

# Environmental performance and environmental disclosure relationship: the moderating effects of environmental cost disclosure in emerging Asian countries

Environmental  
performance  
and disclosure

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## Abstract

**Purpose** – This paper aims to analyze the effect of environmental performance (EP) on environmental disclosure (ED) and determine whether environmental costs (ECs) moderate this relationship. This paper extends legitimacy theory that focuses on the commonly assumed interaction between companies and community, with the effect of quantitative information that can summarize a large amount of narrative disclosure and its effect on narrative ED.

**Design/methodology/approach** – This paper uses regression analysis on 492 unbalanced panel data of emerging Asian countries' publicly listed companies between 2006 and 2019.

**Findings** – Results show that EP has a positive effect on ED. EC weakens the effect of EP and ED.

**Originality/value** – Extending the incentives to signal EP through disclosure, this cross-country study tests how quantitative EC information can summarize the narrative and reduce the level of disclosure. This paper also proves the summarization effect of environmental cost diminution in countries with low market sophistication.

**Keywords** Environmental performance, Environmental disclosure, Environmental costs

**Paper type** Research paper

## 1. Introduction

Environmental degradation resulting from rapid industrial development such as the emission of global warming gases due to the excessive use of nonrenewable energy sources is eminent globally. Emissions of greenhouse gases, especially across emerging countries, have caused continuous rise in temperatures (Lenssen *et al.*, 2019), leading to catastrophic environmental problems. This problem has raised public awareness on the importance of assessing and scrutinizing the role of companies in preserving the environment. The disclosure of high-quality information as a signal enables external stakeholders including the market to assess and scrutinize the extent of the company's effort in preserving the environment, hereafter referred to as environmental performance (EP). A good communication of EP information, i.e. the signal, could maintain a company's reputation and legitimize its existence to the public (Luo and Tang, 2014). Extending this view, this paper investigates the effect of summarization of the signal on the overall quantity of the signal provided by companies to stakeholders. The main objective of this paper is to test the moderating role of environmental costs (EC), an item assumed to provide a summary of important signals, on the relationship between EP and environmental disclosure (ED). As



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market sophistication can determine signal comprehension, this paper also tests whether the moderating role of EC only holds in markets with high sophistication.

Prior studies have shown that the relationship between company EP and ED be viewed from two perspectives, namely, signaling and symbolic (Tadros and Magnan, 2019). Consistent with signaling within legitimacy theory perspective, a majority of studies have found that companies disclose more EP voluntarily due to the benefits obtained from positive news (Dienes *et al.*, 2016) [1].

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This paper examines the relationship further within the context of emerging Asian countries, following the signaling perspective, although the symbolic perspective can become an alternative explanation. This paper suggests that the role of EC must be considered an indicator for substantive strategy in examining the relationship between EP and ED. To increase EP effectively, companies must implement an environmentally sustainable strategy De Villiers *et al.* (2011) and Lisi (2015), such as the use of renewable energy and materials. EC measures the extent of environmental management accounting (EMA) implementation, which has been considered effective in dealing with environmental problems (Wang *et al.*, 2017). EMA is a concrete form of corporate attention and commitment in the strategy for environmental effect control, gathering information related to ECs from internal activities that help companies achieve sustainable EP (Derchi *et al.*, 2013; Zhang and Chen, 2017).

This context is manipulated to examine the incentives for ED further. Whether disclosure of quantitative EC information could reduce the incentives to provide more narrative ED is tested. Theoretically, this paper is important in demonstrating the role of quantitative information that shows companies' strong commitment toward the environment. The commitment is verified by concrete actions that require some investment (EC) from the companies. The incentives to provide narrative disclosure could be reduced because this information is a better summary of environmental strategy adopted by the companies.

In this paper, emerging Asian countries are selected as a context for several reasons. First, the proportion of companies with EMA as indicated by the EC in developed markets is five times higher than that in emerging markets. Thus, the awareness of the companies to be more environmentally responsible is relatively higher in developed markets than in emerging markets, resulting in a lower variation in ED and reduced power of test particularly involving a moderator in the developed markets. Second, this work aims to test the effect of market sophistication variation on the relationships. The markets within the emerging Asian countries with significant variation in the market sophistication serve as a natural laboratory to test this effect.

This paper makes several important contributions. First, by testing the EC moderating effect, this work proves that several narratives in sustainability disclosure can be summarized in a quantitative measure, thus making the report more concise and increasing its verifiability characteristic. This argument implies that the disclosure of several environmental quantitative measures could disincentivize the management from making elaborative narrative disclosure, reducing the level of disclosure. Thus far, not much is known from the literature about the effect of quantitative information on narrative information disclosure. Second, this paper proves that the moderating effect of EC is contingent on the level of market sophistication. Not much is understood on the effect of country level factor on the incentives (or disincentives) for disclosure. Third, further evidence of the importance of EC to signaling or greenwashing debate within the context of emerging Asian countries is provided, an intersection between management accounting and corporate reporting fields. The results show that EP has a positive relationship with ED, reflecting management's signaling incentives.

The rest of this paper is organized as follows. The literature is reviewed, and the hypotheses are developed in the next section. Subsequently, the methodology is described. The results are discussed, and the conclusions are presented.

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## 2. Literature review and hypotheses

Voluntary information signaling, in which ED can be categorized into, can be viewed from the agency theory perspective, i.e. an agent providing signals of private information to the mass owners (shareholders), and the amount of signals may depend on the effectiveness of monitoring mechanisms or stakeholder theory perspective, i.e. provision of information to match the demand from various stakeholders or legitimacy theory perspective, i.e. to obtain validation within the social system of a company's operation. Companies are under growing environmental pressure from various stakeholder groups to develop strategies, policies and practices that are aligned with the organization's environmental objectives (Hofer *et al.*, 2012).

According to Parsons (1960), legitimacy theory is an assessment of the consistency of actions with the shared or general values in the social system, i.e. communities. It assumes a "social contract" between a company and the communities in which it operates (Deegan and Warren, 2003). This perspective suggests that organizational behavior in the form of company activities should be congruent with the social system values in which the company operates (Deegan and Warren, 2003). Companies continue to look for ways to ensure that their operation is within the boundaries and norms of society. Companies are willing to incur costs to deal with disharmonious relations with the community because the effects on the company, such as in terms of legal fees, reputation, loss of customers and employee loyalty, can be high. Therefore, time, energy and assets must be allocated in dealing with environmental problems surrounding the company's operation to gain social legitimacy.

Hogner (1982) stated that company disclosure is motivated by the company's needs to legitimize activities. This assertion means that ED is one of the tools used by companies to obtain, maintain and improve their legitimacy status in the eyes of stakeholders. "Green narratives" are more important than the substantive form of the green initiatives itself (Matejek and Gössling, 2014). In this paper, the use of EMA in companies is expected to strengthen the company's position further in the eyes of stakeholders, i.e. the company is increasingly focusing on the substantive, not merely symbolic, environmental activities. Consistent with legitimacy theory, companies with good EP disclose a high level of environmental information to enhance the company's reputation and create a positive corporate image. Prior studies supported this expectation (Ahmadi and Bouri, 2017; Al-Tuwaijri *et al.*, 2004; Clarkson *et al.*, 2008; Giannarakis *et al.*, 2017; Qiu *et al.*, 2016b; Muhimatul Ifada *et al.*, 2021). All of them concluded that EP has a positive effect on ED.

Based on theory and previous literature, the first hypothesis is stated:

*H1.* A positive relationship exists between EP and ED.

This paper is undertaken due to the mixed results found on this relationship. While the above studies found a positive relationship that suggests the dominance of signaling incentives, Delmas and Burbano (2011), Kurpierz and Smith (2020), and Patten (2002) found a negative relationship that is consistent with greenwashing effects, i.e. cheap talk or false claim (Delmas and Burbano, 2011; Kurpierz and Smith, 2020). Deswanto and Sylvia (2018), Fekrat (1996) and Patten (2002) found that a significant relationship does not exist between the two concepts. This paper introduces EMA as a moderating factor to the relationship between EP and ED that could provide more explanations on the conditions of the relationship.

Based on a continuous recording system, EMA provides data related to financial accounting, cost accounting and physical information Christ and Burritt (2013), such as material flow. EMA aims to improve material efficiency and reduce energy use and wastage, thus minimizing environmental effects and risks, and reducing ECs in the company's operation (Wang *et al.*, 2019). Hansen and Mowen (2006) defined ECs as monetary and nonmonetary effects resulting from the outcomes of company activities that affect environmental quality. The quantitative nature of EMA reflected in EC disclosure could

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add several perspectives: (1) verifiability characteristic that is important to the credibility of disclosure and (2) summarization of information.

First, the verifiability feature. The extent of EMA implementation is related directly to ECs (usually budgeted for), which are usually hidden in the main financial statements due to aggregation. However, the costs potentially provide information on environmental benefits that are often ignored (Jasch, 2003). Hansen and Mowen (2006) grouped ECs into four parts: environmental prevention costs, environmental detection costs, internal failure costs and external failure costs. When a company implements EMA, the company is strongly encouraged to provide environmental budget allocation information, i.e. ECs as part of ED.

Second, the summarization feature. Many summarization models are in the information literature, such as fractal summarization (such as Endres-Niggemeyer *et al.* (1995) and Yang and Wang (2008)), semantic relation extraction (such as Geng *et al.* (2020) and Pawlak (2002)) and rough set theory (such as Chen and Chi (2021)). However, this paper only focuses on quantitative data that can summarize narrative information. Disclosure of such information could discourage companies from providing an elaborative narrative ED because EC can summarize related and relevant information, as described above.

In addition, as narrative ED is self-reported, it could be subjected to greenwashing effects. EC information is a more concrete information that can be easily obtained in the disclosure to be compared with, audited and validated against other numbers in the financial statements. Thus, the information is less likely to be manipulated. A common approach of many disclosure studies is looking at the amount or level of disclosure, using a preconstructed disclosure index and content analysis (Jia *et al.*, 2016). Many researchers have questioned this approach and used developed quality measures of disclosure by looking at information richness (Jia *et al.*, 2016). Along the information richness concept lies the depth dimension of information, i.e. time orientation (historical, forward looking or no time dimension), economic sign (positive, negative or neutral) and the type of measures (financial or nonfinancial) (Beattie *et al.*, 2004; Beretta and Bozzolan, 2004). Prior literature has suggested that quantitative financial information is of higher quality than narrative disclosure (Jia *et al.*, 2016) because it is verifiable (Toms, 2002). However, quantitative financial information is subject to future inquiry (Oliveira *et al.*, 2011) and vulnerable to litigation action. EC information is a form of financial information disclosure that represents how much effort and commitment the company has invested. Having more ECs would reduce the necessity for the company to justify their environmental effort narratively, regardless of the company's EP.

This argument contradicts earlier evidence of a positive association between disclosure quality and quantity (Alotaibi and Hussainey, 2016; Beattie *et al.*, 2004; Hooks and van Staden, 2011; Saha *et al.*, 2019). However, studies attribute ED in companies as propaganda (Collison, 2003) to improve corporate image (Davies and Brennan, 2007) and not genuinely made to reflect the underlying EP (Khalid *et al.*, 2019). Therefore, realizing this perception, companies may become aware of not overdoing their ED and fall under what is called by Khalid *et al.* (2019) as "bad faith" category [2]. This clarification is used as a competing explanation to what is believed as signaling incentives used in most studies in this area.

Therefore, EC weakens the positive effect of EP on ED consistent with the signaling incentives. A higher corporate commitment to EMA implementation, represented by EC, leads to a more thorough understanding of the information needs of EP. Consequently, companies with a high level of EC have a transparent EP management and a good internal accountability, thus reducing the needs for narrative incentives.

Based on this description, the second hypothesis is formulated:

*H2.* The relationship between EP on ED is moderated by ECs. A test is added to determine the effect of market sophistication on the relationships. Consistent with the legitimacy perspective, companies manage their disclosure to be seen good in the

market. However, this argument may not be valid if the market, including investors and consumers, is not sophisticated, i.e. cannot understand the disclosure made by companies. Consistent with [Indjejikian \(1991\)](#) and [Blankespoor \(2019\)](#), the degree of market sophistication may affect the incentives of companies to disclose environmental information. Market sophistication is related to the richness of the information environment and how the recipient of information could process the information and affect their action ([Fiechter and Novotny-Farkas, 2017](#)). Thus, the incentives to manage the disclosure, whether to provide more narrative disclosure or to summarize the information in a more verifiable quantitative information form, depends on the perception of the preparer on the market sophistication in a particular country. Consequently, the moderating effect of EC may diminish in countries with a low market sophistication.

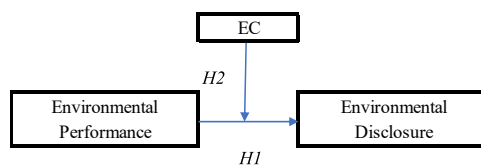
*H3.* The moderating role of ECs on the relationship between EP on ED depends on market sophistication.

This paper also extends eco-efficiency analysis on how EP that consists of energy and water intensity and material intensity efficiency from proactive environmental strategies that use EMA as monitoring tool (summarized as EC) could improve the signals to stakeholders using signaling theory. A good strategy results in lower consumption of energy, water and materials. It also minimizes spending on fuel, water, electricity and materials. Thus, this strategy is expected to preserve the natural environment. Exploring the effects running from EP on ED with EC as the moderating variable is essential to examine whether the theories reinforce each other. The research model is described in [Figure 1](#).

### 3. Research method

The population of this study consists of publicly listed companies in emerging countries within the Asian region. Criteria used to select the data include the following:

- (1) Public companies throughout the emerging Asian market.
- (2) Companies with both financial and nonfinancial data required for analysis such as size, leverage, performance, EP data (air, waste, water, energy and materials) and availability of environmental accounting cost data (in US\$).
- (3) Based on the specified data criteria, the obtained research data consist of the stock index from the stock exchange in China, Hong Kong, Indonesia, India, Malaysia, Pakistan, the Philippines, Sri Lanka, Thailand and Taiwan. All indexes are acquired from the Bloomberg database. Hong Kong and Taiwan are presumed inseparable from China. However, according to the Bloomberg classification, they are in different stock indexes, and significant relationships among the markets do not exist ([Cheng et al., 2019](#); [Ho and Zhang, 2012](#); [Johansson and Ljungwall, 2009](#); [Li, 2007](#)). In addition, many studies in finance (for example, [Nowak et al. \(2021\)](#)) have analyzed the data separately.



**Figure 1.**  
Research model

The final sample is based on panel data of 12 years (2007–2019) consisting of 492 observations from emerging Asian countries. This paper uses unbalance panel data, i.e. a combination of time series and cross-section data with different numbers of observations for the cross-sectional unit to maximize the number of observations. The greatest number of observations (277) comes from China, and the least number of observations is from the Philippines (2) and Sri Lanka (2). Our conclusion might have been affected by the unique practices in certain countries such as China. Thus, country dummy variables are included to control for this effect.

Table 1 shows only one observation in 2007 because other companies do not have available data needed for analysis. The number of companies increases to the highest point in 2018 (103 observations). The number of companies is 76 in 2019. The nature of panel data analysis controls for yearly effects. Bloomberg score is used in this paper to measure ED (Bernardi and Stark, 2018; Hassan and Romilly, 2018; Qiu *et al.*, 2016b).

The ED score provided by the Bloomberg database is also considered objective and accurate. The database provides the extent of ED from a maximum of 60 points. The information regarding energy consumption and emissions, waste data, environmental initiatives and environmental policies are examples of ED (Qiu *et al.*, 2016a). The most disclosed item in the ED scores is greenhouse gas emissions. It is normalized from 0 for companies that do not disclose environmental information to 100 for those with disclosure for each data point collected.

According to Claver-Cortés *et al.* (2007), EP is the effect or result of activities conducted by the company on the environment. EP is also known as “an overview in the use of operational performance indicators that evaluate resource use, waste disposal, emissions, or water consumption” (Nawrocka and Parker, 2009). Bloomberg lists four categories of ED:

- (1) Energy Efficiency Policy (the main EP indicator for energy)
- (2) Emission Reduction Initiatives (the main EP indicator for air)
- (3) Waste Reduction Policy (the main EP indicators for waste)

Selection criteria		# Obs.	
Observations of publicly listed companies from an emerging market in the Asia that have EDS data from 2007 to 2019		512	
Observations that do not have EMA data (4) and EP data (16)		(20)	
Observations with complete data		492	
Data by country			
No	Country	#Obs	Percent
1	China	277	56.3
2	Hong Kong	16	3.3
3	Indonesia	63	12.8
4	India	56	11.4
5	Malaysia	28	5.7
6	Pakistan	9	1.8
7	Philippines	2	0.4
8	Sri Lanka	2	0.4
9	Thailand	31	6.3
10	Taiwan	8	1.6
Total		492	100

**Table 1.**  
Sample

**Source(s):** Bloomberg



(4) Water Policy (the main EP indicator for water)

The EP formula used in the study is as follows:

$$EP = \frac{\sum \text{Company environmental performance indicator}}{\text{Total indicators}}$$

The total score of the company's main EP is divided by the total of the four indicators. The lowest value is 0 if the company does not have an EP indicator, and the highest value is 1 if the company has the four EP indicators.

Annual ECs (obtained from the Bloomberg database) are used as a proxy for EMA (Jasch, 2003). ECs include costs used to manage environmental contamination caused by the company's operational activities, such as waste disposal. Waste in this context is used as a general term for solid waste, wastewater and air emissions; thus, it includes all non-product outputs. Therefore, when calculating ECs, not only the disposal costs are considered but also the purchase value of the wasted material (water and energy) and the production costs of waste and emissions.

Furthermore, this paper uses a panel regression model to test the proposed hypothesis empirically. Specifically, this paper also uses the panel regression technique. The first model investigates the influence of EP on ED in the presence of a control variable. Finally, data on market sophistication are obtained from the World Bank website.

The first model is as follows:

$$ED_{it} = \alpha_0 + \beta_0 EC_{it} + \beta_1 EP_{it} + \beta_2 SIZE_{it} + \beta_3 PERFORM_{it} + \beta_4 LEV_{it} + \beta_5 ID_{it} + \beta_6 GDS_{it} + \varepsilon_{it} \quad (1)$$

The second model examines the moderating effect of EC in the relationship between EC and ED. The second model is formulated as follows:

$$ED_{it} = \alpha_0 + \beta_0 EC_{it} + \beta_1 EP_{it} + \beta_2 SIZE_{it} + \beta_3 PERFORM_{it} + \beta_4 LEV_{it} + \beta_5 ID_{it} + \beta_6 GDS_{it} + \beta_6 EP_{it} * EC_{it} + \varepsilon_{it}, \quad (2)$$

where

ED = Environmental Disclosure, EP = Environmental Performance, EC = Environmental Cost, Size = Total Asset Natural Logarithm/Company size, Perform = Return on Assets, Lev = Leverage, ID = Independent Director, GDS = Governance Disclosure Score, EP \* EC = Environmental Performance \* Environmental Cost and  $\varepsilon$  = Error Term

The effect of market sophistication is tested separately for the sample with high and low market sophistication, using the above empirical equations.

#### 4. Results and discussion

Table 2 presents the descriptive statistics. The mean (median) of ED is 27.595 (23.645) with a maximum of 67.44. The mean (median) for EC is 45.481 (4.97) with a maximum value of 1,550. This evidence highlights the non-normal distribution of EC, a possible heteroscedasticity problem, and the existence of outliers that could affect the results. This distribution is considered, and data (except EP, i.e. EP data) are transformed using log 10. A constant is added to variables that contain negative numbers to enable log transformation. Consistent with prior literature, SIZE is measured as the natural log of total assets.

The company-level data at each country show that the highest average level of ED is recorded by companies in Thailand, followed by those in Indonesia. Companies in Thailand also recorded the highest average level of EC, followed by Malaysia. A notable result is that while acting as one of the most advanced financial hubs in the region, companies in Hong

Kong recorded the lowest average level of ED and EC among the emerging Asian economies.

Table 3 presents the classical assumption tests, i.e. correlation analysis and multivariate normality test for the variables used in the analysis. The Pearson parametric correlation between variables shows that the highest correlation is between LEV and SIZE ( $-0.577$ ), and EP is more prominent in smaller companies. The table shows that ED is correlated positively with EP (consistent with signaling incentives), ECs, company performance and leverage. Center-transformed EC and EP for the interaction variable deal with the multicollinearity issue. The table also indicates that no correlation is higher than 0.800 (Cooper *et al.*, 2006), which suggests multicollinearity is not a serious problem in the regression. A similar trait of correlation is also evident in the Spearman correlation analysis (untabulated). Multicollinearity problem is also performed in each regression using VIF. The results suggest no serious collinearity issue because the VIF values are all below 5.

To ensure the suitability of a linear function, Ramsey Regression Equation Specification Error Test (RESET) test is performed. The result shows that the specification error is within an acceptable range ( $F$ -statistic 0.674980,  $p = 0.4117$ ). For each endogenous variable, three types of tests are performed: pooled model, fixed effect model or random effect model by setting the EGLS function. The advantage of this function is that it relaxes the assumption that the errors are homoscedastic and uncorrelated. Table 4 presents the results. The results of the Hausman tests suggest that model 2, namely, the fixed effect model can be used. Model 2,  $R$  square and adjusted square are the highest values among all the models.

Table 4 shows a positive relationship between ED and EP; hence,  $H_1$  is accepted. Consistent with Cai *et al.* (2016) and Edman *et al.* (2011), companies with better EP have more voluntary disclosures about their environmental effect. On the one hand, ED has been used a “social contract” strategy to gain legitimacy within the community and create a good corporate image for the sustainability to last a long time. On the other hand, information may also lead to more efficient operations and better EP (Schlenker and Scorse, 2017; Yulita Setiawanta *et al.*, 2021). The residuals are also normally distributed (Jarque Bera test 0.227,  $p > 0.10$ ). Harvey (1976) test suggests insignificant heteroscedasticity problem ( $p = 0.9893$ ).

Companies with excellent EP always make EDs. ED increases the firm value, and it is not only a form of compliance with the law but also useful for generating public legitimacy for the company (Kuo and Chen, 2013). The company’s consistency in providing ED can certainly maintain the company’s legitimacy, which eventually has a superior influence on the firm value (Mousa and Hassan, 2015). The company’s role in EP creates a positive image to attract investors to cooperate and invest their shares in the company. It also implies that greenwashing (whether false claim or cheap talk) incentives is not dominant in determining ED in the Asian region.

In addition to showing a positive relationship between EP and ED, Table 4 also presents that EC weakens the relationship between EP and ED; hence,  $H_2$  is accepted. Engaging in corporate social responsibility initiatives is the company’s primary response to calls from stakeholders and society for social legitimacy (Seele and Gatti, 2017), which could subsequently increase global competitiveness (Flammer, 2013). The evidence provided in this study supports that companies have the tendency to provide ED when the EP is good and vice versa. However, the signaling incentives is contingent on the types of information. Quantitative information about ECs is expected to be a good summary measure of sustainability efforts to the extent that it can discourage the companies from disclosing more narrative information. The result also suggests that the quantitative and qualitative types of environmental information, i.e. the type of signal, matters (Hopwood, 2009). This behavior shows that a high (low) EC weakens (strengthens) ED–EP relationship. The relationship is depicted in Figure 2.



	Minimum	Maximum	Mean	Median	Std. Deviation
<i>Panel A: Untransformed</i>					
EC	0.002	1,550	45.481	4.97	176.608
EP	0.25	1	0.782	0.75	0.21
ED	0.78	67.44	27.595	23.645	16.418
PERFORM	-37.3	73.07	7.241	4.55	10.23
LEV	1.12	15.12	2.47	2.12	1.542
ID	0	12	3.9	3	1.71
GDS	14.29	87.48	53.66	51.79	9.09
<i>Panel B: Transformed</i>					
EC	-0.442	3.191	1.058	0.901	0.575
ED	-0.108	1.829	1.356	1.374	0.288
SIZE	6.597	20.378	10.59	9.897	2.796
PERFORM	-0.155	2.046	1.643	1.629	0.125
LEV	0.049	1.18	0.347	0.326	0.181
ID	0	12	3.9	3	1.71
GDS	1.16	1.94	1.72	1.71	0.08
<i>Panel C by country with &gt;10 # observations</i>					
<i>China</i>					
EC	0.478	3.131	1.032	0.838	0.603
EP	0.25	1	0.788	0.75	0.205
ED	-0.108	1.819	1.284	1.251	0.281
<i>Hong Kong</i>					
EC	0.479	1.774	0.7	0.571	0.335
EP	0.5	1	0.783	0.75	0.208
ED	0.844	1.819	1.264	1.212	0.281
<i>India</i>					
EC	0.477	2.73	1.107	0.894	0.596
EP	0.25	1	0.83	0.75	0.185
ED	0.491	1.817	1.412	1.491	0.276
<i>Indonesia</i>					
EC	-0.442	1.982	1.032	1.046	0.468
EP	0.25	1	0.73	0.75	0.239
ED	0.968	1.819	1.465	1.513	0.242
<i>Malaysia</i>					
EC	0.486	3.191	1.206	1.131	0.588
EP	0.25	1	0.75	0.75	0.219
ED	1.003	1.764	1.452	1.497	0.216
<i>Pakistan</i>					
EC	0.478	1.823	1.095	1.138	0.452
EP	0.25	1	0.722	0.75	0.263
ED	0.491	1.747	1.436	1.561	0.388
<i>Taiwan</i>					
EC	0.479	1.803	1.094	1.107	0.468
EP	0.25	1	0.75	0.75	0.267
ED	0.844	1.798	1.369	1.381	0.276
<i>Thailand</i>					
EC	0.495	2.327	1.237	1.212	0.511
EP	0.5	1	0.775	0.75	0.211
ED	1.003	1.829	1.625	1.736	0.242

**Note(s):** *EC* denotes environmental costs, *EP* is environmental performance, *ED* is environmental disclosure, *SIZE* is company size measured as total assets, *PERFORM* is company performance measured as return on assets and *LEV* is leverage measured as debt-to-total asset ratio. *ID* is independent director, and *GDS* is governance disclosure score

**Table 2.**  
Descriptive statistics

MEQ	<i>EC</i>	<i>EP</i>	<i>LGED</i>	<i>SIZE</i>	<i>PERFORM</i>	<i>LEV</i>	<i>ID</i>	<i>GDS</i>
<i>EC</i>	1							
<i>EP</i>	0.282**	1						
<i>ED</i>	0.144**	0.518**	1					
<i>SIZE</i>	-0.117**	-0.543**	-0.324**	1				
<i>PERFORM</i>	0.173**	0.246**	0.451**	-0.399**	1			
<i>LEV</i>	0.171**	0.438**	0.504**	-0.577**	0.363**	1		
<i>ID</i>	0.003	0.054	0.163**	0.005	-0.037	-0.003	1	
<i>GDS</i>	-0.016	-0.047	0.199**	0.091*	0.019	-0.029	0.245**	1

**Note(s):** *EC* denotes environmental costs, *EP* is environmental performance, *ED* is environmental disclosure, *SIZE* is company size measured as the natural logarithm of total assets, *PERFORM* is company performance measured as return on assets and *LEV* denotes leverage measured as debt-to-total asset ratio  
 \*\*. Correlation is significant at the 0.01 level (2-tailed)

**Table 3.**  
Pearson correlation

Dependent var. ED	Basic Pooled OLS model	Model 1 Pooled OLS model	Basic Fixed effect model	Model 2 Fixed effect model	Basic Random effect model	Model 3 Random effect model
C	-1.891***	-1.753***	-0.419	-0.497	-1.356***	-1.293***
EC	-0.031*	0.002	-0.043**	-0.014	-0.032**	-0.001
EP	0.580***	0.616***	0.503***	0.548***	0.530***	0.566***
SIZE	0.021***	0.026***	0.006	0.014**	0.013***	0.019***
PERFORM	0.739***	0.650***	0.606***	0.571***	0.656***	0.594***
LEV	0.538***	0.467***	0.544***	0.501***	0.563***	0.505***
ID	0.019***	0.018**	-0.024*	-0.023*	0.011*	0.010
GDS	0.655***	0.620***	0.162	0.167	0.507***	0.481***
EC*EP	-	-0.434***	-	-0.349***	-	-0.389***
<i>CDUM</i>	YES	YES	YES	YES	YES	YES
$R^2$	0.511	0.536	0.716	0.729	0.527	0.550
$R^2$ adjusted	0.504	0.529	0.609	0.625	0.520	0.543
<i>F</i> stat	72.141	69.860	6.654	7.014	77.015	73.880
<i>p</i> -value	0.000	0.000	0.000	0.000	0.000	0.000
Hausman test			17.777	13.851		
			0.013	0.086		

**Table 4.**  
Test results of pooled, fixed effect and random effect models

**Note(s):** *EC* denotes environmental costs, *EP* is environmental performance, *ED* is environmental disclosure, *SIZE* is company size measured as the natural logarithm of total assets, *PERFORM* is company performance measured as return on assets, *LEV* is leverage measured as debt-to-total asset ratio and *CDUM* are country dummies. \*, \*\* and \*\*\* indicate significance at 0.1, 0.05 and 0.01 levels, respectively (2-tailed)

Organizational decision-makers can use the physical flow and monetary information provided by *EC* to make decisions that affect the organization's environmental and financial performance. While *EMA* supports internal decision-making for organizations whose goals are to minimize costs in general, *ECs* or environmental effect, it provides an important set of information for other users to evaluate the authenticity of *ED*.

**Table 5** shows several samples of companies with low *EC* that have *EDs* of 7.75–47.29 and have 2–4 indicators of *EP*. *ED* is less than 50%, but the companies are still working on *EP*.

The sample is segregated into two, one group (below 50 marks) with relatively low market sophistication indicator, i.e. Pakistan, India and Indonesia, and the rest in the high market sophistication group.

The same regression is run again, and the results are presented in **Tables 6 and 7**.

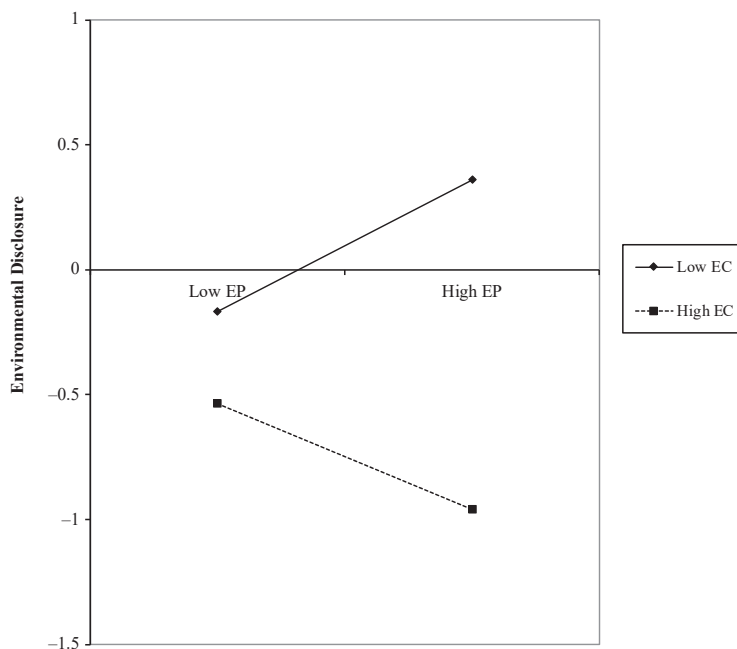
The results show that EP is only significantly related to ED in the high market sophistication group. When market sophistication is low, companies have less incentives for signal EP using ED. Likewise, the moderating effect of EC is only significant in the high market sophistication group. Thus, the summarization and verification effects of quantitative EC information are only reducing the incentives to provide narrative ED in the high market sophistication countries. This finding suggests that market sophistication, which represents the ability of the market to comprehend the signal, is the prerequisite for EC to take a moderating role effect.

Robustness checks are performed on the results. First, to mitigate the concern that our findings might be attributable to systematically higher measurement error (or bias) of EP and cost in countries with high market sophistication, whether EP and cost differ across these categories is tested. The results show that the  $p$ -values of two sample  $T$ -tests are 0.885 and 0.747 for EP and cost, respectively. An additional test is also performed for endogeneity effect (reverse causality) that might challenge our conclusions. Dynamic GMM utilizing lagged one-year independent variables data as instrumental variables is run. The results are qualitatively similar.

Table 8 shows that the specification test has a  $j$ -value probability above 0.05, namely, 0.227 and 0.192, which means the instrument used is valid. Table 8 is a retest by reducing one year of observation and shows that EP positively affects ED. Environmental costs weaken the relationship between EP and ED.

### 5. Conclusion and suggestion

This paper examines the ability of company EP application and measurement to improve company ED. The results are consistent with the research by Iatridis (2013), Al-Tuwaijri *et al.* (2004), Qiu *et al.* (2016b), Ahmadi and Bouri (2017) and Clarkson *et al.* (2008) that explained



**Figure 2.**  
Graphical diagram of  
environmental  
performance and  
environmental  
disclosure conditioned  
by environmental costs

Companies	Country	EC	Environmental performance				ED
			Energy efficiency policy	Emission reduction initiatives	Waste reduction policy	Water policy	
Addsino Co Ltd-A	China	0.0058	1	1	0	0	13.18
Timah Tbk Pt	Indonesia	0.0079	1	1	1	1	26.36
Xiamen XGMA-A Bank	China	0.0105	1	1	1	0	20.16
Tabungan Ne Bank	Indonesia	0.0106	1	1	1	1	22.32
Tabungan Ne Bank	Indonesia	0.0118	1	1	1	1	22.32
Jiangzhong Phm-A	China	0.0151	1	1	0	1	14.73
Sampath Bank PLC	Sri Lanka	0.0209	1	0	1	0	28.57
Sampath Bank PLC	Sri Lanka	0.0237	1	1	1	0	27.68
Citychamp Dart-A	China	0.0246	1	1	0	0	13.95
Aeolus Tyre Co-A	China	0.0281	1	1	0	0	13.18
China Fangda-B	China	0.0317	1	1	0	0	7.75
Media Prima Bhd	Malaysia	0.036	1	0	1	0	12.20
Media Prima Bhd	Malaysia	0.0462	1	0	1	0	20.33
Biocon Ltd	India	0.0566	1	1	1	1	20.16
Biocon Ltd	India	0.0776	1	1	1	1	24.03
Media Prima Bhd	Malaysia	0.0828	1	1	1	1	29.27
China Fangda-B	China	0.0859	1	1	0	0	9.30
Sunjuice	Taiwan	0.0881	1	1	0	0	23.26
Fauji Fertilizer	Pakistan	0.0895	1	1	0	0	29.46
Jonjee Hi-Tech-A	China	0.0908	1	1	1	0	10.08
Sunjuice	Taiwan	0.0945	1	1	0	0	23.26

**Table 5.**  
Companies with low EC

Source(s): Bloomberg

that good EP reduces company exposure to future ECs; thus, this disclosure of information is considered good news by investors. As a result, consistent with Qiu *et al.* (2016a, b), companies with good EP disclose environmental information (in quantity and quality of information) more than companies with worse EP.

The second hypothesis analysis results in the application of EMA summarized in ECs. EC moderates the relationship between EP and ED. The application of EMA is proven effective and efficient in combining the productive capacity and capability of information technology, management and accounting to meet the company's objectives. It aims to improve company performance and the environment as well as expand company ED (Wang and Jin, 2007). Moreover, the potential benefits from EMA implementation include cost reduction, increased

Dependent var. ED	Pakistan India Indonesia	Model 1 Pooled OLS model	Basic Fixed effect model	Model 2 Fixed effect model	Basic Random effect model	Model 3 Random effect model
	Basic pooled OLS model					
C	0.189	0.215	0.224	0.274	0.203	0.235
EC	0.097**	0.100**	0.157***	0.162***	0.136***	0.138***
EP	0.194	0.189	0.054	0.053	0.099	0.098
SIZE	0.013	0.013	-0.006	-0.005	0.001	0.001
PERFORM	0.399***	0.392***	0.352***	0.338***	0.371***	0.364***
LEV	0.767***	0.762***	0.693***	0.682***	0.733***	0.728***
ID	-0.012	-0.012	-0.013	-0.014	-0.012	-0.012
LGGDS	-0.013	-0.017	0.182	0.166	0.113	0.101
EC*EP	-	-0.033	-	-0.086	-	-0.044
CDUM	YES	YES	YES	YES	YES	YES
R <sup>2</sup>	0.618	0.619	0.772	0.773	0.655	0.654
R <sup>2</sup> adjusted	0.593	0.590	0.679	0.676	0.633	0.628
F stat	24.777	21.494	8.298	7.996	29.079	25.074
p-value	0.000	0.000	0.000	0.000	0.000	0.000

**Note(s):** EC denotes environmental costs, EP is environmental performance, ED is environmental disclosure, SIZE is company size measured as the natural logarithm of total assets, PERFORM is company performance measured as return on assets, LEV is leverage measured as debt-to-total asset ratio and CDUM are country dummies. \*, \*\* and \*\*\* indicate significance at 0.1, 0.05 and 0.01 levels, respectively (2-tailed)

**Table 6.** Low market sophistication group

Dependent var. ED	China, Malaysia, the Philippines, Sri Lanka and Thailand					
	Basic pooled OLS model	Model 1 Pooled OLS model	Basic Fixed effect model	Model 2 Fixed effect model	Basic Random effect model	Model 3 Random effect model
C	-2.331***	-2.448***	-0.715	-1.349*	-2.116***	-2.298***
EC	-0.079***	-0.034*	-0.089***	-0.044**	-0.079***	-0.034*
EP	0.621***	0.692***	0.595***	0.664***	0.589***	0.657***
SIZE	0.005	0.017***	-0.001	0.013*	0.002	0.015**
PERFORM	1.366***	1.321***	1.284***	1.335***	1.368***	1.362***
LEV	0.284***	0.218***	0.316***	0.260***	0.307***	0.246***
ID	0.042**	0.036***	0.000	0.003	0.036***	0.031***
LGGDS	0.410**	0.425**	-0.315	-0.120	0.323*	0.336*
EC*EP	-	-0.469***	-	-0.430***	-	-0.460***
CDUM	YES	YES	YES	YES	YES	YES
R <sup>2</sup>	0.585	0.610	0.743	0.760	0.589	0.617
R <sup>2</sup> adjusted	0.577	0.602	0.638	0.660	0.582	0.609
F stat	74.297	71.976	7.067	7.644	75.644	74.068
p-value	0.000	0.000	0.000	0.000	0.000	0.000

**Note(s):** EC denotes environmental costs, EP is environmental performance, ED is environmental disclosure, SIZE is company size measured as the natural logarithm of total assets, PERFORM is company performance measured as return on assets, LEV is leverage measured as debt-to-total asset ratio and CDUM are country dummies. \*, \*\* and \*\*\* indicate significance at 0.1, 0.05 and 0.01 levels, respectively (2-tailed)

**Table 7.** High sophistication group

product pricing, attractiveness of human resource and enhanced company reputation (Bennett et al., 2003; Burritt et al., 2002; De Beer and Friend, 2006). Jasch (2003) believed that applying EMA leads to cost-saving opportunities. Pondeville et al. (2013) supported this opinion by arguing that the application of EMA can ensure that managers use the available resources

effectively for the benefit of the environment. Based on the explanation, the adoption of EMA summarized in EC information can reduce the need for companies to make elaborative narrative disclosure. In addition, the quantitative EC information has a verification advantage over subjective narrative disclosure. An additional test on this argument is when the relationship does not exist in countries with low market sophistication. Overall, this paper extends signaling theory by showing the effect of “quality” that may affect “quantity” of the signal provided by the signaler to the receiver, and the importance of the receiver’s understanding of the signal.

The limitation of this paper is that generalizations need to be done carefully only on those countries with characteristics similar to emerging Asian countries. The implications of this research are first, from a research perspective, the results that determine the role of ECs that can summarize environmental information to be disclosed can be a cost reduction to the firm in the long run. Therefore, to achieve this, companies are highly recommended to introduce a systematic EMA instead of using an unintegrated, informal approach to handle environmental concerns. The EMA system highlights actual ECs under various cost categories. Second, achieving market sophistication is important for countries such that signals by companies can be understood. Third, this paper adds extensive evidence that the observed relationship between EP and ED can be used as a signaling tool by corporate management. Key managers should be responsible for each department’s ECs. It will make them responsible and encourage managers to manage these ECs actively to convince investors and other stakeholders about the actual EP. Finally, for the public, it proves that the company’s ED is not always manipulative. It can serve as a basis for analyzing, investing and controlling the company’s environmental footprint.

Uji generalized method of moments

Dependent var. ED	Basic GMM	Model GMM
LGED (−1)	−0.167***	−0.292***
EC	0.015	0.075**
EP	0.261***	0.339***
SIZE	−0.025**	−0.016*
PERFORM	0.554***	0.474**
LEV	0.873***	0.706***
ID	−0.046***	−0.012***
LGGDS	0.340**	0.280**
EC*EP	−	−0.455***
CDUM	YES	YES
Mean dependent var	0.008	0.008
S.E. of regression	0.193	0.186
J-statistic	29.934	29.782
Prob (J-statistic)	0.227	0.192
S.D. dependent var	0.117	0.117
Sum squared resid	9.271	8.607
Instrument rank	33.000	33.000

**Note(s):** EC denotes environmental costs, EP is environmental performance, ED is environmental disclosure, SIZE is company size measured as the natural logarithm of total assets, PERFORM is company performance measured as return on assets, LEV denotes leverage measured as debt-to-total asset ratio and CDUM are country dummies. \*, \*\* and \*\*\* indicate significance at 0.1, 0.05 and 0.01 levels, respectively (2-tailed)

**Table 8.**  
Results of GMM test



## Notes

1. Another line of research explains that companies with low environmental performance provide more symbolic, deceptive, low-quality or unsupported environmental disclosures, i.e. false claim, cheap talk (boasting) or greenwashing incentives (Matejek and Gössling, 2014; Kurpierz and Smith, 2020).
2. Bad faith refers to companies that engage in self-deception through their social role playing. It starts with lying to themselves about their identity to please others. Bad faith includes unauthentic information reporting targeting specific stakeholder groups with creative narratives for insincere groups. It describes a situation where companies engage in self-deception by acting in ways that do not represent who they really are. The trigger of bad faith is some social pressures to act in a socially desired manner even though it is not considered ideal.

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