



**UNIVERSITÀ
DEGLI STUDI
DI PADOVA**

**PhD in ECONOMICS AND MANAGEMENT
MANAGEMENT CURRICULUM XXXII CYCLE
Department of Economics and Management
University of Padova**

Essays on European Sustainability Reporting, Sustainability Assurance and Analyst Forecast Accuracy

Head of the Ph.D. Program: Prof. Antonio Nicolò

Supervisor: Prof. Federica Ricceri

Co-Supervisor: Prof. Giovanna Michelin

Ph.D. Candidate: Berto Usman

Table of Contents

GENERAL INTRODUCTION.....	4
CHAPTER I.....	9
Sustainability Assurance and Sustainability Disclosure Quality: An Empirical Investigation of Environmentally Sensitive Industries.....	9
Abstract.....	9
1. INTRODUCTION	9
2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT	16
2.1. Theoretical Framework	16
2.2. Hypotheses Development.....	19
2.2.1. Sustainability Assurance and Environmental Disclosure Quality.....	19
2.2.2. Assurance Provider and Environmental Disclosure Quality	21
2.2.3. The Level of Assurance and Environmental Disclosure Quality	24
2.2.4. Commitment to Assurance and Environmental Disclosure Quality	26
3. RESEARCH METHOD	29
3.1. Data and Sample.....	29
3.2. Content Analysis	32
3.2.1. Coding procedures	34
3.3. Regression Model.....	39
3.4. Variable Definitions	41
3.5. Consideration of Potential Sample Bias.....	43
4. RESULTS	46
4.1. Univariate Analysis	46
4.2. Multivariate Analysis	55
4.3. Discussion	60
5. ROBUSTNESS TESTS	63
5.1. Heckman Two-Stage Regression	63
5.2. Propensity Score Matching.....	65
6. CONCLUDING REMARKS.....	69
7. REFERENCES	70
CHAPTER II.....	77
Sustainability Disclosure Quality, Sustainability Assurance and Analyst Forecast Accuracy: Empirical Investigation of European Environmentally Sensitive Industries.....	77
Abstract.....	77
1. INTRODUCTION	77
2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT	82
2.1. Theoretical Framework	82
2.2. Hypotheses Development.....	85
2.2.1. Environmental Disclosure Quality and Analyst Forecasts Accuracy.....	85
2.2.2. Sustainability Assurance and Analyst Forecast Accuracy	87

2.2.3. Environmental Disclosure Quality	90
3. RESEARCH METHOD	90
3.1. Data and Sample.....	90
3.1.1. Sample Distribution	92
3.2. Content Analysis and Multidimensional Measure of Environmental Disclosure Quality.....	93
3.3. Analyst Forecast Accuracy.....	94
3.4. Sustainability Assurance	94
3.5. Variable Definitions	95
3.6. Regression Model.....	96
3.7. Control Variables	98
4. RESULTS	100
4.1. Univariate Analysis	100
4.2. Multivariate Analysis	107
4.3. Discussion	110
5. ROBUSTNESS TESTS	114
5.1. Regression Results using Unidimensional Indices.....	114
5.2. Regression Results using SDQUANTITY	119
5.3. Analyst Earnings Forecast Dispersion and Environmental Disclosure Quality (Unidimensional & Multidimensional Indices Tests)	121
5.4. Analyst Earnings Forecast Dispersion and Alternative Measures of Sustainability Assurance	123
6. CONCLUDING REMARKS.....	127
7. REFERENCES	127
GENERAL CONCLUSIONS.....	134
Appendix 1 (Chapter 1).....	137
Appendix 2 (Chapter 1).....	138
Appendix 3 (Chapter 1).....	139

Acknowledgment

During my Ph.D. study, I learnt a lot of things, which made my Ph.D. journey a truly life-changing experience. This Ph.D. journey would not be possible to be completed without the support and guidance I received from many people.

First, I would like to express my sincere gratitude to my supervisors, Prof. Federica Ricceri and Prof. Giovanna Michelin, whose constant support, guidance, and encouragement made my Ph.D. thesis work possible. I spent undertaking my research and data collection in Padova – Italy and Exeter – United Kingdom. Without their guidance and constant feedback, my Ph.D. thesis would not have been achievable. I am extremely indebted to them for the supervision and challenges to always train me and look at my works from different perspectives.

I gratefully acknowledge the funding I received towards my Ph.D. study from the 32nd cycle Ph.D. scholarship program from the Italian government through the Department of Science Economics and Management, University of Padova. I am also very grateful to all those at the DSEA UNIPD Ph.D. office, especially Prof. Antonio Nicolo and Prof. Amedeo Pugliese. Also, my sincere thank you for Prof. Michele Fabrizi, Prof. Andrea Menini, and others who were always so helpful and provided me with their assistance throughout my works.

My gratitude also goes to Chaoyuan She for his support during my data collection in Exeter and for his views in helping me enriching my ideas. Moreover, I greatly appreciate the support I received from my 32nd cycle Ph.D. fellows, Trang, Naeem, Claudia, Elona, Jose, Lotte, Luca, Yuting, Davide, Guadalupe, and Giovanni Zampone for their warm friendship and mental support during the Ph.D. journey.

I would also like to extend my deep appreciation to my seniors, Dr. Sara, Dr. Fabrizio, Dr. Martin, Dr. Sonal, Dr. Leo, Dr. Xing, my 33rd, and 34th cycle of Ph.D. fellows; Enrico, Simone, Anush, Gegham, Erin, David, and Iqbal. They have made an invaluable contribution towards my Ph.D. I am also grateful to them – for their friendship and the warmth they extended to me during my time in Padova and for always making me feel so welcome.

Last but not least, I am indebted to all my friends and family in Padova and Exeter, who opened their homes to me during my time at UNIPD and UNI EXETER, who were always so helpful in numerous ways. Special thanks to my wife Reren, my little daughter “Aqila”. I would also like to mention a heartfelt thank you to my Mother, Father, Albert, Rian, and Nisa for always believing in me and encouraging me to follow my dreams, my big family, and my office mate at the Department of Management, University of Bengkulu – Indonesia who remembered me in their prayers for ultimate success. I completely acknowledge that they gave me huge moral supports, encouragement, and motivation to accomplish my Ph.D.

GENERAL INTRODUCTION

Sustainability reporting is a process through which companies or organisations are able to communicate the economic, environmental, social, and governance impacts caused by their everyday activities to stakeholders. This reporting is meant to increase the companies' transparency and accountability, which is required to allow stakeholders to better assess and evaluate potential risks and opportunities with respect to economic, environmental, social, and governance impacts. KPMG's 2017 survey on corporate responsibility reporting showed that over the last three decades, the growth in the number of companies publishing corporate responsibility reports (i.e., sustainability reports) has grown significantly. The survey particularly recorded growth in reporting for Global 250 companies (G250) of 93%, while that for N100 companies in the 49 surveyed countries was 75%. These numbers are likely to increase as the disclosure of non-financial information has been mandatory (e.g., in American and European countries) and are going to be mandatory in more countries (Hoffmann, Dietsche, & Hobelsberger, 2018).

The European directive 2014/95/EU is one of many aspects comprising the institutional background against which mandatory non-financial disclosure has been enacted in European countries. This directive requires publicly listed companies operating in Europe to disclose their non-financial and diversity information to the public. As mentioned above, environmental information is one type of non-financial information of which disclosure is deemed important as it is related to environmental sustainability concerns and, thus, to the (environmental) risks associated with companies' use of resources and the impacts of their operations. These are particularly relevant issues for those companies operating in the so-called "environmentally sensitive industries" (ESIs). For instance, problems related to the exploitation and misuse of water, soil, vegetation, fauna, air, and landscape could precipitate issues such as natural resource exhaustion, lethal effects on fauna, damage to aquatic life, loss of valuable

ecosystems, and, worst of all, possible detrimental impacts on human health (Claver, Lopez, Molina, & Tari, 2007). Through environmental disclosure, stakeholders are made aware of the potentially negative impacts and risks resulting from companies' use of resources and other activities.

From a theoretical standpoint, CSR (and thus environmental) reporting can be viewed through the lens of different perspectives (theories). Three theories take precedence above the rest: legitimacy, agency, and signalling theories. Legitimacy theory outlines how environmental information disclosure can be utilised by a manager to legitimise corporate activities, manage stakeholder perceptions, and prevent negative stakeholder reactions (Deegan, 2002; Milne & Patten, 2002; Holm & Rikhardsson, 2008). Agency theory, argues for viewing management (the agent) as a composition of self-interested individual who behave opportunistically, favouring their own interests over those they represent, even if these actions are detrimental to the owner (principal) (Trotman & Trotman, 2015). Thus, agency theory asserts that companies' published information could be used as a mechanism for supervising agent actions (Jensen & Meckling, 1976). Through the enforcement of regulations and governance mechanisms, the condition of asymmetric information could be mitigated. Moreover, signalling theory emphasises that companies possess private information about the costs of engaging in their selected environmentally responsible activities. Therefore, the decision to disclose this information could be an effort to signal their activities and to convey to the public that they bring a high level of commitment and superior environmental strategies to markets (Hasseldine, Salama, & Toms, 2005; Tang, Lai, & Cheng, 2012; Cho, Michelon, Patten, & Roberts, 2014; Bagnoli & Watts, 2017).

Even though the propensity for companies to engage in disclosing environmental information is increasing, sustainability (i.e., environmental) disclosure faces many criticisms. These include lack of credibility (Merkl-Davies & Brennan, 2007), lack of completeness

(Adams & Evans, 2004), disclosure of irrelevant (immaterial) information (Khan, Serafeim, & Yoon, 2016), impression management (Cho, Michelon, & Patten, 2012), camouflaging (Michelon, Pilonato, Ricceri, & Roberts, 2016), and so forth. Moreover, most of the information provided in sustainability reports is deemed biased (Deegan & Rankin, 1997), complex (Gu & Wan, 2005), and hard to understand (Fabrizio & Kim, 2019) due to an overload of irrelevant information provided (e.g., boilerplate sentences) (Michelon et al., 2015). To tackle these issues, recent studies have suggested the external verification (assurance) of sustainability reporting by independent third parties (e.g., professional accountants, consultants) (Adams & Evans, 2004; Mercer, 2004; Moroney et al., 2011). The implementation of assurance is expected to increase the credibility, reliability, and value of the reported information to allow report users to employ it as a value-relevant source of non-financial information. However, the purchase of assurance services from an independent third party has also been met with criticism. Prior studies have documented criticisms of assurance engagement, including its susceptibility to managerial capture, non-engagement with stakeholders (Adams & Evans, 2004), lack of regulation (O'Dwyer & Owen, 2005; Deegan et al., 2006), and, to some extent, suspicion of the lack of independence and the potential untrustworthiness of assurance providers (O'Dwyer & Owen, 2005; Wong & Millington, 2014), which remain open empirical questions to be investigated.

Given the aforementioned existing literature, the aim of this thesis is twofold: first, to understand the role of assurance in driving the quality of environmental disclosure, and second, to investigate whether assurance and the quality of environmental disclosure improve the information environment, especially for a particular type of stakeholder (i.e., financial analysts). To the best of our knowledge, no study specifically investigates the relationship between the quality of disclosed environmental information and its relevance for financial analysts. We, therefore, study whether environmental information disclosure is value-relevant

for financial analysts in improving their earnings forecasts. Also, we consider the importance of sustainability assurance in moderating the relationship between the quality of environmental information disclosure and analysts' forecast accuracy. To further close this research gap, we have structured this Ph.D. thesis using two different chapters. Each chapter has a key objective which is developed throughout a systematic literature review. Each of these chapters is also designed to address the issue of environmental reporting from different perspectives, where the empirical study of Chapter 1 will be the baseline idea for developing the research idea elaborated in Chapter 2.

In Chapter 1, we extend the work of Moroney, Windsor, and Aw (2011) and Michelon, Pilonato, and Ricceri (2015) by examining whether sustainability assurance is positively associated with environmental disclosure quality. We consider several sustainability assurance attributes, such as the type of assurance provider (accountant versus consultant), the level of assurance engagement (limited, reasonable, mixed), and commitment to assurance (assurance persistence and assurance age). We then further assess the environmental disclosure quality of corporate narrative media such as stand-alone reports or environmental-related information in annual reports. As the sample in this chapter, we consider the European publicly listed companies operating in environmentally sensitive industries (ESIs). While Chapter 1 examines the relationship between sustainability assurance and environmental disclosure quality, Chapter 2 complements this work by further investigating whether the reported environmental information is presumed to be value-relevant for financial analysts. We then consider if sustainability assurance plays a moderating role in strengthening the value-relevance of environmental disclosure quality for analyst forecast accuracy.

Regarding the findings, on the one hand, Chapter 1 shows that sustainability assurance has a significant positive association with sustainability (i.e., environmental) disclosure quality. This result suggests that the presence of sustainability assurance can be deemed not only

capable of improving disclosure quality but also of maintaining the credibility of the reported environmental information. On the other hand, Chapter 2 reports that environmental disclosure quality is positively associated with analyst forecast accuracy, suggesting support for the premise that dealing with environmental information disclosure is not a cost-concern activity but rather facilitates better mitigation by the company of the information gap vis-à-vis financial analysts. Reconsidering the role of sustainability assurance, Chapter 2 also confirms that the positive association between environmental disclosure quality and analyst forecast accuracy is stronger among companies with an assurance statement. The results obtained indicate that having assurance is a positive signal to the public that the company brings a superior social and environmental strategy to markets. This also helps to increase the confidence of financial analysts in the credibility of the reported information.

Finally, this Ph.D. thesis makes several contributions. First, it contributes to the literature by providing a new alternative measure of disclosure indices through the consideration of the materiality aspect of a particular type of stakeholder (i.e., financial analysts). Second, it contributes to the debate on the role of sustainability assurance in influencing sustainability disclosure quality. In particular, this thesis explores how sustainability assurance improves sustainability disclosure quality in terms of environmental-related information disclosure. Third, when calls are made to encourage firm to disclose sustainability-related information, our study provides empirical evidence that the commitment to assurance should be corroborated as a way of improving disclosure quality. Fourth, this thesis provides thorough evidence on the value-relevance of environmental disclosure quality for analyst forecast accuracy and the moderating role of sustainability assurance.

CHAPTER I

Sustainability Assurance and Sustainability Disclosure Quality: An Empirical Investigation of Environmentally Sensitive Industries

Abstract

This study examines the relationship between sustainability assurance and sustainability (i.e., environmental) disclosure quality in the context of European environmentally sensitive industries (ESIs). The investigation of how sustainability assurance affects sustainability disclosure has attracted interest among accounting scholars, but prior studies have resulted in inconclusive results. Our study offers an element of originality in focusing on the quality of the information reported and a novel measure that considers the materiality of information from the perspective of financial analysts. Utilising data from 226 public listed companies operating in 24 European countries from 2014 to 2017, we test the characteristics of the practice of sustainability assurance on sustainability disclosure quality. Our findings show that the presence of sustainability assurance, whether provided by accounting or consulting firms, is positively and significantly associated with sustainability disclosure quality. The level of assurance engagement seems to matter only when that level is limited: we do not document any association between disclosure quality and reasonable and mixed levels of assurance engagement. The commitment to assurance (assurance persistency and assurance age) is positively associated with disclosure quality. Taken together, our findings suggest that sustainability assurance enables firms to provide their sustainability information disclosure to the public more effectively.

Keywords: sustainability disclosure, assurance, environmentally sensitive industries

1. INTRODUCTION

Sustainability reporting is now becoming a standard business practice worldwide and is firmly established as a global trend (GRI, 2014; Junior, Best, & Cotter, 2014; KPMG, 2017). As documented by KPMG in 2017, from 1997 to 2017, the percentage of companies engaged in global sustainability reporting was 93% for G250 companies and 75% for N100 companies in 49 surveyed countries. In Europe, the directive 2014/95/EU required large size companies (with more than 500 employees) and those of significant public interest to mandatorily disclose their non-financial and diversity information to the public (European Commission, 2014; Schneider, Michelon, & Paananen, 2018). Non-financial information is commonly disclosed through a stand-alone sustainability report (e.g., CSR reports, sustainability reports, integrated

reports, triple bottom line reports, environmental reports, ESG reports, citizenship reports) or in a dedicated section in the annual report (e.g., registrant report, integrated financial report, consolidated annual report) (Deegan, Cooper, & Shelly, 2006; Simnett, Vanstraelen, & Chua, 2009; Simnett, 2012; Michelon, Pilonato, & Ricceri, 2015; Bagnoli & Watts, 2017; Briem & Wald, 2018). These reports are deemed to be one of the ways to increase firms' transparency and accountability, which are required to render the disclosed information useful and credible to markets and society (Mercer, 2004; GRI, 2014; Junior et al., 2014). Sustainability reporting is implemented as a process that can assist organisations in setting up their goals, particularly by measuring each organisation's economic, environmental, social, and governance performance, reflecting positive and negative impacts, and allowing the management of changes to assure a long-term sustainable global economy (GRI, 2014; O'Dwyer, 2011).

Given the widespread and massive growth of sustainability reporting in recent decades, this practice has also become an important phenomenon in academia, where it is considered a critical field (Cheng, Ioannou, & Serafeim, 2014; Junior et al., 2014; Michelon et al., 2015). Firms may use sustainability (environmental) information to differentiate their performance from that of other firms. For example, firms with good environmental-related engagement could provide more credible information disclosure than firms with low environmental engagement; such disclosure could be unique and not easily replicated by other competitors (Connelly, Certo, Ireland, & Reutzel, 2011; Braam, Weerd, Hauck, & Huijbregts, 2016). However, previous studies have pointed out that there are several issues which suggest sustainability reports are far from being always credible (Merkl-Davies & Brennan, 2007) due to the lack of completeness of the reported information (Adams & Evans, 2004), disclosure of immaterial information (Khan, Serafeim, & Yoon, 2016), reputation risk management (Bebbington, Larrinaga, & Moneva, 2008), impression management (Cho, Michelon, & Patten, 2012), greenwashing and CSR-washing (Mahoney, Thorne, Cecil, & LaGore, 2013; Pope &

Wæraas, 2016), camouflaging (Michelon, Pilonato, Ricceri, & Roberts, 2016), and the symbolical use of CSR reports (Rodrigue, Magnan, & Cho, 2013; Michelin et al., 2015). Therefore, firms may not properly engage in providing a factual and substantial source of sustainable-related information to their investors and stakeholders, instead simply essentially completing a formal box-ticking task in their reporting practice (Schneider et al., 2018).

Recent studies have suggested that sustainability assurance (SA) could overcome and reduce these problems (Adams & Evans, 2004; Mercer, 2004). Although SA¹ is expected to tackle and overcome the criticisms of sustainability reporting, it, in turn, has also been criticised as prone to managerial capture (Owen, Swift, Humphrey, & Bowerman, 2000; Manurung & Basuki, 2010), lacking regulation (O'Dwyer & Owen, 2005; Deegan et al., 2006; Junior, Best, & Cotter, 2014), not engaging stakeholders (Adams & Evans, 2004), as well as characterised by a lack of independence and the untrustworthiness of assurance providers (O'Dwyer & Owen, 2005; Wong & Millington, 2014). Consequently, the criticisms of the influence of sustainability assurance on sustainability reporting provide interesting and relevant debate, and the question as to whether sustainability assurance can enhance the credibility, reliability, validity (Adams & Evans, 2004; Mercer, 2004; Kolk & Perego, 2010), and quality of reported non-financial information (Moroney, Windsor, & Aw, 2011; Michelin et al., 2015) is still an open question.

Inspired by the burgeoning literature and interest in sustainability reporting studies among accounting scholars, our study aims to investigate the implications of sustainability assurance (SA) for the quality of sustainability disclosure, with a specific focus on environmental information. Most of the efforts in studying assurance practices have heretofore

¹ SA is the external verification on the reported non-financial information regarding the environmental, social, and governance impact. The process of assurance is independently carried out by an independent-third party (e.g., accountant or consultant) by following certain assurance standard (i.e., AA1000AS, ISAE3000). Given the management discretion and the voluntary nature of assurance practice, manager may decide to have their CSR or sustainability reports entirely assured, or partially assured.

been focused on assurance statement quality (O'Dwyer & Owen, 2005; Deegan et al., 2006; Manurung & Basuki, 2010) rather than on the role that SA plays in affecting the quality of sustainability disclosure. Some studies have looked into how SA affects the amount of sustainability disclosure but have not dealt much with the quality of information (Beretta & Bozzolan, 2008), with Moroney et al. (2011) and Michelon et al. (2015) as notable exceptions.

In this paper, we conceptualise SA in terms of several attributes (the presence of assurance statements, types of assurance providers, level of assurance, and commitment to assurance) and investigate how they relate to environmental disclosure quality. To the best of our knowledge, no prior study has investigated the relationship between the level of assurance, commitment to assurance, and sustainability (environmental) disclosure quality. Instead, several studies have focused on factors that drive the demand for SA (Mock, Strohm, & Swartz, 2007; Kolk & Perego, 2010; Ruhnke & Gabriel, 2013; Cho, Michelon, Patten, & Roberts, 2014; Gillet-Monjarret, 2015; Briem & Wald, 2018), assurance as a legitimacy tool (O'Dwyer, Owen, & Unerman, 2011; Michelon, Patten, & Romi, 2018), evolutionary trends in external assurance (Perego & Kolk, 2012; Cohen & Simnett, 2015; Briem & Wald, 2018), the role played by SA in the perceived quality, credibility, and reliability of the sustainability reporting (Simnett, Vanstraelen, & Chua, 2009; Pflugrath, Roebuck, & Simnett, 2011; Braam et al., 2016; Briem & Wald, 2018), types of assurance providers (Deegan et al., 2005; 2006; Mock, Strohm, & Swartz, 2007; Perego, 2009; Junior et al., 2014; Wong & Millington, 2014), and the role of accountants in the assurance market (Mock et al., 2007; Huggins, Green, & Simnett, 2011; O'dwyer, 2011; Sierra, Zorio, & García-Benau, 2013; Briem & Wald, 2018).

More in particular, our study is developed in the spirit of expanding on the previous work of Moroney et al. (2011) and Michelon et al. (2015). Their studies developed voluntary environmental disclosure (VED) and CSR disclosure indices which focus on the aspect of quantity and quality of information. However, their studies have not drawn an important issue

related to the materiality of information. Thus, our study specifically captures the materiality of information as seen from the financial analyst perspective and use it as one of the unidimensional aspects of attributes in measuring the disclosure quality. In doing so, we utilise the key performance indicators (KPIs) as released by European Federation of Financial Analyst Society (EFFAS) and further carry out content analysis using KPIs based on the published sustainability reports. The obtained content analysis output is expected to represent the number of material information as required by the financial analyst, which is considered as one of the aspect of disclosure quality component in our analysis. Overall, our study introduces and proposes a variation of environmental disclosure quality as a function of sustainability assurance, the type of assurance provider, the level of assurance, and commitment to assurance. We hypothesise that after the decision to implement SA on a sustainability report, the choice of assurance provider may influence the degree of information provided by firms (Gürtürk & Hahn, 2016). In particular, we investigate whether the choice of having SA provided by accounting or consultancy firms is positively associated with environmental disclosure quality.

In addition, because the implementation of assessment criteria depends on the level of assurance engagement, we expect a higher level of assurance to be associated with higher environmental disclosure quality. However, prior studies seem to be more concentrated on investigating the general content related to assurance statement quality (Perego, 2009; Manurung & Basuki, 2010; Perego & Kolk, 2012) than studying the relationship between the level of assurance and sustainability disclosure quality. Take, for instance, the evidence from the UK provided by O'Dwyer and Owen (2005), who reported that accounting firms tend to provide limited assurance (moderate level) to their clients, whilst environmental consultants provide reasonable assurance (high level). These findings were arrived at by conducting content analysis on the recommended minimum content of assurance statements rather than considering the effects on the quality of disclosures.

Taking into account the possible benefits of assurance engagement, we argue that the commitment to assurance appears to be another significant way to improve environmental disclosure quality and increase users' confidence in the reported information. In this context, we define commitment to assurance as when a company is willing to engage persistently in the practice of assurance over time. As previously documented by several studies, the practice of sustainability reporting and its assurance are, as yet, immature (Michelon et al., 2018). Thus, engaging in the practice of assurance over a longer time (persistent) may allow companies to experience a learning curve in the processes of their internal reporting systems that enhances their readiness to face assurance processes (O'Dwyer, 2011). Specifically, a particular type of stakeholder (i.e., financial analysts) requires reliable and accurate sustainability disclosure to increase forecast accuracy, and this can be facilitated through a complementary assurance statement (Hirst, Koonce, & Miller, 1999; Mercer, 2004). As a result, some studies have reported a consequent increase in the number of financial analysts, leading to a higher level of analyst coverage, fewer forecast errors, and lower capital costs (Dhaliwal, Li, Tsang, & Yang, 2011; Dhaliwal, Radhakrishnan, Tsang, & Yang, 2012; Dhaliwal, Li, Tsang, & Yang, 2014). In line with these findings, there would seem to be a definite need for a persistent commitment to assurance engagement as it may affect environmental disclosure quality.

Utilising a European dataset (226 public listed companies from 2014 to 2017, selected based on the environmentally sensitive industry memberships), our findings indicate that sustainability assurance is positively associated with environmental disclosure quality. Positive associations are found in the following relationships: type of assurance provider-environmental disclosure quality; level of assurance-environmental disclosure quality; and commitment to assurance-environmental disclosure quality. The empirical results obtained suggest that the presence of assurance may be deemed useful, particularly to assure that the environmental information provided is credible. We infer that the utilisation of assurance is an important

practice to enhance environmental disclosure quality that may lead to the increased value of reports for their audience. Additionally, we find that assurance providers from the accounting and consultant professions show a significant association with environmental disclosure quality. However, with regard to the level of assurance, only a limited level of assurance reflects a positive association with environmental disclosure quality, while reasonable and mixed levels of assurance engagement do not indicate any association with environmental disclosure quality. We argue that this insignificant association is mainly driven by the relatively small number of observations of companies engaging in reasonable and mixed levels of assurance in our dataset. To further confirm the obtained result, we combined the data of mixed and reasonable levels of assurance as a single variable. However, the result shows no difference from the main analysis. We also point out the importance of commitment to assurance. The empirical evidence shows that assurance persistence and assurance age as proxies of commitment to assurance are positively associated with environmental disclosure quality. This positive association suggests that companies with a persistent commitment to assurance engagement are more likely to experience greater improvement in their internal system reporting. This allows companies to better provide reports with more informative and useful information to markets. We believe that our study contributes to the debate on the role and implications of sustainability assurance regarding sustainability (environmental) disclosure quality, providing an extension of the prior studies conducted by Moroney et al. (2011) and Michelon et al. (2015).

The contributions of this paper are threefold. First, we expand the study of Moroney et al. (2011) and Michelon et al. (2015) by providing a new alternative measure of disclosure indices through the consideration of the materiality aspect from the perspective of capital market participants (i.e., financial analysts). Second, we contribute to the debate on the role played by SA in sustainability disclosure quality. Our study explores how sustainability

assurance dimensions improve disclosure quality in terms of environmental-related information. Third, there is no prior evidence of quality improvement as a result of commitment to engage in the practice of assurance. Thus, when calls are made to encourage companies to disclose environmental information, the commitment to persistent assurance engagement should be corroborated as a way of improving environmental disclosure quality.

The remainder of this paper is structured as follows: Section 2 highlights the literature review by explaining the major theoretical foundations of the current trend of sustainability assurance and sustainability reporting. Section 3 presents the method of data collection. Section 4 reports and discusses the findings, and Section 5 concludes with the implications of this study.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1. Theoretical Framework

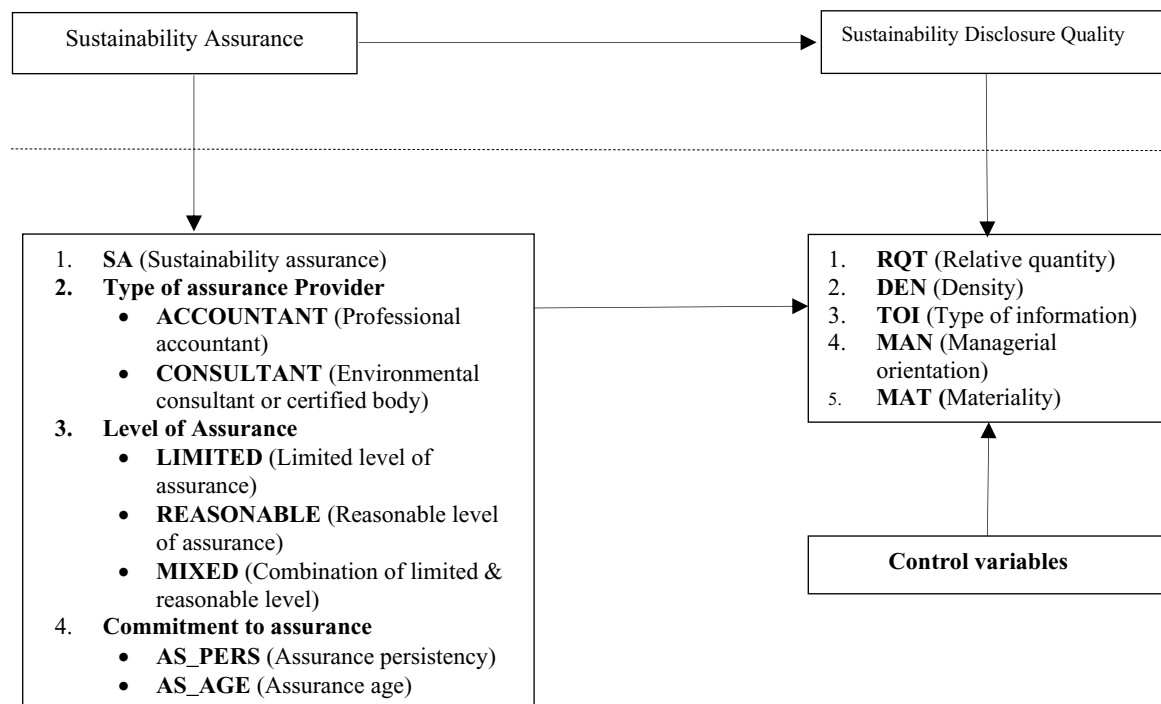
Prior studies in disclosure quality point out that companies' motivation to engage in environmental disclosure is linked to business legitimacy and benefits for society (Cormier, Magnan, & Van Velthoven, 2005; Aerts, Cormier, & Magnan, 2008; Holm & Rikhardsson, 2008). Different theories have been used in explaining voluntary environmental disclosure. One of the most adopted is legitimacy theory, which explains how environmental disclosure can be utilised by a manager to legitimise corporate actions, manage stakeholder perceptions, and prevent negative stakeholder reaction (Patten, 1992; Milne & Patten, 2002; Holm & Rikhardsson, 2008). Meanwhile, from the broader perspective of stakeholder theory, environmental disclosure is linked to an attempt to manage and influence stakeholders' relationships with investors and customers (Aerts et al., 2008; Clarkson, Li, Richardson, & Vasvari, 2008; Holm & Rikhardsson, 2008; Cormier & Magnan, 2015). Corporate marketing and communication theory introduces environmental disclosure as a medium to convey aspects of corporate image and reputation to affect public beliefs (Brammer & Pavelin, 2006; Holm &

Rikhardsson, 2008; Gillet-Monjarret, 2015). Agency theory holds that environmental disclosure attempts to reduce the informational gap between the report preparer and users (Bagnoli & Watts, 2017). Finally, signalling theory states that companies possess private information about their costs related to engaging in environmentally responsible activities. Moreover, they simultaneously choose the level of environmentally responsible activities they wish to engage in. Thus, environmental disclosure is presumably one of many venues where corporations signal their responsible activities to public (Hasseldine et al., 2005; Tang et al., 2012; Bagnoli & Watts, 2017). Notwithstanding how theory predicts that companies will engage in environmental disclosure, we know relatively little about the role of assurance in affecting the credibility, reliability, and effectiveness of environmental disclosure.

Following the previous literatures, we conjecture that agency theory and signalling theory may appropriately explain the potential motive and reason behind companies' decision to engage in sustainability reporting and its assurance. In this regards, companies may have their environmental information assured by assurance providers to mitigate the information gap as the consequence of agency problem between agent and principal. Furthermore, the signalling perspective provides us with a link between research on environmental disclosure and assurance of environmental information. As highlighted by Ruhnke and Gabriel (2013), under circumstances in which there is an increasing degree of asymmetric information, the potential benefit of having assurance is higher. The disclosed environmental information itself is deemed a signal (signalling-level reporting) to the public. The decision to implement assurance of environmental information stands in a complementary relationship in which assurance engagement represents a signalling measure to increase the credibility of the information provided. Cho et al. (2014) offer a similar argument on the complementarity of assurance of CSR reports. In their interpretation, signalling theory suggests that companies adopt assurance to indicate a superior social and environmental strategy to markets. If the assurance is deemed

capable of increasing the credibility of the reported information, market participants would positively value disclosing companies with assurance of reporting. Assurance of the sustainability information, therefore, complementarily reduces the agency problem by increasing the credibility of information, and helps to maintain companies' legitimacy by sending a signal to the public that companies have engaged in desirable, proper, and appropriate actions. Figure 1.1 represents the conceptual framework for this research, as well as how we operationalise it.

Figure 1.1. Research model



Referring to Figure 1.1, we hypothesise that there is a relationship between sustainability assurance and sustainability disclosure quality. However, it is also worth mentioning that what we mean by sustainability disclosure quality applies more to environmental-related disclosure information. We have several particular reasons for choosing environmental section and environmental-related information disclosure rather than social and governance issues. First, sustainable environmental impact involves a broad array of actions.

The government, in cooperation with companies and stakeholders, needs to prevent environmentally damaging behaviour. Second, the increasing market force of environmental sustainability and the adverse reaction of employees, investors, customers, and stock-market valuations could be triggered by information on companies' negative environmental impact. Third, stringent regulations at the regional (Europe, i.e., EU directives) or national level on environmental issues have been enacted and push companies to be environmentally compliant. Given these reasons, it is consequently important to the company to consider the role of environmental disclosure. Thus, to better environmental issues in the sustainability report more effectively, we follow the definition of environmental disclosure of Berthelot, Cormier, and Magnan (2003, p. 22), in which environmental disclosure is defined as "the set of information items that relate to a firm's past, current, and future environmental management activities and performance. This also comprises information about the past, current, and future financial implication resulting from a firm's environmental management decision or action."

Regarding the operationalisation of conceptual framework, we deliberately follow prior studies in establishing the proxies of sustainability assurance and sustainability disclosure quality. The detail of variable selection and their definition is available in the variable definition section, Table 1.4 page 41.

2.2. Hypotheses Development

2.2.1. Sustainability Assurance and Environmental Disclosure Quality

The extensive research in sustainability reporting finds that the role of sustainability assurance in driving environmental disclosure quality, can be seen through the agency and signalling frameworks. We conjecture that these two frameworks (agency and signalling) are complementarity in nature. As the circumstance of potential agency problem requires the company to reduce to condition of asymmetry information among stakeholders (agent and

principal), one of the possible ways is by presenting the voluntary disclosure of non-financial information which at the end can be deemed as a signal that company tries to mitigate the potential asymmetry information. More in detail, the study of Ruhnke and Gabriel (2013) suggested two conditions for the possibility of implementing assurance to increase environmental disclosure quality and mitigate the asymmetric information between agent and principal. By using the mechanism of agency costs and signalling-level reporting, they documented that there is variation in the signalling level of voluntary assurance. They assumed that the higher the degree of conflict of interest and information asymmetry among the stakeholders, the higher the potential benefits that can be realised as a result of assurance engagement. Also, as affirmed by Bagnoli and Watts (2017), it is the company (agent) that best knows its chosen level of environmentally responsible activities. However, the audience for the information (principals, stakeholders, and so forth) does not observe this choice. Hence, the disclosed environmental information is expected to reduce the informational gap, and the assurance complement is expected to increase the credibility of the reported information as well as to lead companies to better disclosure (Dando & Swift, 2003; Mercer, 2004; Moroney et al., 2011; Ruhnke & Gabriel, 2013).

In the context of the signalling framework, assurance engagement is deemed a signal particularly designed to convey to the public that companies bring superior social and environmental strategies to their markets (Cho et al., 2014). This signal is expected to be positively valued by market participants. The findings of prior studies also suggest that assurance of environmental information can have an effect on the quantity and quality of the disclosed environmental information. For instance, a study by Moroney et al. (2011), using a sample of Australian companies, examined the difference in quantity and quality of voluntary environmental disclosures. Their study shows that the quantity of information is higher when the report is assured, and the quality of voluntary environmental disclosure is significantly

higher for the assured companies. On the other hand, in spite of the recent findings of the role of sustainability assurance, a study by Michelon et al. (2015) provides evidence that assurance practices are not associated with sustainability disclosure quality. Utilising a setting of UK companies, they reported that assurance practices do not seem to be enough to avoid the criticism of the lack of credibility of sustainability reporting. Taking the above discussion on board, we test the role of sustainability assurance to enhance environmental disclosure quality. We predict that sustainability assurance could be a channel through which firms can increase the quality of their environmental information.

Hypothesis 1: Sustainability assurance is positively associated with environmental disclosure quality.

2.2.2. Assurance Provider and Environmental Disclosure Quality

Aside from the need to increase the quality of the reported environmental information, we argue that the choice of assurance provider can influence the quality of information provided by firms. Prior studies on assurance practices document that firms can purchase assurance services from a wide variety of providers (Deegan et al., 2006; Bagnoli & Watts, 2017). In general, there are two main groups of assurance providers currently classified in sustainability assurance research. One is assurance providers from the accounting profession (Big N, non-Big N), and second is assurance providers from the environmental consulting or other non-accounting professions (e.g., environmental and engineering consultants, environmental research organisations, social/ethical performance consultants) (Deegan et al., 2006; Simnett et al., 2009; Moroney et al., 2011). Studies comparing the quality of assurance statements provided by the accounting profession and environmental consultants have found that they are essentially different (Hodge, Subramaniam, & Stewart, 2009). The findings of Deegan et al. (2006) and Gürtürk and Hahn (2016) showed that most non-professional accounting assurance providers implement different approaches (i.e., content, executed

process, concrete implementation of the standard) in compiling assurance statements for Triple Bottom Line (TBL) reports. The drawback of assurance reports produced by non-professional accounting assurance providers using various approaches is that they are considered to fail to leverage the potential value of including assurance statements in TBL reports (Deegan et al., 2006).

With regard to expertise, assurance providers from the accounting profession are perceived by clients to provide a better assessment (given their skills, competencies, and market recognition to perform financial audits) during the assurance engagement process (Hodge, Subramaniam, & Stewart, 2009). As noted by Moroney et al. (2011), trained professional accountants undergo a stringent education to acquire a set of skills which is strictly bound by the requirements of the International Federation of Accountants (IFAC) code of ethics (professionalism, independence, objectivity). Another recent argument in support of accounting skills in the assurance engagement process is found in a study by Huggins, Green, and Simnett (2011). They highlighted that accountants might apply the model used in financial statement audits. This procedure requires the accountant to have a clear understanding of the entity and apprehension of the risk of material misstatement. However, Huggins et al. (2011) also indicated that a major criticism emerges due to subject matter expertise. In this case, accountants presumably have neither the necessary grasp of the subject matter nor sufficient knowledge to complete a particular task, while on the other hand, an environmental consultant is deemed to have a wider range of specific skill-sets and extensive knowledge of the subject matter (Huggins et al., 2011). Empirically, these conclusions are also supported by the findings of Wong and Millington (2014), which pointed out that due to the trust issue, stakeholders prefer to enlist assurance services from consultants (specialist environmental assurers) rather than financial auditors.

Given the strengths and weaknesses of professional accounting firms and non-accounting firms in the assurance market, previous studies highlighting the association between types of assurance providers and environmental disclosure quality are still insufficient according to Moroney et al. (2011), who documented that there is no difference in the voluntary environmental disclosure quality of firms that have their reports assured by accountants or consultants. However, more recently, studies on the relationship between the type of assurance provider and sustainability disclosure quality offer a new approach by providing evidence from sustainability restatement (Ballou, Chen, Grenier, & Heitger, 2018; Michelon et al., 2018). Among these studies, Michelon et al. (2018) examined the relationship between sustainability reporting assurance (SRA) and the likelihood of sustainability restatement. Using the type of assurance provider as a proxy for SRA, they showed that consultancy assurance firms are significantly associated with more methodological restatement and restatement of non-material amount information for a sample of U.S. firms from 2010 to 2014. Moreover, the study by Ballou et al. (2018) investigated the relationship between assurance providers (accounting versus non-accounting) and CSR report quality (proxied by the presence of error and non-error restatement²). Their study used an international sample originated from the proprietary survey data of KPMG in 2011 and 2013. They reported that the accounting assurance provider has a greater advantage in identifying error restatement (numerical inaccuracies) than those from non-accounting professions. While, they also pointed out that there is no clear difference in terms of the identification of non-error restatement (i.e., the enhancement of definitions, scope, and methodologies) for accounting versus non-accounting assurance providers.

² Error restatement refers to the correction of information due to error (numerical inaccuracies), while non-error restatement refers to method, definition, or scope updates.

Given the above empirical discussions and arguments, we hypothesise that the type of assurance provider plays an important role in the enhancement of environmental disclosure quality. Thus, we formally propose Hypothesis 2 as follows.

Hypothesis 2: The type of assurance provider is positively associated with environmental disclosure quality

2.2.3. The Level of Assurance and Environmental Disclosure Quality

The level of assurance practice describes the coverage of assessment conducted by the assurance provider (Corporate Register, 2008). As documented by prior studies in the assurance literature (Manetti & Becatti, 2009; Perego, 2009; Huggins et al., 2011; Simnett, 2012; Gillet-Monjarret, 2015), there are two assurance standards currently being adopted by the assurance providers: the AccountAbility 1000 Assurance Standard (AA1000AS), and the International Standards on Assurance Engagement 3000 (ISAE3000). Some studies (Huggins et al., 2011; Simnett, 2012) have distinguished two uses of different types of assurance standards based on the type of assurance provider. In his study, Perego (2009) reported that accounting professionals are more likely to adopt the ISAE3000 in their assurance engagement process, while environmental consultants incline to use the AA1000 standard. Huggins et al. (2011) further confirmed that the ISAE3000 assurance standard is also used interchangeably by both accounting and non-accounting assurance providers. In the more specific case of the practice of assurance (e.g., assurance engagement on greenhouse gas statements) Huggins et al. (2011) pointed out that there are several particular assurance standards that could be utilised by assurance providers (e.g., ISAE 3410³ and ISO 14064-3)⁴.

³ ISAE 3410 is the International Standard on Assurance Engagements (ISAE) which deals with the assurance engagements to report on an organisation's Greenhouse gas (GHG) statement (www.iaasb.org).

⁴ ISO 14064-3 specifies the principles and requirements which provides the guidance for those conducting or managing the validation and/or verification of greenhouse gas (GHG) assertions (www.iso.org).

Of the standard of sustainability assurance practices, AA1000 and ISAE3000 utilise two types of assurance levels: limited assurance versus reasonable assurance (some firms may engage in a combination of these two levels; see Gürtürk & Hahn, 2016). According to studies by Hodge, Subramaniam, and Stewart (2009) and Manetti and Becatti (2009), *limited assurance* refers to a moderate or limited level of assurance, in which the assurance statement is worded in a more negative form. This level attests to the fact that the indicative elements it collects do not necessarily mean that the assurance report covers the total performance of a company in a truthful and correct manner. Meanwhile, *reasonable assurance* refers to communication at a high level of assurance, which is not an absolute level of assurance due to the limitations of the internal control system and the assurance process. At the level of reasonable assurance, Hodge et al. (2009) noted that the assurance statement is worded in a more positive form. Manetti and Becatti (2009) also pointed out that the different levels of assurance are given based on the intrinsic characteristics of the subject matter and the investigation implemented by the assurance provider. By having a specific level of assurance, firms indirectly express the signal that specific standards (criteria of assessment) have been used in assessing the quality of the sustainability (environmental) disclosure for the stakeholders (Corporate Register, 2008; GRI, 2013; Hummel et al., 2017). It is also worth mentioning that the standard of engagement depends on the level of assurance as agreed upon by the firms (clients) and the type of assurance provider in the assurance process (Mock, Strohm, & Swartz, 2007).

Overall, because the implementation of assessment criteria depends on the level of assurance engagement, we expect that a higher level of assurance is associated with higher environmental disclosure quality. Companies' decision to attach the information with respect to the level of assurance engagement will also be a signal to stakeholders that specific criteria and assessment standards have been implemented in evaluating the reported information. More

specifically, prior studies have reportedly disentangled the elements of the level of assurance and assurance statement quality (O'Dwyer & Owen, 2005; Perego, 2009; Perego & Kolk, 2012). Evidence from the UK provided by O'Dwyer & Owen (2005) documented that accounting firms tend to provide low assurance levels (limited level) to their clients, whilst environmental consultants provide higher-level assurance (reasonable assurance). However, previous studies have not dealt with the content of sustainability-related information as disclosed by firms. Considering the essence of signalling theory, which is that companies engage in assurance practices to convey a positive signal to public, we argue that the level of assurance is positively associated with environmental disclosure quality. Accordingly, we offer Hypotheses 3.

Hypothesis 3: A higher level of assurance is positively associated with environmental disclosure quality.

2.2.4. Commitment to Assurance and Environmental Disclosure Quality

Although the evidence regarding commitment to assurance (a company's willingness to implement assurance engagement persistently over time) and its impact on environmental disclosure quality is very scarce, there are several factors (i.e., from preparers' and users' points of view) that may trigger firms to engage or not to persistently implement assurance practices over time (Park & Brorson, 2005; Ruhnke & Gabriel, 2013; Wong & Millington, 2014). Park and Brorson (2005) made an attempt to give sufficient consideration to explaining the factors that may drive firms to engage in voluntary assurance practices from the preparers' perspective. Using data from 28 Swedish firms, they pointed out that the first factor that might relate to the motivation for assurance engagement is benchmarking with peers. Companies which voluntarily seek assurance due to this benchmarking motivation are more likely to be supported by ambitious environmental and information staffs that will carefully follow trends in environmental reporting and its assurance to seek a leading position. Second, they posited that

awards (e.g., European Sustainability Reporting Awards; ESRA) for environmentally or sustainability-related activity reports might increase firms' awareness of the importance of assurance engagement and that it sends a positive signal to users. This motive is in line with the findings of Ruhnke and Gabriel (2013), which show that voluntary assurance demand is driven by a self-selection mechanism. In the context of the presence of ESRA, a firm is motivated to improve the quality of its sustainability report as it is aware of the potential benefits of obtaining awards (legitimacy and reputation). Thus, by the same reasoning, firms with higher-quality disclosures and more comprehensive environmental disclosure information are more confident and more likely to seek assurance. Third, during the process of assurance engagement, there could exist a great opportunity for the evaluated firms to implement better internal reporting systems, leading to increased quality and credibility of the reported environmental information (Park & Brorson, 2005) and, in turn, leading the firms to experience a learning curve from the overall reporting practices and assurance processes (O'Dwyer, 2011). Additionally, from the users' perspective, the study of Wong and Millington (2014) showed that the demand for assurance reporting in the UK assurance market is predominantly triggered by the role of trust. As previously reported by Dando and Swift (2003) and Mercer (2004), the credibility gap and lack of trust in reported sustainability information could be mitigated by the presence of independent third-party assurance.

Whatever the driving factors behind voluntary assurance engagement, Park and Brorson (2005) also determined the underlying causes of firms being reluctant to engage in assurance practices. First, they mentioned that the early time horizon of sustainability reporting might lead firms to postpone their decisions on assurance practices. Firms are aware that there is no immediately significant, realisable benefit in the early stages of business. Therefore, on average, firms in Sweden have their sustainability reports assured by an independent assurance provider three years after they first engaged in voluntary sustainability reporting. Second, the

benefit of assurance engagement (enhanced report credibility) does not seem to provide enough motivation to outweigh the costs incurred by the firms.

Taking into account the possible benefits of assurance engagement, we argue that the commitment to implementing persistent (longer) assurance practices is considered an important aspect of increased sustainability disclosure quality. Moreover, as the standards for sustainability reporting are still immature (Michelon et al., 2018) and there are only non-binding guidelines on the methodology for sustainability reporting (Merkl-Davies & Brennan, 2007), there is the potential benefit that these immature reporting and assurance standards in combination with professional accountants and consultants would likely result in a substantial learning curve for the companies in improving the quality of information disclosure (O'Dwyer, 2011; Michelin et al., 2018). Thus, the presence of high-quality sustainability reports consequently allows for an increase in the number of financial analysts, and complementary assurance increases the users' confidence in the reported information. From the point of view of financial analysts, credible, reliable, and accurate environmental disclosure information is essential to minimise the probability of forecast errors (Aerts et al., 2008; Dhaliwal et al., 2011). In accordance with these arguments, there would therefore seem to be a definite need for a persistent commitment to assurance engagement. Thus, we propose two proxies to measure the commitment to assurance and test its association with environmental disclosure quality. The first proxy is *assurance persistence*, which describes whether or not the company consistently engages in assurance practices during the current and subsequent reporting years. The second proxy focuses on how long (years) companies have been engaging in assurance practices, labelled *assurance age*. Hypothesis 4 is thus formulated as follows.

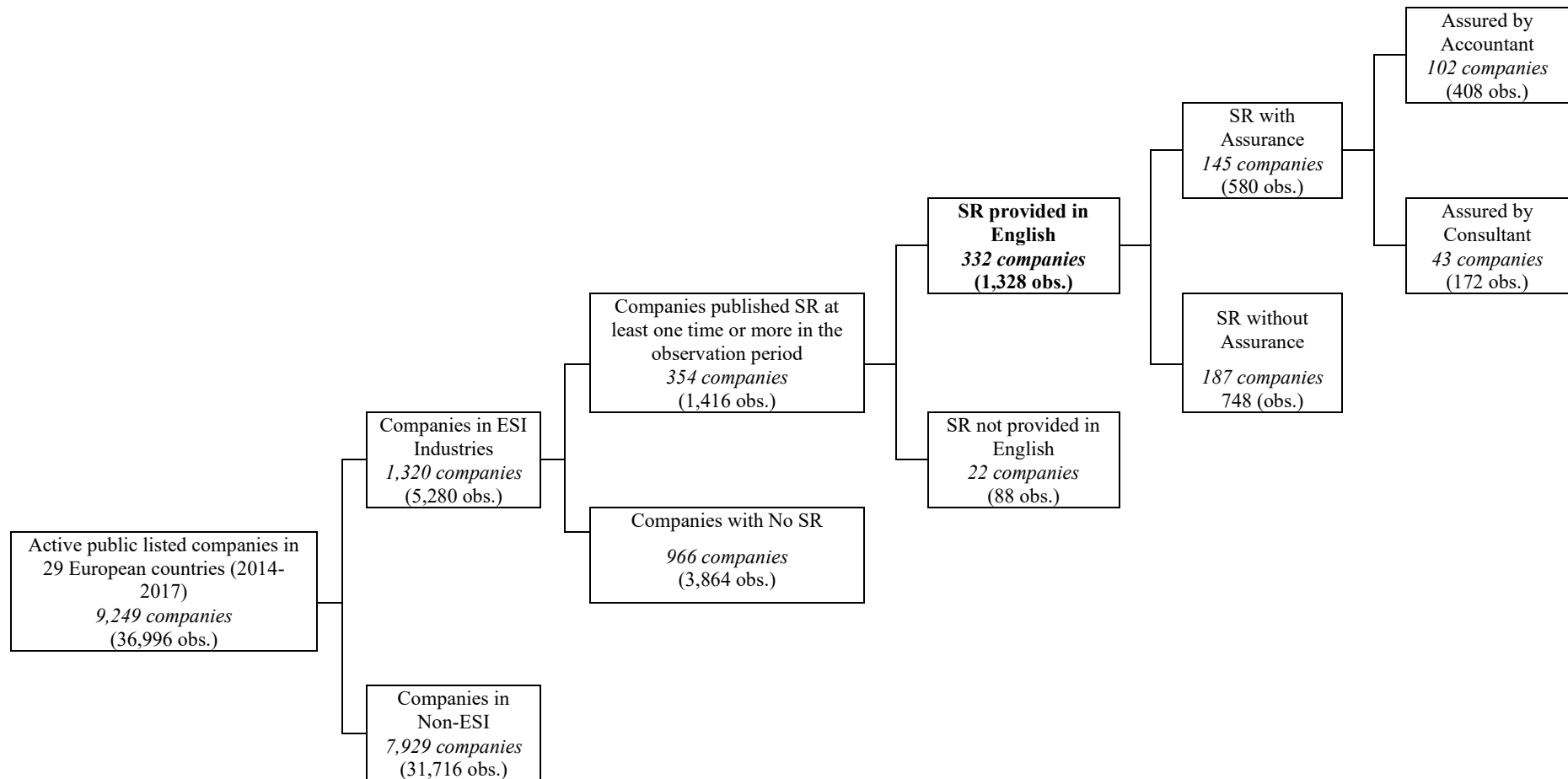
Hypothesis 4: The commitment to assurance is positively associated with environmental disclosure quality.

3. RESEARCH METHOD

3.1. Data and Sample

This study focuses on the empirical investigation of European firms operating in ESIs. We use European data since the European directive 2014/95/EU requires every company operating in Europe to mandatorily disclose its non-financial information, either in annual or stand-alone reports (European Commission, 2014). The European Commission specifically requires firms of a large size (having more than 500 employees) and significant public interest to publish non-financial and diversity information (Schneider et al., 2018). More precisely, we begin the sample construction with all publicly listed companies in the four-year window from 2014 to 2017. The time horizon from 2014 to 2017 is also adopted since we would like to capture the sustainability reports that adopted the GRI G.4 framework after it was introduced in early 2013. Given that, we argue that by having the data from 2014 to 2017 could provide us with a more standardized sustainability reports that adopted GRI disclosure framework. Furthermore, we eliminate all observations that cannot be attributed to the sample selection procedure as follows.

Figure 1.2. Decision tree with observation period spans from 2014 to 2017



Notes: ESI (Environmentally Sensitive Industries), SR (Sustainability Reports), Accountant (professional accounting companies; KPMG, PwC, Deloitte, Ernst & Young, Non-big 4). Consultant (certified bodies or environmental consultants).

Table 1.1 Sample Selection Procedure

No	Sampling procedure	Number of firms	Year-observations (2014-2017)	Percentage (%)
1	Active public listed companies in the capital market of 29 European stock exchanges from 2014 to 2017.	9,249	36,996	100
2	Firms not listed in the ESI industries.	(7,929)	(31,716)	(86)
3	Firms with no sustainability report.	(966)	(3,864)	(10)
4	Sustainability reports not provided in English.	(22)	(88)	(1)
5	Eligible firms with consistent disclosure of sustainability reports from 2014 to 2017 (Full sample).	332	1,328	4
6	Firms without environmental performance scores from ASSET4 database.	(106)	(424)	
7	Eligible firms with consistent sustainability reports and environmental performance from ASSET4 database (ASSET4 sample)	226	904	

Source: Own elaboration.

The data regarding firms' financial information is collected from the Thomson Reuters EIKON database. As previously noted in the sample selection procedure, all firms should be listed in the capital markets of 29 European countries. The screening is further conducted for ESIs using the Global Industry Classification Standard (i.e., Aerospace & Defence, Chemicals, Forestry & Paper, Pharmaceuticals, Metals, Mining, Oil & Gas, and Utilities (Rodrigue et al., 2013; Cho, Michelon, Patten, & Roberts, 2014; Michelon et al., 2015) and further narrowed by considering the availability of sustainability reports collected from the Corporate Register-Global SR resources database (<http://www.corporateregister.com/>). Researchers in the sustainability area consider this database to be the most comprehensive provider of non-financial reports worldwide (Simnett et al., 2009; Dhaliwal et al., 2012; Casey & Grenier, 2015). If a particular report is not available in the Corporate Register database, we further check for the report in the GRI database (<http://database.globalreporting.org/>). In the case that the sustainability report is not available in either database (Corporate Register or GRI), we search for the report on the Internet and check for it on the official websites of the related firms. We finally end up with 332 firms (25.15% of the total population of firms operating in ESIs) which indicate submitting complete sustainability reports and yearly financial data observations from 2014 to 2017. However, it is worth reporting that out of the 332 firms, we discover that there are 106 firms that are not covered in the ASSET4 database, meaning that these firms have no

environmental performance score as one of the indicators of sustainability performance information. Since we control for environmental performance, we limit our analysis to firms covered by the ASSET4 database, ending with a total of 226 public listed companies (904 firm-year observations).

3.2. Content Analysis

Following the coding rules suggested by Krippendorff (2004), Guthrie et al. (2004), and Michelon et al. (2015), we use the sentence as our unit of analysis as sentences are more reliable units of analysis than words, paragraphs, or pages. Each sentence is first coded according to its content, according to the disclosure framework presented in the next paragraph.

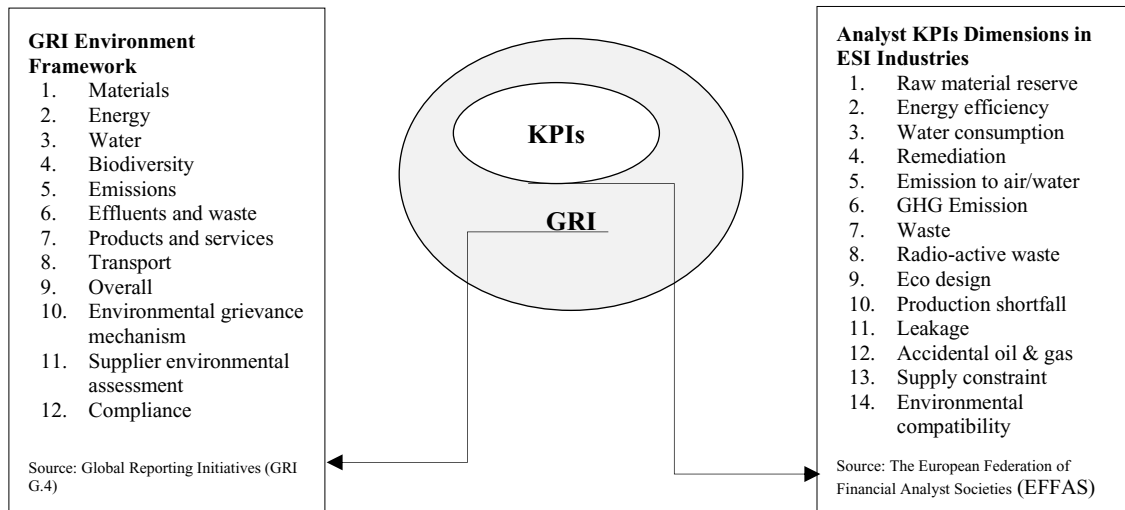
One of the frameworks more commonly used to provide and assess sustainability disclosure is that of GRI, which contributes to providing a commonly accepted, and thus more standardised, grid for sustainability information (GRI, 2014; Junior & Best, 2017). Companies that follow the GRI format for their disclosure framework appear to have a higher level of commitment to sustainability-related issues than companies that eschew GRI adoption (Clarkson et al., 2008). However, the literature also reports concerns regarding how these guidelines may be used for reporting practices (Moneva et al., 2006; Michelon et al., 2015). Michelon et al. (2015) raised the concern that companies' disclosure may be limited to an attempt to tick off as many GRI items possible. As a result, companies may end up with high volumes of disclosures, and questions arise regarding the materiality of the information as well as regarding the difficulties that a "diluted" report can present in terms of its readability by stakeholders.

Moreover, as stakeholders comprise many parties, it is obvious that each type of stakeholder has its own information needs (e.g., what is deemed material by local citizens may be different from what is considered material by financial analysts). Additionally, the

materiality of information also varies according to industry memberships (e.g., material information for chemical companies may be different from material information for utility companies). Therefore, we address this issue by focusing on the materiality dimensions from the point of view of financial analysts, thus adopting the key performance indicators (KPIs) published by the European Federation of Financial Analysts Societies (EFFAS, 2010). These KPIs are industry-specific; therefore, in this way, we aim to address the “industry” concern with regard to materiality. We further check if the environmental KPIs required by financial analysts cover the same issues as required by GRI frameworks. The results show that EFFAS KPIs represent a sub-group of the items included in the environmental section of the GRI disclosure framework (see Figure 1.3). For example, the “Material” aspect in GRI framework overlapped with the “Raw material reserve” in EFFAS dimension. Furthermore, “Energy” aspect in GRI also overlapped with “Energy efficiency” in EFFAS dimension and so forth for the remaining GRI and EFFAS dimensions.

More specifically, we base our analysis on the environmental dimension of the GRI G.4—which aims to represent stakeholders’ concern about environmental-related activities (12 items)—and on the presence of the EFFAS KPIs—which represent the information needs of capital market participants (14 items).

Figure 1.3. The sustainability code: Criteria and indicators related to the declaration of conformity to environmental aspects for GRI and EFFAS indicators



Notes: GRI G.4 (Global Reporting Initiatives. Generation 4). In GRI G.4, we adopt the environmental dimensions which represent the stakeholders' concern on the environmentally related-activities. While, KPIs (Key Performance Indicators) as released by The European Federation of Financial Analyst Societies (EFFAS) is used as the representation of capital market participants (i.e., financial analyst). In this KPIs, we deliberately adopt the environmental indicators which are considered as the most material information by the financial analyst. We further use the items of GRI and EFFAS in the coding procedures of content analysis.

3.2.1. Coding procedures

Each sentence is assigned a score of 1 if the sentence contains information related to environmental items according to GRI guidelines (12 items) and analyst KPIs (14 items). Otherwise, the analysed sentence is assigned a score of 0. Whenever a score of 1 is assigned to a sentence, it is then classified according to its content (GRI items and KPIs), type (qualitative, quantitative, monetary), and managerial orientation (i.e., expectation and context, program, policies and initiatives, objectives and goals, results and outcomes).

In the first stage, a pilot test is conducted by two research assistants on 73 companies (8,861 sentences extracted from 292 reports). The intercoder reliability reached in the pilot test for coding is above 90%. The results of the pilot test are used in a machine-learning procedure to train the computer (naïve based approach) to capture the probability of a sentence being categorised based on a particular term and condition (Li, 2010), for more efficient coding. The software used is R with the *Quanteda* (quantitative textual data analysis) package. Several algorithms are assigned to the machine (computer) to allow it to capture the probability of a

sentence being classified based on the GRI and KPI disclosure items (see Figure 1.3), type of information (i.e., qualitative, quantitative, and monetary), and managerial orientation (i.e., expectation and context, program, policies and initiatives, objectives and goals, results and outcomes).

Quanteda is then run on the remaining sentences of the 259 companies (1,036 reports), obtaining the predicted value for each sentence. This predicted value is further validated by the two researchers, and the validation indicates that the accuracy of machine learning outcomes as compared with the actual manual coding of content analysts from the pilot test matched no less than 90%. Table 1.2 provides an example of the results of the coding procedures.

Table 1.2 Example of Coding

No	Disclosure	GRI item	KPIs	TOI1	TOI2	TOI3	EXP	PROG	OBJ	RES
1	Overall, we spent approximately EUR 514 million on raw material in 2016.	Materials	1	0	0	1	0	1	0	0
2	Expenditure on pulp and natural fibers was about EUR 213 million, on synthetic fibers about 142 million and on chemicals about EUR 159 million.	Materials	1	0	0	1	0	1	0	0
3	Energy expenditure was about EUR 77 million.	Energy	1	0	0	1	0	1	0	0
4	Overall, raw material and energy account for about 60% of our total cost base.	Energy	0	0	1	0	0	1	0	0
5	By far the most important raw material for us is fiber with about 70% of the total.	Materials	0	0	1	0	0	1	0	0
6	In 2016, 79% of the fibers we used as raw material came from renewable sources, compared with 82% in 2015.	Materials	0	1	0	0	0	0	0	1
7	The vast majority, or about 90% of the renewable fiber, is wood pulp from forests.	Materials	0	1	0	0	0	1	0	0
8	Total energy consumption declined by 8.3%.	Energy	0	0	1	0	0	0	0	1
9	Electrical efficiency improved by 2.5%.	Energy	0	0	1	0	0	0	0	1
10	Process heat efficiency improved by 9.8%.	Energy	0	0	1	0	0	0	0	1
11	Our approach is to manage and to reduce energy consumption while ensuring the competitiveness of our business.	Energy	0	1	0	0	0	0	1	0
12	In 2016, our total energy consumption was 3,306 GWh, showing a decrease of 8.3% from the 3,605 GWh consumed in 2015.	Energy	1	0	1	0	0	0	0	1
13	Electrical efficiency increased by 2.5% to 1.28 MWh per gross ton and process heat efficiency improved by 9.8% to 12.5 GJ per gross ton.	Energy	1	0	1	0	0	0	0	1
14	For the future, the energy roadmap will be developed further to better visualize the trends and baseline of our manufacturing process.	Energy	0	1	0	0	1	0	0	0

Notes:

TOI1 : 1 if the sentence is categorised as qualitative information.

TOI2 : 1 if the sentence is categorised as quantitative information.

TOI3 : 1 if the sentence is categorised as monetary information.

EXP : 1 if the sentence is categorised as context, expectation, or hypothesis information.

PROG : 1 if the sentence is categorised as policies, initiatives and strategies information.

OBJ : 1 if the sentence is categorised as objective and goals information.

RES : 1 if the sentence is categorised as results and outcome of actions information.

The environmental-related sentences were extracted from the environmental performance section of the annual report Ahlstrom-Munksjo 2016 (Finland) Page 56-68.

In order to take into account the complexity of environmental information and to better assess the quality of disclosure, we use the results of the above coding procedure to build five main dimensions (indices) that make up for disclosure quality. These indices are used as the components to construct the multidimensional index for environmental disclosure quality, which is our main dependent variable of interest.

The first disclosure index is the relative quantity (RQT), which is computed as the difference between the actual and the expected number of sentences containing GRI environmental information. Following Michelon, Pilonato, and Ricceri (2015), we run the OLS procedure using the number of sentences containing environmental-related information that is disclosed in the form of sentences as a function of a companies' size and industry memberships. We take the standardised residual output from the OLS regression and further use it as the expected disclosure information. The relative quantity is counted as the difference between the actual disclosure (DISC) and the expected disclosure information ($\widehat{DISC}$).

The second index is the density (DEN). With reference to a study by Michelon et al. (2015), density is defined as the ratio between the number of GRI environmental-related sentences over the total number of sentences in the document. In this regard, dilution of the environmental information in the long document as a stand-alone report may serve as the communication method which is deemed most relevant, albeit hard to understand, for users, and there is a chance that the information is loaded with obfuscation and information that diverts readers' attention (Merkl-Davies & Brennan, 2007; Cho, Roberts, & Patten, 2010; Michelon et al., 2015).

The third index is the type of information (TOI). Within the coding procedure, each environmentally-related sentence was coded according to its type and assigned a score of 1 if the sentence was "only" qualitative, 2 if it contained quantitative information, and 3 if it contained monetary information. This index represents the ratio between the sum of the

weighted value of all the sentences that contain GRI environmental-related information over the total number of environmental-related sentences contained in the report.

The fourth index is managerial orientation (MAN). This index captures the time orientation (forward-looking versus backward-looking) of environmental disclosure and whether the disclosure follows a boilerplate or committed approach. The index of managerial orientation (MAN) is calculated by considering the number of sentences containing environmental information in the analysed document. Following the study of Michelon et al. (2015), the procedure for sentence classification can be categorised as considering the time orientation and the boilerplate versus a committed approach to information as follows.

Managerial orientation	Forward-looking	Backward-looking
Boilerplate approach	<i>Context-Expectation-Hypothesis</i>	<i>Policies, initiatives, and strategies</i>
Committed approach	<i>Objective and goals</i>	<i>Results and outcome of actions</i>

The fifth index is the materiality (MAT). This index represents the materiality of information disclosure from the perspective of financial analysts. We focus on capturing the amount of material information that could be reported by the companies in their sustainability reporting. In this context, we consider that the informative provision based on the analysts' KPIs is useful for financial analysts. As we are aware that each industry among ESIs may demand a different type of material information, we, therefore, focus on generating a materiality index by counting the aggregate material information based on the industry categories. We assume that the ratio of matching pieces of information between analyst KPIs and GRI items over the total number of material information of each industry, represent the material information required by financial analysts for different industries (See materiality map in Figure 1.4).

Figure 1.4 Materiality map based on the Financial analyst

ESIs	Environmental-related KPIs													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Aerospace& Defense		✓	✓		✓	✓	✓			✓			✓	✓
Chemicals		✓	✓		✓	✓	✓	✓		✓			✓	
Forestry & Paper		✓	✓	✓	✓	✓	✓	✓	✓	✓				✓
Metals		✓	✓	✓	✓	✓	✓	✓						
Mining		✓	✓	✓	✓	✓	✓	✓						✓
Oil & Gas	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Pharmaceuticals		✓	✓				✓			✓				✓
Utilities		✓	✓	✓	✓	✓	✓		✓		✓			✓

Note: 1. Raw material reserve, 2. Energy efficiency 3. Water consumption, 4. Remediation, 5. Emission to air/water, 6. GHG Emission, 7. Waste, 8. Radioactive waste, 9. Eco-design, 10. Production shortfall, 11. Leakage, 12. Accidental oil & gas, 13. Supply constraint, 14. Environmental compatibility

The raw data obtained to generate the five indices are presented in binomial form (0;1) and then translated into unidimensional indices using the formulae illustrated in Table 1.3.

Table 1.3 Environmental Disclosure Quality Indices

Variable	Definition	Measure	GRI G.4 Environmental Framework	Environmental-related KPIs of Financial Analyst
Unidimensional measures				
DISC	Disclosure quantity	$DISC_{i,t,k} = \sum_{j=1}^n SR_{i,t,k}$	1. Materials	1. Raw material reserve
RQT	Relative Quantity	$RQT_{i,t} = DISC_{i,t} - \overline{DISC}_{i,t}$	2. Energy	2. Energy efficiency
DEN	Density	$DEN_{i,t} = \frac{1}{k_{i,t}} \sum_{j=1}^{k_{i,t}} (SR_{i,t})$	3. Water	3. Water consumption
TOI	Type of Information	$TOI_{i,t} = \frac{\sum_{j=1}^{n_{i,t}} (w * SR_{i,j,t})}{DISC_{i,k,t}}$	4. Biodiversity	4. Remediation
MAN	Managerial Orientation	$MAN_{i,t} = \frac{\sum_{j=1}^{n_{i,t}} (PROG_{i,j,t} + RES_{i,j,t})}{DISC_{i,t}}$	5. Emissions	5. Emission to air/water
MAT	Materiality of Information	$MAT_{i,t} = \frac{1}{n_{i,t}} \sum_{j=1}^{n_{i,t}} \frac{(DISC_KPI_{i,j,t})}{(KPI_f)}$	6. Effluents and waste	6. GHG Emission
			7. Products and services	7. Waste
			8. Transport	8. Radioactive waste
			9. Overall	9. Eco-design
			10. Environmental grievance mechanism	10. Production shortfall
			11. Supplier environmental assessment	11. Leakage
			12. Compliance	12. Accidental oil & gas
				13. Supply constraint
				14. Environmental compatibility
Multidimensional measure				
QUALITY	Standardized sustainability disclosure index	$QUALITY_{it} = \frac{1}{5 * (RQT_{i,t} + DEN_{i,t} + TOI_{i,t} + MAN_{i,t} + MAT_{i,t})}$		

After completing the construction of five unidimensional disclosure indices (RQT; DEN; TOI; MAN; and MAT), these five unidimensional indices are then used to construct a single multidimensional index, which we label as QUALITY. QUALITY is constructed by weighting the values of five unidimensional indices (RQT ranges from 0 to ∞ , DEN ranges from 0 to 1, TOI ranges from 0 to 3, MAN ranges from 0 to 1, and MAT ranges from 0 to 2.8), finally becoming a standardised value of multidimensional environmental disclosure quality.

3.3. Regression Model

Recalling our hypotheses, our study investigates the association between sustainability assurance attributes and environmental disclosure quality. Therefore, we propose four OLS models to assess our hypotheses. For Hypothesis 1, we test whether sustainability assurance (SA) is positively associated with environmental disclosure quality (QUALITY). To accommodate the empirical test for Hypothesis 1, we provide Equation 1. Hypothesis 2 assumes that the type of assurance providers (ACCOUNTANT, CONSULTANT) are positively associated with environmental disclosure quality (Equation 2). We insert two different dummy variables (ACCOUNTANT, CONSULTANT) to clearly capture the magnitudes of coefficient beta generated by two different proxies. Hypotheses 3 empirically tests whether the levels of assurance (LIMITED, REASONABLE, and MIXED) are positively associated with the environmental disclosure quality (Equation 3). With the same reason as used in hypothesis 2, we also perform the regression analysis using three different dummy variables as the proxies of the level of assurance. Hypothesis 4, in the same spirit as the previous hypotheses, examines whether there is a positive association between commitment to assurance (AS_PERS and AS_AGE) and environmental disclosure quality (Equations 4a and 4b). We posit the following OLS regression models for sample i and time t .

Equation 1

$$QUALITY_{i,t} = \alpha + \beta 1SA_{i,t} + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

Equation 2

$$QUALITY_{i,t} = \alpha + \beta 1ACCOUNTANT_{i,t} + \beta 2CONSULTANT_{i,t} + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

Equation 3

$$QUALITY_{i,t} = \alpha + \beta 1LIMITED_{i,t} + \beta 2REASONABLE_{i,t} + \beta 3MIXED_{i,t} + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

As we propose two different ways of measuring the commitment to assurance, we therefore have two proxies. These proxies are assurance persistency (AS_PERS) and assurance age (AS_AGE). We are aware that these two proxies cannot be pooled together in the same equation model as the two proxies are similar in construction and potentially highly correlated as they measure the same underlying construct. Thus, we test the two proxies in different models, as can be seen in Equations 4a and 4b that follow.

Equation 4a

$$QUALITY_{i,t} = \alpha + \beta 1AS_PERS_{i,t} + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

Equation 4b

$$QUALITY_{i,t} = \alpha + \beta 1AS_AGE_{i,t} + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

As written in the above equations, we hypothesise that environmental disclosure quality (QUALITY) is a function of sustainability assurance attributes (the presence of assurance, type of assurance provider, level of assurance, and commitment to assurance). In the proposed statistical model, we explicitly classify each proxy of sustainability assurance in four regression models. By doing so, we perform a partial test by independently testing the association of each attribute with QUALITY as the main dependent variable. The reason for not pooling all the assurance attributes in a single statistical model is the characteristics of the SA attributes, which

are sequential and choice-based decisions by nature. More precisely, the decision to choose a particular type of assurance provider depends on the presence of an assurance report. The choice of the level of assurance engagement also depends on the presence of assurance and the type of assurance provider. Meanwhile, the commitment to assurance engagement is merely based on management decisions. We, therefore, argue that there might be a multicollinearity problem that may harm the estimation output if we pooled each attribute in the same statistical model.

3.4. Variable Definitions

Regarding the main independent and control variables employed in Equations 1 to 4, we also provide variable definitions, which can be seen in Table 1.4.

Table 1.4 Variable Definitions

No	Variable	Measure
1	Unidimensional measure of Sustainability disclosure Indices (RQT) Relative quantity	$RQT_{i,t} = DISC_{i,t} - \widehat{DISC}_{i,t}$ $RQT_{i,t}$ is the relative quantity index for company i in year t, $DISC_{i,t}$ is the observed level of disclosure for company i in year t and $\widehat{DISC}_{i,t}$ is the estimated disclosure level for company i in year t.
2	(DEN) Density	$DEN_{i,t} = \frac{1}{k_{i,t}} \sum_{j=1}^{k_{i,t}} (SR_{i,j,t})$ $DEN_{i,t}$ is the density index for company i in year t, $k_{i,t}$ is the number of sentences in the document analyzed for company i in year t and $SR_{i,j,t} = 1$ if the sentence j in the document analyzed for company i in year t contains environmental-related information and $SR_{i,j,t} = 0$ otherwise.
3	(TOI) Type of information	$TOI_{i,t} = \frac{\sum_{j=1}^{n_{i,t}} (w * SR_{i,j,t})}{DISC_{i,k,t}}$ TOI measures, for each item of environmental disclosure by referring to the GRI disclosure framework. We count the information based on the characteristics of data appears in the environmentally-related sentence. We scale the data as 0 if the sentence does not provide any information about environmental issue, 1 if the sentence is presented in qualitative form of information, 2 if the sentence contains quantitative information, and 3 if the sentence releases a monetary information with respect to the environmental issue. The incidence of recording units containing environmental information in qualitative, quantitative, and or monetary terms over the total of the recording disclosure units containing environmental information.
4	(MAN) Managerial orientation	$MAN_{i,t} = \frac{\sum_{j=1}^{n_{i,t}} (PROG_{i,j,t} + RES_{i,j,t})}{DISC_{i,t}}$

No		Variable	Measure
5		(MAT) Materiality	MAN_i is the managerial orientation index for company _i in year _t, n_{it} is the number of sentences containing environmental-related information in the document analyzed for company _i in year _t, PROG_{ijt} = 1 if sentence _i in the document analyzed for company _i in year _t contains environmental-related information on program, initiatives, and strategies, otherwise PROG_{ijt} equals to 0. RES_{ijt} = 1 if the sentence _i in the document analyzed for company _i in year _t contains environmental-related information on results and outcomes and RES_{ijt} = 0 otherwise. DISC_{i,t} = the total of GRI environmental-related disclosures. $MAT_{i,t} = \frac{1}{n_{i,t}} \sum_{j=1}^{n_{i,t}} \frac{(DISC_KPI_{i,j,t})}{(KPI)_f}$ MAT_i is the materiality index for company _i in year _t, n is the number of overlapped items between GRI and KPIs in the document _i analyzed for company _i in year _t, KPI_f is the number of relevant environmental key performance indicators as required by the financial analyst in industry _f. The obtained data of this index spans from 0 to 2.8. The maximum value of 2.8 is obtained if the companies disclose the whole KPIs (14 items) over the total minimum number of material items required by each particular industry (e.g., see pharmaceutical industry in Figure 1.4 with the least number of KPI items).
6	Multidimensional measure of Sustainability disclosure Index	(QUALITY) The standardized sustainability disclosure quality index	$QUALITY_{i,t} = \frac{1}{5 * (RQT_{i,t} + DEN_{i,t} + TOI_{i,t} + MAN_{i,t} + MAT_{i,t})}$ Following the study of Michelon et al. (2015), we generate a standardized SR disclosure quality index by weighting the standardized value of each five disclosure indices; RQT, DEN, TOI, MAN, and MAT.
7	Sustainability Assurance	SA	1 if the firm has assurance statement, and 0 otherwise.
8	Type of Assurance provider	Accountant	1 if the assurance service is provided by the accounting firms, 0 otherwise.
9		Consultant	1 if the assurance service is provided by the consultant firm, 0 otherwise.
10	Level of assurance	Limited	1 if the assurance statement indicates that the company engages with limited assurance, 0 otherwise.
11		Reasonable	1 if the assurance statement indicates that the company engages with reasonable assurance, 0 otherwise.
12		Mixed	1 if the assurance statement indicates that the company engages with the combination of limited and reasonable assurance, 0 otherwise.
13	Commitment to assurance	(AS_PERS) Assurance Persistency	1 if in the prior year (_{t-1}) and the current year (_{t0}) company have its SR report assured by the assurance provider.
14		(AS_AGE) Assurance Age	The yearly time since the first time a firm adopted the assurance practice.
15	Control variables	SR	1 if the firm published a stand-alone sustainability report, and 0 if the SR information is published in a dedicated page of the annual report.
16		(ENVSCR) Environmental score	Environmental pillar score from ASSET4 database.
17		(GRI) Global Reporting Initiatives	1 if the analyzed document contains a statement declaring GRI adoption, 0 otherwise.
18		(CR_BOARD) CSR sustainability committee	1 if the company has SR committee, and 0 otherwise.
19		(SIZE) Size	Natural logarithm of the total asset.

No	Variable	Measure
20	(AGE) Companies age	The age (years) of the company is counted since the first time it starts to operate.
21	(LEVERAGE) Leverage	Total debt to total equity.
22	(ROA) Return on Asset	Fiscal year-end net income divided by year-end total assets.

Source: own elaboration.

3.5. Consideration of Potential Sample Bias

Since the focus of our study is investigating the association of sustainability assurance with environmental disclosure quality, we also consider the problem of sample selection bias. As noted by Tucker (2010), many key corporate decisions made at the firm level can be classified as “choices.” Given that, we recognise that the sample used in our study is non-randomly assigned, which raises concerns about the validity of the obtained empirical findings. In the procedure of sample selection, we focus on companies that are incorporated in ESIs, where these companies should have had sustainability information reported, assured, and indexed by database providers (e.g., Corporate Register, GRI, ASSET4, and EIKON). In this regard, we consider that our datasets focus on the specific group of large, publicly listed firms, which might induce a coverage bias in the collected sample. Therefore, there is an indication that the sample selection is driven either by the decision to only use companies with sustainability reports with assurance or companies of large size that are classified as ESIs. To deal with this issue, we run the Heckman two-step regression to make sure that self-selection sample bias does not threaten the sampling procedure (Lennox, Francis, & Wang, 2012). The first stage (Stage I) is conducted by employing a probit model as follows.

$$SR/NonSR_{i,t} = \alpha + \beta 1SIZE_{i,t} + \beta 2ENVSCR_{i,t} + \beta 3AGE_{i,t} + \beta 4LEVERAGE_{i,t} + \beta 5ROA_{i,t} + \varepsilon$$

After running the probit model as the first stage of the Heckman 2SLS selection procedure, we generate the inverse Mills ratio (IMR), which is used in correcting the potential

self-selection sample bias in our model. We also consider the exclusion and restriction of variables that are used in the second stage. Following the study of Michelin et al. (2015), we insert firm-specific variables in the first stage and exclude them from the second stage. The obtained value of the IMR is further inserted into the different proposed empirical models for the second stage of each equation (each Stage II).

The second stage of Equation 1

$$QUALITY_{i,t} = \alpha + \beta 1SA_{i,t} + \beta 2IMR + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

The second stage of Equation 2

$$QUALITY_{i,t} = \alpha + \beta 1ACCOUNTANT_{i,t} + \beta 2CONSULTANT_{i,t} + \beta 3IMR + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

The second stage of Equation 3

$$QUALITY_{i,t} = \alpha + \beta 1LIMITED_{i,t} + \beta 2REASONABLE_{i,t} + \beta 3MIXED_{i,t} + \beta 4IMR + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

The second stage of Equation 4a

$$QUALITY_{i,t} = \alpha + \beta 1AS_PERS_{i,t} + \beta 2IMR + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

The second stage of Equation 4b

$$QUALITY_{i,t} = \alpha + \beta 1AS_AGE_{i,t} + \beta 2IMR + \gamma \sum Controls_{i,t} + \gamma \sum Year_{i,t} + \gamma \sum Industry + \varepsilon$$

We are also aware that apart from the self-selection bias problem, we need to deal with the other sample groups that decided not to assure their sustainability reports. Therefore, we use the propensity score matching (PSM) method in the robustness test to better deal with the causal effects and the variance among firms with and without assurance statements. We use

332 companies (1,328 firm-year observations) with complete sustainability reports, even though 106 (424 observations) of them have no information about any environmental performance score. Accordingly, we create a treated group and a control group for the purpose of an observational study. As the number of samples with sustainability assurance statements is 145 and the number of firms without assurance is 187, we decide to use the firms with assurance statements as the treated group and the firms without sustainability assurance as the control group. In this case, we match the assurance adopters (treated group) with non-adopters (control group).

At the initial stage of the matching procedure, the number of observations in the treated group is 583 and the number in the control group is 745 observations. In total, we have 1,328 firm-year observations. By employing propensity score matching with nearest-neighbour matching based on the size of the firms in the nearest year and industry, the final propensity score matching recommends creating eight blocks. This number of blocks ensures that the mean propensity score is not different for the treated and control groups in each block. The first block of pscore is started at 0.023 and the last blocks (eight) ended with 8. Finally, we obtain a total of 583 observations for the treated group and 673 observations for the control group (the total is 1,256 firm-year observations). However, since these two groups indicate that the obtained final observations value is a poor fit given the nature of panel data analysis, we dropped eight (8) observations and, finally, obtained well-balanced panel data of 1,248 observations that are used in the further analyses (see Table 1.11 for further details).

4. RESULTS

4.1. Univariate Analysis

We have obtained unique datasets that contain complete observations and environmental performance information as covered by the ASSET4 database. Thus, we start our empirical analysis by providing the final sample distribution as follows.

Table 1.5 Sample Distribution

Panel A. Sample distribution by country (firm-year observations)

No	Country	Firms	Obs.	%	Stand-alone SR		SA		SA Provider		Level of assurance				GRI	
					No	Yes	No	Yes	Accountant	Consultant	No level	Limited	Reasonable	Mixed	No	Yes
1	Austria	3	12	1.33	5	7	3	9	8	1	3	9	0	0	0	12
2	Belgium	4	16	1.77	10	6	4	12	8	4	4	9	3	0	4	12
3	Croatia	1	4	0.44	4	0	2	2	2	0	2	2	0	0	0	4
4	Czech Republic	2	8	0.88	6	2	7	1	1	0	7	1	0	0	6	2
5	Denmark	11	44	4.87	17	27	28	16	16	0	28	11	5	0	31	13
6	Estonia	1	4	0.44	0	4	0	4	0	4	0	4	0	0	4	0
7	Finland	9	36	3.98	9	27	12	24	24	0	12	24	0	0	6	30
8	France	19	76	8.41	49	27	7	69	63	6	7	61	6	2	32	44
9	Germany	24	96	10.62	63	33	41	55	49	6	41	50	5	0	29	67
10	Greece	8	32	3.54	9	23	13	19	5	14	13	19	0	0	0	32
11	Hungary	3	12	1.33	12	0	8	4	4	0	8	4	0	0	8	4
12	Ireland	1	4	0.44	4	0	4	0	0	0	4	0	0	0	4	0
13	Italy	15	60	6.64	16	44	11	49	46	3	11	49	0	0	11	49
14	Luxemburg	1	4	0.44	0	4	4	0	0	0	4	0	0	0	3	1
15	Netherlands	11	44	4.87	29	15	24	20	16	4	24	16	4	0	19	25
16	Poland	1	4	0.44	0	4	0	4	4	0	0	4	0	0	0	4
17	Portugal	7	28	3.1	23	5	15	13	13	0	15	9	4	0	9	19
18	Romania	1	4	0.44	4	0	4	0	0	0	4	0	0	0	3	1
19	Slovakia	1	4	0.44	4	0	3	1	0	1	3	1	0	0	4	0
20	Slovenia	2	8	0.88	6	2	8	0	0	0	8	0	0	0	8	0
21	Spain	17	68	7.52	31	37	32	36	33	3	32	36	0	0	17	51
22	Sweden	9	36	3.98	8	28	8	28	26	2	8	28	0	0	0	36
23	Swiss	5	20	2.21	11	9	8	12	12	0	8	12	0	0	5	15
24	UK	70	280	30.97	213	67	122	158	90	68	122	142	12	4	141	139
Total		226	904	100%	533	371	368	536	420	116	368	491	39	6	344	560

Panel B. Sample distribution by year (firm-year observations)

Year	Obs.	%	Stand-alone SR		SA		SA Provider		Level of assurance				GRI	
			No	Yes	No	Yes	Accountant	Consultant	No level	Limited	Reasonable	Mixed	No	Yes
2014	226	25	141	85	101	125	99	26	101	114	9	2	97	129
2015	226	25	134	92	94	132	102	30	94	121	9	2	86	140
2016	226	25	127	99	90	136	105	31	90	124	11	1	83	143
2017	226	25	131	95	83	143	114	29	83	132	10	1	78	148
Total	904	100%	533	371	368	536	420	116	368	491	39	6	344	560

Panel C. Sample distribution by Industry Group (firm-year observations)

ESI Industry	Firms	Obs.	%	Stand-alone SR		SA		SA Provider		Level of assurance				GRI	
				No	Yes	No	Yes	Accountant	Consultant	No level	Limited	Reasonable	Mixed	No	Yes
Aerospace & Defense	16	64	7.08	46	18	16	48	31	17	16	48	0	0	32	32
Chemicals	32	128	14.16	83	45	55	73	68	5	55	57	16	0	52	76
Forestry & paper	13	52	5.75	32	20	29	23	19	4	29	23	0	0	14	38
Pharmaceuticals	43	172	19.03	118	54	106	66	56	10	106	65	1	0	97	75
Metals	7	28	3.1	11	17	16	12	12	0	16	12	0	0	9	19
Mining	37	148	16.37	77	71	50	98	65	33	50	87	7	4	37	111
Oil & gas	33	132	14.6	73	59	44	88	68	20	44	83	5	0	38	94
Utilities	45	180	19.91	93	87	52	128	101	27	52	116	10	2	65	115
Total	226	904	100%	533	371	368	536	420	116	368	491	39	6	344	560

Notes: The sample period in our study spans from the fiscal year-end of 2014 to 2017, covers a total of 904 firm-year observations (226 firms) from 24 European countries. We dropped the sample from the five other countries (Bulgaria, Cyprus, Latvia, Lithuania, and Malta) due to the incomplete number of data observations.

Table 1.5 presents the univariate analysis for the sustainability reports and sustainability assurance practices. We classified our sample based on country, year, and industry membership, which are grouped into three panels. Panel A in Table 1.5 is the sample distribution by country. Our sample is dominated by the sample from the UK with 30.97%, followed by Germany (10.62%), France (8.41%), Spain (7.52%), and Italy (6.64%), while Croatia, Estonia, Ireland, Luxemburg, Poland, Romania, and Slovakia stand as the countries with the smallest number of firms operating in ESIs (0.44%). Panel B presents the sample distribution by year. In this panel, we describe sustainability reporting and complementary assurance practice from 2014 to 2017. Recalling our sampling procedures, we use panel data (226 cross-sectional data points) and a four-year time series of data. Although the number of our observations is equally distributed for each year, interestingly, we find that the trend of the practice of assurance of sustainability reporting has steadily increased over the years. In 2014, we record that 125 sustainability reports were assured. This number increases over the next consecutive years of 2015 (132 reports), 2016 (136 reports), and 2017 (143 reports). This point suggests that sustainability reporting and the complementary practice of assurance are emerging as a major trend among the European companies operating in ESIs.

Moreover, in Panel C (sample distribution by Global Industry Classification Standard group), we find that firms operating in the Utilities (19.91%) and Pharmaceutical (19.03%) industries dominate our sample distribution, followed by Mining (16.37%), Oil & Gas (14.6%), and Chemical (14.16%). Meanwhile, the Metals (3.1%), Forestry & Paper (5.75%), and Aerospace & Defence (7.08) groups contribute less compared with other ESIs.

In the next step, we provide the results of the content analysis. The content analysis is conducted using a mechanistic approach. As suggested by Beck et al. (2010), a mechanistic approach captures and describes a surrogate assumed to convey meaning and reporting intent,

which means the focus of the analysis is on volumetric or frequency capture, and semiotic assumptions tend to be applied (see Table 1.6).

Table 1.6 Descriptive Statistics of Environmental Disclosure Components

Variables	Obs	mean	sd	p25th	p50 th	p75 th	min	max
Panel: A Quantity								
Total Page	904	146.68	86.75	80	139.5	200	2	508
SR_Page	904	9.68	12.5	3	6	12	1	162
Total_Sentence	904	513.22	529.94	165	348.5	705	3	4,548
Total DISC	904	168.04	160.09	47.5	115	246.5	6	782
Panel: B Type of Information								
TOI1	904	112.9	106.58	36	80	161	0	739
TOI2	904	56.55	78.95	8	33	78	0	773
TOI3	904	3.63	6.57	0	2	4	0	70
Panel: C Managerial Orientation								
EXP	904	52.88	59.20	16	38	68	0	627
PROG	904	56.17	80.28	7	28	78	0	777
OBJ	904	61.25	75.76	9	33	91	0	649
RES	904	41.21	52.00	9	25	55	0	496

Notes: Panel A of this Table contains the information required to generate relative quantity (RQT) and density (DEN) indices. Panel B provides the material information for generating the type of information (TOI) index, while information in panel C will be used in generating the managerial orientation (MAN) index. All information provided in Table 1.6 refers to the number of sentences as the unit of analysis.

Table 1.6 displays the results of content analysis. We divide this information into three panels. Panel A presents the quantity of observations. We note that the total page of either stand-alone sustainability reports or sustainability information (environmental, social, and governance) in an annual report occupies 146 pages on average. Meanwhile, the sustainability-related information is recorded as occupying 9.6 pages on average. The total sentences dedicated to environmental-related information is 513 on average, whereas the total sentences relevant to the GRI-environmental disclosure framework (DISC) is documented as 168 on average. In Panel B, we report the data with respect to the type of information. Overall, our analysis of the type of information leads to the conclusion that the type of information provided in the sustainability reports is dominated by qualitative information (TOI1), with 112 sentences on average, followed by the sentences containing quantitative information (56 sentences on average) and monetary information (3 sentences on average). The next information in Panel C presents the managerial orientation-related information. In this panel, we classify the disclosed

sentences into the categories of *expectation* (52 sentences), *program* (56 sentences), *objective* (61 sentences), and *results* (41 sentences). Furthermore, Table 1.7 below highlights the unidimensional environmental disclosure indices generated from the information in Table 1.6.

Table 1.7 Descriptive Statistics of Environmental Disclosure Indices and Independent Variables

Variables	Obs	mean	sd	p25th	p50th	p75th	min	max
Panel 1: Disclosure Indices								
DISC	904	168.04	160.09	47.5	115	246.5	6	782
RQT	904	-3.49	135.08	-81.16	-14.78	52.39	-306.7	477.37
DEN	904	0.35	0.13	0.33	0.33	0.33	0.05	0.94
TOI	904	0.09	0.23	0.00	0.01	0.06	0.00	1.26
MAN	904	0.01	0.02	0.00	0.00	0.00	0.00	0.13
MAT	904	1.90	3.72	0.27	0.60	1.55	0.00	2.3
QUALITY	904	3.42	23.12	-4.70	0	8.65	-53.05	95.69
Panel 2: Independent and Control Variables								
SR	904	0.41	0.49	0	0	1	0	1
SA	904	0.59	0.49	0	1	1	0	1
ACCOUNTANT	904	0.46	0.50	0	0	1	0	1
CONSULTANT	904	0.13	0.32	0	0	0	0	1
LIMITED	904	0.54	0.50	0	1	1	0	1
REASONABLE	904	0.04	0.20	0	0	0	0	1
MIXED	904	0.01	0.08	0	0	0	0	1
AS_PERS	904	0.42	0.49	0	0	1	0	1
AS_AGE	904	5.11	5.48	0	3	10	0	16
ENVSCR	904	63.36	20.11	51.40	66.18	78.76	2.33	97.81
GRI	904	0.62	0.49	0	1	1	0	1
CR_BOARD	904	0.68	0.47	0	1	1	0	1
SIZE	904	9.70	0.91	9.14	9.70	10.31	6.54	12.67
AGE	904	22.97	19.29	10	18	27	3	140
LEVERAGE	904	0.34	9.52	0.22	0.56	1.13	-251.31	48.79
ROA	904	2.70	9.89	0.91	3.39	6.14	-79.75	68.71

Notes: Panel 1 shows the final data of disclosure quality indices consisting of relative quantity (RQT), density (DEN), type of information (TOI), managerial orientation (MAN), materiality (MAT), and the main dependent variable (QUALITY). Panel 2 presents the information of the main independent variables and control variables. All firm-level continues variables in Panel 1 and 2 are winsorised at the 1st and 99th percentiles.

Table 1.7 presents the descriptive information for the final environmental disclosure indices and the main independent variables of interest. We also use several control variables. The purpose of adding control variables (firm-specific) is to mitigate the likelihood of spurious regression correlations due to the problem of omitted variables bias. More specifically, Panel 1 in Table 1.7 provides five measures of unidimensional sustainability disclosure indices. We also report the multidimensional index (QUALITY) as the main proxy of environmental disclosure quality. Moreover, in Panel 2, it is worth reporting that 41% of the total sample

disclosed their environmental information in the form of stand-alone sustainability reports (SRs), whilst 59% of the sample disclosed their environmental information on a dedicated page of their annual report. Interestingly, 59% of the total sample also engaged in assurance practice (SA). Among the samples that had their sustainability reports assured, 46% used accounting firm services (ACCOUNTANT), while the other 13% decided to engage consultancy firms (CONSULTANT). In terms of the level of assurance engagement, 54% of firms engaged in a limited level (LIMITED), 4% in a reasonable level (REASONABLE), and 1% engaged in a combination of limited and reasonable levels (MIXED). We also provide information with respect to commitment to assurance during the observed period. In Table 1.7, it is noted that 42% of firms persistently and continuously assured their sustainability reports (AS_PERS), while 58% of the remaining firms did not continuously engage in the practice of assurance. To further strengthen the univariate analysis, we present the information regarding the first-time adoption of the practice of assurance (AS_AGE). According to the data, we report that most of the firms have engaged in the adoption of assurance for five years on average, in which the longest adoption has been conducted for 16 years.

Before proceeding to hypothesis testing, we provide information of the mean value of the environmental disclosure quality index (QUALITY), which is categorised based on the availability of sustainability assurance, the type of assurance provider, and the level of assurance. The quality of the environmental disclosure for firms engaging in assurance is higher than for firms that have not engaged in the practice. In this case, the average value of environmental disclosure quality (QUALITY) for companies without assurance is -1.883, while firms with assurance have a QUALITY value of 8.887 on average. We also carry out a *t*-test, and the un-tabulated output shows that there is a significant difference in terms of the environmental disclosure quality (QUALITY) between firms that have their sustainability reports assured and those without assurance. The results show that the quality of disclosure is

significantly higher for firms with assurance than for firms without assurance (t value = -5.940; $p < 0.01$). Furthermore, the information for environmental disclosure quality (QUALITY) is provided by comparing the quality of reports assured by accountants versus non-accountants and the quality of those reports without assurance. The disclosure quality of reports assured by accountants is 8.496 on average, while that of reports assured by consultants is 10.306 on average. More specifically, we also classify the disclosure quality based on the level of assurance engagement (limited, reasonable, mixed). First, the disclosure quality of firms that have their sustainability reports assured at the limited level is 9.527 on average. Second, the disclosure quality of firms with a reasonable level of assurance is 0.930 on average. Third, we report that the average disclosure quality of firms with a mixed level of assurance is 8.276 on average. In the next step, we provide the correlation matrix regarding the correlation between dependent and independent variables, as illustrated in Table 1.8.

Table 1.8 Correlation Matrix

No	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	QUALITY	1																
2	SA	0.201***	1															
3	ACCOUNTANT	0.142***	0.772***	1														
4	CONSULTANT	0.084*	0.318***	-0.357***	1													
5	LIMITED	0.206***	0.903***	0.690***	0.299***	1												
6	REASONABLE	-0.025	0.176***	0.141***	0.049	-0.232***	1											
7	MIXED	0.016	0.068*	0.088**	-0.031	-0.089**	-0.017	1										
8	AS_PERS	0.166***	0.710***	0.552***	0.220***	0.647***	0.115***	0.04	1									
9	AS_AGE	0.155***	0.697***	0.580***	0.160***	0.604***	0.192***	0.036	0.616***	1								
10	SR	0.123***	0.298***	0.269***	0.036	0.318***	-0.055	-0.013	0.199***	0.219***	1							
11	ENVSCR	0.103**	0.443***	0.361***	0.111***	0.427***	0.024	0.001	0.385***	0.523***	0.220***	1						
12	GRI	0.170***	0.459***	0.410***	0.062	0.406***	0.099**	0.036	0.335***	0.422***	0.399***	0.302***	1					
13	CR_BOARD	0.082*	0.518***	0.390***	0.179***	0.466***	0.088**	0.056	0.399***	0.495***	0.286***	0.268***	0.484***	1				
14	SIZE	0.05	0.515***	0.494***	0.02	0.455***	0.119***	0.026	0.388***	0.606***	0.232***	0.367***	0.435***	0.468***	1			
15	AGE	-0.039	0.099**	0.112***	-0.021	0.099**	0.023	-0.062	0.070*	0.226***	0.048	0.094**	0.059	-0.001	0.140***	1		
16	LEVERAGE	0.036	-0.039	0.029	-0.101**	-0.043	0.008	0.004	-0.06	-0.051	-0.039	-0.042	-0.032	0.012	-0.018	-0.031	1	
17	ROA	0	0.093**	0.109**	-0.025	0.065*	0.055	0.026	0.054	0.072*	0.055	-0.001	0.01	0.071*	0.148***	0.085*	-0.015	1

Notes: *** Significant at the 0.01 level. ** Significant at the 0.05 level. * Significant at the 0.10 level.

Table 1.8 illustrates the correlation matrix among dependent and independent variables. The variable SA, as one of the proxies of sustainability assurance, indicates a positive (0.201) and significant ($p < 0.01$) correlation with QUALITY (see Column 1). The second proxy of sustainability assurance is the type of assurance provider (ACCOUNTANT, CONSULTANT). Regarding the correlation matrix output, it is reported that ACCOUNTANT is positively and significantly ($p < 0.01$) correlated with QUALITY (0.142). Moreover, CONSULTANT shows a positive (0.084) and significant ($p < 0.1$) correlation with QUALITY. The third proxy is the level of assurance (LIMITED, REASONABLE, and MIXED). LIMITED indicates a positive (0.206) and significant ($p < 0.01$) correlation with QUALITY, whilst REASONABLE and MIXED show no correlation with QUALITY. In the fourth proxy, we use the commitment to assurance, in which AS_PERS and AS_AGE indicate positive (0.166; 0.155) and significant ($p < 0.01$) correlations with QUALITY. Additionally, we employed several sustainability report-related practices and firm characteristic variables as our control variables. To represent CSR practices, we use the variables SR, ENVPERF, GRI, and CR_BOARD. To represent firm characteristics with respect to financial information, we use SIZE (natural logarithm of the total assets), the AGE of the companies, LEVERAGE (the ratio of debt to equity), and ROA (the ratio of return on assets).

4.2. Multivariate Analysis

In this stage, we perform direct OLS testing to investigate the association of the main independent variables with the dependent variable. In order to get a clear and robust outcome, we run a panel-corrected standard error model which considers the role of control variables, year fixed-effects, and industry fixed-effects. The aim of inserting control variables is to address the endogeneity problems (omitted variable bias).

Table 1.9 Partial Test of SA Proxies on Environmental Disclosure Quality (QUALITY)

This Table reports the results of estimation using equation 1, 2, 3, and 4 (a, b). We do the partial test to examine our hypotheses. The proxies of sustainability assurance attributes (SA, ACCOUNTANT, CONSULTANT, LIMITED, REASONABLE, MIXED, AS_PERS, and AS_AGE) are partially examined on the multidimensional index of environmental disclosure quality (QUALITY). All variables are defined in Table 1.4. In the partial test, it is documented that several surrogate indicators of sustainability assurance (SA, ACCOUNTANT, CONSULTANT, LIMITED, AS_PERS, AS_AGE) display positive and significant association with QUALITY. All specifications are estimated using OLS regression and included year and industry fixed-effect.

VARIABLES	ASSET4 Sample				
	(1) Quality	(2) Quality	(3) Quality	(4) Quality	(5) Quality
SA	9.961*** (3.654)				
ACCOUNTANT		9.131*** (2.963)			
CONSULTANT		12.24*** (3.268)			
LIMITED			10.51*** (3.676)		
REASONABLE			2.912 (0.462)		
MIXED			11.86 (0.841)		
AS_PERS				9.949*** (3.816)	
AS_AGE					0.755** (2.110)
SR	2.480 (0.869)	2.561 (0.896)	2.065 (0.730)	3.034 (1.070)	3.416 (1.189)
ENVSCR	0.0303 (0.471)	0.0304 (0.473)	0.0260 (0.400)	0.0353 (0.560)	0.0221 (0.344)
GRI	6.320** (2.244)	6.472** (2.301)	6.490** (2.302)	7.092** (2.472)	7.249** (2.464)
CR_BOARD	-2.414 (-0.783)	-2.614 (-0.843)	-2.429 (-0.796)	-1.915 (-0.608)	-1.907 (-0.630)
SIZE	-2.365 (-1.324)	-2.129 (-1.162)	-2.250 (-1.258)	-2.133 (-1.201)	-2.724 (-1.381)
AGE	-0.0815 (-1.190)	-0.0806 (-1.171)	-0.0824 (-1.200)	-0.0792 (-1.167)	-0.110 (-1.651)
LEVERAGE	0.121*** (4.052)	0.132*** (3.994)	0.122*** (4.087)	0.126*** (4.207)	0.123*** (3.552)
ROA	-0.0481 (-0.806)	-0.0480 (-0.796)	-0.0462 (-0.777)	-0.0334 (-0.566)	-0.0209 (-0.343)
Constant	15.89 (1.064)	13.38 (0.864)	14.68 (0.981)	18.01 (1.186)	23.53 (1.355)
Observations	904	904	904	904	904
R-squared	0.077	0.079	0.082	0.076	0.067
Year FE	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
SE Clustered	YES	YES	YES	YES	YES

Notes: Robust t-statistics in parentheses. *** Significant at the 0.01 level, ** Significant at the 0.05 level, and * Significant at the 0.10 level respectively using a two-tail test.

Our hypothesis testing is based on the obtained empirical evidence in Table 1.9. We hypothesise that our proxies of sustainability assurance are positively associated with the multidimensional measure of environmental disclosure quality (QUALITY). First, we test

Hypothesis 1, the notion that there is a positive association between sustainability assurance (SA) and environmental disclosure quality (QUALITY) (see Column 1). The results show that SA is positively ($\beta = 9.961$) and significantly ($p < 0.01$) associated with QUALITY, meaning that Hypothesis 1 is supported. This finding provides support for the study of Moroney et al. (2011), which indicates a positive role played by assurance in the quality of voluntary environmental disclosure. In this respect, a rough test using dichotomous SA data predominantly provides evidence that the assurance practice plays an essential role in helping the report preparer to provide information disclosure more effectively.

In the next step, we examine Hypothesis 2, in which our notion is that assurance providers have a positive association with environmental disclosure quality (QUALITY). Recalling the univariate analysis output, we do recognise that our samples are mainly dominated by firms that have decided to assure their sustainability reports (59%). Consequently, we deliberately test for whether having a sustainability report assured by two types of assurance provider (ACCOUNTING and CONSULTANT) firms would result in a positive association with environmental disclosure QUALITY. The obtained result indicates that the assurance process provided by ACCOUNTING firms results in a positive ($\beta = 9.131$) and significant ($p < 0.01$) association with environmental disclosure quality (QUALITY) (see Column 2). To strengthen the empirical test, we also test to see if reports with CONSULTANT firms as the assurance provider are positively associated with environmental disclosure quality. The obtained output shows that the assurance process provided by CONSULTANT is positively ($\beta = 12.24$) and significantly ($p < 0.01$) associated with environmental disclosure QUALITY. These results provide support for Hypothesis 2, which infers that there is a positive and significant association between the type of assurance provider and environmental disclosure quality (QUALITY). Our findings in this context provide quite a relevant result compared with the findings of Moroney et al. (2011),

who concluded that there was no difference in the disclosure quality among those reports assured by accounting firms versus non-accounting firms.

To test Hypotheses 3, we investigate the association between the level of assurance (LIMITED, REASONABLE, MIXED) and environmental disclosure quality (QUALITY). The empirical test indicates that there is a positive ($\beta = 10.51$) and significant ($p < 0.01$) association between a LIMITED level of assurance and environmental disclosure QUALITY, indicating support for the first proxy of limited level of assurance. Meanwhile, the testing of the second and third proxies reveal that REASONABLE and MIXED levels of assurance do not show any association with environmental disclosure QUALITY, suggesting that the second and third proxies are unsupported (see Column 3). Thus, we draw a conclusion that hypothesis 3 is partially supported. In Hypothesis 4, we assume that there is a positive association between commitment to assurance (AS_PERS and AS_AGE) and environmental disclosure quality (QUALITY). As shown by Table 1.9 in Columns 4 and 5, it can be seen that the variables AS_PERS and AS_AGE are positively ($\beta = 9.949$; $\beta = 0.755$) and significantly ($p < 0.01$, $p < 0.05$) associated with QUALITY. These findings indicate that Hypothesis 4 is supported.

We also conduct a simultaneous, un-tabulated test by pooling together the proxies of sustainability assurance (SA, ACCOUNTANT, CONSULTANT, LIMITED, REASONABLE, MIXED, AS_PERS, AS_AGE) and further test them with the environmental disclosure quality index (QUALITY). Interestingly, the obtained output shows that only the variable AS_PERS consistently indicates a positive association with sustainability disclosure quality (QUALITY), while the other three proxies of sustainability assurance provide us with no significant association. Here, the signs of the coefficient beta of each main independent variable remain the same (positive). However, no statistical significance is found. We argue that the information, whether the sustainability report is

assured or not, is the fundamental information. However, the persistence of assurance engagement is even more important to convince users that the sustainability report has provided reliable information in its reporting practices over time. The other attributes of the assurance provider, namely the levels of assurance and the commitment to assurance, are considered of second importance by the public. In this regard, we may predict that the decision to practice assurance follows a sequential decision pattern (see the study of Simnett et al. (2009) for further discussion), in which the initial decision to disclose environmental information in sustainability reporting itself is an endogenous decision (choice). Moreover, the decision to assure the sustainability report via an independent third party is also endogenous (choice), particularly after firms run a thorough cost-benefit analysis. When firms have decided to engage in the assurance process to increase the quality, reliability, or credibility of the report, they still have to deal with several choices through management discretion: choices related to the option of assurance provider, the level of assurance, and whether the sustainability reporting in the consecutive years is assured. Therefore, in our findings, we note that the information regarding whether the sustainability reports have been assured or not is considered the most critical information. This is presumably necessary as a signal to stakeholders that the firm has been conducting proper sustainability reporting and that the reported information is deemed credible and reliable.

In order to obtain comprehensive results in examining our hypotheses, we further test four proxies of sustainability assurance practice using a lag model (one-year time lag). Overall, in the un-tabulated table of a partial test using lagged variables, we find that the lagged variables of SA, ACCOUNTANT, CONSULTANT, LIMITED, REASONABLE, MIXED, AS_PERS, and AS_AGE show positive and significant association with QUALITY (see Appendix 1). Next, we organise additional tests to provide corroborating

evidence. We further advance the testing to answer the proposed hypotheses by employing stepwise an OLS regression model (see Appendix 2), particularly to identify the change of the magnitudes and the coefficient values of the independent variables. The empirical OLS results remain consistent with the previous findings of our multivariate panel data analysis. Thus, we can report that the variable SA consistently shows a positive and significant association with environmental disclosure quality. However, this positive association only holds until we gradually insert the variable LIMITED. When we insert the next variable, SA no longer shows any significant association with QUALITY. Up until the stage at which we insert the variable AS_PERS, SA shows a consistent positive and significant association with QUALITY even after being controlled for by adding the control variables. A similar propensity appears when we conduct the stepwise regression using the lagged variables as the independent variables (see Appendix 3). In this phase, the previous information regarding sustainability assurance no longer shows a positive association with QUALITY when we insert the next main independent and control variables. However, interestingly, the variable LIMITED level of assurance shows a positive and significant association with QUALITY. This positive association also holds even after being controlled for by the control variables, indicating that the previous engagement of a LIMITED level of assurance positively increases the QUALITY of environmental-related information in the next reporting year. Moreover, as indicated by stepwise regression output using the contemporaneous variables, the stepwise regression using lagged variables also indicates a consistent positive association.

4.3. Discussion

In general, our results indicate that there is a positive association between sustainability assurance (SA) and environmental disclosure quality, providing support for

the study by Moroney et al. (2011) and an extension of the studies by Simnett et al. (2009) and Michelon et al. (2015). To empirically proof our hypotheses, we follow and further advance the studies of Moroney et al. (2011) and Michelon et al. (2015) by using the European panel dataset and considering the importance of material information in constructing the disclosure index. We restrict our sample to those companies operating in ESIs taken from 226 public companies in 24 European countries from 2014 through 2017. Based on the obtained empirical evidence, we conclude that sustainability assurance attributes are positively associated with environmental disclosure quality.

Apart from our empirical evidence, we do note that the practice of sustainability assurance is an external verification process that is expected to address the problem of the lack of credibility of voluntary reporting documents (Adams & Evans, 2004; Mercer, 2004; Simnett et al., 2009; Hodge et al., 2009; Martínez-Ferrero & García-Sánchez, 2016). Additionally, in this study, we assume that sustainability assurance can help to increase the quality of environmental disclosure quality. The association between sustainability assurance and environmental disclosure quality has previously been investigated by researchers. For instance, Moroney et al. (2011) found that voluntary assurance positively affected the quality of voluntary environmental disclosure, in which the presence of the assurance of voluntary environmental disclosures increased the amount of hard disclosure information in CSR reports in Australia. On the contrary, using the setting of a UK-based sample, Michelon et al. (2015) documented that sustainability assurance is not associated with CSR disclosure quality.

Reconsidering our potential contributions, we note that our study contributes to the debate on the role of sustainability assurance (SA) for environmental disclosure quality. Prior studies have offered conflicting findings with respect to the specific role played by SA in the variance of environmental disclosure quality (Moroney et al., 2011; Michelon et

al., 2015). The opposite findings of prior studies indicate that there was a problem of lack of completeness in sustainability reporting and that the practice of assurance was presumably unable to play any significant role in improving the quality of the reported information. Therefore, by expanding the context of the study using European ESIs, we claim that our study may better capture the essence of SA practice and its association with environmental disclosure quality in the European setting. In this debate, we provide clear evidence that sustainability assurance (SA) is positively associated with environmental disclosure quality.

Regarding the other contribution of our study, we introduce a new disclosure index which closely captures the aspect of materiality from the perspective of financial analysts in generating the multidimensional measure of disclosure quality index.. We are aware that the problems of disclosure activity are always related to the problems of insufficient provision of relevant information, excessive provision of irrelevant information, and inefficient communication of information. We assume that the GRI guideline framework referenced by firms when conducting reporting activities is too broad, although it is considered to be appropriate for global stakeholders. This is the underlying reason that we introduce the materiality aspect from the point of view of financial analysts. In Europe, the European Federation of Financial Analysts Societies (EFFAS) released a list of required non-financial (environmental) information. Analysts require this information as complementary data when dealing with earnings forecast activities. The analysts' KPIs are used in our content analysis, and we further run comparisons relative to the available information as coded using the GRI framework. Our materiality index (in an un-tabulated table) shows that the presence of sustainability assurance (SA) is not associated with the materiality index. However, the empirical test using a matched sample group shows that sustainability assurance conducted by accounting firms is positively associated with the

materiality index. In this regard, sustainability assurance performed by accountants helps firms to carry out more relevant disclosure of environmental information more effectively. These results suggest that the disclosed environmental information may be deemed relevant for financial analysts.

With respect to the implications of this research, our study covers all European firms operating in ESIs. The obtained empirical findings will be most relevant for financial planning activities, particularly for financial analysts when dealing with earnings forecasting. Prior studies have documented that the presence of non-financial information is positively associated with analysts' forecast accuracy (Dhaliwal et al., 2011, 2012). Unfortunately, the studies of Dhaliwal et al. (2011, 2012) are mainly driven by a simple dichotomous measure. It would be more interesting from the methodological point of view if their studies could better capture the relevance of non-financial disclosure (i.e., the quality of the reported information) and further link it with analyst forecast accuracy. We, therefore, suggest that future research develop more comprehensive measures of non-financial information to fill in this gap that exists in the literature.

5. ROBUSTNESS TESTS

5.1. Heckman Two-Stage Regression

We certainly realise that our multivariate panel data analysis per se does not seem sufficient to guarantee the robustness of our analysis. Reconsidering our hypotheses, our goal is to seek empirical evidence supporting the premise that sustainability assurance is positively associated with environmental disclosure quality. Given that the practice of providing assurance statements on disclosed environmental information depends on management discretion, the decision to publish non-financial information is also endogenous. Therefore, we are concerned about the endogeneity problem in our estimation

outcome. Since the sampling procedure in our final sample is also non-randomly assigned, there could be possibilities that firms with and without environmental information as covered by the ASSET4 database might behave differently in their sustainability reporting practices. Our assumption is that ASSET4 focuses the majority of its attention on covering large firms of public interest and regularly evaluates their environmental-impact activity. However, in fact, there are more and more companies recognising the importance and benefits of disclosing environmental information, but their sustainability-related performance is covered neither by ASSET4 nor Bloomberg. This circumstance may lead to a self-selection sample bias. Thus, we organise our supplementary analysis by initiating an investigation into the likelihood that a firm engages in non-financial information disclosure. We run a Heckman 2SLS procedure by first running a probit regression to gauge the likelihood of a firm disclosing non-financial information (Stage I). In this stage, we generate the inverse IMR, which could help to correct the problem of self-selection bias in the second stage (Stage II) (Tucker, 2010; Lennox et al., 2012). We further insert the IMR ratio into the various steps in the second stage and found that variable sustainability assurance (SA), GRI, and IMR show positive beta coefficients. However, only SA and GRI are significantly associated with environmental disclosure quality (QUALITY). The positive but insignificant coefficient of the IMR is consistent when we partially use five different attributes of sustainability assurance in the second-stage regressions (See Columns 2, 3, 4, 5, and 6). The positive but insignificant IMR indicates that we have no selection problem in our model, which allows us to proceed with the OLS regression analysis.

Table 1.10 Heckman Two-Stage Regression

This Table presents the Heckman two-stage regression procedures. In the first stage (I), we examine the likelihood to disclose sustainability reports and further generate the Inverse Mill Ratio (IMR) to be included in the second stage (II) of regression. All the specifications are estimated using OLS regression and included year and industry fixed-effect.

VARIABLES	(1) Stage I Likelihood to disclose SR report	(2) Stage II Disclosure quality with SA	(3) Stage II Disclosure quality with Type of assurance providers	(4) Stage II Disclosure quality with Level of assurance	(5) Stage II Disclosure quality with Assurance persistency	(6) Stage II Disclosure quality with Assurance Age
SA		8.894*** (4.013)				
ACCOUNTANT			8.071*** (3.291)			
CONSULTANT			11.73*** (3.222)			
LIMITED				9.399*** (4.050)		
REASONABLE				1.577 (0.255)		
MIXED				11.51 (0.806)		
AS_PERS					9.375*** (4.078)	
AS_AGE						0.525* (1.968)
IMR		1.794 (1.069)	1.801 (1.072)	1.537 (0.923)	2.058 (1.224)	2.269 (1.321)
SIZE	0.236** (2.295)					
ENVSCR	0.0100** (2.427)					
AGE	0.00281 (0.701)					
LEVERAGE	-0.00497 (-0.788)					
ROA	0.00630 (0.894)					
GRI		5.281** (1.987)	5.587** (2.095)	5.451** (2.057)	6.097** (2.318)	6.216** (2.191)
CR_BOARD		-3.114 (-1.031)	-3.207 (-1.057)	-3.088 (-1.032)	-2.580 (-0.843)	-2.079 (-0.703)
Constant	-3.786*** (-3.831)	-6.136* (-1.920)	-6.545** (-2.030)	-6.621** (-2.029)	-1.876 (-0.650)	-3.411 (-1.129)
Observations	904	904	904	904	904	904
R-squared		0.065	0.067	0.069	0.065	0.052
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
SE Clustered	NO	YES	YES	YES	YES	YES

Notes: *** Significant at the 0.01 level, ** Significant at the 0.05 level, and * Significant at the 0.10 level respectively using a two-tail test.

5.2. Propensity Score Matching

Subsequent to the Heckman procedure, we go through the next step by conducting a propensity score matching (PSM) test. It is discernible that there is a problem regarding the observable heterogeneity between firms with and without sustainability assurance of their sustainability reports. As asserted by Angrist and Pischke (2013), panel data analysis

offers a greater variation of variables and greater power of statistical estimation. The combination of cross-sectional and time-series data enables the estimation process to have greater variation that cannot be overcome simply by conducting either cross-sectional or time-series regressions per se. Regardless of its benefits, performing analysis with pooled cross-sectional and time-series samples also leads to a problem, namely that the control group may not be appropriate due to uncontrollable firm-specific characteristics that may differ from one firm to the next. In this case, we consider that reporting and non-reporting firms might conduct different types of reporting procedures prior to assurance engagement. Therefore, in light of previous studies that highlight the important issue of dealing with the endogeneity problem, we follow the studies of Dhaliwal et al. (2012) and Michelon et al. (2015).

In performing the matched-sample analysis, we match the sustainability reports of firms that have been assured and not assured by an independent third party. We perform the matching for each firm-year of the same country and industry closest in size in the same year. Initially, we obtain 583 observations for the treated group and 745 observations for the control group. After carrying out the procedures for the nearest-neighbour matching method, the number for the control group is reduced from 745 to 670, while the number for the treated group remains the same.

Furthermore, three sets of sample groups are employed to identify whether the different subsets of the sample provide us with consistent or inconsistent results. In the first empirical test, we use the complete panel dataset by controlling for the environmental performance information (ENVSCR) as provided by the ASSET4 database (see Table 1.9 for the ASSET4 sample group). The second group uses the complete sample with sustainability reports, even though some of these reports of particular European publicly listed companies are not covered by the ASSET4 database (we dropped the variable

ENVSCR). The last sample group is obtained via the propensity matching score based on company size. The details of the empirical test on the two subsamples are available as follows.

Table 1.11 Analysis with different sample groups

This Table reports the result of multivariate estimation using panel data analysis of equation 1, 2, 3, 4(a,b). The dependent variable is a multidimensional measure of environmental disclosure quality (QUALITY). In this empirical test, we partition the sample into two groups. The first group (column 1-5) is the full sample. The second group is the matched-sample generated from the propensity score matching (PSM) procedure (column 6-10). All the specifications are estimated using OLS regression and included year and industry fixed-effect.

VARIABLES	Full sample (N: 1,328)					PSM sample: (N:1,248)				
	(1) Quality	(2) Quality	(3) Quality	(4) Quality	(5) Quality	(6) Quality	(7) Quality	(8) Quality	(9) Quality	(10) Quality
SA	10.14*** (5.150)					10.50*** (5.270)				
ACCOUNTANT		9.778*** (4.355)					10.13*** (4.430)			
CONSULTANT		11.18*** (3.496)					11.56*** (3.601)			
LIMITED			10.50*** (5.083)					10.77*** (5.179)		
REASONABLE			4.888 (0.853)					5.973 (0.937)		
MIXED			12.08 (0.797)					12.48 (0.837)		
AS_PERS				9.054*** (1.877)					9.508*** (1.923)	
AS_AGE					0.847*** (0.291)					0.872*** (0.298)
CR_REP	1.125 (0.467)	1.142 (0.474)	0.838 (0.350)	1.607 (2.404)	1.893 (2.425)	1.306 (0.530)	1.330 (0.539)	1.118 (0.457)	1.804 (2.457)	2.181 (2.483)
GRI	6.028** (2.403)	6.075** (2.426)	6.139** (2.447)	7.015*** (2.526)	6.902*** (2.627)	5.838** (2.273)	5.875** (2.292)	5.861** (2.280)	6.830*** (2.592)	6.710** (2.699)
CR_BOARD	-0.681 (-0.314)	-0.737 (-0.339)	-0.660 (-0.307)	-0.0853 (2.212)	-0.819 (2.103)	-1.379 (-0.622)	-1.434 (-0.645)	-1.332 (-0.602)	-0.735 (2.264)	-1.485 (2.152)
SIZE	-2.513** (-2.418)	-2.463** (-2.346)	-2.479** (-2.383)	-2.105** (1.035)	-2.561** (1.114)	-2.167* (-1.844)	-2.100* (-1.762)	-2.121* (-1.801)	-1.751 (1.172)	-2.340* (1.282)
AGE	-0.0459 (-0.833)	-0.0452 (-0.816)	-0.0460 (-0.831)	-0.0423 (0.0551)	-0.0727 (0.0540)	-0.0490 (-0.871)	-0.0482 (-0.854)	-0.0484 (-0.860)	-0.0451 (0.0561)	-0.0759 (0.0550)
LEVERAGE	0.121*** (4.143)	0.126*** (3.972)	0.122*** (4.175)	0.125*** (0.0292)	0.126*** (0.0356)	0.124*** (4.148)	0.128*** (3.957)	0.124*** (4.171)	0.128*** (0.0297)	0.128*** (0.0355)
ROA	-0.0212 (-0.865)	-0.0213 (-0.874)	-0.0204 (-0.833)	-0.0213 (0.0244)	-0.0132 (0.0266)	-0.0318 (-1.066)	-0.0314 (-1.054)	-0.0311 (-1.045)	-0.0289 (0.0300)	-0.0262 (0.0327)
Constant	18.91** (2.085)	18.34** (1.990)	18.37** (2.019)	18.58** (9.197)	22.66** (9.869)	16.15 (1.555)	15.43 (1.456)	15.53 (1.488)	15.99 (10.57)	21.21* (11.52)
Observations	1,328	1,328	1,328	1,328	1,328	1,248	1,248	1,248	1,248	1,248
R-squared	0.089	0.089	0.091	0.080	0.077	0.093	0.094	0.095	0.084	0.079
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
SE Clustered	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust t-statistics in parentheses. *** Significant at the 0.01 level, ** Significant at the 0.05 level, and * Significant at the 0.10 level respectively using a two-tail test.

Table 1.11 contains a summary of the overall empirical test (using the full and PSM samples). Our initial sample in the main analysis is collected from 226 companies from 25 European countries (904 firm-year observations; see Table 1.9). To further prove that the

obtained main output in Table 1.9 provides robust outcomes, we perform a concurrent panel data analysis using the full sample and the PSM sample. The test using the full sample (332 companies; 1,328 observations) without controlling for environmental performance also returns similar results, in which SA is positively associated with QUALITY (see Table 1.11, Column 1). ACCOUNTANT, CONSULTANT, LIMITED, AS_PERS, and AS_AGE also indicate positive and significant association with QUALITY. Meanwhile, REASONABLE and MIXED do not show any association with QUALITY. To further confirm the robustness of our results in the full sample, we run the propensity score matching a sample group (312 companies; 1,248 observations) and find that the coefficient sign and the significance of the variable SA remains consistent with the previous test using a different group of samples (see Table 1.11, Column 6). Finally, the variables ACCOUNTANT, CONSULTANT, LIMITED, AS_PERS, and AS_AGE are also found to show a positive and significant association with QUALITY.

Our results suggest that sustainability assurance is associated with environmental disclosure quality. After empirically testing the proposed hypotheses with different types of assurance attributes, our study provides robust empirical evidence that the availability of sustainability assurance (SA) is positively associated with environmental disclosure quality. By employing different types of sample groups (ASSET4 sample, full sample, and PSM sample), the obtained empirical outputs also remain consistent, in which the presence of SA and its attributes (type of assurance provider, level of assurance, and commitment to assurance) are positively associated with environmental disclosure quality.

6. CONCLUDING REMARKS

We contribute to the call for empirical evidence on the relationship between sustainability assurance and environmental disclosure quality. Since the European directive 2014/95/EU was enacted, non-financial (environmental) information disclosure has become a piece of required information that is deemed relevant for stakeholders (European Commission, 2014). With this motivation, we provide evidence that firms with assurance statements in their sustainability reports provide higher environmental disclosure quality, suggesting support for prior literature debating the influence of sustainability assurance on environmental disclosure quality (Moroney et al., 2011; Michelon et al., 2015).

Several caveats apply to our empirical results and inferences. The first limitation is due to data limitations. We do recognise that not all firms among European ESIs have sufficient data, particularly due to missing observations. We reference our main data source against the availability of environmental performance scores in the ASSET4 database. Even though there are alternative environmental ratings (i.e., Bloomberg), we still could not have merged the data of Bloomberg and ASSET4 as the nature of the data collection and the methods used by these two database providers are different. We also note that even though, in general, the Bloomberg database covers more companies than ASSET4, yet, in the context of ESIs, ASSET4 offers more coverage than Bloomberg. The second limitation is related to the number of missing observations. We do acknowledge that apart from the limited number of observations, sustainability reports that are not published in English also limit our coverage. We report that there are 22 firms (88 firm-year observations) that have disclosed their non-financial information during the period of observations, although they are not written in English. We dropped these firms as their sustainability reports could not be analysed in the content analysis.

Moreover, we additionally draw several important things on the practical and policy implications. In the context of practical implication, we provide a thorough review on the Global Reporting Initiative (GRI) G4, Financial Analysts Key Performance Indicators (KPIs) and the role of sustainability assurance on the environmental disclosure quality. In addition to this, our results suggest that the presence of sustainability assurance is considered as relevant in increasing the credibility and reliability of the reported information. More in detail on the policy implication, our results help the policy makers to know better how environmental information reporting has evolved overtime. Thus, regulator may consider to provide rewards (e.g., incentive) to those compliant companies which truthfully and committedly engaged with responsible-environmental activities. Whilst, on the other hand, regulator may consider to design a clear procedure and type of plausible punishment (e.g., monetary or non-monetary) for the uncompliant companies.

7. REFERENCES

- Adams, C. A., & Evans, R. (2004). Accountability, completeness, credibility and the audit expectations gap. *Journal of Corporate Citizenship*, 14, 97–115. Retrieved from <http://greenleaf-publishing.com/content/pdfs/jcc14adam.pdf>
- Aerts, W., Cormier, D., & Magnan, M. (2008). Corporate environmental disclosure, financial markets and the media: An international perspective. *Ecological Economics*, 64(3), 643–659. <https://doi.org/10.1016/j.ecolecon.2007.04.012>
- Angrist, J. D., & Pischke, J.-S. (2013). *Mastering metrics: the path from cause to effect*. Princeton university press (Vol. 53). New Jersey: Princeton University Press. <https://doi.org/10.1017/CBO9781107415324.004>
- Axjonow, A., Ernstberger, J., & Pott, C. (2016). The impact of corporate social responsibility disclosure on corporate reputation: a non-professional stakeholder perspective. *Journal of Business Ethics*. <https://doi.org/10.1007/s10551-016-3225-4>
- Bagnoli, M., & Watts, S. G. (2017). Voluntary assurance of voluntary CSR disclosure. *Journal of Economics and Management Strategy*, 26(1), 205–230. <https://doi.org/10.1111/jems.12171>
- Ballou, B., Chen, P. C., Grenier, J. H., & Heitger, D. L. (2018). Corporate social responsibility assurance and reporting quality: Evidence from restatements. *Journal of Accounting and Public Policy*, 37(2), 167–188. <https://doi.org/10.1016/j.jaccpubpol.2018.02.001>
- Bebbington, J., Larrinaga, C., & Moneva, J. M. (2008). Corporate social reporting and reputation risk management. *Accounting, Auditing & Accountability Journal*, 21(3),

- 337–361. <https://doi.org/10.1108/09513570810863932>
- Beck, A. C., Campbell, D., & Shrives, P. J. (2010). Content analysis in environmental reporting research: enrichment and rehearsal of the method in a British-German context. *British Accounting Review*, 42(3), 207–222. <https://doi.org/10.1016/j.bar.2010.05.002>
- Beretta, S., & Bozzolan, S. (2008). Quality versus quantity: the case of forward-looking disclosure. *Journal of Accounting, Auditing & Finance*, 23(3), 333–376. <https://doi.org/10.1177/0148558X0802300304>
- Berthelot, S., Cormier, D., & Magnan, M. (2003). Environmental disclosure research : Review and synthesis. *Journal of Accounting Literature*, 22(October), 1–44.
- Braam, G. J. M., Uit De Weerd, L., Hauck, M., & Huijbregts, M. A. J. (2016). Determinants of corporate environmental reporting: The importance of environmental performance and assurance. *Journal of Cleaner Production*, 129, 724–734. <https://doi.org/10.1016/j.jclepro.2016.03.039>
- Brammer, S., & Pavelin, S. (2006). Corporate reputation and social performance: the importance of fit. *The Journal of Management Studies*, 43(3), 435–456. <https://doi.org/10.1111/j.1467-6486.2006.00597.x>
- Briem, C. R., & Wald, A. (2018). Implementing third-party assurance in integrated reporting: Companies' motivation and auditors' role. *Accounting, Auditing & Accountability Journal*, 31(5), 1461–1485. <https://doi.org/10.1108/AAAJ-03-2016-2447>
- Brown, N., & Deegan, C. (1998). The public disclosure of environmental performance information - A dual test of media agenda setting theory and legitimacy theory. *Accounting and Business Research*, 29(1), 21–41. <https://doi.org/10.1080/00014788.1998.9729564>
- Campbell, D. (2003). Effects in environmental disclosure: evidence for legitimacy theory? *Business Strategy and the Environment*, 12, 357–371. <https://doi.org/DOI:10.1002/bse.375> INTRA-
- Casey, R. J., & Grenier, J. H. (2015). Understanding and contributing to the enigma of corporate social responsibility (CSR) assurance in the United States. *Auditing: A Journal of Practice & Theory*, 34(1), 97–130. <https://doi.org/10.2308/ajpt-50736>
- Cheng, B., Ioannou, I., & Serafeim, G. (2014). Corporate social responsibility and access to finance. *Strategic Management*, 35(1), 1–23. <https://doi.org/DOI:10.1002/smj.2131>
- Cho, C. H., Michelon, G., & Patten, D. M. (2012). Impression management in sustainability reports: An empirical investigation of the use of graphs. *Accounting and the Public Interest*, 12(1), 16–37. <https://doi.org/10.2308/apin-10249>
- Cho, C. H., Michelon, G., Patten, D. M., & Roberts, R. W. (2014). CSR report assurance in the USA: an empirical investigation of determinants and effects. *Sustainability Accounting, Management and Policy Journal*, 5(2), 130–148. <https://doi.org/10.1108/SAMPJ-01-2014-0003>
- Cho, C. H., & Patten, D. M. (2007). The role of environmental disclosures as tools of legitimacy: A research note. *Accounting, Organizations and Society*, 32(7–8), 639–647. <https://doi.org/10.1016/j.aos.2006.09.009>
- Cho, C. H., Roberts, R. W., & Patten, D. M. (2010). The language of US corporate environmental disclosure. *Accounting, Organizations and Society*, 35(4), 431–443. <https://doi.org/10.1016/j.aos.2009.10.002>
- Clarkson, P. M., Li, Y., Richardson, G. D., & Vasvari, F. P. (2008). Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis. *Accounting, Organizations and Society*, 33, 303–327.

- <https://doi.org/10.1016/j.aos.2007.05.003>
- Claver, E., Lopez, M. D., Molina, J. F., & Tari, J. J. (2007). Environmental management and firm performance : A case study. *Journal of Environmental Management*, 84, 606–619. <https://doi.org/10.1016/j.jenvman.2006.09.012>
- Cohen, J. R., & Simnett, R. (2015). CSR and assurance services: A research agenda. *Auditing: A Journal of Practice & Theory*, 34(1), 59–74. <https://doi.org/10.2308/ajpt-50876>
- Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2011). Signaling theory: A review and assessment. *Journal of Management*, 37(1), 39–67. <https://doi.org/10.1177/0149206310388419>
- Coram, P. J., Monroe, G. S., & Woodliff, D. R. (2009). The value of assurance on voluntary nonfinancial disclosure: An experimental evaluation. *Auditing A Journal of Practice & Theory*, 28(1), 137–151. <https://doi.org/10.2308/aud.2009.28.1.137>
- Cormier, D., & Magnan, M. (2015). The economic relevance of environmental disclosure and its impact on corporate legitimacy: an empirical investigation. *Business Strategy and the Environment*, 24(6), 431–450. <https://doi.org/10.1002/bse.1829>
- Cormier, D., Magnan, M., & Van Velthoven, B. (2005). Environmental disclosure quality in large German companies: Economic incentives, public pressures or institutional conditions? *European Accounting Review*, 14(1), 3–39. <https://doi.org/10.1080/0963818042000339617>
- Corporate Register. (2008). *The CSR assurance statement report*. Corporate Register: London.
- Dando, N., & Swift, T. (2003). Transparency and assurance: Minding the credibility gap. *Journal of Business Ethics*, 44(2–3), 195–200. <https://doi.org/10.2307/25075028>
- Deegan, C. (2002). The legitimising effect of social and environmental disclosures - a theoretical foundation. *Accounting, Auditing & Accountability Journal*, 15(3), 282–311. <https://doi.org/10.1108/09513570210435852>
- Deegan, C., Cooper, B. J., & Shelly, M. (2006). An investigation of TBL report assurance statements: Australian evidence. *Australian Accounting Review*, 16(2), 2–18.
- Deegan, C., & Rankin, M. (1997). The materiality of environmental information to users of annual reports. *Accounting, Auditing & Accountability Journal*, 10(4), 562–583. <https://doi.org/10.1108/09513579710367485>
- Dhaliwal, D., Li, O. Z., Tsang, A., & Yang, Y. G. (2014). Corporate social responsibility disclosure and the cost of equity capital: The roles of stakeholder orientation and financial transparency. *Journal of Accounting and Public Policy*, 33, 328–355. <https://doi.org/10.1016/j.jaccpubpol.2014.04.006>
- Dhaliwal, D. S., Li, O. Z., Tsang, A., & Yang, Y. G. (2011). Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting. *The Accounting Review*, 86(1), 59–100. <https://doi.org/10.2308/accr.00000005>
- Dhaliwal, D. S., Radhakrishnan, S., Tsang, A., & Yang, Y. G. (2012). Nonfinancial disclosure and analyst forecast accuracy: International evidence on corporate social responsibility disclosure. *The Accounting Review*, 87(3), 723–759. <https://doi.org/10.2308/accr-10218>
- European Commission. (2014). Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014. *Official Journal of the European Union*. https://doi.org/http://eur-lex.europa.eu/pri/en/oj/dat/2003/l_285/l_28520031101en00330037.pdf
- Fabrizio, K. R., & Kim, E.-H. (2019). Reluctant disclosure and transparency: Evidence from environmental disclosures. *Organization Science, Article in*(July), 1–25.

- <https://doi.org/10.1287/orsc.2019.1298>
- Faisal, F., Tower, G., & Rusmin, R. (2012). Legitimising corporate sustainability reporting throughout the world. *Australasian Accounting, Business and Finance Journal*, 6(2), 19–34. Retrieved from <http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1335&context=aabfj>
- Gillet-Monjarret, C. (2015). Assurance of sustainability information: A study of media pressure. *Accounting in Europe*, 12(1), 87–105. <https://doi.org/10.1080/17449480.2015.1036894>
- GRI. (2014). G4 Sustainability Reporting Guidelines - Reporting Principles and Standard Disclosures. *Global Reporting Initiative*, 1–97. <https://doi.org/https://www.globalreporting.org/resourcelibrary/G3-Guidelines-Incl-Technical-Protocol.pdf>
- Gürtürk, A., & Hahn, R. (2016). An empirical assessment of assurance statements in sustainability reports: smoke screens or enlightening information? *Journal of Cleaner Production*, 136, 30–41. <https://doi.org/10.1016/j.jclepro.2015.09.089>
- Guthrie, J., Petty, R., Yongvanich, K., & Ricceri, F. (2004). Using content analysis as a research method to inquire into intellectual capital reporting. *Journal of Intellectual Capital*, 5(2), 282–293. <https://doi.org/10.1108/14691930410533704>
- Hasseldine, J., Salama, A. I., & Toms, J. S. (2005). Quantity versus quality: the impact of environmental disclosures on the reputations of UK Plcs. *British Accounting Review*, 37(2), 231–248. <https://doi.org/10.1016/j.bar.2004.10.003>
- Hirst, D. E., Koonce, L., & Miller, J. S. (1999). The joint effect of management's prior forecast accuracy and the form of its financial forecasts on investor judgment. *Journal of Accounting Research*, 37(1999), 101–124. <https://doi.org/10.2139/ssrn.145610>
- Hodge, K., Subramaniam, N., & Stewart, J. (2009). Assurance of sustainability reports: Impact on report users' confidence and perceptions of information credibility. *Australian Accounting Review*, 19(3), 178–194. <https://doi.org/10.1111/j.1835-2561.2009.00056.x>
- Hoffmann, E., Dietsche, C., & Hobelsberger, C. (2018). Between mandatory and voluntary: non-financial reporting by German companies. *Sustainability Management Forum*, 26(1–4), 47–63. <https://doi.org/10.1007/s00550-018-0479-6>
- Holm, C., & Rikhardsson, P. (2008). Experienced and novice investors: Does environmental information influence investment allocation decisions? *European Accounting Review*, 17(3), 537–557. <https://doi.org/10.1080/09638180802016627>
- Huggins, A., Green, W. J., & Simnett, R. (2011). The competitive market for assurance engagements on greenhouse gas statements: Is there a role for assurers from the accounting profession? *Current Issues in Auditing*, 5(2), A1–A12. <https://doi.org/10.2308/ciia-50083>
- Hummel, K., Schlick, C., & Fifka, M. (2017). The role of sustainability performance and accounting assurers in sustainability assurance engagements. *Journal of Business Ethics*, 4(17), 1–25. <https://doi.org/10.1007/s10551-016-3410-5>
- Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4), 305–360. [https://doi.org/10.1016/0304-405X\(76\)90026-X](https://doi.org/10.1016/0304-405X(76)90026-X)
- Junior, R. M., & Best, P. (2017). Article information : GRI G4 content index : does it improve credibility and change the expectation – performance gap of GRI-assured sustainability reports ? *Sustainability Accounting, Management and Policy Journal*, 8(5), 571–594.
- Junior, R. M., Best, P. J., & Cotter, J. (2014). Sustainability reporting and assurance: A

- historical analysis on a world-wide phenomenon. *Journal of Business Ethics*, 120(1), 1–11. <https://doi.org/10.1007/s10551-013-1637-y>
- Khan, M., Serafeim, G., & Yoon, A. (2016). Corporate sustainability: First evidence on materiality. *The Accounting Review*, 91(6), 1697–1724. <https://doi.org/https://doi.org/10.2308/accr-51383>
- Kolk, A., & Perego, P. (2010). Determinants of the adoption of sustainability assurance. *Business Strategy and the Environment*, 19(3), 182–198. <https://doi.org/http://dx.doi.org/10.1016/j.tele.2004.07.001>
- KPMG. (2017). *The KPMG Survey of Corporate Responsibility Reporting 2017*. KPMG. <https://doi.org/10.1038/nnano.2013.238>
- Krippendorff, K. (2004). Reliability in content analysis: Some common misconceptions and recommendations. *Human Communication Research*. <https://doi.org/10.1093/hcr/30.3.411>
- Lennox, C. S., Francis, J. R., & Wang, Z. (2012). Selection models in accounting research. *The Accounting Review*, 87(2), 589–616. <https://doi.org/10.2308/accr-10195>
- Li, F. (2010). The information content of forward- looking statements in corporate filings-A naïve bayesian machine learning approach. *Journal of Accounting Research*, 48(5), 1049–1102. <https://doi.org/10.1111/j.1475-679X.2010.00382.x>
- Mahoney, L. S., Thorne, L., Cecil, L., & LaGore, W. (2013). A research note on standalone corporate social responsibility reports: signaling or greenwashing? *Critical Perspectives on Accounting*, 24(4–5), 350–359. <https://doi.org/10.1016/j.cpa.2012.09.008>
- Manetti, G., & Becatti, L. (2009). Assurance services for sustainability reports: Standards and empirical evidence. *Journal of Business Ethics*, 87(1), 289–298. <https://doi.org/10.1007/s10551-008-9809-x>
- Manurung, A. M., & Basuki, H. (2010). An analytical assessment of assurance practices in social environmental and sustainable reporting in the United Kingdom and North America. *Gadjah Mada International Journal of Business*, 12(1), 75–115.
- Martínez-Ferrero, J., & García-Sánchez, I. M. (2016). The level of sustainability assurance: The effects of brand reputation and industry specialisation of assurance providers. *Journal of Business Ethics*, pp. 1–20. <https://doi.org/10.1007/s10551-016-3159-x>
- Mercer, M. (2004). How do investors assess the credibility of management disclosures? *Accounting Horizons*, 18(3), 185–196. <https://doi.org/10.2308/acch.2004.18.3.185>
- Merkel-Davies, D. M., & Brennan, N. M. (2007). Discretionary disclosure strategies in corporate narratives : incremental information or impression management ? *Journal of Accounting Literature*, 26, 116–196. Retrieved from <http://hdl.handle.net/10197/2907>
- Michelon, G., Patten, D. M., & Romi, A. M. (2018). Creating legitimacy for sustainability assurance practices: Evidence from sustainability restatements. *European Accounting Review*, 8180(May), 1–28. <https://doi.org/10.1080/09638180.2018.1469424>
- Michelon, G., Pilonato, S., & Ricceri, F. (2015). CSR reporting practices and the quality of disclosure: An empirical analysis. *Critical Perspectives on Accounting*, 33, 59–78. <https://doi.org/10.1016/j.cpa.2014.10.003>
- Michelon, G., Pilonato, S., Ricceri, F., & Roberts, R. W. (2016). Behind camouflaging: Traditional and innovative theoretical perspectives in social and environmental accounting research. *Sustainability Accounting, Management and Policy Journal*, 7(1), 2–25. <https://doi.org/10.1108/09574090910954864>

- Milne, M. J., & Patten, D. M. (2002). Securing organizational legitimacy: An experimental decision case examining the impact of environmental disclosures. *Accounting, Auditing & Accountability Journal*, 15(3), 372–405. <https://doi.org/DOI.10.1108/09513570210435889>
- Mock, T. J., Strohm, C., & Swartz, K. M. (2007). An examination of worldwide assured sustainability reporting. *Australian Accounting Review*, 17(41), 67–77. <https://doi.org/10.1111/j.1835-2561.2007.tb00455.x>
- Moneva, M., Archel, P., & Correa, C. (2006). GRI and the camouflaging of corporate unsustainability. *M 30 (2006) 121–137 GRI*, 30, 121–137. <https://doi.org/10.1016/j.accfor.2006.02.001>
- Moroney, R., Windsor, C., & Aw, Y. T. (2011). Evidence of assurance enhancing the quality of voluntary environmental disclosures: An empirical analysis. *Accounting and Finance*, 52(March 2011), 903–939. <https://doi.org/10.1111/j.1467-629X.2011.00413.x>
- O'dwyer, B. (2011). The case of sustainability assurance: Constructing a new assurance service. *Contemporary Accounting Research*, 28(4), 1230–1266. <https://doi.org/10.1111/j.1911-3846.2011.01108.x>
- O'Dwyer, B., & Owen, D. (2007). Seeking stakeholder-centric sustainability assurance. *Journal of Corporate Citizenship*, 2007(25), 18. [https://doi.org/http://dx.doi.org/10.9774/GLEAF.4700.2007.sp.00009](https://doi.org/<a href='\)
- O'Dwyer, B., & Owen, D. L. (2005). Assurance statement practice in environmental, social and sustainability reporting: A critical evaluation. *British Accounting Review*, 37(2), 205–229. <https://doi.org/10.1016/j.bar.2005.01.005>
- O'Dwyer, B., Owen, D., & Unerman, J. (2011). Seeking legitimacy for new assurance forms: The case of assurance on sustainability reporting. *Accounting, Organizations and Society*, 36(1), 31–52. <https://doi.org/10.1016/j.aos.2011.01.002>
- Owen, D. L., Swift, T. A., Humphrey, C., & Bowerman, M. (2000). The new social audits: accountability, managerial capture or the agenda of social champions? *European Accounting Review*, 9(1), 81–98. <https://doi.org/10.1080/096381800407950>
- Park, J., & Brorson, T. (2005). Experiences of and views on third-party assurance of corporate environmental and sustainability reports. *Journal of Cleaner Production*, 13(10–11), 1095–1106. <https://doi.org/10.1016/j.jclepro.2004.12.006>
- Patten, D. M. (1991). Exposure, legitimacy, and social disclosure. *Journal of Accounting and Public Policy*, 10(4), 297–308. [https://doi.org/10.1016/0278-4254\(91\)90003-3](https://doi.org/10.1016/0278-4254(91)90003-3)
- Patten, D. M. (1992). Intra-industry environmental disclosures in response to the Alaskan oil spill: A note on legitimacy theory. *Accounting, Organizations and Society*, 17(5), 471–475. [https://doi.org/10.1016/0361-3682\(92\)90042-Q](https://doi.org/10.1016/0361-3682(92)90042-Q)
- Perego, Paolo, & Kolk, A. (2012). Multinationals' accountability on sustainability: The evolution of third-party assurance of sustainability reports. *Journal of Business Ethics*, 110(2), 173–190. <https://doi.org/10.1007/s10551-012-1420-5>
- Perego, Paulo. (2009). Causes and consequences of choosing different assurance providers : An international study of sustainability reporting. *International Journal of Management*, 26(3), 412–425.
- Pflugrath, G., Roebuck, P., & Simnett, R. (2011). Impact of assurance and assurer's professional affiliation on financial analysts' assessment of credibility of corporate social responsibility information. *Auditing: A Journal of Practice & Theory*, 30(3), 239–254. <https://doi.org/10.2308/ajpt-10047>
- Pope, S., & Wæraas, A. (2016). CSR-washing is rare: a conceptual framework, literature

- review, and critique. *Journal of Business Ethics*, 137(1), 173–193.
<https://doi.org/10.1007/s10551-015-2546-z>
- Rodrigue, M., Magnan, M., & Cho, C. H. (2013). Is environmental governance substantive or symbolic? an empirical investigation. *Journal of Business Ethics*, 114(1), 107–129. <https://doi.org/10.1007/s10551-012-1331-5>
- Ruhnke, K., & Gabriel, A. (2013). Determinants of voluntary assurance on sustainability reports: an empirical analysis. *Journal of Business Economics*, 83(9), 1063–1091.
<https://doi.org/10.1007/s11573-013-0686-0>
- Schneider, T., Michelon, G., & Paananen, M. (2018). Environmental and social matters in mandatory corporate reporting: An academic note. *Accounting Perspective*, 17(2), 275–305. <https://doi.org/10.1111/1911-3838.12173>
- Sierra, L., Zorio, A., & García-Benau, M. A. (2013). Sustainable development and assurance of corporate social responsibility reports published by Ibex-35 companies. *Corporate Social Responsibility and Environmental Management*, 20(6), 359–370.
<https://doi.org/10.1002/csr.1303>
- Simnett, R. (2012). Assurance of sustainability reports Revision of ISAE 3000 and associated research opportunities. *Sustainability Accounting, Management and Policy Journal*, 3(1), 89–98. <https://doi.org/10.1108/20408021211223570>
- Simnett, R., Vanstraelen, A., & Chua, W. F. (2009). Assurance on sustainability reports: An international comparison. *The Accounting Review*, 84(3), 937–967.
<https://doi.org/10.2308/accr.2009.84.3.937>
- Simpson, A. (2010). Analysts' use of nonfinancial information disclosures. *Contemporary Accounting Research*, 27(1), 249–288. <https://doi.org/10.1111/j.1911-3846.2010.01008.x>
- Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of Management Review*, 20(3), 571–610.
<https://doi.org/10.5465/AMR.1995.9508080331>
- Tang, A. K. Y., Lai, K. H., & Cheng, T. C. E. (2012). Environmental governance of enterprises and their economic upshot through corporate reputation and customer satisfaction. *Business Strategy and the Environment*, 21(6), 401–411.
<https://doi.org/10.1002/bse.1733>
- Trotman, A. J., & Trotman, K. T. (2015). Internal audit's role in GHG emissions and energy reporting: Evidence from audit committees, senior accountants, and internal auditors. *Auditing: A Journal of Practice & Theory*, 34(1), 199–230.
<https://doi.org/10.2308/ajpt-50675>
- Tucker, J. W. (2010). Selection bias and econometric remedies in accounting and finance research. *Journal of Accounting Literature*, 29(1), 31–57.
<https://doi.org/10.1016/j.bmc.2009.11.051>
- Wong, R., & Millington, A. (2014). Corporate social disclosures: A user perspective on assurance. *Accounting, Auditing & Accountability Journal*, 27(5), 863–887.
<https://doi.org/10.1108/AAAJ-06-2013-1389>

CHAPTER II

Sustainability Disclosure Quality, Sustainability Assurance and Analyst Forecast Accuracy: Empirical Investigation of European Environmentally Sensitive Industries

Abstract

Our study investigates the association between sustainability disclosure quality (environmentally-related information) and analyst forecast accuracy on a sample of 177 European listed companies' belonging to Environmentally Sensitive Industries (ESIs). More in details, we test whether the sustainability assurance practice moderates the relationship between sustainability disclosure quality and analyst forecast accuracy (proxied by analyst forecast error). Results show a positive (negative) association between sustainability disclosure quality and analyst forecast accuracy (forecast error), and this positive association is stronger when the sustainability report is accompanied by an assurance statement. Thus, findings suggest that the disclosure of sustainability-related information to the public reduces the level of information asymmetry. Moreover, results suggest that the presence of an assurance statement may be considered by financial analysts as a signal that increases the credibility and reliability of sustainability-related information.

Keywords: Sustainability disclosure quality, sustainability assurance, forecast accuracy

1. INTRODUCTION

Research shows that the condition of information asymmetry is affected by the availability of relevant information in the market, either financial or non-financial in nature (Cormier & Magnan, 2007; Carnevale & Mazzuca, 2014; Miralles-Quiros, Miralles-Quiros, & Arraiano, 2017). It is already studied by the prior works of literature along with financial information, non-financial information should also be taken into account by the companies within their external reporting processes (Cho, Lee, & Pfeiffer, 2013; Cheng, Ioannou, & Serafeim, 2014; Dhaliwal, Li, Tsang, & Yang, 2014; Bagnoli & Watts, 2017). This line of research stream typically assumes that non-financial information is value-relevant and acts as incremental information for the stakeholders (i.e., financial analyst) to better evaluate and assess the potential risks and opportunities associated to firms' performance (Calabrese, Costa, & Rosati, 2015).

The relevance of non-financial information can refer to different subjects such as environmental, social, and governance. In a particular case, information on the sustainability dimension (environmental-related issue) is relevant for companies operating in the environmentally sensitive industries (ESIs) - i.e. aerospace and defense, chemicals, forestry and paper, metal, mining, oil and gas, pharmaceuticals, and utilities - concern more on the sustainability issues if compared to their non-ESI peers (Cho & Patten, 2007; Aerts & Cormier, 2009).

Regardless the ongoing investigation on the value-relevant of environmental information in ESI and non-ESI industries, up to this point, debate still exists on whether environmental-related information is value-relevant for a particular type of stakeholders, i.e. financial analysts. Prior studies have documented contradicts and inconclusive results. Some studies reported that environmental information disclosure has negative association with share price volatility (Feldman, Soyka, & Ameer, 1997) and stock price (Hassel, Nilsson, & Nyquist, 2005). While, on the other hand, the issuance of Corporate Environmental Report (CER) as the co-efficiency business strategy⁵ emerges as a component that is positively associated with stock price (Sinkin, Wright, & Burnett, 2008). The study of Moneva & Cuellar, (2009) in the same spirit proof that environmental performance through the environmental disclosure quality (i.e., environmental policy, environmental management system, environmental investment, environmental expenditures, environmental liabilities) showed positive relationship with stock price. Plumlee, Brown, Hayes, & Marshall, (2015) further reported that voluntary environmental disclosure (using GRI disclosure framework) is associated with reduced cost of equity capital, higher stock price, and higher expected future cash flow. In more particular type of

⁵ Co-efficiency business strategy according to Sinkin et al., (2008) is a process that firms seek to maximize the effectiveness of business process while minimizing their impacts on the environment.

environmental information disclosure, the study of Matsumura, Prakash, & Vera-Muñoz, (2014) provided evidence that carbon emissions and carbon disclosure are associated with higher share price. Interestingly, the study on the nexus between corporate environmental disclosure-firms earnings and corporate environmental disclosure-stock price also suggest inconclusive results, particularly due to the country-specific context (different reporting system and different regimes) that may affect environmental reporting in different countries (Cormier & Magnan, 2007).

An increasing number of profit and non-profit organizations (e.g., Corporate Register, EFFAS, GRI, IFAC, KPMG, professional accountants, and consultants) have been recommending to firms disclosing their environmental information, so as to allow the report users to better evaluate firms' performance and risks and opportunities related to environmental sustainability (Calabrese et al., 2015). More importantly, the European Commission (2014) enacted directive 2014/95/EU requiring European companies with more than 500 employees⁶ to mandatorily disclose their non-financial and diversity information to public.

Up to three decades ago, financial analysts relied on financial information when dealing with earnings forecast, investment recommendation, and prediction on corporate bankruptcy (Altman, 1968; Dugar & Nathan, 1995; Ohlson, 1980). However, more recent research shows that financial analysts are starting to recognize the complementarity and the value relevance of non-financial (economics, environmental, social, and governance-related information) information (Lang, Lundholm, & Lang, 1996; Lang & Lundholm, 2000; Ioannou & Serafeim, 2014; Fatemi, Glaum, & Kaiser, 2018; Yoon, Lee, & Ryan, 2018; Muslu, Mutlu, Radhakrishnan, & Tsang, 2019).

⁶ The transitional provision in Law for several countries such as Sweden, Iceland, and Spain would apply to all companies with more than 250 workers, that are deemed to be public-interest entities.

Also in the light of the recent European Commission directive, this study aims to understand whether environmental information is value-relevant for financial analyst. More specifically, we study the relationship between environmental disclosure quality and analysts forecast accuracy. At the best of our knowledge, to date, few studies have investigated this relationship. One of these is Dhaliwal et al., (2012), which specifically investigated the association between the presence of sustainability information and analyst forecast accuracy in an international sample of US, Asian, African, and European companies. They provided initial evidence that non-financial information disclosure is deemed as value-relevant by financial analysts. However, Baumeister & Gutsche, (2017) found that CSR report quality is positively associated with analyst forecast errors as the financial analyst is more likely to overestimate the earnings.

Interestingly, the study of Dhaliwal et al., (2012) only adopted a binary variable as the measure of non-financial information (1 if the company issued a stand-alone non-financial report; 0 otherwise). Whilst, the study of Baumeister & Gutsche, (2017) employed CSR-Sustainability monitor ranking (i.e., the completeness of CSR contextual elements such as; environmental, charity, labor relations, governance, human right, anti-corruption, codes of conduct) as the measure of CSR report quality. The different results and measures of these studies provide room for further empirical investigation on the relationship between non-financial information and analyst forecast accuracy. Given that, using a sample of European ESIs companies, we test if a more refined measure of disclosure quality can provide further insights on the significance of this relationship. Hereby, we adopt CSR disclosure indices from the study of Michelon, Pilonato, & Ricceri, (2015) as the alternate measures of non-financial information used by Dhaliwal et al., (2012). We custom our disclosure index to take into account “materiality” for this type of stakeholders, i.e., the

environmental non-financial Key Performance Indicators (KPIs) required by the European Federation of Financial Analyst Societies (EFFAS).

In terms of the setting of study, we choose Environmentally Sensitive Industries (ESIs) because as companies operating in these industries are more concerned by the environmental impact of their activities. As reported by Claver, Lopez, Molina, & Tari, (2007) there are various negative impacts related, for instance, to the overuse of natural resources from the environment by the companies operating in the environmentally sensitive industries. The exploitation and abusive of water, soil, air, vegetation, fauna, and landscape might end up with the problems of resources exhaustion, damage to aquatic life, lethal effect to flora and fauna, loss of valuable ecosystem, and even linked to the human health. A recent study of Cormier & Magnan, (2015) highlighted that the essence of disclosing truthful activities and impacts regarding the use of natural resources in the ESI industries need to be done to help the stakeholder to reduce the potential agency conflict due to the asymmetric information between companies and public (e.g., financial analyst).

Regardless the essence of environmental disclosure quality, a burgeoning number of literature have also documented that environmental reporting faces strong criticism in relation to its utilization as reputation risk management tool (Bebbington, Larrinaga-González, & Moneva-Abadía, 2008; Bebbington, Larrinaga, & Moneva, 2008; Unerman, 2008), impression management (Hooghiemstra, 2000; Osma & Guillamón-Saorín, 2011; Cho, Michelon, & Patten, 2012), camouflaging, and hypocrisy (Michelon, Pilonato, Ricceri, & Roberts, 2016). Given these problems, external verification on the reported non-financial information, i.e., sustainability assurance, is recommended to increase the credibility and reliability of the reported non-financial information (Mercer, 2004; Coram et al., 2009; GRI, 2014). According to Birkey, Michelon, Patten, & Sankara, (2016) the number of firms voluntarily seeking assurance for their non-financial information is

increasing. They pointed out that the need for voluntary assurance is mainly driven by the motive to address public's concerns on the credibility and completeness of information. We, therefore, investigate two research questions. First, we study whether environmental disclosure quality is associated with analyst forecast accuracy. Second, we study if the presence of sustainability assurance appears as a moderating factor that may enhance the value-relevant of environmental information to financial analyst.

Our empirical results show that environmental disclosure quality is positively associated with analyst forecast accuracy. In regards to the moderating role of external verification of the disclosed information, we find that the interaction of environmental disclosure quality and sustainability assurance appears to increase the analyst earnings forecast accuracy. Further additional analysis is conducted by considering analyst earnings forecast dispersion as an alternate measure of analyst forecast accuracy, in which the obtained results are consistent with the main test.

The remainder of this paper is structured as follows. Section two presents the literature review and develops the research hypotheses. Section three deals with the research method, including sample selection procedure, regression modeling, and statistical test relevant to the hypotheses testing. Section four presents the results of the study and additional analysis. Section five discusses them against previous relevant literature and presents concluding remarks.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1. Theoretical Framework

Our theoretical framework relies on the agency and signaling theories as the fundamental base of hypotheses development. In particular, according to Ruhnke and Gabriel (2013) there are two conditions that may explain the possible relationship between

environmental disclosure quality, sustainability assurance and the reduction of asymmetric information between agent and principal. Through the mechanism of agency costs and signalling-level reporting, Ruhnke and Gabriel (2013) documented that there is variation in the signalling level of information disclosure and voluntary assurance. The higher the degree of conflict of interest and information asymmetry among the stakeholders (agent and principal), the higher potential benefits that can be realised as a result of assurance engagement. In this context, we argue that the benefit as the result of assurance practice is important for financial analyst as one of stakeholders. Also, as affirmed by Bagnoli and Watts (2017), it is the company (agent) that best knows its chosen level of environmentally responsible activities, while the audience of information (principals, financial analyst, general stakeholders, and so forth) does not observe this choice.

More specifically on the informational gap concern as the consequence of agency problem issue, Bagnoli and Watts (2017) explained “asymmetry information” as a condition where if compared to external stakeholders, companies have greater level of knowledge in regards to (environmental dimension of) their performance. Thus, if non-financial (environmental) information is value-relevant, its disclosure is expected to reduce the informational gap between the companies, report preparers, and financial analyst, the report users (Cho et al., 2013; Bagnoli & Watts, 2017; Cuadrado-Ballesteros, Martínez-Ferrero, & García-Sánchez, 2017). On the same line of reasoning, the reported non-financial information is commonly criticized due to the lack of credibility of information. Therefore, signaling theory states that the assurance practice can be considered as a signal to increase the report user confidence. In this regards, the external verification on the reported non-financial information could be a venue to convey a signal that the company has more superior social, and environmental strategy to the market (Hasseldine et al., 2005;

Tang et al., 2012; Ruhnke & Gabriel, 2013; Cho et al., 2014; Lys, Naughton, & Wang, 2015; Bagnoli & Watts, 2017).

Agency and signaling theory bridge the motives behind companies' decision to dealing with non-financial (i.e., environmental) disclosure activities and its implication on the stakeholders (i.e., financial analyst) and market outcomes. Therefore, we start the literature and hypotheses development section by presenting the relationship between our measure of environmental disclosure quality, analyst forecast accuracy, and sustainability assurance. Figure 2.1 illustrates.

Figure 2.1 Research model

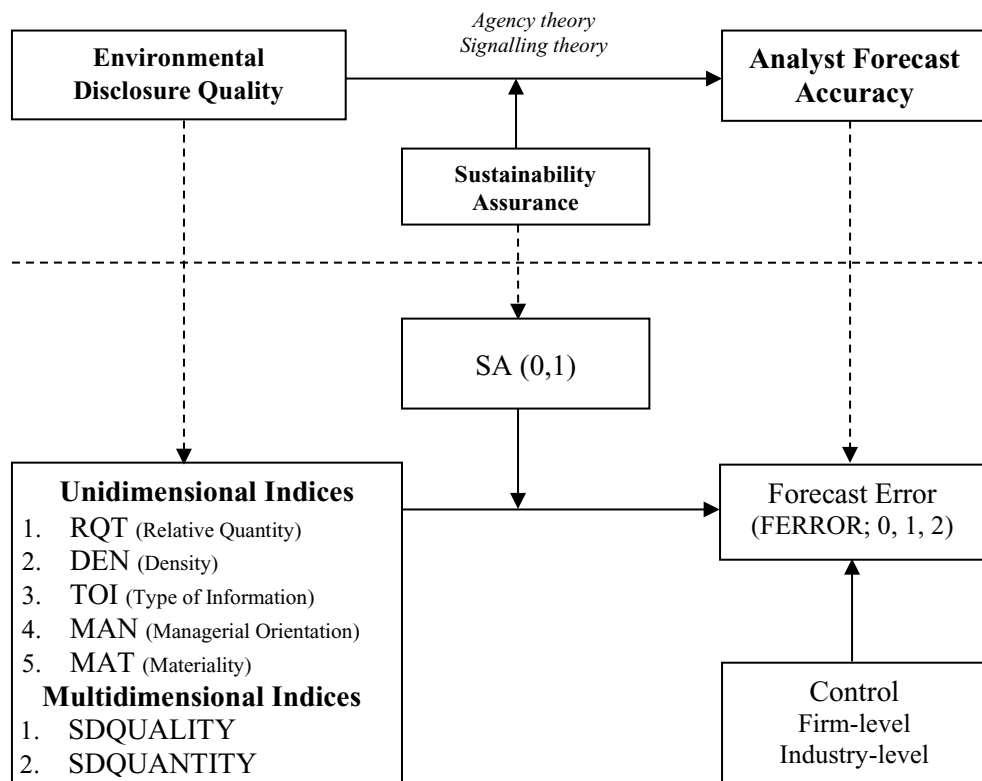


Figure 2.1 represents the research model. Three boxes above the dotted line display the proposed research framework, according to which we aim to test the existence and sign of an association between our main variables: environmental disclosure quality and analyst forecast accuracy; moreover, we test the role played in this relationship by sustainability

assurance. The boxes under the dotted line show how we operationalize our main variables (See Table 2.3 for further details of variables definition). We conjecture that companies' disclosure on non-financial information may enhance market efficiency and mitigate the level of asymmetry information, thus improving analysts forecast accuracy.

2.2. Hypotheses Development

2.2.1. Environmental Disclosure Quality and Analyst Forecasts Accuracy

At the best of our knowledge, to date very few studies have focused on investigating the relationship between environmental disclosure quality and financial analyst forecast accuracy.

One of the most commonly cited studies is the one of Dhaliwal et al. (2012), which investigated the association between the *presence* of sustainability information and analyst forecast accuracy in an international sample of 7,108 of the U.S, Asian, African, and European companies, observed from 1994 to 2007. Results showed that the presence of sustainability information is positively associated with analyst forecast accuracy.

However, the study of Dhaliwal et al., (2012) used a very simple dichotomous measure as the proxy of sustainability disclosure, i.e., the presence of a stand-alone report, which cannot capture the content, the type, the multidimensional features of disclosure, and its quality.

In the same line of reasoning, a prior study by Aerts et al., (2008) investigated, in a sample of continental Europe and North American companies in one year only (2002), the relationship between environmental disclosure and analyst forecast dispersion, i.e. the inverse measure for analysts' forecast accuracy. They focused on the *amount* of environmental information disclosure related to six components (i.e., expenditures and risks, laws and regulations, pollution abatement, sustainable development, land

remediation, and environmental management) made available either in the printed-based or web-based disclosure. Results suggest a negative relationship between the quantity of environmental disclosure and earnings forecast dispersion by financial analyst. In other words, a positive association between one of the dimensions of disclosure quality and analysts forecast accuracy.

A recent study of Baumeister & Gutsche, (2017) documented opposite findings. In a sample of 506 companies belonging to 42 countries (Western Europe, East Asia, North America) observed in 2012, they tested the relationship between the *completeness* of sustainability disclosure and analyst forecast accuracy (proxied by analysts forecast error) up to one year ahead. They found that the *completeness* of sustainability disclosure is negatively (positively) associated with analyst forecast accuracy (analysts forecast error).

As the previous evidence on analyst use of environmental information is scant and yields mixed results, we argue that a possible explanation for the mixed evidence is due to the different measures of sustainability disclosure used. Moreover, no one of these studies takes into account the quality of disclosure and its multidimensional nature, nor the materiality of the investigated disclosure for financial analysts. Recent studies on CSR reporting have also progressively focused on disclosure quality, developing more refined measures for this construct (Cormier & Magnan, 2008; Michelon et al., 2015; Muslu et al., 2019). Starting from the work of Michelon et al., (2015) we offer a novel measure of disclosure quality which includes the materiality index, thus also considering the information needs of financial analyst. Moreover, to better capture the multidimensional nature of disclosure quality, we perform factor analysis from the unidimensional disclosure indices to construct the appropriate multidimensional measures of environmental disclosure quality. Thus, we use our novel multidimensional measure of disclosure quality

to test its association with analyst forecast error, as the inverse measure of analyst forecast accuracy, expecting a positive relationship. We state hypothesis one as follows.

H1: Environmental disclosure quality is positively associated with analyst forecast accuracy.

2.2.2. Sustainability Assurance and Analyst Forecast Accuracy

Recent works of literature have criticized sustainability disclosure for its impression management (Hooghiemstra, 2000; Osma & Guillamón-Saorín, 2011; Cho, Michelon, & Patten, 2012), camouflaging and hypocrisy (Michelon et al., 2016), and lack of completeness (Adams & Evans, 2004; Michelon et al., 2015). These critics showed that companies may use the venue of sustainability (environmental) disclosure to communicate positive impact more than the negative impact (Fabrizio & Kim, 2019). This could be also linked to a self-serving bias (Cho, Roberts, & Patten, 2010) and greenwashing tool (Mahoney, Thorne, Cecil, & LaGore, 2013; Pope & Wæraas, 2016). Given the critics on the sustainability disclosure, the companion of sustainability assurance is considered relevant to increase the credibility and reliability of information (Adams & Evans, 2004; Mercer, 2004; Hodge et al., 2009; Moroney et al., 2011; Birkey et al., 2016). This is in line with the findings of Cho et al., (2014) who pointed out that a company's objective to engage with assurance is motivated as a signal that it has a superior social, and environmental strategy to market.

In hypothesis two, we investigate if the presence of sustainability assurance on the report may help to strengthen the positive (negative) association between environmental disclosure quality and analyst forecast accuracy (forecast error). The financial analyst could consider sustainability report (environmental information) with external assurance is more credible than those without assurance (Wilson, 2008). As noted by Simnett, Vanstraelen,

& Chua, (2009) companies with assurance statement in their sustainability reports are considered by the report users as a report with higher credibility which also leads to a better reputation. Thus, the main motivation of companies' decision to deal with assurance practice is more likely to enhance the confidence, credibility, improve the quality of their reports for better decision-making (Hodge et al., 2009; Wong & Millington, 2014; Maroun, 2018).

In the process of an assurance engagement, the company will be under scrutiny, and the assurance provider is expected to propose critical evaluation on the way companies dealing with their sustainability reporting (O'Dwyer & Owen, 2005). This stage is also known as market oversight, since the external verification through the sustainability assurance practice is expected to push the companies disclosing an accurate, reliable, credible, and complete set of information as compared to those companies without assurance statement in their reports (Casey & Grenier, 2015).

At the best of our knowledge, to date only one study has investigated the role of sustainability assurance on the relationship between the presence of sustainability report and analysts forecast accuracy. This study was investigated by Dhaliwal et al., (2012). In their study, Dhaliwal et al., (2012) used sustainability assurance as a moderating variable. However, they found that there is no moderating effect of sustainability assurance on the relationship between sustainability report and analyst forecast accuracy at three forecast horizons. Given this result, they argued that this finding is driven by the U.S. companies that have a much lower rate of assurance of sustainability reports.

As the number of study examining the relationship between assurance and forecast accuracy is still scant and limited, we thus conjecture that assuring sustainability report may enhance the positive relationship between environmental disclosure quality and analyst forecast accuracy. In the assurance practice, it is widely reported in the prior studies

(Deegan et al., 2006; Simnett et al., 2009; Moroney et al., 2011) that there are two main groups of assurance providers⁷ in the assurance market of sustainability report (Manetti & Becatti, 2009; Perego, 2009). The assurance provider may adopt two different assurance standards⁸ that should be followed when performing the evaluation on the sustainability report. In terms of the application of assessment, these assurance providers also provide two different levels of assurance engagement⁹, in which the level of assurance describes the coverage of assessment and verification on sustainability report (Corporate Register, 2008; Gürtürk & Hahn, 2016; Hummel, Schlick, & Fifka, 2017). We argue that the presence of assurance on the sustainability report could be a positive signal for analyst accuracy, as the assurance statement may enhance user confidence on the reported information. Thus, the presence of assurance statement and its attributes may allow financial analyst in making more accurate earnings forecast. We develop hypothesis two as follows.

H2: The positive relationship between environmentally disclosure quality and analyst forecast accuracy is stronger among companies with sustainability assurance statement.

⁷ The first group is classified as the assurance provider from the accounting profession. In this group, the accounting profession is commonly differentiated based on their reputation as Big N (KPMG, PwC, E&Y, Deloitte) and non-Big N. The second group is the assurance provider from the non-accounting profession (consultant) such as environmental consultant, environmental and engineering consultant, environmental research organization, social/ethical performance consultant and so forth (Deegan et al., 2006; Moroney et al., 2011; Simnett et al., 2009).

⁸ International study on assurance practice has reported that most of the assurance provider adopt three types of assurance standards (Huggins, Green, & Simnett, 2011; Manetti & Becatti, 2009; Perego, 2009; Simnett et al., 2009): Global Reporting Initiative (GRI) guideline, AA1000 assurance standard (AA1000AS), and International Standards on Assurance Engagement (ISAE3000). However, GRI guideline is recently used as the disclosure framework rather than the assurance standard that should be followed by the assurance provider when evaluating an SR report. AA1000AS is commonly used by the non-accounting profession due to its standards which focuses more on the stakeholder inclusiveness. Meanwhile, ISAE3000 is used by the accounting profession given its focus on procedural characteristics of assurance (Perego, 2009). Nevertheless, AA1000AS and ISAE3000 are somehow used interchangeably either by the accounting or non-accounting profession (Gillet-Monjarret, 2015; Huggins et al., 2011; Manetti & Becatti, 2009).

As exhibited in the AA1000AS and ISAE3000 assurance standards, either AA1000AS or ISAE3000 use two types of assurance levels in their assurance statement. AA1000AS used the term Moderate and High level, while ISAE3000 use Limited and Reasonable assurance terms in the assurance statement.

⁹ According to Gürtürk & Hahn, (2016) several companies may engage in the combination of two levels of assurance (moderate (limited) and high (reasonable) on certain SR section). These two-levels differ in the assessment and verification of the internal control system and the involvement of stakeholders in the assurance process. When the companies have their SR reports assured in a high (reasonable) level of assurance, it may send a signal to financial analyst that a specific standard or criteria of assessment has been implemented in verifying a SR information (Corporate Register, 2008; GRI, 2014; Hummel et al., 2017).

2.2.3. Environmental Disclosure Quality

It has been argued that prior literature does not comprehensively address the complexity, and thus also the quality, of information that management can communicate on the environmental impact of their corporate activities (Deegan & Rankin, 1997; Moneva et al., 2006; Fabrizio & Kim, 2019). This is also because most of the disclosure frameworks used by previous studies have been built primarily on the (simple) presence or absence for ad hoc reporting (i.e. CSR reports), or on the analysis of disclosure against a checklist of items, mainly capturing the amount and/or completeness of such disclosure (Michelon et al., 2015; Boiral, Heras-saizarbitoria, & Brotherton, 2017). To deal with this issue, we offer a novel measure of disclosure quality which includes the materiality index, thus also considering the information needs of financial analyst. More in details, we use GRI G4 and Analysts KPIs as the disclosure framework used in the content analysis (please see Figure 1.3 in Chapter 1 for further details on GRI G4 and Analyst KPIs environmental items). Finally, to better capture the multidimensional¹⁰ nature of disclosure quality, we follow the study of Helfaya & Whittington, (2019) by performing factor analysis to construct the appropriate multidimensional measures of environmental disclosure quality from the unidimensional disclosure indices.

3. RESEARCH METHOD

3.1. Data and Sample

This study utilizes longitudinal (2014-2017) European data of companies belonging to ESI industries to investigate: the existence and sign of a relationship between

¹⁰ Different multidimensional measure is used. In Chapter one, the multidimensional index is calculated based on the weighted average value of five unidimensional indices. However, in Chapter 2, the multidimensional index is measured through the factor analysis output. The output of factor analysis created two main factor which are labelled as disclosure quality (DISQUALITY) and disclosure quantity (DISQUANTITY).

environmental disclosure quality and analyst forecast accuracy, and the role played in this relationship, if any, by assurance practice.

Regarding the disclosure media used to extract environmental information, we focus on the environmental section of stand-alone sustainability reports (e.g., CSR reports, sustainability reports, integrated reports, triple bottom line reports, environmental reports, ESG reports, citizenship reports), or of annual reports, when a stand-alone sustainability report was not available. The disclosure media were collected from Corporate Register database and GRI database. In case the report of certain companies cannot be found in the previous two databases, we further seek the reports checked on the companies' webpage. The disclosure media is further proceeded in the content analysis (see. Section 3.2).

Environmental performance data is measured through environmental performance pillar score from ASSET4 database. Financial data (leverage, return on asset, number of analyst following, and firm size) are extracted from Thomson EIKON database, and the data of analyst forecast is taken from Institutional Brokers' Estimate System (I/B/E/S). After screening the data from the available population of European companies in the Environmentally sensitive industries, our final sample consists of 708 corporate narratives reports published by 177 public listed companies from 2014 to 2017. The detail information regarding our sampling procedure is available in Table 2.1 as follows.

Table 2.1 Sample selection procedure

No	Sampling procedure	Number of firms	Year-observations (2014-2017)	Percentage (%)
1	Active public listed companies in the capital market of 29 European stock exchanges from 2014 to 2017.	9,249	36,996	100
2	Firms not listed in the ESI industries.	(7,929)	(31,716)	(86)
3	Firms with no sustainability information.	(966)	(3,864)	(10)
4	Sustainability reports not provided in English.	(22)	(88)	(1)
5	Firms whose consistently published sustainability information reports from 2014 to 2017.	332	1,328	4
6	Firms without environmental performance scores from ASSET4 database.	(106)	(424)	
8	Firms that have less than 3 analysts following.	(49)	(196)	
9	Eligible firms with sufficient observations.	177	708	

Note: we dropped the sample from 9 countries due to the insufficient number of data observations.

3.1.1. Sample Distribution

Given the number of the final samples as informed in Table 2.1, we also provide the final sample distribution by year and industry in Table 2.2. Panel A, presents the final sample by year. Since the nature of our dataset is balanced panel data, we, therefore, report that we have 177 reports (either in the form of stand-alone sustainability report or combined into the annual report) for years 2014-2017. In Panel B, we describe the final sample distribution by industry. Following the study of Michelon, Pilonato, & Ricceri, (2015) we group the sample based on eight major Environmentally Sensitive Industries (aerospace & defense, chemicals, forestry & papers, metals, mining, oil & gas, pharmaceuticals, and utilities). As shown by the descriptive statistics in Panel B, the sample from Utility industries dominates the overall sample composition as 136 SR reports, followed by Pharmaceutical (128 reports), and Mining (116 reports), respectively.

Table 2.2 Sample distribution

Panel A: Final sample by year

Year	No of firm-year observations (1)	No of Stand-alone report (2)	No of reports with assurance (3)	% of Stand-alone report (4) = (2)/(1)	% of SR report with assurance (5) = (3)/(1)
2014	177	74	104	41.81	58.76
2015	177	80	110	45.20	62.15
2016	177	84	110	47.46	62.15
2017	177	81	119	45.76	67.23
Total	708	319	443		

Panel B: Final sample by Industry

Industry	No of firm-year observations (1)	No of Stand-alone report (2)	No of report with assurance (3)	% of Stand-alone report (4) = (2)/(1)	% of SR report with assurance (5) = (3)/(1)
Aerospace & Defense	52	18	40	34.62	76.92
Chemicals	96	37	60	38.54	62.50
Forestry & paper	52	20	23	38.46	44.23
Metals	20	44	12	220.00	60
Mining	116	17	75	14.66	64.66
Oil & gas	108	58	77	53.70	71.30
Pharmaceuticals	128	55	51	42.97	39.84
Utilities	136	70	105	51.47	77.21
Total	708	319	443		

Note: the sample period is from 2014 to 2017 and covers as total 20 European countries.

3.2. Content Analysis and Multidimensional Measure of Environmental Disclosure Quality

In performing content analysis on the selected disclosure media, we employed two computer-assisted qualitative data analysis software (Atlas.ti8 and R with QUANTEDA package) to analyze and code each sentence of the environmental section in 177 non-financial reports. Please refer to Chapter 1 section 3.2 for further details on content analysis.

As described in Chapter 1 (section 3.2 and subsection of 3.2.1 page 31-37) we content analyzed the collected environmental reports, using the sentences as recording units and coding each sentence according to its content (GRI framework and EFFAS KPIs), to the type of information provided (qualitative, quantitative, monetary) and to the emerging managerial orientation (i.e., expectation and context, program, policies and initiative, objectives and goals, results and outcomes). The results of the coding were used to build five unidimensional indices (RQT, DEN, TOI, MAN, MAT).

In Chapter 1, we used the standardized or the weighted value of these five unidimensional indices. In this Chapter, we import the five unidimensional indices into factor analysis procedure to capture the “common vs. different characteristics” of disclosure quality. The result of factor analysis indicates that our unidimensional indices converged on two factors. Factor 1 (F1) is labeled as environmental disclosure quality (SDQUALITY) since the nature of the component indices (TOI; classification on the type of information, and MAN; the classification of information according to the managerial commitment and time orientation) shared the commonalities which capture the richness of information as implied by the environmental sentences. Meanwhile, Factor 2 (F2) is labeled as environmental disclosure quantity (SDQUANTITY) as the nature of the converged components of this factor (RQT, DEN, and MAT) capture the characteristics of information quantity of disclosure (RQT; the difference quantity between the actual and expected

environmental disclosure, DEN; the density of environmental information relative to the overall disclosure, and MAT; the number of material information relative to industry memberships as required by the analyst). As the two factors (SDQUALITY and SDQUANTITY) imply different characteristics of information, we therefore decide to use SDQUALITY as the main proxy of environmental disclosure quality and further use the SDQUANTITY in the additional analysis.

3.3. Analyst Forecast Accuracy

We follow the study of Dhaliwal et al., (2012) by using the analyst forecast error as the inverse measure of forecast accuracy. Analyst forecast error is defined as the average of actual errors of all forecasts made in the year for target earnings, scaled by the stock price at the beginning of the year (Dhaliwal et al., 2012). In this forecast error setting, we differentiate the forecast made for different years. As reported by De Bondt & Thaler, (1990) the forecast error gets larger when the time horizon increases. Also, we limit the forecast horizon to a maximum of two years since the financial analysts typically do not make a forecast for more than the second fiscal year ahead (De Bondt & Thaler, 1990; Dhaliwal et al., 2012).

3.4. Sustainability Assurance

The presence of sustainability assurance (SA) is expected to overcome the concerns against the biases in sustainability reporting. Thus, the utilization of sustainability assurance in our study is meant to capture the role of sustainability assurance in enhancing the credibility and thus value-relevance of environmental information from the point of view of financial analyst. To empirically measure sustainability assurance, we employ a

dummy variable, assigning 1 to companies with assurance statements in their stand-alone or annual reports, and 0 otherwise.

3.5. Variable Definitions

In the next step, we present how we defined and thus operationalized the above variables that will be used in the empirical model.

Table 2.3 Variable definitions

No	Variable	Measure	Source
1	Forecast error FERROR(Y) (Y= 0, 1, 2)	FERROR(0), FERROR(1), FERROR(2) $FERROR(Y)_{i,t} = \frac{1}{n} \sum_{j=1}^N FC_{i,t,j}^Y - EPS_{i,t,j}^Y / P_{i,t}$ Represent the firms' actual value of average analyst forecast error for forecast made in year t for earnings of year t0, t+1, t+2 respectively. The forecast error of each individual forecast is computed as the actual difference between the actual EPS and the forecast, scaled by the stock price at the beginning of the year.	EIKON I/B/E/S/
2	Unidimensional measure of environmental sustainability disclosure indices (RQT) Relative quantity	$RQT_{i,t} = DISC_{i,t} - \widehat{DISC}_{i,t}$ RQT _{i,t} is the relative quantity index for company i in year t, DISC _{i,t} is the observed level of disclosure for company i in year t and $\widehat{DISC}_{i,t}$ is the estimated disclosure level for company i in year t.	Corporate Register/ GRI database
3	(DEN) Density	$DEN_{i,t} = \frac{1}{k_{i,t}} \sum_{j=1}^{k_{i,t}} (SR_{i,t})$ DEN _i is the density index for company i in year t, k _{i,t} is the number of sentences in the document analysed for company i in year t, and SR _{i,t} = 1 if the sentence j in the document analyzed for company i in year t contains environmental-related information and SR _{i,t} = 0 otherwise.	Corporate Register/ GRI database
4	(TOI) Type of information	$TOI_{i,t} = \frac{\sum_{j=1}^{n_{i,t}} (w * SR_{i,j,t})}{DISC_{i,k,t}}$ TOI measures, for each item of environmental disclosure by referring on the GRI disclosure framework. We count the information based on the characteristic of data appears in the environmentally-related sentence. We scale the data as 0 if the sentence does not provide any information about environmental issue, 1 if the sentence is presented in qualitative form of information, 2 if the sentence contains quantitative information, and 3 if the sentence releases monetary information with respect to the environmental issue. The incidence of recording units containing environmental information in qualitative, quantitative, and or monetary terms over the total of the recording disclosure units containing environmental information.	Corporate Register/ GRI database
5	(MAN) Managerial orientation	$MAN_{i,t} = \frac{\sum_{j=1}^{n_{i,t}} (PROG_{i,j,t} + RES_{i,j,t})}{DISC_{i,t}}$ MAN _i is the managerial orientation index for company i in year t, n _{i,t} is the number of sentences containing environmental-related information in the document analyzed for company i in year t, PROG _{i,j,t} = 1 if sentence j in the document analyzed for company i in year t contains environmental-related information on program, initiatives, and strategies, otherwise PROG _{i,j,t} equals to 0. RES _{i,j,t} = 1 if the sentence j in the document analyzed for	Corporate Register/ GRI database

No		Variable	Measure	Source
			company i in year t contains environmental-related information on results and outcomes and $RES_{ijt} = 0$ otherwise. $DISC_{i,t}$ = the total of GRI environmental-related disclosures.	
6		(MAT) Materiality	$MAT_{i,t} = \frac{1}{n_{i,t}} \sum_{j=1}^{n_{i,t}} \frac{(DISC_KPI_{i,j,t})}{(KPI)_f}$ MAT_i is the materiality index for company i in year t, n is the number of overlapped items between GRI and KPIs in the document i analyzed for company i in year t. KPI_f is the number of relevant environmental key performance indicators as required by the financial analyst in industry f. The obtained data of this index spans from 0 to 2.8. The maximum value of 2.8 is obtained if the companies disclose the whole KPIs (14 items) over the total minimum number of material items required by each particular industry (e.g., see pharmaceutical industry in Figure 1.4 Chapter 1 with the least number of KPI items).	Corporate Register/ GRI database
7	Multidimensional measure of environmental sustainability disclosure indices	SDQUALITY	Is the factor constructed by the convergence of type of information TOI and managerial orientation (MAN) indices in the factor analysis.	Unidimensional Indices
8		SDQUANTITY	Is the factor constructed by the convergence of type of relative quantity (RQT), density (DEN), and materiality (MAT) indices in factor analysis.	Unidimensional indices
9	Sustainability assurance	SA	1 if the firm has assurance statement, and 0 otherwise.	EIKON / Corporate Register/ GRI database
10	Control variables	SR	1 if the firm published a stand-alone sustainability report, and 0 if the CR information is published in a dedicated page of the annual report.	Corporate Register/ GRI database
11		(ENVSCR) Environmental score	Environmental pillar score from ASSET4 database.	ASSET4
12		(GRI) Global Reporting Initiatives	1 if the analysed document contains a statement declaring GRI adoption, 0 otherwise.	ASSET4
13		(CR_BOARD) CSR sustainability committee	1 if the company has a CR committee, and 0 otherwise.	ASSET4
14		(SIZE) Size	Natural logarithm of the total asset.	EIKON
15		(AGE) Companies age	The age of the company is counted since the first time it starts to operate.	EIKON
16		(LEVERAGE) Leverage	Total debt to total equity.	EIKON
17		(ROA) Return on Asset	Fiscal year-end net income divided by year-end total assets.	EIKON
18		(ANANO) Analyst following	The number of analysts following.	EIKON

3.6. Regression Model

As we have two multidimensional indices (SDQUALITY and SDQUANTITY), we decide to use SDQUALITY as the main independent variable and further use SDQUANTITY in the additional analysis. The decision of choosing SDQUALITY than

SDQUANTITY is also justified by comparing the Cronbach alpha value of the two multidimensional indices. SDQUALITY has higher alpha value than SDQUANTITY which suggests SDQUALITY as a more reliable measure as the proxy of environmental disclosure quality. To measure the association between SDQUALITY and analyst forecast error (FERROR), we use Equation 1 as follows.

$$\begin{aligned} \text{FERROR}(Y)_{i,t} = & \alpha + \beta_1 \text{SDQUALITY}_{i,t} + \beta_2 \text{SA}_{i,t} + \beta_3 \text{SDQUALITY} * \text{SA}_{i,t} \\ & + \gamma \sum \text{Controls}_{i,t} + \gamma \sum \text{Year}_{i,t} + \gamma \sum \text{Industry}_{i,t} + \varepsilon \end{aligned}$$

The above equation is estimated separately for each three different forecast horizons. As it can be seen in the model, the dependent variable (FERROR) takes three forms, namely FERROR0 as the representation of forecast error at the contemporaneous year earnings (t0), FERROR1 as the forecast horizon for one-year-ahead (t+1), and FERROR2 for forecast horizon of two-years-ahead (t+2).

In line with the proposed hypotheses, equation 1 facilitates the empirical test for hypothesis one and hypothesis two. Hypothesis one conjectures that report with high environmental disclosure quality (SDQUALITY) is positively (negatively) associated with analyst forecast accuracy (FERROR). Whilst, hypothesis two tests if the positive (negative) association between environmental disclosure quality (SDQUALITY) and analyst forecast accuracy (FERROR) is stronger among companies with sustainability assurance statement. We use a dichotomous variable as the surrogate indicators of sustainability assurance (SA). SA is employed as moderating variable, which is expected to increase (reduce) the degree of analysts forecast accuracy (forecast error) as shown by the relationship between environmental disclosure quality (SDQUALITY) and analyst forecast accuracy (FERROR).

3.7. Control Variables

Following the study of Dhaliwal et al., (2012) and Michelon et al., (2015) we include a number of additional variables, as we are aware that our model could be harmed by the omitted correlated variable bias issue, that may affect the robustness of our estimate. Therefore, we inserted firm-level (i.e., SR, ENVSCR, GRI, CR_BOARD, SIZE, AGE, LEVERAGE, ROA, ANANO) and industry-levels (i.e. industry fixed effect; ESI industries memberships) control variables.

The first control variable is the type of sustainability report (SR). Prior studies report that firms' decision to publish a stand-alone SR allows the firms to disclose more information and to better explain their environmental-related activities to stakeholders (Moneva et al., 2006; Hahn & Lulfs, 2014; Michelon et al., 2015; Junior & Best, 2017). The adoption of stand-alone sustainability report also allows companies to report in a broader sense of organizations' unique activities (Moneva et al., 2006; GRI, 2014). This variable takes value 1 if environmental information is published in the form of stand-alone report, 0 if provided in the annual report.

The second control variable is the environmental score (ENVSCR). This variable reflects the firms' environmental impact as evaluated by the third independent party. By having this information in the model, we aim at controlling firms environmental impact (Braam, Weerd, Hauck, & Huijbregts, 2016). The environmental pillar score is provided by ASSET4 database, which uses ratio scaled from 0 (less positive impact) to 100 (high positive impact).

The third control variable is the adoption of a Global Reporting Initiative (GRI) disclosure framework. Firms whose adopt the GRI disclosure framework are deemed to provide better structure of disclosure (Moroney et al., 2011; Michelon et al., 2015). This

variable takes value 1 if the report indicates adoption of a GRI disclosure framework, 0 otherwise.

The fourth control variable is CR_BOARD denotes the presence of corporate social responsibility committee. Firms with a CSR committee in their governance structure are deemed to have better policies and action plans on sustainability issues. As noted by Michelin & Parbonetti, (2012) good corporate governance and sustainability disclosure could be considered as a complementary legitimacy mechanism. This variable takes value 1 if firms mention they have corporate social responsibility committee, 0 otherwise.

The fifth control variable is firm size (SIZE). Size is included as sustainability disclosure varies according to firm size. Therefore, we conjecture that the bigger firms are more likely to engage with more environmental disclosure as they want to convey that they have a more superior social and environmental strategy to public (Cho, Michelin, Patten, & Roberts, 2014). Size is measured using the logarithm natural of total asset.

The sixth control variable is the firm age (AGE). AGE is inserted to capture firm commitment and its past environmental performance. If the companies have been in operation for long-term, companies have also been in charge and responsible for natural resources exploration and resource exploitation during their business operation. The longer companies operate, the more information they have which may facilitate analyst to have more information about firms' environmental impact (Dhaliwal et al., 2012).

The seventh control variable is LEVERAGE, which is included to capture the information demand by the debtholder (Dhaliwal et al., 2012). In this sense, the debtholder may have concerns about the firms' downgrade risk. Lenders are more likely to be sensitive to CSR concerns in the absence of security (Goss & Roberts, 2011). In the context of environmentally sensitive industries, we argue that lenders will be more sensitive when the

companies are exposed by an adverse impact of negative news, which signals the decreasing ability of companies dealing with debt payment.

The eighth control variable is return on asset (ROA). Profitable firms may have more financial resources for their environmental-related activities than less profitable firms. The ninth and last control variable is the number of analysts following (ANANO), which is included to capture the analyst attention of environmental-related activities. The increasing number of analyst following also reflects more intense competition among them, which eventually leads to greater incentives for analyst with more accurate earnings forecast (Lys & Soo, 1995; Dhaliwal et al., 2012). Moreover, having industry fixed-effect in the model is deemed important to account for systematic differences in the incentives to publish nonfinancial report across industries (Michelon et al., 2015).

4. RESULTS

4.1. Univariate Analysis

We start our empirical analysis by providing the sample distribution by country. Table 2.4, Panel A presents the summary of information with respect to the key variable by country, followed by the descriptive statistics for the main dependent, independent, and control variables in Panel B, C, and D.

Panel A in Table 2.4 displays the univariate analysis output. As can be seen in Panel A, most of the observations are dominated by the sample from the UK (204 observations). While the Czech Republic, Ireland, Luxemburg, and Romania contribute are the countries with the smallest number of observations. In regards to the presence/availability of stand-alone sustainability reports (SR), the sample from the UK dominates the overall observations (57 reports), followed by Italy (39 reports) and Spain (35 reports). Ireland and Romania are noted as the countries with no stand-alone sustainability report. Even so,

environmental-related information is included in their annual report. The same propensity occurs when the sample dealing with assurance engagement. The UK's companies stand as the group with the highest number of assurance engagement (121 assurance statements), followed by France (64), Germany (50), and Italy (41), respectively.

We then considered the analyst forecast accuracy grouped by country. We use forecast error (FERROR) as the inverse measure of analyst forecast accuracy. We classify the forecast error information for the contemporaneous time (t_0), one-year ($t+1$) and two-years- $(t+2)$ ahead. Out of 20 countries, ten of them provide less accurate earnings forecast for the contemporaneous year. These 10 countries show negative mean forecast errors, suggesting that the actual earnings less than what was forecasted by the analyst forecast for the given year.

Panel B illustrates the information in regards to the main independent variables. In this Panel, the main information is provided in terms of mean value for the environmental disclosure quality indices, and sustainability assurance by country. The information of the overall descriptive statistics for the main dependent, independent, and control variables are available in Panel C, and D.

Table 2.4 Descriptive statistics

Panel A: Data distribution by country

No	Country	No of firm- year observations (1)	No of stand- alone report (2)	No of report with assurance (3)	% of stand- alone report (4) = (2)/(1)	% of Report with assurance (5) = (3)/(1)	average no of pages per report (6)	Average environmental section page (7)	% of average environmental page (8) = (7)/(5)	No of analyst following (9)	FERROR0 (10)		FERROR1 (11)		FERROR2 (12)	
											mean	stdv	mean	stdv	mean	stdv
1	Austria	12	7	9	58.33	75	140	6	4.29	18	-0.62	0.71	-0.43	0.38	-0.16	0.88
2	Belgium	16	6	12	37.50	75	130	5	3.85	13	0.10	2.03	0.06	2.48	-0.34	3.91
3	Czech Republic	4	2	1	50	25	220	14	6.36	18	1.22	1.14	0.82	0.74	1.09	1.22
4	Denmark	28	19	12	67.86	42.86	52	3	5.77	14	0.13	0.63	0.01	1.04	-0.40	2.28
5	Finland	36	27	24	75.00	66.67	110	13	11.82	14	-0.48	0.98	-0.37	0.92	-0.15	2.09
6	France	64	26	64	40.63	100	198	10	5.05	16	0.31	1.47	0.70	2.58	0.88	2.50
7	Germany	84	28	50	33.33	59.52	184	7	3.80	22	0.05	1.06	0.20	1.61	0.19	2.13
8	Greece	16	12	4	75	25	88	13	14.77	8	-0.30	2.30	0.70	2.76	0.84	3.62
9	Ireland	4	0	0	0	0	154	9	5.84	3	-0.24	0.30	-0.04	0.04	0.03	0.07
10	Italy	48	39	41	81.25	85.42	186	26	13.98	14	-0.02	0.70	0.14	1.06	0.14	1.40
11	Luxemburg	4	4	0	100	0	52	7	13.46	14	0.14	0.71	-0.08	0.34	0.11	0.81
12	Netherland	36	15	20	41.67	55.56	146	10	6.85	18	-0.31	1.45	-0.15	1.39	0.10	2.60
13	Poland	4	4	4	100	100	168	28	16.67	6	0.32	0.88	0.44	1.15	1.94	1.74
14	Portugal	24	5	13	20.83	54.17	220	10	4.55	9	-0.90	1.22	-0.53	1.41	-0.28	1.49
15	Romania	4	0	0	0	0	194	6	3.09	5	0.81	3.44	-0.85	2.25	-2.90	4.96
16	Slovenia	8	2	0	25	0	201	24	11.94	4	-0.36	0.66	-0.39	0.58	2.12	4.92
17	Spain	64	35	36	54.69	56.25	172	21	12.21	17	0.18	1.38	0.12	1.64	0.34	2.25
18	Sweden	32	26	24	81.25	75	85	7	8.24	13	-0.01	0.83	0.01	0.67	0.10	0.96
19	Swiss	16	5	8	31.25	50	138	11	7.97	21	-0.04	0.38	-0.08	0.41	0.54	2.01
20	UK	204	57	121	27.94	59.31	137	5	3.65	15	0.00	0.42	-0.02	0.25	-0.68	2.65
Total		708	319	443												

Table 2.4 (continued)

Panel B: Data distribution by country

No	Country	No of firm-year observations (1)	No of stand- alone report (2)	No of reports with assurance (3)	Environmental Disclosure Quality Indices ($\bar{x}$) (4)						
					Unidimensional indices					Multidimensional indices	
					RQT	DEN	TOI	MAN	MAT	SDQUALITY	SDQUANTITY
1	Austria	12	7	9	0.000	0.064	1.514	0.089	3.097	0.195	0.699
2	Belgium	16	6	12	0.000	0.058	1.713	0.071	4.869	0.444	0.989
3	Czech Republic	4	2	1	0.000	0.013	1.238	0.114	7.233	-0.405	0.523
4	Denmark	28	19	12	0.000	0.082	1.271	0.085	7.780	-0.564	0.665
5	Finland	36	27	24	0.319	0.041	1.659	0.084	2.687	0.596	0.980
6	France	64	26	64	2.097	0.010	1.352	0.133	1.061	0.175	-0.170
7	Germany	84	28	50	2.250	0.010	1.279	0.107	1.239	-0.172	-0.138
8	Greece	16	12	4	2.536	0.006	1.384	0.157	0.377	0.448	-0.341
9	Ireland	4	0	0	0.000	0.012	1.112	0.048	1.997	-1.028	0.319
10	Italy	48	39	41	2.685	0.007	1.478	0.169	0.385	0.733	-0.348
11	Luxemburg	4	4	0	0.000	0.031	1.435	0.138	5.783	0.230	0.461
12	Netherland	36	15	20	1.700	0.009	1.275	0.112	1.169	-0.122	-0.003
13	Poland	4	4	4	5.952	0.002	1.373	0.160	0.103	0.452	-1.017
14	Portugal	24	5	13	1.368	0.041	1.324	0.123	2.172	0.160	0.377
15	Romania	4	0	0	0.000	0.009	1.315	0.133	0.702	0.025	-0.007
16	Slovenia	8	2	0	4.113	0.005	1.277	0.102	0.393	-0.156	-0.448
17	Spain	64	35	36	2.746	0.016	1.340	0.115	0.610	0.036	-0.248
18	Sweden	32	26	24	2.020	0.009	1.222	0.101	0.934	-0.336	-0.146
19	Swiss	16	5	8	2.167	0.011	1.252	0.057	0.638	-0.589	-0.032
20	UK	204	57	121	1.905	0.014	1.312	0.104	1.461	-0.155	-0.092

Note: The information of environmental disclosure indices and sustainability assurance practice are reported in the form of mean value. To simplify the interpretation, the mean value of each information in the above Table can be translated into percentage relative to the number of firm-year observations.

Table 2.4 (continued)

Panel C: Descriptive statistics of the overall dependent, independent, and control variables

Variable	Obs	mean	stdv	p25th	p50th	p75th	min	max
<i>Dependent variables</i>								
FERROR0	708	-0.02	1.09	-0.27	-0.01	0.06	-3.68	5.00
FERROR1	708	0.06	1.38	-0.27	-0.01	0.07	-3.77	8.55
FERROR2	708	-0.03	2.45	-0.36	0.00	0.22	-10.33	10.52
<i>Independent variables</i>								
RQT	708	1.86	2.20	0	0	4.04	0	6.48
DEN	708	0.355	0.137	0.33	0.33	0.33	0.08	0.95
TOI	708	1.35	0.19	1.22	1.33	1.43	1	1.94
MAN	708	0.12	0.05	0.08	0.11	0.14	0	0.23
MAT	708	1.64	3.50	0.25	0.51	1.37	0	2.3
SA	708	0.63	0.48	0	1	1	0	1
<i>Control variables</i>								
SR	708	0.45	0.50	0	0	1	0	1
ENVSCR	708	64.40	20.37	53.20	67.75	79.56	2.33	97.81
GRI	708	0.68	0.47	0	1	1	0	1
CR_BOARD	708	0.73	0.44	0	1	1	0	1
SIZE	708	9.82	0.79	9.32	9.79	10.33	6.54	11.80
AGE	708	23.17	19.41	10.5	18	27	3	140
LEVERAGE	708	0.87	2.35	0.25	0.57	1.15	-16.97	48.79
ROA	708	2.99	9.44	1.27	3.55	6.06	-79.75	68.71
ANANO	708	15.86	8.79	9	15	23	3	37

Panel D: Descriptive statistics of environmental disclosure components

Variable	Obs	mean	stdv	p25th	p50th	p75th	min	max
TOTALPAGE	708	151.30	90.13	81	144	208	4	508
ER_PAGE	708	10.64	13.42	3	6	13	1	162
TOTAL_STNC	708	552.12	562.72	187	375	739.5	7	4,548
DISC	708	185.05	177.81	55.5	129	264	6	984
QUALITATIVE	708	122.32	112.34	40.5	89	181	0	739
QUANTITATIVE	708	62.80	85.41	10	39	84.25	0	773
MONETARY	708	3.52	6.42	0	2	4	0	70
EXPECTATION	708	0.08	0.18	0.01	0.024	0.05	0	1
PROGRAM	708	0.12	0.29	0.01	0.025	0.1	0	1
OBJECTIVE	708	0.09	0.17	0.01	0.022	0.077	0	1
RESULT	708	0.09	0.17	0.02	0.033	0.087	0	1

Notes. To ensure that the obtained estimation results are not driven by the extreme values, we winsorised all firm-level continuous variables (FERROR0, FERROR1, FERROR2, RQT, DEN, TOI, MAN, MAT, QUALITY) at the 1st and 99th percentiles.

The interpretation of categorical (binomial) variables is interpreted in the percentage form. For instance, our control variable SR shows a mean value of 0.45, i.e. the 45 percent of the total sample in our study have reported adopting stand-alone corporate responsibility reporting for their environmental information disclosure. While, the remaining 55 percent are having environmental information reported in the annual report. Furthermore, in regards to the presence of sustainability assurance (SA) either on the stand-alone or annual report, we document that the 63 percent of the total sample have their

reports verified by the third-independent party. This also indicates that 37 percent of our sample have no assurance on their sustainability reports.

In regards to the companies' environmental performance, as seen in Panel C, the value of the ASSET4 environmental performance score stands for 64.40 on average. Finally, in regards to the adoption of GRI guidelines, these are followed by the 68 percent of companies. Regarding CSR-governance system, 73 percent of the sample have CSR board committee in their governance system.

Table 2.5 Correlation matrix

Panel B: Correlation FERROR (0, 1, 2) to multidimensional indices of sustainability disclosure quality and sustainability assurance

No	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	FERROR0	1													
2	FERROR 1	0.306***	1												
3	FERROR 2	0.180***	0.181***	1											
4	SDQUALITY	-0.153***	-0.103**	-0.036	1										
5	SA	-0.059	-0.011	0.014	0.254***	1									
6	SR	-0.051	-0.025	0.04	0.116**	0.260***	1								
7	ENVSCR	-0.071	0.009	-0.025	0.152***	0.483***	0.250***	1							
8	GRI	-0.039	-0.048	0.028	0.255***	0.376***	0.402***	0.315***	1						
9	CR_BOARD	-0.018	-0.022	-0.01	0.285***	0.460***	0.279***	0.270***	0.419***	1					
10	SIZE	-0.073	-0.066	0.042	0.244***	0.546***	0.283***	0.451***	0.421***	0.421***	1				
11	AGE	0.022	0.015	0.016	-0.021	0.073	0.062	0.07	0.058	-0.053	0.161***	1			
12	LEVERAGE	0.008	0.044	0.02	0.121**	-0.012	-0.052	-0.012	0.027	0.052	0.032	-0.014	1		
13	ROA	-0.121**	-0.055	0.002	0.109**	0.039	0.014	-0.027	-0.031	-0.01	0.097*	0.083*	-0.084*	1	
14	ANANO	-0.098**	-0.122**	-0.035	0.187***	0.456***	0.216***	0.454***	0.336***	0.396***	0.696***	0.149***	-0.018	0.024	1

Notes: *** Significant at the 0.01 level. ** Significant at the 0.05 level. * Significant at the 0.10 level.

Table 2.5 displays the correlation matrix between the analyst forecast accuracy (FERROR) and multidimensional index of sustainability disclosure quality (SDQUALITY) and sustainability assurance (SA). The correlation matrix shows that SDQUALITY has negative and significant correlation with forecast error for the contemporaneous (FERROR0) and one-year-ahead forecast (FERROR1). Even though the same negative sign occurs in the correlation between SDQUALITY and FERROR2, results indicate no statistical correlation between these two variables. Moreover, the presence of sustainability assurance (SA) shows negative correlation with the forecast error for the contemporaneous (FERROR0) and one-year-ahead (FERROR1). Interestingly, the correlation coefficient between sustainability assurance (SA) and forecast error for two-year-ahead (FERROR2) turns to positive sign, but statistically insignificant. Since we are interested in understanding if sustainability assurance (SA) may strengthen the positive (negative) association between environmental disclosure quality (SDQUALITY) and analyst forecast accuracy (FERROR) in the un-tabulated information, we include the interaction variable in the correlation analysis. The obtained results show that the interaction between environmental disclosure quality and sustainability assurance (SDQUALITYxSA) is negative and significantly correlated with forecast error for the contemporaneous year (FERROR0) ($r = -0.164$; $p < 0.01$) and one-year-ahead (FERROR1) ($r = -0.139$; $p < 0.01$). The negative correlation also appears in forecast error for two-years-ahead (FERROR2) even though statistically insignificant.

4.2. Multivariate Analysis

To empirically test our notion as stated in the proposed hypotheses, we used the multidimensional measure of environmental disclosure quality (SDQUALITY) obtained from factor analysis (see section 3.2 of content analysis and multidimensional measure of

environmental disclosure quality) which represents the quality of information. The result of our main analysis is available in Table 2.6.

Table 2.6 Analyst forecast accuracy (FERROR 0, 1, 2), multidimensional environmental disclosure index (SDQUALITY), and sustainability assurance (SA)

VARIABLES	(1) FERROR0	(2) FERROR0	(3) FERROR1	(4) FERROR1	(5) FERROR2	(6) FERROR2
SDQUALITY	-0.321*** (-3.856)	-0.124 (-1.233)	-0.291** (-2.398)	-0.0359 (-0.230)	-0.325 (-1.568)	-0.170 (-0.603)
SA		-0.0241 (-0.229)		0.0358 (0.250)		0.0813 (0.319)
SDQUALITY x SA		-0.351** (-2.488)		-0.456** (-2.043)		-0.278 (-0.698)
SR	-0.199** (-2.155)	-0.207** (-2.257)	-0.113 (-0.837)	-0.127 (-0.944)	0.0472 (0.201)	0.0365 (0.155)
ENVSCR	-0.00357 (-1.435)	-0.00285 (-1.078)	0.00108 (0.282)	0.00160 (0.436)	-0.0106* (-1.667)	-0.0107* (-1.717)
GRI	0.0877 (0.787)	0.103 (0.923)	-0.148 (-1.012)	-0.130 (-0.906)	-0.0270 (-0.0919)	-0.0186 (-0.0631)
CR_BOARD	0.134 (1.021)	0.132 (1.036)	0.268 (1.344)	0.250 (1.292)	0.233 (0.863)	0.208 (0.788)
SIZE	0.00523 (0.0456)	-0.0147 (-0.124)	0.0847 (0.788)	0.0444 (0.387)	0.543*** (2.608)	0.505** (2.351)
AGE	0.00327** (2.088)	0.00315** (2.032)	0.00508** (2.347)	0.00494** (2.263)	0.00343 (0.822)	0.00335 (0.801)
LEVERAGE	0.000782 (0.0814)	-0.000837 (-0.0830)	0.0233 (1.165)	0.0220 (1.065)	0.0318 (1.112)	0.0317 (1.075)
ROA	-0.0124** (-2.292)	-0.0136** (-2.551)	-0.00522 (-0.852)	-0.00690 (-1.093)	-0.0112 (-0.549)	-0.0124 (-0.594)
ANANO	-0.0123 (-1.142)	-0.0107 (-1.002)	-0.0363** (-2.482)	-0.0341** (-2.367)	-0.0383** (-2.230)	-0.0369** (-2.139)
Constant	-0.380 (-0.393)	-0.284 (-0.284)	-0.952 (-0.994)	-0.690 (-0.690)	-4.448** (-2.406)	-4.167** (-2.217)
Observations	708	708	708	708	708	708
R-squared	0.150	0.157	0.116	0.124	0.094	0.095
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES

Notes: Robust t-statistics in parentheses; each asterisk ***, **, * indicates that the estimated coefficients are statistically significant at the 1, 5, and 10 percent levels respectively, in two-tailed tests based on robust standard errors. All the firm-level continuous variables are winsorized at the 1st and the 99th percentiles.

Table 2.6 shows the main analysis output with respect to the hypotheses one and two.

In hypothesis one, we conjecture that environmental disclosure quality (SDQUALITY) is positively (negatively) associated with analyst forecast accuracy (forecast error). To facilitate the empirical test, we perform panel data analysis in which we conducted the direct test between sustainability disclosure quality (SDQUALITY) and forecast error for contemporaneous

(FERROR0), one (FERROR1), and two-years-ahead (FERROR2). The obtained empirical outputs show that SDQUALITY is negatively ($\beta = -0.321$; $p < 0.01$) ($\beta = -0.291$; $p < 0.05$) and significantly associated with forecast error for the contemporaneous (FERROR0) and one-year-ahead (FERROR1). Meanwhile, the test on the forecast error for two-years-ahead indicates a negative ($\beta = -0.325$) but insignificant ($p > 0.1$) association of SDQUALITY with FERROR2. Given the negative and significant association as shown by SDQUALITY and FERROR0, FERROR1, we infer that hypothesis one is statistically supported for the shorter-term forecasts.

In hypothesis two, we test if the presence of sustainability assurance (SA) strengthens the negative association between environmental disclosure quality (SDQUALITY) and forecast error (FERROR). In this regards, we empirically investigate the incremental effect of having sustainability assurance on the relationship between sustainability disclosure quality and forecast accuracy. First, we see if having sustainability assurance (SA) may result in a stronger negative association between SDQUALITY and FERROR0. In this test, we are interested in the coefficient sign and significance of interaction between environmental disclosure quality and sustainability assurance (SDQUALITYxSA). As it can be seen in column 2, the moderating effect of having sustainability assurance on environmental disclosure quality is -0.351 and statistically significant at 5 percent alpha ($p < 0.05$). We report that the negative association between SDQUALITY and FERROR0 is stronger as -0.03 by the presence of interaction between SDQUALITY and SA (SDQUALITYxSA). The same propensity of incremental effect is also found when we further test the interaction of SDQUALITY and SA (SDQUALITYxSA) with forecast error for one-year-ahead (FERROR1). As can be seen in column 4, the interaction between sustainability disclosure quality and sustainability assurance (SDQUALITYxSA) shows a coefficient value as -0.456 and statistically significant at 5 percent level alpha ($p < 0.05$). This denotes that the presence of sustainability assurance on the

sustainability report is able to reduce the forecast error by -0.165. The results of the different test using FERROR0 and FERROR1 as the dependent variables provide support for hypothesis two. Therefore, we infer that hypothesis two is supported, in which the positive (negative) relationship between environmental disclosure quality and analyst forecast accuracy (forecast error) is stronger among companies with sustainability assurance statement.

Given the negative and significant association of SDQUALITYxSA with forecast error for the contemporaneous (FERROR0) and one-year-ahead (FERROR1), our result interestingly indicates that the insignificant association appears when we run the test between SDQUALITYxSA and FERROR2. However, even though no significant relationship is found, but the coefficient value of SDQUALITYxSA is reportedly negative (-0.278). This result is in line with the findings of De Bondt & Thaler, (1990) and Dhaliwal et al., (2012) who reported that the relevance of non-financial disclosure is getting weak as the time forecast horizon gets larger. Hereby, we also note that the relevance of environmental disclosure quality and the companion of sustainability assurance hold in increasing (decreasing) analyst forecast accuracy (forecast error) for the contemporaneous and one-year-ahead. In terms of the goodness of model, the obtained R square (R^2) value is more likely similar to the obtained R^2 in the study of Dhaliwal et al., (2012). Their study showed that the adjusted R^2 value by including assurance as the moderating variable in their model increased by 0.0006 from 0.1205 to 0.1211 (i.e., this R^2 is obtained using FERROR0 as the dependent variable, see Table 4 in Dhaliwal et al., 2012 page 742, column I and II). In our study, we show that the inclusion of sustainability assurance as the moderating variable increase the R^2 value by 0.007 from 0.150 to 0.157 (i.e., this R^2 is obtained using FERROR0 as the dependent variable, see Table 2.6 column 1 and 2).

4.3. Discussion

Concerning our first hypothesis, empirical evidence shows a negative and significant association between environmental disclosure quality and analyst forecast accuracy. Using a

multidimensional measure of environmental disclosure quality index (SDQUALITY), we find that the association on two out of three different forecast horizons provide significant results. Our result is in line with the a priori hypothesis that sustainability disclosure quality is positively (negatively) associated with analyst forecast accuracy (forecast error). The previous study of Dhaliwal et al., (2012) documented that the presence of stand-alone reports is positively (negatively) associated with analyst forecast accuracy (forecast error). These results suggesting that non-financial information is value-relevant and useful for the analyst in producing more accurate earnings forecast, and possibly reducing financial opacity. However, Dhaliwal et al., (2012) did not consider the content and type of information disclosed, whilst our study does so.

More recent findings of Muslu et al., (2019) documented that companies with high CSR disclosure scores are associated with more accurate earnings forecast, whilst companies with low CSR disclosure scores are not associated with more accurate earnings forecast than those companies who do not publish CSR information. The findings of Muslu et al., (2019) suggested that the variability of content in the sustainability report helps the analyst in improving their forecast accuracy, and it is reflected through the decreasing forecast error. Our study provides support to the findings of Muslu et al., (2019) in terms of the measurement method. They developed disclosure score based on the readability, length, tone, horizon content, and numerical information in the CSR report narratives. Meanwhile, our study develops environmental disclosure quality using information richness (type of information; qualitative, quantitative, monetary), managerial orientation on the disclosed information of management commitment and its time horizon (expectation and context, program, policies, and initiative, objectives and goals, results and outcome), and material information required by the financial analyst.

Our results support the prior literature by showing that environmental disclosure quality (SDQUALITY) is positively (negatively) associated with analyst forecast accuracy (forecast error). Meanwhile, in the un-tabulated test (see robustness tests in Section 5.2), another multidimensional measure of environmental disclosure quantity (SDQUANTITY) is not associated with forecast error. In this regards, we argue that the insignificant association of environmental disclosure quantity with forecast error could be linked to the study of Mishra & Modi, (2013). Their study argued that most of the corporate narrative is predominantly overlooking at the positive aspect of CSR actions and initiatives. In the circumstance where the companies opportunistically provide uncredible and/or uninformative information to the public, the number of information disclosure is unlikely to have a significant impact on analyst forecast accuracy. Meanwhile, in the case, if the financial analysts only look for the incident in the sustainability report and not properly read the content of report, then these reports are more likely to be considered as uninformative reports. Another explanation is reported by a recent study of Fabrizio & Kim, (2019). They pointed out that companies may intentionally provide more complex and hard to understand information. For the financial analyst, the blurry information (particularly the negative one) increases the required time and cost of information processing, that makes analyst cannot fully interpret the meaning of information (Gu & Wan, 2005).

Furthermore, we provide empirical evidence on the importance of sustainability assurance (SA) in enhancing the value of environmental information. As previously highlighted in the literature review, the companion of sustainability assurance is recommended by the regulators. A non-profit institution such as GRI recommends the companies who adopt GRI disclosure framework to have the reported information assured by the third-independent party (accountant or consultant) (GRI, 2014). This is important to validate the information in tackling the critics of impression management, greenwashing, and camouflaging attached to

sustainability reporting. Moreover, previous studies have witnessed a long debate on whether sustainability assurance may serve as a proper tool in increasing the quality and the credibility of corporate responsibility report. Several empirical studies reveal that sustainability assurance is necessary for improving the disclosure reliability, credibility, recognition, and trust on the reported information to public (Dando & Swift, 2003; Mercer, 2004; Wong & Millington, 2014). However, the presence of sustainability assurance could be harmed by the opportunistic behaviors between companies and assurance provider. These problems have been reported by Owen, Swift, Humphrey, & Bowerman, (2000) as managerial capture agenda, and similarly O'Dwyer & Owen, (2005) and Wong & Millington, (2014) also reported that assurance practice is conducted by the lack independence of assurance provider. However, in our study, we expect that the presence of assurance statement in the sustainability report can help to reduce the potential risk with respect to misstatement of information and mismeasurement of non-financial metric indicators, so as to increase the value of report and help the analyst to mitigate the level of asymmetry information (Lang et al., 1996; Lang & Lundholm, 2000; GRI, 2014; Cuadrado-Ballesteros et al., 2017). In our study, we particularly provide evidence whether the interaction between environmental disclosure quality (SDQUALITY) and sustainability assurance (SA) are positively (negatively) associated with analyst forecast accuracy (forecast error). Our findings in this regard, indicate that the companion of sustainability assurance on the environmental information in sustainability report is able to help financial analyst reducing earnings forecast errors for the contemporaneous and one-year ahead.

This study is subject to several limitations. First, we use environmental information of 177 reports (stand-alone and annual report) from 2014 to 2017. However, these reports are not equally distributed across the 20 sample countries. In this respect, we report that most of the companies operating in ESI industries are mainly collected from the United Kingdom.

Meanwhile, we also report that there are several countries with a limited number of sample in the ESI industries (i.e., Czech Republic, Ireland, Luxemburg, Poland, and Romania). Second, we conjecture that financial analyst on each country may behave differently in responding either the environmental disclosure quality (SDQUALITY) or environmental disclosure quantity (SDQUANTITY) to market.

5. ROBUSTNESS TESTS

To obtain a hold and robust estimation results, we therefore proceed to additional analysis. The performed additional tests are; First, regression analysis using unidimensional indices as the proxy of environmental disclosure quality (Table 2.7). Second, regression using SDQUANTITY multidimensional index as the alternate proxy of main independent variable (Table 2.8). Third, we perform the empirical test using the analyst earnings forecast dispersion (Edispersion) as the alternate proxy of analyst forecast accuracy (Table 2.9). In this sense, we want to test whether the environmental disclosure quality (unidimensional and multidimensional indices) is positively (negatively) associated with analyst forecast accuracy (Edispersion). Last, we perform several different measures of sustainability assurance attributes on Edispersion (Table 2.10).

5.1. Regression Results using Unidimensional Indices

In our first research hypothesis, we examine whether the environmental disclosure quality is positively associated with analyst forecast accuracy. In this test, we still use analyst forecast error as the inverse measure of analyst forecast accuracy. However, here we employ the unidimensional environmental disclosure quality indices (i.e., (RQT, DEN, TOI, MAT, and MAN) instead of the multidimensional one. The output of regression analysis is performed on three different forecasts horizons as the dependent variables.

Table 2.7 Analyst forecast accuracy (FERROR0) and unidimensional environmental disclosure indices

VARIABLES	(1) FERROR0	(2) FERROR0	(3) FERROR0	(4) FERROR0	(5) FERROR0	(6) FERROR0
RQT	0.00148 (0.0776)					0.0133 (0.703)
DEN		0.860*** (2.962)				0.808*** (2.787)
TOI			-0.753** (-2.387)			-0.509 (-1.409)
MAN				-2.608** (-2.414)		-1.679 (-1.344)
MAT					0.00564 (0.508)	0.000885 (0.0880)
SR	-0.141 (-1.590)	-0.184** (-2.003)	-0.168* (-1.822)	-0.145 (-1.628)	-0.137 (-1.551)	-0.210** (-2.268)
ENVSCR	-0.00312 (-1.196)	-0.00282 (-1.114)	-0.00341 (-1.368)	-0.00315 (-1.262)	-0.00315 (-1.249)	-0.00343 (-1.327)
GRI	0.0687 (0.613)	0.0681 (0.603)	0.0777 (0.693)	0.0974 (0.869)	0.0716 (0.630)	0.0864 (0.778)
CR_BOARD	0.0329 (0.257)	0.0794 (0.605)	0.0999 (0.745)	0.0531 (0.418)	0.0345 (0.267)	0.141 (1.039)
SIZE	0.0215 (0.185)	-0.0179 (-0.153)	0.0164 (0.142)	0.0373 (0.323)	0.0252 (0.214)	-0.00844 (-0.0725)
AGE	0.00279* (1.783)	0.00309** (1.964)	0.00343** (2.142)	0.00213 (1.349)	0.00266* (1.663)	0.00316* (1.813)
LEVERAGE	-0.00626 (-0.705)	-0.00370 (-0.407)	-0.00334 (-0.368)	-0.000378 (-0.0395)	-0.00599 (-0.676)	0.00129 (0.132)
ROA	-0.0144*** (-2.670)	-0.0140*** (-2.595)	-0.0131** (-2.429)	-0.0135** (-2.478)	-0.0145*** (-2.682)	-0.0126** (-2.323)
ANANO	-0.0185* (-1.668)	-0.0182* (-1.664)	-0.0138 (-1.269)	-0.0159 (-1.458)	-0.0184* (-1.669)	-0.0133 (-1.222)
Constant	-0.424 (-0.425)	-0.327 (-0.335)	0.574 (0.529)	-0.470 (-0.479)	-0.480 (-0.476)	0.332 (0.298)
Observations	708	708	708	708	708	708
R-squared	0.133	0.142	0.141	0.141	0.133	0.152
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES

Notes: Robust t-statistics in parentheses; each asterisk ***, **, * indicates that the estimated coefficients are statistically significant at the 1, 5, and 10 percent levels respectively, in two-tailed test based on robust standard errors. All the firm-level continuous variables are winsorized at the 1st and the 99th percentiles.

Table 2.7 summarizes the association of unidimensional environmental disclosure quality indices with forecast error at the contemporaneous year (t_0). The obtained empirical result shows that three out of five unidimensional measures indicate a positive and two negative significant associations with forecast error. These variables are DEN ($\beta = 0.860$; $p < 0.01$), TOI ($\beta = -0.753$; $p < 0.05$), and MAN ($\beta = -2.608$; $p < 0.05$). Meanwhile, RQT and MAT do not show significant association with forecast error at the contemporaneous year (t_0). DEN shows

a positive association with FERROR0, suggesting that the higher the degree (density) of environmental disclosure information, the higher forecast error. In this study, DEN is built using a ratio between 0 and 1. The value close to 1 indicating that less dilution of relevant information. However, given the positive association between DEN and FERROR0, we infer that sustainability reporting practice is correlated with more information. Thus, this information is more likely to be diluted with unnecessary information, that may cause the financial analyst hard to disentangle the relevant and material information (Michelon et al., 2015). Meanwhile, two unidimensional measures with significant negative correlations indicate that the higher number of quantitative and monetary information contains in the report (TOI), and the more committed approach of managerial orientation as shown on the program and firm actions (MAN), are relevant information for financial analyst to better forecast earnings in the contemporaneous year (FERROR0).

Interestingly, several control variables are also negatively and significantly associated with forecast error at the contemporaneous year (FERROR0). Among them, partial test by including variable SR on the test between DEN-FERROR0, TOI-FERROR0, and MAN-FERROR0 show negative coefficient beta and statistically significant. This result suggests that the use of stand-alone SR report may facilitate the firms to disclose more value-relevant information for financial analysts. The issuance of a stand-alone report is also considered as a potential venue to comprehensively communicate firms' environmental impact (Dhaliwal et al., 2012; Dhaliwal et al., 2014). This explanation is also in line with the empirical study of Mahoney et al., (2013) who found that the utilization of stand-alone report in SR reporting can be a good signal of firms' commitment to stakeholders. In this regard, the signaling theory proposes that a company with a stand-alone report presumably has more confidence in conveying their superior environmental strategy and its impact to public (Cho et al., 2014).

This, in turn, leads to a suggestion that the company with stronger environmental record and performance will be more likely to issue a stand-alone report.

Moreover, even though the environmental performance score (ENVSCR) does not report significant result, but this control variable indicates negative sign of association. This result implies that the higher firms' environmental performance score sends a positive signal to financial analyst so as to allow them to make more accurate earnings forecast. Global Reporting Initiative (GRI) on the contrary, shows no association with the analyst forecast error at the contemporaneous year (FERROR0). We have previously identified (in the correlation analysis) that GRI showed negative but insignificant association with forecast error. Considering the insignificant coefficient beta of GRI, we argue that the GRI framework is apparently capturing more dispersed dimensions, that is suitable for a wider type of stakeholder (Moneva et al., 2006; Joseph, 2012). The same propensity also occurs in the association of CR_BOARD and firms' SIZE. These results denote that the presence of CR_BOARD committee in the firms' governance system and firm SIZE are not associated with forecast error.

The remaining firm-specific information relates to the information of AGE, debt ratio (LEVERAGE), profitability ratio (ROA), and the number of analysts following (ANANO). As can be seen in Table 2.7, the older company is positively associated with higher forecast error. The alternate explanation could be linked to companies which are reluctant to disclose their past and current negative environmental impacts. Also, companies may obfuscate their negative news to make the information more complex and hard to understand by financial analysts (Fabrizio & Kim, 2019). LEVERAGE, on the other hand, shows negative association but statistically insignificant with forecast error. Profitability ratio, as depicted by ROA indicates negative and significant association with forecast error (FERROR0). The number of analysts following (ANANO) also appears to negatively and significantly associated with

forecast error. The negative and significant association between ANANO and FERROR also appears in the main test (see Table 2.6) and in the study of Dhaliwal et al., (2012). As previously explained in the control variable section, the greater number of analysts following depicts the intense competition among financial analysts, and it relates to the incentive they can earn when dealing with more accurate earnings forecasts. In the next step, we proceed to the empirical test of environmental disclosure quality and forecast error for one-year-ahead (FERROR1) in un-tabulated Tables.

In the previous test (see Table 2.7), we found negative association for variable DEN, TOI, and MAN indices with FERROR0. However, in the test of using forecast error for one-year-ahead (FERROR1), we report that only variable TOI ($\beta = -0.941$; $p < 0.05$) and MAN ($\beta = -2.957$; $p < 0.1$) maintain negative and statistically significant association (un-tabulated results). Even though RQT and DEN show negative signs, these two unidimensional indices report no significant association with FERROR1. Since we have less number of unidimensional measure that is statistically associated with forecast error for one-year-ahead (FERROR1), these results suggest that some unidimensional indices are stronger other than the other indices, as they remain relevant also for the forecast one-year-ahead.

Moreover, we also proceed to the test of using forecast error for two-years-ahead (FERROR2) as the dependent variable. The obtained results show that out of five unidimensional measures of disclosure indices, only DEN shows a positive and significant association with the forecast error (FERROR2). The coefficient beta value of variable DEN is also positive when we do the concurrent test (un-tabulated). This result strengthens the previous findings on the test between environmental disclosure and forecast error for the contemporaneous year (FERROR0, where the information in sustainability report is more likely to be diluted, and may cause a higher potential forecast error.

5.2. Regression Results using SDQUANTITY

Table 2.8 Analyst forecast accuracy (FERROR 0, 1, 2), multidimensional environmental disclosure index (SDQUANTITY), and sustainability assurance (SA)

VARIABLES	(1) FERROR0	(2) FERROR0	(3) FERROR1	(4) FERROR1	(5) FERROR2	(6) FERROR2
SDQUANTITY	-0.0853 (-1.021)	0.00495 (0.0441)	-0.175 (-1.549)	0.105 (0.692)	-0.224 (-1.093)	-0.0104 (-0.0325)
SA		-0.00392 (-0.0360)		0.0395 (0.262)		0.0978 (0.355)
SDQUANTITY x SA		-0.155 (-0.938)		-0.488** (-2.225)		-0.382 (-0.915)
SR	-0.130 (-1.476)	-0.120 (-1.362)	-0.0394 (-0.313)	-0.00888 (-0.0713)	0.133 (0.560)	0.155 (0.647)
ENVSCR	-0.00290 (-1.142)	-0.00279 (-1.071)	0.00191 (0.500)	0.00193 (0.535)	-0.00963 (-1.471)	-0.0100 (-1.589)
GRI	0.0830 (0.739)	0.0775 (0.688)	-0.136 (-0.939)	-0.155 (-1.064)	-0.00990 (-0.0330)	-0.0259 (-0.0854)
CR_BOARD	0.0338 (0.263)	0.00949 (0.0780)	0.179 (0.943)	0.0903 (0.517)	0.134 (0.507)	0.0486 (0.186)
SIZE	0.0311 (0.263)	0.0343 (0.284)	0.119 (1.098)	0.119 (1.050)	0.584*** (2.731)	0.570*** (2.620)
AGE	0.00243 (1.511)	0.00275 (1.634)	0.00392* (1.827)	0.00492** (2.103)	0.00201 (0.467)	0.00278 (0.636)
LEVERAGE	-0.00437 (-0.491)	-0.00607 (-0.649)	0.0207 (1.103)	0.0160 (0.822)	0.0296 (1.038)	0.0268 (0.914)
ROA	-0.0143*** (-2.641)	-0.0146*** (-2.662)	-0.00695 (-1.148)	-0.00795 (-1.312)	-0.0132 (-0.641)	-0.0141 (-0.684)
ANANO	-0.0178 (-1.637)	-0.0178 (-1.644)	-0.0403*** (-2.719)	-0.0403*** (-2.726)	-0.0426** (-2.425)	-0.0424** (-2.436)
Constant	-0.612 (-0.591)	-0.672 (-0.635)	-1.374 (-1.391)	-1.466 (-1.442)	-4.982** (-2.533)	-4.930** (-2.466)
Observations	708	708	708	708	708	708
R-squared	0.134	0.136	0.111	0.121	0.093	0.095
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES

Notes: Robust t-statistics in parentheses; each asterisk ***, **, * indicates that the estimated coefficients are statistically significant at the 1, 5, and 10 percent levels respectively, in two-tailed tests based on robust standard errors. All the firm-level continuous variables are winsorized at the 1st and the 99th percentiles.

Table 2.8 illustrates the output of the association test between environmental disclosure quantity (SDQUANTITY) and forecast error for three different time horizons. As shown by the empirical output, it is discernible that SDQUANTITY has shown negative but insignificant coefficient beta on the test using FERROR0 as the dependent variable. Furthermore, this sign is consistently found on the test using FERROR1 and FERROR2. We further insert sustainability assurance (SA) as the moderating variable to see if the presence of sustainability

assurance may help to strengthen the negative association between environmental disclosure quantity (SDQUANTITY) and forecast error (FERROR). The result shows that sustainability assurance (SDQUANTITYxSA) does not statistically moderate the relationship between environmental disclosure quantity and forecast error for the contemporaneous and two-years-ahead. However, variable SDQUANTITYxSA appears to show a negative and significant association with forecast error of one-year-ahead. This suggests that in the short-term, the presence of sustainability assurance (SDQUANTITYxSA) may enhance the relationship between environmental disclosure quantity (SDQUANTITY) and forecast error (FERROR1).

In relation to the insignificant association between environmental disclosure quantity (SDQUANTITY) and forecast error (FERROR; 0, 1, 2), we argue that environmental disclosure quantity, i.e., the amount of environmental information, is not associated with analyst forecast accuracy (forecast error). Even though our study provides different results of information quantity, our findings indicate that it is not the amount of information that helps financial analyst to do better forecasts, but the quality of information disclosed. It also suggests that higher amounts of information disclosed do not necessarily mean “better” (i.e., high quality) information for analysts. On the contrary, these results may suggest that an excessive provision of irrelevant information may reduce the overall quality of information, as it becomes harder for the user of such information to find the relevant pieces of information. Moreover, most of the information disclosed, reported either through stand-alone report or within the annual report, is still reported in an unstructured format. It eventually leads to a high information processing cost and time required to analyze the reports (Gu & Wan, 2005). Also, in the case where the composition of qualitative information is higher than the quantitative and monetary information, there is a propensity that the companies use the qualitative information to obfuscate their negative environmental impact (Fabrizio & Kim, 2019). As concerned by Hooghiemstra, (2000) and Michelin et al., (2016) the high portion of qualitative information

may indicate, in between the lines, that lead to the impression that companies opportunistically use the report as impression management and camouflaging tool. Whereas, if it is seen from the side of financial analyst, the plausible explanation given the insignificant relationship between environmental disclosure quantity and analyst forecast can be centered to the analyst behavior. An analyst may prefer to closely read the content of the report rather than relying on the number of incidences per se.

5.3. Analyst Earnings Forecast Dispersion and Environmental Disclosure Quality (Unidimensional & Multidimensional Indices Tests)

As the completion of main analysis, we also perform robustness test by concurrently inserting unidimensional and multidimensional disclosure indices as the main independent variable of interest. Following the study of Dhaliwal et al. (2011), we use analyst earnings forecast dispersion in year t_0 (Edispersion: the logarithm of the standard deviation of analyst EPS forecasts divided by the consensus forecast) as the alternate measure of analyst forecast accuracy. In line with the proposed hypothesis, we expect that unidimensional and multidimensional disclosure indices are negatively associated with analyst earnings forecast dispersion. The output of empirical evidence is illustrated in Table 2.9.

Table 2.9 Analyst earnings forecast dispersion (Edispersion), unidimensional and multidimensional disclosure quality indices

VARIABLES	(1) Edispersion	(2) Edispersion	(3) Edispersion	(4) Edispersion	(5) Edispersion	(6) Edispersion	(7) Edispersion
RQT	-0.465* (-1.760)						
DEN		12.42** (2.208)					
TOI			-3.981 (-0.798)				
MAN				-33.64** (-2.555)			
MAT					-0.403 (-1.588)		
SDQUALITY						-3.100** (-2.454)	
SDQUANTITY							-0.697 (-0.531)
SR	0.131 (0.0702)	-0.734 (-0.389)	-0.238 (-0.115)	-0.158 (-0.0808)	-0.305 (-0.163)	-0.657 (-0.321)	-0.00909 (-0.00497)
ENVSCR	-0.140*** (-2.596)	-0.147*** (-2.831)	-0.153*** (-2.873)	-0.152*** (-2.849)	-0.147*** (-2.878)	-0.156*** (-2.898)	-0.150*** (-2.730)
GRI	3.442* (1.821)	3.225* (1.764)	3.288* (1.762)	3.605* (1.890)	3.087* (1.712)	3.422* (1.826)	3.355* (1.767)
CR_BOARD	0.811 (0.412)	1.662 (0.867)	1.341 (0.570)	1.251 (0.613)	0.836 (0.414)	1.967 (0.891)	0.995 (0.493)
SIZE	5.338*** (3.135)	4.765*** (3.124)	5.307*** (3.113)	5.537*** (3.195)	5.072*** (3.164)	5.177*** (3.101)	5.412*** (3.202)
AGE	-0.00524 (-0.178)	0.00233 (0.0776)	0.00132 (0.0413)	-0.0105 (-0.362)	0.00680 (0.247)	0.00257 (0.0852)	-0.00499 (-0.175)
LEVERAGE	-0.269* (-1.875)	-0.253* (-1.851)	-0.274* (-1.944)	-0.214* (-1.703)	-0.303** (-2.002)	-0.221* (-1.745)	-0.274** (-1.965)
ROA	-0.137** (-2.381)	-0.132** (-2.314)	-0.130** (-2.335)	-0.125** (-2.255)	-0.127** (-2.145)	-0.118** (-2.152)	-0.137** (-2.386)
ANANO	-0.639*** (-3.250)	-0.633*** (-3.243)	-0.613*** (-3.203)	-0.604*** (-3.189)	-0.646*** (-3.257)	-0.578*** (-3.156)	-0.632*** (-3.238)
Constant	-25.98** (-2.136)	-23.72** (-2.035)	-19.88 (-1.325)	-25.72** (-2.099)	-21.33* (-1.895)	-24.72** (-2.048)	-26.68** (-2.250)
Observations	708	708	708	708	708	708	708
R-squared	0.355	0.358	0.354	0.357	0.356	0.357	0.354
Year FE	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES

Notes: Robust t-statistics in parentheses; each asterisk ***, **, * indicates that the estimated coefficients are statistically significant at the 1, 5, and 10 percent levels respectively, in two-tailed tests based on robust standard errors. All the firm-level continuous variables are winsorized at the 1st and the 99th percentiles.

In Table 2.9, we use analyst earnings forecasts dispersion as the alternate measure of forecast accuracy. Hereby, we account for forecasts dispersion in year t, which is calculated as the logarithm of the standard deviation of analyst estimates of year t earnings divided by the consensus forecast of year t earnings (Dhaliwal et al., 2011). The results show that two (RQT and MAN) out of five unidimensional measures indices are negatively and statistically

associated with earnings forecast dispersion (Edispersion). In this context, the coefficient value of RQT (relative quantity) is -0.465 and statistically significant at ten percent alpha ($p < 0.1$). It denotes that the higher relative quantity reflected through the expected information of the disclosed environmental information can help to lower the forecast dispersion among financial analyst. Meanwhile, the positive association as shown by the relationship between DEN and Edispersion suggest that environmental information in the sustainability or annual report is more likely to be diluted. This circumstance leads to higher analyst earnings forecast dispersion as the analyst have to interpret more complex and irrelevant information. Moreover, the negative association is also shown by the coefficient value of MAN (managerial orientation). MAN shows negative and significant association with earnings forecast dispersion as -33.64 ($p < 0.05$). This result suggests that companies with a more committed approach (focus on program, action, and results) on their environmental information disclosure, provide more useful information for lowering the earnings forecast dispersion among analyst. This empirical output agreed quite well with our notion, in which we conjecture that the unidimensional measures of environmental disclosure quality are positively (negatively) associated with analyst forecast accuracy (Edispersion). In addition to this, we report that the multidimensional index (SDQUALITY) as the main independent variable of interest maintains its negative and significant relationship with earnings dispersion (Edispersion). This means that the availability of environmental information of “good” quality not only improves forecast accuracy but also contributes to reducing analyst earnings forecast dispersions.

5.4. Analyst Earnings Forecast Dispersion and Alternative Measures of Sustainability Assurance

Moreover, we notice that the study on the relationship between sustainability assurance and analyst forecast accuracy is still under-researched. Among them, the empirical evidence of

Dhaliwal et al., (2012) shows that the interaction between the number of CSR pages and the presence of assurance on the non-financial information is negatively associated with forecast error for one-year and two-year-ahead. However, their study merely relies on a conventional measure of sustainability assurance (a dichotomous variable). Therefore, we proposed more advanced and refined measures of sustainability assurance in the additional analysis, and we further test its association with earnings forecast dispersion (Edispersion). As previously noticed by Hobson & Kachelmeier, (2005) managers have the incentive to distort disclosure. Meanwhile, the use of assurance as reported by Simnett et al., (2009) is related to the incentive of firms to increase the credibility of their CSR report. Thus, it is suggested that a more credible report is deemed as more informative to the analyst (Wilson, 2008; Dhaliwal et al., 2011, 2012). Technically, we use four variables as the alternate proxy of sustainability assurance. The first and second variables are the type of assurance provider (ACCOUNTANT and CONSULTANT). The third variable is the level of assurance engagement (LEV_ASSURANCE), and the last variable is the assurance age (AS_AGE).

Table 2.10 Analyst earnings forecast dispersion (Edispersion) and sustainability assurance attributes

VARIABLES	(1) Edispersion	(2) Edispersion	(3) Edispersion	(4) Edispersion
ACCOUNTANT	1.661 (1.220)			
CONSULTANT		-2.402 (-1.367)		
LEV_ASSURANCE			-1.727* (-1.866)	
AS_AGE				-0.569** (-2.191)
SR	-0.178 (-0.0899)	-0.118 (-0.0603)	-0.0954 (-0.0492)	-0.413 (-0.206)
ENVSCR	-0.154*** (-2.878)	-0.140** (-2.568)	-0.141*** (-2.736)	-0.114** (-2.211)
GRI	3.160* (1.748)	3.213* (1.762)	3.372* (1.824)	3.348* (1.809)
CR_BOARD	0.837 (0.425)	1.335 (0.622)	1.400 (0.681)	2.213 (0.960)
SIZE	5.082*** (3.026)	5.485*** (3.188)	5.818*** (3.229)	7.078*** (3.394)
AGE	-0.00262 (-0.0882)	-0.00330 (-0.111)	-0.00445 (-0.146)	0.00897 (0.268)
LEVERAGE	-0.267** (-1.966)	-0.284** (-2.016)	-0.316** (-2.098)	-0.341** (-2.149)
ROA	-0.137** (-2.393)	-0.133** (-2.338)	-0.133** (-2.317)	-0.140** (-2.391)
ANANO	-0.660*** (-3.215)	-0.674*** (-3.201)	-0.642*** (-3.247)	-0.591*** (-3.195)
Constant	-22.60* (-1.814)	-26.34** (-2.181)	-29.88** (-2.292)	-42.67*** (-2.932)
Observations	708	708	708	708
R-squared	0.354	0.354	0.355	0.360
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES

Note: In particular, the level of assurance is differently measured as compared with the level of assurance used in Chapter 1. In Chapter 1, we used three dummy variables as our sample contains some observation with mixed level of assurance of engagement. Meanwhile, in Chapter 2, our sample indicated no observation with mixed level of assurance. Thus, to accommodate the empirical test, we label companies with limited level of assurance as 1 and reasonable level as 2.

Table 2.10 summarises the additional analysis concerning the role played by the sustainability assurance (SA) attributes. Apart from the use of binomial variable to measure the presence of sustainability assurance, we use several alternate measures. Several studies have provided a descriptive explanation of sustainability assurance practice such as the assurance providers, and the level of assurance engagement (Manetti & Becatti, 2009; Cuadrado-

Ballesteros et al., 2017). To advance the findings of prior studies, we consider assurance age by capturing the number of years from the first adoption of assurance engagement.

As can be seen in Table 2.10, we distinguish the assurance provider into two different entities. First, assurance provider from the accounting profession (ACCOUNTANT). Second, assurance provider from the non-accounting profession which we labeled as CONSULTANT. The empirical test using two different proxies of assurance providers shows that there is no association ($p < 0.05$) whether the assurance practice was performed by an accountant or consultant. In the next test, we use the level of assurance. In the practice, companies have two options: whether to engage in a moderate (limited) or high (reasonable) assurance engagement. In some cases, there is a possibility that companies may end up with two different levels of assurance (mixed level of assurance). This information is declared by the assurance provider in the assurance statement of report. We marked 1 if the assurance statement was provided in moderate or limited level, and 2 if the level of assurance was provided with a high or reasonable level. The obtained results show that the level of assurance (LEV_ASSURANCE) is negatively ($\beta = -1.727$) and significantly ($p < 0.1$) associated with earnings forecast dispersion. Suggesting an explicit conclusion that the higher the level of assurance engagement, the more rigorous the verification. As a result of this, the information is deemed more credible and reliable for the analysts, and help them better estimate the potential earnings in almost similar earnings forecast level. Last, we test whether assurance age (AS_AGE) is positively (negatively) associated with analyst forecast accuracy (Edispersion). The obtained empirical evidence shows that assurance age is negatively ($\beta = -0.569$) and significantly ($p < 0.05$) associated with earnings forecast dispersion. This result suggests that companies with longer track record of assurance adoption are more likely to show less analyst earnings forecast dispersion.

6. CONCLUDING REMARKS

Our study examines whether environmental disclosure quality can help the financial analyst to increase their forecast accuracy. In addition to this, we also test if the presence of sustainability assurance moderates the relationship between environmental disclosure quality and forecast accuracy. We test the role of sustainability-related information by employing environmental disclosure quality indices, and further use forecast error as the inverse measure of analyst forecast accuracy. Our results reveal that environmental disclosure quality is negatively associated with forecast error at the contemporaneous and one-years ahead, which indicates support for the positive (negative) relationship between environmental disclosure quality and analyst forecast accuracy (forecast error). After controlling for variously potential confounding factors, our study provides evidence that the higher environmental disclosure quality, the more accurate earnings forecast as produced by the financial analyst. Furthermore, we also investigate the role of sustainability assurance. We show that the presence of sustainability assurance strengthens the positive (negative) association between environmental disclosure quality and forecast accuracy (forecast error).

7. REFERENCES

- Adams, C. A., & Evans, R. (2004). Accountability, completeness, credibility and the audit expectations gap. *Journal of Corporate Citizenship*, 14, 97–115. Retrieved from <http://greenleaf-publishing.com/content/pdfs/jcc14adam.pdf>
- Aerts, W., & Cormier, D. (2009). Media legitimacy and corporate environmental communication. *Accounting, Organizations and Society*, 34(1), 1–27. <https://doi.org/10.1016/j.aos.2008.02.005>
- Aerts, W., Cormier, D., & Magnan, M. (2008). Corporate environmental disclosure, financial markets and the media: An international perspective. *Ecological Economics*, 64(3), 643–659. <https://doi.org/10.1016/j.ecolecon.2007.04.012>
- Al-Tuwaijri, S. A., Christensen, T. E., & Hughes, K. E. (2004). The relations among environmental disclosure, environmental performance, and economic performance: a simultaneous equations approach. *Accounting, Organizations and Society*, 29(5–6), 447–471. [https://doi.org/10.1016/S0361-3682\(03\)00032-1](https://doi.org/10.1016/S0361-3682(03)00032-1)
- Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, 23(4), 589–609. <https://doi.org/10.1111/j.1540-6261.1946.tb01544.x>

- Bagnoli, M., & Watts, S. G. (2017). Voluntary assurance of voluntary CSR disclosure. *Journal of Economics and Management Strategy*, 26(1), 205–230. <https://doi.org/10.1111/jems.12171>
- Baumeister, S., & Gutsche, R. (2017). *The impact of CSR reporting quality on analyst forecast accuracy*. Swissterland. Retrieved from https://www.alexandria.unisg.ch/251911/1/BG_CSR2017.pdf
- Bebbington, J., Larrinaga-González, C., & Moneva-Abadía, J. M. (2008). Legitimizing reputation/the reputation of legitimacy theory. *Accounting, Auditing & Accountability Journal*, 21(3), 371–374. <https://doi.org/10.1108/09513570810863969>
- Bebbington, J., Larrinaga, C., & Moneva, J. M. (2008). Corporate social reporting and reputation risk management. *Accounting, Auditing & Accountability Journal*, 21(3), 337–361. <https://doi.org/10.1108/09513570810863932>
- Birkey, R. N., Michelon, G., Patten, D. M., & Sankara, J. (2016). Does assurance on CSR reporting enhance environmental reputation? an examination in the U.S. context. *Accounting Forum*, 40(3), 143–152. <https://doi.org/10.1016/j.accfor.2016.07.001>
- Boiral, O., Heras-saizarbitoria, I., & Brotherton, M. (2017). Assessing and improving the quality of sustainability reports : The auditors' perspective. *Journal of Business Ethics*, 155(3), 703–721. <https://doi.org/10.1007/s10551-017-3516-4>
- Braam, G. J. M., Uit De Weerd, L., Hauck, M., & Huijbregts, M. A. J. (2016). Determinants of corporate environmental reporting: The importance of environmental performance and assurance. *Journal of Cleaner Production*, 129, 724–734. <https://doi.org/10.1016/j.jclepro.2016.03.039>
- Calabrese, A., Costa, R., & Rosati, F. (2015). A feedback-based model for CSR assessment and materiality analysis. *Accounting Forum*, 39(4), 312–327. <https://doi.org/10.1016/j.accfor.2015.06.002>
- Carnevale, C., & Mazzuca, M. (2014). Sustainability report and bank valuation: evidence from European stock markets. *Business Ethics A European Review*, 23(1), 69–90. <https://doi.org/10.1111/beer.12038>
- Casey, R. J., & Grenier, J. H. (2015). Understanding and contributing to the enigma of corporate social responsibility (CSR) assurance in the United States. *Auditing: A Journal of Practice & Theory*, 34(1), 97–130. <https://doi.org/10.2308/ajpt-50736>
- Cheng, B., Ioannou, I., & Serafeim, G. (2014). Corporate social responsibility and access to finance. *Strategic Management*, 35(1), 1–23. <https://doi.org/DOI: 10.1002/smj.2131>
- Cho, C. H., Michelon, G., & Patten, D. M. (2012). Impression management in sustainability reports: An empirical investigation of the use of graphs. *Accounting and the Public Interest*, 12(1), 16–37. <https://doi.org/10.2308/apin-10249>
- Cho, C. H., Michelon, G., Patten, D. M., & Roberts, R. W. (2014). CSR report assurance in the USA: an empirical investigation of determinants and effects. *Sustainability Accounting, Management and Policy Journal*, 5(2), 130–148. <https://doi.org/10.1108/SAMPJ-01-2014-0003>
- Cho, C. H., & Patten, D. M. (2007). The role of environmental disclosures as tools of legitimacy: A research note. *Accounting, Organizations and Society*, 32(7–8), 639–647. <https://doi.org/10.1016/j.aos.2006.09.009>
- Cho, C. H., Roberts, R. W., & Patten, D. M. (2010). The language of US corporate environmental disclosure. *Accounting, Organizations and Society*, 35(4), 431–443. <https://doi.org/10.1016/j.aos.2009.10.002>
- Cho, S. Y., Lee, C., & Pfeiffer, R. J. (2013). Corporate social responsibility performance and information asymmetry. *Journal of Accounting and Public Policy*, 32(1), 71–83. <https://doi.org/10.1016/j.jaccpubpol.2012.10.005>
- Claver, E., Lopez, M. D., Molina, J. F., & Tari, J. J. (2007). Environmental management and

- firm performance : A case study. *Journal of Environmental Management*, 84, 606–619. <https://doi.org/10.1016/j.jenvman.2006.09.012>
- Coram, P. J., Monroe, G. S., & Woodliff, D. R. (2009). The value of assurance on voluntary nonfinancial disclosure: An experimental evaluation. *Auditing A Journal of Practice & Theory*, 28(1), 137–151. <https://doi.org/10.2308/aud.2009.28.1.137>
- Cormier, D., & Magnan, M. (2007). The revisited contribution of environmental reporting to investors' valuation of a firm's earnings: An international perspective. *Ecological Economics*, 62(3–4), 613–626. <https://doi.org/10.1016/j.ecolecon.2006.07.030>
- Cormier, D., & Magnan, M. (2014). The impact of social responsibility disclosure and governance on financial analysts' information environment. *Corporate Governance*, 14(4), 467–484. <https://doi.org/10.1108/CG-01-2013-0012>
- Cormier, D., & Magnan, M. (2015). The economic relevance of environmental disclosure and its impact on corporate legitimacy: an empirical investigation. *Business Strategy and the Environment*, 24(6), 431–450. <https://doi.org/10.1002/bse.1829>
- Corporate Register. (2008). *The CSR assurance statement report*. Corporate Register: London.
- Cuadrado-Ballesteros, B., Martínez-Ferrero, J., & García-Sánchez, I. M. (2017). Mitigating information asymmetry through sustainability assurance: The role of accountants and levels of assurance. *International Business Review*, 26(6), 1141–1156. <https://doi.org/10.1016/j.ibusrev.2017.04.009>
- Dando, N., & Swift, T. (2003). Transparency and assurance: Minding the credibility gap. *Journal of Business Ethics*, 44(2–3), 195–200. <https://doi.org/10.2307/25075028>
- De Bondt, Werner, F. M., & Thaler, Richard, H. (1990). Do Security Analysts Overreact? *The American Economic Review*, 80(2), 52/57.
- Deegan, C., Cooper, B. J., & Shelly, M. (2006). An investigation of TBL report assurance statements: Australian evidence. *Australian Accounting Review*, 16(2), 2–18.
- Deegan, C., & Rankin, M. (1997). The materiality of environmental information to users of annual reports. *Accounting, Auditing & Accountability Journal*, 10(4), 562–583. <https://doi.org/10.1108/09513579710367485>
- Dhaliwal, D., Li, O. Z., Tsang, A., & Yang, Y. G. (2014). Corporate social responsibility disclosure and the cost of equity capital: The roles of stakeholder orientation and financial transparency. *Journal of Accounting and Public Policy*, 33, 328–355. <https://doi.org/10.1016/j.jaccpubpol.2014.04.006>
- Dhaliwal, D. S., Radhakrishnan, S., Tsang, A., & Yang, Y. G. (2012). Nonfinancial disclosure and analyst forecast accuracy: International evidence on corporate social responsibility disclosure. *The Accounting Review*, 87(3), 723–759. <https://doi.org/10.2308/accr-10218>
- Dugar, A., & Nathan, S. (1995). The effect of investment banking relationships on financial analysts' earnings forecasts and investment recommendations. *Contemporary Accounting Research*, 12(1), 131–160. <https://doi.org/10.1111/j.1911-3846.1995.tb00484.x>
- EFFAS. (2010). *KPIs for ESG. A Guideline for the integration of ESG into financial analysis and corporate valuation*. The European Federation of Financial Analysts Societies (EFFAS). Frankfurt/Germany. Retrieved from <http://ec.europa.eu/DocsRoom/documents/1547/attachments/1/translations/en/renditions/pdf>
- European Commission. (2014). Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014. *Official Journal of the European Union*. https://doi.org/http://eur-lex.europa.eu/pri/en/oj/dat/2003/l_285/l_28520031101en00330037.pdf

- Fabrizio, K. R., & Kim, E.-H. (2019). Reluctant disclosure and transparency: Evidence from environmental disclosures. *Organization Science, Article in*(July), 1–25. <https://doi.org/10.1287/orsc.2019.1298>
- Fatemi, A., Glaum, M., & Kaiser, S. (2018). ESG performance and firm value: The moderating role of disclosure. *Global Finance Journal*, 38, 45–64. <https://doi.org/10.1016/j.gfj.2017.03.001>
- Feldman, S. J., Soyka, P. A., & Ameer, P. G. (1997). Does improving a firm's environmental management system and environmental performance results in a higher stock price? *The Journal of Investing*, 16(4), 87–97.
- García-Sánchez, I. M., Hussain, N., Martínez-Ferrero, J., & Ruiz-Barbadillo, E. (2019). Impact of disclosure and assurance quality of corporate sustainability reports on access to finance. *Corporate Social Responsibility and Environmental Management*, 26(4), 832–848. <https://doi.org/10.1002/csr.1724>
- Gillet-Monjarret, C. (2015). Assurance of sustainability information: A study of media pressure. *Accounting in Europe*, 12(1), 87–105. <https://doi.org/10.1080/17449480.2015.1036894>
- Goss, A., & Roberts, G. S. (2011). The impact of corporate social responsibility on the cost of bank loans. *Journal of Banking and Finance*, 35(7), 1794–1810. <https://doi.org/10.1016/j.jbankfin.2010.12.002>
- GRI. (2014). G4 Sustainability Reporting Guidelines - Reporting Principles and Standard Disclosures. *Global Reporting Initiative*, 1–97. <https://doi.org/https://www.globalreporting.org/resourcelibrary/G3-Guidelines-Incl-Technical-Protocol.pdf>
- Gu, F., & Wan, W. (2005). Intangible assets, information complexity, and analysts' earnings forecasts. *Journal of Business Finance and Accounting*, 32(9–10), 1673–1702. <https://doi.org/10.1111/j.0306-686X.2005.00644.x>
- Gürtürk, A., & Hahn, R. (2016). An empirical assessment of assurance statements in sustainability reports: smoke screens or enlightening information? *Journal of Cleaner Production*, 136, 30–41. <https://doi.org/10.1016/j.jclepro.2015.09.089>
- Hahn, R., & Lulfs, R. (2014). Legitimizing negative aspects in GRI-oriented sustainability reporting: a qualitative analysis of corporate disclosure strategies. *Journal of Business Ethics*, 123(3), 401–420. <https://doi.org/10.1007/s10551-013-1801-4>
- Hassel, L., Nilsson, H., & Nyquist, S. (2005). The value relevance of environmental performance. *European Accounting Review*, 14(1), 41–61. <https://doi.org/10.1080/0963818042000279722>
- Hasseldine, J., Salama, A. I., & Toms, J. S. (2005). Quantity versus quality: the impact of environmental disclosures on the reputations of UK Plcs. *British Accounting Review*, 37(2), 231–248. <https://doi.org/10.1016/j.bar.2004.10.003>
- Helfaya, A., & Whittington, M. (2019). Does designing environmental sustainability disclosure quality measures make a difference? *Business Strategy and the Environment*, 28(4), 525–541. <https://doi.org/10.1002/bse.2262>
- Hobson, J. L., & Kachelmeier, S. J. (2005). Strategic Disclosure of Risky Prospects : A Laboratory Experiment. *The Accounting Review*, 80(3), 825–846.
- Hodge, K., Subramaniam, N., & Stewart, J. (2009). Assurance of sustainability reports: Impact on report users' confidence and perceptions of information credibility. *Australian Accounting Review*, 19(3), 178–194. <https://doi.org/10.1111/j.1835-2561.2009.00056.x>
- Hooghiemstra, R. (2000). Corporate communication and impression management—new perspectives why companies engage in corporate social reporting. *Journal of Business Ethics*, 28(1/2), 55–68. <https://doi.org/10.1023/A:1006400707757>

- Huggins, A., Green, W. J., & Simnett, R. (2011). The competitive market for assurance engagements on greenhouse gas statements: Is there a role for assurers from the accounting profession? *Current Issues in Auditing*, 5(2), A1–A12. <https://doi.org/10.2308/ciia-50083>
- Hummel, K., Schlick, C., & Fifka, M. (2017). The role of sustainability performance and accounting assurors in sustainability assurance engagements. *Journal of Business Ethics*, 4(17), 1–25. <https://doi.org/10.1007/s10551-016-3410-5>
- IFAC. (2013). International standard on assurance engagements (ISAE) 3000 revised, assurance engagements other than audits or reviews of historical financial information. *International Standard on Assurance Engagements (ISAE) 3000*, (December), 1. Retrieved from <https://www.ifac.org/publications-resources/international-standard-assurance-engagements-isae-3000-revised-assurance-eng>
- Ioannou, I., & Serafeim, G. (2014). The impact of corporate social responsibility on investment recommendations: Analyst' perception and shifting institutional logics. *Strategic Management Journal*, 1081(May 2014), 1053–1081. <https://doi.org/10.1002/smj>
- Joseph, G. (2012). Critical perspectives on accounting ambiguous but tethered : An accounting basis for sustainability reporting. *Critical Perspectives on Accounting*, 23(2), 93–106. <https://doi.org/10.1016/j.cpa.2011.11.011>
- Junior, R. M., & Best, P. (2017). Article information : GRI G4 content index : does it improve credibility and change the expectation – performance gap of GRI-assured sustainability reports ? *Sustainability Accounting, Management and Policy Journal*, 8(5), 571–594.
- KPMG. (2017). *The KPMG Survey of Corporate Responsibility Reporting 2017*. KPMG. <https://doi.org/10.1038/nnano.2013.238>
- Lang, M. H., & Lundholm, R. J. (2000). Voluntary disclosure and equity offerings: reducing information asymmetry or hyping the stock? *Contemporary Accounting Research*, 17(4), 623–662. <https://doi.org/10.1506/9N45-F0JX-AXVW-LBWJ>
- Lang, M. H., Lundholm, R. J., & Lang, M. H. (1996). Corporate Disclosure Policy and Analyst Behavior. *The Accounting Review*, 71(4), 467–492.
- Lys, T., Naughton, J. P., & Wang, C. (2015). Signaling through corporate accountability reporting. *Journal of Accounting and Economics*, 60(1), 56–72. <https://doi.org/10.1016/j.jacceco.2015.03.001>
- Lys, T., & Soo, L. G. (1995). Analysts' forecast precision as a response to competition. *Journal of Accounting, Auditing & Finance*, 10(4), 751–765.
- Mahoney, L. S., Thorne, L., Cecil, L., & LaGore, W. (2013). A research note on standalone corporate social responsibility reports: signaling or greenwashing? *Critical Perspectives on Accounting*, 24(4–5), 350–359. <https://doi.org/10.1016/j.cpa.2012.09.008>
- Manetti, G., & Becatti, L. (2009). Assurance services for sustainability reports: Standards and empirical evidence. *Journal of Business Ethics*, 87(1), 289–298. <https://doi.org/10.1007/s10551-008-9809-x>
- Maroun, W. (2018). A conceptual model for understanding corporate social responsibility assurance practice. *Journal of Business Ethics*, 0(0), 1–23. <https://doi.org/10.1007/s10551-018-3909-z>
- Matsumura, E. M., Prakash, R., & Vera-Muñoz, S. C. (2014). Firm-value effects of carbon emissions and carbon disclosures. *Accounting Review*, 89(2), 695–724. <https://doi.org/10.2308/accr-50629>
- Mercer, M. (2004). How do investors assess the credibility of management disclosures? *Accounting Horizons*, 18(3), 185–196. <https://doi.org/10.2308/acch.2004.18.3.185>
- Michelon, G., & Parbonetti, A. (2012). The effect of corporate governance on sustainability

- disclosure. *Journal of Management and Governance*, 16(3), 477–509.
<https://doi.org/10.1007/s10997-010-9160-3>
- Michelon, G., Pilonato, S., & Ricceri, F. (2015). CSR reporting practices and the quality of disclosure: An empirical analysis. *Critical Perspectives on Accounting*, 33, 59–78.
<https://doi.org/10.1016/j.cpa.2014.10.003>
- Michelon, G., Pilonato, S., Ricceri, F., & Roberts, R. W. (2016). Behind camouflaging: Traditional and innovative theoretical perspectives in social and environmental accounting research. *Sustainability Accounting, Management and Policy Journal*, 7(1), 2–25. <https://doi.org/10.1108/09574090910954864>
- Miralles-Quiros, M. del M., Miralles-Quiros, J. L., & Arraiano, I. G. (2017). Are Firms that Contribute to Sustainable Development Valued by Investors? *Corporate Social Responsibility and Environmental Management*, 24(1), 71–84.
<https://doi.org/10.1002/csr.1392>
- Mishra, S., & Modi, S. B. (2013). Positive and negative corporate social responsibility, financial leverage, and idiosyncratic risk. *Journal of Business Ethics*, 117, 431–448.
<https://doi.org/10.1007/s10551-012-1526-9>
- Moneva, M., Archel, P., & Correa, C. (2006). GRI and the camouflaging of corporate unsustainability. *M 30 (2006) 121–137 GRI*, 30, 121–137.
<https://doi.org/10.1016/j.accfor.2006.02.001>
- Moroney, R., Windsor, C., & Aw, Y. T. (2011). Evidence of assurance enhancing the quality of voluntary environmental disclosures: An empirical analysis. *Accounting and Finance*, 52(March 2011), 903–939. <https://doi.org/10.1111/j.1467-629X.2011.00413.x>
- Muslu, V., Mutlu, S., Radhakrishnan, S., & Tsang, A. (2019). Corporate social responsibility report narratives and analyst forecast accuracy. *Journal of Business Ethics*, 154(4), 1119–1142. <https://doi.org/10.1007/s10551-016-3429-7>
- O'Dwyer, B., & Owen, D. L. (2005). Assurance statement practice in environmental, social and sustainability reporting: A critical evaluation. *British Accounting Review*, 37(2), 205–229. <https://doi.org/10.1016/j.bar.2005.01.005>
- Ohlson, J. A. (1980). Financial ratios and the probabilistic prediction of bankruptcy. *Journal of Accounting Research*, 18(1), 109–131. <https://doi.org/10.2307/2490395>
- Osma, G. B., & Guillamón-Saorín, E. (2011). Corporate governance and impression management in annual results press releases. *Accounting, Organizations and Society*, 36(4–5), 187–208. <https://doi.org/10.1016/j.aos.2011.03.005>
- Owen, D. L., Swift, T. A., Humphrey, C., & Bowerman, M. (2000). The new social audits: accountability, managerial capture or the agenda of social champions? *European Accounting Review*, 9(1), 81–98. <https://doi.org/10.1080/096381800407950>
- Perego, P. (2009). Causes and consequences of choosing different assurance providers : An international study of sustainability reporting. *International Journal of Management*, 26(3), 412–425.
- Plumlee, M., Brown, D., Hayes, R. M., & Marshall, R. S. (2015). Voluntary environmental disclosure quality and firm value: Further evidence. *Journal of Accounting and Public Policy*, 34(4), 336–361. <https://doi.org/10.1016/j.jaccpubpol.2015.04.004>
- Pope, S., & Wæraas, A. (2016). CSR-washing is rare: a conceptual framework, literature review, and critique. *Journal of Business Ethics*, 137(1), 173–193.
<https://doi.org/10.1007/s10551-015-2546-z>
- Ruhnke, K., & Gabriel, A. (2013). Determinants of voluntary assurance on sustainability reports: an empirical analysis. *Journal of Business Economics*, 83(9), 1063–1091.
<https://doi.org/10.1007/s11573-013-0686-0>
- Simnett, R., Vanstraelen, A., & Chua, W. F. (2009). Assurance on sustainability reports: An international comparison. *The Accounting Review*, 84(3), 937–967.

- <https://doi.org/10.2308/accr.2009.84.3.937>
- Sinkin, C., Wright, C. J., & Burnett, R. D. (2008). Eco-efficiency and firm value. *Journal of Accounting and Public Policy*, 27(2), 167–176.
<https://doi.org/10.1016/j.jaccpubpol.2008.01.003>
- Tang, A. K. Y., Lai, K. H., & Cheng, T. C. E. (2012). Environmental governance of enterprises and their economic upshot through corporate reputation and customer satisfaction. *Business Strategy and the Environment*, 21(6), 401–411.
<https://doi.org/10.1002/bse.1733>
- Unerman, J. (2008). Strategic reputation risk management and corporate social responsibility reporting. *Accounting, Auditing & Accountability Journal*, 21(3), 362–364.
<https://doi.org/10.1108/09513570810863941>
- Wilson, W. M. (2008). Restatements an empirical analysis of the decline in the information content of earnings following restatements. *The Accounting Review*, 83(2), 519–548.
- Wong, R., & Millington, A. (2014). Corporate social disclosures: A user perspective on assurance. *Accounting, Auditing & Accountability Journal*, 27(5), 863–887.
<https://doi.org/10.1108/AAAJ-06-2013-1389>
- Yoon, B., Lee, J. H., & Ryan, B. (2018). Does ESG performance enhance firm value? Evidence from Korea. *Sustainability*, 10, 1–18. <https://doi.org/10.3390/su10103635>

GENERAL CONCLUSIONS

The overall aim of this PhD thesis is to investigate the relationship between sustainability assurance (SA) and sustainability (i.e., environmental) disclosure quality, the value-relevance of environmental information for financial analyst, and the moderating role of sustainability assurance. This section provides the conclusions of PhD thesis and group them based on two different papers findings.

As it was aforementioned on the general introduction of this PhD thesis, the first chapter entitled “*sustainability assurance and sustainability disclosure quality: an empirical investigation of environmentally sensitive industries*” is meant to empirically test the association between sustainability assurance attributes and sustainability (i.e., environmental) disclosure quality. This chapter infers that there is positive and significant association between sustainability assurance attributes and sustainability disclosure quality. More in details, the conclusion of this chapter is broken down into four parts. First, there is a positive association between the presence of sustainability assurance and sustainability disclosure quality. Second, there is no differences in the disclosure quality whether the sustainability assurance was performed by accountant or consultant, and these two assurance providers are positively and significantly associated with sustainability disclosure quality. Third, in terms of the level of assurance engagement, it can be concluded that limited level of assurance engagement is the only level which shows significant association with disclosure quality in our research. Meanwhile, reasonable and mixed level of assurance show no significant association with disclosure quality. The relevant explanation of this finding is given the low number of firm observations with reasonable and mixed level engagement. We argue that due to the high cost of assurance service, most of our sample can only afford to have limited level. It is also argued by several prior studies that engaging with reasonable is very hard to be done given the thorough evaluation with many data, engagement with many stakeholders, and comprehensive

assessment of non-financial metric calculation. Also, the price for purchasing mixed or reasonable level of assurance are relatively more expensive. Four, in respect of commitment to assurance, it can be inferred that assurance persistency and assurance age are positively associated with sustainability disclosure quality. This finding supports the idea that sustainability reporting and its assurance is immature (O'Dwyer, 2011; Michelon 2018), thus persistent assurance engagement over time is considered matter for disclosure quality improvement (learning-curve experience).

The second chapter entitled “*sustainability disclosure quality, sustainability assurance and analyst forecast accuracy*” provides the empirical analysis on the value-relevance of environmental disclosure quality for financial analyst, and the moderating role of sustainability assurance. The first finding of this chapter concludes that environmental disclosure quality is positively (negatively) associated with analyst forecast accuracy (forecast error). Moreover, we show that the positive (negative) association between environmental disclosure quality and analyst forecast accuracy (forecast error) is stronger for those companies with assurance statement. In our analysis, we deliberately use forecast error with different forecast horizons (contemporaneous year, one-year, and two-year ahead) as the inverse measure of analyst forecast accuracy. In the different test using three forecast horizons, we report that environmental disclosure quality is relevant for short-time period (i.e., forecast error for the contemporaneous year and for one-year ahead). This finding is consistent even when we conduct the additional analysis using different alternate proxy of analyst forecast accuracy (we used analyst earnings forecast dispersion in the robustness test).

Given the obtained empirical results in this PhD thesis, we would also like to draw several important things on the practical and policy implications. First, with respect to practical implication, we provide a review on the Global Reporting Initiative (GRI) G4, Financial Analysts Key Performance Indicators (KPIs), and they have implications on the value-

relevance of environmental information for financial markets. In addition to this, our results suggest that the presence of sustainability assurance either on the stand-alone or annual report is presumed as relevant in increasing the credibility and reliability of the reported information. Second, in respect of policy implication, our results help the policy makers to know better how environmental information reporting has evolved overtime. Thus, regulator may consider to provide rewards (e.g., incentive) to those compliant companies which truthfully and committedly engaged with responsible-environmental activities. Whilst, on the other hand, regulator may consider to design a clear procedure and type of plausible punishment (e.g., monetary or non-monetary) for the uncompliant companies.

Appendix 1

Partial test using independent lag variables of assurance attributes on the environmental disclosure QUALITY

VARIABLES	(1) Quality	(2) Quality	(3) Quality	(4) Quality	(5) Quality
SA_{i,t-1}	10.91*** (3.620)				
ACCOUNTANT_{i,t-1}		9.544*** (2.778)			
CONSULTANT_{i,t-1}		14.54*** (3.292)			
LIMITED_{i,t-1}			11.47*** (3.654)		
REASONABLE _{i,t-1}			5.891 (0.744)		
MIXED _{i,t-1}			-6.562 (-1.403)		
AS_PERS_{i,t-1}				11.59*** (4.298)	
AS_AGE_{i,t-1}					0.755** (2.046)
SR _{i,t-1}	3.783 (1.143)	3.893 (1.175)	3.411 (1.033)	4.374 (1.338)	5.031 (1.518)
ENVSCR _{i,t-1}	0.0186 (0.264)	0.0201 (0.284)	0.0172 (0.243)	0.0271 (0.396)	0.0184 (0.261)
GRI _{i,t-1}	4.809 (1.445)	5.008 (1.516)	4.874 (1.446)	5.907* (1.709)	5.729* (1.652)
CR_BOARD _{i,t-1}	-3.622 (-1.032)	-3.951 (-1.115)	-3.576 (-1.027)	-3.064 (-0.869)	-2.587 (-0.747)
SIZE _{i,t-1}	-1.718 (-0.905)	-1.346 (-0.689)	-1.618 (-0.851)	-1.490 (-0.793)	-2.049 (-0.969)
AGE _{i,t-1}	-0.0744 (-1.091)	-0.0722 (-1.051)	-0.0798 (-1.164)	-0.0774 (-1.109)	-0.102 (-1.486)
LEVERAGE _{i,t-1}	0.180* (1.736)	0.204* (1.862)	0.182* (1.807)	0.187* (1.821)	0.143 (1.327)
ROA _{i,t-1}	-0.0335 (-0.488)	-0.0318 (-0.461)	-0.0214 (-0.316)	-0.00255 (-0.0376)	0.0155 (0.220)
Constant	9.017 (0.574)	5.096 (0.311)	7.935 (0.506)	11.65 (0.741)	16.18 (0.884)
Observations	672	672	672	672	672
R-squared	0.081	0.085	0.087	0.080	0.065
Year FE	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
SE Clustered	YES	YES	YES	YES	YES

Notes: Robust t-statistics in parentheses. *** Significant at the 0.01 level, ** Significant at the 0.05 level, and * Significant at the 0.10 level respectively using a two-tail test.

Appendix 2

Stepwise regression using contemporaneous independent variables on environmental disclosure QUALITY

VARIABLES	(1) quality	(2) quality	(3) quality	(4) quality	(5) quality	(6) quality	(7) quality	(8) quality	(9) quality	(10) quality	(11) quality	(12) quality	(13) quality	(14) quality	(15) quality	(16) quality
CR_REP	5.817** (2.171)	3.183 (1.184)	3.312 (1.226)	3.312 (1.226)	2.946 (1.094)	2.950 (1.098)	2.950 (1.098)	3.094 (1.149)	3.079 (1.141)	3.050 (1.122)	1.744 (0.617)	1.982 (0.703)	2.025 (0.718)	2.246 (0.791)	2.354 (0.831)	2.390 (0.843)
SA		9.268*** (3.873)	11.68*** (3.083)	11.68*** (3.083)	5.923 (0.874)	15.35 (1.130)	15.35 (1.130)	12.06 (0.873)	11.79 (0.867)	11.82 (0.873)	10.68 (0.725)	11.72 (0.794)	11.12 (0.755)	9.747 (0.683)	10.12 (0.709)	10.37 (0.730)
ACCOUNTANT			-3.061 (-0.781)	-3.061 (-0.781)	-2.959 (-0.737)	-3.136 (-0.780)	-3.136 (-0.780)	-3.243 (-0.806)	-3.301 (-0.812)	-3.308 (-0.813)	-3.807 (-0.933)	-4.009 (-0.987)	-2.980 (-0.717)	-2.885 (-0.692)	-3.354 (-0.808)	-3.354 (-0.806)
LIMITED					6.294 (1.114)	-2.978 (-0.229)	-2.978 (-0.229)	-3.011 (-0.229)	-3.022 (-0.233)	-3.087 (-0.238)	-2.918 (-0.205)	-3.140 (-0.220)	-2.824 (-0.198)	-1.710 (-0.124)	-1.762 (-0.128)	-1.925 (-0.141)
REASONABLE						-10.72 (-0.730)	-10.72 (-0.730)	-10.59 (-0.712)	-10.73 (-0.726)	-10.74 (-0.730)	-11.02 (-0.700)	-11.32 (-0.716)	-10.76 (-0.683)	-9.989 (-0.650)	-10.12 (-0.659)	-10.25 (-0.670)
AS_PERS								4.879** (2.195)	4.641** (2.048)	4.629** (2.039)	4.950** (2.181)	5.058** (2.216)	4.789** (2.124)	4.375* (1.930)	4.533** (2.001)	4.515** (1.995)
AS_AGE								0.0665 (0.196)	0.0524 (0.150)	-0.0242 (-0.0687)	0.0601 (0.177)	0.238 (0.642)	0.360 (0.938)	0.375 (0.977)	0.370 (0.977)	0.370 (0.965)
ENVSCR										0.00869 (0.136)	0.00327 (0.0514)	-0.00313 (-0.0484)	0.00327 (0.0503)	0.000580 (0.00896)	0.000287 (0.00443)	-0.000437 (-0.00672)
GRI											5.001** (2.029)	5.924** (2.137)	6.731** (2.378)	6.830** (2.451)	6.916** (2.482)	6.840** (2.421)
CR_BOARD												-3.625 (-1.236)	-2.682 (-0.895)	-3.243 (-1.094)	-3.493 (-1.177)	-3.459 (-1.164)
SIZE													-2.889 (-1.532)	-2.734 (-1.444)	-2.705 (-1.434)	-2.622 (-1.349)
AGE														-0.0974 (-1.457)	-0.0958 (-1.432)	-0.0953 (-1.430)
LEVERAGE															0.144*** (4.004)	0.143*** (4.011)
ROA																-0.0277 (0.0619)
Constant	-0.728 (-0.346)	-6.659** (-2.283)	-7.004** (-2.392)	-7.004** (-2.392)	-7.347** (-2.447)	-7.401** (-2.463)	-7.401** (-2.463)	-5.704* (-1.963)	-5.747* (-1.954)	-6.199 (-1.495)	-6.564 (-1.567)	-4.909 (-1.098)	20.86 (1.258)	23.23 (1.380)	22.72 (1.357)	22.01 (1.281)
Observations	904	904	904	904	904	904	904	904	904	904	904	904	904	904	904	904
R-squared	0.022	0.055	0.056	0.056	0.060	0.061	0.061	0.064	0.064	0.064	0.071	0.074	0.081	0.087	0.090	0.090
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
SE Clustered	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust t-statistics in parentheses. *** Significant at the 0.01 level, ** Significant at the 0.05 level, and * Significant at the 0.10 level respectively using a two-tail test.

Appendix 3

Stepwise regression using lag independent variables on environmental disclosure QUALITY

VARIABLES	(1) quality	(2) quality	(3) quality	(4) quality	(5) quality	(6) quality	(7) quality	(8) quality	(9) quality	(10) quality	(11) quality	(12) quality	(13) quality	(14) quality	(15) quality	(16) quality
SR _{i,t-1}	7.311*															
	*	4.378	4.574	4.574	4.205	4.209	4.209	4.373	4.373	4.363	3.394	3.614	3.631	3.860	3.906	3.909
	(2.521)	(1.473)	(1.527)	(1.527)	(1.416)	(1.412)	(1.412)	(1.466)	(1.465)	(1.443)	(1.032)	(1.107)	(1.108)	(1.167)	(1.184)	(1.183)
SA _{i,t-1}		9.542***	13.53***	13.53***	6.446	-2.140	-2.140	-5.732	-5.901	-5.896	-6.531	-5.346	-5.865	-7.446	-7.167	-7.125
		(3.619)	(3.068)	(3.068)	(0.860)	(-0.296)	(-0.296)	(-0.810)	(-0.803)	(-0.801)	(-0.964)	(-0.792)	(-0.857)	(-1.034)	(-0.993)	(-0.984)
ACCOUNTANT _{i,t-1}			-5.099	-5.099	-4.919	-4.745	-4.745	-5.052	-5.090	-5.093	-5.357	-5.588	-4.932	-4.805	-5.076	-5.075
			(-1.096)	(-1.096)	(-1.036)	(-1.000)	(-1.000)	(-1.062)	(-1.057)	(-1.054)	(-1.107)	(-1.156)	(-1.003)	(-0.976)	(-1.018)	(-1.017)
LIMITED _{i,t-1}					7.659	16.09***	16.09***	15.96***	15.97***	15.95***	15.91***	15.64***	15.85***	16.97***	17.00***	16.97***
					(1.238)	(3.111)	(3.111)	(3.140)	(3.090)	(3.073)	(3.580)	(3.604)	(3.565)	(3.385)	(3.425)	(3.417)
REASONABLE _{i,t-1}						10.11	10.11	10.24	10.14	10.14	10.05	9.768	10.14	10.90	10.94	10.92
						(1.004)	(1.004)	(1.023)	(1.017)	(1.016)	(1.064)	(1.040)	(1.070)	(1.105)	(1.116)	(1.108)
AS_PERS _{i,t-1}								6.277**	6.196**	6.191**	6.486***	6.710***	6.615***	6.532***	6.759***	6.755***
								(2.549)	(2.584)	(2.595)	(2.769)	(2.855)	(2.790)	(2.744)	(2.814)	(2.822)
AS_ _{i,t-1}								0.0338	0.0294	-0.0339	0.0553	0.173	0.285	0.291	0.291	0.291
								(0.0952)	(0.0816)	(-0.0927)	(0.159)	(0.456)	(0.734)	(0.750)	(0.743)	(0.743)
ENVSCR _{i,t-1}									0.00260	-0.00237	-0.00646	-0.00251	-0.00492	-0.00539	-0.00545	-0.00545
									(0.0379)	(-0.0345)	(-0.0927)	(-0.0356)	(-0.0701)	(-0.0766)	(-0.0772)	(-0.0772)
GRI _{i,t-1}									3.399	4.613	5.105	5.204	5.319	5.309	5.309	5.309
											(1.159)	(1.397)	(1.525)	(1.578)	(1.613)	(1.593)
CR_BOARD _{i,t-1}												-4.302	-3.626	-4.160	-4.630	-4.626
												(-1.345)	(-1.079)	(-1.232)	(-1.358)	(-1.355)
SIZE _{i,t-1}													-1.843	-1.703	-1.736	-1.728
													(-0.917)	(-0.840)	(-0.861)	(-0.834)
AGE _{i,t-1}														-0.0897	-0.0911	-0.0909
														(-1.316)	(-1.331)	(-1.334)
LEVERAGE _{i,t-1}															0.231**	0.231**
															(2.051)	(2.045)
ROA _{i,t-1}																-0.00403
																(-0.0584)
Constant	-2.777	8.975***	9.426***	9.426***	9.852***	9.807***	9.807***	-7.800**	-7.808**	-7.942*	-8.094*	-6.290	10.14	12.46	12.75	12.67
	(-1.248)	(-2.830)	(-2.966)	(-2.966)	(-3.005)	(-2.987)	(-2.987)	(-2.401)	(-2.393)	(-1.778)	(-1.806)	(-1.319)	(0.589)	(0.714)	(0.734)	(0.712)
Observations	672	672	672	672	672	672	672	672	672	672	672	672	672	672	672	672
R-squared	0.032	0.066	0.071	0.071	0.075	0.076	0.076	0.081	0.081	0.081	0.084	0.089	0.092	0.096	0.098	0.098
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
SE Clustered	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Robust t-statistics in parentheses. *** Significant at the 0.01 level, ** Significant at the 0.05 level, and * Significant at the 0.10 level respectively using a two-tail test.