed companies in France must publish. Conversely, Article 228 of the Grenelle II Act is about a nationwide test of environmental product labeling. This test took place in France from 2011 to 2013 and was based on LCA; participating companies agreed to provide consumers with information on the environmental performance of their products. But such a test has not been repeated ever since. Similarly, EU Directive 2014/95/EU amending certain provisions of Directive 2013/34/EU on annual financial statements, consolidated financial statements, and related reports concerning non-financial reporting does not require publication of LCA information. The same is true for Directive 2013/34/EU.

In sum, there is no law or regulation in France that obliges companies to disclose information on LCA, despite a long-lasting encouragement by the government to use this tool. However, to give more credibility to environmental and social information, to be transparent and to be legitimate for society, French companies could disclose the method used to

calculate their environmental impact. Disclosing information on LCA is facilitated in the French context, in which social and environmental concerns are strongly institutionalized. Given that LCA disclosures are not mandatory, i.e., absence of a legal regime, this study measures the influence of voluntary regimes such as international sustainability initiatives on LCA disclosures. The adherence to such initiatives could explain why firms tend to disclose LCA information since the initiatives' main objective is to encourage companies to improve their social and environmental reporting and to allow stakeholders to make comparisons across companies, time and countries (Chelli et al., 2018; Karaman et al., 2018).

2.2. An institutional approach to legitimacy and environmental disclosure

Legitimacy theory is the most widely used theoretical framework in social and environmental disclosure research (Chen and Roberts, 2010; Deegan, 2002; Jones, 2010). It constitutes an explanatory frame for the motives and the determinants of voluntary disclosure of social and environmental information by companies (Michelon et al., 2016). Therefore, it fits perfectly well the research object of this study. The theory suggests that environmental and social information tends to be used as a legitimizing tool to limit public pressure and reduce criticisms from stakeholders (Haller et al., 2018).

Legitimacy is defined by Suchman (1995, p. 574) as a “generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions.” It is one of the key concepts of organizational institutionalism and it changes over time along with changes in organizations, sources, and criteria (Deephouse et al., 2017). Societal expectations are not static, but rather change across time, requiring firms to comply with social rules and institutional norms to gain or maintain legitimacy. For this reason, legitimacy theory is one of the most important theories that explain the interaction between companies and their environment (Phiri et al., 2019).

Legitimacy theory is based on the idea that there is a social contract between organizations and society (Cho, 2009; Deegan, 2002; Deegan and Shelly, 2014). For this contract to be accepted by both parties, the organization's value system needs to be aligned with that of society. Conversely, if there is a disparity between the two systems, the social contract is broken and organizational legitimacy is threatened (Dowling and Pfeffer, 1975).

According to Suchman (1995), organizational legitimacy can be considered from two different perspectives: strategic and institutional. The strategic perspective depicts legitimacy as an “operational resource” that organizations try to extract from their environments (Chelli et al., 2018; Suchman, 1995). The institutional perspective considers that legitimacy is a set of constitutive beliefs. This perspective emphasizes the importance for the organization of complying with social rules and values to be considered legitimate and to ensure their survival (Chelli et al., 2018; Depoers and Jérôme, 2017; Suchman, 1995). In this article, the institutional approach to organizational legitimacy is employed to explain the influence of international sustainability initiatives on the disclosure of LCA information.

The institutional approach to legitimacy has been used in the literature; for example, to determine the institutional structures, procedures, and activities that society accepts and considers legitimate (Chelli et al., 2018; Chen and Roberts, 2010). An organization can ensure its legitimacy if it adheres to these institutional structures, procedures, and activities and complies with social rules, norms, and values (Beck et al., 2017; Chelli et al., 2018; Chen and Roberts, 2010; Depoers and Jérôme, 2017). In the institutional approach, organizational legitimacy is therefore achieved when there is convergence between the entity's value system and the value system of the social system to which the entity belongs (Chen and Roberts, 2010; Depoers and Jérôme, 2017). Compliance with institutional requirements to disclose social and environmental information signals an organization's adherence to established

institutional patterns and is a way for it to maintain its legitimacy (Chelli et al., 2018; Suchman, 1995).

Although compliance with the law is an important component of a company's legitimacy (Chelli et al., 2014; Depoers and Jérôme, 2017), other institutional pressures can affect the terms of the social contract by codifying society's values and concerns (Beck et al., 2017; Chelli et al., 2018; Chen and Roberts, 2010). Companies are surrounded not only by rules, but also by social standards and requirements related to social and environmental reporting, which they must also comply with to be legitimate.

The institutional approach to legitimacy therefore predicts that companies will comply not only with laws but also with regulations, public initiatives, and recommendations issued by international organizations such as the United Nations (UN), the GC or the GRI (Beck et al., 2017; Chelli et al., 2018). In addition to being governed by the provisions of legal regimes, companies are also likely to submit themselves to non-legal regimes, such as the GRI or GC initiatives (Beck et al., 2017; Chelli et al., 2018). The regulation of social and environmental disclosure is thus based both on a coercive institutional model, via legal regimes, and on a normative model, via non-legal regimes (Beck et al., 2017; Chelli et al., 2018).

Chelli et al. (2018), for instance, show that the application of the GRI guidelines by a sample of large French and Canadian companies affects the quantity of social and environmental information disclosed by these companies. Similarly, several studies show a positive and significant relationship between the quantity of social and environmental information disclosed and adherence to non-legal regimes, such as the GRI (Galani et al., 2012; Mahoney et al., 2013; Rankin et al., 2011), the GC (Chen and Bouvain, 2009; Liesen et al., 2015), or the CDP (Rankin et al., 2011). Thus, based on the institutional view of legitimacy theory and taking into account the results already highlighted in the literature, it is expected that companies that adhere to international sustainability initiatives, such as the GRI or GC, are more likely to disclose LCA information, and to disclose more information than others, in order to maintain their legitimacy.

2.3. Hypotheses

2.3.1. Individual influence of international sustainability initiatives

The Global Reporting Initiative

The GRI, created in 1997, is at the origin of the most widely used sustainable development reporting frameworks in the world (Bebbington et al., 2012; Brown et al., 2009; Dienes et al., 2016; Mori Junior and Best, 2017). The GRI guidelines were first published in 2000 and subsequently revised in 2002 (G2), 2006 (G3), 2011 (G3.1), 2013 (G4), and 2016 (GRI Standards). They contain a set of reporting principles, a list of economic, social, and environmental indicators, and rules for reporting on these indicators. While the GRI Sustainability Guidelines include a wide variety of indicators on environmental, social, and economic issues and are known for their comprehensiveness, they do not cover every single sustainability topic or item (Cahaya et al., 2015; Lozano and Huisinigh, 2011). In fact, the guidelines contain no items specifically dedicated to LCA. However, three versions of the GRI guidelines (G3, G3.1, and G4) mention "Potential sources of information include product lifecycle assessments (LCA) or documents related to product design, development, and testing" (G3, p. 33; G3.1, p. 33; G4, p. 128).

According to the institutional view of legitimacy, conforming to the institutional recommendations is the simplest way for companies to gain legitimacy (Kent and Zunker, 2013; Suchman, 1995). The present study attempts to identify whether the GRI influences companies in their decision to disclose LCA information. The aim of GRI is to enhance the quality and the transparency of sustainability reporting through developing guidelines for reporting on social and environmental information (Chelli et al. 2018; Rankin et al., 2011).

According to Beretta and Bozzolan (2004, 2008) and Michelon et al. (2015), the quality of disclosure depends on both the quantity of information disclosed (how much) and on the richness of disclosure (what and how is disclosed). Many researchers rely on the assumption that the release of more environmental information is necessary to reinforce corporate accountability (Boiral, 2013).

Firms utilise the GRI to ensure that their institutional legitimacy is maintained (Comyns, 2016). Therefore, companies who adhere to the GRI guidelines are expected to provide at least a minimum quantity of reported LCA information. Moreover, as outlined by Kolk (2003, p. 289), standardization of sustainability reporting is likely to positively influence both the quality and quantity of sustainability information disclosed by companies. In addition, most studies show a significant and positive relationship between the adherence to the GRI guidelines and the overall amount of social and environmental information disclosed (Chelli et al., 2018; Galani et al., 2012; Mahoney et al., 2013). Rankin et al. (2011) and Comyns (2016) confirm this result for GHG emissions disclosures. Michelon et al. (2015) is the only study to find no significant relationship. However, these studies measure social and environmental information based on a checklist of items or indicators prescribed by the GRI guidelines, whereas this does not exist for LCA information.

Relying on an institutional view of legitimacy, compliance to GRI guidelines provides a higher degree of legitimacy. Considering the strong normative pressure exerted by the GRI on companies adhering to its guidelines (Bebbington et al., 2012; Chelli et al., 2018) and based on the results of previous studies mentioned above, the following hypotheses are formulated:

H1a: There is a positive relationship between the adoption of GRI guidelines and the decision to disclose LCA information.

H1b: There is a positive relationship between the adoption of GRI guidelines and the quantity of LCA information disclosed.

The Global Compact

The United Nations Global Compact, or GC, unites companies, organizations, United Nations agencies, and civil society around ten universally recognized principles (UN GC, 2019). These ten principles are grouped into four areas: human rights, labor, the environment, and anti-corruption. By joining the GC, companies commit to report on their progress toward sustainable development. This approach, known as “communication on progress”, requires members to provide an annual update to their stakeholders to explain how they are implementing the ten principles of the GC, as well as expected and achieved results. Companies may communicate their efforts towards implementing the ten principles via Sustainability Reports (SRs) or other public reports, websites, or any other means of communication. There are no standardized reporting requirements installed by GC and the UN does not perform a comprehensive content review. Nevertheless, it is important to note that the GC recommends using LCA in order to comply with Principle 8, “Undertake initiatives to promote greater environmental responsibility”, and Principle 9, “Encourage the development and diffusion of environmentally friendly technologies”.

Some studies show that companies who comply with the principles-based GC initiative are more likely to disclose environmental information. For example, Chen and Bouvain (2009) find that GC member companies disclose more information on workers and the environment than non-member companies. Liesen et al. (2015) find a positive and significant relationship between the adoption of the GC principles and the decision to disclose GHG emissions.

Relying on the institutional view of legitimacy, compliance to the GC principles helps companies to maintain their legitimacy. It is expected that firms facing greater pressure from their environment, e.g., from initiatives such as the GC, are more likely to disclose LCA information. In addition, the GC encourages its members to use the GRI guidelines when

submitting their “Communications on Progress” (Lim and Tsutsui, 2012). One aim of the GC is to encourage companies to provide more comprehensive disclosure related to the ten principles. Therefore, companies who use these ten GC principles are expected to report on LCA to demonstrate their commitment to environmental issues in their public reports.

Thus, consistent with the institutional view of legitimacy and the empirical results from the literature, it can be assumed that GC member firms will be more likely to disclose LCA information, and to disclose more information, than non-member firms. Therefore, the following hypotheses are proposed:

H2a: There is a positive relationship between adhering to GC principles and the decision to disclose LCA information.

H2b: There is a positive relationship between adhering to GC principles and the quantity of LCA information disclosed.

The Carbon Disclosure Project

The Carbon Disclosure Project (CDP) was created in 2000, and since 2003 it has requested that companies complete an annual questionnaire in order to collect information on GHG emissions. The CDP encourages companies to communicate information not only on the carbon emissions directly linked to the manufacture of their products (scope 1) but also on indirect emissions (scope 2) relating to the energy consumption required to manufacture these products. Scope 3 emissions are all other carbon emissions that occur in other stages of a product’s life cycle (procurement, transport, use, disposal, etc.). Scopes 1 and 2 must be reported in order to comply with the GHG Protocol methodology, while scope 3 is strongly recommended but not mandatory. In 2010, the CDP conducted an annual survey of companies on their water management, called “CDP Water” and since 2013 the CDP launched another survey on companies’ impacts on forests, called “CDP Forests”.

It is important to note that the CDP does not require companies to use a specific methodology, but it does recommend that companies describe the methodology used to calculate GHG emissions, water management, and the impact of their activities on forests. Nevertheless, given that LCA can be used to assess a company’s carbon footprint and water footprint, as well as its impacts on ecosystem quality and natural resources, it seems reasonable to assume that companies joining the CDP may be more inclined to use this method than companies that do not adhere to the CDP. In addition, LCA provides emission factors per unit of production for each stage of the life cycle and can therefore be used to estimate each scope (1, 2, and 3 upstream and downstream) that the CDP recommends companies to report on.

A company that mentions LCA in its CDP questionnaire is also likely to mention this methodology in its institutional documents (annual report, registration document, SR). For example, in 2015, 58% of CAC40, CAC Next15, and SBF120 Last15 companies disclosed at least one CDP scope 3 indicator in their reports (Mazars, 2016).

Rankin et al. (2011) show that companies responding to the CDP questionnaires communicate more information on GHG emissions than other companies. They argue that these firms have a higher likelihood of publicly disclosing information on GHG emissions because of the institutional investor pressure related to the CDP. Indeed, corporations are under increasing pressure from institutional investors to disclose information on their GHG emissions (Kolk et al., 2008; Liesen et al., 2015; Rankin et al., 2011). Depoers and Jérôme (2017) state that increased investor pressures make managers more inclined to communicate on their socially acceptable behavior in order to appear legitimate. However, studies conducted in different contexts have shown the lack of consistency and comparability of climate change reporting across firms, limiting the ability for stakeholders to properly assess the effects of global warming (Ben-Amar et McIlkenny, 2015; Kolk et al., 2008; Liesen et al.,

2015). This is partly due to the fact that firms choose not to disclose information on the method used to calculate their GHG emissions (Pinkse and Kolk, 2009; Stanny, 2013). LCA information can help investors to compare between companies based not only on their GHG emissions, but also on water consumption and impact on forests, and may therefore ultimately influence their investment decisions.

Given the institutional pressure of investors and the results of previous studies, it is expected that companies adhering to the CDP are more likely to disclose LCA information. In addition, CDP attempt to increase and improve corporate reporting associated with climate change, water and forests (Rankin et al., 2011). It is, therefore, expected that institutional investors exercise pressure on corporations to disclose more LCA information as to facilitate their investment decisions. According to the institutional view of legitimacy, conforming to the CDP is a way for companies to establish or maintain legitimacy within society. These elements lead to formulating the following hypotheses:

- H3a: There is a positive relationship between responding to the CDP questionnaires and the decision to disclose LCA information.*
- H3b: There is a positive relationship between responding to the CDP questionnaires and the quantity of LCA information disclosed.*

2.3.2. Cumulative influence of international sustainability initiatives

In recent years, the GRI has created formal links with the United Nations GC and the CDP. The GRI’s alliance with these organizations is aimed at ensuring that social and environmental reporting becomes both transparent and comparable between organizations and it plays an important role in this respect. No studies to date have tested the cumulative influence of these three international sustainability initiatives on the disclosure of environmental and social information. However, Kolk (2003) considers that Fortune Global 250 multinationals applying the recommendations of international social and environmental reporting initiatives are likely to disclose more information in their reports. Moreover, Adams and Petrella (2010) state that GRI and GC together can affect social and environmental disclosure more than they can do alone.

According to the institutional view of legitimacy, compliance with social norms is a means by which firms can maintain organisational legitimacy (Chelli et al., 2014; Suchman, 1995). Managers may perceive international sustainability initiatives as a representation of societal values, beliefs and expectations, and compliance with international initiatives is an important way to maintain organisational legitimacy. Based on the institutional view of legitimacy and on the findings of Adams and Petrella (2010) and Kolk (2003), it is considered that disclosures provided by corporate managers are a response to different external institutional pressures, e.g., international sustainability initiatives, to maintain their legitimacy. This leads to the following hypotheses:

- H4a: There is a positive relationship between the cumulative number of international initiatives a company adheres to and its decision to disclose LCA information.*
- H4b: There is a positive relationship between the cumulative number of international initiatives a company adheres to and the quantity of LCA information disclosed.*

Table 1 summarizes the hypotheses.

Insert Table 1 here

3. Research method

3.1. Data collection

The present study examines the voluntary disclosure of LCA information by companies listed on the French CAC40 index over a 13-year period from 2002 to 2014. France was chosen because it is a pioneer country that has enacted legislation for mandatory social and environmental disclosure and provides a favorable context to study the disclosure of LCA information (see §2.1.1). The study focused on a single country in order to avoid country effects as was called for by Bouten et al. (2012). Several reasons explain the choice of the time period. First, LCA was progressively introduced in France in the 1990s so the start of the period was chosen to match CAC40 companies' use of the tool. 2002 was also chosen as the starting year because the law "Nouvelles Régulations Economiques" ("new economic regulations" in English, see §2.1.1) was enacted in the previous year. Finally, 2002 is also the year during which the United Nations Environment Programme and the Society of Environmental Toxicology and Chemistry published an institutional framework for the development and use of LCA by industrial companies. Second, the time period ends in 2014 because at this date, almost all companies (89%) had adhered to the three international initiatives. Moreover, in 2011, the average number of initiatives companies adhered to rose to 2.8 out of a maximum of 3 and stayed at this level afterwards. Hence, adding more years to the time period after 2014 would not result in any major changes in the independent variables. Third, providing a longitudinal analysis allows shedding light on evolving patterns in environmental disclosures (Bouten et al., 2012).

The CAC40 index was chosen because it is the most-followed and most-visible market index in France. CAC40 companies have a stronger likelihood to adopt LCA and to disclose about it than small companies because LCA is an expensive management tool. Furthermore, these companies are subject to pressure from various stakeholders (e.g., NGOs or analysts) regarding the disclosure of environmental information. The companies listed on the French CAC40 in 2014 were selected in order to study them over the entire period from 2002 to 2014.¹ As a result the sample remains stable throughout the period studied, which allows better monitoring of the evolution of LCA disclosure practices. Four companies belonging to the banking and insurance sector were excluded from the sample because they are subject to different disclosure and statutory requirements making any comparison with the other CAC40 companies difficult. Hence, the final sample is composed of the 36 companies.

Most studies on the disclosure of social and environmental information focus on the study of Annual Reports (ARs). However, ARs are insufficient for studying social reporting, as highlighted by Déjean and Martinez (2009). In addition, only a few studies examine two types of reports at the same time, for instance ARs and Sustainability Reports (SRs) (e.g., Chauvey et al., 2015; Chelli et al., 2014), despite the fact that the joint study of these reports provides a relatively comprehensive view of communication practices (Déjean and Martinez, 2009).

For the purpose of this article, two types of reports were considered: registration documents (RDs)² and SRs. RDs present a very large quantity of detailed financial and non-financial information, while ARs present this information in summary form. Furthermore, RDs are "a means of strengthening the credibility of the company's financial information and facilitating relations between the company and its national and international stakeholders. The COB [the French Securities and Exchange Commission] allows companies to file their annual report as their registration document, and accordingly lays down presentation and content rules for the document that go beyond those governing the content of annual reports"

¹ Some companies changed their name during the period studied, but they were included in the sample in order to ensure continuity.

² Since 1991, the *Autorité des Marchés Financiers* (AMF, the French financial markets authority) has encouraged French companies to prepare an annual RD (Regulation n° 91-02). To draft their RD, companies can either prepare a specific document or can tailor their annual report to the presentation and content rules laid down by the AMF.

(Michaïlesco, 1999, p. 90). A total of 675 reports (424 RDs and 251 SRs) were collected. Most of them were extracted from the websites of the selected companies. Certain RDs were also gathered from the AMF database. The panel data comprises 433 firm-years observations (unbalanced panel with 35 firm-years missing observations).

To construct the two dependent variables (i.e., *decision to disclose LCA information* and *quantity of LCA information disclosed*), first a content analysis was performed of the 675 RDs and SRs included in the corpus. The first step comprised an in-depth reading of the RDs and SRs available for 2014 in order to identify the terms used to describe LCA³ disclosures. The second step was to use ATLAS-ti software and the terms identified in the first step to search for and manually code the LCA information disclosed in the 675 reports of the corpus. The sustainable development sections in the RDs were also fully read in order to refine the research. For each type of report studied and each firm-year, all words, sentences, diagrams, figures, and tables concerning LCA were also identified and recorded in a specific database. The third step involved summarizing the information in this newly-created database in order to measure the two dependent variables for each firm-year and each type of report.

3.2. Measurement of variables

Two dependent variables are studied in this article. A distinction was made between the decision to disclose and the quantity of information disclosed because the determinants for such decisions may differ (Bouten et al., 2012; Brammer and Pavelin, 2006). The first variable, called *decision to disclose LCA information*, or DISC_DECISION, relates to the decision as to whether or not the company discloses LCA information. It is dichotomous and takes the value 1 if a company discloses LCA information either in its RD or SR (or in both), and the value 0 if not.

The second variable concerns the quantity of LCA information disclosed, or DISC_QUANTITY. There is significant debate in the literature on the “correct” way to measure the quantity of social and environmental information disclosed. Unerman (2000) identifies six methods: the number of characters, words, sentences, pages, and the proportion of social and environmental information disclosed (number of pages or global volume) compared to the total volume of information disclosed. There is no consensus on the best measurement, and it is possible that the results obtained will differ according to the type of measure used, although this is not systematically the case (e.g., Bouten et al., 2012). To contribute to this methodological debate, and to make the results more robust, three different methods were used to measure the quantity of LCA information disclosed: the number of words (DISC_WORDS)⁴, the number of sentences (DISC_SENTENCES), and the number of pages (DISC_PAGES)⁵. Further, to reduce subjectivity (Archambault and Archambault, 2003; Chithambo and Tauringana, 2014), an unweighted scoring approach was used to measure the quantity of LCA disclosure, i.e. the same weight was given to words/sentences/pages whether they were disclosed in a SR or a RD.

By analyzing and coding the 675 reports in the corpus, a total of 433 observations were gathered for the two dependent variables. Their operationalization is summarized in Table 2.

Insert Table 2 here

³ The following French terms were identified: *ACV, analyse du cycle de vie, cycle de vie, écoconception, éco-conception, éco-design, éco-bilan* (i.e., LCA, life cycle assessment, life cycle, ecodesign, eco-design, eco-footprint).

⁴ DISC_WORDS for a firm-year = number of words on LCA disclosed in the RD + number of words on LCA disclosed in the SR. The same calculation principle is used for DISC_SENTENCES and DISC_PAGES.

⁵ Tables, graphs and figures are taken into account when measuring the quantity of LCA information disclosed in number of pages.

Table 3 specifies the measurement of explanatory variables (panel A) and control variables (panel B). The data for these variables were extracted from the Thomson Reuters Eikon ASSET4⁶ database and/or manually from the RDs, SRs, and companies' websites.

Insert Table 3 here

3.3. Explanatory models

Four models were used to test the hypotheses. Models 1 and 2 are used to test the influence of international sustainability initiatives respectively on the decision to disclose information on LCA (model 1) and on the quantity of information disclosed (model 2), as measured by the number of words, the number of sentences, and the number of pages. Models 3 and 4 examine the link between the cumulative adherence to the three international sustainability initiatives and the decision to disclose LCA information (model 3), and the quantity of information disclosed on LCA (model 4) respectively. The four models are written as follows:

Model 1:

$$\text{DISC_DECISION}_{it} = \alpha + \beta_1 \text{GRI}_{it} + \beta_2 \text{GC}_{it} + \beta_3 \text{CDP}_{it} + \beta_4 \text{IND}_{it} + \beta_5 \text{SIZE}_{it} + \beta_6 \text{ROA}_{it} + \beta_7 \text{DEBT}_{it} + \beta_8 \text{ENV_PERF}_{it} + u_i + \lambda_t + \varepsilon_{it}$$

Model 2:

$$\text{DISC_QUANTITY}_{it} = \alpha + \beta_1 \text{GRI}_{it} + \beta_2 \text{GC}_{it} + \beta_3 \text{CDP}_{it} + \beta_4 \text{IND}_{it} + \beta_5 \text{SIZE}_{it} + \beta_6 \text{ROA}_{it} + \beta_7 \text{DEBT}_{it} + \beta_8 \text{ENV_PERF}_{it} + u_i + \lambda_t + \varepsilon_{it}$$

Model 3:

$$\text{DISC_DECISION}_{it} = \alpha + \beta_1 \text{GRI_GC_CDP}_{it} + \beta_2 \text{IND}_{it} + \beta_3 \text{SIZE}_{it} + \beta_4 \text{ROA}_{it} + \beta_5 \text{DEBT}_{it} + \beta_6 \text{ENV_PERF}_{it} + u_i + \lambda_t + \varepsilon_{it}$$

Model 4:

$$\text{DISC_QUANTITY}_{it} = \alpha + \beta_1 \text{GRI_GC_CDP}_{it} + \beta_2 \text{IND}_{it} + \beta_3 \text{SIZE}_{it} + \beta_4 \text{ROA}_{it} + \beta_5 \text{DEBT}_{it} + \beta_6 \text{ENV_PERF}_{it} + u_i + \lambda_t + \varepsilon_{it}$$

Where:

i = company, $i=1, \dots, N$; t = year, $t=1, \dots, T$

$\text{DISC_DECISION}_{it}$ = decision to disclose LCA information

$\text{DISC_QUANTITY}_{it}$ = number of words, number of sentences, number of pages on LCA

GRI_{it} = adoption of GRI guidelines

GC_{it} = adherence to Global Compact principles

CDP_{it} = responding to Carbon Disclosure Project questionnaire

GRI_GC_CDP_{it} = adherence to the three international initiatives

IND_{it} = industry sector environmentally-sensitive

SIZE_{it} = size of company

ROA_{it} = financial performance

DEBT_{it} = debt level

PERF_ENV_{it} = environmental performance

α = constant

β = model parameters to be estimated

u_i = firm-specific effect

λ_t = time effect⁷

⁶ This database is used in many environmental and social disclosure research studies (Haque, 2017; Qiu et al., 2016; Trumpp et al., 2015). It is considered one of the leading global databases for social, environmental, and governance information. The ASSET4 data are collected from several sources (annual reports, registration documents, sustainable development reports, etc.) and are then verified by different research analysts.

ε_{it} = unobservable random term

As the data have two dimensions, i.e., individual and temporal, panel data regression methods were used. In order to explain the decision to disclose LCA information (models 1 and 3), a sample-wide logit model was used. To explain the quantity of LCA information disclosed (models 2 and 4), regression models were used solely for those observations (firm-years) where LCA information is disclosed ($\text{DISC_DECISION} = 1$), as recommended by Bouten et al. (2012)⁸. Statistical processing was performed using STATA16 software.

4. Results

4.1. Descriptive statistics

Out of the 433 observations in the sample, LCA information is disclosed in 301 cases, i.e. approximately 70% of observations. As shown in Figure 1, the proportion of CAC40 companies disclosing LCA information increases steadily from 2002 to 2011, before stagnating at around 86% from 2011 onwards. This stagnation may arise because companies attain a certain level of maturity in their use of the LCA method, although using LCA and disclosing information on LCA might not necessarily be aligned.

Insert Figure 1 here

Panels A and B of Table 4 provide descriptive statistics relating to the quantity of LCA information disclosed. To facilitate modeling, the natural logarithm of the number of words, sentences, and pages was used. The standard deviation of each variable is rather high, indicating that observations are widely spread. After removing zero observations (panel B of Table 4), a relatively widely spread quantity of LCA information disclosed (measured by number of pages) was observed.

Insert Table 4 here

Figure 2 shows that the quantity of LCA information disclosed, measured by the average number of pages per firm⁹, has continued to increase significantly¹⁰ over the period studied. It increased threefold between 2002 and 2012 and appears to have reached a peak in 2013. It can be noted that 2013 marked the end of the French environmental labeling test period of consumer products.

Insert Figure 2 here

Descriptive statistics for the independent variables are shown on panels C and D of Table 4. Firm size spread is relatively small, which is linked to the choice to focus solely on companies belonging to the CAC40 companies. Regarding the adherence to the three international sustainability initiatives, statistics show that it is extremely rare for a company to adhere to none of them.

4.2. Correlation matrices

⁷ Time effect is measured by the inclusion of an additional T – 1 dummy variable. One of the time effects must be dropped to avoid perfect collinearity—see Greene (2012, p. 404).

⁸ Bouten et al. (2012) show that the best approach for explaining the quantity of information disclosed is to exclude firm-years where this amount is zero. They also recommend using a Hurdle model to study both the determinants of the decision to disclose and the quantity of information disclosed. However, this type of model is not suitable for the present study because of its longitudinal nature: it effectively considers that if $Y = 0$ for a firm-year, then $Y = 0$ for the entire analysis period. This model is therefore only valid for studies covering a single year (Engel and Moffat, 2014).

⁹ A similar graphic representation was obtained with the number of words or the number of sentences.

¹⁰ The significance of the year effect was tested with the option “testparm i.YEAR” in Stata.

Tables 5 and 6 present the Pearson correlation coefficients between variables. There is no strong collinearity between the explanatory variables: the highest coefficient is equal to 0.518. Examination of Variance Inflation Factors (VIFs) and tolerance in the regression models confirms the absence of multicollinearity between the different independent variables. Overall, each of the three variables relating to adherence to the international sustainability initiatives (i.e., GRI, GC, CDP), and the variable representing cumulative adherence to these three initiatives (i.e., GRI_GC_CDP), are significantly correlated with both the decision to disclose and the quantity of LCA information disclosed, measured in different ways. In addition, the correlation coefficient of cumulative adherence (GRI_GC_CDP) is higher than the three initiatives taken separately, for both the decision to disclose and the quantity of information disclosed.

Insert Tables 5 and 6 here

4.3. Test of explanatory models

Table 7 summarizes the results for the two models linking individual adherence to each of the three international initiatives with the dependent variables (models 1 and 2). The decision to disclose LCA information (model 1) is positively and significantly associated with adherence to the GRI guidelines and GC principles, and with responding to the CDP questionnaire. Hypotheses H1a, H2a, and H3a are therefore confirmed. In terms of the control variables, only environmental performance (ENV_PERF) is significantly and positively correlated with the decision to disclose LCA information.

Insert Table 7 here

For model 2, panel regression results show that the GRI is the only initiative where adherence is significantly and positively associated with the quantity of LCA information disclosed, regardless of how this amount is measured. Hypothesis H1b is thus confirmed. On the other hand, the two other explanatory variables (adherence to GC, and CDP) are not significantly associated with the quantity of LCA information disclosed, regardless of the measurement method. Hypotheses H2b, and H3b are therefore rejected.

Table 8 presents the results for the two models linking cumulative adherence to the three international initiatives with the dependent variables (models 3 and 4). Results show that there is a positive and significant relationship between the cumulative number of international initiatives and the decision to disclose LCA information. Hypothesis H4a is therefore confirmed. The results also show that there is a positive and significant relationship between the cumulative number of international initiatives and the quantity of LCA information disclosed, regardless of how quantity is measured. Nevertheless, the margin of error is 10% for the natural logarithm of the number pages, 5% for the natural logarithm of the number of sentences, while it is only 1% for the natural logarithm of the number of words. Hypothesis H4b is therefore confirmed.

Insert Table 8 here

4.4. Additional tests

Several additional tests were conducted to assess the robustness of the main findings. First, alternative measures for firm size (natural logarithm of total assets instead of natural logarithm of total sales) and financial performance (Return On Equity instead of ROA) were used to run Models 1-4 (not tabulated). The results of these additional tests are consistent with the main findings except for firm size. A negative but marginally significant (10% level) relationship was found between firm size measured by the natural logarithm of total assets and the quantity of LCA information disclosed measured by the natural logarithm of the number of pages. Overall, the results of these additional tests are consistent with the main

findings and provide additional support for the hypothesised relationships between individual and cumulative adherence to international sustainability initiatives and both the decision to disclose LCA information and the quantity of information disclosed.

Second, two additional firm characteristics were included as control variables in Models 1-4. These are systematic risk, measured by the beta of the company, and ownership structure, measured by the percentage of share capital available to ordinary investors. No significant relationship was found for any of these two additional control variables and the results were consistent with the main findings regarding the relationships between the adherence to international sustainability initiatives and the disclosure of LCA information.

Third, to test for sample selection bias, the same procedure as Bouten et al. (2012) and Liesen et al. (2015) was followed. Some additional robustness checks were run to control for the possibility that the characteristics of firms disclosing LCA information are significantly different from those that do not. This heterogeneity in firm characteristics might lead to unobserved sample selection biases in Models 2 & 4 (quantity of LCA information disclosed), given that the effects of independent variables on quantity of LCA information disclosed might be impacted by unobserved and uncontrolled effects of the same independent variable on the decision to disclose (Models 1 & 3). To control for this possibility, standard procedure (Collier and Gregory, 1999; Gupta et al., 2008) was followed. An Inverse Mills Ratio was computed using Heckman's (1979) procedure and was then added as additional control variable to Models 2 & 4. The results of these robustness tests show no changes in the significance of any variable.

Fourth, to verify that GRI exerts the greatest normative pressure on CAC40 companies to disclose LCA information, additional tests were run relating to the cumulative influence of the two other international initiatives (GC and CDP) on the quantity of LCA information disclosed. The results of these tests confirm this finding since the cumulative number of initiatives adopted, other than the GRI, is not significantly correlated with the quantity of LCA information disclosed (see Appendix 1). This is consistent with the fact that the GRI is considered to be the most influential initiative in social and environmental reporting (Chauvey et al., 2015; Chelli et al., 2018; Milne and Gray 2013).

5. Discussion

This paper studies the influence of international sustainability initiatives on the disclosure of LCA information. The results show that the proportion of companies disclosing LCA information in their RDs and SRs continued to rise from 35% in 2003 to 90% in 2011 and then remained stable at this level. This result could be interpreted as companies listed on the French CAC40 becoming progressively aware of the importance of disclosing this type of information. Furthermore, the quantity of LCA information disclosed increases significantly over time. These initial results are in line with those obtained by Chelli et al. (2018), who show that the quantity of environmental information disclosed by a sample of 20 French SBF120 companies increased between 2001 and 2013.

Figure 3 summarizes the main findings of the study. Overall, the results show that both the single and the cumulative adherence to the GRI, GC and CDP are positively and significantly associated with the decision to disclose LCA information. These results are in line with the theoretical framework used in this study, i.e., an institutional approach to legitimacy theory. According to this theory, companies respond to pressure from the institutional actors in their environment in order to maintain their legitimacy (Beck et al., 2017; Suchman, 1995).

Insert Figure 3 here

Disclosing LCA information sends a strong signal to society and stakeholders and is thus a means of demonstrating the company's environmental commitment. This concurs with van

Staden and Hooks (2007), who state that environmental disclosures in general are necessary for companies to demonstrate legitimacy and to avoid legitimacy threats, i.e., if society is not aware that they are operating within its norms and expectations. The study also extends the work of Chelli et al. (2018), who find that voluntary regimes in combination with local legislative regimes can prompt environmental disclosure. The present study refines these findings, by showing that within one local legislative regime (i.e., France), in which multiple voluntary frameworks co-exist, these frameworks can exert different normative pressures towards environmental disclosure. The following sections discuss the influence of each of these voluntary frameworks in more depth, as well as their cumulative influence.

5.1. Influence of the GRI

CAC40 companies' adoption of the GRI guidelines is positively and significantly associated with the decision to disclose LCA information and with the quantity of information disclosed. These results corroborate those obtained by previous studies on the disclosure of overall social and environmental information (Chelli et al., 2018; Galani et al., 2012; Mahoney et al., 2013) and those focusing on one category of environmental information (Comyns, 2016; Rankin et al., 2011).

Given the legitimacy of the GRI guidelines (Brown et al., 2009; Joseph, 2012; Waddock, 2008), companies attempting to comply with their requirements are more likely to disclose environmental information, including data on LCA, thereby signaling their adherence to established institutional patterns. In contrast to other voluntary initiatives, the GRI provides a comprehensive framework to report on an organization's sustainability performance, including guidance on how to report, what to report on and which indicators put forward (Joseph, 2012). This may encourage companies adhering to GRI to disclose LCA information and to disclose this information in a more extensive way.

Furthermore, CAC40 companies may disclose more LCA information as a response to the aim of GRI to enhance the quality and rigour of the environmental and social information disclosed. The GRI is the only international sustainability initiative that proposes principles for ensuring the quality of disclosure, which are: balance, comparability, accuracy, timeliness, clarity and reliability. For example, the principle of accuracy requires the reporting organization to provide sufficiently detailed information for stakeholders to be able to assess the organization's performance (GRI, 2013). This principle may positively affect the quantity of environmental information provided in the company reports.

Certain authors are critical of the GRI (Joseph, 2012; Moneva et al., 2006), pointing out that managers may use the guidelines with the sole aim of appearing legitimate to society (Michelon et al., 2015; Moneva et al., 2006). Some companies may increase the number of indicators they disclose in order to "check" as many GRI "boxes" as possible, while limiting the amount of information disclosed for each item (Villiers and Alexander, 2014). The company's objective may therefore be to send a positive signal to its stakeholders, showing them that it belongs to the "club" of environmentally responsible companies when in fact it fails to disclose sufficient information to enable readers to draw their own conclusions. The present study counters to some extent this "opportunistic" view of corporate behavior towards the GRI guidelines in two ways. First, it is shown that many companies disclose LCA information, despite it not being explicitly included in the list of environmental indicators defined by the GRI. Hence, the GRI encourages companies to report on more issues than what is minimally required by their guidelines. Second, the GRI is the only one of the three international initiatives studied in this paper to be significantly and positively associated with the quantity of LCA information disclosed. This implies, as mentioned above, that the GRI indirectly motivates companies to report more extensively on LCA information than other initiatives, which partly counters Villiers and Alexander's (2014) findings. From a

stakeholder point of view, the results of the current study also suggest that external stakeholders could primarily focus on encouraging companies to adhere to the GRI if they want to have access to a larger quantity of LCA information.

5.2. Influence of the GC

Contrary to the results obtained for the GRI, adhering to the principles of the GC is only significantly associated with the decision to disclose LCA information. This result may be explained by the fact that the GC ultimately only plays a marginal role in the disclosure of social and environmental information. Many researchers (e.g. Brown et al., 2018; Runhaar and Lafferty, 2009; Sethi and Schepers, 2014; Zinenko et al., 2015) highlight the overly general nature of its ten principles, which have no real normative character, and which leave member companies free to implement only few actual changes.

The goal of the GC is to offer general and universal guidelines for all types of companies to align their strategies and operations with ten principles in the areas of human rights, labour, the environment and anti-corruption and to be accountable towards these issues, rather than to increase disclosure (Brown et al., 2018; Zinenko et al., 2015). Furthermore, as noted by Sethi and Schepers (2014), the GC is not an organization that is focused on monitoring or developing standards for sustainability disclosure, nor did it explicitly include enforcement mechanisms to obtain companies' adherence to the principles (Williams, 2014).

The results of this study are also contrary to those obtained in previous studies, such as Chen and Bouvain (2009) and Liesen et al. (2015). Chen and Bouvain (2009) found that the GC has an effect on the amount of information disclosed related to the environment. Liesen et al. (2015) demonstrated that the GC has no influence on the disclosure of complete GHG emissions data. This may be due to the fact that the object studied, and its measurement are different, as are the duration of the study and its context (i.e., country, institutional and normative framework).

5.3. Influence of the CDP

Responding to the CDP questionnaires is positively and significantly associated with the decision to disclose LCA information. This result highlights the normative pressure exerted by the CDP, and in particular the power of its institutional investors, who appear to exert significant influence on companies' communication strategies in order to obtain information on the methods used to calculate GHG emissions, water management, and the impact of companies' activities on forests. The legitimacy of the CDP may encourage companies that respond to its questionnaires to transfer elements of their responses to their RDs and SRs (Jérôme, 2013), thereby disclosing information on LCA.

Andrew and Cortese (2011) show that responses to the CDP questionnaires not only provide investors with information on companies' climate change strategies, but also contribute to the development of coherent disclosure practices. LCA information can help investors to compare companies based on their GHG emissions, water consumption, and impact on forests, and may therefore ultimately influence their investment decisions. On the other hand, according to the results of the present study, responding to the CDP questionnaires is not significantly correlated with the quantity of LCA information disclosed. While not measuring the same type of environmental information, these results contradict those obtained by Rankin et al. (2011) on the link between adhering to the CDP and the extent of published GHG emissions data.

The objective of the CDP is to collect climate change, water and forest data from companies around the world by asking them to respond to its questionnaires. Therefore, the company's CDP response can be used to assess the climate, water and forests disclosures made in its reports. Cotter et al. (2011) demonstrate through a case study of a large Australian company that it does not disclose as much information in its sustainability report as in its

CDP response. They explain that companies see their sustainability report mainly as a way to communicate with stakeholders other than institutional investors. As these stakeholders generally do not require very detailed information to meet their needs related to environmental issues, this information may be available, but is not necessarily included in the sustainability report. This could explain why no significant relationship was found in the present study between CDP adherence and the quantity of LCA information disclosed.

5.4. Cumulative influence of the sustainability initiatives

Finally, it can be noted that there is a positive and significant relationship between the cumulative number of international initiatives adopted and both the decision to disclose LCA information and the quantity of information disclosed. This result is consistent with the theoretical framework, which is based on an institutional approach to legitimacy theory. According to this theory, companies disclose environmental information in response to the different normative pressures stemming from their environment. The greater these pressures, represented in this study by the cumulative number of international initiatives adopted, the more inclined managers will be to communicate their company's socially responsible behavior, with the aim of increasing or maintaining their company's legitimacy (Aerts et al., 2008; Kent and Zunker, 2013).

These results corroborate the findings of Ngo (2012), who states that, together, the CDP and GRI act as important catalysts for companies to disclose LCA information. Moreover, this is in line with Adams and Petrella (2010), who claim that through collaboration, the GRI and the GC can reach more organizations and can achieve greater attention to sustainability issues, including environmental disclosure, than each of them could alone.

In general, some studies have highlighted that companies who adhere to international sustainability initiatives can build a positive reputation with stakeholders (e.g. Boesso et al., 2013; Melo and Garrido-Morgado, 2012). The current study suggests that adherence to multiple sustainability initiatives may be able to further augment this effect, since their combined use leads to an increase in LCA disclosure. This is in line with Zinenko et al. (2015), who claimed that international sustainability initiatives play complementary roles in improving social and environmental disclosure. The existence of a cumulative effect is an important insight for this study: it provides reasons for promoting the co-existence of multiple sustainability initiatives within one institutional context, as a way to lead to increased sustainability disclosures.

Finally, the results of this research may encourage international sustainability initiatives to, jointly or individually, introduce standardization in the reporting of LCA information, as this may lead to a further increase in disclosure and to more accurate and comprehensive information. This could ensure comparability across firms, over time, and across countries. An enhanced comparability of reports might improve stakeholders' ability to analyze the disclosed information. Thus, policymakers may take actions towards improving sustainability practices and reporting by standardizing the presentation and the content of LCA disclosure to avoid the risk of low-quality environmental disclosure (Chauvey et al., 2015).

5.5. Control variables

With respect to the control variables of the study, only environmental performance is significantly and positively associated with the decision to disclose LCA information and no variable is significantly associated with the quantity of information disclosed¹¹. Environmental performance is an important issue for investors and other stakeholders (Busco et al., 2019; Villiers and van Staden, 2011); the results of the present study demonstrate that if

¹¹ In addition, the U relation between the quantity of LCA disclosure and environmental performance was tested and no significant relationship was found.

a company is performing well on the environmental level, it would disclose a higher quantity of LCA information. Proponents of legitimacy theory argue that companies use social and environmental disclosure to improve stakeholders' perception of their performance (Deegan, 2002). They also believe that there is a negative relationship between environmental performance and the quantity of information disclosed: companies with poor performance may be more likely to disclose and may disclose more information in order to offset the negative effect of this poor performance on their legitimacy (Cho and Patten, 2007; Cho et al., 2012; Hummel and Schlick, 2016). The data of this study show the opposite: environmentally efficient companies are more likely to disclose LCA information than non-performing companies. This may be due to the fact that previous studies have tested the link between environmental performance and the disclosure of environmental and social information as a whole, while this study focuses on LCA information only.

These results of the present study are in line with Busco et al. (2019), who also show that there is a positive relationship between companies with higher levels of integrated thinking and reporting and environmental performance. LCA disclosure would reassure and convince stakeholders of the current environmental performance achieved. This is due the specific characteristics of LCA. In fact, it is considered as a proactive tool for the French industry to protect against potential attacks from competitors or ecologists (Antheaume, 2018; Gibassier, 2017). In general, LCA information is more likely to help users assess the company's environmental performance than other types of environmental information (Riot, 2013; 2014). Another possible explanation for the positive link between environmental performance and LCA disclosure is that the number of companies disclosing LCA information is increasing. This forces non-performing companies to follow the tendency. The objective is then to portray an image of environmental commitment while limiting the level of information disclosed to not allow stakeholders to assess their actual non-performance. This would be in line with the logic of organizational hypocrisy (Cho et al., 2015; Michelon et al., 2016).

Finally, the results show no significant relationship between company size and environmentally sensitive industry, on the one hand, and the decision to disclose and the quantity of LCA information disclosed, on the other hand. This result is interesting because it contradicts a branch of the literature, which maintains that large companies and those in environmentally sensitive sectors tend to disclose more information than others because they are subject to greater institutional and public pressure (Cho, 2009; Peters and Romi, 2014). However, the findings of Chelli et al. (2018) are confirmed; they demonstrated that there is no significant relationship between French firms belonging to environmentally sensitive sectors, their size, and the level of environmental disclosure. It is possible that, in line with Brammer and Pavelin (2006), the absence of such a relationship in the study is explained by the low sectoral diversity of the sample and the fact that it is exclusively comprised of very large companies.

6. Conclusion

The objective of this research was to investigate the individual and combined influence of international sustainability initiatives on the decision to disclose LCA information and the quantity of LCA information disclosed. The results show that the proportion of companies disclosing LCA information continues to increase significantly over time, as does the quantity of LCA information disclosed. Furthermore, adhering to the GRI guidelines, the GC principles, and responding to the CDP questionnaires is significantly and positively associated with the decision to disclose LCA information. However, the quantity of LCA information disclosed is only significantly and positively associated with the adoption of the GRI guidelines. The study also shows that there is a positive and significant relationship between the cumulative number of international initiatives adopted and both the decision to disclose

LCA information and the quantity of information disclosed. In line with the theoretical framework, which is based on an institutional approach to legitimacy theory, the GRI can be considered the initiative that exerts the strongest normative pressure on CAC40 companies to disclose LCA information in their reports.

This article is not without limitations. The first set of limitations relates to the sample of the study. While the number of companies may seem small (36), a longitudinal approach was used, as requested by Bouten et al. (2012), resulting in a total sample of 433 firm-year observations. This approach allowed us to shed light on the evolving patterns of both the decision to disclose and the quantity of LCA information and to have a large set of observations. Nevertheless, the panel data structure has a rather poor ratio between the number of cross-sectional units (36) and time periods (13). Therefore, the stationarity of the data was tested and confirmed, by performing Fisher-type unit-root tests. Moreover, the exclusion of non-financial companies avoids not being able to compare adequately. Focusing on a single context is recommended by Bouten et al. (2012) to avoid country effects. Second, the authors acknowledge that only a selected number of firm characteristics are included as control variables in the study. Including other characteristics, such as managerial culture or international exposure, could add to the understanding of LCA disclosure practices. Third, only two types of communication channels have been studied in this research, i.e., RDs and SRs. It is possible that some companies may disclose information on LCA through other types of communication channels, such as websites, and that this type of disclosure is explained by other variables than the ones included in this study. Taking into account the aforementioned limitations, any generalizing statement about the results of this study should be made carefully. For example, the disclosure of LCA information by French Small- and Medium-sized Enterprises could be explained by other variables than the ones included in our study of large, non-financial companies included in the CAC40 index.

Going forward, it would be interesting to extend the existing sample to SBF120 or SBF250 companies in order to examine a greater variety of industry sectors and company sizes. Moreover, financial companies were excluded because they are subject to different disclosure and statutory requirements making comparisons with other types of companies difficult. Hence, one avenue for future research would consist in focusing on financial companies only. It would also be interesting to compare the results of the current study, obtained in the French context, with those of other countries. Such a comparison would enable researchers to explore the potential influence of cultural factors, which might explain the tendency of companies to comply with regulations and could also allow examining the most effective type of regime (legal or non-legal). For example, Arena et al. (2018) demonstrate that the level and breath of sustainability disclosure is not the same accros different regulatory regimes in Southeast Asian countries. In addition, the operationalization of the GRI adoption is binary in the present study. Future studies could measure the application level of GRI guidelines to refine the analysis of the results (Karaman et al., 2018). Another avenue for further research would be to conduct interviews to further explore the reasons why companies listed on the French CAC40 disclose LCA information in their reports. In addition, the integration of another quality dimension of LCA information (i.e., the richness of disclosure, in addition to the quantity of information disclosed) would add to the understanding of LCA reporting practices. Finally, future research can investigate corporations' LCA disclosures as a response to catastrophic events (Vourvachis et al., 2016).

Acknowledgements

The authors wish to thank Marc Journeault, Florence Depoers, Isabelle Martinez, Tiphaine Jérôme, Emmanuelle Nègre, Delphine Gibassier, Michèle Rodrigue, Jonathan Maurice, Dennis Voeller, the participants to the 39th French Accounting Association Annual Meeting,

and the participants to the Toulouse School of Management doctoral program workshops for their valuable comments and suggestions provided on earlier versions of this paper. The first author acknowledges the financial support provided by the French Accounting Association for her research stay in Université Laval, Canada, to improve earlier versions of this research.

References

- Adams, C. and Petrella, L. (2010), "Collaboration, connections and change: The UN Global Compact, the Global Reporting Initiative, Principles for Responsible Management Education and the Globally Responsible Leadership Initiative", *Sustainability Accounting, Management and Policy Journal*, Vol. 1 No. 2, pp.292-296.
- Aerts, W., Cormier, D. and Magnan, M. (2008), "Corporate environmental disclosure, financial markets and the media: An international perspective", *Ecological Economics*, Vol. 64 No. 3, pp. 643-659.
- Andrew, J. and Cortese, C. (2011), "Accounting for climate change and the self-regulation of carbon disclosures", *Accounting Forum*, Vol. 35 No. 3, pp. 130-138.
- Antheaume, N. (2018), "A history of SEA in France: Government, engineers and mathematics", *Sustainability Accounting, Management and Policy Journal*, Vol. 9 No. 3, pp. 207-228.
- Archambault, J. J. and Archambault, M. E. (2003), "A multinational test of determinants of corporate disclosure", *The International Journal of Accounting*, Vol. 38 No. 2, pp. 173-194.
- Arena, C., Liong, R. and Vourvachis, P. (2018), "Carrot or stick: CSR disclosures by Southeast Asian companies", *Sustainability Accounting, Management and Policy Journal*, Vol. 9 No. 4, pp. 422-454.
- Bebbington, J., Kirk, E.A. and Larrinaga, C. (2012), "The production of normativity: A comparison of reporting regimes in Spain and the UK", *Accounting, Organizations and Society*, Vol. 37 No. 2, pp. 78-94.
- Beck, C., Dumay, J. and Frost, G. (2017), "In pursuit of a 'single source of truth': From threatened legitimacy to integrated reporting", *Journal of Business Ethics*, Vol. 141 No. 1, pp. 191-205.
- Ben-Amar, W. and McIlkenny, P. (2015), "Board Effectiveness and the Voluntary Disclosure of Climate Change Information", *Business Strategy and the Environment*, Vol 24 No.8, pp. 704-719.
- Ben Ismail, N. (2018), "Trois essais sur la diffusion volontaire d'information sur l'Analyse du Cycle de Vie: le cas des entreprises du CAC40", Thèse de Doctorat, Université Toulouse 1 Capitole.
- Bicalho, T., Richard, J. and Bessou, C. (2012), "Limitations of LCA in environmental accounting for biofuels under RED", *Sustainability Accounting, Management and Policy Journal*, Vol. 3 No. 2 pp. 218-234.
- Bicalho, T., Sauer, I., Rambaud, A. and Altukhova, Y (2017), "LCA data quality: A management science perspective", *Journal of Cleaner Production*, Vol. 3, pp. 888-898.
- Boesso, G., Kumar, K. and Michelon, G. (2013), "Descriptive, instrumental and strategic approaches to corporate social responsibility: Do they drive the financial performance of companies differently?", *Accounting, Auditing and Accountability Journal*, Vol. 26 No. 3, pp.399-422.

- Boiral, O. (2013), "Sustainability reports as simulacra? A counteraccount of A and A? GRI reports", *Accounting, Auditing and Accountability Journal*, Vol. 26 No.7, pp.1036–1071.
- Bouten, L., Everaert, P. and Roberts, R.W. (2012), "How a two-step approach discloses different determinants of voluntary social and environmental reporting", *Journal of Business Finance & Accounting*, Vol. 39 No. 5/6, pp. 567-605.
- Brammer, S.J. and Pavelin, S. (2006), "Voluntary Environmental Disclosures by Large UK Companies", *Journal of Business Finance & Accounting*, Vol. 33 No. 7/8, pp. 1168-1688.
- Brown, J.A., Clark, C. and Buono, F.A. (2018), "The United Nations Global Compact: Engaging Implicit and Explicit CSR for Global Governance", *Journal of Business Ethics*, Vol. 147 No. 4, pp. 721-734.
- Brown, H.S., de Jong, M., and Levy, D.L. (2009), "Building institutions based on information disclosure: lessons from GRI's sustainability reporting", *Journal of Cleaner Production*, Vol. 17 No. 2, pp. 571–580.
- Buniamin, S. (2010), "The quantity and quality of environmental reporting in annual reports of public listed companies in Malaysia", *Issues in Social and Environmental Accounting*, Vol. 4 No. 2, pp. 115-135.
- Burritt, R.L., Christ, K.L. and Omori, A. (2016), "Drivers of corporate water-related disclosure: evidence from Japan", *Journal of Cleaner Production*, Vol. 129, pp. 65-74.
- Busco, C., Malafrente, I., Pereira, J. and Starita, M.G. (2019), "The determinants of companies' levels of integration: Does one size fit all?", *The British Accounting Review*, Vol. 51 No.3, pp. 277-298.
- Cahaya, F.R., Porter, S., Tower, G. and Brown, A. (2015), "The Indonesian Government's coercive pressure on labour disclosures: Conflicting interests or government ambivalence?", *Sustainability Accounting, Management and Policy Journal*, Vol. 6 No 4, pp. 475-497.
- Camilleri, M.A. (2015), "Environmental, social and governance disclosures in Europe", *Sustainability Accounting, Management and Policy Journal*, Vol. 6 No. 2, pp. 224-242.
- Carbon Disclosure Project (2018), Climate change, <https://www.cdp.net/en/climate> (accessed 15 October 2019).
- Carbon Disclosure Project (2018), Water, <https://www.cdp.net/en/water> (accessed 15 October 2019).
- Carbon Disclosure Project (2018), Forests, <https://www.cdp.net/en/forests> (accessed 15 October 2019).
- Carbon Disclosure Project (2019), About us, <https://www.cdp.net/fr/info/about-us> (accessed 15 October 2019).
- Chauvey, J.N., Giordano-Spring, S., Cho, C.H. and Patten, D.M. (2015), "The normativity and legitimacy of CSR disclosure: evidence from France", *Journal of Business Ethics*, Vol. 130 No. 4, pp. 789-803.
- Chelli, M., Durocher, S. and Richard, J. (2014), "France's new economic regulations: insights from institutional legitimacy theory", *Accounting, Auditing & Accountability Journal*, Vol. 27 No. 2, pp. 283-316.
- Chelli, M., Durocher, S. and Fortin, A. (2018), "Normativity in Environmental Reporting: A Comparison of Three Regimes", *Journal of Business Ethics*, Vol. 149 No. 2, pp. 285-311.

- Chen, S. and Bouvain, P. (2009), "Is Corporate Responsibility Converging? A Comparison of Corporate Responsibility Reporting in the USA, UK, Australia, and Germany", *Journal of Business Ethics*, Vol. 87 No. 1, pp. 299-317.
- Chen, J.C. and Roberts, R.W. (2010), "Toward a more coherent understanding of the organization-society relationship: A theoretical consideration for social and environmental accounting research", *Journal of Business Ethics*, Vol. 97 No. 4, pp. 651-665.
- Chithambo, L. and Tauringana, V. (2014), "Company specific determinants of greenhouse gases disclosures", *Journal of Applied Accounting Research*, Vol. 15 No 3, pp. 323-338.
- Cho, C.H. (2009), "Legitimation strategies used in response to environmental disaster: A French case study of Total SA's Erika and AZF incidents", *European Accounting Review*, Vol. 18 No. 1, pp. 33-62.
- Cho, C.H., Freedman, M. and Patten, D. M. (2012), "Corporate disclosure of environmental capital expenditures: A test of alternative theories", *Accounting, Auditing & Accountability Journal*, Vol. 25 No. 3, pp. 486-507.
- Cho, C.H., Laine, M., Roberts, R.W. and Rodrigue, M. (2015), "Organized hypocrisy, organizational façades, and sustainability reporting", *Accounting, Organizations and Society*, Vol. 40, pp. 78-94.
- Cho, C. H., Roberts, R. W. and Patten, D. M. (2010), "The language of US corporate environmental disclosure", *Accounting, Auditing & Accountability Journal*, Vol 35 No. 4, pp. 431-443.
- Cho, C.H. and Patten, D.M. (2007), "The role of environmental disclosures as tools of legitimacy: A research note", *Accounting, Organizations and Society*, Vol. 32 No. 7/8, pp. 639-647.
- Chu, C.I., Chatterjee, B. and Brown, A. (2013), "The current status of greenhouse gas reporting by Chinese companies: A test of legitimacy theory", *Managerial Auditing Journal*, Vol. 28 No. 2, pp. 114-139.
- Collier, P. and Gregory, A. (1999), "Audit committee activity and agency costs", *Journal of Accounting and Public Policy*, Vol. 18 Nos 4-5, pp. 311-332.
- Comyns, B. (2016), "Determinants of GHG Reporting: An Analysis of Global Oil and Gas Companies", *Journal of Business Ethics*, Vol. 136 No. 2, pp. 349-369.
- Cotter, J., Najah, M. and Wang, S.S. (2011), "Standardized reporting of climate change information in Australia", *Sustainability Accounting, Management and Policy Journal*, Vol. 2 No. 2, pp.294-321.
- Danilecki, K., Mroziak, M., Smurawski, P. (2017), "Changes in the environmental profile of a popular passenger car over the last 30 years e Results of a simplified LCA study", *Journal of Cleaner Production*, Vol. 141, pp. 208-218.
- Deegan, C. (2002), "Introduction: The legitimising effect of social and environmental disclosures. A theoretical foundation", *Accounting, Auditing & Accountability Journal*, Vol. 15 No. 3, pp. 282-311.
- Deegan, C. and Shelly, M. (2014), "Corporate social responsibilities: Alternative perspectives about the need to legislate", *Journal of Business Ethics*, Vol. 121 No. 4, pp. 499-526.
- Deephouse, D.L., Bundy, J., Tost, L.P. and Suchman, C. (2017). Organizational Legitimacy: Six Key Questions. In Greenwood, R., Oliver, C., Lawrence, T.B., Meyer, R.E (Eds.), *The SAGE Handbook of Organizational Institutionalism (2nd ed.)*: Thousand Oaks CA: Sage,

pp. 27-54.

- Déjean, F. and Martinez, I. (2009), “Communication environnementale des entreprises du SBF 120: Déterminants et conséquences sur le coût du capital actions”, *Comptabilité - Contrôle - Audit*, Vol. 15 No. 1, pp. 55-78.
- Delmas, M. and Blass, V.D. (2010), “Measuring Corporate Environmental Performance: the Trade-Offs of Sustainability Ratings”, *Business Strategy and the Environment*, Vol.19, pp. 245-260.
- Depoers, F., Jeanjean, T. and Jérôme, T. (2016), “Voluntary Disclosure of Greenhouse Gas Emissions: Contrasting the Carbon Disclosure Project and Corporate Reports”, *Journal of Business Ethics*, Vol. 134 No. 3, pp. 445-461.
- Depoers, F. and Jérôme, T (2017), “Stratégies de publication des dépenses environnementales dans un cadre réglementaire”, *Comptabilité - Contrôle – Audit*, Tome. 23 Vol. 1, pp. 1-44.
- de Villiers, C. and Alexander, D. (2014), “The institutionalization of corporate social responsibility reporting”, *The British Accounting Review*, Vol. 46 No. 2, pp. 198-212.
- de Villiers, C. and van Staden, C.J. (2011), “Where firms choose to disclose voluntary environmental information”, *Journal of Accounting and Public Policy*, Vol. 30 No. 6, pp. 504-525.
- Dienes, D., Sassen, R. and Fischer, J. (2016), “What are the drivers of sustainability reporting? A systematic review”, *Sustainability Accounting, Management and Policy Journal*, Vol. 7 No. 2, pp. 154-189.
- Dossche, C., Boel, V. and De Corte, W. (2018), “Comparative material-based life cycle analysis of structural beam-floor systems”, *Journal of Cleaner Production*, Vol. 197, pp. 327-341.
- Dowling, J. and Pfeffer, J. (1975), “Organisational legitimacy: Social values and organisational behavior”, *Pacific Sociological Review*, Vol. 10 No. 1, pp. 122-136.
- Engel, C. and Moffat, P.G. (2014), “A review on the impact of mining and mineral processing industries through life cycle assessment”, *Journal of Cleaner Production*, Vol. 231, pp. 1200-1217.
- European Union (2013), Directive 2013/34/EU of the European Parliament and the Council of 26th June 2013 on the annual financial statements, the consolidated financial statements and the reports related on certain types of firms, amending Directive 2006/43/EC of the European Parliament and the Council and repealing directives 78/660/EEC and 83/349/EEC.
- European Union (2014), Directive 2014/95/EU of the European Parliament and the Council of 22 October 2014 amending Directive 2013/34/EU as regards the disclosure of non-financial information and information related to diversity by certain large firms and groups.
- Farjana, S.H., Huda, N., Mahmud, M.A.P. and Lang, C. (2019), “Impact analysis of goldsilver refining processes through life-cycle assessment”, *Journal of Cleaner Production*, Vol. 228, pp. 867-881.
- Fifka, M.S. (2013), “Corporate Responsibility Reporting and its Determinants in Comparative Perspective – a Review of the Empirical Literature and a Meta-analysis”, *Business Strategy and the Environment*, Vol. 23 No. 7, pp. 1-35.
- Fortanier, F., Kolk, A. and Pinkse, J. (2011), “Harmonization in CSR Reporting: MNEs and

- Global CSR Standards”, *Management International Review*, Vol. 51 No. 5, pp. 665-696.
- Galani, D., Gravas, E. and Stavropoulos, A. (2012), “Company Characteristics and Environmental Policy”, *Business Strategy and the Environment*, Vol. 21, pp. 236-247.
- Gallego-Alvarez, I., Lozano, M.B. and Rodríguez-Rosa, M. (2018), “An analysis of the environmental information in international companies according to the new GRI standards”, *Journal of Cleaner Production*, Vol. 182, pp. 57-66.
- Gibassier, D. (2014), “*Environmental Management Accounting Development: Institutionalization, Adoption and Practice*”, Doctorat en sciences de gestion, Paris: École des Hautes Études Commerciales.
- Gibassier, D. (2017), “From écobilan to LCA: The elite’s institutional work in the creation of an environmental management accounting tool”, *Critical Perspectives on Accounting*, Vol. 42, pp. 36-58.
- Gibassier, D., Maurice, J. and Cho, C. (2018), “Guest editors’ introduction”, *Sustainability Accounting, Management and Policy Journal*, Vol. 9 No. 3, pp. 202-206.
- Gibassier, D. and Schaltegger, S. (2015), “Carbon management accounting and reporting in practice”, *Sustainability Accounting, Management and Policy Journal*, Vol. 6 No. 3, pp. 340-365.
- Gibson, K. and O’Donovan, G. (2007), “Corporate governance and environmental reporting: an Australian study”, *Corporate Governance An International Review*, Vol. 15 No 5, pp. 944-956.
- Global Reporting Initiative. (2006), “Sustainability reporting guidelines, version 3”, Amsterdam: Global Reporting Initiative.
- Global Reporting Initiative. (2011), “Sustainability reporting guidelines, version 3.1”, Amsterdam: Global Reporting Initiative.
- Global Reporting Initiative. (2013), “G4 sustainability reporting guidelines”, Amsterdam: Global Reporting Initiative.
- Gonzales, B., Adenso-Diaz, B. and Gonzalez-Torre, P.L. (2002). A fuzzy logic approach for the impact assessment in LCA. *Resources, Conservation and Recycling*, Vol. 37 No. 1, pp. 61-79.
- Gray, R., Javad, M., Power, D.M. and Sinclair, C.D. (2001), “Social and environmental disclosure and corporate characteristics: A research note and extension”, *Journal of Business Finance & Accounting*, Vol. 28 No. 3/4, pp. 327-356.
- Grisel, L. and Osset, P. (2008), “L’analyse de cycle de vie d’un produit ou d’un service, applications et mise en pratique”, Afnor Ed.: Paris.
- Greene, W. H., (2012), *Econometric Analysis*, Seventh edition, Pitman publishing.
- Guérin-Schneider, L., Tsanga-Tabi, M., Roux, P., Catel, L. and Biard, Y. (2018), “How to better include environmental assessment in public decisionmaking: Lessons from the use of an LCA-calculator for wastewater systems”, *Journal of Cleaner Production*, Vol. 187, pp. 1057-1068.
- Guidry, R.P. and Patten, D.M. (2012), “Voluntary disclosure theory and financial control variables: An assessment of recent environmental disclosure research”, *Accounting Forum*, Vol. 36 No. 2, pp. 81-90.
- Gupta, A., Otley, D. and Young, S. (2008), “Does superior firm performance lead to higher

- quality outside directorships?”, *Accounting, Auditing & Accountability Journal*, Vol. 21 No. 7, pp. 907-932.
- Hahn, R. and Kühnen, M. (2013), “Determinants of sustainability reporting: a review of results, trends, theory, and opportunities in an expanding field of research”, *Journal of Cleaner Production*, Vol. 59, pp. 5-21.
- Haller, A. van Staden, C. J. and Landis. (2018), “Value Added as part of Sustainability Reporting: Reporting”, *Journal of Business Ethics*, Vol.152, No.3, pp.763-781.
- Haque, F. (2017), “The effects of board characteristics and sustainable compensation policy on carbon performance of UK firms”, *The British Accounting Review*, Vol. 49 No.3, pp. 347-364.
- Hartmann, F., Perego, P. and Young, A. (2013), “Carbon accounting: Challenges for research in management control and performance measurement”, *Abacus*, Vol. 49 No. 4, pp. 539-563.
- Heckman, J.A. (1979), “Specification tests in econometrics”, *Econometrica*, Vol. 47 No. 1, pp. 153-161.
- Hummel, K. and Schlick, C. (2016), “The relationship between sustainability performance and sustainability disclosure – Reconciling voluntary disclosure theory and legitimacy theory”, *Journal of Accounting and Public Policy* Vol. 35 No.5, pp. 455-476.
- Hur, T., Lee, L. Ryu, J. and Kwon, E. (2005). Simplified LCA and matrix methods in identifying the environmental aspects of a product system. *Journal of Environmental Management*, Vol. 75 No. 3, pp. 229-237.
- ISO (2006), “ISO 14040: Environmental management - Life cycle assessment - Principles and framework”, Genève: International Standard Organisation.
- Jastram, S. and Klingenberg, J. (2018), “Assessing the Outcome Effectiveness of Multi-Stakeholder Initiatives in the Field of Corporate Social Responsibility: The Example of the United Nations Global Compact”, *Journal of Cleaner Production*, Vol. 189, pp. 775-784.
- Jérôme, T. (2013), “Stratégie(s) de diffusion volontaire d’informations sur les gaz à effet de serre: Le cas du Carbon Disclosure Project”, Doctorat en sciences de gestion, Paris: École des Hautes Études Commerciales.
- Jones, M.J. (2010). Accounting for the environment: Towards a theoretical perspective for environmental accounting and reporting. *Accounting Forum*, Vol. 34 No. 2, pp. 123-138.
- Jose, A. and Lee, S.M. (2007), “Environmental reporting of global corporations: A content analysis based on website disclosures”, *Journal of Business Ethics*, Vol. 72 No. 4, pp. 307-321.
- Joseph, G. (2012), “Ambiguous but tethered: An accounting basis for sustainability reporting”, *Critical Perspectives on Accounting*, Vol. 23 No. 2, pp. 93-106.
- Joseph, C. and Taplin, R. (2011), “The measurement of sustainability disclosure: Abundance versus occurrence”, *Accounting Forum*, Vol. 35 No. 1, pp. 19-31.
- Karaman, A., Kilic, M. and Uyar, A. (2018), “Sustainability reporting in the aviation industry: worldwide evidence”, *Sustainability Accounting, Management and Policy Journal*, Vol. 9 No. 4, pp. 362-391.
- Kent, P. and Zunker, T. (2013), “Attaining legitimacy by employee information in annual reports”, *Accounting, Auditing & Accountability Journal*, Vol. 26 No. 7, pp. 1072-1106.

- Kolk, A. (2003), “Trends in sustainability reporting by the Fortune Global 250”, *Business Strategy and the Environment*, Vol. 12 No. 5 pp. 279-291.
- Kuczynski, B. (2018), “Disclosure of product system models in Life Cycle Assessment Achieving transparency and privacy”, *Journal of Industrial Ecology*, Vol. 23 No. 3 pp. 574-586.
- Levy, D.L., Brown, H.S. and De Jong, M. (2010), “The contested politics of corporate governance: the case of the Global Reporting Initiative?”, *Business & Society*, Vol.49, pp. 88-115.
- Liesen, A., Hoepner, A. G., Patten, D.M. and Figge, F. (2015), “Does stakeholder pressure influence corporate GHG emissions reporting? Empirical evidence from Europe”, *Accounting, Auditing & Accountability Journal*, Vol. 28 No.7, pp. 1047-1074.
- Lim, A. and Tsutsui, K. (2012), “Globalization and commitment in corporate social responsibility: Cross-national analyses of institutional and political-economy effects”, *American Sociological Review*, Vol.77 No. 1 pp.69-98.
- Loi NRE (2001), “Loi 2001-420 du 15 Mai 2001 sur les Nouvelles Régulations Economiques”, Journal Officiel de la république Française, 15 May.
- Lozano, R. and Huisingh. D. (2011), “Inter-linking issues and dimensions in sustainability reporting”, *Journal of Cleaner Production*, Vol. 19 No.2-3, pp. 99-107.
- Mahoney, L.S., Thorne, L., Cecil, L. and LaGore, W. (2013), “A research note on standalone corporate social responsibility reports: Signaling or greenwashing?”, *Critical Perspectives on Accounting*, Vol. 24 No. (4/5), pp. 350-359.
- Mazars (2016). Pratiques et tendance de reporting extra-financier en France - Baromètre 2016.
- Melo, T. and Garrido-Morgado, A. (2012), “Corporate reputation: a combination of social responsibility and industry”, *Corporate Social Responsibility and Environmental Management*, Vol. 19 No. 1, pp.11-33.
- Michaïlesco, C. (1999), “Une étude empirique des déterminants de la qualité de l’information diffusée par les entreprises françaises au cours de la période 1991-1995”, *Comptabilité - Contrôle – Audit*, Vol. 1 Tome. 5, pp. 83-108.
- Michelon, G., Pilonato, S. and Ricceri, F. (2015), “CSR reporting practices and the quality of disclosure: An empirical analysis”, *Critical Perspectives on Accounting*, Vol. 33, pp. 59-78.
- Michelon, G., Pilonato, S., Ricceri, F. and Roberts, R.W. (2016), “Behind camouflaging: traditional and innovative theoretical perspectives in social and environmental accounting research”, *Sustainability Accounting, Management and Policy Journal*, Vol. 7 No.1, pp. 2-25.
- Milne, M.J. and Gray, R. (2013), “W(h)ither ecology? The triple bottom line, the global reporting initiative, and corporate sustainability reporting”, *Journal of Business Ethics*, Vol. 118 No. 1, pp. 13-29.
- Moneva, J., Archel, P. and Correa, C. (2006), “GRI and the camouflaging of corporate unsustainability”, *Accounting Forum*, Vol. 30 No. 2, pp. 121-137.
- Mori Junior, R. and Best, P. (2017), “GRI G4 content index: Does it improve credibility and change the expectation–performance gap of GRI-assured sustainability reports?”, *Sustainability Accounting, Management and Policy Journal*, Vol. 8 No. 5, pp.571-594.

- Ngo, K.A. (2012). Building Capacity for life Cycle Assessment in Developing Countries. In *Life Cycle Assessment Handbook: A Guide For Environmentally Sustainable Products* (Eds, Curran, M.A). pp. 563-584.
- Patchell, J. (2018), “Can the implications of the GHG Protocol's scope 3 standard be realized?”, *Journal of Cleaner Production*, Vol. 185, pp. 941-958.
- Pell, R., Wall, F., Yan, X., Li, J. and Zeng, X. (2019), “Mineral processing simulation based-environmental life cycle assessment for rare earth project development: A case study on the Songwe Hill project”, *Journal of Environmental Management*, Vol. 249, <https://doi.org/10.1016/j.jenvman.2019.109353>.
- Peters, G.F. and Romi, A.M. (2014), “Does the voluntary adoption of corporate governance mechanisms improve environmental risk disclosures? Evidence from greenhouse gas emission accounting”, *Journal of Business Ethics*, Vol. 125, pp. 637-666.
- Phiri, O., Mantzari, E. and Gleadle, P. (2019), “Stakeholder interactions and corporate social responsibility (CSR) practices: Evidence from the Zambian copper mining sector”, *Accounting, Auditing and Accountability Journal*, Vol. 32 No. 1, pp.26-54.
- Prado-Lorenzo, J.M., Gallego-Alvarez, I. and García-Sánchez, I.M. (2009), “Stakeholder engagement and corporate social responsibility reporting: The ownership structure effect”, *Corporate Social Responsibility and Environmental Management*, Vol. 16 No. 2, pp. 94-107.
- Qiu, Y., Shaukat, A. and Tharyan, R. (2016), “Environmental and social disclosures: Link with corporate financial performance”, *The British Accounting Review*, Vol. 48 No. 1, pp. 102-116.
- Rankin, M., Windsor, C. and Wahyum, D. (2011), “An investigation of voluntary corporate greenhouse gas emissions reporting in a market governance system: Australian evidence”, *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. 1037-1070.
- Reid, E.M. and Toffel, M.W. (2009), “Responding to public and private politics: Corporate disclosure of climate change strategies”, *Strategic Management Journal*, Vol. 30 No. 11, pp. 1157- 1178.
- Rimmel, G. and Jonäll, K. (2013), “Biodiversity reporting in Sweden: corporate disclosure and preparers' views”, *Accounting, Auditing & Accountability Journal*, Vol. 26 No. 5, pp. 746-778.
- Riot, J. (2013), “Le management de l’environnement à travers ses instruments: De la diffusion d’outils à la construction de dynamiques d’action collective pour l’innovation environnementale”, Doctorat en sciences de gestion, Paris: Mines Paris Tech.
- Riot, J. (2014), “Construire l’innovation durable. Les instruments de la gestion environnementale”, Paris: Presses des Mines, collection Économie et Gestion.
- Riot, J., Labouze, E. and Aggeri, F. (2011), “L’outil scientifique comme instrument d’objectivation de la communication environnementale: discussion d’un usage de l’analyse de cycle de vie (ACV)”, *Recherches en communication*, Vol. 35 No.35, pp. 63-67.
- Runhaar, H. and Lafferty, H. (2009), “Governing Corporate Social Responsibility: An Assessment of the Contribution of the UN Global Compact to CSR Strategies in the Telecommunications Industry”, *Journal of Business Ethics* Vol. 84 No. 4, pp. 479-495.
- Russo-Spena, T., Tregua, M. and De Chiara, A. (2018), “Trends and Drivers in CSR Disclosure: A Focus on Reporting Practices in the Automotive Industry”, *Journal of*

- Business Ethics* Vol. 151 No. 2, pp. 563-578.
- Sethi, S.P. and Schepers, D.H. (2014), “United Nations Global Compact: the promise performance gap”, *Journal of Business Ethics* Vol. 122 No. 2, pp. 193–208.
- Suchman, M.C. (1995), “Managing legitimacy: Strategic and institutional approaches”, *Academy of Management Review*, Vol. 20 No. 3, pp. 571-610.
- Trumpp, C., Endrikat, J., Zopf, C. and Guenther, E. (2015), “Definition, conceptualization, and measurement of corporate environmental performance: A critical examination of a multidimensional construct”, *Journal of Business Ethics*, Vol. 126 No. 4, pp. 185-204.
- Unerman, J. (2000), “Methodological Issues: Reflections on Quantification in Corporate Social Reporting Content Analysis”, *Accounting, Auditing and Accountability Journal*, Vol. 13 No. 5, pp. 667-81.
- UN GC (2019), UN Global Compact - The Ten Principles of the UN Global Compact, <https://www.unglobalcompact.org/what-is-gc/mission/principles> (accessed 15 October 2019).
- Van Staden, C.J. and Hooks, J. (2007), “A comprehensive comparison of corporate environmental reporting and responsiveness”, *British Accounting Review*, Vol.39 No.3, pp.197-210.
- van Liempd, D. and Busch, J. (2013), “Biodiversity reporting in Denmark”, *Accounting, Auditing and Accountability Journal*, Vol. 26 No. 5, pp. 833-872.
- Vourvachis, P., Woodward, T., Woodward, D.G. and Patten, D.M. (2016), “CSR disclosure in response to major airline accidents: a legitimacy-based exploration”, *Sustainability Accounting, Management and Policy Journal*, Vol. 7 No 1, pp. 26-43.
- Waddock, S. (2008), “Building a new institutional infrastructure for corporate responsibility”, *Academy of Management Perspectives*, Vol. 22 No. 3, pp. 87-108.
- Wanderley, L.S.O., Lucian, R., Farache, F. and de Sousa Filho, J.M. (2008). CSR information disclosure on the web: A context-based approach for analyzing the influence of country of origin and industry sector. *Journal of Business Ethics*, Vol. 82, pp. 369-378.
- Williams, O.F (2014), “The United Nations Global Compact: What Did It Promise?”, *Journal of Business Ethics*, Vol. 122 4, pp. 241-251.
- Zanghelini, G.M., Cherubini, E. and Soares, S.R. (2018), “How Multi-Criteria Decision Analysis (MCDA) is aiding Life Cycle Assessment (LCA) in results interpretation”, *Journal of Cleaner Production*, Vol. 172, pp. 609–622.
- Zinenko, A., Rovira, M.R. and Montiel, I. (2015), “The fit of the social responsibility standard ISO 26000 within other CSR instruments: Redundant or complementary?”, *Sustainability Accounting, Management and Policy Journal*, Vol. 6 No. 4, pp. 498-526.

Figure 1: Percentage of companies disclosing LCA information

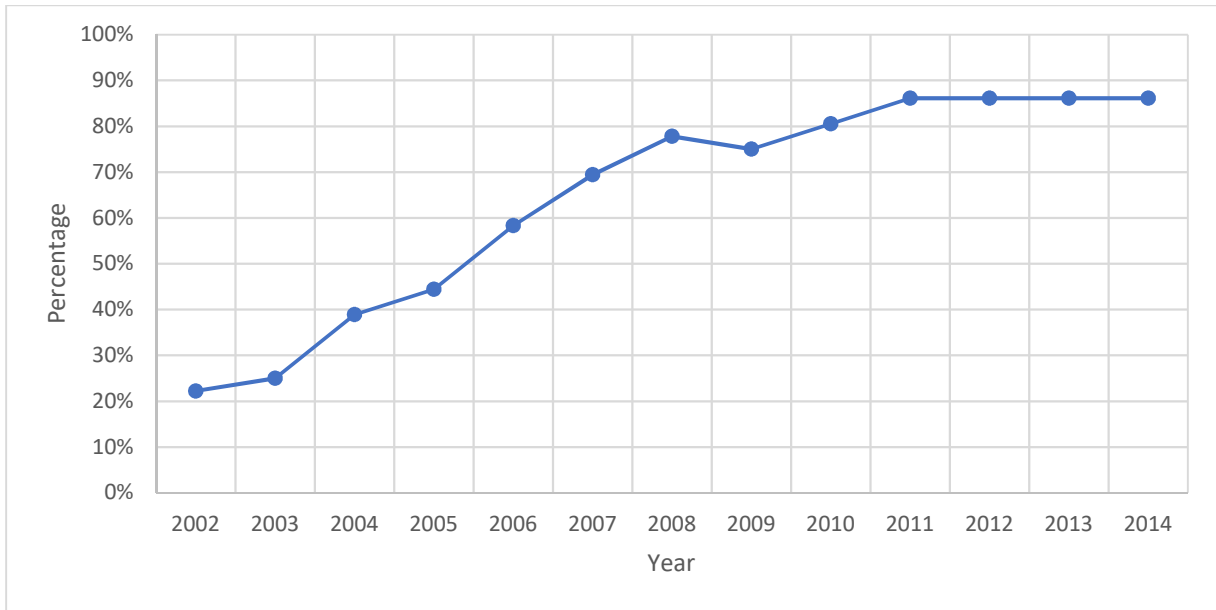


Figure 2: Quantity of LCA information disclosed (average number of pages per firm)

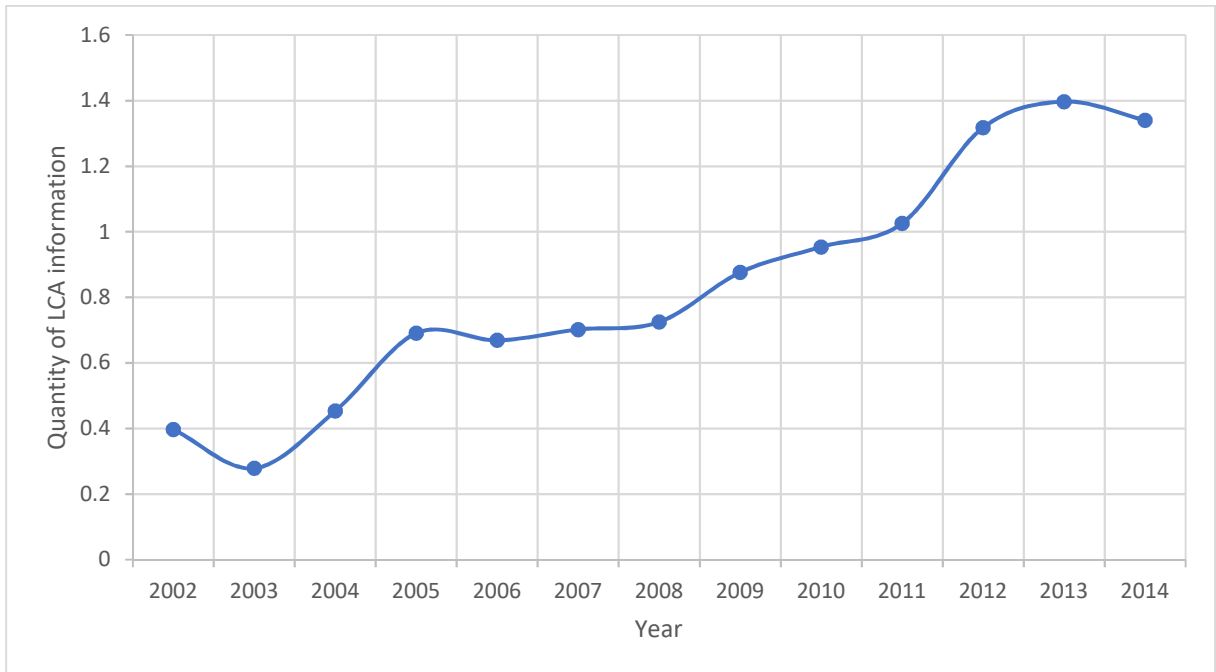


Figure 3: Summary of the main results

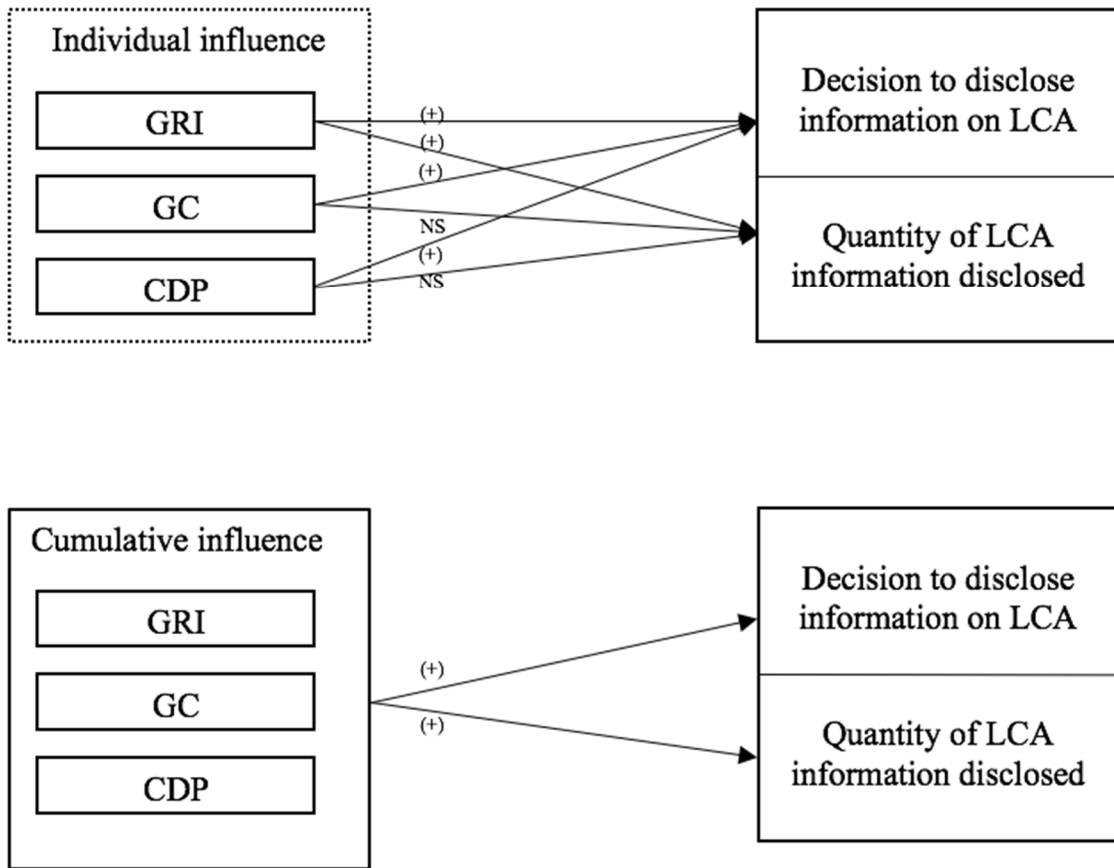


Table 1: Summary of the hypotheses

Hypothesis	Expected effect on the decision to disclose LCA information (a)	Expected effect on the quantity of LCA information disclosed (b)
H1. Adoption of the GRI guidelines	+	+
H2. Adherence to the GC principles	+	+
H3. Response to the CDP questionnaires	+	+
H4. Cumulative adherence to international initiatives	+	+

Table 2: Measurement of dependent variables

Variable	Name	Measurement
Decision to disclose LCA information	DISC_DECISION	1 if a firm discloses some information on LCA either in its RD or SR (or both), 0 otherwise
Quantity of LCA information disclosed	DISC_WORDS	Natural logarithm of the number of words disclosed related to LCA information
	DISC_SENTENCES	Natural logarithm of the number of sentences on LCA
	DISC_PAGES	Natural logarithm of the number of pages on LCA

Table 3: Measurement of explanatory and control variables

Variable	Name	Measurement	Source
Panel A: Explanatory variables			
Adoption of the GRI guidelines	GRI	1 if the company adopts the GRI standards, 0 otherwise	Thomson Reuters Eikon, RDs, SRs
Adherence to the GC principles	GC	1 if the company adheres to the GC principles, 0 otherwise	Thomson Reuters Eikon, RDs, SRs
Response to the CDP questionnaires	CDP	1 if the company responds to the CDP questionnaires, 0 otherwise	RDs, SRs and CDP website
Cumulative adherence to international initiatives (GRI, GC, CDP)	GRI_GC_CDP	0 if the company does not adhere to any initiative, 1/2/3 if the company adheres to 1/2/3 initiative(s)	Thomson Reuters Eikon, RDs, SRs
Panel B: Control variables			
Environmentally sensitive industry	IND	1 if company is part of an environmentally sensitive industry, 0 otherwise	Thomson Reuters Eikon
Size of company	SIZE	Natural logarithm of total sales	Thomson Reuters Eikon
Financial performance	ROA	Net income / total assets * 100	Thomson Reuters Eikon
Debt level	DEBT	Medium and long-term debts / total assets * 100	Thomson Reuters Eikon
Environmental performance	ENV_PERF	Score that measures the company's impact on natural systems	Thomson Reuters Eikon

Table 4: Descriptive statistics of dependent and independent variables

Variables	N	Min.	Max.	Mean	St. Dev.
Panel A: Dependent variables, all companies					
DISC_WORDS	433	0	8.28	4.07	2.87
DISC_SENTENCES	433	0	4.90	1.85	1.53
DISC_PAGES	433	0	1.77	0.39	0.45
Panel B: Dependent variables, disclosing companies only					
DISC_WORDS	301	2.30	8.28	5.86	1.16
DISC_SENTENCES	301	0.69	4.90	2.65	1.08
DISC_PAGES	301	0.02	1.77	0.56	0.44
Panel C: Quantitative independent variables					
SIZE	433	13.36	19.02	16.68	1.09
ROA	432	-16.34	37.61	4.63	4.73
DEBT	433	1.17	100.20	42.56	16.04
ENV_PERF	417	18.15	97.29	88.18	13.05
Panel D: Qualitative independent variables					
Variable	N	Frequency (%)			
		0	1	2	3
GRI	433	110 (25.4)	323 (74.6)		
GC	433	98 (22.6)	335 (77.4)		
CDP	433	168 (38.8)	265 (61.2)		
IND	433	160 (37.0)	273 (63.0)		
GRI_GC_CDP	433	44 (10.1)	76 (17.6)	92 (21.2)	221 (51.0)

Table 5: Correlation matrix between dependent and independent variables

	Panel (A) All observations (N = 433)				Panel (B) Observations with DIFF_DECISION = 1 only (N = 301)		
	DIFF_ DECISION	DIFF_ WORDS	DIFF_ SENTENCES	DIFF_ PAGES	DIFF_ WORDS	DIFF_ SENTENCES	DIFF_ PAGES
GRI	0.461	0.483	0.443	0.373	0.231	0.198	0.216
GC	0.266	0.306	0.308	0.268	0.224	0.218	0.196
CDP	0.354	0.402	0.395	0.359	0.252	0.230	0.245
GRI_GC_CDP	0.470	0.518	0.499	0.436	0.335	0.311	0.326
IND	0.105	0.125	0.117	0.092	0.093	0.066	0.047
SIZE	0.281	0.261	0.211	0.155	-0.010	-0.027	-0.006
ROA	-0.014	-0.037	-0.047	-0.064	-0.086	-0.074	-0.085
DEBT	0.115	0.133	0.131	0.110	0.090	0.081	0.067
ENV_PERF	0.383	0.376	0.333	0.261	0.116	0.112	0.131

Bold values indicate significant correlations at the 5% level

Table 6: Correlation matrix between independent and control variables

	GRI	GC	CDP	GRI_ GC_CDP	IND	SIZE	ROA	DEBT	ENV_ PERF
GRI	1								
GC	0.287	1							
CDP	0.473	0.383	1						
GRI_GC_CDP	0.761	0.709	0.828	1					
IND	0.081	-0.081	0.039	0.020	1				
SIZE	0.372	0.104	0.194	0.290	0.226	1			
ROA	-0.009	0.001	-0.045	-0.025	-0.006	-0.202	1		
DEBT	0.011	0.024	-0.099	-0.032	0.002	0.255	-0.411	1	
ENV_PERF	0.299	0.101	0.224	0.273	0.280	0.338	0.002	0.031	1

Bold values indicate significant correlations at the 5% level

Table 7: Test of models 1 and 2

VARIABLES	Model 1 ^a	Model 2 ^b		
	DISC_DECISION	DISC_WORDS	DISC_SENTENCES	DISC_PAGES
GRI	1.744*** (0.485)	0.788*** (0.229)	0.621*** (0.221)	0.262*** (0.099)
GC	1.337*** (0.509)	0.286 (0.260)	0.161 (0.246)	0.0163 (0.104)
CDP	1.225*** (0.416)	-0.026 (0.508)	-0.042 (0.503)	0.027 (0.222)
IND	0.219 (0.772)	0.301 (0.311)	0.184 (0.293)	0.061 (0.110)
SIZE	0.437 (0.379)	-0.090 (0.177)	-0.068 (0.170)	-0.062 (0.056)
ROA	0.036 (0.039)	-0.018 (0.015)	-0.016 (0.013)	-0.008 (0.006)
DEBT	0.023 (0.018)	0.009 (0.009)	0.006 (0.008)	0.003 (0.004)
ENV_PERF	0.072*** (0.024)	-0.004 (0.008)	-0.005 (0.007)	-0.002 (0.002)
Constant	-16.470** (6.414)	5.540* (3.004)	2.510 (2.896)	1.075 (0.931)
Observations	416 ^c	296	296	296
R ²	0.303 ^d	0.339	0.290	0.268
Year effect: Yes/No	No	Yes	Yes	Yes
Fixed or Random effect	Random effect	Random effect	Random effect	Random effect
Theta ^e		Min = 0.571 Median = 0.735 Max = 0.777	Min = 0.589 Median = 0.748 Max = 0.789	Min = 0.518 Median = 0.697 Max = 0.745
Rho ^f	0.502	0,596	0,622	0,524
LM Test ^g	47.04***	247.72***	266.81***	215.32***

Robust standard errors in parentheses

The stationarity of DISC_WORDS, DISC_SENTENCES and DISC_PAGES was checked

*** p < 0.01, ** p < 0.05, * p < 0.1

^a Panel logit model (random effect confirmed by Hausman test). The study covers the entire sample. The explained variable is dichotomous (the company discloses LCA information: yes / no).

^b Panel regression (random effect confirmed by Hausman test). Only disclosing companies are included (DISC_DECISION = 1).

^c Observations (16 environmental performance and 1 ROA) are lost because data are not available in Thomson Reuters Eikon ASSET 4.

^d Mc Fadden's pseudo R-square

^e Theta allows us to check whether the random effects estimator is biased

^f Rho is the percentage of variance due to differences across units, known as the intraclass correlation

^g Breusch-Pagan Lagrange Multiplier (LM) test

Table 8: Test of models 3 and 4

VARIABLES	Model 3 ^a		Model 4 ^b	
	DISC_DECISION	DISC_WORDS	DISC_SENTENCES	DISC_PAGES
GRI_GC_CDP	1.421*** (0.209)	0.422*** (0.142)	0.304** (0.129)	0.118* (0.063)
IND	0.232 (0.777)	0.287 (0.312)	0.174 (0.291)	0.057 (0.109)
SIZE	0.469 (0.376)	-0.078 (0.176)	-0.055 (0.170)	-0.056 (0.057)
ROA	0.037 (0.039)	-0.018 (0.014)	-0.015 (0.013)	-0.008 (0.006)
DEBT	0.023 (0.017)	0.008 (0.009)	0.005 (0.008)	0.002 (0.004)
ENV_PERF	0.072*** (0.024)	-0.003 (0.008)	-0.004 (0.007)	-0.001 (0.002)
Constant	-16.910*** (6.383)	5.257* (2.955)	2.284 (2.866)	0.955 (0.931)
Observations ^c	416	296	296	296
R ²	0.301 ^d	0.322	0.274	0.251
Year effect: Yes/No	No	Yes	Yes	Yes
Fixed or Random effect	Random effect/	Random effect	Random effect	Random effect
Theta ^e		Min = 0.559 Median = 0.727 Max = 0.770	Min = 0.579 Median = 0.741 Max = 0.782	Min = 0.514 Median = 0.694 Max = 0.742
Rho ^f	0.508	0.580	0.607	0.518
LM Test ^g	50.21***	242.28***	264.59***	209.65***

Robust standard errors in parentheses

The stationarity of DISC_WORDS, DISC_SENTENCES and DISC_PAGES was checked

*** p < 0.01, ** p < 0.05, * p < 0.1

^a Panel logit model (random effect confirmed by Hausman test). The study covers the entire sample. The explained variable is dichotomous (the company discloses LCA information: yes / no).

^b Panel regression (random effect confirmed by Hausman test). Only disclosing companies are included (DISC_DECISION = 1).

^c Observations (16 environmental performance and 1 ROA) are lost because data are not available in Thomson Reuters Eikon ASSET 4.

^d Mc Fadden's pseudo R-square

^e Theta allows us to check whether the random effects estimator is biased

^f Rho is the percentage of variance due to differences across units, known as the intraclass correlation

^g Breusch-Pagan Lagrange Multiplier (LM) test

Appendix 1: Results of additional tests

The aim of Model 5 is to test whether the GRI exerts the greatest normative pressure to disclose LCA information of all three sustainability initiatives.

Model5

$$\text{DISC_QUANTITY}_{it} = \alpha + \beta_1 \text{GC_CDP}_{it} + \beta_2 \text{IND}_{it} + \beta_3 \text{SIZE}_{it} + \beta_4 \text{ROA}_{it} + \beta_5 \text{DEBT}_{it} + \beta_6 \text{ENV_PERF}_{it} + u_i + \lambda_t + \varepsilon_{it}$$

VARIABLES	Model 5 ^a		
	DISC_WORDS	DISC_SENTENCES	DISC_PAGES
GC_CDP	0.248 (0.226)	0.146 (0.199)	0.041 (0.080)
IND	0.246 (0.308)	0.142 (0.288)	0.044 (0.109)
SIZE	0.002 (0.176)	0.005 (0.168)	-0.031 (0.055)
ROA	-0.015 (0.0149)	-0.013 (0.0146)	-0.007 (0.006)
DEBT	0.008 (0.009)	0.005 (0.008)	0.002 (0.004)
ENV_PERF	-0.002 (0.009)	-0.003 (0.008)	-0.001 (0.003)
Constant	4.094 (2.935)	1.366 (2.813)	0.576 (0.893)
Observations ^c	296	296	296
R ²	0.298	0.259	0.237
Year effect: Yes/No	Yes	Yes	Yes
Fixed or Random effect	Random effect	Random effect	Random effect
Theta ^d	Min = 0.522 Median = 0.700 Max = 0.747	Min = 0.546 Median = 0.718 Max = 0.762	Min = 0.483 Median = 0.671 Max = 0.722
Rho ^e	0.530	0.562	0.478
LM Test ^f	234.83***	259.26***	205.40***

Robust standard errors in parentheses

The stationarity of DISC_WORDS, DISC_SENTENCES and DISC_PAGES was checked

*** p < 0.01, ** p < 0.05, * p < 0.1

^a Panel regression (random effect confirmed by Hausman test). Only disclosing companies are included (DISC_DECISION = 1).

^c Observations (16 environmental performance and 1 ROA) are lost because data are not available in Thomson Reuters Eikon ASSET 4.

^d Theta allows us to check whether the random effects estimator is biased

^e Rho is the percentage of variance due to differences across units, known as the intraclass correlation

^f Breusch-Pagan Lagrange Multiplier (LM) test