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The impact of voluntary environmental disclosure on firm value: Does organizational visibility play a mediation role?

**Keywords:** Analyst Coverage, Analysts Following, Institutional Ownership, Organizational Visibility, Firm Value, Greenhouse Gases, Environmental Disclosure, Environmental Performance, Environmental Policy.

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**Authors:** Omaima A.G. Hassan

**Corresponding author:**

Dr Omaima Hassan  
Department of Accounting and Finance  
Aberdeen Business School  
Robert Gordon University  
Aberdeen  
AB10 7QB  
Scotland, UK  
Email: [o.hassan@rgu.ac.uk](mailto:o.hassan@rgu.ac.uk)  
Phone: +44 (0)1224 26 3929

# The impact of voluntary environmental disclosure on firm value: Does organizational visibility play a mediation role?

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## **Abstract**

The current study investigates whether organizational visibility, i.e. the extent to which analysts follow, and institutions hold, a firm's stock (Baker et al., 1999, p.47), may explain the mechanism through which corporate environmental disclosure (CED) affects firm value. It explores whether CED impacts organizational visibility, and if so, whether firm value increases in organizational visibility, after accounting for greenhouse gas emissions intensity (GHG) as well as several firm-level and country-level controls. It utilizes a sample of S&P Global 1200 companies from 2010 to 2015. Using structural equation modelling (SEM) to address the complex interrelationships between the variables of interest and employing Full Information Maximum Likelihood (FIML) regression method, the findings show that organizational visibility does not play a statistically significant mediation role on the relationship between CED and firm value. However, organizational visibility is significantly associated with both CED and firm value, which indicates that failing to control for organizational visibility when examining the relationship between CED and firm value could yield misleading results. The results also show that prior CED significantly reduces current GHG. Interestingly, analyst coverage is found to play a full mediation role on the relationship between institutional ownership and firm value as well as a partial mediation role on the relationship between prior GHG and firm value. Thus, this study suggests that corporate management lobby financial analysts and educate them about their firms' environmental disclosure and performance to improve their information set and increase firm visibility and value.

**Keywords:** Organizational Visibility, Firm Value, Greenhouse Gases, Environmental Disclosure, Environmental Performance, Environmental Policy.

## 1. Introduction

Managers have long associated enhanced corporate voluntary reporting with additional costs incurred through information collection and dissemination, costs of weakened competition because of making more information about environmental activities available to rivals such as production process inefficiency and environmental initiatives, and litigation costs in case the company is sued regarding its disclosure information, for example in case of reporting misleading information or errors (e.g., Cormier and Magnan, 1999; Beierle, 2004; Aerts *et al.*, 2008). There is also evidence that companies fear misrepresentation and would not want to disclose potentially harmful environmental information (Solomon and Lewis, 2002). Hence, to promote transparency in capital markets, managers need to be convinced that enhanced corporate environmental disclosure has potential benefits which might offset or even exceed the associated costs. Enhanced corporate environmental disclosure could benefit a company by increasing its value through a reduction in its cost of capital, or enhanced cash flows or both. Thus, prior empirical studies on corporate environmental disclosure have typically focused on its association with the firm's cost of capital and/or its value (e.g., Gupta and Goldar, 2005; Murray *et al.*, 2006; Clarkson *et al.*, 2013; Plumlee *et al.*, 2015). However, another stream of literature suggests that firm value increases in organizational visibility (e.g., Merton, 1987; Brammer and Millington, 2006; Chen *et al.*, 2002; Leavy and Sloan, 2008). Furthermore, a third stream of literature suggests an association between environmental disclosure and organizational visibility (e.g., Neu *et al.*, 1998; Aerts *et al.*, 2008; Rupley *et al.*, 2012; Wang, 2017; Tucker, 2010; Yu, 2010; Tsao *et al.*, 2016; Sundgren *et al.*, 2018). In this context, the current study explores whether organizational visibility plays a mediation role on the relationship between corporate voluntary environmental disclosure and firm value, where a mediator is defined as the carrier or transporter of information along the causal chain of effects (Little *et al.*, 2007, p.207). According to Baron and Kenny (1986), a variable performs as a mediator when the following three empirical conditions are met: (i) the independent variable significantly affects the mediator, (ii) the mediator significantly impacts the dependent variable, and

(iii) the direct relationship between the independent variable and the dependent variable diminishes when the mediator is included in the model. Thus, if the relationship between corporate voluntary disclosure and firm value is fully mediated, then all the significant variance of that relationship will be accounted for by the indirect effect from organizational visibility to firm value, which corporate management can strategically exploit to influence the value of their business. To carry out this investigation, the current study develops a system of equations that addresses the dynamics and complexity of the relationships between the constructs of interest and estimates it simultaneously using FIML regression method for a sample of S&P Global 1200 from 2010 to 2015 with 2365 firm-year observations. The purpose is to address the full causation route between CED and firm value. It first regresses current firm value on  $CED_{-1}$  after accounting for GHG and several firm and country controls via a system of equations to establish that there is a significant effect from  $CED_{-1}$  to current firm value which may be mediated. Then, it re-estimates current firm value after including organizational visibility in the model to see: (i) if  $CED_{-1}$  is significantly related to organizational visibility, (ii) if organizational visibility is significantly related to firm value, and (iii) if the direct relationship between  $CED_{-1}$  and current firm value diminishes after including organizational visibility in the model (Little et al., 2007). The current study measures organizational visibility using two variables: analyst coverage and institutional ownership (e.g., Arbel *et al.*, 1983; Merton, 1987; Baker *et al.*, 1999; Brockman *et al.*, 2017). It uses Bloomberg's environmental disclosure score as a measure of CED and market capitalization of equity to proxy for firm value. The initial results show a significant positive relationship between  $CED_{-1}$  and current firm value which may be mediated (e.g., Al-Tuwaijri *et al.*, 2004; Clarkson *et al.*, 2013). After controlling for organizational visibility, the direct impact of  $CED_{-1}$  on current firm value is no longer significant, indicating some evidence of a full mediation role of organizational visibility. A further examination of the results using Wald-test shows that the observed mediation role of organizational visibility is statistically insignificant. However, the results also show that organizational visibility is significantly associated with both CED and firm value, which indicates

that current evidence on the association between CED and firm value is prone to omitted variable bias. There is also evidence that CED enhances analyst coverage after controlling for environmental performance. The results also show that prior CED significantly reduces current GHG. Another interesting result of the current study is that analyst coverage plays a full mediation role on the relationship between institutional ownership and firm value as well as a partial mediation role on the relationship between prior GHG and firm value.

The results are of interest to corporate management and investors alike. Corporate environmental disclosure is documented to be positively related to analyst coverage after controlling for GHG, which indicates that it provides incremental information about corporate environmental performance beyond what is already known from greenhouse gas emission intensity. Thus, it enables analysts and investors to better assess the value of the business. CED can also be used as a managerial tool to attract a larger analyst following and enhance organizational visibility. The findings also suggest that prior environmental disclosure significantly reduces current GHG, which indicates that corporate management can use CED as a managerial tool to create organizational pressure and incentives to drive actions to reduce GHG. Furthermore, the current study uncovers the full mediation role which financial analysts play on the relationship between institutional ownership and firm value as well as their partial mediation role on the relationship between prior GHG and firm value. This, in turn, further emphasizes the crucial influence of financial analysts on firm value. Thus, this study suggests that corporate management lobby financial analysts and educate them about their firms' environmental disclosure and performance to improve their information set and enhance firm visibility and value.

The current study is related to, but differs from, the work of Aerts *et al.* (2008) and Dhaliwal *et al.* (2011). Aerts *et al.* (2008) investigate the associations between corporate environmental disclosure, financial analysts' earnings forecasts and a firm's media exposure for a sample of 205 continental European firms and 477 North American firms for the year 2002 using a system of

equations. Their results show that enhanced environmental disclosure translates into more precise earnings forecasts by analysts, but this effect is reduced for firms with extensive analyst following and firms from environmentally sensitive industries. However, the study does not control for the potential dynamics in the association between CED and media coverage, i.e. the potential impact of CED on media coverage. Also, the study seems to consider analyst coverage as an exogenous variable to the research model despite the potential interrelationships between analyst coverage, media coverage and CED. In addition, the study uses media coverage as a proxy for public apprehension of a firm's environmental activities, which only considers the negative side of organizational visibility. Furthermore, it does not control for environmental performance and lacks a temporal dimension in the data.

Dhaliwal *et al.* (2011) examine whether and how corporate social responsibility (CSR) disclosure is related to firms' cost of capital for a sample of 11,925 firm-year observations from 23 different US industries over the period 1993 to 2007 utilizing a lead-lag approach. They find that firms with a high cost of equity capital in the previous year tend to initiate disclosure of CSR activities in the current year and that initiating firms with superior social responsibility performance enjoy a subsequent reduction in the cost of equity capital. Furthermore, firms initiating CSR disclosure with superior CSR performance attract dedicated institutional investors and analyst coverage, and these analysts achieve lower absolute forecast errors and dispersion following such disclosure. However, the study does not consider the interactions between institutional ownership and analyst coverage. Also, it does not account for the potential impact of both institutional ownership and analyst coverage on both CSR disclosure and cost of capital. Furthermore, the study uses a dummy variable to measure the initiation of CSR disclosure which fails to reflect on the quantity or quality of such disclosure.

The current study contributes to the literature in several aspects. It contributes to the strand of literature that focuses on how corporate environmental disclosure affects firm value by



investigating a potential route of such relationship, i.e. organizational visibility. In other words, it examines whether organizational visibility plays a mediation role in the observed relationship between CED and firm value. The current study also adds to the growing literature on environmental policies and organizational visibility by exploring the dynamics of the relationship between CED and organizational visibility after controlling for GHG. It also extends the relatively thin literature on the determinants of GHG where it considers the impact of organizational visibility separated from firm size, in addition to prior CED (Bowen, 2000; Hassan and Romilly, 2018). It employs SEM to address the interrelationships between the variables of interest for a sample of S&P Global 1200 from 2010 to 2015 with 2365 firm-year observations. According to Baron and Kenny (1986, p. 1177), SEM has the advantages that all the relevant paths are directly tested, and none are omitted as in ANOVA. In addition, complications of measurement error, correlated measurement error, and even feedback are incorporated directly into the model. The use of panel data also provides several advantages over both the traditional cross-sectional and time-series analyses. It gives the researcher a larger number of observations, thus increasing the degrees of freedom for any statistical testing, and reducing the collinearity among the explanatory variables, improving thereby the efficiency of estimates. It also reduces the magnitude of some econometric problems such as omitted variable bias (Hsiao, 2003). Furthermore, the S&P Global 1200 represents 70% of global market capitalization, which means that the results of this study are more generalizable compared to results from prior studies (e.g., Aerts *et al.*, 2008; Dhaliwal *et al.*, 2011). It uses a measure of environmental performance, i.e. GHG, which is acknowledged as one of the most important components of corporate environmental performance (Dragomir, 2012; Hassan and Romilly, 2018). GHG is also comparable across companies, countries and time which enables the current longitudinal cross-country study in contrast to most prior studies on environmental performance which tend to be cross-sectional and localized due to data limitations (Dragomir, 2012). Unlike prior studies that employ self-constructed measure of environmental disclosure (e.g., De'Jean and Martinez, 2009; Clarkson *et al.*, 2013; Plumlee *et al.*, 2015), this study

employs Bloomberg's environmental disclosure score, which covers 60 different environmental data items collected from companies' annual reports, sustainability reports, press releases and third-party research. This extensive list includes information about energy consumption and emissions, waste data, environmental initiatives and environmental policies. Thus, this measure of corporate voluntary environmental disclosure provides incremental information beyond what investors already know from historical environmental performance measured by GHG (Clarkson *et al.*, 2013; Hassan and Romilly, 2018). This measure of CED also enables the current multi-country longitudinal study to produce more replicable and comparable results in contrast to those of prior studies, which tend to use relatively more subjective measures of disclosure that inevitably restricts the sample size and/or coverage (e.g., Al-Tuwaijri *et al.*, 2004; De'Jean and Martinez, 2009; Clarkson *et al.*, 2013; Plumlee *et al.*, 2015).

The remainder of this paper is organized as follows. Section 2 provides a brief review of the related literature and develops the research hypotheses. The research model is presented in section 3, while section 4 describes the sample and discusses the results. Section 5 provides concluding remarks.

## 2. Related Research and Hypothesis development

### *2.1 Environmental disclosure and organizational visibility*

The current study is related to prior studies on the association between CED and organizational visibility which often focus on organizational visibility as a driver of corporate environmental responsiveness (Bowen, 2000; Yu *et al.*, 2017). This stream of literature suggests that more visible companies attract more attention from different stakeholders and thus are more prone to social and political pressure to enhance their environmental disclosures to maintain their legitimacy (e.g., Neu *et al.*, 1998; Aerts *et al.*, 2008; Rupley *et al.*, 2012; Wang; 2017). In this context, organizational visibility is a negative attribute that exposes companies to institutional pressure which motivates higher voluntary environmental disclosure. Using a cost-benefit analysis, Cormier and

Magnan (1999) find firms which have higher trading volumes and are widely followed by investors, i.e. more visible firms, to be associated with more environmental disclosure. Thus, both legitimacy theory and the economic theory suggest organizational visibility to positively impact CED. However, this literature typically fails to account for the dynamics of the relationship between organizational visibility and CED despite evidence on a reverse causation from corporate voluntary disclosure to organizational visibility. For example, Lang and Lundholm (1996), Hope (2003), Yu (2010) and Tsao *et al.* (2016) and Sundgren *et al.* (2018) find enhanced voluntary corporate disclosure to be significantly associated with high analyst coverage. Healy *et al.* (1999) and Tucker (2010) also document a decrease in analyst coverage for firms that have become less forthcoming, such as firms whose disclosure ratings have declined and those who withhold bad news. In this context, the current study addresses the dynamics of the relationship between environmental disclosure and organizational visibility. It postulates that prior environmental disclosure impacts current organizational visibility, which, in turn, impacts current levels of environmental disclosure. But, for the purpose of the current investigation of the mediation role of organizational visibility, the first research hypothesis addresses only the expected association between prior environmental disclosure and organizational visibility as follows:

H1: Prior environmental disclosure positively affects current organizational visibility.

## ***2.2 Organizational visibility and firm value***

The current study defines organizational visibility as the extent to which analysts follow, and institutions hold, a firm's stock (Baker *et al.*, 1999, p.47). This definition coincides with Arbel *et al.* (1983) and Merton (1987) views about neglected or less-visible firms as the ones that attract low institutional holdings and less attention from financial analysts. Visibility is important to organizations because it impacts firm value. Higher organizational visibility suggests greater flow and accessibility of credible information about a firm, which can draw investors' attention to the firm and create greater awareness about its prospects (Baker *et al.*, 1999). This, in turn, reduces the information asymmetry

between managers, insiders and outside providers of funds and enables better valuation of a firm's future financial performance, which reduces the rate of return required by investors and improves firm value (Merton, 1987; Brammer and Millington, 2006). In addition, stakeholders who are more informed about corporate activities are more likely to take actions towards companies, which makes more visible organizations subject to higher levels of scrutiny (Brammer and Millington, 2006). This, in turn, can influence firm value through pure cash-flow effects by reducing the potential diversion of the firm's cash flows to managers and controlling shareholders because the firm will be subject to greater levels of scrutiny which reduces agency costs (Lang *et al.*, 2003). Furthermore, empirical evidence suggests that investors are more likely to buy stocks they are familiar with, which increases the liquidity of more visible stocks (e.g., Grullon *et al.*, 2004; Barber and Odean, 2008; Keloharju *et al.*, 2012). Prior studies also suggest firm value to impact its visibility (e.g., Bhushan, 1989; Hussain, 2000; Baker *et al.*, 1999; Lang *et al.*, 2004; Boubaker and Labégorre, 2008). For example, Baker *et al.* (1999) find that increases in organizational visibility are significantly associated with increases in market capitalization. This suggests that the association between firm value and visibility could be bi-directional, hence the second research hypothesis is stated as follows:

H2: There is a positive association between organizational visibility and firm value.

### ***2.3 Environmental disclosure and firm value***

Discretionary disclosure theory (Verrecchia, 1983; Dye, 1985) predicts that enhanced corporate voluntary disclosure will improve stock liquidity by reducing transactions costs and increasing the demand for shares. Moreover, it predicts that enhanced disclosure will reduce uncertainty about future cash flows; thus, stocks with more credible information will be perceived as less risky. *Ceteris paribus*, the rate of return required by investors to buy a firm's shares will decrease; hence a firm's cost of capital will fall, and its value will increase. Moreover, it is argued that enhanced corporate disclosure can influence firm value directly through pure cash-flow effects by reducing

agency costs (Lang *et al.*, 2003). Following Amir and Lev's (1996) paper on the value relevance of non-financial information, several empirical studies have examined the value relevance of corporate discretionary environmental disclosure while controlling for corporate environmental performance. For example, Freedman and Patten (2004) study market reaction to the Toxic Release Inventory (TRI) information and 10-K report environmental disclosures employing a cross-sectional analysis for a sample of 112 US firms. Their results show a negative market reaction to poor environmental performance and a positive reaction to environmental disclosure. Using a cross-sectional analysis of a sample of 112 companies from the French SBF<sup>1</sup> 120 stock market index for the financial year 2006 and a self-constructed environmental disclosure index, De'Jean and Martinez (2009) find a positive association between voluntary environmental disclosure and the cost of capital at the 10% level of significance, which implies that higher voluntary environmental disclosure is associated with higher cost of capital, inconsistent with theory. Clarkson *et al.* (2013) examine the information content of voluntary environmental disclosure and the source of this information content, i.e. either facilitating the prediction of future financial performance and/or reducing the cost of capital, for a sample of 195 firm-year observations from the five most polluting industries in the US. They find that voluntary environmental disclosure provides valuation relevant information incremental to the information provided by TRI data. However, they find no association between voluntary environmental disclosure and the cost of capital. Based on a sample of 474 firm-year observations from five US environmentally sensitive and non-sensitive industries over a six-year period (2000-2005), Plumlee *et al.* (2015) examine the value relevance of environmental disclosure after controlling for environmental performance. They measure environmental disclosure quality using a disclosure index consistent with the Global Reporting Initiative disclosure framework and consider both the type (hard or soft) and

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<sup>1</sup> The SBF 120 is Société des Bourses Françaises 120 Index.

nature (positive, negative, or neutral) of disclosure. Their results suggest that the overall voluntary environmental disclosure is not associated with either future cash flow or cost of equity components, but both the type and nature of disclosures are informative in predicting firm value. While Clarkson *et al.* (2013) used prior environmental disclosure and performance in their research model, Plumlee *et al.* (2015) relied on the concurrent values of these variables. Thus, theoretically, this stream of literature suggests that voluntary environmental disclosure is value relevant through its direct impact on a firm's cost of capital and/or its value, however, the empirical evidence is inconclusive and difficult to generalize because of the variety of metrics used for the constructs of interest (Hassan and Romilly, 2018). Consequently, the third research hypothesis is stated in terms of a non-directional null hypothesis as follows:

H3: Prior environmental disclosure does not impact current firm value.

### **3. Research Model**

This paper uses Ohlson (1995) valuation model in which the market value of equity is a function of both the book value of equity and abnormal accounting earnings. It extends Ohlson's model by including corporate environmental disclosure and performance as well as a range of firm-level and country-level controls. More importantly, it incorporates organizational visibility as a potential mediator variable for the relationship between firm value and environmental disclosure. It does so by modelling the complex interrelationships between the variables of interest using structural equation modelling. It addresses the potential bidirectional associations between analyst coverage (NOA), institutional ownership (INST) and firm value (MCAP) (e.g., Hussain, 2000; Baik *et al.*, 2010; Hassan and Skinner, 2016). It also considers the dynamics of the relationships between environmental response (CED; GHG), organizational visibility (NOA, INST) and firm value (MCAP). It assumes that environmental response (CED; GHG) cannot have a concurrent effect on organizational visibility (NOA; INST) or firm value (MCAP), but it can have a lagged effect on these both constructs (Clarkson *et al.*,

2013). However, organizational visibility (NOA; INST) and firm value (MCAP) can have a contemporaneous association with environmental response (CED; GHG). Furthermore, it assumes environmental disclosure to be made some months after greenhouse gas emissions have occurred and after the financial year-end (Hassan and Romilly, 2018). This, in turns, implies that environmental disclosure cannot have a simultaneous association with environmental performance, but it could have a lagged association with it, although it is assumed that environmental performance can have a contemporaneous association with environmental disclosure. Thus, the current study proposes the following model specification (cross-section and time identifiers are suppressed for simplicity) to test the research hypotheses developed in the previous section:

$$(1) \text{ NOA} = \alpha_0 + \alpha_1 \text{INST} + \alpha_2 \text{GHG}_{(-1)} + \alpha_3 \text{CED}_{(-1)} + \alpha_4 \text{MCAP} + \alpha_5 \text{LEV} + \alpha_6 \text{ROA} + \alpha_7 \text{EMP} + \alpha_8 \text{GDP} + \alpha_9 \text{CGOV} + \alpha_{10} \text{BIG4} + \alpha_{11} \text{VOL} + \varepsilon_1$$

$$(2) \text{ INST} = \partial_0 + \partial_1 \text{NOA} + \partial_2 \text{GHG}_{(-1)} + \partial_3 \text{CED}_{(-1)} + \partial_4 \text{MCAP} + \partial_5 \text{LEV} + \partial_6 \text{ROA} + \partial_7 \text{EMP} + \partial_8 \text{GDP} + \partial_9 \text{CGOV} + \partial_{10} \text{CAP} + \partial_{11} \text{BETA} + \varepsilon_2$$

$$(3) \text{ GHG} = \beta_0 + \beta_1 \text{NOA} + \beta_2 \text{INST} + \beta_3 \text{CED}_{(-1)} + \beta_4 \text{MCAP} + \beta_5 \text{LEV} + \beta_6 \text{ROA} + \beta_7 \text{EMP} + \beta_8 \text{GDP} + \beta_9 \text{CGOV} + \beta_{10} \text{ENG} + \beta_{11} \text{IND} + \varepsilon_3$$

$$(4) \text{ CED} = \gamma_0 + \gamma_1 \text{NOA} + \gamma_2 \text{INST} + \gamma_3 \text{GHG} + \gamma_4 \text{MCAP} + \gamma_5 \text{LEV} + \gamma_6 \text{ROA} + \gamma_7 \text{EMP} + \gamma_8 \text{GDP} + \gamma_9 \text{CGOV} + \gamma_{10} \text{ERI} + \gamma_{11} \text{UNS} + \varepsilon_4$$

$$(5) \text{ MCAP} = \delta_0 + \delta_1 \text{NOA} + \delta_2 \text{INST} + \delta_3 \text{GHG}_{(-1)} + \delta_4 \text{CED}_{(-1)} + \delta_5 \text{LEV} + \delta_6 \text{ROA} + \delta_7 \text{EMP} + \delta_8 \text{GDP} + \delta_9 \text{CGOV} + \delta_{10} \text{BVE} + \delta_{11} \text{ABE} + \varepsilon_5$$

### 3.1 Endogenous variables

#### *Voluntary environmental disclosure (CED)*

CED, a proprietary Bloomberg score that has been used in several recent related academic studies (e.g., Qiu *et al.*, 2016; Bernardi and Stark, 2018; Hassan and Romilly, 2018). The environmental disclosure score is weighted to emphasize the most commonly disclosed fields such as greenhouse gas

emissions and normalized to range from zero for companies that do not disclose environmental information to 100 for those which disclose every data point collected. In addition, Bloomberg accounts for industry-specific disclosures by normalizing the final score based only on a selected set of fields applicable to the industry type. For example, “Total Power Generated” is only included in the disclosure score of utility companies. Table 1 shows the measurement of the different variables included in the research model.

< Insert Table 1 about here >

### *Greenhouse gas emissions intensity (GHG)*

Corporate environmental performance in the current study is measured by the ratio of metric tons of greenhouse gases, if unavailable, carbon dioxide (CO<sub>2</sub>), emitted per million of assets. GHG can affect corporate operational, investment and financial activities and litigation risks, thereby influencing firm visibility and valuation. For example, in countries where public concern about environmental issues is high, better environmental performers can improve brand image and corporate reputation, enhancing their sales revenues and reducing the possibility of litigation costs (e.g., Brown and Dacin, 1997; Lev *et al.*, 2010). Also, GHG might impact corporate financial performance through cost-saving, cost or liability avoidance, revenue-generation or being an exemplar for best practice (Murray *et al.*, 2006; Al-Najjar and Anilido, 2012). In addition, if environmental pollution represents inefficient resource usage then its reduction or elimination will benefit both the environment and the bottom line (Porter and van der Linde, 1995; Castro and Chose, 2006). Thus, corporate environmental performance is expected to provide valuable information to investors to help them assess a firm’s future cash flows and associated risks (Cordeiro and Sarkis, 1997).



*Organizational visibility (NOA; INST):*

Organizational visibility is a latent variable, i.e. it cannot be measured directly. Thus, scholars measure it through other observable variables. Earlier research on organizational visibility has typically used firm size as a proxy for organizational visibility (e.g., Henriques and Sadorsky, 1996; Sharma and Nguan, 1999). However, firm size can capture much more than organizational visibility can such as corporate resources and power (Baker *et al.*, 1999; Meznar and Nigh, 1995). Recent studies have used a variety of proxies for organizational visibility such as institutional ownership, analyst coverage and media coverage. The current study, consistent with the definition of organizational visibility, measures it using two variables: analyst coverage (NOA) and institutional ownership (INST) (e.g., Arbel *et al.*, 1983; Merton, 1987; Baker *et al.*, 1999; Brockman *et al.*, 2017).

Institutions consistently avoid investment in neglected stocks because these stocks are relatively less liquid and riskier than their more visible counterparts. Furthermore, institutional investment will generally result in more than 5 per cent ownership requiring an insider's report to comply with stock market regulations. Institutional holding could quickly become large enough to necessitate managerial input, which often falls outside the institution's area of interest and expertise (Arbel *et al.*, 1983, p.57).

Financial analysts are information intermediaries who collect a wide range of information (about the firms they follow, their industries and markets), analyze it, produce reports and disseminate these reports to their audience. These reports may include buy, sell or hold recommendations, the competitive position of the firm relative to its rivals, and analysts' forecasts of earnings and cash flows. These forecasts have proven to impact investors' expectations and are usually used as a proxy for a market's beliefs (Simpson, 2010). Financial analysts increase the visibility of the firms they follow by signalling information about their performance, increasing thereby the demand for their common shares even when they do not actively add new information about these firms (Mola *et al.*, 2013; Li and You, 2015). Also, analyst coverage may lead to the company being included either

in industry reports or as an industry comparison in a report on a larger company, creating both visibility and credibility (Bushee and Miller, 2012). Bushee and Miller (2012) note that smaller and less-visible firms may resort to hiring investor relations professionals to pitch their business to security analysts to enhance organisational visibility.

#### *Firm value (MCAP)*

Firm value is measured by the market value of equity of the firm at the fiscal year-end.

### **3.2 Predetermined variables**

#### *Firm-level control variables*

The current study considers a wide range of firm-level controls including firm size (EMP; BVE), capital spending (CAP), profitability (ROA, ABE), financial leverage (LEV), return volatility (BETA; VOL), the quality of financial reporting (BIG4), industry type (IND), energy consumption (ENG), the application of emissions reduction initiatives (ERI) and whether the company is a UN Global Compact Signatory (UNS) (e.g., Bhushan, 1989; Boubaker and Labégorre, 2008; Boubakri and Bouslimi, 2010; Hassan and Skinner, 2016; Freedman and Patten, 2004; Clarkson *et al.*, 2013; Plumlee *et al.*, 2015; Madsen and Ulhøi, 2016; Hassan and Romilly, 2018).

Firm size is measured using the number of employees (EMP) and the book value of equity (BVE). CAP is capital expenditure. Profitability is measured using the return on assets (ROA), and abnormal earnings (ABE) which is the difference between net income and the expected return (Palepu *et al.*, 2013). The expected return is calculated as the cost of equity times the one-year lagged book value of equity<sup>2</sup>. Financial leverage (LEV) is the ratio of non-current liabilities to total assets. Return volatility is measured using both BETA and VOL. BETA is the market model beta for each stock

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<sup>2</sup> The cost of equity capital is provided by Bloomberg database and derived using the capital asset pricing model. Cost of Equity = Risk-free Rate + [Beta \* Country Risk Premium], where the default value for the risk-free rate is the country's long-term bond rate (10-year).

measured via the market model using weekly data. VOL is the standard deviation of the relative price change for the 360 calendar days closing price, expressed as a percentage. BIG4 is used to proxy for the quality of financial reporting, where it takes the value of one if the company's accounts are audited by one of the big four audit firms and zero otherwise. Industry type (IND) is also considered where environmentally sensitive industries takes the value of one and zero otherwise. Total energy consumption figure (ENG) is measured in thousands of megawatt hours (MWh). In addition, the study includes a dummy variable (ERI) that takes the value of one if the company has implemented any initiatives to reduce its environmental emissions to air and zero otherwise to control for environmental reduction initiatives. Furthermore, the study also includes a dummy variable that takes the value of one if the company is a signatory of the United Nations Global Compact and zero otherwise.

#### ***Country-level control variables***

country-level controls include country income measured by the gross domestic product per capita (GDP) and corporate governance (e.g., Hassan and Romilly, 2018). CCGP is the first principal component of corporate governance indicators at the country level. This measure is derived from six different corporate governance indicators: control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law, and voice and accountability. These indicators range from -2.5 to +2.5 and are highly correlated. The current study applies principal component analysis to these indicators (results not tabulated) and uses the first<sup>3</sup> principal component (CCGP) in subsequent analysis. This CCGP component explains 78 percent of the variation in the original six corporate governance indicators.

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<sup>3</sup> The second principal component had an eigenvalue of less than one and added almost 10% to the variation in the original six corporate governance indicators, therefore it was decided to use the first component only in the subsequent analysis.

## 4. Research sample and results

### 4.1 Research sample

The current study explores whether organizational visibility plays a mediation role on the relationship between CED and firm value after accounting for GHG as well as several firm-level and country-level controls for a sample of S&P Global 1200 companies<sup>4</sup> for the years 2010 to 2015; deliberately avoiding the recent financial crisis of 2008/09. Data at firm-level are collected from the Bloomberg database, while country-level data are collected from the World Bank. S&P Global 1200 represents 70% of global market capitalization, which provides good variation in the variables of interest and has international coverage in contrast to related prior studies (e.g., Aerts *et al.*, 2008; Dhaliwal *et al.*, 2011). The initial sample consists of 1187 companies with 7122 firm-year observations. However, due to missing observations on different variables in the research model, the final common sample consists of 815 companies with 2365 firm-year observations from 29 countries worldwide.

### 4.2 Descriptive analysis

Table 2 shows the descriptive analysis after winsorizing all continuous variables at a 5 percent level of each end of the tails to mitigate the impact of outliers on the subsequent analysis. It shows that the average company in the research sample has a market value of equity (MCAP) of 25,948 million USD compared to a book value (BVE) of 12,047 million USD, spends 1,426 million USD on the purchase of tangible fixed assets (CAP), employs (EMP) 54,237 persons, and is followed by 22 financial analysts (NOA) on average. The average company in the research sample has institutional ownership (INST) of 61 percent and is more likely to be audited by one of the big four audit firms (BIG4).

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<sup>4</sup> The S&P Global 1200 consists of 7 indices, many of which are accepted leaders in their regions. These include the S&P 500 (US), S&P Europe 350, S&P TOPIX 150 (Japan), S&P/TSX 60 (Canada), S&P/ASX All Australian 50, S&P Asia 50 and S&P Latin America 40.

In addition, the average company has a return variability (VOL) of 30 percent, while the value of market beta (BETA) is one on average. Furthermore, 30 percent of the sample firms come from environmentally insensitive industry (IND). The average company has a financial leverage (LEV) of 32 percent, makes an average return on assets (ROA) of 5.25 USD, and yields positive abnormal earnings of 149 million USD.

< Insert Table 2 about here >

Moreover, Table 2 shows that the average company in the research sample comes from a country that generates an income of 46,105 USD in GDP with a moderate governance performance (CCGP). It also shows that the average company consumes (ENG) 15,011 thousand MWh, produces 143 million tons of GHG and has a disappointingly low level of environmental disclosure (CED) of about 44 points. However, most of the sample firms have some sort of emissions reduction initiatives (ERI), but less than half of it has signed up for the United Nations Global Compact (UNS).

#### *4.3 The correlation matrix*

Table 3 reports the results of the Spearman correlation test between the variables. It shows that organizational visibility (NOA; INST) is higher for larger (MCAP), more profitable firms (ROA; ABE), firms with higher market betas (BETA), and those that are audited by one of the big four audit firms (BIG4) but is lower for companies which belong to environmentally sensitive industries (IND), emit more GHG, and those with higher return volatility (VOL). However, the two proxies for organizational visibility behave differently with the rest of the variables. For example, NOA (INST) has a positive (negative) and significant association with each of the environmental disclosure (CED), number of employees (EMP), corporate governance at country-level (CGOV), capital expenditure (CAP), energy consumption (ENG), environmental reduction initiatives (ERI), UN signatory (UNS), and book value of equity (BVE). In addition, INST (NOA) is increasing (decreasing) in financial leverage (LEV). While the

results for NOA are generally on line with expectations and results from prior studies (e.g., Bhushan, 1989; Hussain, 2000; Baik *et al.*, 2010; Boubaker and Labégorre, 2008; Boubakri and Bouslimi, 2010; Hassan and Skinner, 2016), the case for INST is less clear due to the thin literature on this area (Brammer and Pavelin, 2006; Yu *et al.*, 2017). Unsurprisingly, the results also show that CED is positively and significantly correlated with MCAP. It is worth noting that, while there is a positive and significant correlation between the two proxies for organizational visibility and that both variables behave similarly with firm value (MCAP) and GHG, they behave differently with CED. However, these results only focus on the pairwise correlations between the variables; a multiple regression analysis may yield different results.

Finally, Table 3 shows moderate correlations between the variables which indicates that multicollinearity is not an issue for the current study. The only few unsurprisingly high correlations are reported between ENG and GHG (0.817), ROA and ABE (0.802), and CAP and BVE (0.720). However, the use of panel data analysis should reduce the impact of collinearity among the explanatory variables on the regression results (Hsiao, 2003).

< Insert Table 3 about here >

#### ***4.4 Multiple regression analysis***

This section reports the results of the research model using the Full Information Maximum Likelihood regression method (FIML) after controlling for heteroscedasticity. Different alternatives of a system of equations were first considered, namely: two-stage least squares, three-stage least squares, FIML, and the generalized method of moments. Based on both the adjusted R-squared and the standard errors of the regressions, the FIML method produced the highest adjusted R-squared and the lowest standard errors of regressions, therefore it is used in the current study. The FIML regression method estimates all the equations in the research model simultaneously using maximum likelihood

under the assumption that the contemporaneous errors have a joint normal distribution. Provided that the likelihood function is correctly specified, FIML is fully efficient. In addition, a log transformation of all continuous variables is used when appropriate to reduce the impact of outliers on the current analysis.

The study first examines the association between firm value and environmental disclosure in Table 4 in line with prior studies (e.g., Freedman and Patten, 2004; Clarkson *et al.*, 2013; Plumlee *et al.*, 2015), but it differs from this stream of studies in an important aspect, which is addressing the dynamic of the relationship between firm value and CED after controlling for GHG. The purpose is to establish a relationship between  $CED_{-1}$  and current firm value that may be mediated. Thus, in Table 4, organizational visibility is not included in the research model. Then, it reports the full estimation of the research model in Table 5. The purpose is to explore the impact of introducing organizational visibility on the relationship between prior environmental disclosure and current firm value.

Table 4 shows that prior environmental disclosure positively and significantly affects firm value consistent with results from prior studies (e.g., Al-Tuwaijri *et al.*, 2004; Clarkson *et al.*, 2013; Hassan and Romilly, 2018). This result is line with expectations from voluntary disclosure theory which suggests that credible environmental disclosure which conveys incremental information beyond what investors already know from GHG increases firm value by facilitating the prediction of future financial performance and/or reducing the cost of capital (Clarkson *et al.*, 2013). Table 4 also shows that GHG is negatively and significantly associated with MCAP consistent with results from prior studies (e.g., Freedman and Patten, 2004; Clarkson *et al.*, 2013; Plumlee *et al.*, 2015). It also shows that prior environmental disclosure reduces current GHG, consistent with the management-orientation perspective suggested by Qian and Schaltegger (2017), i.e. corporate environmental disclosure can be used as a management tool to create organizational pressure and incentives to drive actions to reduce greenhouse gas emissions. The results also show that current GHG positively and significantly

influences current CED, consistent with legitimacy theory which suggests poorer performers to voluntarily disclose more environmental information to preserve their social legitimacy (e.g., Cho and Patten, 2007; Clarkson *et al.*, 2011; Hassan and Romilly, 2018). The results for the control variables show highly significant associations with the dependent variables, except in five cases where there is either a low level of significance or no association at all.

< Insert Table 4 about here >

Table 5 shows the results for the full research model as discussed in section 3, i.e. it shows the impact of prior environmental disclosure on current firm value after controlling for the two proxies of organizational visibility (NOA; INST). Firstly, it shows that prior environmental disclosure (CED<sub>-1</sub>) positively and significantly impacts analyst coverage (NOA) at less than 10% level of significance (two-tailed), consistent with H1. Corporate environmental disclosure includes various information items such as energy consumption and emissions, waste data, environmental initiatives, environmental policies, environmental capital expenditures, contingent environmental liabilities and fines and penalties, which have a direct impact on a firm's future cash flows and associated risk, and ultimately its value (Cormier *et al.*, 2015). This, in turn, means that CED<sub>-1</sub> provides information over and above what is revealed through GHG, which may improve the information set of financial analysts and help them produce better forecasts (e.g., Aerts *et al.*, 2008; Dhaliwal *et al.*, 2012; Cormier and Magnan, 2015), increasing thereby the demand for their services. Secondly, Table 5 also shows that NOA is positively and significantly associated with MCAP, consistent with H2 and suggestions from prior studies (e.g., Baik *et al.*, 2010; Grullon *et al.*, 2004; Barber and Odean, 2008; Keloharju *et al.*, 2012). Thirdly, it shows that CED<sub>-1</sub> does not impact MCAP consistent with H3, which contrasts with the result obtained in Table 4. The acceptance of the three research hypotheses indicates that organizational visibility, measured by NOA, plays a full mediation role on the relationship between prior environmental disclosure and firm value (Little *et al.*, 2007). However, the results are different for



INST. Firstly, the results show that prior environmental disclosure ( $CED_{-1}$ ) does not impact INST, rejecting thereby H1. Secondly, the results show no association between INST and MCAP, rejecting thereby H2. Thirdly, the results show  $CED_{-1}$  does not impact MCAP, consistent with H3. The rejection of H1 and H2 when INST is the proxy for organizational visibility indicates that INST does not play a mediation role on the relationship between prior environmental disclosure and firm value.

Table 5 also reinforces the results on the relationship between environmental disclosure and performance that are obtained in Table 4. It shows that prior environmental disclosure ( $CED_{-1}$ ) significantly reduces current GHG consistent with the management-orientation perspective suggested by Qian and Schaltegger (2017), while current GHG significantly increases current CED consistent with predictions from legitimacy theory. Table 5 also shows that prior greenhouse gas emissions intensity ( $GHG_{-1}$ ) significantly reduces current firm value (MCAP) and analyst coverage (NOA) indicating lower firm value and analyst coverage for poorer environmental performers consistent with results from prior studies (e.g., Freedman and Patten, 2004; Clarkson *et al.*, 2013; Plumlee *et al.*, 2015; Dhaliwal *et al.*, 2012), but it induces institutional ownership (INST). The results also show that higher institutional ownership (INST) reduces analyst coverage (NOA), perhaps due to more dependence on in-house analyst service rather than outside analyst service (Bhushan, 1989), while higher analyst coverage induces higher institutional ownership, possibly due to the role which financial analysts play in monitoring the business and increasing the visibility of its stocks.

< Insert Table 5 about here >

The results for the associations between the control variables and each of  $\log(GHG)$ ,  $\log(CED)$  and  $\log(MCAP)$  are generally consistent across tables 4 and 5, so that the introduction of the two proxies of organizational visibility (NOA; INST) did not alter such associations. For example, more profitable companies (ROA) are associated with higher GHG and MCAP but lower CED. Table 5 also shows that NOA is positively and significantly associated with firm size (EMP), return volatility (VOL),

quality of financial reporting (BIG4), but negatively associated with financial leverage (LEV) consistent with results from prior studies (e.g., Bhushan, 1989; Hassan and Skinner, 2016). In addition, institutional ownership (INST) increases in financial leverage (LEV) and firm profitability (ROA), but decreases in firm size (EMP) and capital spending (CAP). While country income (GDP) is positively associated with MCAP, GHG, and INST, it is negatively associated with NOA and CED. This result indicates that richer countries are associated with more valuable businesses, emit more GHG and attract more institutional ownership, but release less voluntary environmental information and attract lower analyst coverage, compared to their poorer counterparts. Corporate governance at country level is negatively and significantly associated with GHG and INST, indicating that better governance is associated with lower concentration of institutional ownership and lower greenhouse gas emissions intensity, consistent with results from Hassan and Romilly (2018).

In sum, the results of the FIML regression analysis document a mediation role of NOA on the relationship between CED<sub>-1</sub> and MCAP, but no impact of INST on such a relationship. To further examine the significance of the findings, a series of Wald-test is employed (Little et al., 2007), and the results are presented in Table 6. It shows the analysis of numerous null hypotheses, their results and implications. For example, it shows that the observed mediation role of NOA on the relationship between CED<sub>-1</sub> and MCAP from the FIML analysis is not statistically significant. It also shows that an inverse mediation role of MCAP on the relationship between CED<sub>-1</sub> and NOA is not evident. Furthermore, Table 6 shows no mediation role of INST on the relationship between CED<sub>-1</sub> and MCAP, as well as no evidence of an inverse mediation of MCAP on the relationship between CED<sub>-1</sub> and INST. However, it shows that organizational visibility (NOA; INST) is significantly associated with both CED and MCAP. This, in turn, means that omitting organizational visibility when examining the relationship between corporate environmental disclosure and firm value is prone to endogeneity bias. Antonakis *et al.* (2010) suggest that if endogeneity exists, even a simple correlation between the dependent

variable and independent variable cannot be inferred because the magnitude of the effect can be wrong as well as its sign.

Table 6 also documents a significant bi-directional relationship between NOA and MCAP consistent with suggestion from Baik *et al.* (2010). Although there is no significant relationship between INST and MCAP, such a relationship is significant for the whole model as shown in the null hypothesis no 5 in Table 6. In addition, there is a significant bi-directional relationship between NOA and INST consistent with results from Hussain (2000).

< Insert Table 6 about here >

Table 6 also shows that NOA plays a significant full mediation role on the relationship between INST and MCAP. This means that NOA is a route by which institutional ownership influences firm value. Furthermore, the results show a partial mediation role of NOA on the relationship between GHG<sub>-1</sub> and MCAP. In addition, there is evidence of a significant inverse mediation role of MCAP on the relationship between GHG<sub>-1</sub> and NOA. INST does not play a mediation role on the relationship between GHG<sub>-1</sub> and MCAP and there is no evidence on an inverse mediation. These results uncover the remarkable impact of analyst coverage on firm value.

## **5. Concluding remarks**

This study examines whether organizational visibility plays a mediation role on the relationship between corporate environmental disclosure and firm value after controlling for GHG for a sample of S&P Global 1200 for the years 2010 to 2015. It employs SEM to address such a complex relationship and estimates it using FIML regression method. Then it runs a series of Wald-test to examine the statistical significance of such a mediation role.

In detail, the initial results establish a significant and positive relationship between prior environmental disclosure and current firm value which may be mediated, after considering GHG as

well as several firm-level and country-level controls. However, after controlling for organizational visibility, the results show that prior environmental disclosure significantly and positively impacts analyst coverage consistent with the research hypothesis no 1. Also, the results show that firm value increases in analyst coverage consistent with the research hypothesis no 2. Furthermore, the previously observed direct relationship between prior environmental disclosure and firm value diminishes after including organizational visibility in the model consistent with the research hypothesis no 3. The acceptance of the three research hypotheses indicates a full mediation role of analyst coverage on the relationship between prior environmental disclosure and firm value. No mediation role is evidenced for institutional ownership though. To further examine the statistical significance of such results, a series of Wald-test was conducted. The results show that the initially observed mediation role of analyst coverage on the relationship between prior environmental disclosure and firm value is not statistically significant. However, the results also show that organizational visibility is significantly associated with both environmental disclosure and firm value. Taking these results together, it is vital to consider organizational visibility when investigating the relationship between environmental disclosure and firm value, otherwise the results could be misleading. The results also show significant bi-directional associations between analyst coverage and firm value, and between analyst coverage and institutional ownership. Interestingly, the results document a full mediation role of analyst coverage on the relationship between institutional ownership and firm value. Moreover, analyst coverage plays a significant partial mediation role on the relationship between  $\text{GHG}_{-1}$  and firm value. Nonetheless, firm value, as well, plays a partial mediation role on the relationship between  $\text{GHG}_{-1}$  and analyst coverage.

A potential limitation of the current study, however, is that it is potentially geared towards large listed companies. Thus, a fruitful extension of the current study could examine the mediation effect of organizational visibility on firm value for smaller companies. However, it could be difficult for smaller firms to attract institutional ownership and analyst coverage due to structural barriers (Bushee

and Miller, 2012), thus using other proxies for organizational visibility such as the extent of media coverage and the existence of investor relations professionals could be more attainable. In addition, due to data limitations concerning other proxies for environmental performance, it was not possible to check the sensitivity of the results to this measure. If large scale data becomes available on alternative proxies of environmental performance in the future, it would be interesting to replicate the study using as many proxies as possible to check the consistency of these results.

Nonetheless, the results of this study are of interest to investors and managers in that they improve our understanding of the factors that impact organizational visibility and firm value. It shows that corporate management can improve organizational visibility and attract more financial analysts by enhancing corporate voluntary environmental disclosure. It also shows that corporate environmental disclosure provides financial analysts with incremental information beyond what they already knew from greenhouse gas emissions intensity which could improve their information set for business valuation purposes. Given that the average level of corporate environmental disclosure for S&P Global 1200 companies is currently low, companies have more room to improve their CED and enhance their visibility and value. The results also suggest that prior environmental disclosure significantly reduces current GHG, which indicates that corporate management can use CED as a managerial tool to create organizational pressure and incentives to drive actions to reduce GHG. The findings also highlight the imperative influence of analyst coverage on firm value through their full mediation role of the relationships between institutional ownership and firm value, as well as their partial mediation role on the relationship between prior GHG and firm value. Thus, this study suggests that corporate management lobby financial analysts and educate them about their firms' environmental disclosure and performance to improve their information set and enhance firm visibility and value.

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**Table 1: List of Variables**

<b>Variable</b>	<b>Measurement</b>
<b>NOA</b>	The number of analysts making recommendations for a stock.
<b>INST</b>	The percentage of outstanding shares held by institutional investors.
<b>GHG</b>	Greenhouse gas emissions to total assets.
<b>CED</b>	Corporate voluntary environmental disclosure score, which is a proprietary Bloomberg score based on the extent of a company's environmental disclosure.
<b>MCAP</b>	The market value of equity of the firm at the fiscal year-end.
<b>LEV</b>	Financial leverage measured as non-current liabilities to total assets.
<b>ROA</b>	Return on assets measured as net income to total assets.
<b>EMP</b>	The total number of employees of the firm at the fiscal year-end.
<b>BIG4</b>	A dummy variable takes the value of 1 if the company's accounts are audited by one of the big four audit firms and 0 otherwise.
<b>VOL</b>	The standard deviation of the relative price change for the 360 calendar days closing price, expressed as a percentage.
<b>CAP</b>	The amount the company spent on the purchases of tangible fixed assets.
<b>BETA</b>	The market model beta for each stock measured via the market model using weekly data.
<b>ENG</b>	Total energy consumption figure in thousands of megawatt hours (MWh).
<b>IND</b>	A dummy variable that equals one if the firm is in the industrial, energy or utility sectors according to the Bloomberg Industry Classification System (BICS) and zero otherwise.
<b>ERI</b>	A dummy variable takes the value of 1 if the company has implemented any initiatives to reduce its environmental emissions to air and 0 otherwise.
<b>UNS</b>	A dummy variable takes the value of 1 if the company is a signatory of the United Nations Global Compact and 0 otherwise.
<b>BVE</b>	The book value of equity of the firm at the fiscal year-end.
<b>ABE</b>	Abnormal earnings measured as the difference between net income and the expected return. The expected return is calculated as the cost of equity times the one-year lagged book value of equity.
<b>GDP</b>	Gross domestic product per capita.
<b>CGOV</b>	The first principal component of corporate governance indicators at country level.

**Table 2: Descriptive analysis**

Variable	Mean	Median	Std. Dev.	Skewness	Kurtosis
NOA	21.96	21.00	8.12	0.21	2.16
INST	60.82	60.96	25.01	-0.09	1.88
GHG	142.50	42.42	216.96	2.14	6.87
CED	43.56	43.41	10.71	-0.29	2.61
MCAP	25948.32	15398.92	26570.79	1.62	4.67
LEV	0.32	0.31	0.14	0.32	2.48
ROA	5.25	4.69	4.68	0.39	2.88
EMP	54237.35	32518.00	55691.32	1.42	4.01
GDP	46105.28	47150.37	6317.52	-1.57	5.82
CGOV	0.34	-0.04	1.81	-1.57	10.74
BIG4	0.74	1.00	0.44	-1.07	2.15
VOL	30.07	27.86	10.62	1.21	5.35
CAP	1426.14	772.82	1561.98	1.59	4.80
BETA	1.01	1.00	0.24	0.27	2.40
ENG	15010.86	2923.93	27087.38	2.38	7.77
IND	0.30	0.00	0.46	0.85	1.73
ERI	0.96	1.00	0.20	-4.63	22.42
UNS	0.47	0.00	0.50	0.12	1.02
BVE	12047.30	7656.06	12492.24	2.00	6.64
ABE	148.75	76.17	1462.74	0.16	3.88

**Table 3: Spearman's correlation matrix**

	NOA	INST	GHG	CED	MCAP	LEV	ROA	EMP	GDP	CGOV	BIG4	VOL	CAP	BETA	ENG	IND	ERI	UNS	BVE	ABE
NOA	1.000																			
INST	.053*	1.000																		
GHG	-.128**	-.073**	1.000																	
CED	.145**	-.154**	.138**	1.000																
MCAP	.553**	.053*	-.141**	.178**	1.000															
LEV	-.042*	.162**	.210**	-.056**	0.034	1.000														
ROA	.206**	.259**	-.175**	-.056**	.460**	-.085**	1.000													
EMP	.333**	-.134**	0.002	.168**	.429**	-.064**	-0.005	1.000												
GDP	-0.010	.202**	.047*	-.087**	.148**	.095**	.222**	-.084**	1.000											
CGOV	.068**	-.069**	.053*	-.048*	0.040	-0.034	.134**	-.087**	.383**	1.000										
BIG4	.364**	.393**	-.041*	-.079**	.275**	.256**	.342**	-0.021	.326**	.235**	1.000									
VOL	-.050*	-.166**	.110**	0.005	-.418**	-.153**	-.406**	-.072**	-.210**	-.044*	-.206**	1.000								
CAP	.354**	-.236**	.349**	.271**	.531**	.213**	-.094**	.462**	-0.024	-0.001	-0.017	-0.022	1.000							
BETA	.053*	.055**	.157**	-0.004	-.153**	-.069**	-.238**	0.039	.097**	-0.021	-.046*	.552**	.048*	1.000						
ENG	.067**	-.215**	.817**	.279**	.192**	.237**	-.230**	.256**	-0.033	0.005	-.088**	.043*	.682**	.117**	1.000					
IND	-.061**	-.081**	.255**	.093**	-.093**	.141**	-.187**	-0.016	-.081**	-.067**	-.080**	.096**	.165**	.137**	.252**	1.000				
ERI	.044*	-.070**	.110**	.203**	.089**	0.029	-0.028	.142**	-0.033	.043*	-.071**	-0.020	.159**	0.040	.166**	.067**	1.000			
UNS	.254**	-.233**	0.027	.263**	.140**	-.074**	-.091**	.225**	-.134**	.051*	.051*	0.040	.197**	-0.033	.159**	-.043*	.113**	1.000		
BVE	.458**	-.168**	.044*	.286**	.724**	-.116**	0.030	.463**	-0.035	-0.029	-0.016	-.095**	.720**	0.028	.452**	0.011	.122**	.217**	1.000	
ABE	.240**	.205**	-.212**	-.051*	.492**	.102**	.802**	.102**	.195**	.080**	.373**	-.495**	0.004	-.358**	-.166**	-.125**	-0.015	-0.022	0.028	1.000

\*\* . Correlation is significant at the 0.01 level (2-tailed). \* . Correlation is significant at the 0.05 level (2-tailed). N = 2365 firm-year observations. VIF is variance inflation factor.

**Table 4: Regression analysis for the relationship between CED and MCAP without considering organizational visibility**

Estimation method: Full Information Maximum Likelihood - Coefficient covariance computed using Huber-White method

Included observations: 3021- Total system (balanced) observations: 9063

Variable	Log(GHG)	Prob.	Log(CED)	Prob.	Log(MCAP)	Prob.
Intercept	-5.410	0.000	3.459	0.000	-1.597	0.051
Log(NOA)						
Log(INST)						
Log (GHG <sub>-1</sub> )			0.022*	0.000	-0.074	0.000
Log(CED <sub>-1</sub> )	-0.208	0.000			<b>0.072</b>	<b>0.013</b>
Log(MCAP)	-0.637	0.000	0.053	0.000		
Log(LEV)	0.053	0.078	-0.035	0.000	0.312	0.000
ROA	0.081	0.000	-0.006	0.000	0.076	0.000
Log(EMP)	-0.060	0.000	-0.001	0.907	0.101	0.000
Log(GDP)	0.897	0.000	-0.069	0.065	0.357	0.000
CGOV	-0.040	0.000	-0.002	0.573	-0.004	0.559
BIG4						
Log(VOL)						
Log(CAP)						
Log (BETA)						
Log(ENG)	0.844	0.000				
IND	0.048	0.000				
ERI			0.373	0.000		
UNS			0.091	0.000		
Log(BVE)					0.714	0.000
ABE					7.11E-05	0.000
Adjusted R-squared	0.82		0.19		0.77	
S.E. of regression	0.70		0.25		0.48	

\*: Log (GHG) is used in the environmental disclosure model rather than log(GHG<sub>-1</sub>) in line with the research model. P-value (2-tailed). These notes apply to tables 4 and 5.

**Table 5: Regression analysis for the relationship between CED and MCAP after including organizational visibility**

Estimation method: Full Information Maximum Likelihood - Coefficient covariance computed using Huber-White method

Included observations: 2246 - Total system (balanced) observations: 11230.

Variable	Log(NOAA)	Prob.	Log(INST)	Prob.	Log(GHG)	Prob.	Log(CED)	Prob.	Log(MCAP)	Prob.
Intercept	3.396	0.000	-10.213	0.000	-6.684	0.000	3.805	0.000	-3.255	0.001
Log(NOAA)			0.843	0.000	0.213	0.000	-0.011	0.519	<b>0.181</b>	<b>0.000</b>
Log(INST)	-0.370	0.000			0.160	0.000	-0.017	0.173	<b>-0.024</b>	<b>0.532</b>
Log (GHG <sub>i</sub> )	-0.015	0.007	0.035	0.000			0.025*	0.000	-0.077	0.000
Log(CED <sub>i</sub> )	<b>0.048</b>	<b>0.077</b>	<b>-0.021</b>	<b>0.635</b>	-0.206	0.000			<b>0.030</b>	<b>0.356</b>
Log(MCAP)	0.156	0.000	-0.027	0.480	-0.702	0.000	0.052	0.000		
Log(LEV)	-0.043	0.011	0.205	0.000	0.010	0.783	-0.032	0.003	0.324	0.000
ROA	3.99E-04	0.874	0.006	0.095	0.082	0.000	-0.005	0.001	0.076	0.000
Log(EMP)	0.042	0.000	-0.029	0.012	-0.054	0.001	0.002	0.732	0.096	0.000
Log(GDP)	-0.178	0.088	1.273	0.000	0.935	0.000	-0.089	0.042	0.515	0.000
CGOV	-0.006	0.546	-0.096	0.000	-0.028	0.024	-0.002	0.773	-0.006	0.464
BIG4	0.429	0.000								
Log(VOL)	0.170	0.000								
Log(CAP)			-0.183	0.000						
Log (BETA)			0.081	0.169						
Log(ENG)					0.854	0.000				
IND					0.049	0.107				
ERI							0.330	0.000		
UNS							0.093	0.000		
Log(BVE)									0.689	0.000
ABE									7.17E-05	0.000
Adjusted R-squared	0.21		0.04		0.83		0.17		0.80	
S.E. of regression	0.36		0.49		0.67		0.25		0.45	

**Table 6: Wald-test**

No	Null hypothesis	Chi-square (p-values)	Decision	Indication
(1)	$\alpha_1 = \alpha_3 = \alpha_4$ $= \partial_1 = \partial_3 = \partial_4$ $= \delta_1 = \delta_2 = \delta_4$ $= 0$	589.07 (0.000)	Reject	Dependent model.
(2)	$\alpha_4 = \delta_1 = 0$	190.66 (0.000)	Reject	Both variables are individually and jointly significant indicating a bi-directional relationship between NOA and MCAP.
(3)	$\alpha_3 * \delta_1 = 0$	2.47 (0.116)	Accept	The interaction term is insignificant, thus the mediation role of NOA on the relationship between CED-1 and MCAP is insignificant.
(4)	$\delta_4 * \alpha_4 = 0$	0.85 (0.358)	Accept	The interaction term is insignificant, indicating no possibility for an inverse mediation of MCAP on the relationship between CED-1 and NOA.
(5)	$\partial_4 = \delta_2 = 0$	5.41 (0.067)	Reject	Although both variables are individually insignificant, they are jointly significant for the whole model.
(6)	$\partial_3 * \delta_2 = 0$	0.14 (0.706)	Accept	The interaction term is insignificant, indicating no mediation role of INST on the relationship between CED-1 and MCAP.
(7)	$\delta_4 * \partial_4 = 0$	0.32 (0.569)	Accept	The interaction term is insignificant indicating no possibility for an inverse mediation role of MCAP on the relationship between CED-1 and INST.
(8)	$\alpha_1 = \partial_1 = 0$	87.60 (0.000)	Reject	Both variables are individually and jointly significant indicating a bi-directional relationship between INST and NOA.
(9)	$\partial_1 * \delta_2 = 0$	0.42 (0.515)	Accept	The interaction term is insignificant, indicating no mediation role of INST on the relationship between NOA and MCAP.
(10)	$\alpha_1 * \delta_1 = 0$	6.29 (0.012)	Reject	The interaction term is significant, thus NOA plays a mediation role on the relationship between INST and MCAP.
(11)	$\alpha_1 * \delta_1 = 0, \delta_2 = 0$	7.43 (0.024)	Reject	There is evidence of a full mediation role of NOA on the relationship between INST and MCAP.
(12)	$\alpha_2 * \delta_1 = 0, \delta_3 = 0$	160.69 (0.000)	Reject	NOA plays a partial mediation role on the relationship between GHG-1 and MCAP.
(13)	$\delta_3 * \alpha_4 = 0, \alpha_2 = 0$	58.85 (0.000)	Reject	MCAP plays a partial moderation role on the relationship between GHG-1 and NOA.
(14)	$\partial_2 * \delta_2 = 0$	0.34 (0.560)	Accept	The interaction term is insignificant, indicating no mediation role of INST on the relationship between GHG-1 and MCAP.
(15)	$\delta_3 * \partial_4 = 0$	0.50 (0.480)	Accept	The interaction term is insignificant, indicating no possibility for an inverse mediation from MCAP on the relationship between GHG-1 and INST.
(16)	$\alpha_3 = \partial_3 = \gamma_1 = \gamma_2 = 0$	20.22 (0.001)	Reject	The association between CED and organizational visibility is significant to the whole model.
(17)	$\alpha_4 = \partial_4 = \delta_1 = \delta_2 = 0$	385.63 (0.000)	Reject	The association between organizational visibility and firm value is significant to the whole model.

The null hypothesis is rejected if the p-values are significant (less than 10%).