



SCHOOL OF BUSINESS ADMINISTRATION
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Dissertation

**EXPLORING THE RELATION BETWEEN ENVIRONMENTAL DISCLOSURE
AND ENVIRONMENTAL PERFORMANCE IN THE GREEK CONTEXT**

By

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ABSTRACT

Purpose: In the new economic and accounting era, environmental principles and issues are crucially considered. The relation of corporate environmental performance and environmental reporting has gained ongoing attention from a broad spectrum of stakeholders, including academics, and has been a matter of in-depth exploration and analysis, over the recent years, in various contexts. This dissertation project was conducted with the aim to define the relation between environmental disclosure and environmental performance in the Greek context, which constitutes a novel case study given that it is deprived of scientific evidence on this topic.

Design/Methodology/Approach: This project employed an econometric model and a research design previously developed by Clarkson et al. (2008; 2011) and drew upon voluntary environmental disclosure theories in order to assess how both the level and the nature of corporate environmental disclosures of Greek firms relate to their underlying environmental performance. The selected sample was comprised of 15 companies from different sectors in Greece, including *inter alia* financial services, insurance, travel and tourism, telecommunication services, energy, integrated oil and gas, oil refining and marketing, retailing, conventional electricity, construction materials and cement, metal fabricating, fishing and farming. The year period of examination ranged from 2010 to 2016.

Findings: This study embraced the socio-political theories' perspective and concluded to a negative relation between the level of environmental disclosures and environmental performance for the sample of Greek firms. It, also, identified that Greek inferior environmental performers, i.e. companies with a higher pollution propensity, not only disclose more information as a means to legitimize their activities, but rely relatively more on hard, objective and verifiable disclosures, in order to communicate this information and position themselves in the Greek market, than Greek superior environmental performers do.

Research implications: Results of this empirical endeavor underline the validity of concerns with regards to the reliability of corporate voluntary environmental disclosures. These findings could, also, inform Greek policy authorities and regulators to take actions in order to assure that more Greek companies in the future will successfully deal with their environmental footprint and maybe report more holistically on their environmental performance.

KEY WORDS: *environmental disclosure, environmental performance, environmental reporting, Greek context*

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LIST OF ACRONYMS

ASEAN	Association of South East Asian Nation
CDLI	Carbon Disclosure Leadership Index
CDP	Carbon Disclosure Project
CEP	Council for Environmental Priorities in the United States
CERES	Coalition for Environmental Responsible Economics
CSMAR	China Stock Market Accounting Research
CSR	Corporate Social Responsibility
CSRC	China Securities Regulatory Commissions
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPI	Environmental Performance Indicators
EU	European Union
GHG	Green House Gas emissions
GRI	Global Reporting Initiative
IFRS	International Financial Reporting Standards
NPI	National Pollutant Inventory
NPRI	National Pollutant Release Inventory
OLS	Ordinary Least Squares
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
TRI	Toxic Release Inventory in the United States
UK	United Kingdom
UNCTAD	United Nations Conference on Trade And Development
UNDSD	United Nations Division of Sustainable Development
US	United States of America

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CHAPTER 1

INTRODUCTION

1.1 Research background

It is beyond a doubt that the increasing recognition of the impact of industry on the environment has led to a radical questioning of previous traditional and conventional economic and accounting practices (Jones, 2010; Deegan, 2013). Businesses are entities inextricably connected to the environment, in which they operate, and, thus, the general consensus, in the recent years, has forced them to acknowledge the extent to which they are responsible towards the environment (Gunningham et al., 2004). Hence, in a whole new economic and accounting era, where environmental principles and issues are crucially considered, the ground for two main pillars, which support, affect, legitimize or go beyond any corporate economic activity, has been created. These pillars include corporate environmental performance and environmental reporting. The latter is, also, referred as environmental disclosure. Both of them are gaining ongoing attention from all different kinds of stakeholders, either internal or market-related, such as shareholders, consumers, potential investors, creditors, regulators, non-governmental organizations and the general public (Ilinitch et al., 1998; Kassinis and Vafeas, 2006; Huang and Kung, 2010; Neubaum et al., 2012). The remaining question, nevertheless, is how these two pillars relate to each other in order to add business value and what is the nature of this relation.

Both environmental performance and disclosure are embedded within the broad heading of Corporate Social Responsibility (CSR). There is no universally accepted term for CSR but the majority of definitions that have been proposed, thus far, primarily refer to stakeholders' expectations, needs and interests (Giannarakis et al., 2011) with regards to firms' commitment to behave socially and environmentally responsible while striving for economic growth (Isaksson and Steimle, 2009). Ingley et al. (2010) argue that CSR practices incorporate all the appropriate social, environmental and economic actions that firms should undertake in order to satisfy the concerns and demands of stakeholders, as well as, the financial requirements of shareholders. Additionally, CSR implies that business activities should be advantageous for the society, harnessing the potential of the natural environment, and organizing social life in such

a way as to ensure: quality development in new production processes; the sustainability of natural resources; the improvement of the quality of life in relation to the protection and restoration of the environment (Karagiorgos, 2010). The increasing influence of CSR on the development of accounting has led to the birth of a new branch of accounting, CSR accounting (Roberts, 1992). Furthermore, a number of pilot solutions were developed in the areas of external and internal reporting, over the recent years, so that all stakeholders and shareholders could eventually be informed about the social and environmental outcomes of a given economic and business activity, which has, also, led to CSR reporting (Huang and Watson, 2015). The essence of CSR accounting and reporting lies on the argument that a firm with an ethical corporate identity will take full responsibility to present an insightful account of its non-financial activities, such as social and environmental activities, to communicate with stakeholders and provide them with all the necessary information (Balmer et al., 2007). Therefore, CSR, in conjunction with the concept of sustainable development, under which a firm should function according to economic prosperity, environmental quality and social justice (Elkington, 1998; Norman and MacDonald, 2004), incorporates both environmental performance and environmental reporting.

Environmental performance has been of fundamental interest in research over the recent years. However, documented evidence in the literature supports that there is an exceeded disagreement pertaining to the definition and conceptualization of this construct (Trumpp et al., 2013). For instance, the magnitude of this disagreement is mirrored in the following definition; corporate environmental performance is “a theoretical creation that can be defined in conceptual terms but cannot be observed and, therefore, anchored to observable reality by means of indicators” (Bisbe et al., 2007, pp.790). The vast majority of studies fail to provide an explicit definition of environmental performance, as it entails multiple dimensions (Ilinitch et al., 1998). However, previous research endeavors have concluded that environmental performance is: the effectiveness of firms’ commitment to reach environmental excellence (Judge and Douglas, 1998); the quantity of a plant’s pollutants (Klassen and Whybark, 1999); a reduction of a firm’s environmental damage (de Burgos Jiménez and Céspedes Lorente, 2001); the performance of a firm with respect to environmental aspects (Wagner and Schaltegger, 2003); the results of a firm’s responsiveness towards the environment (Elsayed, 2006); the financial value of firm’s management of its environmental factors (Salo, 2008); the level of a company’s activities with respect to environmental impacts (Boucekkine et al., 2011); the output of management of the environment (López-Gamero et al., 2009); a level of environmental impacts (Clemens and

Bakstran, 2010); the performance of an organization with respect to environmental responsibility (Yang et al., 2011); the outcome of a firm's strategic activities that manage environmental impacts (Walls et al., 2012); the results of an organization's management of its environmental aspects (ISO14031, 2013). Lober (1996) argues that companies take into account four main dimensions in order to define their environmental effectiveness and, subsequently, their environmental performance, including: a) how sufficiently they meet their previously stated goals, b) information flows and employee communication, c) the extent to which stakeholders' needs and demands are fulfilled and d) how well they capture resources in order to gain competitive advantage.

Environmental reporting, also called sustainability reporting or social and environmental reporting refers to the dissemination of information with regards to a firm's environmental performance (Azzone et al., 1996). This information is usually structured and is available in reports or publications that are periodically published via different disclosure channels, such as annual reports, stand-alone-reports or websites (Gray et al., 1995; Azzone et al., 1996), and which systematically and holistically describe the state of environmental burden caused by firms' activities, as well as, the state of environmental efforts that companies strategize in order to mitigate this burden (Azzone et al., 1997; Campbell, 2004). These efforts may include environmental planning considerations, environmental policies and objectives, specific programs and their outcomes and organizational structures and systems that monitor firms' environmental activities (Jose and Lee, 2006). These environmental reports, also named environmental disclosures, normally follow specific international environmental reporting guidelines. However, in practice these reports may range from simple public relations statements to a detailed and in-depth evaluation of companies' environmental performance, policies and strategies, practices and future direction (Azzone et al., 1996; Fortes, 2002). Research, during the recent years, has questioned the relevance, reliability, comprehensibility and comparability of those disclosures (Azzone et al., 1996; Deegan and Rankin, 1996; Neu et al., 1998), as it was found that companies that undertake the environmental reporting process are usually at different stages of environmental management and this may result in different implications with regards to the depth and content of the reports they produce. Notwithstanding, if a company fails to target the intended audience and assess this audience's requirements or needs, then it is likely that it will produce a report which is neither relevant nor clearly understood by its readers and users (Azzone et al., 1996). Therefore, such disclosures

can be viewed as highly incomplete by some stakeholders who will in turn doubt those disclosures' ability to reflect on firms' actual environmental performance (Azzone et al., 1996).

Over the years, the relation of these two constructs has consistently been a matter of intense interest, for a broad spectrum of stakeholders, such as: employees; banks, insurance companies and shareholders; potential private and institutional investors; lenders; regulators and policy makers; industrial and commercial customers; environmental groups and non-governmental organizations (Adams, 2004). Employees, who are directly involved and affected by a firm's environmental activities and performance, have required to be constantly informed and updated on the environmental consequences of their operations (Ramus, 2001; Alt et al., 2014); banks, insurance companies and shareholders have been concerned in trying to forecast how future environmental-related results of the company and the dissemination of these results to the public could affect their profits; private and institutional investors have been concerned with assessing investments and their current portfolios in environmental terms by utilizing environmental information of companies' environmental performance (Ernest and Young, 2014; UNCTAD, 2018); lenders have been concerned about how adverse environmental issues, such as fines or environmental penalties with regards to firms' environmental performance, and the dissemination of these issues to the public could impact on security values, cash flows and the company's overall viability (Thompson, 1998); local communities have demonstrated an interest in analyzing how the plants located in their geographical area and their environmental performance and disclosures could affect the environment (Azzone et al., 1996); regulators and policy makers have been interested in understanding whether firms have been complying with all appropriate environmental laws and regulations and whether this compliance has been ensured and has been disseminated via their disclosures (Kagan et al., 2003); industrial and commercial customers have primarily been concerned with the environmental practices of their suppliers and with the environmental impact and liability of those suppliers' products, as well as, with the extent to which these suppliers report on their environmental practices (Iyer, 1999); environmental groups and non-governmental organizations have been concerned with whether firms demonstrate a clear accountability and responsibility of their actions with regards to the environment and whether they mask or detract from pressing environmental issues by not disclosing them (Azzone et al., 1996). Above all, academics have been concerned with how this relation has been established, monitored and evolved over time and thereby this has been a topic of in-depth exploration and analysis for them. Several empirical studies in various contexts across the globe, such as the American context (Wiseman, 1982; Hughes et al., 2001; Patten,

2002; Al-Tuwaijri et al., 2004; Clarkson et al., 2008; Giannarakis et al., 2017), the Australian context (Clarkson et al., 2011), the Canadian context (Bewley and Li, 2000), the Chinese context (Meng et al., 2014), the Malaysian context (Iatridis, 2013), have been focused on exploring the relation between environmental reporting – disclosure and environmental performance with the means to understand how the one impacts or influences the other, to critically assess measurements of environmental performance and disclosure and key reporting issues, as well as, to evaluate how meaningful and relevant the corporate reported environmental information is to the firms' actual environmental performance (Hughes et al., 2001; Clarkson et al., 2008; Iatridis, 2013).

Greece constitutes an important and novel case study given that there is no documented scientific evidence between environmental disclosure and environmental performance in this particular context. Interestingly, in Greece, companies have begun to meet the international requirements for corporate environmental accountability in the last decade (Li, 2001; UNDS, 2001) and, although Greece is a European Union (EU) member, it has fallen behind in CSR embeddedness (Skouloudis et al., 2011), in adapting and implementing environmental practices, as well as, in environmental reporting (Papaspopylos et al., 2010), compared to other EU countries and countries from all around the globe. Several previous empirical endeavors have studied these two constructs rather separately than jointly (Skouloudis and Evangelinos, 2009; Papaspopylos et al., 2010; Skouloudis et al., 2010; Alexopoulos et al., 2011; Giannarakis et al., 2011; Giannarakis and Theotokas, 2011; Skouloudis et al., 2014; Eleftheriadis and Anagnostopoulou, 2015; Halkos and Skouloudis, 2016; Tarquinio et al., 2018). Therefore, the estimation and establishment of a relation between environmental disclosure and performance is absent in the Greek business context. As Greek companies struggle to meet the international demands of corporate environmental accountability, research on the relation between environmental disclosure and environmental performance is crucial and may, also, shed light on the actions that should be taken towards this direction.

1.2 Research purpose and research question

On the basis of this brief overview, and given that Greece constitutes a novel case study, this dissertation aims to fill the research gap on the estimation of the relation between environmental disclosure and environmental performance in the Greek business context and to contribute to

the existing environmental reporting literature. In order to address the main research aim of this dissertation, the following research question will be tested statistically and analyzed via an empirical econometric research model developed by Clarkson et al. (2008; 2011) for a selected sample of Greek firms, that are listed in the Athens Stock Exchange, and over the year period of 2010 to 2016.

Research question (RQ): *How is environmental disclosure of Greek firms associated with their environmental performance?*

1.3 Main Structure

The present dissertation is structured in five main chapters.

First, the present chapter 1 concerns the introduction that gives a brief definition of the two main constructs, namely: environmental disclosure and environmental performance, provides a rationale for the selected context under investigation and concludes to the main research purpose and the main research question of this dissertation.

Second, chapter 2 concerns the theoretical framework of this dissertation and presents a systematic methodological approach by which the literature review was conducted, the environmental disclosure theories that constitute the governing philosophy of the relation between environmental disclosure and environmental performance and a critical evaluation of previous empirical studies that have been conducted across the globe with the means to determine this relation. Chapter 2, also, concludes to the hypothesis development of this project.

Third, chapter 3 presents the research methodological framework by which this project was organized and conducted in order to address the main research objective which is the exploration of the relation between environmental disclosure and environmental performance in the Greek business context. An analysis of the econometric model that was employed, the key dependent and independent variables used in this model, the sampling selection and the data collection process is provided.

Fourth, chapter 4 presents descriptive statistics of the key variables used in the econometric research model that was employed, as well as, empirical results that were derived

from the use and application of this model. An analysis of those results is, also, presented, followed by a short discussion in which results of this research project are compared to those of previous empirical studies.

Finally, chapter 5 concerns concluding thoughts and remarks of this research project, identifies this dissertation's contribution to existing environmental reporting literature, analyzes the limitations that this dissertation suffered and concludes to recommendations for future research and practice on the same topic.

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CHAPTER 2

LITERATURE REVIEW – HYPOTHESIS DEVELOPMENT

2.1 Introductory chapter notes

In this chapter of the dissertation, after an extensive search of the global academic literature in accounting and finance journals, as well as, in environmental and management journals, a number of selected papers of empirical studies, which examine the relation between environmental disclosure and environmental performance, constitute the basis of exploration and analysis of this review and are critically evaluated. The main purpose of this evaluation is to provide a synthesis and a synopsis of the existing literature, to identify gaps in research, to assist in addressing the main research question and in hypothesis formulation of this dissertation, and, subsequently, to explore potential avenues for future research on this topic. An overview of how the review was conducted is also discussed and analyzed as follows.

2.2 A systematic methodological approach towards the literature review

This section presents and explains the systematic process by which the literature review was organized and conducted in order to assist in addressing the main research objective of this dissertation, which is the estimation of a relation between environmental disclosure and environmental performance in the Greek business context. A protocol was developed in order to generate a corpus of publications for review. Study selection had a starting point of 2000 so as to examine how the relation between environmental disclosure and environmental performance has been measured and has been developed over the last 20 years. This protocol was informed by the updated PRISMA checklist for the reporting of systematic reviews, following discussion regarding appropriate search terms and relevant databases. PRISMA stands for Preferred Reporting Items for Systematic Reviews and Meta-Analyses and it is “an evidence-based minimum set of items which focuses on the reporting of review evaluating randomized trials” (Moher et al.: The PRISMA Group, 2009). However, the present study did not focus exclusively on randomized trials. The PRISMA statement consists of a 27-item checklist and a flow diagram of four phases, namely identification, screening, eligibility, and

included articles and its main aim is to provide authors with assistance on improving the reporting of their review and analysis (Moher et al.: The PRISMA Group, 2009).

Business databases, namely EBSCO host research, Business source complete and Scopus were used to search for relevant publications. The following search terms were employed to identify relevant publications: *environmental accounting* (as the main umbrella term), *environmental accounting and management*, *environmental reporting*, *environmental disclosure and environmental performance*. The precise combination of search terms had been initially agreed in collaboration with the supervisor. Research articles published in the peer-reviewed literature were included, as well as, studies that were on going and in press. Theses, case studies and editorials were excluded. Studies conducted in different parts of the world were included so as to generate a multi-dimensional understanding of how the relation of environmental disclosure and environmental performance is perceived and measured internationally. Journal citations, articles, and abstracts were obtained from the list of accounting and finance journals, as well as, from other related journals, including environmental and management journals, presented in Table 2.A, as follows.

Table 2.A List of Journals employed for the literature review

Journals	
Abacus (Wiley)	Critical Perspectives on Accounting (Elsevier - ScienceDirect)
Accounting and Business Research (Taylor and Francis) (ABR)	Ecological Economics (Elsevier - ScienceDirect)
Accounting and Finance (Wiley)	Emerging Markets Review (Elsevier – ScienceDirect)
Accounting Forum (Elsevier - ScienceDirect)	Environmental Quality Management (Wiley Online Library)
Accounting Forum (Taylor and Francis)	European Accounting Review (Taylor and Francis) (EAR)
Accounting, Auditing and Accountability Journal (Emerald Insight)	International Journal of Accounting (Elsevier - ScienceDirect)
Accounting, Organizations and Society (Elsevier - ScienceDirect)	International Journal of Accounting Information Systems (Elsevier - ScienceDirect)
Advances in Accounting (Elsevier - ScienceDirect)	International Journal of Environmental Research (Springer Link)
Advances in Environmental Accounting and Management (Emerald Insight) (JAEAM)	International Journal of Law and Management (Emerald Insight) (IJLM)
Advances in Public Interest Accounting (Emerald Insight)	International Review of Applied Economics (Taylor and Francis)
Business Strategy and the Environment (Wiley Online Library)	Journal of Accounting & Organizational Change (JAOC)
Corporate Social Responsibility and Environmental Management (Wiley Online Library)	Journal of Accounting and Public Policy (Elsevier - ScienceDirect)

(Continued)

Journals	
Journal of Accounting Research (Wiley Online Library)	Journal of Contemporary Accounting and Economics (Elsevier – ScienceDirect)
Journal of Accounting, Auditing and Finance (SAGE Journals)	Journal of Environmental Management (Elsevier - ScienceDirect)
Journal of Applied Accounting Research (Emerald Insight) (JAAR)	Journal of International Accounting, Auditing and Taxation (Elsevier - ScienceDirect)
Journal of Business Research (Elsevier - ScienceDirect)	Management Accounting Research (Elsevier - ScienceDirect) (MAR)
Journal of Cleaner Production (Elsevier - ScienceDirect)	The British Accounting Review (Elsevier - ScienceDirect)

The appraisal of the studies included four main phases based on those of the PRISMA flow chart (Moher et al.: The PRISMA Group, 2009) shown below.

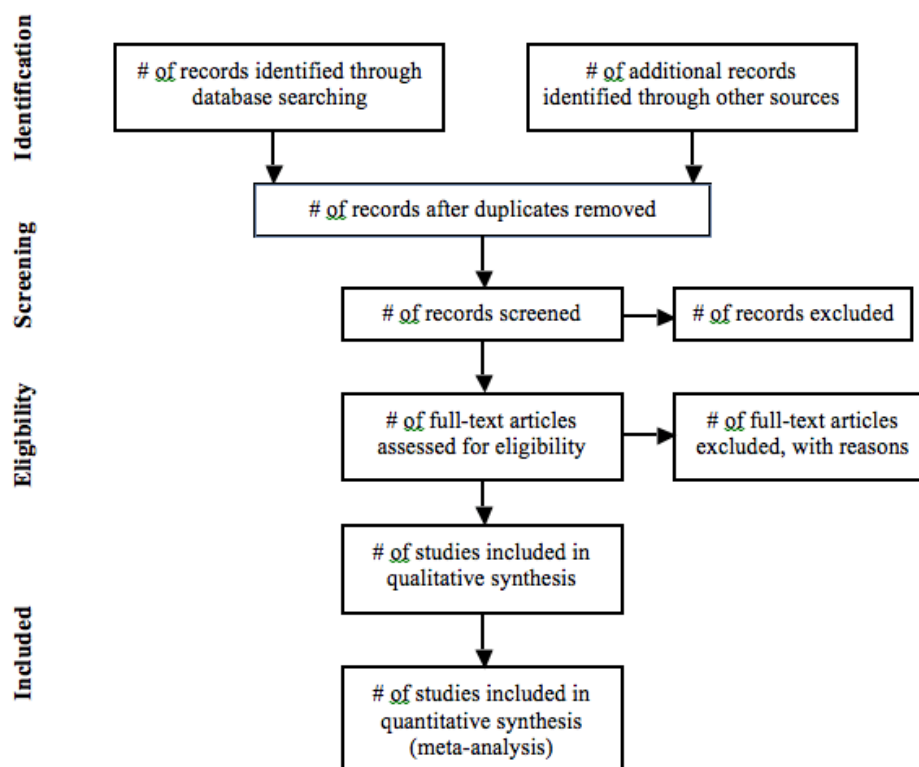


Figure 2.A Flow of information through the different phases of a systematic review

(Adapted from ‘Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement.’ by Moher et al.: The PRISMA Group, 2009)

First, an *identification* of appropriate records was organized through searching and records title screening in the above-mentioned databases and journals. There is a large volume

of published material concerned with environmental accounting, cost, and management but the major objective was to restrict the search precision only to records which were specifically relevant to environmental disclosure and environmental performance. The research identified 838 records and after duplicates were removed the number of records reduced to 422.

Second, 422 records were identified as relevant for the purpose of this review. Next a *screening* of the abstract of these records was developed in order to determine whether a record was relevant or not. The vast majority of them were reviews and focused on one of the two main constructs under investigation, i.e. numerous studies were focused exclusively on environmental disclosure and reporting while others were concentrated on corporate performance and environmental performance.

Third, these 422 records were assessed for their *eligibility* and 398 of them were excluded. The exclusion criteria consisted of non-empirical articles and articles that were not model-related.

Fourth, a total of 24 studies were considered eligible and deemed to be potentially relevant for this review. Thus, they were included for full text assessment. Lastly, 16 of these studies were selected to be reviewed, and critically evaluated as they were the most relevant ones and included specific research designs and models. However, the selection was narrowed down and included 11 studies as those publications in particular used and described specific and innovative for their time measures and models to capture and examine the relation between environmental disclosure and environmental performance. Additionally, another previous important study which constitutes a starting point in existing literature with regards to a rigorous research design for its time, the one of Wiseman (1982), was also included even though it did not fall into the selected year period. Therefore, the final selection *included* 12 studies altogether.

These papers were the basis of analysis, exploration, and assessment of the existing research designs and models used to measure the relation between environmental performance and environmental disclosure. Each of these 12 articles were evaluated with the governing philosophy behind the assessment and a more thorough understanding of the relation between environmental disclosure and environmental performance. Moreover, these 12 studies had sufficiently dealt with issues of quantitative analysis and included valid and reliable models and research designs.

2.3 Review of the academic literature

2.3.1 Environmental disclosure theories

Prior to examining the academic literature on the relation between environmental disclosure and environmental performance, it is essential to draw on two main theories that have been developed, thus far, to explain voluntary corporate environmental disclosure.

Research investigating the relationship between environmental disclosure and environmental performance has classically appealed to one of two conceptual frameworks, namely: *voluntary disclosure theory* (Verrecchia, 1983; Dye, 1985; Bewley and Li, 2000; Ho and Wong, 2001), which is also referred as signaling theory (Luo and Tang, 2014) and *socio-political theories* which consist of legitimacy theory along with stakeholder theory and political theory (Gray et al., 1995). Although both frameworks voice exclusively discretionary – voluntary disclosure, they take into account different incentives and as a result they present opposing predictions.

Voluntary disclosure theory, as supported by Verrecchia (1983), Dye (1985) and Li et al. (1997), suggests that companies which score a high environmental performance are, in accordance, highly motivated to increase their disclosure level of environmental information. Their basic incentive is to publicly disseminate and communicate this good environmental news in order to: capture investors' and stakeholders' attention, reduce uncertainty and skepticism (Iatridis, 2013) and differentiate themselves from companies with poor environmental performance, in an antagonistic manner (Clarkson et al., 2008). Hence, firms which are superior environmental performers exploit and strategize the use of environmental disclosures (Verrecchia, 1983) in order to signal specific information and in this way attract investments (Hughes et al., 2001), enhance corporate reputation and public image (Guthrie and Parker, 1990), gain brand competitive advantage (Waddock and Graves, 1997) and win governmental support related to environmental management and protection (Liu and Anbumonshi, 2009; Zeng et al., 2010; Zhang et al., 2011; 2014). Such disclosure efforts may, therefore, be expected to lead to the company outperforming its peers in terms of profit (Russo and Fouts, 1997). From the other hand, firms that are inferior environmental performers manifest a restrictive tendency in providing environmental information, and due to the fact that they cannot mimic the credible environmental disclosures of good environmental performers, they remain relatively silent

regarding their environmental information and, thus, they disclose less. Therefore, voluntary disclosure theory predicts a positive association between environmental performance and environmental disclosure (Clarkson et al., 2008).

Contrary to voluntary disclosure theory, socio-political theories, as supported by Gray et al. (1995) and Deegan (2002), embrace the perspective that economic matters and problems cannot be investigated in isolation from the social, political and institutional frameworks, within which they exist and that tensions among these frameworks relate to the notion of legitimacy. Thus, social disclosure is a reaction to the pressure which is exerted by institutional or public stakeholders (Magness, 2006). Legitimacy, and legitimacy theory in general, is based on the concept of social contract; an implicit agreement among the members of a society to cooperate for social benefits (Patten, 1992; Mathews, 1997, Mousa and Hassan, 2015). Accordingly, when a real or perceived inequality or difference between a company's and society's value system exists, the company is likely to face threatened legitimacy. For instance, if a company does not meet society's or stakeholders' expectations regarding corporate environmental performance, then it might experience threatened legitimacy. As a result, companies are expected to employ disclosures as a means to confront the legitimacy threats (Dowling and Pfeffer, 1975; Fallan and Fallan, 2009), because it is easier for them to change public expectations by managing their image rather than by making actual changes to performance, operations or values. Specifically, companies with poor environmental performance that face greater exposure to such threats of legitimacy are more likely expected to provide more extensive offsetting or positive information in their environmental disclosure reports in order to legitimize their activities and meet the demands of institutional or public stakeholders (Cho and Patten, 2007; Clarkson et al., 2008). Generally, if a firm suspects that its legitimacy is, or might be threatened, it will be empowered to increase the level of disclosures, in an attempt to: deflect attention from the issue of concern by highlighting other environmental achievements (Deegan, 2002); educate and inform relevant stakeholders about changes in performance that should be made; provide a clear strategic plan and a full action of responsibility on how to address these changes so as to improve its performance; change perceptions of the organization; seek to change public expectations with regards to its performance (Patten, 2002). Thus, the socio-political perspective predicts a negative relation between environmental performance and environmental disclosure (Clarkson et al., 2008; 2011).

These theories constitute the governing philosophy behind the relation of environmental performance and environmental disclosure, and most of the studies under examination have

applied these theories in order to investigate and explain this relation and in order to formulate and test their hypotheses. However, not all results can be based or explained by the aforementioned theories. According to Bewley and Li (2000), companies which score a high environmental performance can decrease the level of disclosures and provide less environmental information; firstly, because a high environmental performance score is not always perceived by managers as good news and secondly, because good environmental performance is beyond the demands of environmental accounting standards. Additionally, between the extremes of superior and inferior performers, there are many mixed or average performers (Meng et al., 2014). These companies have basic performance disclosure expectations, as their environmental legitimacy cannot be highly threatened by disclosures, and they have little to gain by emphasizing their environmental performance. Thus, a phenomenon whereby inferior environmental performers disclose more than average performers (consistent with legitimacy and socio-political theories), and superior environmental performers disclose more than average performers (consistent with voluntary disclosure theory) would not be surprising at all.

2.3.2 Critical evaluation of previous empirical studies

This literature review evaluates different empirical approaches to clarify the link between corporate environmental performance and disclosure (Wiseman, 1982; Bewley and Li, 2000; Hughes et al., 2001; Patten, 2002; Al-Tuwaijri et al., 2004; Clarkson et al., 2008; 2011; Freedman and Jaggi, 2009; Iatridis, 2013; Luo and Tang, 2014; Meng et al., 2014; Giannarakis et al., 2017). It covers the year period of 2000 to 2019, except for a previous important empirical study included (see Wiseman, 1982). It is intentionally restricted in notable and recent studies, as the concept of environmental responsibilities and reporting criteria alters over time (Igalens and Gond, 2005), and it adopts a chronological ordering presentation.

Early empirical evidence on the relation between environmental performance and environmental disclosure was provided by Wiseman (1982) in the United States (U.S.). Wiseman conducted her research using a sample of 26 firms in environmentally sensitive industries, such as steel and oil, and evaluated the quality and accuracy of their corporate environmental disclosures, which were available at their annual reports. She employed a research design similar to the ones used by Singhvi and Desai (1971) and Buzby (1974), but

moved a step forward and with the aid of environmental reporting literature, created an environmental disclosure index which covered eighteen items in four main categories. These 4 categories included economic factors, litigation, pollution abatement and other environmentally related information. The items were scored depending on whether or not the disclosure was quantitative (i.e. 3 for quantitative disclosure, 2 for non-quantitative disclosure, 1 for a general mention and 0 for no mention and disclosure). Her indexing procedure was used to measure the information contained in the disclosures in order to provide a systematic numerical basis for comparing firms' disclosures with external environmental performance evaluations. These external evaluations were collected from the Council on Economic Priorities (CEP), a non-profit organization in the U.S. with dedication to analyzing corporate social activities of firms which have reported great environmental problems or have spent great expenditures on pollution control. The CEP rankings were based primarily on pollution emission facts. Each of the environmental disclosure index rankings was tested for degree of association with CEP rankings using Spearman's rank correlation coefficient. Results of this study indicated that there was no particular or significant relation between environmental disclosures that companies published at their annual reports and their actual environmental performance. This study added value to environmental reporting literature as it was the first study with a more rigorous empirical design for its time. Although it concluded to no association between environmental performance and environmental disclosure, a result similar to the Ingram's and Frazier's (1980) outcome, its significance lies on the fact that it highlighted the poor quality of environmental disclosures in annual reports and shifted the attention of academics and professionals towards the improvement of corporate environmental reporting.

Bewley and Li (2000) appealed to voluntary disclosure theory and conducted research in Canada with the view to examine factors related to corporate environmental disclosures. They used a sample of 188 manufacturing firms and assessed their 1993 annual reports using Wiseman's (1982) index in order to measure environmental disclosures. They proxied firms' pollution propensity (i.e. environmental performance) by their industry membership and by whether they report to the Ministry of Environment under the NPRI program. NPRI stands for National Pollutant Release Inventory and is Canada's public inventory for releases, disposals and transfers. It, also, serves as a pollution control policy tool (Johnston Edwards and Walker, 2019) and tracks over 320 pollutants from over 7,000 facilities across Canada. These reporting facilities include factories, which manufacture a variety of goods, mines, oil and gas, as well as, power plants and sewage treatment plants. Results of this study, were consistent with the

socio-political theories and revealed a negative association between environmental disclosures and environmental performance. Findings, also, underlined that firms with more news media coverage of their environmental exposure, higher pollution propensity and more political exposure are more likely to disclose more environmental information. This study considered the Canadian context. Canada has one of the highest ecological footprints in the world (Wilson and Grant, 2009) and most of its citizens have always openly supported governmental actions and policies for the protection of the environment. Therefore, the societal norm in Canada requires from businesses to analytically report their environmental activities and those businesses which do not act accordingly to this norm face legitimacy threats. So, this study adds value to the existing environmental reporting literature as it provides an explicit outcome on the relation between environmental disclosure and performance which is imprinted in the Canadian societal norms. However, it comes with a basic limitation that should be acknowledged; its proxy for pollution propensity is not an objectively quantifiable measure and thus results might not be generalizable in other geographical contexts.

Another important study on the relation between environmental performance and environmental disclosure was conducted in the U.S. by Hughes et al. (2001). They explored environmental disclosures made by 51 manufacturing companies in 1992 and 1993, using a slightly modified Wiseman index to quantify environmental disclosures. They applied content analysis on annual report disclosures and specifically on the president's letter, on the management's discussion and analysis, as well as on the notes' section, and used this analysis in conjunction with environmental performance ratings of those companies, compiled by the CEP. Content analysis is a scientifically accepted research technique used to interpret, evaluate and code textual material, such as documents, oral communication and graphics, thereby converting qualitative into quantitative data (Morgan, 1993). Their research aim was to identify whether environmental disclosure was different among firms which have been rated by CEP as good, mixed and poor environmental performers and whether these disclosure differences could be utilized in order to differentiate between real environmental performance levels. Their findings revealed that companies rated as poor environmental performers by CEP disclosed the most information regarding their environmental activities. As a result, they concluded to a negative association between environmental performance and environmental disclosure, thereby embracing socio-political theories and legitimacy's main argument. Additionally, these findings were attributed, by the authors, to increased regulatory scrutiny which forces poor environmental performers to disclose more information regarding their environmental activities

and performance. This study constitutes a clear contribution to environmental reporting literature and provides a clear outcome regarding the relation between environmental disclosure and environmental performance, similar to Bewley's and Li's (2000), which is also consistent with socio-political theories. However, it suffers a major limitation; it slightly expands Wiseman's (1982) index and utilizes ambiguous indicators for the measurement and explanation of the researched constructs. Also, Hughes et al. (2001), exactly as Wiseman (1982), relied on indices of environmental performance issued by CEP. Even though at Wiseman's time those indices considered the only available source for credible environmental performance information, at the millennium era these evaluation criteria may have altered across industries.

Patten (2002) questioned the significance of previous scientific endeavors on the estimation of the relation between environmental performance and environmental disclosure (Ingram and Frazer, 1980; Freedman and Jaggi, 1982; Wiseman, 1982; Freedman and Wasley, 1990). He identified three possible contributors to the previous insignificant findings, namely: failure to control for other not included factors associated with the level of environmental disclosure; insufficient sample selection; inadequate environmental performance proxies. Thus, he conducted his research with the aim to address these problems and provide an unambiguous outcome. He explored a sample of 131 firms from 24 different industries in the U.S. context and used data from TRI to proxy for environmental performance. According to the author, TRI data is an opulent measure of environmental performance, as: they represent releases reported by the firms themselves; they derive from same objective measures for all reporting firms; they are obtainable for a large sample of firms. TRI stands for Toxic Release Inventory and consists of a resource database in which industrial and federal facilities in the U.S. report their toxic chemical releases of land, water and air pollutants, as well as, their pollution prevention activities and strategies (TRI, 2019). TRI program was established by the Emergency Planning and Community Right-to-Know Act (EPCRA) in accordance with U.S. Environmental Protection Agency (EPA). He employed toxic releases data scaled by sales in order to measure environmental performance whereas he measured environmental disclosure using content analysis based on eight aspects of environment and a line count of the environmental information provided in sample firms' annual reports in 1990. He applied regression analysis and concluded to a significant negative relation between environmental disclosure and environmental performance, which is similar to the outcome of Hughes et al. (2001) and consistent with socio-political theories' perspective. He, also, found that the level of disclosures

of companies from environmentally sensitive industries is less affected by toxic releases than the one of firms from environmentally non-sensitive industries. His contribution to environmental reporting literature, contrary to previous examinations, underlined the importance of two control variables in the estimation of the relation between environmental performance and environmental disclosure; firms' size and industry classification. Moreover, his pioneering method to proxy for environmental performance (i.e. using TRI toxic releases) was definitely innovative but raises the question whether this proxy can be applied in other contexts and specifically in the Greek one, where there is no official database similar to TRI.

The first study to provide a positive relationship between environmental performance and environmental disclosure was a cross-sectional study conducted by Al-Tuwaijri et al. (2004) in the U.S. They used a sample of 198 large American firms and they constructed simultaneous equations models in order to examine the interrelations among environmental disclosure, environmental performance and economic performance. They measured environmental performance as the ratio of total waste recycled to total waste generated utilizing data from the TRI database. In order to proxy for environmental disclosure, they applied content analysis in four categories: the total amount of toxic waste generated and transferred or recycled; financial penalties resulting from violations of 10 Federal environmental laws; potential responsible party designation for the cleanup responsibility of hazardous-waste sites; the occurrence of reported oil and chemical spills, most of which are mainly non-discretionary disclosures. Based on these proxies they documented the first positive association between environmental performance and disclosure, which relies on the perspective of voluntary disclosure theory. The contribution of this study to existing literature is valuable; firstly, it constitutes a more rigorous research design and approach for the estimation of the interrelations among environmental performance, environmental disclosure and economic performance; secondly, it provides a more holistic overview of how these three corporate functions are jointly determined and affected by the overall management strategy of a firm, as, also stated by Ullman (1985), thereby explaining that results from previous evidence might have been mixed because researchers did not allow for these constructs to be endogenous; thirdly, it introduces new proxies for environmental performance and environmental disclosure that have not previously been used; fourthly, it highlights that companies with good environmental performance tend to be more transparent in disclosing that performance. However, it suffers two major limitations: a) the environmental performance proxy aggregates all waste into one medium (i.e. air pollution is combined with water pollution) and even though it is considered suitable for inter-industry

comparisons, it might not be relatively useful for industry-specific metrics and b) the sample of this study is drawn only from large Standard and Poor's 500 (S & P 500) U.S. companies which implies that results might not be generalized for small or medium size firms.

A further examination of the environmental disclosure and environmental performance relation was conducted by Clarkson et al. (2008) in the U.S. They used a sample of 191 firms drawn from the 5 most polluting industries in the U.S., including: pulp and paper; chemicals; oil and gas; metals and mining; utilities. They employed a research design that examined the 2003 environmental and social reports and web-based disclosures of the sample firms and focused exclusively on voluntary disclosures, contrary to prior studies which have incorporated both voluntary and mandatory disclosures (Wiseman, 1982; Al-Tuwaijri et al., 2004). Their main attempt was to address the issues raised by Patten (2002). They measured environmental disclosure with a unique but systematic approach based on the GRI sustainability reporting guidelines (2002). GRI stands for Global Reporting Initiative and is an independent institution that was formed in 1997 as a joint initiative of the U.S. non-governmental Coalition for Environmentally Responsible Economics (CERES) and the United Nations (UNs) Environmental Program, with the vision that 'reporting on economic, environmental, and social performance by all organizations is as routine and comparable as financial reporting' (GRI, 2007). In its database, companies from all over the globe publish their annual sustainability and corporate responsibility reports and disclose relevant information regarding their environmental activities, strategies and pollutants. This GRI-based index covers in total 95 equally weighted disclosure items and consists of seven broad categories, A1 to A7, namely: A1) Governance Structure and Management Systems; A2) Credibility; A3) Environmental Performance Indicators (EPI); A4) Environmental Spending; A5) Vision and Strategy Claims; A6) Environmental Profile; A7) Environmental Initiatives. The first 4 categories (A1 to A4) are comprised of 79 hard disclosure items while the last 3 categories (A5 to A7) include 16 soft disclosure items. This mix of hard and soft disclosure items reflects the notion of GRI guidelines and it is considered an objective quantifiable measure of environmental disclosure (Clarkson et al., 2008; 2011). As far as environmental performance was concerned, it was proxied with the aid of two TRI measures: a) toxic release index measured as the ratio of toxic releases scaled by sales and b) the percentage of toxic waste treated, recycled or processed during production. They focused exclusively on voluntary disclosures made by firms via their corporate internet web sites and stand-alone reports and they found a positive association between environmental performance and the level of discretionary environmental disclosures, a result consistent with

voluntary disclosure theory and similar to the one of Al-Tuwaijri et al. (2004). Thus, their results revealed that superior environmental performers tend to provide more discretionary information via disclosure channels. Additionally, Clarkson et al. (2008) agreed that, as implied by socio-political theories, companies with poor environmental performance face greater exposure and so they are expected to provide more information in their environmental disclosures, in an attempt to confront the increased threats to their legitimacy. This is, also, referred as 'legitimization' by Hughes et al. (2001). However, they supported that socio-political theories are not robust in predicting the level of voluntary disclosure. In order to further examine this argument, they implemented a new proxy for environmental disclosure, which according to the researchers allows for an exploration of the extent of companies' legitimization. This proxy consists of the ratio of hard to total disclosures. They found that poor environmental performers, which experience threats to their legitimacy, score significantly lower on this measure. Clarkson's et al. (2008) study adds value to the existing literature and research as it monadically uses a new measurement for environmental disclosures; a measurement that categorizes disclosures to hard and soft disclosures. Moreover, this study raises concerns that future environmental disclosure research should not only tap into the relation between environmental performance and environmental disclosure but also to further examine the specific types of disclosure (i.e. the nature of disclosures; hard or soft) or disclosure strategies that businesses implement in order to disseminate their environmental information. However, the econometric model applied in this study is focused exclusively on one specific year rather than a year range or different years and, thus, this study does not tap into how the relation between environmental performance and disclosure might have altered over time. Also, it employs TRI U.S. data for the proxy of environmental performance which might be difficult to accomplish in contexts where there is no such specific database, like the Greek context.

Clarkson et al. (2011) extended previous Clarkson's et al. (2008) research in a different context, the Australian context. They used a sample of 51 Australian firms and examined their environmental disclosures and performance in both 2002 and 2006. They employed Clarkson's et al. (2008) previous research design and measured environmental disclosures of the sample firms with the aid of the GRI disclosure index, exactly as Clarkson et al. (2008, pp. 311 – 313). In order to assess both the level and the nature of environmental disclosures, they classified them in two main categories: a) total environmental disclosures (comprised of hard and soft disclosures) and b) the ratio of hard to total environmental disclosures. Also, in order to proxy for environmental performance, they used emissions data from the NPI and implemented two

environmental performance indicators: a) the toxic release index (i.e. various toxic air, land and water emissions scaled by sales) and b) the percentage of toxic waste treated, recycled or used in the production, as Clarkson et al. (2008). NPI stands for Australian National Pollutant Inventory and reflects the level of Australian firms' toxic emissions (NPI, 2019). The NPI is based on similar international inventories, such as U.S. TRI, and demands all facilities in Australia that emit pollutants to submit, on annual basis, reports that quantify their land, water and air emissions. Their results illustrated that there was a modest improvement in disclosures by firms between 2002 and 2006. Moreover, in terms of the level of disclosures, their findings revealed that environmental disclosure was negatively linked to environmental performance, in the notion implied by socio-political theories meaning that firms with higher pollution propensity (i.e. greater emissions and, thus, low environmental performance) disclosed more environmental information. In terms of the nature of disclosures, their findings suggested that poor environmental performers made relatively more use of hard environmental disclosures, which are viewed as more objective and verifiable by GRI, than did companies with better environmental performance. This research considered the Australian context and with a rigorous research design produced a clear outcome regarding both the level and the nature of disclosures and firms' environmental performance, contrary to previous attempts in the same context (see Deegan and Gordon, 1996; Brown and Deegan, 1998; Tilt, 2001). It addresses the issues raised by Clarkson et al. (2008) regarding the specificity of disclosures and introduces a new proxy for the assessment of the nature of environmental disclosures. However, similar to previous empirical studies in the global context, it does not use a universally applicable proxy for environmental performance and, thus, an analogous research endeavor in the Greek context, which lacks an official and accessible emissions database, might produce obscure results.

Another important study on the relation between environmental disclosure and environmental performance was conducted by Iatridis (2013), who focused on the Malaysian context. Malaysia is an ASEAN member state and constitutes an advanced emerging market. ASEAN stands for the Association of South East Asian Nations. He used a sample of 529 Malaysian companies, listed on the Bursa Malaysia, formerly known as Kuala Lumpur Stock Exchange, which belong to environmentally sensitive industries, including among others: aerospace and defense, automobiles and parts, beverages and chemicals, electricity, electronic and electrical equipment, general industrials. The year period was from 2005 to 2011. In order to proxy for environmental disclosure, he used the scoring index which has been based on the GRI guidelines, as adopted by Clarkson et al. (2008, pp. 311 – 313; 2011, pp. 58 – 60) whereas

in order to measure environmental performance, he used the total amount of hazardous waste produced in tones divided by net sales. Results of this study indicated a positive association between environmental performance and environmental disclosure, consistent with voluntary disclosure theory. Firms in Malaysia that displayed smaller amounts of hazardous waste or had taken initiatives to reduce toxic chemicals, thereby demonstrating a higher environmental performance, also, exhibited higher environmental disclosure scores. This study is definitely an important contribution to existing environmental reporting literature as it considers an under-researched and emerging context, the Malaysian context. In Malaysia, the implementation of International Financial Reporting Standards (IFRS) began in 2012 and as a result this study was one of the first to examine the quality of financial reporting and environmental disclosures under IFRS, as opposed to previous Malaysian accounting standards. Additionally, this study adds significant value to existing literature as it incorporated some other important parameters that had not been tested or included before, such as corporate governance, capital constraints, value relevance and investors' perceptions, and assessed how these parameters are associated with environmental disclosures. Findings illustrated that superior environmental disclosers demonstrated effective corporate governance, displayed important levels of managerial and institutional ownership, were value relevant, improved investors' perceptions and overall faced no difficulties in accessing capital markets. Therefore, this study provided a clear scientific evidence that, for the Malaysian context, high quality environmental disclosures do not only report on the impact of firms' environmental decisions on the balance sheet or on the income statement figures, but they can also reflect on the quality of corporate governance, firms' risk management approaches, firms' reputation and future financial prospects (Iatridis, 2013).

Along with the Malaysian context, another significant context far from the Western world, in the Asian continent, is the one of China. Meng et al. (2014) conducted research in China between 2009 and 2010, in order to estimate the relation between environmental performance and environmental disclosure of 533 firms listed on the Chinese stock exchange. They assessed firms' annual reports, independent Corporate Social Responsibility (CSR) or environmental reports and bulletins related to the environment; information obtained from the website of Shanghai and Shenzhen stock exchanges, as well as, from China's Securities Regulatory Commission (CSRC) website. Additionally, sample firms' financial data were drawn for CSMAR database. CSMAR stands for China Stock Market Accounting Research and CSMAR database is administered by the China Accounting and Finance Research Center of Hong Kong Polytechnic University and Shenzhen Financial Information Center. In order to

quantify the level of environmental disclosures they used monetary and non-monetary related environmental disclosure information and constructed an indexing technique which was comprised of 43 distinct items based on 8 dimensions, namely: 1) values, policy and environmental organization, 2) environmental management system and initiatives, 3) technology, investment and expenditure related to the environment, 4) resource consumption and pollutant control, 5) environmental performance improvement, 6) important environmental issues and environmental impact, 7) compliance with environmental regulations, 8) environmental public welfare activities. They scored each item based on the level of its disclosure, ranging from 0 to 3; 3 if the item was described in monetary or other quantitative terms, 2 if there existed a specific description of the item, 1 if the item was discussed in general, and 0 if no information regarding the item was provided. In order to measure environmental performance, the researchers employed a methodology similar to CEP's rankings, as they had previously identified a lack of quantifiable environmental performance data in the Chinese setting. They categorized the sample firms in poor, mixed and good environmental performers, depending on their environmental violation events, as those violations were imposed by the Chinese Ministry of Environment. Results of this study indicated a non-linear relationship between environmental performance and environmental disclosure for the sample of Chinese firms. More specifically, results illustrated that: mixed or average performers provided less significant environmental information than both poor and good performers (consistent with legitimacy theory and voluntary disclosure theory, respectively); good performers communicated their good environmental performance to stakeholders with more objective and verifiable disclosures whereas poor performers relied on more soft and unverifiable disclosures; poor performers increased their disclosures only after their environmental violations were exposed by the Chinese Ministry of Environment, included less sensitive environmental information in those disclosures than the one that was expected and did not report their environmental news objectively. Thus, this study provides evidence for the existence of a non-linear relationship between environmental performance and disclosure in the Chinese setting and raises concerns of accuracy and reliability in the Chinese firms' disclosures, thereby implying that environmental disclosure may not be a valid mechanism for Chinese investors and stakeholders to identify poor and good performers. Therefore, the contribution of this study to existing environmental reporting literature is dual; firstly, it underlines the importance of mandatory reporting requirements, which should be imposed internationally, in order to tackle firms' selective environmental disclosures or their concealing of key environmental activities; secondly, it suggests that voluntary disclosure theory and legitimacy theory need to be

integrated, rather than studied in isolation, so as to explain disclosure patterns in the Chinese firms' environmental disclosures, which might, also, be applicable to other contexts.

Recently, research has shifted from the general aspect of environmental performance to emissions and carbon performance (Freedman and Jaggi, 2009; Luo and Tang, 2014; Giannarakis et al., 2017).

Along similar lines, Freedman and Jaggi (2009) conducted a comparative study in order to evaluate whether Green House Gas (GHG) emissions disclosures reflect the GHG performance of a sample of 282 firms from Canada, Japan, and the European Union (EU). This sample was derived from the Forbes magazine's list of the 2000 largest companies in the world in 2005, that operationalize in the following industries: airlines, capital goods, chemicals, conglomerates, consumer durables, energy, property and casualty insurance, materials, motor vehicles, oil, gas and utilities. Researchers examined sample firms' disclosures from 2004 to 2006, which were available on their websites, annual reports, social, environmental and sustainability reports, and applied content analysis in order to assess these disclosures. They, also, examined the responses of the selected firms to a questionnaire developed by the CDP. CDP stands for the Carbon Disclosure Project which is a project organized by a not-for-profit charity that: runs the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts; demands from large firms that are affected by global warming to complete a questionnaire annually; and produces assessable information via reports of firms' carbon activities and emissions (CDP, 2019). Additionally, CDP encourages the development of web-based forms of corporate accountability and successfully uses institutional investors to mobilize the world's largest companies to disclose carbon information (Kolk et al., 2008). CDP's questionnaire pays particular attention to how a company is affected by global warming or by the need to reduce its GHG emissions, and therefore requests information about firms' past and current GHG emissions, as well as, information regarding firms' plans to reduce these emissions. A number of studies globally have utilized CDP information in their research (Stanny, 2012; Tang and Luo, 2011; Luo et al., 2012). In order to proxy for environmental disclosure, Freedman and Jaggi (2009) developed a scoring index that facilitated the content analysis of their source of information. This index was based on a set of 8 categories which included: 1) mention or allude to global warming, 2) GHG (or carbon) emissions for 2005, 3) prior years' GHG (or carbon) emissions, 4) statement concerning the reasons that cause the firm to produce emissions, 5) existence of external environmental audit, 6) amount of energy used in 2005, 7) particular plans to reduce GHG emissions, 8) future expenditures for reducing GHG

emissions. Also, for EU companies two extra categories were included, namely: 9) statement of their carbon allocation for 2005 (or 2006), 10) need for carbon credits, whereas for non-EU companies one extra category was included: 11) any information about obtaining carbon credits. An equal weighting scheme, where each category of disclosure was given the weight of 1, was adopted and accordingly the maximum score for EU companies was 10 whereas for non-EU companies was 9. In order to measure GHG performance of the sample firms, they used the percentage change of carbon emission from 2004 to 2006 but, also, calculated the carbon emission change in tones from 2004 to 2006 divided by revenue in dollars, in order to consider the effect of growth on the emissions. Results illustrated that there was no statistically significant association between GHG disclosures and GHG performance in the selected sample firms and that EU firms, providing carbon data, disclosed relatively less compared to Japanese and Canadian companies. This study did not reach a clear conclusion regarding the relation between GHG disclosures and GHG performance. However, it constitutes an important contribution to existing environmental reporting literature for two major reasons; firstly, it focuses specifically on emissions disclosures and performance under the notion of global warming control and suggests that the implementation of a stricter mandated scheme will eventually assist companies in reducing their emissions, thereby resulting in better emission performance and reporting. Proper dissemination of information on the companies' efforts to reduce emissions is critical to keep the stakeholders informed about the companies' strategies and actions on GHG issues (Freedman and Jaggi, 2005).; secondly, it considers and examines firms operating in EU countries, Canada and Japan, all of which have ratified the Kyoto Protocol agreement. Kyoto protocol went into effect in 2005 and it was an agreement which underlined the pressing need for overall reduction of environmental pollution and specifically reduction of GHG emissions in order to control global warming and retain a cleaner global environment (Freedman and Jaggi, 2005).

Another important study on the relation between voluntary carbon disclosures and corporate carbon performance was conducted by Luo and Tang (2014). They used a sample of 474 large Australian, American and British firms that were listed as Australian Securities Exchange 200 (ASX 200), Standard and Poor's 500 (S&P 500) and Financial Times United Kingdom (U.K.) 350 (FTSE 350) companies in 2010. These companies were selected due to the richness in availability of their data. In order to quantify environmental, or more specifically, carbon disclosure, the authors used the CDLI and, also, assessed the level or extent of disclosures, based on content analysis. CDLI stands for Carbon Disclosure Leadership Index

and is developed by the CDP. The CDP methodology incorporates basically binary questions, while other questions need qualitative or narrative answers, which are then scored via the use of content analysis. The CDLI methodology is based on specific information relevant to carbon disclosure and climate change rather than counting on the quantity of information. Each disclosure item does not have equal importance contrary to the majority of previous empirical studies, which adopt an equal value of importance (Wiseman, 1982; Patten, 2002; Clarkson et al., 2008; 2011). A firm's total standardized disclosure score (i.e. a firm's total CDLI score) is equal to the total achieved scores divided by the total available scores and then normalized to a 100-point scale. The CDLI reflects the comprehensiveness of a company's response in terms of the depth and breadth of its answers to the CDP questionnaire (CDP, 2014). Carbon performance is a rather complex and multidimensional concept, and, thus, researchers used a multifaceted approach which consisted of four different proxies in order to measure it; two of them were based on the carbon intensity of emissions while the rest two were focused on carbon reduction outcomes. All these proxies were based on Scope 1 and Scope 2 GHG emissions and, collectively, reflected firms' attempts to control their emissions. Scope 1 emissions are direct emissions that occur onsite or are from sources that a company owns and controls. Scope 2 emissions are indirect emissions that result from generation of electricity, heat, or steam that a firm needs in order to operate. Scope 3 emissions include all indirect emissions other than those represented by Scope 2 emissions. Results of this study, consistent with voluntary disclosure theory, revealed a statistically significant positive relation between carbon disclosure and performance, and suggested that companies' voluntary carbon disclosure in the CDP actually reflects their underlying carbon performance. This study contributes to existing environmental reporting literature and suggests that companies should use a stand-alone GHG report for the dissemination of their environmental and carbon information, as carbon information is very complex and disclosures incorporated in other forms, such as annual reports or sustainability reports, are likely to be brief and insufficient for internal or external users. However, this study suffers three major limitations that should be acknowledged in order to inform future research and practice; Firstly, the authors relied on CDP reports for their analysis and, thus, their results might not be generalizable to information disclosed via other communication channels. Secondly, they used only large firms and, therefore, the application of their analysis to other smaller firms in less industrialized contexts than the Australian, the U.S. and the U.K. could not possibly be exercised in the same way; Thirdly, they analyzed firms' carbon reporting practices over a single year and, hence, future research should extend this study over multiple periods in order to provide a more holistic picture of the changing nature of carbon reporting.

Studies covering multiple distinct years or continuous year periods (Clarkson et al., 2011; Iatridis, 2013) are particularly useful, especially when within a given year companies adopt a proactive strategy that might affect their performance.

Lastly, Giannarakis et al. (2017) conducted research with the aim to investigate the effect of environmental performance on the environmental disclosure level. They used a sample of 102 companies from the Standard and Poor's 500 (S&P 500) population over a five-year period, 2009 – 2013 and they employed Bloomberg as a source to retrieve their data. In order to measure the level of carbon disclosures they used the CDLI index supported by CDP organization (exactly as Luo and Tang, 2014) and in order to proxy for carbon environmental performance they used GHG emissions. According to the authors, GHG emissions has not been used in the literature extensively and it is considered an appropriate and objective measure, as well as, a proper indicator to evaluate a corporation's environmental performance. It, also, reflects an observable and quantifiable result achieved by the company. Results illustrated a positive relationship between environmental performance and carbon disclosure level, consistent with voluntary disclosure theory. Good environmental performers, i.e. firms with low pollution levels of GHG emissions and, thus, good GHG performance, displayed more carbon information in their disclosures. This study contributes to existing environmental reporting literature. It extends previous studies by focusing specifically on GHG performance and on carbon disclosure level and it covers an extended and continuous five-year period contrary to many previous empirical studies. However, it unavoidably suffers two major limitations; firstly, it considers only large S&P 500 firms, thereby neglecting small and medium size companies. The comparison of three different size companies, i.e. large, small and medium, could have provided more valuable information regarding environmental strategies and policies, as well as, the relation between environmental performance and disclosure. Secondly, it introduces a specific measure of environmental performance, which is GHG emissions but as GHG emissions cannot be eliminated totally by any company, an integration of different proxies for environmental performance would generally be more reliable and verifiable.

All these studies, collectively, provide an important portrayal and a thorough understanding of how the relation between environmental performance and environmental disclosure has been conceptualized, investigated and measured over a twenty-year period approximately. On the basis of this overview, a number of considerable remarks could be underlined. Initially, both environmental performance and environmental disclosure constitute two constructs difficult to measure. Environmental performance is characterized by the absence

of a generally accepted and reliable measure and has been a significant subject of exploration. Various studies have used different measures in order to proxy for environmental performance; CEP's evaluations and rankings (Ingram and Frazier, 1980; Wiseman, 1982; Hughes et al., 2001); TRI data (Patten, 2002; Al-Tuwaijri et al., 2004; Clarkson et al., 2008); NPI data (Clarkson et al., 2011); NPRI data (Bewley and Li, 2000); amount of hazardous waste scaled by net sales (Iatridis, 2013); environmental violation events (Meng et al., 2014); GHG emissions (Luo and Tang, 2014; Giannarakis et al., 2017), and, thus, there is no consensus regarding the measurement of environmental performance. Clarkson et al. (2011) claims that this limitation is depicted in lack of data availability, as well as, in differentiated perceptions regarding environmental performance. As far as environmental disclosure is concerned, there is, also, no consensus regarding the items that constitute a good and reliable environmental disclosure index, while emissions related items are usually deserted from the calculation procedure of an environmental index (though see Freedman and Jaggi, 2009; Luo and Tang, 2014 for insightful exceptions). Furthermore, there is a confusion in the number of disclosure items that constitute an environmental disclosure index; Wiseman (1982) incorporated 18 disclosure items from 4 main categories and a line count; Bewley and Li (2000) used Wiseman's index; Hughes et al. (2001) were based on Wiseman's (1982) 4 categories and used 23 items; Patten (2002) used both content analysis based on 8 environmental aspects and a line count; Al-Tuwaijri et al. (2004) were based only on 4 key indicators and assigned different weight depending on information level; Clarkson et al. (2008; 2011) developed an environmental index of 95 items based on global reporting initiative criteria; Iatridis (2013) utilized Clarkson's et al. (2008; 2011) environmental index; Freedman and Jaggi (2009) used 8 to 11 categories, adopting an equal weighted scheme and considering the GHG dimension; Luo and Tang (2014) and Giannarakis et al. (2017) used CDLI approach and CDP reports; Meng et al. (2014) identified 43 items across 8 main categories to compute the environmental information level, where each of the 43 items was scored according to its level of disclosure. Furthermore, results of most previous empirical endeavors are not based on long periods but consider only an one-year period data. Samples of previous studies considered only large companies instead of a variety of small, medium and large companies due to the richness in data availability that large companies usually offer.

As far as the findings of previous empirical studies are concerned, they still remain ambiguous. A number of studies found mixed results with regards to the association between environmental performance and environmental disclosure (Freedman and Jaggi, 2009; Meng et

al., 2014) while in the early beginning of this exploration Wiseman (1982) found no significant relation between environmental performance and disclosure. Bewley and Li (2000), Hughes et al. (2001), Patten (2002) and Clarkson et al. (2011) concluded to a negative association, consistent with socio-political theories and particularly with legitimacy theory, underlining that poor environmental performers disclosed most of their environmental information. From the other side of the environmental disclosure and performance puzzle, Al-Tuwaijri et al. (2004), Clarkson et al. (2008), Iatridis (2013), Luo and Tang (2014) and Giannarakis et al. (2017) resulted in a positive association, consistent with voluntary disclosure theory, highlighting that superior environmental performers disclosed the most environmental information.

Table 2.B below summarizes the findings of this review and presents a clear image of what has been examined over the 20-year period with regards to the relation between environmental performance and disclosure.

Table 2.B Summary of the literature review findings

Authors & Journals (Study conducted by:)	Research outcome – Relation between environmental disclosure and performance	Environmental performance index	Environmental disclosure index and categories
Wiseman (1982) <i>Accounting, Organizations & Society</i>	No relation	CEP's evaluations and rankings of environmental performance	Based on environmental reporting literature. Four main categories: 1) economic factors, 2) litigation, 3) pollution abatement, 4) other environmentally related information (18 disclosure items)
Bewley and Li (2000) <i>Advances in Environmental Accounting and Management</i>	Negative association	Reporting in NPRI	Based on Wiseman's (1982) index and its four main categories: 1) economic factors, 2) litigation, 3) pollution abatement, 4) other environmentally related information (18 disclosure items)
Hughes et al. (2001) <i>Journal of Accounting and Public Policy</i>	Negative association	CEP's evaluations and rankings of environmental performance	Based on Wiseman's (1982) four categories (23 disclosure items)
Patten (2002) <i>Accounting, Organizations & Society</i>	Negative relation	Amounts of toxics released into the environment (TRI data scaled by sales)	Eight aspects of environment: 1) Discussion or mention of specific environmental regulations, 2) Discussion or mention of firm's processes, facilities or product innovations relative to reduction of environmental degradation, 3) Statement or discussion of the company's concern for the environment, 4) Statement or discussion of firm's environmental compliance status, 5) Disclosure of current or past years' capital expenditures for pollution control or abatement, 6) Disclosure of projected future capital expenditures for pollution control or abatement, 7) Disclosure of current or past years' operating costs for pollution control or abatement, 8) Disclosure of projected future operating costs for pollution control or abatement

(Continued)

Authors & Journals (Study conducted by:)	Research outcome – Relation between environmental disclosure and performance	Environmental performance index	Environmental disclosure index and categories
Al-Tuwaijri et al. (2004) <i>Accounting, Organizations & Society</i>	Positive relation	Toxic waste recycled to toxic waste generated	Four key environmental indicators: 1) The total amount of toxic waste generated and transferred or recycled, 2) Financial penalties resulting from violations of 10 Federal environmental laws, 3) Potential responsible party (PRP) designation for the cleanup responsibility of hazardous-waste sites, 4) The occurrence of reported oil and chemical spills
Clarkson et al. (2008; 2011) <i>Abacus; Accounting, Organizations & Society</i>	Positive relation; negative relation	Toxic release index and toxic waste treated, recycled or processed in the production	Based on Global Reporting Initiatives (GRI) requirements (95 disclosure items classified in two main categories: hard and soft disclosures)
Freedman and Jaggi (2009) <i>Advances in Environmental Accounting & Management</i>	No relation	Percentage change of carbon emissions from 2004 to 2006 / Carbon emission change in tones from 2004 to 2006 divided by revenue in dollars	Based on the following categories: 1) mention or allude to global warming, 2) GHG (or carbon) emissions for 2005, 3) Previous years' GHG (or carbon) emissions, 4) Statement with regards to what causes the company to produce emissions, 5) existence of external environmental audit, 6) amount of energy used in 2005, 7) Specific plans to reduce GHG emissions, 8) Future expenditures for reducing GHG emissions <i>For EU companies:</i> 1) Stating their carbon allocation for 2005 (or 2006) & 2) Stating whether they need to buy/sell carbon credits <i>For Non-EU companies:</i> Anything about obtaining carbon credits
Iatridis (2013) <i>Emerging Markets Review</i>	Positive relation	Total amount of hazardous waste produced in tones divided by net sales	Based on Global Reporting Initiative (GRI) requirements and on Clarkson's et al. (2008; 2011) GRI index (95 disclosure items classified in two main categories: hard and soft disclosures)
Luo and Tang (2014) <i>Journal of Contemporary Accounting & Economics</i>	Positive association	Carbon intensity of emissions and carbon mitigation	CDLI (Carbon Disclosure Leadership Index) developed by Carbon Disclosure Project (CDP)
Meng et al. (2014) <i>Journal of Environmental Management</i>	Non-linear relationship	Environmental violation events	Based on eight dimensions (43 disclosure items): 1) Values, policy and environmental organization, 2) Environmental management system and initiatives, 3) Technology, investment and expenditure related to the environment, 4) Resource consumption and pollutant control, 5) Environmental performance improvement, 6) Important environmental issues and environmental impact, 7) Compliance with environmental regulations, 8) Environmental public welfare activities and other CDLI
Giannarakis et al. (2017) <i>International Journal of Law and Management</i>	Positive relation	GHG (Green House Gas) emissions	CDLI (Carbon Disclosure Leadership Index) developed by Carbon Disclosure Project (CDP)

2.4 Hypothesis Development

On the basis of this critical evaluation of previous empirical studies, that have been conducted in order to determine the relation between environmental performance and environmental disclosure, and with the lens of two conceptual frameworks, namely: voluntary disclosure theory and socio-political theories, two series of hypotheses can be extrapolated and presented as follows.

The first hypothesis, presented from both theoretical perspectives, that were analyzed in section 2.3.1 of this literature review, and in alternate form, is:

H1a: *The level of firms' voluntary environmental disclosures is positively linked to corporate environmental performance, as implied by voluntary disclosure theory.*

H1b: *The level of firms' voluntary environmental disclosures is negatively linked to corporate environmental performance, as implied by socio-political theories.*

Additionally, the second hypothesis, stated in the alternate form, is:

H2: *The nature of firms' environmental disclosures, given by the ratio of hard to total disclosures, is positively associated with corporate environmental performance.*

2.5 Chapter summary

This literature review focused on exploring the relation between environmental disclosure and environmental performance over a 20-year period approximately and sought to elucidate and address the lacunae in existing research. Drawing on two conceptual frameworks, namely: voluntary disclosure theory (Verrechia, 1983; Dye, 1985; Li et al., 1997) and socio-political theories (Gray et al., 1995; Deegan, 2002) and drawing upon environmental performance and disclosure indexes and proxies that have been developed thus far in order to measure these two constructs, this review aimed to identify strengths and weaknesses of existing measures and to inform a more thorough understanding of how these measures were perceived and

operationalized in different contexts and across different business sectors. Studies discussed and evaluated in this review, collectively, provide an important portrayal of how the relation between environmental performance and disclosure has been investigated in the international setting and highlight the pressing need to extend this research into different contexts of the global setting, such as the Greek context. The next chapter of this dissertation presents and analyzes the methodological framework under which the relation between environmental disclosure and environmental performance was explored in the Greek context, for a sample of Greek firms.

2.6 Chapter references

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CHAPTER 3

RESEARCH METHODOLOGICAL FRAMEWORK

3.1 Introductory chapter notes

This chapter of the dissertation presents the research methodological framework by which this project was organized and conducted in order to address its main research objective which is the exploration of the relation between environmental disclosure and environmental performance in the Greek business context. The following sections present and analyze the econometric model that was employed for the estimation of this association between environmental disclosure and environmental performance, the proxies for environmental disclosure and environmental performance that have been utilized, the sampling selection of the Greek firms under investigation, as well as, the data collection process.

3.2 Research econometric model and control variables

In order to test the relation between environmental disclosure and environmental performance in the Greek business context, as described in the hypotheses formulated in Chapter 2, variants of the following econometric model developed by Clarkson et al. (2008; 2011) were employed:

Table 3.A Research econometric model

$$Eds_{i,t} = a_0 + a_1 * \ln(pp)_{i,t} + a_2 * \ln(size)_{i,t} + a_3 * new_{i,t} + a_4 * capin_{i,t} + a_5 * fin_{i,t} + a_5 * tobsq_{i,t} + a_6 * roa_{i,t} + a_7 * lev_{i,t} + a_8 * vol_{i,t} + e_i$$

Source: Adapted by Clarkson et al. (2008; 2011)

where *pp* denotes environmental performance (pollution propensity) (analytically described in section 3.3) and *Eds* denotes environmental disclosure (thoroughly described in section 3.4). The remaining control variables used in this model are described as follows in Table 3.B:

Table 3.B Definition and measurement of independent control variables

Independent variable	Definition of variable
<i>ln(size)</i>	= corporation's size, measured as the natural logarithm of total assets at fiscal year end
<i>new</i>	= asset newness, calculated as the ratio of net property, plant and equipment (PPE) to gross property, plant and equipment (PPE) at fiscal year end
<i>capin</i>	= capital intensity, computed as the ratio of capital expenditures to total sales revenue at the end of fiscal year
<i>fin</i>	= amount of capital raised by business, estimated and sized as proceeds from common share issues minus share buybacks plus long-term debt, all scaled by beginning of year total assets
<i>tobsq</i>	= Tobin's Q, counted as market value of common equity (i.e. total amount of common shares multiplied by share closing price at 31/12/xx) divided by total assets at fiscal year end
<i>roa</i>	= firm's performance, quantified as return on assets equal to earnings before interests, taxes and abnormal items at the end of fiscal year scaled by beginning of year total assets
<i>lev</i>	= leverage, determined as total liabilities divided by total assets at fiscal year end
<i>vol</i>	= stock price volatility, measured as the standard deviation of market returns at the end of the month during the fiscal year
e _i , i, t: e _i is the standard error term whereas i, t refer to each specific company and year, respectively.	

Source: Adapted by Clarkson et al. (2008; 2011)

The selection of control variables included in this model is guided by previous literature and is in essence and accordance with voluntary environmental disclosure and voluntary disclosure, more generally (Clarkson et al., 2011). A number of considerable remarks regarding the control variables is crucial. *Size*, *new* and *capin* constitute the first set of control variables and its inclusion in the model is drawn from environmental disclosure literature. *Size*, *new* and *capin* stand for firm's size, assets' newness and capital intensity, respectively. It is claimed that these variables usually affect positively the level of environmental disclosures (Patten, 1992; Gray et al., 1995, Clarkson et al., 2008). It is, also, argued that large firms normally benefit from economies of scale and when they invest in new equipment, they are more likely to use cleaner and less polluting technologies, thereby causing less harm to the environment and, subsequently, demonstrating a good environmental performance (Clarkson et al., 2011). The second set of control variables included in this econometric model concerns *fin*, *vol*, *tobsq*, *roa*, and *lev*. Financial activity, denoted by *fin*, is included under the philosophy that firms which raise capital demonstrate a tendency in reducing information asymmetry, thereby lowering their cost of capital (Clarkson et al., 2011). *Vol* and *tobsq* stand for stock price volatility and Tobin's Q and are included in this model as it is suggested that they capture information asymmetry

(Clarkson et al., 2011). Firms which exhibit higher measures of both stock price volatility and Tobin's Q are expected to increase disclosures, as stated by Healy and Palepu (2001). Moreover, return on assets and leverage, denoted by *roa* and *lev*, respectively, are included so as to support the claim that firms with high *roa* and, subsequently, with advanced earning prospects, are more likely to disclose this good information while high leverage is predicted to increase the demand for such good information (Clarkson et al., 2011). Lastly, it is noteworthy to mention that in the initial econometric model developed by Clarkson et al. (2008; 2011) another control variable was included; the *JF*, which stands for the Janis-Fadner coefficient of imbalance. This variable provides a measure of firms' environmental legitimacy by capturing the unfavourability of media coverage during the calendar year. Since collecting information for the measurement of *JF* would be impossible in the Greek context, this variable was excluded from the above econometric model employed for the main purpose of this research project.

3.3 Environmental performance index

In the above econometric model, developed by Clarkson et al. (2008; 2011), environmental performance index was calculated as the natural logarithm of the ratio of companies' emissions of various land, water and air pollutants to total sales revenue at the end of fiscal year. In Clarkson's et al. (2008) first study, regarding the U.S. context, this measure was based on the emissions data available from U.S. TRI database. TRI stands for Toxic Release Inventory and consists of a resource database in which industrial and federal facilities in the U.S. report their toxic chemical releases of land, water and air pollutants, as well as, their pollution prevention activities and strategies (TRI, 2019). TRI program was established by the Emergency Planning and Community Right-to-Know Act (EPCRA) in accordance with U.S. Environmental Protection Agency (EPA). TRI database in the U.S. contributes to informed decision making by communities, government agencies, companies and others. In Clarkson's et al. (2011) second study, regarding the Australian context, environmental performance index was measured with the aid of emissions data that were available at the Australian NPI. NPI stands for Australian National Pollutant Inventory and reflects the level of Australian firms' toxic emissions (NPI, 2019). The NPI is based on similar international inventories, such as U.S. TRI, and demands all facilities in Australia that emit pollutants to submit, on annual basis, reports that quantify their land, water and air emissions. Both TRI and NPI cover a large diversified set of companies, in the American and Australian context respectively, and constitute official and

legal environmental databases from which one who has access to can extract considerable information regarding firms’ measurable emissions of various land, water and air pollutants.

Since there is no such legally official environmental database in Greece, this study relies on the internet as the only information source in order to extract emissions data, and particularly it relies on the available emissions data published at companies’ social responsibility and sustainability reports. Thus, the environmental performance index used in this project derives directly from the original Clarkson’s et al. (2008; 2011) index but is specifically fractioned in the Greek context and, therefore, considers only total air emissions, as an objectively unified quantifiable measure of environmental performance for the sample of Greek companies. Unexceptionally, each of the Greek companies that constitute this research sample has published air emissions data. Total air emissions include direct and indirect Green House Gas (GHG) emissions of Scope 1, 2 and 3, as well as, other important gas emissions. Scope 1 emissions are direct emissions that occur onsite or are from sources that a company owns and controls. Scope 2 emissions are indirect emissions that result from generation of electricity, heat, or steam that a firm needs in order to operate. Scope 3 emissions include all indirect emissions other than those represented by Scope 2 emissions.

Table 3.C Definition and measurement of environmental performance independent variable

Independent variable	Definition of variable
<i>ln(pp)</i>	= pollution propensity – environmental performance, measured as the natural logarithm of total air emissions scaled by total sales revenue at fiscal year end

3.4 Environmental disclosure index

Environmental disclosure is measured and quantified via the adoption and use of the GRI-based index, which was developed by Clarkson et al. (2008, pp. 311 – 313; 2011, pp. 58 – 60) and members of the GRI Steering Committee. GRI stands for Global Reporting Initiative and is an independent institution that was formed in 1997 as a joint initiative of the U.S. non-governmental Coalition for Environmentally Responsible Economics (CERES) and the United Nations (UNs) Environment Program, with the vision that ‘reporting on economic, environmental, and social performance by all organizations is as routine and comparable as financial reporting’ (GRI, 2007). In its database, companies from all over the globe publish

their annual sustainability and corporate responsibility reports and disclose relevant information regarding their environmental activities, strategies and pollutants.

This index is comprised of detailed instructions for each item resulting in a relatively mechanical process of measurement where quality, rigor and utilization of sustainability reporting guidelines are enhanced (Clarkson et al., 2008). The GRI guidelines follow 11 principles, namely: transparency; inclusiveness; control; completeness; relevance; sustainability; accuracy; neutrality; comparability; clarity and timeliness, in order to ensure that corporate social responsibility and sustainability reports: a) present a reasonable and balanced assessment of economic, environmental and social performance, b) facilitate timely and business-to-business comparison, and c) reliably present issues of concern to stakeholders. The first set of GRI guidelines was published in 1999 as a draft report and has been thus far subject to several revisions (GRI, 2007). For the purpose of this project, the Sustainability Reference Guidelines of GRI, which were published in 2002, were used, exactly as they have been reported and developed in the study of Clarkson et al. (2008).

Therefore, the environmental disclosure GRI-index employed for the purpose of this research project, as directly follows from Clarkson et al. (2008, pp. 311 – 313; 2011, pp. 58 – 60) covers in total 95 equally weighted disclosure items and consists of seven broad categories, A1 to A7, namely: A1) Governance Structure and Management Systems; A2) Credibility; A3) Environmental Performance Indicators (EPI); A4) Environmental Spending; A5) Vision and Strategy Claims; A6) Environmental Profile; A7) Environmental Initiatives.

The first 4 categories (A1 to A4) are comprised of 79 hard disclosure items while the last 3 categories (A5 to A7) include 16 soft disclosure items. It is essential to mention that hard disclosure items are viewed by GRI as objective, verifiable and difficult to be mimicked by firms with poor environmental performance, whereas soft disclosure items are perceived as not easily verified and could be provided by all corporations in spite of their environmental performance type (Clarkson et al., 2008; 2011).

For each of the items in categories A1, A2, A4, A5, A6 and A7, the score is 1 if the item is mentioned in the firm's sustainability report and 0 otherwise. For category A3, the items are 10 overall and the rating scale per item ranges from 0 to 6, depending on the level of analysis and inclusion per item presented in firms' sustainability reports. More specifically, a point is awarded for each of the following inclusions: 1) performance data are included, 2) performance data are presented relative to peers/rivals or the industry, 3) performance data are demonstrated

relative to previous periods, i.e. in form of trend analysis, 4) performance data are portrayed relative to targets, 5) performance data are presented both in absolute and normalized form, and 6) performance data are presented at disaggregate level, i.e. plant or business unit or even in geographic segment (Clarkson et al., 2008).

In meticulous detail, Table 3.D presents the GRI-based scoring index. The first column illustrates the index items which are classified in two main categories, hard and soft disclosures and the second column shows the mapping of index items to the GRI 2002 Guidelines.

Table 3.D GRI-Based Scoring Index divided in Panel A and B

Panel A: Hard disclosure items	
Item	Map to GRI
<i>A1) Governance Structure and Management Systems (maximum score is 6)</i>	
1. Existence of a Department for pollution control and/or management positions for environmental management (0-1)	3.1
2. Existence of an Environmental and/or a Public Issues Committee on the board (0-1)	3.1
3. Existence of terms and conditions applicable to suppliers and/or customers regarding environmental practices (0-1)	3.16
4. Stakeholder involvement in setting corporate environmental policies (0-1)	1.1, 3.10
5. Implementation of ISO14001 at the plant and/or firm level (0-1)	3.14, 3.20
6. Executive compensation is linked to environmental performance (0-1)	3.5
<i>A2) Credibility (maximum score is 10)</i>	
1. Adoption of GRI sustainability reporting guidelines or provision of a CERES report (0-1)	3.14
2. Independent verification/assurance about environmental information disclosed in the EP report (0-1)	2.20, 2.21
3. Periodic independent verification/audits on environmental performance and/or systems (0-1)	3.19
4. Certification of environmental programs by independent agencies (0-1)	3.2
5. Product Certification with respect to environmental impact (0-1)	3.16
6. External Environmental Performance Awards and/or inclusion in a Sustainability Index (0-1)	
7. Stakeholder involvement in the environmental disclosure process (0-1)	1.1, 3.10
8. Participation in voluntary environmental initiatives endorsed by EPA or Department of Energy (0-1)	3.15
9. Participation in industry specific associations/initiatives to improve environmental practices (0-1)	3.15

(Continued)

Panel A: Hard disclosure items	
Item	Map to GRI
10. Participation in other environmental organizations/associations to improve environmental practices (if not awarded under 8 or 9 above) (0-1)	3.15
A3) Environmental Performance Indicators (EPI) (maximum score is 60)	
1. EPI on energy use and/or energy efficiency (0-6)	EN3, 4, 17
2. EPI on water use and/or water use efficiency (0-6)	EN5, 17
3. EPI on greenhouse gas emissions (0-6)	EN8
4. EPI on other air emissions (0-6)	EN9, 10
5. EPI on NPI (land, water, air) (0-6)	
6. EPI on other discharges, releases and/or spills (not TRI) (0-6)	EN12, 13
7. EPI on waste generation and/or management (recycling, re-use, reducing, treatment and disposal) (0-6)	EN11
8. EPI on land and resources use, biodiversity and conservation (0-6)	EN6, 7
9. EPI on environmental impacts of products and services (0-6)	EN14
10. EPI on compliance performance (e.g. exceedances, reportable incidents) (0-6)	EN16
A4) Environmental Spending (maximum score is 3)	
1. Summary of euro savings arising from environment initiatives to the company (0-1)	
2. Amount spent on technologies, R&D and/or innovations to enhance environmental performance and/or efficiency (0-1)	EN35
3. Amount spent on fines related to environmental issues (0-1)	EN16
Panel B: Soft disclosure items	
Item	Map to GRI
A5) Vision and Strategy Claims (maximum score is 6)	
1. CEO statement on environmental performance in letter to shareholders and/or stakeholders (0-1)	1.1, 1.2
2. A statement of corporate environmental policy, values and principles, environmental codes of conduct (0-1)	1.1, 1.2, 3.7
3. A statement about formal management systems regarding environmental risk and performance (0-1)	3.19
4. A statement that the firm undertakes periodic <i>reviews and evaluations</i> of its environmental performance (0-1)	3.19
5. A statement of <i>measurable goals</i> in terms of future environmental performance (if not awarded under A3) (0-1)	1.1, 1.2
6. A statement about specific environmental innovations and/or new technologies (0-1)	1.1, 1.2

(Continued)

Panel B: Soft disclosure items	
Item	Map to GRI
<i>A6) Environmental Profile (maximum score is 4)</i>	
1. A statement about the firm's compliance (or lack thereof) with specific environmental standards (0-1)	GN8
2. An overview of environmental impact of the industry (0-1)	GN8
3. An overview of how the business operations and/or products and services impact the environment (0-1)	GN8
4. An overview of corporate environmental performance relative to industry peers (0-1)	GN8
<i>A7) Environmental initiatives (maximum score is 6)</i>	
1. A substantive description of employee training in environmental management and operations (0-1)	3.19
2. Existence of response plans in case of environmental accidents (0-1)	
3. Internal Environmental Awards (0-1)	
4. Internal Environmental Audits (0-1)	3.19, 3.2
5. Internal certification of environmental programs (0-1)	3.19
6. Community involvement and/or donations related to environment (if not awarded under A1.4 or A2.7) (0-1)	SO1, EC10

Source: Adapted by Clarkson et al. (2008, pp. 311 – 313; 2011, pp. 58 – 60)

The above Table 3.D illustrates the relevant components that were used to construct all the dependent variables in this study, namely *Eds_total*, *Eds_hard*, *Eds_soft* and *Eds_ratio*. *Eds_total*, *Eds_hard* and *Eds_soft* are concerned with the level of environmental disclosures whereas *Eds_ratio* is concerned with the nature of environmental disclosures. *Eds_total*, *Eds_hard* and *Eds_soft* will be tested with environmental performance index and the rest of the control variables in order to accept or reject the first set of this dissertation's hypotheses, and particularly the relation between the level of environmental disclosures and environmental performance. *Eds_ratio* will be tested with environmental performance index and the rest of the control variables in order to accept or reject the second set of this dissertation's hypotheses, and particularly the relation between the nature of environmental disclosures and environmental performance. More specifically, Table 3.E below demonstrates how each dependent variable was eventually measured (see also Appendix A as a detailed illustrative example).

Table 3.E Definition and measurement of environmental disclosure dependent variables

Dependent variable	Definition of variable
<i>Eds_total</i>	= total environmental disclosure score, measured as the sum of firm's total score in all hard and soft disclosure items scaled by 95
<i>Eds_hard</i>	= hard environmental disclosure score, measured as the sum of firm's score in hard disclosure items divided by 79
<i>Eds_soft</i>	= soft environmental disclosure score, measured as the sum of firm's score in soft disclosure items divided by 16
<i>Eds_ratio</i>	= ratio environmental disclosure score, measured as the ratio of hard to total disclosures

3.5 Sampling

In order to estimate the relation between environmental disclosure and environmental performance in the Greek business context, a sample of Greek companies (groups) was examined and used to analyze the above model. Two key criteria constitute the basis for this selection.

First, this sample is comprised of a group of companies which are listed in the Athens Stock Exchange Group. According to Galani et al. (2012), listed companies normally disclose more information about their business financial and particularly non-financial activities than non-listed companies due to the competitive advantage that the former face in the stock market. Additionally, the larger a firm is by volume and number of employees, the more information it self-reports so as to gain recognition from stakeholders. A full list of 182 companies which are listed in the Athens Stock Exchange is presented in Appendix B.

Second, the sample of Greek companies was, also, selected according to whether or not they provide environmental information and data via their sustainability reports published at the GRI database. The full list of 126 Greek companies that publish corporate social responsibility and sustainability reports at the GRI database is presented in Appendix C.

A total of 102 Greek companies were excluded from the GRI database search as they did not publish sustainability reports for a long continuous period. Additionally, companies that published sustainability reports at the GRI database but were not listed in the Athens Stock Exchange Group were removed. As a result, this led to the definition of the time period of data analysis, which is the year period 2010 – 2016, a period that consists of 7 sequential years. This

period, also, corresponds to the period of the Greek Financial Crisis, and it is noteworthy to mention that during this period most of the companies' data were indeed available as opposed to data from earlier periods or even sometimes as opposed to data from later periods. Finally, the total number of observations of this study is 105 (15 companies * 7 sequential years).

Table 3.F below presents the list of Greek companies included in this research sample.

Table 3.F Research Sample - List of Greek companies included in the sample

a/a	Company's name	Abbreviation in the Athens Stock Exchange	Sector
1.	Alpha Bank Group	ALPHA	Banks – Financial Services
2.	Eurobank Ergasias EFG	EUROB	Banks – Financial Services
3.	National Bank of Greece	ETE	Banks – Financial Services
4.	Piraeus Bank Group	TPEIR	Banks – Financial Services
5.	European Reliance	EUPIC	Full Line Insurance
6.	Attica Group	ATTICA	Travel and Tourism
7.	ElvalHalcor (Hellenic Copper and Aluminium Industry)	ELHA	Metal Fabricating – Metal Products
8.	Fourlis Group	FOURK	Diversified Retailers
9.	Hellenic Petroleum	ELPE	Integrated Oil and Gas – Energy
10.	Hellenic Telecommunication Organization (OTE)	HTO	Telecommunication Services – Telecommunications
11.	Motor Oil (Hellas) Corinth Refineries	MOH	Oil Refining and Marketing – Energy
12.	Mytilineos Group	MYTIL	Diversified Industrials – Conglomerates
13.	Nireus Aquaculture Group	NIR	Farming, Fishing, Ranching and Plantations – Food and Beverage Products
14.	Public Power Corporation	PPC	Conventional Electricity – Energy Utilities
15.	Titan Cement Group	TITC	Cement – Construction Materials

3.6 Data collection

Data were collected from 105 annual consolidated financial reports that were available on the selected companies' websites, as well as, from 105 annual corporate social responsibility and sustainability reports that were published at the GRI database.

Also, in order to measure stock price volatility of the companies included in the sample, three websites were employed, namely: Athenxgroup.gr, which is the main website of Athens Exchange Stock Market, Yahoo Finance and Capital.gr. These three sites provide considerable financial information and historical data for the stock prices of companies' shares, as well as, for their market adjusted monthly and annual returns.

Data were formed into panel data and analyzed via the aid of the Pooled Ordinary Least Squares (OLS) Regression method. The software that was employed for the analysis of the data was Eviews 9. Eviews is considered the most appropriate software for analyzing time series balanced panel data (Lilien, 2000). Panel data are a special case of cluster data and have been widely used in modern econometrics in recent years. Panel data constitute a set of elements where a stratified sample is depicted over time. Therefore, panel data are, also, a combination of stratigraphic data and chronological orders (time series). Particularly, in this study the layers' reference period is the same (2010 to 2016) and thus panel data are balanced. According to Dritsaki and Dritsaki (2012), panel data are advantageous as they: a) reduce the problem of multilinearity among independent variables, b) increase the number of sample observations and thus the degrees of freedom which results in improving the efficiency of the estimated factors, c) settle the main problem in stratigraphic data, heteroskedasticity, as each layer is probed with temporal data, and lastly d) provide the researcher with the unique ability to form a better view of the characteristics of a layer (a stratum unit) as s/he studies it over time.

3.7 Chapter summary

This chapter presented and analyzed the methodological process which was employed in order to address the main research aim of this dissertation; the exploration of the relation between environmental performance and both the level and the nature of environmental disclosures in the Greek business context. The following chapter of this dissertation presents the descriptive statistics of key variables and the results that are derived from the application and use of this econometric model for the sample of Greek firms. Analysis of those results is, also, included, followed by a short discussion in which results are compared to findings from previous studies.

3.8 Chapter references

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CHAPTER 4

EMPIRICAL RESULTS – ANALYSIS

4.1 Introductory chapter notes

This chapter of the dissertation presents the empirical results that were derived from the use and application of the econometric model developed by Clarkson et al. (2008; 2011) for the selected sample of Greek firms. Section 4.2 presents the descriptive statistics for the set of independent and depended variables used in the econometric model and Section 4.3 presents Pooled OLS Regression results along with analysis of the relation between both the level and the nature of environmental disclosures and environmental performance in the Greek business context. Then, a short discussion in which these empirical results are compared with findings from previous empirical studies follows in Section 4.4.

4.2 Descriptive statistics of independent and dependent variables

Table 4.A below presents the descriptive statistics for all the independent and dependent variables included in the research econometric model that was developed by Clarkson et al. (2008; 2011) and was employed for the main research purpose of this dissertation; the estimation of the relation between both the level and the nature of environmental disclosures and environmental performance in the Greek business context. As revealed, there is a considerable cross section variation in all measures.

Table 4.A Descriptive Statistics of key variables

Panel A: Descriptive Statistics of key variables (dependent and independent variables)					
Key variables	Mean	Median	Std. Dev.	min	max
<i>Eds_total_{i,t}</i>	0.684110	0.894737	0.342119	0.105263	1.000000
<i>Eds_hard_{i,t}</i>	0.670645	0.886076	0.357934	0.063291	1.000000
<i>Eds_soft_{i,t}</i>	0.749405	0.875000	0.281183	0.187500	1.000000
<i>Eds_ratio_{i,t}</i>	0.782150	0.831579	0.096230	0.466667	0.870968

(Continued)

Panel A: Descriptive Statistics of key variables (dependent and independent variables)

Key variables	Mean	Median	Std. Dev.	min	max
$\ln(pp)_{i,t}$	-1.574399	-2.701479	3.164932	-6.292192	5.831693
$\ln(size)_{i,t}$	22.32629	21.83250	2.015908	19.24595	25.51694
$new_{i,t}$	0.596700	0.597142	0.155982	0.065629	0.953866
$capin_{i,t}$	0.055699	0.035843	0.050978	-0.027390	0.205114
$fin_{i,t}$	0.316020	0.311447	0.128772	0.048728	0.666723
$tobsq_{i,t}$	2.631897	0.831221	7.871501	0.021222	71.85846
$roa_{i,t}$	0.092486	0.032128	0.575054	-0.144108	5.912866
$lev_{i,t}$	0.740776	0.764873	0.163548	0.421042	1.039306
$vol_{i,t}$	0.039968	0.035216	0.020380	0.012625	0.110841
Sample size	105	105	105	105	105

The sample period is 2010 to 2016. The sample consists of 105 firm-years. $Eds_total_{i,t}$ is the GRI-based environmental disclosure score for total disclosures, $Eds_hard_{i,t}$ is the GRI-based environmental disclosure score for hard disclosures, $Eds_soft_{i,t}$ is the GRI-based environmental disclosure score for soft disclosures, $Eds_ratio_{i,t}$ is the ratio of hard to total disclosures based on the GRI index, $\ln(pp)_{i,t}$ is the environmental performance proxy which is measured as the natural logarithm of total air emissions scaled by total sales revenue at fiscal year-end, $\ln(size)_{i,t}$ is the natural logarithm of total assets at fiscal year-end, $new_{i,t}$ is the ratio of net property, plant and equipment (PPE) to gross property, plant and equipment (PPE) at fiscal year-end, $capin_{i,t}$ is the ratio of capital expenditures to total sales revenue at the end of fiscal year, $fin_{i,t}$ is the amount of capital raised by business, sized as proceeds from common share issues minus share buybacks plus long-term debt, all scaled by beginning of year total assets, $tobsq_{i,t}$ is Tobin's Q and is counted as market value of common equity (i.e. total amount of common shares multiplied by share closing price at 31/12/xx) divided by total assets at fiscal year-end, $roa_{i,t}$ is return on assets, equal to earnings before interests, taxes and abnormal items at the end of fiscal year scaled by beginning of year total assets, $lev_{i,t}$ is leverage determined as total liabilities divided by total assets at fiscal year-end and $vol_{i,t}$ is stock price volatility measured as the standard deviation of market returns at the end of the month during the fiscal year.

With regards to the dependent variables, as it can be observed from Table 4.A above, Eds_total has a mean score of 0.68 which illustrates that the selected sample of Greek companies comply with environmental disclosures imposed by GRI guidelines by 68% on average. Eds_hard , Eds_soft and Eds_ratio , scored a mean of 0.67, 0.74 and 0.78 respectively. Overall, Greek companies that constitute the sample of this study are disclosing environmental information along the lines of GRI. As far as the independent variables are concerned, the mean value of $\ln(pp)$ is -1,57, the mean score of $\ln(size)$ is 22.32, the mean outcome of new is 0,59, the mean of $capin$ is 0.05, the mean score of fin is 0.31, the mean of $tobsq$ is 2.63, the mean of roa is 0.09, the mean value of lev is 0.74, while the mean score of vol is 0.03.

4.3 Pooled Ordinary Least Squares Regression results and analysis

Table 4.B below presents the results for variants of models 1, 2, 3, and 4, relating the total, hard, soft and ratio (hard to total) environmental disclosure score to environmental performance (i.e. pollution propensity) for the sample of Greek firms. In each instance, all models include all control variables.

Table 4.B Regression results for models 1, 2, 3 and 4 of total, hard, soft and ratio (hard to total) disclosures

Panel B: Pooled Ordinal Least Squares (OLS) Regression				
	Model 1	Model 2	Model 3	Model 4
Variable	<i>Eds_total_{i,t}</i>	<i>Eds_hard_{i,t}</i>	<i>Eds_soft_{i,t}</i>	<i>Eds_ratio_{i,t}</i>
Intercept	-0.559389 (0.0986)	-0.660676 (0.0627)	-0.089277 (0.7577)	0.450250 (0.0001)
ln(pp)_{i,t}	0.057794*** (<0.001)	0.058979*** (<0.001)	0.051376*** (<0.001)	0.005787* (0.0880)
ln(size)_{i,t}	0.063608*** (0.0006)	0.068946*** (0.0004)	0.039226** (0.0128)	0.017779** (0.0044)
new_{i,t}	-0.074833 (0.6478)	-0.074227 (0.6649)	-0.073543 (0.6019)	-0.010683 (0.8474)
capin_{i,t}	1.026800* (0.0812)	0.993218 (0.1065)	1.164533** (0.0223)	-0.076595 (0.6990)
fin_{i,t}	0.009925 (0.9609)	0.044962 (0.8319)	-0.157751 (0.3662)	0.158565** (0.0227)
tobsq_{i,t}	0.003476 (0.3193)	0.003314 (0.3640)	0.004216 (0.1615)	-0.001006 (0.3951)
roa_{i,t}	0.052378 (0.2216)	0.052053 (0.2454)	0.055230 (0.1349)	0.011236 (0.4382)
lev_{i,t}	0.124229 (0.6010)	0.096869 (0.6966)	0.235439 (0.2507)	-0.010605 (0.8952)
vol_{i,t}	-5.187442*** (0.0006)	-5.646097*** (0.0003)	-2.951112** (0.0204)	-2.149829*** (<0.001)
R ²	0.524380	0.524493	0.478698	0.309027
Adj R ²	0.479321	0.479445	0.429311	0.243566
Sample size	105	105	105	105

(Continued)

Panel B: Pooled Ordinal Least Squares (OLS) Regression

***, ** and * statistical significance at 1%, 5% and 10% (two – tailed) level, respectively. Probabilities reported in parentheses. The sample period is 2010 to 2016. The sample consists of 105 firm-years. *Eds_total_{i,t}* is the GRI-based environmental disclosure score for total disclosures, *Eds_hard_{i,t}* is the GRI-based environmental disclosure score for hard disclosures, *Eds_soft_{i,t}* is the GRI-based environmental disclosure score for soft disclosures, *Eds_ratio_{i,t}* is the ratio of hard to total disclosures based on the GRI index, *ln(pp)_{i,t}* is the environmental performance proxy which is measured as the natural logarithm of total air emissions scaled by total sales revenue at fiscal year-end, *ln(size)_{i,t}* is the natural logarithm of total assets at fiscal year-end, *new_{i,t}* is the ratio of net property, plant and equipment (PPE) to gross property, plant and equipment (PPE) at fiscal year-end, *capin_{i,t}* is the ratio of capital expenditures to total sales revenue at the end of fiscal year, *fin_{i,t}* is the amount of capital raised by business, sized as proceeds from common share issues minus share buybacks plus long-term debt, all scaled by beginning of year total assets, *tobsq_{i,t}* is Tobin's Q and is counted as market value of common equity (i.e. total amount of common shares multiplied by share closing price at 31/12/xx) divided by total assets at fiscal year-end, *roa_{i,t}* is return on assets, equal to earnings before interests, taxes and abnormal items at the end of fiscal year scaled by beginning of year total assets, *lev_{i,t}* is leverage determined as total liabilities divided by total assets at fiscal year-end and *vol_{i,t}* is stock price volatility measured as the standard deviation of market returns at the end of the month during the fiscal year.

Notes: This study has accounted for heteroscedasticity, departure from normality, autocorrelation and multicollinearity, where appropriate. Thus, the Pooled OLS assumptions are tested and are valid.

Models 1, 2 and 3 are concerned with the level of environmental disclosures and therefore test the first set of hypotheses of this dissertation (H1a and H1b), whereas model 4 is concerned with the nature of environmental disclosures and tests the second set of hypotheses of this dissertation (H2).

The R^2 in models 1, 2 and 3 is approximately 0.50 and the adjusted R^2 is approximately 0.45, whereas in model 4 R^2 is 0.30 and adjusted R^2 is 0.24. Thus, in model 1, 2 and 3 the total volatility of the dependent variables is, respectively, interpreted by 50%, whereas in model 4 it is interpreted by 30%. The remaining 50% in models 1, 2 and 3, as well as, the remaining 70% in model 4 is interpreted by other factors.

With regards to the level of environmental disclosures:

On the basis and essence of the two conceptual frameworks discussed in Chapter 2, namely: voluntary disclosure theory and socio-political theories, and as relatively lower values of *ln(pp)* declare reduced emissions and, consequently, higher environmental performance, two important predictions are underlined (Clarkson et al., 2011). Voluntary disclosure theory predicts a negative coefficient on the *ln(pp)* measure (**H1a**) whereas socio-political theories predict a positive coefficient (**H1b**) (Clarkson et al., 2011).

Interestingly, as far as models 1, 2 and 3 are concerned the coefficient on $\ln(pp)$ is consistently positive and significant at 1% level with prob. <0.001 in all 3 models. Subsequently, results of all 3 models support H1b and suggest that, for the selected sample of Greek firms, the total, hard and soft level of environmental disclosure is negatively associated with environmental performance, as implied by socio-political theories. More specifically, Greek corporations with a higher pollution propensity and with greater total air emissions, i.e. Greek poor environmental performers, scored higher on the hard, soft and total items of the GRI disclosure index.

With regards to the nature of environmental disclosures:

Furthermore, based on arguments from both conceptual frameworks, i.e. voluntary disclosure theory and socio-political theories, a negative coefficient on the $\ln(pp)$ is expected to support hypothesis H2, as firms with greater emissions and thereby with a higher pollution propensity are likely to make relatively less use of hard, objective and verifiable disclosures (Clarkson et al., 2011).

Surprisingly, contrary to the aforementioned prediction, in model 4, the coefficient on $\ln(pp)$ is positive and significant at 10% level, suggesting that Greek firms with greater emissions and thereby poorer environmental performance rely relatively more on hard environmental disclosures, than Greek corporations with lower emissions and thereby better environmental performance do. Therefore, H2 is rejected and the null hypothesis of the second set of hypotheses of this dissertation is accepted.

With regards to the rest of the control variables, a number of comments are underlined. $\ln(size)$ is consistently significant in all 4 models, and more specifically, it is significant at 1% level in model 1 and 2 whereas in model 3 and 4 it is statistically significant at 5% level. Its coefficient is again consistently positive in all 4 models, as it was expected (Clarkson et al., 2011). Thus, this demonstrates that firms with a large size, which are visible in the marketplace and are followed by financial analysts, market authorities and potential investors due to their size, tend to disclose more significant information regarding their environmental activities, irrelevant of whether this information is ‘good’ or ‘bad’ news (Iatridis, 2013). Additionally, vol is another control variable which is consistently significant in all 4 models. Particularly, it is significant at 1% level in models 1, 2 and 4 whereas it is significant at 5% level in model 3. As discussed in chapter 3 and section 3.2., vol along with $tobsq$ are the two control variables included in the above econometric model due to the fact that they capture information asymmetry (Clarkson et al., 2011). As also stated by Healy and Palepu (2001), companies with

high measures of both *vol* and *tobsq* are more likely to increase environmental disclosures. However, in this instance, *vol* is consistently negative and significant in all 4 models whereas *tobsq* is positive in models 1, 2 and 3 and negative in model 4 while it is non-significant across all 4 models. So, a negative association between environmental disclosures and information asymmetry would be implied if *tobsq* had been consistently significant but due to the fact that it is not, this conclusion cannot be reached (Iatridis, 2013). Moreover, the coefficient on *capin* is positive and significant in model 3, which could imply that some Greek firms with high capital spending would be expected to possess and utilize environmentally friendly technologies, machinery and equipment, thereby demonstrating higher environmental performance which could be accordingly communicated via thorough environmental disclosures (Iatridis, 2013). However, in this instance, such a scenario does not reflect the overall outcome of model 3. Lastly, the coefficient of *fin* is positive and significant in model 4 which indicates that Greek corporations that seek capital in money and stock markets demonstrate a higher tendency for solid, informative and meaningful disclosures so as to influence the terms of financing (Iatridis, 2013); this is depicted in the overall findings of model 4 as results of model 4 suggest that Greek poor environmental performers rely on hard and verifiable disclosures in order to position themselves in the market.

4.4 Discussion

This research project employed an econometric model and a research design previously developed by Clarkson et al. (2008; 2011) in order to assess the relation of both the level and the nature of corporate environmental disclosures and environmental performance in the Greek business context. It embraced the socio-political theories' perspective and concluded to a clear outcome; a negative relation between the level of environmental disclosures and environmental performance for the sample of Greek firms. This research project, also, found that Greek inferior environmental performers rely relatively more on hard, objective and verifiable disclosures (as viewed by GRI) in order to position themselves in the Greek market, than Greek superior environmental performers do. Additionally, results of this study illustrated that Greek sample firms are aligned with GRI's environmental reporting requirements by almost 70%. These results, in general, are consistent with previous empirical endeavors in different contexts, such as Bewley's and Li's (2000) findings concerning the Canadian context, Hughes' et al. (2001) and Patten's (2002) results regarding the American context and Clarkson's et al. (2011)

findings with regards to the Australian context. However, findings of this study are inconsistent with Al-Tuwaijri's et al. (2004), Clarkson's et al. (2008) and Giannarakis' et al. (2017) results on the American context, Freedman's and Jaggi's (2010) results concerning the Canadian, Japanese and the European Union contexts respectively, Iatridis' (2013) findings on the Malaysian context, Luo and Tang (2014) results on the Australian, American and British contexts respectively, as well as, Meng's et al. (2014) results with regards to the Chinese context.

This study focused on the Greek context which constitutes an ill-researched context with regards to environmental reporting and its relation to environmental performance, as it was, also, argued in the introduction. The selective sample in this project is comprised of companies from different sectors, including *inter alia* financial services, insurance, travel and tourism, telecommunication services, energy, integrated oil and gas, oil refining and marketing, retailing, conventional electricity, construction materials and cement, metal fabricating, fishing and farming. However, it is definitely a small sample which also constitutes the whole population of Greek firms that are aligned with GRI guidelines and publish corporate social responsibility and sustainability reports on the GRI database for the selected year period. Thus, such a small population of firms that follows internationally environmental reporting guidelines implies that Greece has been left backwards in terms of environmental reporting. Added to this small population, another major constraint that might have influenced results of this study was the availability of environmental data; there is no official Greek database, similar to U.S. TRI or Australian NPI, in which Greek firms can upload records of their various land, water and air emissions. Consequently, results of this empirical endeavor might not be applicable or generalizable in other more industrialized contexts but should inform Greek policy authorities to take actions and urge or force more Greek companies to successfully deal with their environmental footprint. Further empirical research on the same topic and in the same context, based upon a more rigorous research design and with more recent and rich environmental data, will either support these findings and build upon them or it will contradict them.

4.5 Chapter summary

This chapter of the dissertation presented the research outcome of the investigation regarding the relation between environmental disclosure and environmental performance in the Greek business context. For the selected sample of Greek firms, it was found that the level of

environmental disclosures is negatively associated with environmental performance, as implied by socio-political theories, and that Greek inferior environmental performers rely relatively more on hard disclosures than Greek superior environmental performers do. Moreover, results of this investigation in the Greek context revealed that Greek sample firms are aligned with GRI environmental reporting requirements and guidelines by almost 70%. The following chapter concerns the conclusion and limitations of this dissertation, as well as, its research contribution to the existing environmental reporting literature. Recommendations for future research and practice on the same topic are, also, provided in the next chapter.

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CHAPTER 5

CONCLUSION

5.1 Concluding remarks

This research project was conducted with the aim to examine the relation between environmental disclosure and environmental performance in the Greek business context. The Greek context under examination constitutes a crucial and novel case study as it lacks previously documented scientific evidence on this particular topic. Drawing upon two main theories that constitute the governing philosophy behind the relation of environmental disclosure and environmental performance, namely: voluntary disclosure theory and socio-political theory, and applying a rigorous research design formerly developed by Clarkson et al. (2008; 2011), this project provided a clear outcome for the researched context; a negative association between environmental disclosure and environmental performance. Thus, Greek firms of this study's selected sample that denote a higher pollution propensity, thereby demonstrating a poor environmental performance, disclose more environmental information and rely on objective and verifiable disclosures so as to communicate this information to potential stakeholders and to the general public. Finally, Table 5.A below presents a comparison of similarities and differences of this study with previous empirical endeavors that were critically evaluated in the literature review and provides this project's concluding remarks.

Table 5.A Similarities and differences of this project with previous studies

Previous studies	Similarities with this project	Differences with this project
Wiseman (1982)	Similar sample size Similar data collection process: annual reports	Large context Different proxies for environmental disclosure and performance Single year period of investigation
Bewley and Li (2000)	Similar outcome: negative relation Similar data collection process: annual reports	Large context / Big sample size Different proxies for environmental disclosure and performance Sample concerned only manufacturing firms Single year period of investigation
Hughes et al. (2001)	Similar outcome: negative relation	Large context Different proxies for environmental disclosure and performance Sample concerned only manufacturing firms Big sample size Single year period of investigation

(Continued)

Previous studies	Similarities with this project	Differences with this project
Patten (2002)	Similar outcome: negative relation Similar environmental proxy based on emissions data	Large context Different proxies for environmental disclosure and performance Large sample and rich data Single year period of investigation
Al-Tuwaijri et al. (2004)	Similar environmental proxy based on emissions data Variation of sectors in which sample firms operate	Opposing outcome: positive relation Large context Big sample size Single year period of investigation
Clarkson et al. (2008)	Same econometric model Same proxy for environmental disclosure and similar for environmental performance Similar data collection process for the measurement of environmental disclosure: annual reports	Opposing outcome: positive relation Large context Big sample size Sample concerned only polluting industries' firms
Clarkson et al. (2011)	Same econometric model Similar outcome: negative relation Same proxy for environmental disclosure and similar for environmental performance Similar data collection process for the measurement of environmental disclosure: annual reports Variation of sectors in which sample firms operate	Large context Big sample size Two distinct years as an investigation period (2002; 2006)
Freedman and Jaggi (2009)	Year period (2004 – 2006) Variation of sectors in which sample firms operate	Opposing outcome: no clear relation Large sample size Only GHG emissions as a proxy for environmental performance Variation of contexts
Iatridis (2013)	Same econometric model Same proxy for environmental disclosure and similar for environmental performance Same year period in terms of number of sequential years (2005 – 2011) Variation of sectors in which sample firms operate	Opposing outcome: positive relation Large context Very large sample
Luo and Tang (2014)	Variation of sectors in which sample firms operate	Opposing outcome: positive relation Large context Large sample size Rich data Variation of contexts Single year period of investigation
Meng et al. (2014)	Similar data collection process: annual reports	Opposing outcome: non-linear relation Large context / Big sample size Single year period of investigation
Giannarakis et al. (2017)	Similar year period – four sequential years (2009 – 2013)	Opposing outcome: positive relation Large context Big sample size Rich data (Bloomberg) Only GHG emissions as a proxy for environmental performance

5.2 Research contribution

This study contributes to the general environmental reporting literature as it constitutes an initial scientific attempt to fill the research gap on the relation between environmental disclosure and environmental performance in the ill-researched Greek context. Further empirical research on the same topic and in the same context, based upon a more rigorous research design and with more recent and rich environmental data, is recommended in order to support these findings and build upon them or contradict them and continue to add value to this crucial ongoing debate.

5.3 Limitations

There are several limitations associated with this project that should be acknowledged so that future work in this area can address them and fill the remain lacunae in our knowledge concerning the relation between environmental disclosure and environmental performance in the Greek context.

First, both environmental performance and environmental disclosure constitute of two constructs that are difficult to measure. Thus, the problem is far more sizeable and complex than it appears and harder to handle in all sort of ways. It is considerably bigger due to the fact that there is no universally applicable proxy for the measurement of both environmental performance and environmental disclosure, and harder to manage in terms of reliability issues that specifically voluntary environmental disclosures might entail. This study relied on previous measurements of the two constructs under investigation and, as a result, this might not reflect precisely the Greek context.

Second, similar to many previous studies which attempted to explore the relation of environmental disclosure and environmental performance, this study is, also, constrained by data availability. This project relied on the internet as the only information source to extract both financial and environmental data. There is no official Greek database, similar to U.S. TRI or Australian NPI, in which Greek firms can upload records of their various land, water and air emissions.

Third, the selected sample in this research project is definitely a small sample. However, it constitutes the whole population of Greek firms that are aligned with international reporting

guidelines and publish, over a relatively long and continuous year period, corporate social responsibility and sustainability reports along these lines, and particularly in the GRI database. Thus, results of this empirical endeavor might not be applicable or generalizable in other larger and more industrialized contexts than this specific one.

Fourth, due to the fact that this was a student project, it was impossible to work collaboratively within a team of researchers who could cross-check the selection of articles for critical evaluation, the proxies for both environmental performance and environmental disclosure, the data collection process and the 210 annual consolidated financial statements and corporate social responsibility and sustainability reports that were employed for the purpose of this study. A student dissertation is an independent piece of work and this kind of collaboration, which is normally the case for such projects, was not appropriate.

5.4 Recommendations for future research and practice

While this research project provides a significant first step in building understanding of the relation between environmental disclosure and environmental performance in the Greek context, there are a number of as yet unexplored research opportunities.

First, the nature of this topic demonstrates the respective importance of qualitative and quantitative research methods that need to be integrated rather than used in isolation for the purpose of this examination. A multi-level analysis of this topic is rather complex and, therefore, requires a multi-methodological research plan that, also, incorporates qualitative methods, such as interviews with environmental managers and people in charge. These qualitative methods are likely to tap into perceptions and understandings of companies' leaders and provide deeper insights, with regards to the factors that drive business environmental reporting that in turn can reflect the actual corporate environmental performance.

Second, even if a seven-year period of investigation between environmental disclosure and environmental performance is considered in this research project for the first time in this context, it still remains appropriate for future research to broaden further the year range and incorporate a longer period or even extend this study to a longitudinal one.

Third, due to the fact that this study was constraint by a small sample size, it is recommended that the next empirical endeavor on the same topic and in the same context should

enlarge the sample size. Although Greece has lagged behind in terms of environmental accountability contrary to other EU or non-EU countries, there will always be room for substantial improvement and, therefore, as years progress, more and more businesses will follow the lines of internationally accepted and validated practices of environmental reporting.

Fourth, a further exploration of this topic could be accomplished by the use of different measurements for both environmental disclosure and environmental performance rather than the ones previously constructed and utilized in other contexts. These new measurements, for instance, could, also, consider cultural values that Greek people may have with regards to the environment.

Fifth, further research on this topic could be conducted in a more interdisciplinary domain. The complexity of this topic highlighted that an approach towards it might require assembling of cross-functional teams, bringing together: accountants and financial staff with mathematicians, statisticians and actuaries; engineers, geologists, ecologists and chemists with accounting and environmental information systems designers; operators with production and environmental managers.

Sixth, as far as the academia world is concerned, qualified and motivated professionals who could shift Greek environmental culture towards a more sensitive direction, are needed to contribute to environmental policy and management in both the public and private sectors. Thus, the provision of an appropriate educational programme in the advanced undergraduate and graduate curriculum is, also, recommended.

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APPENDICES

Appendix A: Example of measurement of the environmental disclosure variables (*eds_hard*, *eds_soft*, *eds_total*, *eds_ratio*) for ElvalHalcor Group.

	D	E	F	G	H	I	J	K	L	M
		Items	Map to GRI	2010	2011	2012	2013	2014	2015	2016
3	1.	Existence of a Department for pollution control and/or management positions for environmental management (0-1)	3.1	1	1	1	1	1	1	1
4	2.	Existence of an Environmental and/or a Public Issues Committee on the board (0-1)	3.1	1	1	1	1	1	1	1
5	3.	Existence of terms and conditions applicable to suppliers and/or customers regarding environmental practices (0-1)	3.16	0	0	0	0	1	1	1
6	4.	Stakeholder involvement in setting corporate environmental policies (0-1)	1.1, 3.10	0	0	0	0	0	0	0
7	5.	Implementation of ISO14001 at the plant and/or firm level (0-1)	3.14, 3.20	1	1	1	1	1	1	1
8	6.	Executive compensation is linked to environmental performance (0-1)	3.5	0	0	1	1	1	1	1
9	1.	Adoption of GRI sustainability reporting guidelines or provision of a CERES report (0-1)	3.14	1	1	1	1	1	1	1
10	2.	Independent verification/assurance about environmental information disclosed in the Environmental Performance report (0-1)	2.20,2.21	1	0	1	1	1	1	1

11	3.	Periodic independent verifications/audits on environmental performance and/or systems (0-1)	3.19	1	0	1	1	1	1	1
12	4.	Certification of environmental programmes by independent agencies (0-1)	3.20	1	0	1	1	1	1	1
13	5.	Product Certification with respect to environmental impact (0-1)	3.16	1	0	1	1	1	1	1
14	6.	External Environmental Performance Awards and/or inclusion in a Sustainability Index (0-1)	-	0	0	0	0	0	0	0
15	7.	Stakeholder involvement in the environmental disclosure process (0-1)	1.1, 3.10	0	0	0	0	0	0	0
16	8.	Participation in voluntary environmental initiatives endorsed by EPA or Department of Energy (0-1)	3.15	0	0	0	0	0	0	0
17	9.	Participation in industry specific associations/initiatives to improve environmental practices (0-1)	3.15	1	1	1	1	1	1	1
18	10.	Participation in industry specific associations/initiatives to improve environmental practices (if not awarded under 8 or 9 above) (0-1)	3.15	0	0	0	0	0	0	1
19	1.	EPI on energy use and/or energy efficiency (0-6)	EN3,4,17	6	6	6	6	6	6	6
20	2.	EPI on water use and/or water use efficiency (0-6)	EN5.17	4	5	6	6	6	6	6

D	E	F	G	H	I	J	K	L	M
20	2. EPI on water use and/or water use efficiency (0-6)	EN5,17	4	5	6	6	6	6	6
21	3. EPI on greenhouse gas emissions (0-6)	EN8	6	6	6	6	6	6	6
22	4. EPI on other air emissions (0-6)	EN9,10	5	6	6	6	6	6	6
23	5. EPI on NPI (land, water, air) (0-6)	EN11	4	5	6	6	6	6	6
24	6. EPI on other discharges, releases and/or spills (not TRI) (0-6)	EN12,13	6	6	6	6	6	6	6
25	7. EPI on waste generation and/or management (recycling, re-use, reducing, treatment and disposal) (0-6)	EN11	6	6	6	6	6	6	6
26	8. EPI on land and resources use, biodiversity and conservation (0-6)	EN6,7	2	2	4	6	6	6	6
27	9. EPI on environmental impacts of products and services (0-6)	EN14	2	1	6	6	6	6	6
28	10. EPI on compliance performance (e.g. exceedances, reportable incidents) (0-6)	EN16	0	6	6	6	6	6	6
29	1. Summary of euro/dollar savings arising from environmental initiatives to the company (0-1)	-	0	0	0	0	0	0	0
30	2. Amount spent on technologies, R&D and/or innovations to enhance environmental performance and/or efficiency (0-1)	EN35	1	1	1	1	1	1	1
31	3. Amount spent on fines related to environmental issues (0-1)	EN16	0	1	1	1	1	1	1
32	1. CEO statement on environmental performance in letter to shareholders and/or to stakeholders (0-1)	1.1,1.2	1	1	1	1	1	1	1
	A statement of corporate environmental policy, values and								

D	E	F	G	H	I	J	K	L	M
35	4. A statement that the firm undertakes periodic reviews and evaluations of its environmental performance (0-1)	3.19	1	1	1	1	1	1	1
36	5. A statement of measurable goals in terms of future environmental performance (if not awarded under A3) (0-1)	1.1,1.2	1	1	1	1	1	1	1
37	6. A statement about specific environmental innovations and/or new technologies (0-1)	1.1,1.2	1	1	1	1	1	1	1
38	1. A statement about the firm's compliance (or lack thereof) with specific environmental standards (0-1)	GN8	1	1	1	1	1	1	1
39	2. An overview of environmental impact of the industry (0-1)	GN8	1	1	1	1	1	1	1
40	3. An overview of how the business operations and/or products and services impact the environment (0-1)	GN8	0	0	0	1	1	1	1
41	4. An overview of corporate environmental performance relative to industry peers (0-1)	GN8	0	1	1	0	0	1	1
42	1. A substantive description of employee training in environmental management and operations (0-1)	3.19	1	1	1	1	1	1	1
43	2. Existence of response plans in case of environmental accidents (0-1)	-	1	1	1	1	1	1	1
44	3. Internal Environmental Awards (0-1)	-	0	0	0	0	0	0	0
45	4. Internal Environmental Audits (0-1)	3.19,3.20	1	1	1	1	1	1	1
46	5. Internal certification of environmental programmes (0-1)	3.19	1	1	1	1	1	1	1
	Community involvement and/or donations related to								

D	E	F	G	H	I	J	K	L	M
40	3. An overview of how the business operations and/or products and services impact the environment (0-1)	GN8	0	0	0	1	1	1	1
41	4. An overview of corporate environmental performance relative to industry peers (0-1)	GN8	0	1	1	0	0	1	1
42	1. A substantive description of employee training in environmental management and operations (0-1)	3.19	1	1	1	1	1	1	1
43	2. Existence of response plans in case of environmental accidents (0-1)	-	1	1	1	1	1	1	1
44	3. Internal Environmental Awards (0-1)	-	0	0	0	0	0	0	0
45	4. Internal Environmental Audits (0-1)	3.19,3.20	1	1	1	1	1	1	1
46	5. Internal certification of environmental programmes (0-1)	3.19	1	1	1	1	1	1	1
47	6. Community involvement and/or donations related to environment (if not awarded under A1.4 or A2.7) (0-1)	SO1,EC10	1	1	1	1	1	1	1
48			51	56	70	72	73	73	74
49		eds_hard	0,64557	0,708861	0,886076	0,911392	0,924051	0,924051	0,936709
50			13	14	14	14	14	15	15
51		eds_soft	0,8125	0,875	0,875	0,875	0,875	0,9375	0,9375
52			51,8125	56,875	70,875	72,875	73,875	73,9375	74,9375
53		eds_total	0,545395	0,598684	0,746053	0,767105	0,777632	0,778289	0,788816
54		eds_ratio	0,984318	0,984615	0,987654	0,987993	0,988156	0,98732	0,98749

Appendix B: 182 Listed Companies on the ATHEXGROUP - Athens Stock Exchange Group.

a/a	Sector	Name
1.	Computer Services (5)	<ul style="list-style-type: none"> · BYTE COMPUTER S.A. (BYTE) · PERFORMANCE TECHNOLOGIES S.A. (PERF) · PROFILE SYSTEMS & SOFTWARE S.A. (PROF) · QUALITY AND RELIABILITY S.A. (QUAL) · QUEST HOLDINGS S.A. (QUEST)
2.	Software (5)	<ul style="list-style-type: none"> · ENTERSOFT S.A. (ENTER) · EPSILON NET S.A. (EPSIL) · ILYDA S.A. (ILYDA) · LOGISMOS INFORMATION SYSTEMS S.A. (LOGISMOS) · MLS INNOVATION INC. (MLS)
3.	Computer Hardware (3)	<ul style="list-style-type: none"> · ALPHA GRISSIN S.A. (AGRI) · CPI COMPUTER PERIPHERALS INTERNATIONAL (CPI) · IDEAL GROUP S.A. (INTEK)
4.	Telecommunications Equipment (3)	<ul style="list-style-type: none"> · INTRACOM S.A. HOLDINGS (INTRK) · OPTRONICS TECHNOLOGIES S.A. (OPTRON) · SPACE HELLAS S.A. (SPACE)
5.	Telecommunications Services (3)	<ul style="list-style-type: none"> · FORTHNET S.A. (FORTH) · HELLENIC TELECOM. ORG. (HTO) · NEWPHONE HELLAS S.A. AUDIOTEX (NEWS)
6.	Health Care Facilities (3)	<ul style="list-style-type: none"> · AXON S.A. HOLDING (AXON) · EUROMEDICA S.A. (EUROM) · IASO S.A. (IASO)
7.	Health Care Services (2)	<ul style="list-style-type: none"> · ATHENS MEDICAL C.S.A. (IATR) · VIDAVO S.A. (VIDAVO)
8.	Medical Equipment (1)	<ul style="list-style-type: none"> · MEDICON HELLAS S.A. (MEDIC)

9.	Pharmaceuticals (1)	· LAVIPHARM S.A. (LAVI)
10.	Banks (6)	· ALPHA BANK S.A. (ALPHA) · NAT. BANK OF GREECE S.A. (ETE) · EUROBANK ERGASIAS S.A. (EUROB) · ATTICA BANK S.A. (TATT) · BANK OF GREECE (TELL) · PIRAEUS BANK S.A. (TPEIR)
11.	Diversified Financial Services (2)	· CNL CAPITAL E.K.E.S. – AIFM (CNLCAP) · MARFIN INVESTMENT GROUP HOLDINGS S.A. (MIG)
12.	Asset Managers & Custodians (2)	· ALPHA TRUST ANDROMEDA S.A. (ANDRO) · ALPHA TRUST MUTUAL FUND AND ALTERNATIVE INVESTMENT FUND MANAGEMENT S.A. (ATRUST)
13.	Investment Services (2)	· EUROXX SECURITIES S.A. (EX) · HELLENIC EXCHANGES – ATHENS STOCK EXCHANGE S.A. (EXAE)
14.	Full Line Insurance (1)	· EUROPEAN RELIANCE GEN. INSURANCE CO. S.A. (EUPIC)
15.	Insurance Brokers (1)	· EUROBROKERS S.A. (EUBRK)
16.	Real Estate Holding and Development (7)	· ELVIEMEK LAND DEVELOPMENT – LOGISTICS PARKS – ENERGY – RECUCLING S.A. (ELBIO) · REDS S.A. (KAMP) · KEKROPS S.A. (KEKR) · KERAMIA-ALLATINI S.A. REAL ESTATE MANAGEMENT & HOLDING COMPANY (KERAL) · LAMDA DEVELOPMENT S.A. (LAMDA) · PASAL REAL ESTATE DEVELOPMENT S.A. (PASAL) · BABIS VOVOS INTERNATIONAL TECHNICAL S.A. (VOVOS)
17.	Real Estate Services (1)	· ALPHA ASTIKA AKINITA S.A. (ASTAK)
18.	Diversified REITs (2)	· INTERCONTINENTAL INTERNATIONAL REIC (INTERCO) · NBG PANGAEA R.E.I.C. (PANGAEA)
19.	Office REITs (2)	· BRIQ PROPERTIES REIC (PRIQ) · TRASTOR REAL ESTATE INVESTMENT COMPANY (TRASTOR)
20.	Rental & Leasing Services: Consumer (1)	· AUTOHELLAS S.A. (OTOEL)
21.	Home Construction (1)	· TECHNICAL OLYMPIC S.A. (OLYMP)
22.	Household Furnishings (3)	· DROMEAS S.A. OFFICE FURNITURE INDUSTRY (DROME) · SATO OFFICE AND HOUSEWARE SUPPLIES S.A. (SATOK) · VARANGIS AVEPE S.A. (VARG)
23.	Household Appliance (3)	· F.G. EUROPE S.A. (FGE) · G.E. DIMITRIOU S.A. (GED) · YALCO – CONSTANTINO S.A. (YALCO)
24.	Electronic Entertainment (1)	· CENTRIC HOLDINGS S.A. (CENTR)
25.	Toys (1)	· JUMBO S.A. (BELA)
26.	Clothing & Accessories (3)	· DUROS S.A. (DUR) · ELVE S.A. (ELBE) · MINERVA KNITWEAR S.A. (MIN)

27.	Entertainment (1)	· AUDIO VISUAL ENTERPRISES S.A. (AVE)
28.	Publishing (4)	· ATTICA PUBLICATIONS S.A. (ATEK) · LIVANIS S.A. (LIVAN) · NAYTEMPORIKI PUBLISHING S.A. (NAFT) · PEGASUS PUBLISHING S.A. (PEGAS)
29.	Radio & TV Broadcasters (1)	· TELETIPOS S.A. (TELET)
30.	Diversified Retailers (2)	· FOURLIS S.A. (FOURK) · PLAISIO COMPUTERS S.A. (PLAIS)
31.	Apparel Retailers (2)	· LANAKAM S.A. (LANAC) · DIVERSA S.A. (ORAORA)
32.	Home Improvement Retailers (1)	· N. VARVERIS – MODA BAGNO S.A. (MODA)
33.	Specialty Retailers (5)	· AS COMPANY S.A. (ASCO) · FOLLI FOLLIE S.A. (FFGRP) · CARS MOTORCYCLES AND MARINE ENGINE TRADE AND IMPORT COMPANY S.A. (MOTO) · NAKAS MUSIC (NAKAS) · SFAKIANAKIS S.A. (SFA)
34.	Airlines – Aviation (1)	· AEGEAN AIRLINES S.A. (AEGN)
35.	Travel & Tourism (4)	· ANEK LINES S.A. (ANEK) · ATTICA HOLDINGS S.A. (ATTICA) · KIRIACOULIS MEDITERRANEAN CRUISES SHIPPING S.A. (KYRI) · MARITIME COMPANY OF LESVOS S.A. (NEL)
36.	Casinos & Gambling (2)	· INTRALOT S.A. (INLOT) · GREEK ORGANISATION OF FOOTBALL PROGNOSTICS S.A. (OPAP)
37.	Hotels & Motels (2)	· LAMPSA HOTEL CO. (LAMPS) · GEKE S.A. (PRESD)
38.	Distillers & Vintners (2)	· KTIMA KOSTAS LAZARIDIS S.A. (KTIKA) · J. BOUTARIS & SON HOLDINGS S.A. (MPK)
39.	Soft Drinks (1)	· COCA-COLA HBC AG (EEE)
40.	Farming Fishing Ranching & Plantations (5)	· KRE.KA S.A. (KREKA) · NIREUS S.A. (NIR) · PERSEUS S.A. (PERS) · SELONDA AQUACULTURE S.A. (SELO) · THE HOUSE OF AGRICULTURE SPIROY S.A. (SPIR)
41.	Food Products (9)	· KRETA FARM S.A. (CRETA) · EVROFARMA S.A. (EVROF) · CHATZIKRANIOTIS & SONS MILLS S.A. (HKRAN) · FLOUR MILLS KEPENOS S.A. (KEPEN) · KARAMOLENGOS BAKERY INDUSTRY S.A. (KMOL) · KRI-KRI S.A. (KRI) · LOULIS MILLS S.A. (KYLO) · FLOUR MILLS C. SARANTOPOULOS S.A. (KYSA) · P.G. NIKAS S.A. (NIKAS)
42.	Tobacco (1)	· KARELIA TOBACCO COMPANY INC. S.A. (KARE)
43.	Food Retailers & Wholesalers (3)	· ELGEKA S.A. (ELGEK) · STELIOS KANAKIS S.A. (KANAK) · MEDITERRA S.A. (MSHOP)

44.	Personal Products (2)	<ul style="list-style-type: none"> · PAPOUTSANIS S.A. (PAP) · GR. SARANTIS S.A. (SAR)
45.	Construction (10)	<ul style="list-style-type: none"> · AEGEK S.A. (AEGEK) · AVAX S.A. (AVAX) · BIOTER S.A. (BIOT) · DOMIKI KRITIS S.A. (DOMIK) · EKTER S.A. (EKTER) · ELLAKTOR S.A. (ELLAKTOR) · GEK TERNA HOLDING REAL ESTATE CONSTRUCTION S.A. (GEKTERNA) · INTRACOM CONSTRUCTIONS S.A. TECHN & STEEL CONSTR. (INKAT) · PROODEFTIKH TECHNICAL COMPANY S.A. (PRD)
46.	Cement (1)	<ul style="list-style-type: none"> · TITAN CEMENT INTERNATIONAL S.A. (TITC)
47.	Building Materials: Other (3)	<ul style="list-style-type: none"> · AKRITAS S.A. (AKRIT) · BIOKARPET S.A. (BIOKA) · IKTINOS HELLAS S.A. – GREEK MARBLE INDUSTRY
48.	Electrical Components (1)	<ul style="list-style-type: none"> · CENERGY HOLDINGS S.A. (CENER)
49.	Diversified Industrials (3)	<ul style="list-style-type: none"> · N. LEVENTERIS (LEBEK) · MYTILINEOS S.A. (MYTIL) · VIOHALCO SA/NV (VIO)
50.	Plastics (3)	<ul style="list-style-type: none"> · DAIOS PLASTICS S.A. (DAIOS) · CRETE PLASTICS S.A. (PLAKR) · THRACE PLASTICS HOLDING AND COMMERCIAL S.A. (PLAT)
51.	Containers & Packaging (5)	<ul style="list-style-type: none"> · FLEXOPACK S.A. (FLEXO) · KARATZIS S.A. (KARTZ) · E. PAIRIS S.A. (PAIR) · PAPERPACK S.A. (PPAK) · VIS CONTAINER MANUFACTURING CO. (VIS)
52.	Machinery: Industrial (3)	<ul style="list-style-type: none"> · UNIBIOS HOLDINGS S.A. (BIOSK) · DOPPLER S.A. (DOPPLER) · FRIGOGLASS S.A.I.C. (FRIGO)
53.	Machinery: Construction & Handling (1)	<ul style="list-style-type: none"> · ELTRAK S.A. (ELTRK)
54.	Industrial Suppliers (6)	<ul style="list-style-type: none"> · DIONIC AEBE (DION) · ELTON S.A. (ELTON) · GEN. COMMERCIAL & IND. (GEBKA) · INTERTECH S.A. INTER TECHNOLOGIES (INTET) · VOGIATZOGLOU SYSTEMS S.A. (VOSYS) · INTERWOOD – XYLEMPORIA A.T.E.N.E. (XYLEK)
55.	Back Office Support HR & Consulting (2)	<ul style="list-style-type: none"> · EUROCONSULTANTS S.A. (EUROC) · FOODLINK S.A. (FOODL)
56.	Forms & Bulk Printing Services (2)	<ul style="list-style-type: none"> · XAIDEMENOS S.A. (HAIDE) · INFORM P. LYKOS S.A. (LYK)
57.	Commercial Vehicles & Parts (1)	<ul style="list-style-type: none"> · PETROS PETROPOULOS S.A. (PETRO)
58.	Marine Transportation (1)	<ul style="list-style-type: none"> · NEORION HOLDINGS S.A. (NEORS)
59.	Transportation Services (2)	<ul style="list-style-type: none"> · THESSALONIKI PORT AUTHORITY S.A. (OLTH) · PIRAEUS PORT AUTHORITY S.A. (PPA)
60.	Diversified Materials (1)	<ul style="list-style-type: none"> · MATHIOS REFRACTORY S.A. (MATHIO)

61.	Textile Products (6)	<ul style="list-style-type: none"> · WOOL INDUSTRY TRIA ALFA S.A. (AAAK) · SELECTED TEXTILE IND. ASSOC. S.A. (EPIL) · FIERATEX S.A. (FIER) · EL. D. MOUZAKIS S.A. (MOUZK) · NAFPAKTOS TEXTILE INDUSTRY S.A. (NAYP) · VARNARESSOS S.A. (VARNH)
62.	General Mining (1)	<ul style="list-style-type: none"> · MERMEREN KOMBINAT A.D. PRILEP (MERKO)
63.	Iron & Steel (5)	<ul style="list-style-type: none"> · ELASTRON S.A. (ELSTR) · KORDELLOS CH. BROS S.A. (KORDE) · BITROS HOLDING S.A. (MPITR) · PIPE WORKS L. GIRAKIAN PROFIL S.A. (PROFK) · SIDMA S.A. STEEL PRODUCTS (SIDMA)
64.	Metal Fabricating (2)	<ul style="list-style-type: none"> · ELVALHALCOR HELLENIC COPPER AND ALUMINIUM INDUSTRY S.A. (ELHA) · MEVACO S.A. (MEVA)
65.	Aluminium (1)	<ul style="list-style-type: none"> · ALUMIL ALUMINIUM INDUSTRY S.A. (ALMY)
66.	Integrated Oil & Gas (1)	<ul style="list-style-type: none"> · HELLENIC PETROLEUM S.A. (ELPE)
67.	Oil Refining and Marketing (3)	<ul style="list-style-type: none"> · ELINOIL S.A. (ELIN) · MOTOR OIL (HELLAS) CORINTH REFINERIES S.A. (MOH) · REVOIL S.A. (REVOIL)
68.	Alternative Electricity (1)	<ul style="list-style-type: none"> · TERNA ENERGY S.A. (TENERGY)
69.	Conventional Electricity (2)	<ul style="list-style-type: none"> · ADMIE (IPTO) HOLDING S.A. (ADMIE) · PUBLIC POWER CORPORATION S.A. (PPC)
70.	Water (2)	<ul style="list-style-type: none"> · THESSALONIKI WATER AND SEWAGE COMPANY S.A. (EYAPS) · ATHENS WATER SUPPLY & SEWAGE CO. (EYDAP)

(Adapted by / Source: <https://www.helex.gr/web/guest/companies-map/-/cmap/s/-1/2>)

Appendix C: List of 126 Hellenic Companies that publish Corporate Social Responsibility Reports and Sustainability or Sustainable Development Reports at the Global Reporting Initiative (GRI) database.

Hellenic Companies at GRI				
a/a	Name	Size	Sector	Reporting Period
1.	AB Vassilopoulos	Large	Retailers	2008 – 2017
2.	AEGEAN AIRLINES	Large	Aviation	2009 – 2010
3.	Aegean Motorway	Large	Non-Profit/Services	2015 – 2017
4.	ALPHA Bank	Large	Financial Services	2007 – 2017
5.	Apivita	Large	Healthcare Services	2010
6.	ATEbank	Large	Financial Services	2012
7.	Athenian Brewery	SME	Food and Beverage Products	2008 – 2015
8.	Athens International Airport S.A.	Large	Aviation	2004 – 2015
9.	Athens Medical Group	Large	Healthcare Services	2015, 2017
10.	Attica Group	Large	Other	2008 – 2015
11.	Attikes Diadromes	Large	Other	2014 – 2016
12.	Attiki Odos	Large	Construction	2009 – 2017

13.	Bairamoglou	SME	Household and Personal Products	2010 – 2013
14.	Barba Stathis	Large	Food and Beverage Products	0
15.	Bluegr Hotels & Resorts	SME	Tourism/Leisure	2016
16.	BSH IKIAKES SYSKEVES ABE	Large	Household and Personal Products	2010 – 2013
17.	Cactus Hotels	SME	Tourism/Leisure	2016 – 2017
18.	Centre for Sustainability and Excellence	SME	Non-Profit/Services	2011 – 2013
19.	Citibank	MNE	Financial Services	2012, 2014
20.	Club Hotel Casino Loutraki	Large	Tourism/Leisure	2010
21.	Coca-Cola Hellenic Bottling Company	MNE	Food and Beverage Products	2012 – 2016
22.	Coca-Cola Tria Epsilon	Large	Food and Beverage Products	2014
23.	COCO-MAT	Large	Consumer Durables	2012 – 2014
24.	Comergon	SME	Financial Services	2009 – 2013
25.	Corinth Pipeworks	Large	Other	2008 – 2016
26.	Cosmote Mobile Telecommunications S.A.	Large	Telecommunications	2007 – 2014
27.	Creta Maris Beach Resort	SME	Tourism/Leisure	2013 – 2017
28.	Delta Foods	Large	Food and Beverage Products	2016
29.	DEPA S.A.	Large	Energy Utilities	2012, 2014 – 2016
30.	DESFA	Large	Energy	2011 – 2014
31.	Diageo Hellas	Large	Food and Beverage Products	2004, 2007 – 2009
32.	DKG Group	MNE	Commercial Services	2012, 2014 – 2016
33.	ELAIS – UNILEVER HELLAS	MNE	Food and Beverage Products	2010, 2012 – 2014, 2016
34.	Elbisco	Large	Food and Beverage Products	2015 – 2016
35.	ELINOIL	Large	Energy	2012, 2014
36.	ELLAKTOR	Large	Construction	2008 – 2010, 2013 – 2017
37.	Elval	Large	Metals Products	2008 – 2016
38.	Elvalhacor S.A.	Large	Metals Products	0
39.	Emporiki Bank	Large	Financial Services	2008 – 2011
40.	ETHNIKI INSURANCE COMPANY	Large	Financial Services	2018
41.	Eurobank	MNE	Financial Services	2010 – 2018
42.	European Reliance	Large	Financial Services	2011 – 2017
43.	EYDAP	Large	Water Utilities	0
44.	Fourlis Group of Companies	MNE	Conglomerates	2010 – 2015, 2018
45.	FrieslandCampina Hellas	Large	Food and Beverage Products	2010
46.	Frigoglass	MNE	Food and Beverage Products	2007 – 2009, 2011 – 2012, 2016 – 2018
47.	GEFYRA	SME	Construction	2008 – 2012
48.	GEK TERNA	MNE	Construction	2013 – 2017
49.	GEP	SME	Other	2017
50.	Global Sustain	SME	Commercial Services	2012 – 2017
51.	GOLDAIR HANDLING	Large	Aviation	2016 – 2017
52.	GRANT THORNTON GREECE	MNE	Financial Services	2013 – 2014
53.	GRIVALIA PROPERTIES REIC	SME	Real Estate	2017
54.	Halcor (ElvalHalcor)	Large	Metals Products	2008 – 2017
55.	Hatzopoulos	SME	Consumer Durables	2013, 2015 – 2016

56.	Hellas Gold	Large	Mining	2013 – 2017
57.	Hellenic Bank	Large	Energy	2007, 2011 – 2013
58.	Hellenic Cables	MNE	Construction Materials	2009 – 2017
59.	Hellenic Petroleum	Large	Energy	2008 – 2016
60.	Hellenic Public Real Estate Corporation (HPREC)	SME	Public Agency	2007 – 2009
61.	Hellenic Telecommunications Organizations S.A. (OTE)	Large	Telecommunications	2006 – 2017
62.	Heracles General Cement	MNE	Construction Materials	2008 – 2016
63.	Hygeia Group	MNE	Healthcare Services	2010, 2012 – 2016
64.	ICAP GROUP	Large	Other	2017
65.	INTERAMERICAN	Large	Other	2008 – 2015
66.	Interlife	SME	Financial Services	2011 – 2017
67.	INTRALOT	MNE	Tourism/Leisure	2012 – 2013, 2015 – 2017
68.	INTRASOFT International	MNE	Computers	2017
69.	JetOil	SME	Energy	2008 – 2013
70.	J&P-AVAX S.A.	Large	Construction	2016 – 2017
71.	Kentriki Odos	Large	Construction	2015
72.	KLEEMANN	Large	Metals Products	0
73.	LAMPSPA HELLENIC HOTELS S.A.	Large	Tourism/Leisure	2016
74.	LIDL HELLAS	Large	Retailers	0
75.	Loulis Mills S.A.	Large	Agriculture	2014 – 2016
76.	Marinopoulos	Large	Retailers	2009 – 2014
77.	McCain Greece	Large	Food and Beverage Products	2007 – 2008
78.	MELISSA KIKIZAS	Large	Food and Beverage Products	2016
79.	Mellon Group of Companies	MNE	Conglomerates	2010 – 2011, 2013 – 2016, 2018
80.	Mercedes-Benz Hellas	SME	Automotive	2013 – 2016
81.	MetLife Alico	SME	Other	2013
82.	METRO S.A.	Large	Retailers	2011 – 2012
83.	MINETTA	Large	Financial Services	2016
84.	MIO-ECSDE	SME	Non-Profit/Services	2012
85.	Motor Oil Hellas	MNE	Energy	2002 – 2016
86.	MSD	Large	Healthcare Products	2015 – 2016
87.	Municipality of Agios Dimitrios	SME	Public Agency	2016
88.	MYTILINEOS S.A.	Large	Conglomerates	2007 – 2018
89.	National Bank of Greece	MNE	Financial Services	2007 – 2015
90.	Nea Odos S.A.	SME	Other	2014 – 2015
91.	Neptune Lines	Large	Logistics	2013 – 2015
92.	Nestle Hellas	SME	Food and Beverage Products	2011
93.	Nexans Hellas	SME	Other	2010 – 2014
94.	Nireus	MNE	Food and Beverage Products	2010 – 2016
95.	Novartis Hellas	Large	Healthcare Products	2010, 2013 – 2015
96.	OPAP	Large	Tourism/Leisure	2006 – 2017
97.	PAEGAE	SME	Logistics	2015 – 2016
98.	Papadopoulos Biscuits	Large	Food and Beverage Products	2013
99.	Pfizer Hellas	Large	Healthcare	2015 – 2016
100.	Piraeus Bank	MNE	Financial Services	2008 – 2016
101.	Piraeus Port Authority	Large	Tourism/Leisure	2012 – 2013, 2018
102.	Piscines Ideales	Large	Other	2009 – 2012
103.	Plaisio	Large	Retailers	0

104.	PressiousArvanitidis	SME	Other	2017
105.	PricewaterhouseCoopers (PwC) Greece	Large	Commercial Services	2017
106.	PUBLIC	Large	Retailers	2016
107.	PUBLIC POWER CORPORATION (PPC)	Large	Energy Utilities	2010 – 2016
108.	Quest Holdings	SME	Other	2014 – 2016
109.	Regency Entertainment	Large	Other	2009 – 2010
110.	Sani Resort	Large	Tourism/Leisure	2014 – 2017
111.	SARANTIS	Large	Household and Personal Products	2016 – 2017
112.	S&B Industrial Minerals	Large	Mining	2005 – 2013
113.	SELONDA	Large	Other	2017
114.	Solar Cells Hellas Group S.A.	SME	Other	2010 – 2011
115.	Soltech	SME	Energy	2010
116.	Sprint Advertising	SME	Media	2012
117.	SUNLIGHT	Large	Energy Utilities	2016
118.	Synergy S.A.	SME	Logistics	2017
119.	TEMES S.A.	Large	Tourism/Leisure	2015
120.	TERNA ENERGY	SME	Energy	2015 – 2017
121.	The Smile of the Child	SME	Non-Profit/Services	2012
122.	Thrace Group	MNE	Other	2016
123.	TITAN CEMENT	Large	Construction Materials	2003 – 2017
124.	Tsakiris	SME	Food and Beverage Products	2014
125.	Vodafone Greece	Large	Telecommunications	2002 – 2016
126.	Wind Hellas Telecommunication	Large	Telecommunications	2008 – 2016

(Adapted by / Source: <https://database.globalreporting.org/search/>)

Appendix D: Histograms and descriptive statistics of all key variables (dependent and independent)

