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Determinants of Corporate Climate Change Disclosure for European Firms

Grigoris Giannarakis,[1] Eleni Zafeiriou,[2*] Garyfallos Arabatzis[2] and Xanthi Partalidou[3]

[1]*Department of Business Administration (Grevena), Western Macedonia University of Applied Sciences, Grevena, Greece*
[2]*Agricultural Development, Democritus University of Thrace, Orestiada, Greece*
[3]*Department of environmental engineering and Pollution Control, Technological Education Institute of West Macedonia, Kozani, Greece*

ABSTRACT

This study identifies the determinants of climate change disclosure under the prism of sustainable development in European context. The selected variables involve environmental performance, ownership structure, and verification of climate change initiatives. Cross-sectional data derived from the Bloomberg terminal of the European 500 index concerning 215 firms in the year 2014 are employed. The novelty of the present study stands on the use of proxies for climate change disclosure by adopting the Climate Performance Leadership Index (CPLI). The results reveal that better environmental performance positively affects the level of climate change disclosure. In addition, governmental ownership and independent verification of environmental data determine climate change disclosure. Thus, climate change disclosure is thought to be an effective managerial tool for shareholders and stakeholders to superintend corporate management limiting information asymmetry level; furthermore, higher environmental performers prefer actual climate change disclosure providing a plausible signal. Copyright © 2017 John Wiley & Sons, Ltd and ERP Environment

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Introduction

In recent decades, global climate change is considered a significant threat to human survival and political stability (Huisingh *et al.*, 2015). Therefore, an abundance of different corporate strategies aiming at the mitigation of greenhouse gas (GHG) emissions have emerged, especially with the adoption of the Kyoto Protocol (Cadez and Czerny, 2016). Corporate reporting of environmental initiatives has been put forward as a plausible solution, given that it is a low-cost regulatory and effective solution for carbon emissions mitigation (Wang *et al.*, 2008). Therefore, this field has attracted scientific interest since it has become a high priority issue for stakeholders and organizations (Hughes *et al.*, 2001). Issuance of sustainability reports, firms' certification and environmental index ratings provide a few examples of environmental performance (Hahn and Kühnen, 2013; Chaklader and

*Correspondence to: Eleni Zafeiriou, Democritus University of Thrace, Agricultural Development, 193 Pantazidou str, Orestiada GR68200, Greece.
E-mail: ezafeir@agro.duth.gr

Gulati, 2015). Among different corporate sustainability tools, several deficiencies can be mentioned, including lack of standardization that hampers comparability, the tendency of corporations to hide their actual practices through these tools, intentional manipulation of stakeholder perception through green-washing, and a lack of consideration given to uncertainty in the assessment of sustainability performance (Siew, 2015). Still, sustainability reporting is considered an accurate means of including information on credible and relevant corporate environmental, social, and economic performance (Palenberg *et al.,* 2006). Within the last decade standalone annual sustainability reports have emerged as a a usual corporate practice. (Malarvizhi & Matta, 2016).

This study identifies the potential determinants of the level of climate change disclosure among the following factors: environmental performance, ownership structure, and verification of environmental information. Moreover, two different approaches are incorporated as a proxy of environmental performance; the first is based on environmental output whereas the second approach considers the intention of environmental initiatives. For this reason, GHG emissions and the climate change policy a firm implements throughout its business operations have been used as a proxy for environmental performance. Consistent with Dam and Scholtens (2012), the present study focuses on 500 of the most liquid capitalized European companies for the year 2014 which voluntarily disclosed their sustainability reports, providing some useful insight into climate change disclosure for the Bloomberg European 500 Index.

The Climate Performance Leadership Index (CPLI) is employed as a proxy for climate change disclosure level for the first time, given that it reflects the extent and the quality of climate change disclosure focusing on climate change mitigation strategy. Implicitly, it provides a signal that a company is measuring, verifying, and managing its carbon footprint. The findings of this study entail valuable implications for different stakeholders, helping them to comprehend climate change and disclosure behavior.

The rest of the study is structured as follows. The following sections present the existing theories that underpin the explanatory variables along with hypotheses development. Next, the methodological steps taken are presented followed by the results along with a thorough discussion of same. Finally, conclusions limitations and issues for further research are provided in the last section.

Literature Review

The increased awareness of corporate sustainability has forced firms to integrate sustainability strategies to demonstrate their engagement to sustainability via voluntary sustainability disclosure, such as climate change disclosure, and so enhance environmental performance (Brammer and Pavelin, 2008; Kolk, 2008; Amran *et al.,* 2015). According to Helfaya and Moussa (2017), broad corporate social responsibility (CSR) strategy has a positive and significant effect, both on the quantity and quality of environmental sustainability disclosure.

A substantial body of studies supports that there is a strategic element to the disclosure process. For instance, environmental disclosure can be used to formulate outside users' perception of company performance. In addition, environmental disclosure receives greater importance when environmental concerns and fines receive the attention of media (Neu *et al.,* 1998; Deegan *et al.,* 2000). Moreover, environmental disclosure is considered a diversive managerial tools for financial stakeholders such as investors (Freedman and Jaggi, 1988; Neu *et al.,* 1998).

Next, a short presentation of the conceptual framework is provided, interpreting the environmental disclosure level as a function of explanatory variables including environmental performance, ownership structure, and initiatives' verification. Regarding environmental performance, two main theories have been developed: legitimacy theory and voluntary disclosure theory. In terms of the socio-political aspect, legitimacy theory argues that companies with poor environmental performance tend to disseminate more information via environmental disclosure (Patten, 1992). According to the voluntary disclosure theory, companies with superior environmental performance are motivated to increase the extent of their environmental disclosure (Verrecchia, 1983; Li *et al.,* 1997). Better environmental performers disseminate more information differentiating them from companies with poorer environmental performance. Poorer environmental performers possibly prefer a 'silent' approach or disseminate less information

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regarding environmental performance and so they are placed in a pool of companies with an average level of performance (Clarkson *et al.*, 2008).

Regarding ownership type, agency theory interprets managerial behavior in response to the level environmental information provided to shareholders. The seperation and control issue may well raise the risk of opportunistic managers' behavior (Jensen and Meckling, 1976). Furthermore, agency theory assumes information asyymmetry among managers and shareholders limiting their ability to detect opportunistic managers' behaviors increasing agency costs (Adams, 1994; Jensen and Meckling, 1976). The dissemination of information via disclosure can be considered as a crucial tool for the reduction in the information asymmetry between corporate insiders and outsiders and agency costs (Vander Bauwhede and Willekens, 2008; Cheung *et al.*, 2010). Regarding ownership structure, concentrated ownership enhances the monitoring procedure by obtaining improved information on managerial performance (Berle and Means, 1932). This study investigates whether government ownership hassles or not management's propensity to disclose information relative to climate change and thus decrease agency cost.

Companies that intend to enhance the credibility of the reported information and build corporate reputation are more likely to have their voluntary reports verified (Simnett *et al.*, 2009). For this reason, independent assessors verify the environmental initiatives to assure the benefits. The stakeholder-agency theory may explain the relationship between verified environmental initiatives and the dissemination of corporate disclosures. Hill and Jones (1992) established the concept of stakeholder-agency theory. Stakeholders provide vital resources to a company and, in return, they have a legitimate interest in it (Freeman, 1984).

According to Hill and Jones (1992), managers have a unique role in the nexus of implicit and explicit contracts that constitute the firm. Managers are the only stakeholders associated via a contractual relationship with shareholders and have divergent interests evidenced by this contract which determines the relationship context. This unique feature of managers characterizes them as agents for the rest of the stakeholders. Even though not all stakeholders are of equal significance, the terms of stakeholder-agent and principal-agent are suggested to explain the implicit and explicit contractual relationships of corporate stakeholders.

Unlike previous empirical studies which focus only on the level of information transparency, this study explores the main determinants for dissemination of climate change information and corporate climate change strategy level under multiple aspects of theories: legitimacy theory and voluntary disclosure theory, agency theory and, finally, stakeholder-agency theory. Unlike previous studies, CPLI is employed to provide an indication of corporate transparency, mitigation of, and adaptation to climate change. In addition, the sample focuses on multi-country level to ascertain how European firms behave in relation to climate change information contrary to most prior studies which focus only on one country (Rankin *et al.*, 2011; Kalu *et al.*, 2016) or a comparison concerning a few countries (De Villiers & Von Staden, 2011). Furthermore, this study extends previous empirical studies by investigating the role of environmental performance on climate change disclosure under environmental output by incorporating GHG emissions and intention of environmental initiatives. Finally, the impact of environmental verified initiatives on environmental disclosure has not been examined extensively.

Hypotheses Development

To get an insight into the sustainability disclosure mechanisms, several studies intended to examine the factors that affect environmental disclosure level are presented (Brammer and Pavelin, 2008; Tagesson *et al.*, 2009; Eleftheriadis and Anagnostopoulou, 2015; D'Amico *et al.*, 2016).

Environmental Performance

As already mentioned, two theories explain the effect of environmental performance on environmental disclosure. Legitimacy theory predicts that poorer corporate environmental performers disseminate more environmental information (Patten, 2002) whilst the voluntary disclosure theory predicts a positive effect of corporate environmental performance on environmental disclosure level (Verrecchia, 1983; Dye, 1985). Prior empirical

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studies divulge that the effect of environmental performance on the extent of environmental disclosure is controversial.

Luo and Tang (2014) used CO_2 emissions to examine the effect of environmental performance on the extent of environmental disclosure by adopting the Carbon Disclosure Leaders Index. According to their findings for US, UK, and Australian companies for the year 2010, good environmental performers seem to disseminate more precise information in reporting. Clarkson *et al.* (2008) found that superior environmental performers tend to disseminate more information via reports and websites. Similar results were found by Clarkson *et al.* (2011) in an Australian business context adopting similar proxies of environmental performance and disclosure consistent with Clarkson *et al.* (2008). Al-Tuwaijri *et al.* (2004) revealed that lower environmental polluters disseminate more information via disclosure than higher environmental polluters. Therefore, environmental disclosure can be a tool for the formulation of a proactive environmental image. Based on a sample of Dutch companies, Braam *et al.* (2016) showed that poorer environmental performers in terms of GHG emissions and water consumption are more likely to disseminate more environmental information than better environmental performers. Finally, some studies provided mixed results, such as Meng *et al.* (2014) and Wiseman (1982). Based on this argument, two hypotheses are proposed in this study.

H1a: *Based on voluntary disclosure theory, higher corporate environmental performance positively affects the level of climate change disclosure.*

H1b: *Based on legitimacy theory, lower corporate environmental performance positively affects the level of climate change disclosure.*

Ownership Structure

The ownership structure is considered an important explanatory factor that could affect the extent of environmental disclosure (Chau and Gray, 2002). Governments own firms and participate in the stock of listed firms to carry out many tasks and responsibilities such as enhancing environmental quality, reducing unemployment, and engaging in regional development and education (OECD, 2010; Dam and Scholtens, 2012). Wang *et al.* (2008) find a positive relation among the extend of voluntary disclosure of a firm and the proportion of state ownership. Based on Malaysian listed companies, Nazli and Ghazali (2007), with the assistance of a dummy variable, showed that companies in which the government is a substantial shareholder tend to disseminate more information in their disclosure. Cheng and Courtenay (2006) stated that the effect of government ownership on corporate disclosure policy is ambiguous. The results implied that state-controlled firms tend to be more transparent, supporting enhanced governance and disclosure policies. However, Xiao *et al.* (2004) found that state owners do not have voluntary information as a priority because company profitability is not the major concern. Finally, Huafang and Jianguo (2007) investigated the impact of ownership structure and board composition on voluntary disclosures of listed companies in China and found little evidence about their relationship.

Based on agency theory, a government's commitment to companies is expected to be more politically sensitive because corporate practices are in the center of public scrutiny; thus, environmental disclosure is expected to increase in order to monitor and control corporate managers. Thus, the underlying assumption is:

H2: *A higher proportion of government ownership increases the dissemination level of climate change disclosure.*

Verification Process

Based on empirical studies, Simnett *et al.* (2009) found that corporate reporting is indicative of organizational commitment, risk management, and a desire to build corporate reputation. The perceived and actual credibility of the reported information. According to their findings, firms seeking to improve the credibility of their reports and enhance their reputation are more likely to have their reports confirmed. Moroney *et al.* (2012) considered listed Australian companies between 2003 and 2007 and indicated that environmental assurance is connected to the quality of

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environmental disclosure. Braam *et al*. (2016) investigated the role of assurance in the variability of environmental disclosure initiatives for Dutch companies for the period 2009–2011. The results indicate that the process of assurance positively affects corporate environmental accountability.

To sum up, companies aiming at the verification of environmental initiatives assure the credibility of the environmental information leading to more objective and verifiable environmental information in environmental disclosure level.

H3: *External assurance of initiatives increase the extent and the quality of corporate climate change disclosure.*

Methodology

Sample

The initial sample included companies of Bloomberg European 500 Index for the economic year 2014. The study focuses on the 500 most liquid capitalized European companies to generalize the results regarding their contribution level to climate change mitigation, adaptation, and transparency, a result that is inconsistent with a range of empirical studies being country-specific (Gamerschlag *et al*., 2011; Braam *et al*., 2016). Of the 500 companies, the final sample of the study is limited to 215 companies representing 43% of the Bloomberg European 500 Index due to lack of corporate data regarding CPLI and governance indicators.

Dependent and Independent Variables

For the first time, this study uses the CPLI as a dependent variable and a proxy of climate change disclosure level based on qualitative and quantitative items calculated by Carbon Disclosure Project (CDP). The CPLI describes the level of action on climate change mitigation, adaptation, and transparency. A high performance score signals that a company is measuring, verifying, and managing its carbon footprint. Regarding the performance formula, performance points earned (the numerator) is divided by performance points available (the denominator) and multiplied by 100. Then the percentages are grouped into bands. The CDP assigns a performance band from A (higher performance) to E (lower performance) to companies scoring above 50 on disclosure scores. Finally, performance scoring does not make any assessment of the impact of a company's disclosed activities and it cannot be considered as a comprehensive metric of the level to which a company is a low-carbon emitter or not[1] (Cotter and Najah, 2012; CDP, 2014; Luo and Tang, 2014).

Environmental performance is considered a multidimensional construct based on the recognition, measurement, verification, and reporting of environmental performance indicators (Dragomir, 2012). This study uses GHG emissions as a proxy of environmental performance based on environmental output impact. In particular, two different indicators of GHG emissions were employed in the proposed model; the first indicator refers to the ratio of GHG calculated as metric tonnes of GHGs emitted to sales revenue in the company's reporting currency (GHGE).[2] The second indicator refers to sector-adjusted GHG emissions (GHGEs), calculated using firms' GHGE minus their sector mean (Luo & Tang, 2014). The formula for the second indicator is follows:

$$\mathrm{GHGES}_i = GHGE_{\mathrm{i}} - \frac{1}{\mathrm{N}} \sum_{\mathrm{i}=o}^{\mathrm{N_j}} \mathrm{GHGE_i} \tag{1}$$

where Nj denotes the total number of firm observations in sector j and j = Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Telecommunication

[1]Full details of disclosure items both for CDLI and CPLI are available at: https://www.cdp.net/documents/guidance/2014/cdp-2014-climate-change-scoring-methodology.pdf [May 12, 2016].
[2]The GHGE indicator is found statistically insignificant to Climate Change Disclosure. Thus, it is not presented in the following results of the study.

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Services, or Utilities. This study fills the gap in the literature review suggesting a dummy variable for the developed climate change policy in business operation as a proxy of environmental performance.

Regarding the government ownership structure as an explanatory variable, empirical studies recommend similar indicators as a proxy of government ownership in a company (Eng and Mak, 2003; Cheng and Courtenay, 2006; Huafang and Jianguo, 2007). Finally, external verification concerns whether the company's environmental policies and data were subject to an independent assessment for the reporting period (Simnett *et al.,* 2009; Moroney *et al.,* 2012; Braam *et al.,* 2016).

Three control variables are introduced in the proposed model: firm size, profitability, and size of board of directors. In general, larger companies are subject to higher attention from stakeholders as regards environmental performance than smaller ones. Thus, larger companies confront greater pressure to disseminate more information than smaller ones (Schipper, 1991; Deegan and Gordon, 1996; Udayasankar, 2008). Sales are used as a proxy of corporate size consistent with Tauringana and Chithambo (2015). Return on invested capital (ROIC) is employed as a proxy for corporate profitability consistent with Gamerschlag *et al.* (2011). Finally, several prior studies show the significant impact of board size on the extent of voluntary disclosures, for example Siregar and Bachtiar (2010) and Esa and Ghazali (2012).[3] Table 1 presents all variables and control variables that are incorporated in the study. All data were retrieved from Bloomberg online database.

Model Development

The present study employs the ordered logit regression to detect the main determinants of climate change disclosure. The ordered response model as well as a binary model, initially introduced by Aitchison and Silvey (1957) is estimated under a certain set of assumptions about the latent error distribution. In ordered dependent variable models, the observed dependent variable denotes outcomes representing ordered or ranked categories. The model observed response is represented by considering a latent variable y^*that depends linearly on several explanatory variables represented by the vector x:

$$y_i^* = x_i'\beta + e_i \tag{2}$$

where e_i denotes the independent and identically distributed random errors. The observed dependent variable is determined by the corresponding latent variable by using the following rule:

$$y_i = \begin{cases} 1 \;\; if \;\; 0 < y_i^* \leq 20\% \\ 2 \; if \;\; 20 < y_i^* \leq 40\% \\ 3 \; if \;\; 40 < y_i^* \leq 60\% \\ 4 \; if \;\; 60 < y_i^* \leq 85\% \\ 5 \; if \;\; y_i^* > \text{`}85\% \end{cases} \tag{3}$$

The real values employed for each category representing the dependent variable are arbitrary. It is necessary for the correct ordering to be maintained so that, for example, $y_i^* < y_j^*$ implies the validity of the same inequality relationship for the real variables. Thus, the probabilities for the response of each dependent variable are provided by the following relationships;

$$\Pr(y = 1 | x_i, \beta, \gamma) = F\left(\gamma_2 - x_i'\beta\right) - F\left(\gamma_1 - x_i'\beta\right) \tag{4}$$

[3]A number of different control variables were considered in the proposed model, such as CEO Duality, Number of Board meetings, Financial Leverage and Return on Asset; however, they were statistically insignificant.

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Variables	Measurement
Climate Performance Leadership Index	Reflects the level of company commitment to climate change mitigation, adaptation, and transparency. A performance band is a measure of firm's response to CDP requirements. 5 - Band A/A- (performance score > 85%) 4 - Band B (performance score > 60%) 3 - Band C (performance score > 40%) 2 - Band D (performance score > 20%) 1 - Band E (performance score > 0%)
Climate Change Policy	Indicates whether the company has outlined its intention to help reduce global emissions of the GHGs that cause climate change through its ongoing operations and/or the use of its products and services. Examples might include efforts to reduce GHG emissions, efforts to improve energy efficiency, efforts to derive energy from cleaner fuel sources, investment in product development to reduce emissions generated or energy consumed in the use of the company's products, etc.
GHGE	Firms' GHGE minus their sector mean (free from the sector bias).
Government Ownership	Percentage of publicly reported holdings by government.
Verification	Indicates whether the company's environmental policies and data were subject to an independent assessment for the reporting period.
Size	Total of operating revenues less various adjustments to Gross Sales. Adjustments: Returns, discounts, allowances, excise taxes, insurance charges, sales taxes, and value added taxes.
Profitability	Return on invested capital: (Net operating profit after tax / Average invested capital)*100.
Board Size	Number of directors on the company board.

Table 1. Definitions of the variables

$$\Pr(y = 2 \rfloor x_i, \beta, \gamma) = F\left(\gamma_3 - x_i'\beta\right) - F\left(\gamma_2 - x_i'\beta\right) \tag{5}$$

$$\Pr(y = 3 \rfloor x_i, \beta, \gamma) = F\left(\gamma_4 - x_i'\beta\right) - F\left(\gamma_3 - x_i'\beta\right) \tag{6}$$

$$\Pr(y = 4 \rfloor x_i, \beta, \gamma) = F\left(\gamma_5 - x_i'\beta\right) - F\left(\gamma_4 - x_i'\beta\right) \tag{7}$$

$$\Pr(y = 5 \rfloor x_i, \beta, \gamma) = 1 - F\left(\gamma_5 - x_i'\beta\right) \tag{8}$$

where F is the cumulative distribution function of the errors. The estimation of the threshold values is based on the maximization of the log likelihood function along with β coefficients.

The interpretation of the signs of the coefficients requires an extensive analysis. Implicitly, the sign of an estimated coefficient illustrates the direction of the probability change of the endpoint ranking for a marginal change of the independent variable. Thus, the probability of the sign of the coefficient is in line with the movement to the lowest endpoint while the opposite result is valid for the highest threshold.

The two models to be estimated are provided by the following formulas;

$$\text{CPLI} = a_{11}CCP + a_{12}VER + a_{13}GOWN + a_{14}ROIC + a_{15}SZ + a_{16}BS \tag{9}$$

$$\text{CPLI} = a_{21}GHGE + a_{22}VER + a_{23}GOWN + a_{24}ROIC + a_{25}SZ + a_{26}BS \tag{10}$$

where:

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CPLI: = Climate Performance Leadership Index

CCP: = Climate Change Policy

GHGES: = a firm's GHGE minus their sector mean[4]

VER: = Verification

GOWN: = Government Ownership

ROIC: = Return on Invested Capital

SZ: = Firm Size

BS: = Board Size

Results

Descriptive Results and Correlation Matrix

The final sample includes companies originating from 18 different European countries. In particular, 26% ($n = 57$) of the sample is in Great Britain, 19% ($n = 41$) is in France, 12% ($n = 26$) in Germany, 6% ($n = 14$) in Spain and Switzerland, respectively, while the rest of the companies come from Sweden, Norway, Finland, Denmark, and other countries operating in different sectors such as Financial, Industrial, Consumer Discretionary, and Materials. As far as the performance band is regarded, companies of the sample achieve Band A/A, 84 companies attain Band B, 51 companies achieve Band C, and the rest (40) of the companies achieve Bands D and E. Table 2 presents the descriptive statistics of the dependent and explanatory variables along with control variables including the mean, median, minimum, maximum, and standard deviation. The mean for the CPLI is 3.5 out 5 and is generally considered as a satisfactory score. Firms will never disseminate all corporate confidential information voluntarily probably because it concerns critical aspects of their competitiveness. Thus, firms do not intend to unveil critical corporate information that would distinct them from competitiors. The sales' variable extends from €91 200 to €421.105 million implying that the study focuses not only on large sized but also medium sized companies. Further analysis reveal that 163 companies outlined their intentions to reduce global emissions of GHGs. Although the independent assessment can be costly and time consuming, 145 companies prefer an assessment of their environmental policy and data by an independent body indicating the assessment trend in the business environment. Finally, the sample incorporates firms completely private and firms that re governed by European governments as the minimum and maximum range from 0 to 96.42.

Table 3 presents Pearson's correlation analysis among the variables with their significance level. The results of the study show that Pearson's correlations between the explanatory variables range from 0.1208 to 0.3786; thus, multicollinearity cannot be a problem for interpreting the proposed model (Guajarati, 1995). In particular, both GHGE and CCP environmental performance are positively and significantly correlated to climate change disclosure. Similarly, both Government Ownership and Verification variables affect CPLI in a statistically significant way.

Ordered Logit Regression

Tables 4 and 5 present the estimation results for the two models investigating climate change disclosure with different proxies of environmental performance. For every determinant of the dependent variable, statistical significance for different levels of significance is confirmed.

[4]Negative values of GHGEs mean better environmental performance than the sector's environmental performance.

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Variables	Mean	Min	Max	Standard Deviation
CPLI	3.54	1	5	1.07
CCP	0.76	0	1	0.43
GHGES	0	−0.81	9.64	0.79
GOWN	9.89	0	96.42	15.16
VER	0.67	0	1	0.47
ROIC	8.57	−15.92	42.28	7.97
SZ	31122.26	91.2	421105	50687.03
BS	12.39	6	23	3.72

Table 2. Descriptive analysis

Explicitly, in the case of Eqn 9, our findings validate that CCP has a positive and a statistically significant impact on CPLI. In addition, given the positive sign of the estimated coefficient, an increase in CCP leads to an increase in the probability of moving to the lowest threshold (in line with the sign of the coefficient) and a decrease in the probability of the firm to move to the highest threshold. The same findings are validated for the verification of environmental policies (positive and significant as a determinant of CPLI at 1% level of significance), while Government Ownership is statistically significant at 5% level of significance positive to CPLI. In addition, the Firm Size and the number of directors on the board play a significant and positive impact on CPLI at 10% and 1% level, respectively. The profitability index also seems to have a significant impact on CPLI for 10% level of significance (Table 4).

Concerning Eqn 10 presented in Table 5, GHGE is found to be negative and statistically significant at 10% level of significance, in case CPLI as dependent variable. Thus, an increase in the GHGE leads to a decrease in the probability of the firm to move to the lowest threshold, while the opposite is validated in the case of the highest threshold. For all the other independent variables, a positive sign is validated while Government Ownership and the verification of environmental policies and data are found to affect in a statistically significant way the CPLI at 1% level of significance. Finally, corporate size and board size are found statistical significant at 5% level but the profitability index is not found to play a key role at common levels of significance.

The results are in line with the suggested hypotheses. Equation 9 verifies that superior environmental performers in terms of CCP are characterized by a higher level of climate change disclosure. Companies with good environmental performance tend to be forthright and transparent to set themselves apart in terms of acquiring a competitive advantage from inferior environmental performers that face difficulties in copying this approach to disclosure. (Al-Tuwaijri *et al.*, 2004; Clarkson *et al.*, 2008; Luo and Tang, 2014). Regarding the second model, the results verify that higher levels of environmental performers in terms of GHG emissions within the sector induce firms that disseminate more information in disclosure regarding climate change than poorer ones. The results of the study are consistent with those of Al-Tuwaijri *et al.* (2004), Clarkson *et al.* (2014), Luo and Tang (2014), and conflict with the findings of Hughes *et al.* (2001), Patten (2002), and Braam *et al.* (2016). This evidence is also consistent with the findings of

Variables	CPLI	GHGES	CCP	VER	GOWN	ROIC	SZ	BS
CPLI	1							
GHGES	−0.131670***	1						
CCP	0.305564*	−0.067439	1					
VER	0.350876*	−0.061293	0.302955*	1				
GOWN	0.221482*	−0.032791	0.148678**	0.225175*	1			
ROIC	−0.054102	0.008904	−0.102882	−0.226518*	−0.193879*	1		
SZ	0.239461*	−0.032603	0.173849**	0.177569*	0.169479**	−0.120848***	1	
BS	0.378648*	−0.019305	0.246859*	0.201594*	0.112416	−0.192911*	0.160498**	1

Table 3. Correlation matrix of variables
*$p < 0.01$,
**$p < 0.05$,
***$p < 0.1$

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Threshold of the Dependent variable	Estimated Coefficient	Wald Statistic	P - value
2 - Band D (performance score > 20%)	0.467428	0.732579	0.4638
3 - Band C (performance score > 40%)	2.438001***	4.168807	0.0000
4 - Band B (performance score > 60%)	3.880718***	6.354720	0.0000
5 - Band A/A- (performance score > 85%)	6.157547***	8.845106	0.0000
Independent Variables			
CCP	0.617456**	1.976381	0.0481
VER	0.984359***	3.242793	0.0012
GOWN	0.020440**	2.212339	0.0269
ROIC	0.031899*	1.751846	0.0798
SZ	4.26E-06*	1.665710	0.0958
BS	0.208411***	5.049229	0.0000
Model statistics			
Pseudo R-squared	0.120808		
LR statistic	74.14749*** (0.000000)		

Table 4. Ordered logit regression results for the first model
***,
**,
*denotes 1, 5 and 10% level of significance respectively

Threshold of the Dependent variable	Estimated Coefficient	Wald Statistic	P - value
2 - Band D (performance score > 20%)	0.232706	0.326791	0.7438
3 - Band C (performance score > 40%)	2.257003***	3.518697	0.0004
4 - Band B (performance score > 60%)	3.685369***	5.496509	0.0000
5 - Band A/A- (performance score > 85%)	5.942107***	7.807459	0.0000
Independent Variables			
GHGES	−0.332038*	−1.651571	0.0986
VER	1.103247***	3.530987	0.0004
GOWN	0.0217***	2.699713	0.0069
ROIC	0.0326	1.514251	0.1300
SZ	4.76E-06**	1.995184	0.0460
BS	0.219932***	4.339447	0.0000
Model statistics			
Pseudo R-squared	0.119735		
LR statistic	73.48866*** (0.0000)		

Table 5. Ordered logit regression results for the second model
***,
**,
*denotes 1, 5 and 10% level of significance, respectively

Clarkson *et al*. (2008) who pointed out that inferior performers select a more silent strategy for the reporting of their environmental performance so as to be considered as belonging to a group of companies with an average level of environmental performance. Furthermore, the results imply that firms with superior environmental performance seem Furthermore, the results indicate that firms with superior environmental performance seem that they implement a proactive environmental strategy in their operations by sending the signal to investors and other stakeholders regarding their practices of climate change mitigation, adaptation, and transparency.

Thus, the results reveal that higher environmental performance in terms of environmental output impact and intention positively affects the level of climate change disclosure. Therefore, climate change disclosure according to the CDP disclosure requirement does not allow companies to manipulate environmental information (Luo and

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Tang, 2014). Finally, the results of the study amplify the role of voluntary disclosure in terms between environmental performance and disclosure relationship and thus accepting the H_{1a} and rejecting H_{1b}.

The positive effect of government ownership on climate change disclosure could be explained by the fact that among government objective priorities are social or environmental ones by providing related information (Eng and Mak, 2003; OECD, 2010). Another interpretation is related to the government's intention to disseminate more information in order to show its commitment to transparency and corporate-governance reform (Cheng and Courtenay, 2006). Furthermore, corporate managers intend to disseminate more climate change information in order to inform potential investors of the role of European governments as shareholders in relation to environmental concerns (Lan *et al.*, 2013). Thus, the European governments' commitment in firms can be considered a crucial determinant for the diffusion of climate change information reducing the asymmetry information level. To summarize, the hypothesis regarding the impact of ownership structure on climate change disclosure cannot be rejected.

The results reveal that companies willing to verify their environmental policies and data incorporate more and better-quality information regarding environmental issues such as climate change mitigation compared to those that do not want verification as mentioned in the work of Moroney *et al*. (2012) and Braam *et al*. (2016). Thus, European companies defer to public pressures for reliable and accurate climate change disclosures. For these firms that respond to social pressure or consider the need to be engaged in independent assessment, expecting marginal benefits related to social confidence and stakeholder trust due to their sustainable development policies which outweigh the assessment cost. (Fonseca, 2010; Braam *et al*., 2016). Therefore, the verification is a tool for stakeholders to control managers in their decisions and to eliminate the information asymmetry, accepting H_3. Improvement of the quality and credibility of climate change information disclosure leads users to make more accurate decisions regarding the environmental aspect of companies.

Furthermore, consistent with prior empirical studies, corporate size is a determining factor positively affecting environmental information in terms of initiatives on the mitigation of and adaption to climate change findings consistent with those of Monteiro and Aibar-Guzmán (2010), Prado-Lorenzo and Garcia-Sanchez (2010), Andrikopoulos and Kriklani (2012), Luo and Tang (2014), Tauringana and Chithambo (2015), and Braam *et al*. (2016).

Finally, regarding profitability, a positive effect on climate change disclosure is verified, a result consistent with prior empirical results provided by Gamerschlag *et al*. (2011) and inconsistent with those of Andrikopoulos and Kriklani (2012) and Liao *et al*. (2015). To be more specific, profitable companies are more free and flexible than less profitable ones to develop environmental initiatives. Another possible explanation is the political pressure that requires profitable companies to explain how they 'produce' profitability. Finally, it is confirmed that European firms with larger boards of directors contribute toward the discussion on mitigation and adaptation to climate change consistent with Siregar and Bachtiar (2010) and Esa and Ghazali (2012).

Conclusions

The present study investigates the determinants of climate change disclosure for high liquidity European firms, including environmental performance, government ownership of companies, and the verification of environmental initiatives.

The results of the study reveal that the corporate environmental performance based on these approaches, government ownership, and verification of environmental initiatives (independently assessed) along with control variables are validated as statistically significant and positively related to climate change disclosure.

The voluntary disclosure theory adequately interprets the positive effect of environmental performance on climate change disclosure. Thus, CPLI can be an efficient and effective signal for stakeholders to get an insight into the relationship between corporate commitment on climate change transparency, mitigation, adaptation, and environmental performance. Thus, environmentally responsible investors can incorporate companies from the CPLI list in their portfolios, thus advancing conventional portfolio management. Agency theory suggests that ownership structure is a significant factor in climate change disclosure. An implication of this relationship is that disclosure can be a significant tool for reducing information asymmetry leading also to reduced agency costs.

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In addition, companies with independent assessment of environmental initiatives are linked to higher levels of CPLI than non-verified companies, limiting the possibility for the dissemination of climate change information to be manipulated by companies. Therefore, objective assessment plays a crucial role in the evaluation of climate change risks and issues of high concerns that may further enhance environmental disclosure transparency on the adoption of climate change mitigation strategies. Consequently, stakeholders may be ascertained for the credibility of information reducing agency costs. Agency theory and stakeholder-agency theory, as provided by the results of the study, confirm that CDP organizations incorporate all disclosure items valuable both to shareholders and stakeholders to control and monitor corporate managers and eliminate agency costs. Assistance of voluntary disclosure theory, agency theory, and stakeholder-agency theory contributes to interpreting managerial behavior for the dissemination level of environmental information

Integrating climate change disclosure into a business's strategy is considered a crucial decision for them as it can have vital implications for their environmental performance, the asymmetry level of information between business insiders and external stakeholders and, finally, stakeholder confidence level. Furthermore, business strategy in relation to sustainable disclosure is explained by the voluntary disclosure theory in which companies with good environmental performance set themselves apart from firms with inferior climate change performance as it is difficult for businesses to align with the CDP criteria (Clarkson *et al.,* 2011; Meng *et al.,* 2014). However, businesses should develop and apply several different internal communication means as well as maintain the existing ones in order to ensure that managers act only in the interest of shareholders.

The public policies implemented can be crucial. For instance, setting precise standards for corporate carbon reporting such as lists of metrics, formats, and frequency of reporting. Furthermore, governments may well provide incentives in the form of awards, certifications, and support for verification. Furthermore, even though environmental disclosure is a voluntary corporate process, governments may well mandate sanctions for non-disclosure and for failure to report accurate carbon data (Noronha *et al.,* 2012; Lee *et al.,* 2015).

Some limitations of the present study should be mentioned, and could be a subject of a future survey. First of all, a comparison of the results derived in the present study should be conducted with companies operating in different corporate, political, and economic environments such as the USA or Japan being considered as leaders of management practices in relation to corporate responsibilities. The present study is focused on the Bloomberg European 500 Index including European companies highest in terms of liquidity and disregarding small and medium companies. The comparison between these two groups of companies could provide valuable results on disclosure strategies. Future studies should employ data over longer time periods in order for the evolution of climate change disclosure during the period studied to be surveyed as a function of the exogenous variables already employed in the present work.

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