IS ENVIRONMENTAL DISCLOSURE GOOD FOR THE ENVIRONMENT? A META-ANALYSIS AND RESEARCH AGENDA

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May 2016

To cite this paper:

CHO (Charles H.), MAURICE (Jonathan), NÈGRE (Emmanuelle) and VERDIER (Marie-Anne), "Is Environmental Disclosure Good for the Environment? A Meta-analysis and Research Agenda," *Korean Accounting Review*, June 2016, vol. 41, no. 3, pp. 239–277.

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ABSTRACT

This paper reviews the literature on the association between environmental disclosure and environmental performance. Results from previous studies are mixed. While some studies conducted in an economic perspective document a positive association between these two environmental dimensions, other studies obtain a negative association that they mainly explain using arguments drawn from socio-political theories. Given these conflicting results, we conduct a meta-analysis to provide an average direction and magnitude of the association between environmental disclosure and environmental performance. The meta-analysis reveals that there is no association between the environmental disclosure and the environmental performance of the 2,672 companies of our cumulated sample, and that this non-association remains constant over time despite the continuous reinforcement of environmental regulations. Based on these results, we discuss theoretical and methodological issues associated with prior literature that could explain this overall non-association and we suggest avenues for future research.

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1. Introduction

Today's business and planetary contexts make the high consideration of environmental sustainability issues by corporations unavoidable. Among the major elements, the notion of "environmental performance" is still an ongoing debate—and a challenge. Besides the sometimes *apparent* (but not always verified or sincere) efforts by corporate management to minimize the impact of their business operations on the physical environmental and contribute to make the planet less unsustainable, the communication and reporting aspects of such efforts and activities are important. While extensive regulations with regards to both environmental performance and environmental disclosure have been flourishing in the last decades, whether those were substantially effective still remains unclear (see Bebbington et al., 2012; Chauvey et al., 2015). Nonetheless, firms are likely to have different motivations and incentives to provide and disclose environmental information.

These relatively new corporate concerns have led researchers in the area of social and environmental accounting to focus on environmental voluntary reporting practices. Gray et al. (1987, p. 9) define social and environmental accounting as "*the process of communicating the social and environmental effects of organizations' economic actions to particular interest groups within society and to society at large*". Derived from social and environmental accounting, corporate environmental disclosure constitutes a specific element within such accounting and is defined as the "*set of information items related to a firm's past, current and future environmental management activities and performance*", "*comprises information about the past, current and future financial implications resulting from a firm's environmental management decisions or actions*" (Berthelot et al., 2003, p. 2), and also includes non-financial information disclosed to an organization's stakeholders (Cho and Caron, 2013). Some examples of environmental disclosure are statements or discussion of the company's (i)

environmental policy or concern for the environment, (ii) pollution control facilities or processes, and (iii) compliance with environmental regulations (Cho et al., 2006; Patten, 2002), or more specific items such as environmental capital expenditures (Cho et al., 2012; Patten, 2005), various environmental costs (Cho and Patten, 2008), or environmental liabilities (Chen et al., 2014; Schneider et al., forthcoming).

As such, providing environmental disclosures has become a common practice for firms in a large number of countries. Several studies have focused on the determinants of environmental disclosure to identify managers' motivations behind such disclosures (e.g., Brammer and Pavelin, 2006; Cormier and Magnan, 2003; Gao et al., 2005). One key potential driver of environmental disclosure that has been examined and tested by prior studies is corporate environmental performance. The primary, and sometimes sole, purpose of these studies was to investigate whether environmental disclosure is associated (or not) with environmental performance.

Therefore, our objective is to provide a state of the art and agenda for future of research in this area by considering the following two broad questions.

RQ1: Does environmental disclosure reflect environmental performance?
RQ2: Is environmental disclosure good for the environment?

To answer these questions, we review the prior empirical literature that investigates the relation between environmental disclosure and environmental performance. A classic, traditional review of the literature leads us to conclude that results from previous studies are mixed. While some studies conducted from neo-classical economy theories document a positive association between these two environmental dimensions, other studies reveal the opposite—a negative association, which is largely explained by arguments drawn from socio-political theories.

Given the conflicting results of previous investigations, we contribute to the environmental accounting literature by conducting a meta-analysis to provide an average

direction and magnitude of the association between environmental disclosure and environmental performance. We find that the association is not significant on the whole and that the non-association remains constant over time. With this in mind, we then discuss several avenues for future research. We seek to provide some fruitful reflections to address the various issues from both a theoretical and methodological perspective that could explain these mixed results.

The remainder of this paper is organized as follows. Section 2 reviews the literature on the association between environmental disclosure and environmental performance. Section 3 presents the method and results of a meta-analysis of previous studies on such association. Section 4 finally discusses several research issues and proposes a research agenda and Section 5 concludes.

2. The association between environmental disclosure and environmental performance: A literature review

Previous empirical studies have investigated the association between environmental disclosure and environmental performance but obtained mixed results. Some of them find no association between environmental disclosure and performance (e.g., Cormier and Magnan, 2015; Fekrat et al., 1996; Freedman and Jaggi, 1982; Ingram and Frazier, 1980; Sutantoputra et al., 2012; Wiseman, 1982) (see sub-section 2.1). Other studies reveal a significant association between environmental disclosure and environmental performance and, among them, a first set of studies document a positive relation between these two environmental dimensions (e.g., Al-Tuwaijri et al., 2004; Clarkson et al., 2008; Connors and Gao, 2011; Dhaliwal et al., 2011; Iqbal et al., 2013; Hassan and Kouhi, 2014) (see sub-section 2.2). A second set of studies provide evidence of a negative relation between these two variables (e.g., Bewley and Li, 2000; Cho and Patten, 2007; Cho et al., 2012; Clarkson et al., 2011; Hugues et al., 2001; Li et al., 1997; Ling, 2007; Patten, 2002) (see sub-section 2.3). Finally, a last set of studies exhibit a U-shape relation between environmental disclosure and

performance (Dawkins and Fraas 2011; Meng et al. 2014). In other words, both very poor and very good performers tend to disclose more information about their environmental performance than other companies (see sub-section 2.4).

2.1. No association between environmental disclosure and environmental performance

Earlier studies that examine the association between environmental performance and environmental disclosure fail to find significant results. Ingram and Frazier (1980) are the first to examine this association. They measure environmental disclosure in annual reports by using a content analysis score and proxy environmental performance by a performance index provided by the Council on Economic Priorities (CEP), a non-profit organization specialized in the evaluation of corporate social performance. Their sample consists of 40 firms covered by the CEP indices and they do not obtain a significant association between environmental disclosure and environmental performance. For these authors, this lack of significance could be explained by the lack of external monitoring of firms' environmental disclosure. Since managers can select the information to disclose, poor performing firms have incentives to bias their selections in order to appear like the better performing firms. Freedman and Jaggi (1982) extend the study of Ingram and Frasier (1980) to overcome several of its weaknesses. They measure the extent of environmental disclosure in both annual statements and 10Ks of 37 U.S. firms and focus on a time period when firms, in contrast to Ingram and Frazier's study, did *not* have to provide mandatory environmental disclosures. Despite these methodological improvements, Freedman and Jaggi (1982) find similar results—environmental disclosure and environmental performance are not significantly correlated. With a similar research design and a focus on disclosures made by 26 firms in environmentally sensitive industries, Wiseman (1982) also shows that corporate environmental disclosure is not related to its environmental performance. Based on a sample of 50 companies from the same environmentally sensitive industries (steel, oil, pulp and paper and electric industries) between 1972 and 1976,

Freedman and Wasley (1990) obtained similar results. The companies' environmental disclosure scores based on Wiseman (1982) are not significantly correlated with the CEP environmental performance scores.

Later, Fekrat et al. (1996) use a similar sample of 26 firms that are ranked by the CEP in three categories (Toxic Releases, PRP[2] Sites and an average of Toxic Releases by PRP Site). Their results regarding the association between environmental performance and environmental disclosure are not significant. For these authors, their results suggest that, contrary to the voluntary disclosure hypothesis, firms are simply untruthful with regards to their environmental disclosures—in other words, environmental claims made by firms appear to be disconnected from their environmental actions. More recently, two more studies also find a non-significant association between environmental disclosure and performance. Sutantoputra et al. (2012) test this relation in the Australian context using two different measures of environmental performance for 53 companies and find similar results. In the North-American setting again, Cormier and Magnan (2015) show no association between the total environmental disclosures of 550 Canadian and U.S. firms and their environmental performance as measured by the Toxic Release Inventory of the Environmental Protection Agency.

2.2. Positive association between environmental disclosure and environmental performance

Several other studies provide evidence of a positive association between environmental performance and environmental disclosure (e.g., Al-Tuwaijri et al., 2004; Clarkson et al., 2008). This result is consistent with neo-classical economic theories of signaling and voluntary disclosure (Dye, 1985; Verrechia, 1983). Economic theories assume that firms with good news have incentives to signal their superiority (e.g., in terms of their performance) to the market in order to avoid the adverse selection problem. In contrast, given costs associated

[2] Superfund Potentially Responsible Party.

with false disclosure, firms with bad news disclose less or remain silent. In the specific environmental accounting setting, firms with superior environmental performance should have incentives to disclose more credible environmental information to signal their environmental superiority to the market.

Al-Tuwaijri et al. (2004) examine the association between environmental performance and environmental disclosure from a neo-classical economic perspective. They measure environmental performance in a more quantitative (and sophisticated) way than previous studies. More precisely, they take the ratio of toxic waste recycled to total toxic waste.[3] Environmental disclosure is measured with a score which takes into account both the occurrence and quality of a specific environmental disclosure (i.e., pollution-related disclosure). Based on a sample of 198 firms listed in the IRRC's 1994 Environmental Profiles Directory (limited to Standard and Poor's 500 companies), their results provide evidence that ''good'' environmental performance is significantly and positively associated with pollution-related disclosure.

Clarkson et al. (2008) revisit the association between environmental performance and environmental disclosure. They employ a large content analysis index based on the Global Reporting Initiative (GRI) sustainability reporting guidelines to measure the level of discretionary environmental disclosure in environmental and social responsibility reports or on the firms' websites. Using a sample of 191 firms from the five most polluting industries in the U.S., they report a positive association between environmental performance and the level of discretionary environmental disclosures. Using the same methodology, Connors and Gao (2011) focus on the U.S. electric utility industry to also find a positive association between environmental disclosure and performance in a sample of 324 companies.

[3] Data obtained from the Corporate Environmental Profiles Directory disclosed by the Investor Responsibility Research Center.

In a similar vein, Dhaliwal et al. (2011) obtain a significant positive correlation between environmental disclosure and environmental performance. More precisely, they study the decision of U.S. firms to issue a standalone CSR report and proxy for environmental performance by using the KLD social performance rating scores. For these authors, the main motivation for disclosure is the reduction of the firm's cost of equity capital. Two more studies – Iqbal et al. (2013) and Hassan and Kouhi (2014) – also document a positive association between environmental disclosure and performance in non-Western countries, i.e., Indonesia and Nigeria, respectively. The former conducted their analysis on a sample of 59 listed Indonesian manufacturing companies while the latter examined a sample of 11 Nigerian oil and gas companies.

2.3. Negative association between environmental disclosure and environmental performance

In contrast with neo-classical economic theories of voluntary disclosure, some studies report a negative association between environmental disclosure and environmental performance. This result is consistent with social political theories, such as legitimacy theory (e.g., Dowling and Pfeffer, 1975; Deegan, 2002) suggesting that managers' disclosure decisions are driven by social and political pressures faced by firms. In this paradigm, corporate managers use environmental disclosure as an opportunistic and legitimacy tool rather than to increase their transparency and accountability, which leads firms with poorer environmental performance to disclose more environmental disclosure to legitimate their actions than firms with good environmental performance. Many studies have documented such negative relation.

Patten (2002) examines the association between 1990 annual report environmental disclosures and environmental performance measured through toxic release data from 1988 (made available in 1990). Based on a sample of 131 U.S firms and controlling for firm size and industry classification, results indicate a significant negative association between

environmental performance and environmental disclosure for the sample firms. This relation is stronger for firms from non-environmentally sensitive industries than for firms from environmentally sensitive industries. For the author, firms facing little or no public policy pressure increase their exposure when they have poor environmental performance, and this leads to higher levels of environmental disclosure.

As a follow-up study, Cho and Patten (2007) use size-matched groups based on industry membership (environmentally sensitive vs. non-environmentally sensitive) and environmental performance (worse performers vs. better performers) to test for differences in the use of monetary and non-monetary non-litigation related environmental disclosure. Their results provide evidence that environmental disclosure is higher for worse environmental performers and for firms operating in environmentally sensitive industries. Adopting a similar legitimacy perspective, Clarkson et al. (2011) document a negative relation between disclosure and performance for 51 firms from mining and manufacturing industries in Australia. In another study, Cho et al. (2012) continue to find a negative association between the environmental disclosures of 92 U.S. manufacturing firms and their environmental performance as measured by a *Newsweek* ranking. Overall, these results lead them to conclude that firms do appear to use environmental disclosure as a legitimizing tool.

These studies have been conducted in "routine" situations (i.e., in the normal course of business). However, legitimacy theory has also been extensively used by the prior literature that focuses on firm environmental disclosure in "non-routine" situations such as after environmental disasters or other shocks occur (e.g., Patten, 1992; Deegan et al., 2000; Cho, 2009; Beelitz and Merkl-Davies, 2012). In such situations, firms use disclosure as an (almost immediate) response to both public pressure and increased media attention (Hooghiemstra, 2000) and eventually alter the public's perception of the firm's legitimacy and sometimes existence. Patten (1992) examines the effect of the Exxon Valdez oil spill on the level of

environmental disclosure of others petroleum firms. In line with the prediction of legitimacy theory, he finds a significant increase in such disclosures after the spill—and the amount of change is related to firm size and ownership in the Alyeska Pipeline Service Company, which is owned by a consortium of seven petroleum firms. Deegan et al. (2000) examine the reaction of Australian firms, in terms of disclosure, to five major environmental incidents. Their results show that firms that belong to affected industries provide more social information in their annual reports than they did prior to the incidents. For these authors, firms use disclosure strategically as a means to influence society's perception and legitimize their existence. In a specific French context, Cho (2009) obtains similar results. Based on a case study, he provides evidence that Total SA, which is one of the largest oil and gas firms in the world, uses communication strategies to defend its environmental performance and activities after two major environmental incidents. Finally, in the German context, Beelitz and Merkl-Davies (2012) formulate the same conclusions about a nuclear plant incident.

These results highlight that firms do have incentives to provide environmental disclosure rather than implementing good or better environmental practices. This leads Freedman and Patten (2004) and Patten (2015) to underline that such disclosure is likely to have a negative and harmful effect on the protection of the physical environment.

Far from the legitimacy explanation of environmental disclosure but similar in terms of conclusion, Li et al. (1997) provide a sequential game-theoretic model that predicts the extent of disclosure of bad environmental performing firms. They derive three hypotheses about the decision to disclose environmental information and test them empirically on a sample of 49 Canadian firms that have experienced spills, administrative orders and/or prosecutions over a 12-year period. They conclude that an increased pollution propensity (which can be considered as a proxy for environmental performance) leads to an increase of environmental disclosure. Relying on various measures of environmental disclosure (based on Wiseman

1982) and two measures of pollution propensity (based on SIC codes and NPRI records in Canada), Bewley and Li (2000) exhibit a negative and significant relation between disclosure and performance based on a sample of 188 Canadian firms. Hugues et al. (2001) replicate the study of Wiseman (1982) with an environmental performance measured by a CEP index in 1992 and 1993 and also find that the poor environmental performers among 51 U.S. firms tend to disclose more information. Contrary to Clarkson et al. (2008), but following their analytical framework, Ling (2007) finds a negative association between environmental disclosure and environmental performance as measured by the ratio of toxic waste disposed over the total production-related toxics of 74 U.S. firms.

2.4. Toward a U-shape relation between environmental disclosure and performance

Two distinct studies find that the relation between environmental disclosure and performance is non-linear. Dawkins and Fraas (2011) firstly report that both poor and good environmental performers provide more environmental disclosures than average performers. They use an ordinal disclosure score based on the Carbon Disclosure Project and the KLD database to measure the environmental performance of 363 U.S. firms. They explain this curvilinear relation by arguing that best environmental performers use this competitive advantage as an opportunity platform (Fombrun et al., 2000) while poor environmental performers use disclosure to maintain their legitimacy. In other words, they suggest that both explanations on what drives environmental disclosure (to increase legitimacy or to signal a good performance) can be considered in future research. Meng et al. (2014) find a similar U-shape relation in the Chinese context by distinguishing between good and poor environmental performers among 533 listed firms. They show that there is a negative association between environmental disclosure and environmental performance for poor environmental performing firms (based on the number of environmental penalties they incurred) and a positive one for better environmental performing firms. They conclude that the economic explanation of

environmental disclosure is not relevant in China because it does not enable determining what firm is environmentally sustainable or not.

Therefore, as an attempt to overcome the variance and heterogeneity of prior literature empirical results on the link between environmental disclosure and environmental performance, we perform a meta-analysis of the previous studies. Section 3 provides the method, data and results of this quantitative and comprehensive analysis of the literature, and discusses its implications.

3. A meta-analysis of previous studies

Meta-analysis is useful and relevant to summarize mixed results in a broad or specific literature studying the relation between two variables, especially when they comprise significant and non-significant effects. The aim of a meta-analysis is to provide an average direction and magnitude of this relation based on a comprehensive review and inclusion of all relevant studies providing quantitative results. Moreover, it enables an assessment of the homogeneity of the results included and helps provide explanations on the factors that generate opposite results in the literature. Subsection 3.1 describes the method and data utilized in this paper and subsection 3.2 provides the results of our meta-analysis. Finally, subsection 3.3 discusses them.

3.1. Method and data

A meta-analysis is based on the combination of effect size statistics and their variances as weights to provide a quantitative summary of the literature results. Effect size statistics are an appropriate measure to encode quantitative research findings in the perspective of a meta-analysis and "*produces a statistical standardization of the study findings such that the resulting numerical values are interpretable in a consistent fashion across all the variables and measures involved*" (Lipsey and Wilson, 2001, p. 4). To account for the association between two variables (here environmental disclosure and environmental performance), we

used the Pearson product-moment correlation coefficient as an effect size. This statistic is already a standardized measure of the association between two variables and is widely used by meta-analysts in this situation. When the correlation coefficient was not available from the collected studies, we converted other statistics (such as *t*-tests) into a correlation coefficient following Lipsey and Wilson's (2001) procedures and, if that was still not possible, we did not include the study in the meta-analysis.

The relevant studies were collected by an extensive search in *Google Scholar* with the keywords 'environmental performance' and 'environmental disclosure'. We also collected some remaining studies in the literature reviews of the more recent articles on the topic (e.g., Meng et al., 2014). A total of 27 studies documenting the association between environmental disclosure and environmental performance were identified. Sixteen of them provided sufficient data to compute effect sizes while seven studies did not provide the Pearson product-moment correlation coefficient and were excluded from the main meta-analysis. We re-included them in our sensitivity analysis. Three remaining studies were not available (Belhak and Damak-Ayadi, 2011; Fontana et al., 2015; Wu and Shen, 2011). Table 1 summarizes these studies and the information collected and coded. The final database of the meta-analysis consisted of sixteen studies, each representing an independent sample, with a cumulated total sample of 2,672 companies for which the relation between environmental disclosure and environmental performance has been measured.

[Table 1 about here]

To investigate the relation between environmental disclosure and environmental performance, we extracted from the studies all methodological information (industry, country, description of the sample, environmental disclosure method, environmental performance measure, etc.) and statistics necessary to calculate effect sizes (correlation coefficients, sample sizes). One of the authors coded the whole set of studies. When several correlation

coefficients were available for one specific study (and sample), we have considered their mean as the raw effect size of the study. Based on the correlation coefficient, we calculate and use for each study the Fisher Z_r-transform (Hedges and Olkin, 1985) as the final effect size (*ES*), which is defined as:

$$ES = \text{Fisher } Z_r = 0.5 \log_e \left(\frac{1+r}{1-r}\right),$$

where *r* is the correlation coefficient (Lipsey and Wilson, 2001). This metrics avoids the undesirable statistics properties of the correlation coefficient, especially concerning its standard error. On the contrary, the standard error (*SE*) of the Fisher Z_r-transform is only a function of the sample size:

$$SE_{Z_r} = \frac{1}{\sqrt{n-3}},$$

where *n* is the sample size of the study. This leads to the following weight attributed to each study in the meta-analysis:

$$\omega_{Z_r} = \frac{1}{{SE_{Z_r}}^2} = n - 3.$$

This inverse variance weight privileges studies with more precise results due to larger sample sizes.

To calculate the average effect size, its standard error and its confidence interval, two methods are available. First, the fixed-effects model assumes that all effect sizes are homogeneous, i.e., represent the same population effect size. If effect sizes are heterogeneous, a random-effects model can be performed and assumes that each observed effect size differs from the population mean. In that case, the random-effects model allows accounting for effect sizes that vary across studies because of sampling errors *and* other sources of variability assumed to be randomly distributed. The homogeneity test is based on a *Q* statistic equal to $\sum \omega_i (ES_i - \overline{ES})^2$. This statistic is significant if it exceeds the critical value for a chi-square with $k-1$ degree of freedom where k is the number of studies. Hunter and Schmidt (1990)

propose a 75% rule of thumb to determine the cut-off between heterogeneity and homogeneity. If at least 75% of the variability in the results comes from sampling errors, one can consider that effect sizes are homogeneous. Otherwise, the meta-analysis must rely on a random-effects model to determine the average direction and magnitude of the studied relation and has to find the factors causing the heterogeneity (e.g., various study methods, sample characteristics, periods of observation, countries, etc.). A transformation of the Q statistic is useful in the case of a small number of studies. The I-squared statistic is often use instead of Q to increase the power of the test (Hunter and Schmidt 1990). Its formula is:

$$I\text{-squared} = 100\% \cdot \frac{Q - df_Q}{Q}.$$

We conduct our meta-analysis using the macros "MeanES.ado" and "MetaF.ado" for Stata developed by David Wilson (available at http://mason.gmu.edu/~dwilsonb/ma.html) and the meta-analysis packages provided in Stata (version 13). We also conduct a cumulative meta-analysis showing the evolution of the mean effect size study after study. This method helps distinguish the direction trend of the mean effect size according to the studies' periods of analysis.

3.2. Results of the meta-analysis

3.2.1. Overall effect size of the relation between environmental disclosure and environmental performance

We perform our meta-analysis on the sixteen studies in bold characters of Table 1. The homogeneity test reveals a strong heterogeneity in the results. The Q statistics is equal to 84.46 (I-squared = 82.24%), confirming the use of the random-effects model (homogeneity hypothesis rejected, p-value = 0.000). Relying on a random-effects model of meta-analysis prevents us from estimating a biased overall effect size. Indeed, this model assumes that "*each observed effect size differs from the population mean by subject level-sampling error plus a value that represents other sources of variability assumed to be randomly distributed*"

(Lipsey and Wilson, 2001, p. 119). As a result, sampling errors as well as other differences between studies such as sample characteristics, periods of analysis, construct measures, research procedures, etc. are taken into account in estimating our overall effect size, assuming that these variations are random. Table 2 summarizes the overall effect size and its confidence interval obtained with a random-effects model.

[Table 2 about here]

On the basis of all studies available for a quantitative meta-analysis (representing N = 2,672 companies ensuring a robust result), the association between environmental disclosure and environmental performance is not significant ($\overline{ES} = 0.013$, p-value = 0.796; random-effects model). Figure 1 gives the forest plot of the random-effects meta-analysis.

[Figure 1 about here]

The forest plot represents the effect sizes (ES) of each study with their confidence interval (at 95%) and the weight of the study in the overall effect size ($\overline{ES}$). ES are represented by black dots and confidence intervals by horizontal black lines. A horizontal line crossing the black vertical line (zero effect) means that the association between environmental disclosure and environmental performance is not significant for the corresponding study. The overall effect size is represented by the vertical red dash line and its confidence interval by the blue diamond. Figure 1 shows that the overall effect size measuring direction and magnitude of the relation between environmental disclosure and environmental performance is near zero (slightly positive but not significant). This can be viewed as our main result and labeled Result 1.

Result 1. Based on a sample of 2,672 companies, a meta-analysis of all the available previous studies providing sufficient data to be coded confirms that, as a whole, environmental disclosure is not related to environmental performance.

Result 1 holds under the assumption that heterogeneity in study effect sizes comes from some sources of variability that are randomly distributed. Subsection 3.2.3 provides evidence that

only one identifiable variation across studies can significantly decrease the heterogeneity in the results, so that we were unable to reject this random assumption.

3.2.2. Cumulative meta-analysis

To go further in determining the direction and magnitude of the association between environmental disclosure and environmental performance, we also run a cumulative meta-analysis based on a random-effects model. This allows us to observe the evolution of the link between environmental performance and environmental disclosure study after study, and one period of analysis after the other. Figure 2 reports the average cumulated effect size when studies are added one by one. For each study, the corresponding effect size and its confidence interval represent the results of a meta-analysis comprising the study *plus* all the previous ones. Thus, Figure 2 exhibits a strong stability, over time, in the overall effect size that remains around zero. Although the correlation tends to become slightly positive when adding the last publications with more comprehensive samples and accurate environmental data, the association between environmental disclosure and environmental performance remains clearly non-significant. We label this Result 2.

[Figure 2 about here]

Result 2. The non-association between environmental disclosure and environmental performance remains constant over time.

This result is particularly striking and leads us to question the impact of regulatory changes on the association between environmental performance and environmental disclosure. In other words, neither stronger environmental regulations nor improvements in environmental disclosure guidelines (e.g., the widely adoption of the GRI framework, for instance) have had an effect on linking corporate actions and words.

3.2.3. Heterogeneity analysis

Among the possible sources of variation across studies that could have explained effect size heterogeneity, we consider the following factors: (1) time-period of analysis of the

studies, (2) environmental disclosure and (3) environmental performance measures that have been used, (4) geographical location, and (5) industry sensitivity (whether the samples include firms from environmentally sensitive industries). For each of these criteria, we conducted a meta-analytic analog to the one-way ANOVA on the *Q* statistic of the fixed-effects model. We decompose the total variance in a between-studies component and a within-studies component. Our results show that, except for the time-period of analysis, none of the other criteria is able to significantly decrease the between-studies variance of the *Q* statistic. Consequently, we can conclude that neither geographical location, nor the industry sensitivity, nor the measure differences of the constructs between studies explain the heterogeneity of the results. We can rely on our overall effect size of the random-effects model and assume that most of the variations observed come from sampling errors and other randomly distributed sources of variability.

The only source of variability that has been identified is very specific time-periods of analysis, suggesting some temporal contingencies in the association between environmental disclosure and environmental performance. Because environmental disclosure may depend on regulatory changes and increased institutional pressures over time, and because environmental performance rankings and measures affect an increasing number of firms, the association between environmental disclosure and performance can evolve and vary over several decades. As such, we decompose the *Q* statistic by grouping the studies according to the decade of the observations. Given that no study with sufficient information uses data from the 1980s, three groups are considered as follows: (i) four studies using 1970s data, (ii) four studies using 1990s data, and (iii) eight studies using 2000s data. Table 3 summarizes the results.

[Table 3 about here]

In Panel A, the total *Q* statistic (variance across studies) is decomposed in between-studies and within-studies components. This decomposition reveals that grouping the data

according to their period of analysis reduces between-studies heterogeneity. The remaining variance (within-studies) is explained by sampling errors. Panel C confirms that studies of the 1970s have homogeneous effect sizes while the two other decades suffered from significant heterogeneity in their results. As Panel C indicates, we can trust the non-significant relation exhibited in the 1970s but need to be careful in interpreting the results for the two other decades due to heterogeneity issues.

Because only a few temporal contingencies can explain the variance in the results, our heterogeneity analysis, associated with the results of the cumulative meta-analysis, confirms that most of the variations across studies are not identifiable and can be assumed to be randomly distributed. In the next section, we reinforce this statement by controlling Result 1 and Result 2 with publication bias, studies' sampling error and problems associated with missing studies.

3.2.4. Additional analyses: publication bias, sampling errors and missing studies

We first test whether our meta-analysis was subject to publication biases. Indeed, significant results are more likely to be published than non-significant ones. This situation can distort the outcome of the meta-analysis. In our case, the Egger's test cannot reject the null hypothesis of no small-study effect (p-value = 0.494), which means that no publication bias is likely to distort the results of our meta-analysis. The fact that several studies on the relation between environmental disclosure and environmental performance have been published with non-significant results reinforces the idea that the publication bias is limited in our meta-analysis.

Second, following Schmidt and Hunter (2015), we estimated the sampling error variance ($\sigma_e^2 = 0.006$) and derived the estimate of the variance of population correlations

($\sigma_\rho^2 = -0.00574$).[4] Because a negative estimated variance corresponds to an estimated standard deviation of the population equal to 0, we can conclude that sampling errors cause all the variations in our results and the overall correlation between environmental disclosure and environmental performance we previously calculated is reliable.

Third, we assess whether our meta-analytic results can be biased by the non-inclusion of the seven studies showing a significant association between environmental disclosure and performance, but providing insufficient data to calculate an effect size (i.e., studies of Table 1 whose authors' names are not in bold characters). To overcome this missing data problem (thus assuming that the non-inclusion of studies is not random), we follow the approach suggested by Lipsey and Wilson (2001), which consists of imputing a value to the missing effect sizes determined as follows. For each of these studies, we first assumed that the association between our two variables of interest is significant at the 5% threshold. Based on this assumption, we were able to calculate a *t*-value for each study considering its sample size. We derive the effect size using the following formula: $ES_r = t/\sqrt{t^2 + df}$, where *df* is the degree of freedom of the *t*-test (Lipsey and Wilson, 2001). This method to re-compute missing effect sizes is conservative and "*adequate only for purposes of rejecting the null hypothesis that the effect of interest is zero in the population*" (Lipsey and Wilson, 2001, p. 70), which corresponds to our situation. We re-conducted the same analyses as above with the seven additional effect sizes. This procedure increases the sample size up to $N = 3{,}184$ companies. The results of these additional analyses do not change our conclusions; that is,

[4] The reader may note that the estimate of the variance is negative. This is explained here by Schmidt and Hunter (2015, p. 103): "*the estimated variance of population correlations is not computed as a conventional variance, that is, the average squared deviation of given numbers. Rather, it is computed as the difference between the given variance of observed correlations and the statistically given sampling error variance, the variance of observed correlations is a sample estimate. Unless the number of studies is infinite, there will be some sampling error in that empirical estimate. If the population difference is 0, then error will cause the estimated difference to be positive or negative with probability one half. Thus, in our case, sampling error caused the variance of observed correlations to differ slightly form the expected value, and that error caused the estimating difference to be negative.*"

there is no association between environmental disclosure and environmental performance when combining all previous studies on this relation and this non-association remains constant over time, even with observations from the 1980s.

Perspectives from this synthesis of previous literature

Taken together, the results of this meta-analysis can be summarized as follows. First, the relation between environmental disclosure and environmental performance is not significant when all relevant studies with eligible quantitative metrics are taken into account. This result holds with various sensitivity analyses, including heterogeneity analysis, cumulative meta-analysis, and control for publication bias, sampling errors and missing data. What is interesting to note is that this association does not change over time, suggesting a stable non-relation between environmental disclosure and performance. Finally, because the meta-analysis does not consider non-linear relations, the average non-significant correlation between environmental disclosure and environmental performance, as well as the existence of both positive and negative results in the literature suggest considering the U-shape relation for future research, similar to Dawkins and Fraas (2011) and Meng et al. (2014).

As previously stated, the relation between environmental performance and environmental disclosure has been subject to several investigations, particularly for disclosure in routine situations. The mixed results led authors to use competing theories to explain managers' motivations to voluntarily disclose environmental information. From a neo-classical economic perspective, firms disclose environmental information to improve transparency whereas from a legitimacy perspective, environmental disclosure has more opportunistic motivations and aims at mitigating the negative effect of worse environmental performance on the firm reputation (Cho et al., 2012). It is interesting to note that conflicting results only exist for disclosure in routine situations. Indeed, at the time of environmental

disasters, it seems clear that this relation is negative and that disclosure is a response to increased political and social pressures.

In an attempt to reconcile these mixed results, two recent studies tested the argument of a U-shape relation between environmental disclosure and environmental performance. They found that both the poorer and the best environmental performing firms tend to provide more environmental disclosure. Both a legitimacy perspective and a neo-classical economic perspective can explain these behaviors. Best environmental performers provide more information to signal their good performance to the markets and also build their legitimacy to the society in the aim of acquiring a competitive advantage (Fombrun et al., 2000). Similarly, firms with poor environmental performance disclose significant environmental information in order to maintain their legitimacy to operate in the society, mostly because they are under greater public and political scrutiny than less visible and polluting firms.

In the following section, we suggest new avenues for future research in discussing both theoretical and methodological issues of these studies and, more broadly, of social and environmental accounting research.

4. Research agenda

In order to better understand managers' motivations for environmental disclosure, we begin this research agenda by discussing both theoretical and methodological issues from the prior literature that could explain the mixed results obtained. We also suggest avenues for improvements or new directions.

4.1. Theoretical issues

Several authors underline that there is a need to go beyond theories currently used in SEA research (e.g., Adams, 2002; Adams and Larrinaga-González, 2007; Unerman and Chapman, 2014). The limitations of dominant theories such as legitimacy theory have been largely discussed by Spence et al. (2010). First, it appears that this theory is unable to explain

all corporate disclosure practices (Guthrie and Parker, 1989; O'Dwyer, 2002). Such theoretical lens is only useful to analyze general trends in CSR reporting. Second, the concept of a social contract established between organizations and society, central to legitimacy theory (e.g., Cho, 2009; Deegan, 2002; Deegan and Blomquist, 2006; Hooghiemstra, 2000; Patten, 1992), is still confusing. 'Society' refers to several publics that could differ in terms of "*values, interests, power and perceptions*" (Spence et al., 2010, p. 81).

Spence (2007) suggests to analyze managers' motivations for social and environmental reporting and to investigate the ideological implications of these motivations by using Laclau and Mouffe's discourse theory who are positioned within the Gramscian framework. The objective would be to contribute to the literature by showing why environmental disclosure may "*be somewhat more multifarious and complex than sending risk management signals to investors*" (p. 860). Based on interviews, their results show that the interviewees talk about environmental disclosure in terms of strategic considerations. However, motivations appear to be diverse within each firm (risk and reputation management, stakeholder management, peer pressure, business efficiency and internal champions). Overall, they confirm that environmental disclosure is driven by several motivations.

More recently, Cho et al. (2015) use a new theoretical framework based on prior work in organized hypocrisy (Brunsson, 1989) and organizational façades (Nystrom and Strabuck, 1984; Abrahamson and Baumard, 2008). Brunsson (2007) defines organized hypocrisy as a "*response to a world in which values, ideas, or people are in conflict—a way in which individuals and organizations handle such conflicts*" (p. 113) and as a "*way of handling conflicts by reflecting them in inconsistencies among talk, decisions, and actions*'' (p. 115). Given the conflicting demands of different stakeholders, he posits that organized hypocrisy seems necessary to preserve firms' legitimacy. From this perspective, organizations can have incentives to adopt stakeholder strategies that lack of internal consistency. However, if

stakeholders detect these strategies, there is a risk of reputation damages for the firm. Thus, to maintain legitimacy, firms may develop sub-structures, also called organizational façades, to respond to specific claims of different stakeholders. Abrahamson and Baumard (2008, p. 437) define organizational façades as ''*a symbolic front erected by organizational participants designed to reassure their organizational stakeholders of the legitimacy of the organization and its management.*" Based on two cases studies, Cho et al. (2015) conclude that the concepts of organizational façades and organized hypocrisy contribute to the social and environmental accounting literature because they provide new theoretical lenses to understand how the economic system and conflicting stakeholder demands constrain the reporting decisions of managers. For the authors, "*by utilizing the concepts of organizational façade and organized hypocrisy, the sustainability disclosure literature moves beyond its usual focus on signaling, or legitimacy and impression management by more formally acknowledging and incorporating constraints on an individual corporation' action choices given the current economic system*" (p. 79).

In the strategy literature, Hann et al. (2015) propose a theoretical framework based on cognitive frames (Smith and Lewis, 2011; Smith and Tushman 2005) to explain managers' behavior related to sustainability concerns. According to the managerial cognition perspective (e.g., Stubbart, 1989; Walsh, 1995), given that managers operate in organizations with complex and ambiguous signals, they use cognitive heuristics to deal with such situations. Based on this theory, Hann et al. (2015) develop two cognitive frames that reflect managers' choices associated with sustainability in order to deal with ambiguities. The first one, called the business case frame, is based on alignment logic and reflects the "*belief in a unitary truth [which] means inconsistencies cannot fundamentally coexist*" (Smith and Tushman, 2005, p. 525). In this view, economic attributes are first considered and environmental aspects are only taken into account when they are aligned on financial concerns. In contrast, in the second

frame – called the paradoxical frame – tensions and inconsistencies cannot be eliminated. In such circumstances, managers accept tensions and try to accommodate conflicting economic, social and environmental concerns rather than eliminate them. For the authors, these two frames represent two ideal-type conceptualizations of how managers consider social and environmental aspects related to economic and financial concerns. Depending on whether managers hold more a business case frame or a paradoxical frame, there are some differences in terms of managerial scanning, interpreting and responding with regard to sustainability concerns, leading authors to suggest twelve theoretical propositions.[5]

By underlining the role played by individual cognition in managerial decision making on corporate sustainability, this paper based on managerial cognitive theories can offer an important contribution for the literature on the relation between environmental performance and environmental disclosure. The existence of different managerial frames can indeed be one explanation for why the previous literature lacks to obtain similar results about this relation. Consequently, considering the cognitive frame held by managers could extend the conclusions provided through signaling and legitimacy theories by going beyond the general trends suggested by these theories.

To conclude, if legitimacy theory dominates the SEA field of research, it also has some limitations that make necessary for researchers to open up to recent theoretical suggestions.

4.2. Methodological issues

We argue that the mixed results of the previous literature regarding the association between environmental performance and environmental disclosure could also be explained, at least partially, from a methodological perspective. Indeed, there are, in some studies, methodological issues that can be discussed here.

[5] See Hann et al. (2015) for more details about these propositions.

According to Patten (2002), the non-significant results obtained in earlier studies could be explained by three main reasons. First, these studies do not consider the potential influence of both the firm size and industry on the environmental disclosure whereas several studies find that larger firms and firms from sensitive industries disclose more information than others (e.g., Cowen et al., 1987; Deegan and Gordon, 1996; Patten, 1992). Second, Patten (2002) underlines that focusing on firms ranked by the CEP causes a problem of sample selection. Indeed, since the CEP report only includes firms from four industries, the results are specific to these industries and are obtained from limited sample size. Finally, the measure(s) for environmental performance employed in these studies could also be criticized.

"Measuring" environmental performance is a major issue in SEA research. As mentioned by Patten (2015), researchers sometimes employ proxies that do not really capture the studied phenomenon. This is the case of the KLD social performance rating scores used, for example, by Dhaliwal et al. (2011). The KLD database has been the subject of several criticisms. First, KLD ratings use indicator variables to define a firm's CSR performance, which leads to an important loss of information. Second, for Chatterji et al. (2009), these ratings do a better job to identify worse environmental performers than good environmental performers. Indeed, KLD environmental strengths do *not* accurately predict both pollution levels and compliance violations. In addition, they provide evidence that KLD ratings do not use publicly available data in an optimal manner. It may be surprising to note that this proxy is still used without any correction after the Chatterji et al. (2009) study's results. In the same vein, Cho et al. (2012) document that worse environmental performance is significantly associated with a greater likelihood of membership in the Dow Jones Sustainability Index (DJSI) as well as higher environmental reputation scores as reported in the Newsweek magazine's first ranking of the greenest companies in America. However, DJSI membership has been employed as a proxy for CSR reputation in several studies (e.g., Robinson et al.

2011). This discussion does not mean that proxies should be systematically avoided. As suggested by Patten (2015), strength of future studies' findings could be improved by using several measures of a same construct. If results hold despite several metrics, the quality of the results is insured.

Another issue that could explain differences in results in past studies is related to the choice and justification of other independent or control variables included in the regression models. Studies that document a positive association between environmental performance and environmental disclosure are mainly found in mainstream research. They focus on the influence of the financial control variables on environmental disclosure (using arguments based upon economic disclosure theories) without looking at the variables employed in SEA research (e.g., media coverage). However, Guidry and Patten (2012) find no consistent patterns of a significant relation between the financial control variables such as Tobin's Q and environmental disclosure. They also provide evidence that the omission of this type of variables in the Cho and Patten (2007)'s study does not drive the results obtained. In other words, there is still a significant and negative association between environmental disclosure and environmental performance after controlling for financial variables. In the same way, it could be interesting to replicate the analyses of Clarkson et al. (2008) by including variables employed in SEA research and removing those used in financial disclosure models. The perspective of a curvilinear relation between both constructs could also give fruitful interpretations of firms' behavior.

Finally, to resolve the conflicting results of the prior literature, it would be interesting to conduct more qualitative investigations on the motivations for environmental or more generally CSR disclosure. Spence et al. (2010, p. 81) note that "*the internal forces, motivations and conflicts which drive the organizations from inside to implement legitimacy strategies using SER [Social Environmental Reporting] have not been studied in-depth*".

O'Dwyer (2002) is one of the first to gather the managers' point of view about CSR disclosure practices. For the author, the semi-structured interviews conducted with senior managers furnish a "*more complex, complete and critical story of the motives for CSD* [Corporate Social Disclosure]" (p. 406). To give insights into the processes by which company make disclosure, Adams (2002) conducts interviews with seven large multinational companies in the chemical and pharmaceutical sectors of the U.K. and Germany. In the same vein, O'Donovan (2002) underlines that qualitative approaches enable the discovery of more explicit reasons for disclosure. Conducting in-depth case studies could also be useful to move from the view of disclosure as a static process to the view of disclosure as a dynamic and mutual influence process. There is a recent field of the literature on CSR disclosures that focuses on the verbal interactions between organizations and their audiences (e.g., Beelitz and Merkl-Davies, 2012; Brennan et al., 2014; Deegan and Blomquist, 2006). They investigate how stakeholders could "force" firms to make CSR disclosures, particularly in the case of specific events.

5. Conclusion

The purpose of this paper was to provide a state of the art on the relation between environmental performance and environmental disclosure and an agenda for future research in this area. A 'classic' review of the literature concludes that results from previous studies are mixed. While some studies find no significant association between environmental disclosure and environmental performance, others document a significant and positive or negative relation between these two environmental dimensions. These conflicting results led us to meta-analyse the results of 16 studies that provide sufficient data to perform such a method. We believe that that our meta-analysis helps contribute to the environmental accounting literature by providing an average direction and magnitude of the association between environmental disclosure and environmental performance—this enabled us to document that

the association is not significant on the whole and remains stable over time. This result holds despite a few temporal contingencies and remains robust to publication bias and missing studies problems. Based on this result, we discuss theoretical and methodological issues of the prior literature that could explain such heterogeneity in the results and suggest future improvements such as examining non-linear relations or other methodologies.

One interesting avenue for future research is related to the issue of silence. Indeed, the majority of SEA research examines the influence of the sensitivity of firms' industry on the relation between environmental disclosure and environmental performance using a binary variable (e.g., Patten 2002; Cho and Patten 2007). However, for firms that belong to sensitive industries, environmental disclosure could be viewed as necessary because of mimetic phenomenon. In such circumstances, it could be important to study why firms decide not to disclose environmental information. In other words, we ask the following questions—is silence the strategy employed only by poor environmental performers? There are only few studies on the absence of environmental disclosure (Buhr 2001; O'Dwyer 2002), thus future research could be conducted on this topic.

Finally, we conclude this paper with a word of caution—it is about the recent research work on environmental and/or CSR accounting published in mainstream journals such *The Accounting Review* or the *Journal of Accounting and Economics*. Papers published there (e.g., Dhaliwal et al., 2011) do not really focus on (and care about) the implications in terms of environmental and planetary sustainability and how to improve it. Instead, this research area is being "rediscovered" and appropriated without acknowledging more than three decades of prior research (see Cho and Patten, 2013; Patten 2013 for more insights on this). More specifically, measures for environmental disclosure and/or environmental performance are regressed on very narrowly defined financial variables, the analysis becomes a statistical exercise where non-financial variables are introduced in various models and the overall broad

message is buried and eventually lost. We urge SEA researchers *not* to fall in this trap and pursue their work by keeping their objective to improve the natural environment.

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Table 1. Articles examining the association between environmental disclosure and environmental performance

Studies	Industries	Period of analysis	Sample size	Country	ED Measure	EP Measure	EP characteristics	Effect size (corr. coef.)	Fisher *Z*	Std. Err. *Z*	Inverse variance weight	Effect sign	Significance
Ingram and Frazier (1980)	Steel, Oil, Pulp and Paper, and Electric Utilities	1970-1974	40	Mainly USA	Disclosure index (monetary)	CEP	Qualitative	0.187	0.189	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (non-monetary)	CEP	Qualitative	0.125	0.126	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (qualitative)	CEP	Qualitative	0.197	0.200	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (declarative)	CEP	Qualitative	0.227	0.231	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (none)	CEP	Qualitative	0.090	0.090	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (past)	CEP	Qualitative	0.231	0.235	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (present)	CEP	Qualitative	0.209	0.212	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (future)	CEP	Qualitative	0.193	0.196	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (specific)	CEP	Qualitative	0.208	0.211	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (general)	CEP	Qualitative	0.161	0.163	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (public interest)	CEP	Qualitative	0.177	0.179	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (economic consequences)	CEP	Qualitative	0.176	0.178	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (irrational activists)	CEP	Qualitative	0.069	0.069	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (government regulation)	CEP	Qualitative	0.152	0.153	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (litigation)	CEP	Qualitative	–0.142	–0.143	0.164	37	–1	No
		1970-1974	40	Mainly USA	Disclosure index (compliance)	CEP	Qualitative	0.104	0.104	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (actual accomplishments)	CEP	Qualitative	0.205	0.208	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (proposed accomplishments)	CEP	Qualitative	0.267	0.273	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (environmental concern)	CEP	Qualitative	0.161	0.163	0.164	37	1	No
		1970-1974	40	Mainly USA	Disclosure index (other)	CEP	Qualitative	0.077	0.077	0.164	37	1	No
		1970-1974	**40**	**Mainly USA**	**Disclosure index (TOTAL)**	**CEP**	**Qualitative**	**0.154**	**0.155**	**0.164**	**37**	**1**	**No**
Freedman and Jaggi (1982)	Steel, Oil, and Pulp and Paper	1972-1973-1977	**37**	USA	Disclosure index	CEP	Qualitative	**–0.040**	**–0.040**	**0.171**	**34**	–1	No
Wiseman (1982)	Steel	1972	26	Mainly USA	Disclosure index	CEP	Qualitative	–0,054	–0,054	0,500	4	–1	No
	Steel	1976	26	Mainly USA	Disclosure index	CEP	Qualitative	0,036	0,036	0,500	4	1	No
	Oil	1974	26	Mainly USA	Disclosure index	CEP	Qualitative	–0,265	–0,272	0,447	5	–1	No
	Pulp and Paper	1972	26	Mainly USA	Disclosure index	CEP	Qualitative	0,305	0,315	0,354	8	1	No
	All	**1972-1976**	**26**	**Mainly USA**	**Disclosure index**	**CEP**	**Qualitative**	**0.005**	**0.005**	**0.209**	**23**	**1**	**No**
	Steel	1972	7	Mainly USA	Wiseman (1982) – Annual report	CEP	Qualitative	0.230	0.234	0.500	4	1	No
	Steel	1976	7	Mainly USA	Wiseman (1982) – Annual report	CEP	Qualitative	–0.320	-0.332	0.500	4	–1	No
	Oil	1974	8	Mainly USA	Wiseman (1982) – Annual report	CEP	Qualitative	0.770	1.020	0.447	5	1	Yes
	Pulp and Paper	1972	21	Mainly USA	Wiseman (1982) – Annual report	CEP	Qualitative	–0.020	-0.020	0.236	18	–1	No

Studies	Industries	Period of analysis	Sample size	Country	ED Measure	EP Measure	EP characteristics	Effect size (corr. coef.)	Fisher *Z*	Std. Err. *Z*	Inverse variance weight	Effect sign	Significance
Freedman and Wasley (1990)	Electric Utilities	1975	14	Mainly USA	Wiseman (1982) – Annual report	CEP	Qualitative	0.200	0.203	0.302	11	1	No
	Steel	1972	7	Mainly USA	Wiseman (1982) – 10K report	CEP	Qualitative	0.380	0.400	0.500	4	1	No
	Steel	1976	7	Mainly USA	Wiseman (1982) – 10K report	CEP	Qualitative	0.070	0.070	0.500	4	1	No
	Oil	1974	8	Mainly USA	Wiseman (1982) – 10K report	CEP	Qualitative	–0.480	–0.523	0.447	5	–1	No
	Pulp and Paper	1972	21	Mainly USA	Wiseman (1982) – 10K report	CEP	Qualitative	–0.040	–0.040	0.236	18	–1	No
	Electric Utilities	1975	14	Mainly USA	Wiseman (1982) – 10K report	CEP	Qualitative	0.340	0.354	0.302	11	1	No
	Steel	1973	7	Mainly USA	Wiseman (1982) – 10K report	CEP	Qualitative	0.210	0.213	0.500	4	1	No
	Pulp and Paper	1973	7	Mainly USA	Wiseman (1982) – 10K report	CEP	Qualitative	–0.290	–-0.299	0.500	4	–1	No
	All	**1972-1976**	**50**	**Mainly USA**	**Wiseman (1982)** – All reports	**CEP**	**Qualitative**	**0.088**	**0.088**	**0.146**	**47**	**1**	**No**
Fekrat, Inclan and Petroni (1996)	Large manufacturing firms	1991	26	USA	Wiseman (1982)	Toxic Releases (CEP)	Qualitative	0.322	0.334	0.209	23	1	No
		1991	26	USA	Wiseman (1982)	PRP Sites (CEP)	Qualitative	0.268	0.274	0.209	23	1	No
		1991	26	USA	Wiseman (1982)	Average Toxic/PRP (CEP)	Qualitative	0.436	0.468	0.209	23	1	No
		1991	**26[1]**	**USA**	**Wiseman (1982)**	**CEP (TOTAL)**	**Qualitative**	**0.342**	**0.356**	**0.209**	**23**	**1**	**No**
Li, Richardson and Thornton (1997)	Companies with negative environmental performance	1982-1994	106	Canada	Binary measure of disclosure	Pollution propensity (binary variable for MISA monitored-firms)	Qualitative					–1	Yes
Bewley and Li (2000)	Manufacturing firms	1993	188	Canada	Wiseman (1982)	SIC (pollution propensity)	Qualitative	–0.250	–0.255	0.074	185	–1	Yes
		1993	188	Canada	Wiseman (1982) – Financial ED	SIC (pollution propensity)	Qualitative	–0.270	–0.277	0.074	185	–1	Yes
		1993	188	Canada	Wiseman (1982) – Non-Financial ED	SIC (pollution propensity)	Qualitative	–0.210	–0.213	0.074	185	–1	Yes
		1993	188	Canada	Binary measure of Financial ED	SIC (pollution propensity)	Qualitative	–0.250	–0.255	0.074	185	–1	Yes
		1993	188	Canada	Wiseman (1982)	NPRI records (pollution propensity)	Qualitative	–0.430	–0.460	0.074	185	–1	Yes
		1993	188	Canada	Wiseman (1982) – Financial ED	NPRI records (pollution propensity)	Qualitative	–0.320	–0.332	0.074	185	–1	Yes
		1993	188	Canada	Wiseman (1982) – Non-Financial ED	NPRI records (pollution propensity)	Qualitative	–0.410	–0.436	0.074	185	–1	Yes
		1993	188	Canada	Binary measure of Financial ED	NPRI records (pollution propensity)	Qualitative	–0.320	–0.332	0.074	185	–1	Yes
		1993	**188**	**Canada**	**TOTAL MEAN**	**TOTAL MEAN**	**Qualitative**	**–0.313**	**–0.323**	**0.074**	**185**	**–1**	**Yes**
Hughes, Anderson and Golden (2001)	Various environmentally	1992	51	USA	Adapted from Wiseman (1982) and Freedman and Jaggi (1986) – Notes (economic factors)	CEP	Qualitative	–0.325	–0.337	0.144	48	–1	Yes
		1992	51	USA	Adapted from Wiseman (1982) and Freedman and Jaggi (1986) – MD&A (economic factors)	CEP	Qualitative	–0.358	–0.374	0.144	48	–1	Yes
		1992	51	USA	Adapted from Wiseman (1982) and Freedman and Jaggi (1986) – MD&A (litigation)	CEP	Qualitative	–0.358	–0.374	0.144	48	–1	Yes
		1993	51	USA	Adapted from Wiseman (1982) and Freedman and Jaggi (1986) – Notes (economic factors)	CEP	Qualitative	–0.358	–0.374	0.144	48	–1	Yes

Studies	Industries	Period of analysis	Sample size	Country	ED Measure	EP Measure	EP characteristics	Effect size (corr. coef.)	Fisher *Z*	Std. Err. *Z*	Inverse variance weight	Effect sign	Significance
	sensitive industries	1993	51	USA	Adapted from Wiseman (1982) and Freedman and Jaggi (1986) – Notes (litigation)	CEP	Qualitative	–0.289	–0.297	0.144	48	–1	Yes
		1993	51	USA	Adapted from Wiseman (1982) and Freedman and Jaggi (1986) – MD&A (economic factors)	CEP	Qualitative	–0.396	–0.419	0.144	48	–1	Yes
		1993	51	USA	Adapted from Wiseman (1982) and Freedman and Jaggi (1986) – MD&A (litigation)	CEP	Qualitative	–0.325	–0.337	0.144	48	–1	Yes
		1992-1993	**51**	**USA**	**Adapted from Wiseman (1982) and Freedman and Jaggi (1986) (TOTAL MEAN)**	**CEP**	**Qualitative**	**–0.344**	**–0.358**	**0.144**	**48**	**–1**	**Yes**
Patten (2002)	Various industries	1988-1990	131	USA	Content analysis	TRI/Revenue	Quantitative					–1	Yes
Al-Tuwaijri, Christensen and Hughes II (2004)	Large companies with environmental scrutiny	1994	**198**	International sample	Disclosure index	Toxic Waste Recycled/Total Toxic Waste Generated	Quantitative	**0.342**	**0.356**	**0.072**	**195**	1	Yes
Cho and Patten (2007)	Various industries rated by KLD	2001-2002	–	USA	Non-monetary disclosure index	KLD Score	Qualitative	–0.038	–0.038	–	–	–1	No
		2001-2002	–	USA	Monetary disclosure index	KLD Score	Qualitative	–0.186	–0.189	–	–	–1	Yes
		2001-2002	–	USA	Non-monetary disclosure index	KLD Score	Qualitative	–0.389	–0.411	–	–	–1	Yes
		2001-2002	**100**	**USA**	**Monetary disclosure index**	**KLD Score**	**Qualitative**	**–0.205**	**–0.208**	**0.102**	**97**	**–1**	**Yes**
Ling (2007)	Chemical	2004	74	USA	Clarkson et al. (2008)	Toxic Waste Recycled/Total Toxic Waste Generated	Quantitative					1	No
		2004	74	USA	Clarkson et al. (2008)	Toxic Waste Disposed/Total Production-Related Toxics	Quantitative					–1	Yes (soft disclosure)
Clarkson, Li, Richardson and Vasvari (2008)	Pulp and Paper, Chemical, Oil and Gas, Metals and Mining, and Utilities	2003	191	USA	Disclosure index based on GRI guidelines	Toxic Waste Recycled/Total Toxic Waste Generated	Quantitative	0.230	0.234	0.073	188	1	Yes
		2003	191	USA	Disclosure index based on GRI guidelines	–TRI/Sales	Quantitative	0.170	0.172	0.073	188	1	Yes
		2003	**191**	**USA**	**Disclosure index based on GRI guidelines**	**TOTAL MEAN**	**Quantitative**	**0.200**	**0.203**	**0.073**	**188**	**1**	**Yes**
Clarkson, Overell and Chapple (2011)	Mining and Manufacturing	2002-2006	51	Australia	Clarkson et al. (2008)	National Pollutant Inventory (pollution propensity)	Quantitative					–1	Yes
Connors and Gao (2011)	Electric Utilities	2001-2007	**324**	USA	Clarkson et al. (2008)	–TRI/Sales	Quantitative	**0.131**	**0.132**	**0.056**	**321**	1	Yes
Dawkins and Fraas (2011)	Various industries rated by KLD	2005-2006	363	USA	CDP disclosure (ordinal variable)	KLD Score	Qualitative					U-shape relation	
Dhaliwal, Li, Tsang and Yang (2011)	Various industries rated by KLD	1993-2007	**213**	USA	Binary measure for disclosing a CSR report a first time	KLD Score	Qualitative	**0.090**	**0.090**	**0.069**	**210**	1	Yes

Studies	Industries	Period of analysis	Sample size	Country	ED Measure	EP Measure	EP characteristics	Effect size (corr. coef.)	Fisher *Z*	Std. Err. *Z*	Inverse variance weight	Effect sign	Significance
Cho, Guidry, Hagueman and Patten (2012)	Basic Materials, Oil, and Utilities	2009	**92**	USA	Clarkson et al. (2008)	Environmental impact score (*Newsweek*)	Qualitative	**–0.303**	**–0.313**	**0.106**	**89**	–1	Yes
Sutantoputra, Lindorff and Johnson (2012)	Various industries with environmental ratings	2007	53	Australia	Clarkson et al. (2008)	National Pollutant Inventory	Quantitative	–0.150	–0.151	0.141	50	–1	No
		2007	53	Australia	Clarkson et al. (2008)	Environmental rating	Qualitative	0.103	0.103	0.141	50	1	No
		2007	**53**	**Australia**	**Clarkson et al. (2008)**	**TOTAL MEAN**	**Both**	**–0.024**	**–0.024**	**0.141**	**50**	**–1**	**No**
Iqbal, Prihat Assih and Rosidi (2013)	Various industries with environmental ratings	2010	59	Indonesia	Disclosure index based on GRI guidelines	PROPER list ranking	Qualitative					1	Yes
Hassan and Kouhy (2014)	Oil	1997-2009	11	Nigeria	Content analysis and volumetric measure	Gas flaring-related environmental performance index	Quantitative					1	Yes
Meng, Zeng, Shi, Qi and Zhang (2014)	Various industries with environmental ratings	2009-2010	533	China	Own index adapted from previous studies	Poor performers based on environmental penalties	Qualitative	–0.250	–0.255	0.043	530	–1	Yes
		2009-2010	533	China	Own index adapted from previous studies	Good performers based on five criteria	Qualitative	0.480	0.523	0.043	530	1	Yes
		2009-2010	**533**	**China**	**Own index adapted from previous studies**	**TOTAL MEAN**	**Qualitative**	**0.115**	**0.116**	**0.043**	**530**	**1**	**Yes**
Cormier and Magnan (2015)	Various industries with environmental data	2009	**550**	USA and Canada	Adapted from Wiseman (1982)	TRI/Sales (binary variable)	Qualitative	**–0.010**	**–0.010**	**0.043**	**547**	–1	No

Notes of Table 1:

1. While Fekrat et al. (1996) measure environmental disclosure scores of 168 firms, they were able to assess the correlation between environmental disclosure and environmental performance for only 26 firms (for which a measure of environmental performance was available).

Studies and numbers in bold characters are included in the meta-analysis and represent in total 16 studies for a total sample size of 2,672 companies (sum of studies' sample sizes in bold characters).

The environmental performance measure is considered to be "qualitative" when it is based on a ranking (e.g., CEP, KLD, etc.) and "quantitative" when it is based on a physical measure of pollution, for instance.

ED = Environmental disclosure; EP : Environmental Performance.

Fisher *Z* is the Fisher Z_r-transform (Hedges and Olkin 1985), defined as Fisher $Z = 0.5 \log_e \left(\frac{1+r}{1-r}\right)$ where *r* is the correlation coefficient (Lipsey and Wilson 2001).

Table 2. Average correlation coefficient between environmental disclosure and environmental performance (random-effects model)

16 studies	**Mean (correlation)**	**–95% CI**	**+95% CI**	***Z***	***p*-value**
Random-effects	0.013	–0.088	0.114	0.259	0.796

Table 3. Meta-analytic analog to the one-way ANOVA on the Q statistic of the fixed-effects model according to studies' periods of analysis

Panel A – Total variance analysis				
Source	*Q*	df	*p*-value	
Between	0.996	2	0.608	Homogeneity not rejected
Within	83.461	13	0.000	Homogeneity rejected
Total	84.457	15	0.000	Homogeneity rejected

Panel B – Average correlation per group of studies according to their period of analysis							
Decades	Mean	St. Err.	[95% Conf. Int.]		*Z*	*p*-value	*n*
1970s	0.061	0.084	–0.104	0.226	0.726	0.468	4
1990s	0.001	0.047	–0.091	0.094	0.029	0.977	4
2000s	0.052	0.022	0.009	0.096	2.351	0.019	8
Total	0.044	0.020	0.006	0.082	2.249	0.025	16

Panel C – Total variance analysis per group of studies according to their period of analysis				
Decades	*Q*	df	*p*-value	
1970s	0.778	4	0.968	Homogeneity not rejected
1990s	53.158	4	0.000	Homogeneity rejected
2000s	29.525	2	0.000	Homogeneity rejected

Figure 1. Forest plot displaying an inverse-variance weighted random-effects meta-analysis of the association between environmental disclosure and environmental performance (*yearobs* is the last year of each study's period of analysis)

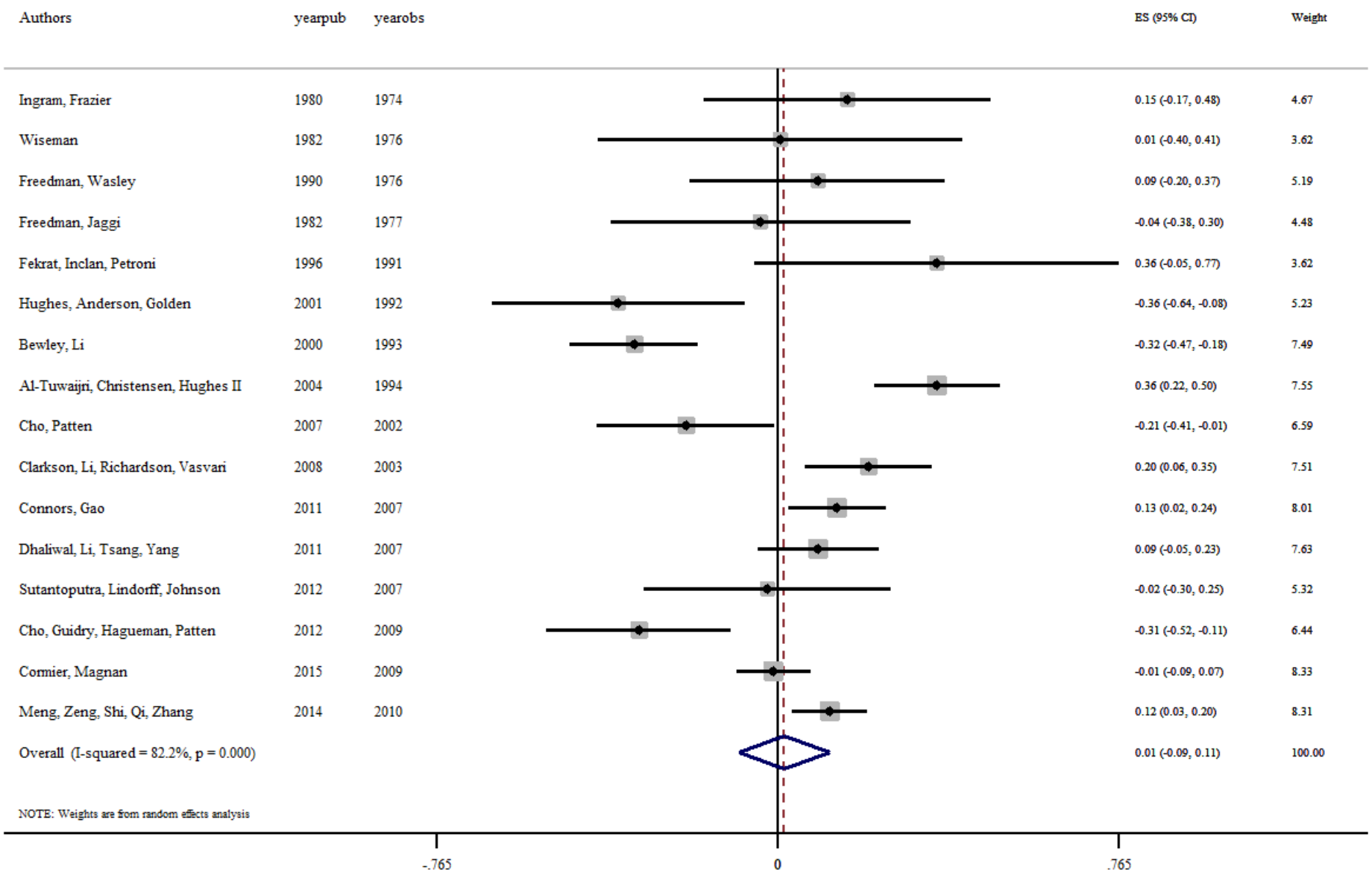
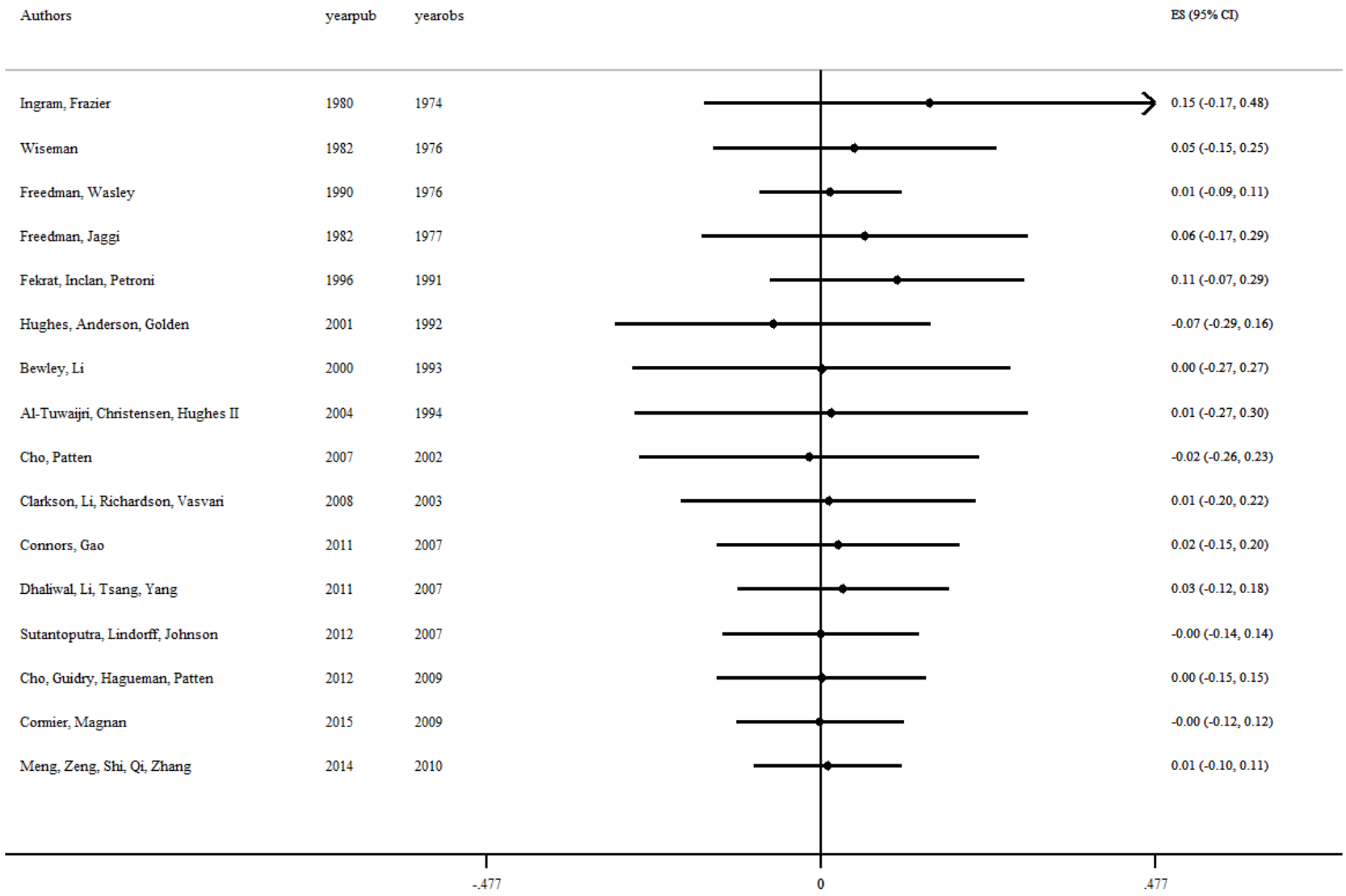
Figure 2. Cumulative random-effects meta-analysis of the association between environmental disclosure and environmental performance (*yearobs* is the last year of each study's period of analysis)