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Unpacking the Relationship between Environmental Profile and Financial Profile; Literature Review toward Methodological Best Practice

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Abstract

Despite a large body of empirical studies examining the relationship between Environmental Profile (EP) and Financial Profile (FP), the results are still inconsistent. The majority of research exploring EP-FP relationships have focused on the results and overlooked the precedence of data in the process. To understand where the field currently stands, the purpose of this paper is twofold. Firstly, it offers a comprehensive definition and conceptualisation of both EP and FP as both are multidimensional constructs. Secondly, it identifies several critical issues in theorising and testing these relationships for which current practice falls short. These focus on construct clarity by highlighting the inconsistency in measuring constructs, sampling errors, different research design, and sample characteristics. This paper analyses 98 empirical studies using data as the key element in each study, and to outline what is known and unknown about the EP-FP relationship from methodological points of view. The outcomes then made related to the comparability and replicability of studies.

The results indicate how methodological artefacts such as characteristics of data sources and a data sample, data quality, data collection method as well as analysis method directly influence the results. In addition, comparability and replicability of results are strongly influenced by data source and data type. Moreover, the findings of this review reveal that the main analysis trend is the impact of EP on FP, particularly examining the linear relationship between environmental performance-output-based and accounting-based variables as EP and FP measurement respectively.

Keywords: Environmental Profile, Financial profile, Research Methodology, Comparability and replicability, Literature review

Declarations of interest: none

1   Overview

The relationship between Environmental Profile (EP) and Financial Profile (FP) of companies has been examined extensively over the last 40 years in the academic literature and is still expanding. The main reason motivating researchers to examine two areas together relates to increasing external pressures on firms to pay attention to their environmental performance (Walls and Hoffman, 2013). This has been highlighted further following the financial crises in 2008. Various not-for-profit organisations have developed the promotion of non-financial performance aspects such as environmental performance to represent a holistic view of the organisation's performance. Voluntary initiatives such as the OECD Principles, the UN Global Compact and the World Bank Group encourage firms to integrate environmental and social aspects to their financial performance (J. Walls et al., 2012). In addition, environmental disasters such as BP's Gulf of Mexico oil spill in 2010, illustrates that environmental issues can result in billions of dollars in clean-up costs and fines (de Villiers et al., 2011). Therefore, recent evidence suggests that investors are not only looking for high

financial returns along with ecologically sustainable development through their investment (Sariannidis *et al*., 2013), but also the management of U.S. firms is becoming increasingly conscious of the strategic importance of the natural environment (Berrone and Gomez-Mejia, 2009; Etzion, 2007; Neubaum and Zahra, 2006).

Although a large number of empirical studies have provided evidence of positive relationships between EP and FP (e.g. (Hourneaux et al., 2014), (Iatridis, 2013)); others have shown negative relationships (e.g. (Chen et al., 2014), (Sariannidis et al., 2013)) or with some providing insignificant results (e.g. (Böhringer et al., 2012), (Post et al., 2011)).

Even as studies are accumulating, they still fail to provide a solid theoretical foundation, and as such knowledge consensus is still to be reached (Lankoski, 2008). The most widely cited theoretical framework in the literature identified is the traditionalist view (Palmer et al., 1995)(Walley and Whitehead, 1994) suggests that environmental management is merely a cost incurred for environmental protection as economic performance declines. The revisionist view that formulates the so-called Porter hypothesis (Porter and Linde, 1995) suggests that strengthening environmental performance is positively correlated with economic performance. The resource-based view (Russo and Fouts, 1997) as an evolution of the Porter hypothesis which recognises the importance of both tangible and intangible resources in EP-FP relationship. Moreover, Wagner et al. (2002) developed a theoretical model of a curvilinear (U-shaped or inverse U-shaped curve) relationship between the EP and FP.

In addition to the theoretical arguments, a number of comparative studies have been carried out to understand the reasons behind mixed results and to identify the factors influencing the EP-FP relationship. These set of studies take either an empirical approach so-called Meta-Regression analysis (Orlitzky, Schmidt and Rynes, 2003; Allouche and Laroche, 2005; Margolis, Elfenbein and Walsh, 2009; Albertini, 2013; Dixon-Fowler et al., 2013; Endrikat, Guenther and Hoppe, 2014) or a narrative/vote counting approach (Ambec and Lanoie, 2008; Endrikat et al., 2014; Margolis and Walsh, 2001).

All previous Meta-Regression analysis have mainly examined a number of methodological and measurement differences. Although they have generally concluded a modest positive relationship, there is no reason to assume that this relationship is predetermined due to both theoretical and methodological issues (Ruf et al., 2001). Although advancing the theory requires thoughtful consideration to the measurements and methodological issues (Venkatraman, 2008), the methodological shortcomings are based on two totally interdependent issues. Firstly, the lack of comprehensive definition and conceptualisation of EP and FP (Elsayed and Paton, 2009) as they are both multidimensional constructs (Endrikat et al., 2014; Richard et al., 2009; Trumpp et al., 2015). Secondly, construct clarity (Suddaby, 2010), the inconsistency in measuring constructs (Waddock and Graves, 1998), sampling error and differences in the study design and differences in sample structure (Cooper, 1998).

Therefore, the objective of this study is to address the methodological shortcomings with the aim to clarify and resolve some of the conceptual problems attributed to issues that relate to the methodological artefacts. Although previous comparative studies attempt to provide a comprehensive definition of EP construct and its validity (Trumpp et al., 2015), this research provides a comprehensive review of the relevant literature to provide definitions for both EP and FP and conceptualise a framework of the EP-FP relationship. In addition, this study advances and shows that constructs and their measurements are tightly linked to data as a foundation of any empirical

study. While previous Meta-Regression analysis has partially considered dataset characteristics, this study provides an integrated analysis of all relevant measurement characteristics such as (i) data source characteristics; (ii) dataset characteristics; (iii) the quality of both EP and FP measures. In addition, this study examines the comparability and replicability characteristics of those studies using publicly available datasets as opposed to the dataset collected through interviews or questionnaires.

This review contributes to the existing literature in three different ways. Firstly, definitions of both EP and FP are presented, which enables a comprehensive understanding of this relationship. Secondly, the results support the "It depends" hypothesis by (Reinhardt, 1998), where Lankoski (2008) also emphasises the fact that the existing variability and inconsistency in the EP-FP relationship depends on the specifics of each situation. The current study complements this argument by focusing on the methodological concerns of the EP-FP relationship. Thirdly, this review demonstrates that consideration of the measurement characteristics is a key methodological artefact in examining the EP-FP relationship and that allowing studies to be more directly comparable and subsequently more reduplicative (Hartshorne and Schachner, 2012).

The remainder of the paper is organised as follows. Section 2 describes the research method that begins with the definition of EP and FP, selection and inclusion criteria will be studied and finally a description of the dimensions of the comparisons. Section 3 mainly presents the summary table of previous studies and discussion on each dimension of the comparison table. Section 4 provides an overall discussion by reflecting on the distinctive features of the EP-FP relationship as well as the shortcomings of existing research. Section 5 concludes the paper and provides possible directions for future research.

2   Methods and measures

First, this section provides clear definitions of both Environmental Profile and Financial Profile of the work. Then, the scope of the literature review and the criteria that we applied to identify the 68 relevant articles are discussed. Finally, the comparison's dimension is discussed.

2.1   Definition of Environmental Profile and Financial Profile

Reviewing past studies reveals that there is a lack of consistent theoretical definitions for both EP and FP and consequently, lack of clarity in formulating the construct(s) used (Richard et al., 2009). It is crucial to acknowledge the multidimensionality of both EP and FP which are also recognised in (Trumpp et al., 2015) and (Henri, 2004) respectively and discussed theoretically in (Venkatraman and Ramanujam, 1986; Venkatraman, 2008). This section provides definitions for EP and FP as follow:

The Environmental Profile (EP) profile of a firm describes the environmental features and characteristics of activities, products and services of the firm that have an impact on the environment in which it operates. By definition, EP is multidimensional (Albertini, 2013; Endrikat et al., 2014) and the three dimensions used are *Environmental Management, Environmental Performance* and *Environmental Disclosure*. Environmental Management captures a firm's attitudes and objectives towards environmental responsibility as well as environmental management structure and processes (Schultze and Trommer, 2012). Environmental performance is the outcome of a firm's strategic activities that manage (or not) its impact on the natural environment (Walls et

al., 2011). Finally, Environmental Disclosure describes the impact firm activities have on the physical or natural environment in which they operate (Wilmshurst and Frost, 2000).

The Financial Profile (FP) profile of a firm captures its financial and governance characteristics. Similar to EP, FP is multidimensional as well, and for the purposes of this paper, the three dimensions used are *market-based*, *accounting-based* and *organisational-based*. Accounting-based indicators are measuring profitability, and they are mainly backwards-looking (Al-Matari et al., 2014; Hamann et al., 2013; Peloza, 2009; Richard et al., 2009). ROA and ROE are examples of accounting-based indicators (Al-Matari et al., 2014; Richard et al., 2009). Market-based measures have forward-looking aspects, and they mainly concern with the firm's future performance and investment that has its basis on previous or current performance. Tobin's Q and market-to-book value are examples of market-based indicators (Al-Matari et al., 2014; Richard et al., 2009). Furthermore, FP involves organisational aspects measured by other indicators rather than accounting-based or market-based variables. We define organisational-based measures as a set of firm characteristics such as corporate governance score (Cong and Freedman, 2011), board characteristics such as Independent director (Amran et al., 2014), and CEO compensation (Goktan, 2014; J. L. Walls et al., 2012).

2.2 Methodology: study selection and inclusion criteria

In order to collect our study sample, we assumed that major contributions are found in journals of high reputation and quality (Webster and Watson, 2002), and thus, we conducted a systematic search in management, accounting, marketing and finance journals from 2004 to 2018. In our initial search, we used different combinations of keywords for EP and FP such as "corporate environmental performance", "environmental performance", "environmental management", "environmental disclosure", "CO_2 emissions", "financial performance", "corporate governance", "board characteristics", "profitability". In the next step, we manually search the reference lists of each study, which were collected previously. Finally, we manually reviewed the reference lists of previous Meta-Regression analysis studies and cross-referenced them with our sample (Albertini, 2013; Dixon-Fowler et al., 2013; Horváthová, 2010; Margolis et al., 2009). To construct the final set of studies, we excluded studies that are conceptual and non-empirical analysis such as (Claver et al., 2007; Oberhofer and Dieplinger, 2014; Perrini and Tencati, 2006; Petrini and Pozzebon, 2009). The final sample consists of 98 studies published from 2004 to 2018. Table 1 lists the studies included in the review. A code is assigned to each study, which will be used in the rest of the paper to refer to each paper.

2.3 Dimensions of the comparison table

Each study is carefully examined to identify the relationships between EP and FP and factors that could influence this relationship. Datasets as the root of examined variables could have a high potential of influencing the results. Therefore, this study attempts to examine the datasets in full details such as datasets, EP variables and their data sources, FP variables and their data sources, time span of analysis, sample size, sector, country/region coverage, type of datasets for both EP and FP which could be structured, unstructured or both. In this study, structured data is described as a set of information organised into a well-structured format where the schema of the data is defined in advance; this could be a relational database, or any other forms of data tables which has the advantage of being easily stored, queried and analysed.

On the other hand, unstructured data is the opposite of structured data; it has no schema that defines the form, the characteristics, and the structure of data. Because of the nature and the free structure makes working on this kind of data very challenging (Hadzic et al. 2011, p.4;7). Table 3, 4 and 5 shows the summary of datasets characteristics.

The EP of studies also investigated regarding Environmental Profile definition and variables. Figure 1 shows the summary of EP variables. In addition, the type of FP variables is examined as well which could be accounting-based, market-based and organisational-based. Table 6 shows the summary of the FP variables. Moreover, the research methodology employed by each study and the way of dealing with endogeneity is presented in Table 7. Finally, general patterns among findings are discovered using data mining techniques and presented in Table 8. Table 9 shows the summary of key findings.

Table 1. List of studies included in this review

Year				
2004	(Al-Tuwaijri et al., 2004)	(Clarkson et al., 2004)	(Filbeck and Gorman, 2004)	3
2005	(Cormier et al., 2005) (Gupta and Goldar, 2005)	(Elsayed and Paton, 2005) (Hassel et al., 2005)	(González-Benito and González-Benito, 2005) (Russo and Harrison, 2005) (Wagner, 2005)	7
2006	(Brammer and Pavelin, 2006)		(Cole et al., 2006)	2
2007	(López et al., 2007)	(Nakao et al., 2007)		2
2008	(Cordeiro and Sarkis, 2008) (Yamaguchi, 2008)	(Lucas and Wilson, 2008) (Stanny and Ely, 2008)	(Ngwakwe, 2008) (Sharfman and Fernando, 2008)	6
2009	(Berrone and Gomez-Mejia, 2009) (Johnstone and Labonne, 2009)	(Elsayed and Paton, 2009) (López-Gamero et al., 2009)	(Iraldo et al., 2009)	5
2010	(Henri and Journeault, 2010) (Lundgren and Olsson, 2010) (Rassier and Earnhart, 2010)	(Hibiki and Managi, 2010) (Monteiro and Aibar-Guzmán, 2010) (Wagner, 2010)	(Jacobs et al., 2010) (Prado-Lorenzo and Garcia-Sanchez, 2010)	8
2011	(Busch and Hoffmann, 2011) (Fisher-Vanden and Thorburn, 2011) (Post et al., 2011)	(Cong and Freedman, 2011) (Iwata and Okada, 2011) (Rassier and Earnhart, 2011)	(de Villiers et al., 2011) (Lanoie et al., 2011)	8
2012	(Alvarez, 2012) (Böhringer et al., 2012) (Hofer et al., 2012) (Lioui and Sharma, 2012)	(Ameer and Othman, 2012) (Boiral et al., 2012) (Horváthová, 2012) (Uhlaner et al., 2012)	(Barnett and Salomon, 2012) (Hatakeda et al., 2012) (Lioui and Sharma, 2012) (J. L. Walls et al., 2012)	12
2013	(Forsman, 2013) (Meng et al., 2013)	(Fujii et al., 2013) (Sariannidis et al., 2013)	(Iatridis, 2013)	5
2014	(Amran et al., 2014) (Goktan, 2014) (Post et al., 2014)	(Hourneaux et al., 2014) (Qi et al., 2014) (Zou et al., 2014)	(Frias-Aceituno et al., 2014) (Lewis et al., 2014)	8
2015	(Chen et al., 2015) (Liao et al., 2015) (Sen et al., 2015)	(Gallego-Álvarez et al., 2015) (Muhammad et al., 2015)	(Lee et al., 2015) (Plumlee et al., 2015) (Ortiz-de-Mandojana and Aragon-Correa, 2015)	8
2016	(Chen et al., 2016) (Lee et al., 2016)	(Feng et al., 2016) (Qiu et al., 2016)	(Glass et al., 2016)	5
2017	(Chiarini, 2017) (Hassan and Romilly, 2018) (S. Li et al., 2017) (Trumpp and Guenther, 2017)	(Capece et al., 2017) (Lewandowski, 2017) (Nishitani et al., 2017) (Yadav et al., 2017)	(Fan et al., 2017) (J. Li et al., 2017) (Song et al., 2017) (Bergmann et al., 2017)	12
2018	(Alexopoulos et al., 2018) (Shahab et al., 2018) (Malesios et al., 2018)	(Brouwers et al., 2018) (Cucchiella et al., 2018)	(Elmagrhi et al., 2018) (Zou et al., 2018)	7
Total				98

5

3 Discussion on comparison dimensions

3.1 Datasets

In every research, research design is considered as the next step after formulating the research questions. In this step, a set of decision needs to be made about data collection. Researchers usually use a variety of data sources and data collection methods in investigating the relationship between EP and FP. The understanding that data is gathered differently and has its characteristics in different studies is fundamental to differentiate the results. Therefore, we consider that there is a need to move on from just comparing the results and attempt to generalise the results, to understanding better how data collection methodology, the characteristics of data sources and selected data sample could influence the comparability and replicability of results. In this study, a set of dataset's characteristics for each study are reviewed which are listed in Table 2.

Table 2. An overview of datasets characteristics

Column Name	Description	Example
Paper reference	Paper reference	(Walls et al.,2012)
Datasets	The list of datasets which are used to extract EP and FP variables	BoardEx
EP Profile	EP variables	GHG emissions
FP Profile	FP variables	ROA
Time Span	The period of the selected sample	1996-2010
Sample size	The number of firms analysed in a study	1,417
Sector	Industrial sector	Manufacturing
Country/ region	Country/ region coverage for the selected sample	US
Replicability	Whether someone could replicate the analysis	Yes/No
EP dataset type	Structured/ Unstructured/ Both	Structured
FP dataset type	Structured/ Unstructured/ Both	Unstructured

After considering the data sources used in the reviewed studies, the three main data sources are identified namely, primary data source, secondary data source and mixed data, which is the combination of primary and secondary data sources. Each data source is discussed with more details in the following section.

Primary data

As shown in Table 3, the list of the relevant studies and dataset characteristics is presented. These studies use the primary data, which is mainly collected through questionnaire. I believe that the main justification for using primary data is that these studies are conducted in countries with a limitation of data availability. They are Canada (Boiral et al., 2012; Henri and Journeault, 2010), the Netherlands (Uhlaner et al., 2012), OECD countries (Canada, France, Germany, Hungary, Japan, Norway, US)(Johnstone and Labonne, 2009; Lanoie et al., 2011), and Europe (Chiarini, 2017; Iraldo et al., 2009). Another possible reason is that they are looking at a specific sector such as SMEs in (Uhlaner et al., 2012). The majority of studies focus on manufacturing firms that are usually categorised in the polluting sector. Consequently, there is a concern about the social and environmental effects where some of their operations have on the environment and people. In addition, these firms are more committed to the regulations and willing to release the relevant information.

Table 3: Overview of dataset characteristics in studies using primary dataset

Study	Sample size	Country coverage	Sector	Year	Measurement of construct
(Iraldo et al., 2009)	101	Europe	Manufacturing, Services and other sectors	2005	Measurement scale 1 … 5
(Lopez-Gamero et al., 2009)	240	Spain	Hotel	2004	Measurement scale 1 … 7
(Johnstone & Labonne, 2009)	4144	OECD	Manufacturing		Measurement scale 0 or 1
(Henri & Journealt, 2010)	303	Canada	Manufacturing		Measurement scale 1 … 7
(Lanoie et al. 2011)	4144	OECD	Manufacturing	2003	Measurement scale 0 or 1
(Boiral et al. 2012)	319	Canada	Manufacturing		Measurement scale 1 … 5
(Uhlaner et al. 2012)	689	Netherlands	SMEs	2006, 2008	Measurement scale 0 To 1
(Feng et al., 2016)	214	China	Manufacturing		Measurement scale 1 … 7
(Sen et al., 2016)	251	UK, India	Manufacturing		Measurement scale 1 … 5
(Chiarini, 2017)	164	Europe	Manufacturing		Measurement scale 1 … 5
(Nishitani et al., 2017)	100	Indonesia	Mining, manufacturing, agriculture, and electricity, gas & water supply		Measurement scale 1 … 5
(Malesios et al., 2018)	119	UK, France, India			Measurement scale 1 … 5 Measurement scale 1 … 10

Mixed data (Secondary dataset and Primary dataset)

The next set of studies is using both primary and secondary data sources to obtain variables (Busch and Hoffmann, 2011; Chen et al., 2016; González-Benito and González-Benito, 2005; Hourneaux et al., 2014; Ngwakwe, 2008; Russo and Harrison, 2005). Table 4 provides an overview of dataset characteristics for this group of studies. All studies are using secondary datasets for FP except (Russo and Harrison, 2005) who wants to know whether a portion of salary for the environmental quality manager or the plant manager had tied to environmental performance.

Moreover, except (Russo and Harrison, 2005) who uses EPA TRI for EP, other studies use a questionnaire to collect the necessary data to measure EP. So far, all of them use a measurement scale to quantify the perception of participants. The reason may be due to the selected data sample from a specific country (countries) for a specific sector. In addition, we can see that all of them just analyse one year, which it is not panel data.

Having arrived at this classification, the next question is whether these studies are comparable and replicable. Both Table 3 and Table 4 reveal the following points:

- Data availability is a major problem in the examined countries.
- A number of studies measure some specific variables such as the proportion of salary tied to Environmental performance, which is not usually reported in the secondary dataset.
- Data is collected for only one year except (Ngwakwe, 2008). Therefore, the results cannot be reliable. In the majority of studies, the year conducted the research (questionnaire) is not very recent. However, after financial crises in 2008, firms have been asked to report on not only financial performance but also on environmental performance. Therefore, recent studies are motivated to analyse panel data, which is mainly due to the availability of EP data.

- Using questionnaire causes that both EP and FP are measured via the perceptual instrument. In addition, the locality nature of primary data prevents generalizability and further analysis.

Table 4. Overview of dataset characteristics in studies using mixed dataset

Paper	Sample size	Sector	Country coverage	Year	EP data source(s)	FP data source(s)
(Gonzalez-Benito & Gonzalez-Benito 2005)	186	Chemical products, electronic and electrical equipment and furniture and fixtures industries	Spain	2002	**Structured:** Questionnaire	**Structured:** Dun& Bradstreet 2002 database
(Russo & Harrison, 2005)	169	Electronic plants	US	1999	**Structured:** EPA TRI	**Structured:** Survey
(Ngwakwe, 2008)	60	Manufacturing firms (the chemical and paints industry group, the automobile and tyre group, and breweries)	Nigeria	1997-2006	**Structured:** Questionnaire	**Structured:** Firms' Financial statements, Questionnaire
(Busch & Hoffmann 2011)	174	Carbon and energy-intense industries	EU, North America, Japan, Rest of the World	2007	Main data source: Questionnaire Cross-checked with: CDP, Sustainable Asset Management, Official firms' reports	**Structured:** COMPUSTAT
(Hourneaux Jr. et al., 2014)	149	Industrial sector	Brazil	2010	**Structured:** Questionnaire with 7-points scale	**Structured:** Brazilian Central Bank (BACEN) database
(Chen et al., 2016)	54	Construction	China	2011	**Unstructured:** environmental report/ annual reports/ websites	**Structured:** DataStream

Secondary data

A large number of studies have used data, which have been initially collected for other purposes. This type of dataset is usually known as a secondary dataset. There are a number of the data repository and research platforms, which collect specific historical data for a specific region (e.g. North America), or a country, (e.g. the UK or Germany) from various independent sources. Data comes from these kinds of data services is usually structured and provides quantified variables for the research. Data validation, integrity and consistency of data provide access to bias-free information, which allow researchers to replicate the analysis of previous studies to evaluate and compare their findings.

On the other hand, those studies obtained their data from unstructured data sources require a mechanism to extract variables from unstructured data sources, which is usually content analysis (e.g. (de Villiers et al., 2011)) or manual search (e.g. (Zou et al., 2014)). Unstructured data could be criticised regarding evaluating the source of information, data extraction methodology, difficulties in repeating the same analyses, access to historical data and consequently the impacts of data errors on the results of analysis and consequently the results of these studies cannot be replicable.

To this end, I map the main variables of each study to the relevant data sources and then determine whether studies use structured, unstructured or both structured and unstructured data sources.

Once a data source contains both structured and unstructured data (e.g. Carbon Disclosure Project (CDP)), I consider whether an EP variable belongs to a structured part of the data source. In addition, this paper considers firms' web pages, annual reports or other type of corporate reports as a secondary dataset. In following, the FP and EP data sources are discussed separately.

The sample size is between 17 to 3,697 companies where data is collected for the various period, between 1 year to 21 years with mean= 5.28 and median= 4.5. This indicates that generally, studies are analysing a short period. In addition, the majority of studies analysed a data sample covering years before 2008 where financial crises have happened. Since then, companies have been forced to measure their non-financial performance. Among the studies, which reported the sector as part of data sample characteristics, the majority of studies have focused on High Pollution Sectors such as energy and manufacturing. In addition, 13 studies have focused on all sectors, and only one study analysed low pollution sector.

FP Profile data sources

Financial performance reporting is relatively well-established. Companies are required to submit their financial performance reports based on the financial standards set out in the country /region at the end of each financial year. Table 5, panel A shows the most popular data sources classified based on the country coverage and data structure. The presented information in this table reveals some interesting similarities and differences between FP data sources, including:

- Despite the country coverage, 59 out of 76 studies using structured data sources.
- The US studies tend to use Compustat as the main source for FP variables (13 out of 28), followed by Thomson Reuters (4 out of 28). The most popular data source for Japanese studies is Nekkei. In addition, DataStream is a popular data source for various studies focusing on the UK, Japan, India, and European countries.
- It is notable that ten studies use various types of reports to extract financial data. Therefore, a number of studies extract financial profile variables from such sources using either content analysis (e.g. (Amran et al., 2014)) or manual search (e.g. (Frias-Aceituno et al., 2014)). In addition, depends on the selected sample, some studies first rely on structured data sources to get data and then attempts to obtain the unreported data from unstructured sources or sometimes use unstructured data sources for cross-checking purposes.

EP Profile data sources

There is great variability in environmental profiles' data sources. Each source of environmental data contains different variables due to differences in data collection, measurement and reporting. This makes it difficult to compare studies. Table 5, panel B cross-tabulates the EPs' data sources classification with country coverage, sector and data structure.

- In general, the country coverage of the majority of studies is the US (28 studies), followed by Japan (9 studies), UK (5 studies) and China (10 studies). Although 30.4% of studies do not state the examined sector(s), 45% of studies are cross-sectional, and the 23% of studies are analysed only one sector, which is mainly in the US studies.

9

- Also, there is considerable variation within countries, most notably among the US and other countries. Among 28 US studies, the KLD, EPA, CDP and IRRC are the structured data sources that have been widely used. In the case of Japan, the focus is on manufacturing firms, and there are two primary sources of environmental data, which are the Japanese Ministry of the Environment and Nihon Keizai Shimbun who develop Nikkei Environmental Management Survey. As a result, there is a potential for research based on the available structured data for both EP and FP in Japan.

- As anticipated, there is not a one-to-one mapping between EP data sources and countries. For instance, ten studies analyse a sample of Chinese firms, which are mainly using unstructured data sets such as social responsibility reports, annual reports, and websites of government offices. There must be some reasons like geographical expansion or business model or simply not publicly available environmental data, which lead these studies to collect data themselves. Two recent studies used RSK rating (Elmagrhi et al., 2018; Shahab et al., 2018).

- Those studies that use structured EP data sources tend to analyse industrial sectors, manufacturing or energy intense sectors. Because of the concerns on this type of industries, they are regularly measuring and reporting their environmental performance. Consequently, panel data is available for firms in these sectors.

- A majority of studies analyse a panel data except few studies which collect and analyse data only for 1 year (Al-Tuwaijri et al., 2004; Amran et al., 2014; Bergmann et al., 2017; Chen et al., 2015, 2014; Cole et al., 2006; Cordeiro and Sarkis, 2008; Goktan, 2014; Hatakeda et al., 2012; J. Li et al., 2017; Liao et al., 2015; Lucas and Wilson, 2008; Ortiz-de-Mandojana and Aragon-Correa, 2015; Rassier and Earnhart, 2010; Sharfman and Fernando, 2008; Stanny and Ely, 2008). There are different reasons behind analysing only one year, such as include event study and data availability, which was anticipated.

Event studies are a subset of studies which are using secondary datasets (Gupta and Goldar, 2005)(Yamaguchi, 2008)(Lundgren and Olsson, 2010)(Monteiro and Aibar-Guzmán, 2010)(Fisher-Vanden and Thorburn, 2011). As a measure of the financial profile, the stock return has been used to measure the market reaction to the announcement of environmental performance. In all studies, the stock return is obtained from the structured dataset. In the collection of the announcement of environmental performance, some studies use a specific data source to collect data (e.g. collect environmental incidence information from GES in (Monteiro and Aibar-Guzmán, 2010)), while others search various keywords and expression on different sources. The main point is that time; event window; and space are essential factors in event studies.

Table 5. Classification of secondary data sources by country, sector and data structure

Panel A: FP data sources

Country	Total	Data structured			Data source									
		Structured	Unstructured	Both	Compustat	ExecuComp	Thomson Reuters	Bloomberg	Reports	Others	DataStream	Nekkei	CSMAR	CMIE
US	28	26	2		13	2	4	2	2	16				
Japan	9	9								4	1	7		
UK	5	5								2	4			
China	9	8	2						2	2			5	
International Firms	6	6	2					1	3		2			
India	1	1												1
Malaysia	1	1										1		
Asia-Pacific region	2	1	1						1	1				
European countries	15	9	4	1			1		5	8	3			
Total	76	59	11	1	13	2	5	3	13	33	11	7	5	1

Panel B: EP data sources

Country	Total	Data structured			Sector		Data source														
		Structured	Unstructured	Both	Single	Cross-sectional	CDP	KLD	IRRC	EPA	Lexis-Nexis Search engine	Reports	Others	Management Today's BMAC	EIN	China CSR	GRI	Green rating CSE	Nikkei Environmental Management Ranking survey	Japanese Ministry of the Environment
US	28	25	3	1	6	8	3	13	3	5	3	5	5				1			
Japan	9	8			2	7							4						3	4
UK	5	5				3	1						3	2						
China	10	5	4		1	5						4	2		1	1	1			
International Firms	8	6	2			4	1					2	2				1			
India	1	1				1												1		
Malaysia	1		1			1						1								
Asia-Pacific region	2		1									1	1							
European countries	15	11	4		1	5					1	5	7				2			
Total	76	61	15	1	10	34	5	13	3	6	3	18	24	2	1	1	5	1	3	4

11

3.2 EP variables

EP variables vary in previous studies due to different data availability and relative lack of standardising environmental reporting. EP is a multidimensional construct (Albertini, 2013; Endrikat et al., 2014), and as it is shown in Figure 1, we can distinguish between three concepts, which are Environmental Management, Environmental Performance and Environmental Disclosure.

Environmental performance is the outcome of a firm's strategic activities that manage (or not) its impact on the natural environment (Walls et al., 2011). Environmental performance evaluates environmental impacts in physical and monetary terms (Albertini, 2013). This group comprises of many variables, which could be categorised as input-based variables (e.g. resource consumption, total energy input) or output-based variables (e.g. GHG emissions, waste). Following this definition, it can be clearly seen that there is a misunderstanding between environmental management and environmental performance. For example, a number of studies use KLD scores (usually KLD environmental strengths, KLD environmental concerns) as environmental performance. While by considering the variables, we can conclude that they are mainly targeting environmental practices. Therefore, in this study, KLD measures are acknowledged as part of the environmental management category. The breakdown of EP variables into input-based and output-based variables is presented in Figure 1. The number of studies that employ each EP measure is mentioned in front of them. It is clearly indicated that almost all studies are using output-based variables in their analysis. CO_2 emissions, overall environmental performance, GHG emissions and then belonging to the specific Index such as DJSI, CSR, etc., are the most popular EP measures in 8, 7, 5 and 5 studies respectively.

Environmental Management addresses a firm's attitudes and objectives towards environmental responsibility as well as environmental management structure and processes (Schultze and Trommer, 2012). In this category, variables mostly refer to environmental strategy, integration of environmental issues into strategic planning processes, environmental practices, process-driven initiatives, product-driven management systems, ISO 14001 certification, environmental management system (EMS) adoption, and participation in voluntary programs (Molina-Azorín et al., 2009; Schultze & Trommer, 2012). The breakdown of the studies in the categories mentioned above is presented in Figure 1. Environmental Management is explored in 38 out of 80 studies. In particular, studies pay attention to environment practice in 13 studies, where the environmental practice reported by KLD is the most popular one (9 studies).

Environmental Disclosure is defined as disclosures that describe the impact that firm activities have on the physical or natural environment in which they operate (Wilmshurst and Frost, 2000). Albertini (2013, p.435) summarises the variables mostly refer to them as environmental disclosure in the previous studies, namely; (i) Information releases regarding toxic emissions; (ii) Environmental awards; (iii) Environmental accidents and crises, (iv) Environmental investment announcement. In total, 22 out of 80 studies use environmental disclosure variables. After careful consideration, we specify a category of variables, which are trying to capture the quality of released information rather than releasing the information regarding the toxic emissions. Therefore, we introduce a new category of environmental disclosure variables, which is called "environmental disclosure quality". The breakdown of the studies in the categories mentioned above is presented in Figure 1. In this category, releasing information regarding emissions, then environmental investment announcements and then environmental disclosure quality are the most popular variables examined in 11, 6 and 5 studies respectively. In total, 94 EP variables have been used in previous studies,

where 35% of EP variables measure output-based Environmental Performance, 24% of EP variables measure Environmental Disclosure, 38% of EP variables measure Environmental Management and 9% of EP variables measure input-based Environmental Performance.
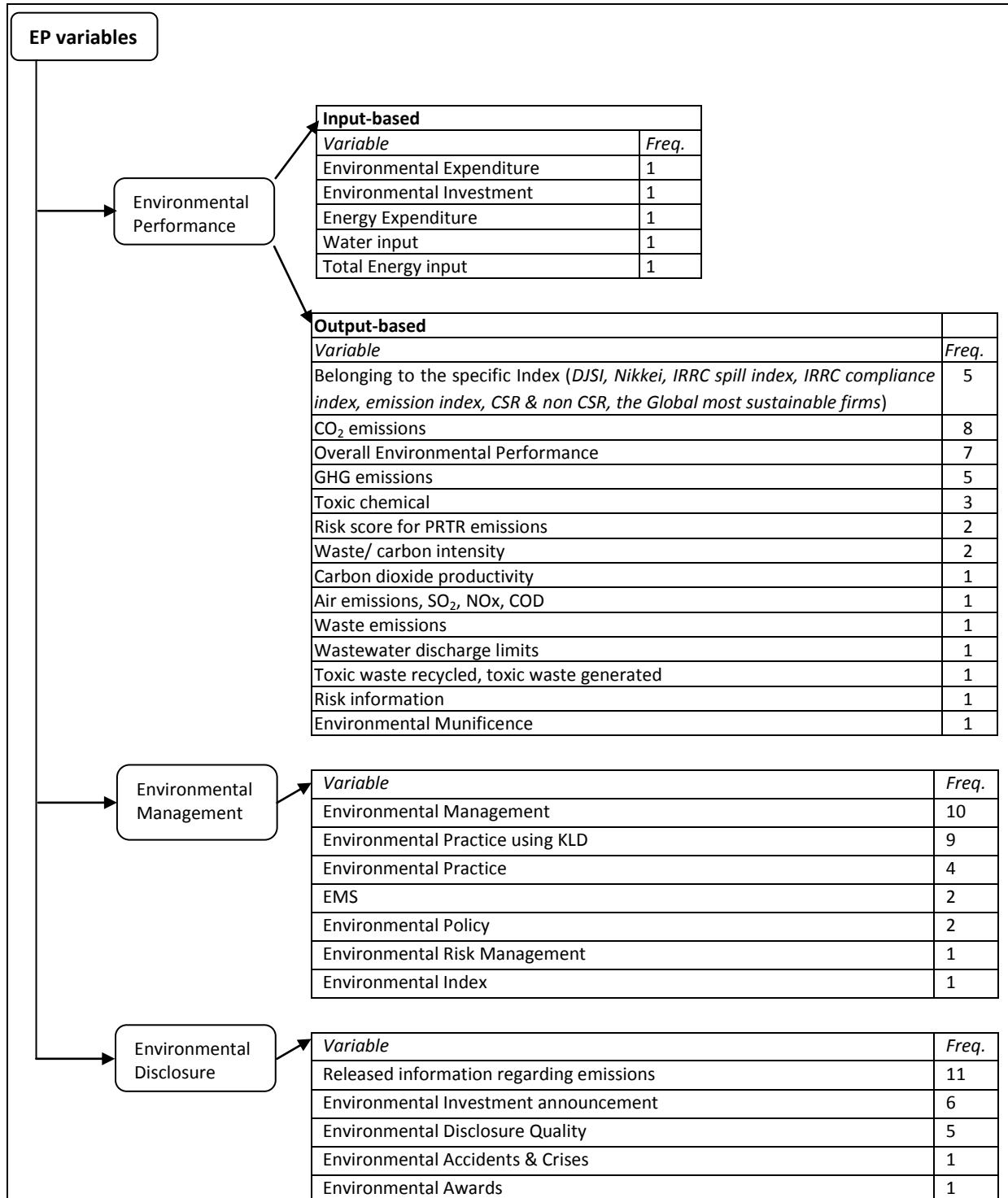
EP variables

Environmental Performance

Input-based

Variable	Freq.
Environmental Expenditure	1
Environmental Investment	1
Energy Expenditure	1
Water input	1
Total Energy input	1

Output-based

Variable	Freq.
Belonging to the specific Index (*DJSI, Nikkei, IRRC spill index, IRRC compliance index, emission index, CSR & non CSR, the Global most sustainable firms*)	5
CO_2 emissions	8
Overall Environmental Performance	7
GHG emissions	5
Toxic chemical	3
Risk score for PRTR emissions	2
Waste/ carbon intensity	2
Carbon dioxide productivity	1
Air emissions, SO_2, NOx, COD	1
Waste emissions	1
Wastewater discharge limits	1
Toxic waste recycled, toxic waste generated	1
Risk information	1
Environmental Munificence	1

Environmental Management

Variable	Freq.
Environmental Management	10
Environmental Practice using KLD	9
Environmental Practice	4
EMS	2
Environmental Policy	2
Environmental Risk Management	1
Environmental Index	1

Environmental Disclosure

Variable	Freq.
Released information regarding emissions	11
Environmental Investment announcement	6
Environmental Disclosure Quality	5
Environmental Accidents & Crises	1
Environmental Awards	1

Figure 1. EP variables with their frequency

3.3 FP variables

Previous studies employ a variety of FP variables to examine the relationship between EP and FP. One of the important questions is that how the selected FP variable(s) might affect analysing this relationship.

Most of the reported research shows that the FP indicators are correlated and dependent on each other to some degree and no preference is given regarding the FP indicators. Following (Albertini, 2013; Endrikat et al., 2014) we can distinguish between accounting-based and market-based measures which are measuring profitability and investment respectively. In contrast to accounting-based measures, which are backwards-looking, market-based measures have forward-looking aspect, and they mainly concern about the firm's future performance which has its basis on previous or current performance (Al-Matari et al., 2014). Also, we are considering another category for FP, which is considering the organisational characteristics such as the number of independent directors, board diversity, CEO education degree, the existence of the CSR committee among others. Table 6 presents the breakdown of FP variables. Panel A in Table 6 shows that (29 out of 80 studies) 36.2% of studies examine accounting-based measures and ROA is the most used measures between this set of measures. Panel B in Table 6 shows that (33 in 80 studies) 41.2% of studies examine market-based measures and Tobin's Q is most popular analysed in 13 studies. Panel C in Table 6 indicates that (18 out of 80) 22.5% of studies consider organisational-based measures.

Table 6. List of FP variables and their frequency

Accounting-based measures	Freq.	Market-based measures	Freq.	Organisational-based measures	Freq.
ROA	26	Tobin's Q	16	Board characteristics	38
ROE	12	Market Value	4	CEO characteristics	14
ROS	8	Stock return	3	Ownership	6
Firm size	5	Profit	3	Firm characteristics	3
Leverage	4	Sales growth	3	Note:	
ROCE	4	Net income	3	Board characteristics include board size,	
ROIC	3	Market return	2	independent directors, gender diversity.	
ROI	2	Cash flow from operating activities	2		
Total assets	2	Growth opportunities	2	CEO characteristics include CEO	
Cost of equity capital	2	Stock price behaviour	1	compensation, Bonuses, CEO tenure.	
Net Profit Margin	2	Sales/ revenue growth	1		
Earnings per share	2	Profit before tax (PBT)	1	Ownership includes managerial	
Operating earning	1	GVA	1	ownership.	
Capital turnover	1	Firm's sales	1		
Replacement costs	1	Quotation on the stock market	1	Firm characteristics include firm size.	
Fines & Penalties	1	Foreign sale	1		
Cost of capital	1	Growth of profit before tax	1		
Cost of Debt capital	1	CAR	1		
Panel A. Accounting-based measures		**Panel B. Market-based measures**		**Panel C. Organisational-based measures**	

It worth mentioning that using a variety of FP variables entirely depends on the context of examined hypotheses in each study. This could be an important point to differentiate the findings of studies. In addition, sometimes FP variables such as firm size are used as main variables in the analysis while in most cases firm size is considered as a control variable. It is also important to consider how these FP variables are measured. For example, seven studies use firm size as an FP variable. It is measured as

Ln(Total Assets) in (Brammer and Pavelin, 2006; Frias-Aceituno et al., 2014; Monteiro and Aibar-Guzmán, 2010), but is measured as total employment in (Cole et al., 2006)(Uhlaner et al., 2012) or as a score of total assets in (Amran et al., 2014).

3.4   Research Methodology and Dealing with endogeneity

Despite the importance of high-quality data and the variation in EP and FP variables discussed in the previous sections, relatively little has been done to explore the research methodologies employed in each study and the way of dealing with endogeneity.

A majority of studies are analysing unbalanced panel data where both the Environmental and Financial Profile of companies are observed over time. Therefore, the general equation to show the relationship between EP and FP is as follow:

$$y_{it} = \beta_0 + \beta_1 x_{it} + \beta_2 z_{it} + e_{it} + \varepsilon_i$$

where y is the dependent variable, i is the number of observation from 1 to n, t is time, β_0 is a constant, β_1 and β_2 are unstandardised regression coefficients of the independent variables x and z which mainly refer to how much change in one unit of x and z affect y. e and ε are the error terms which refer to unobserved causes of y as well as other sources of error. Here, the dependent variable (y) could be any FP variable/any EP variable and the independent variable(s) is a set of EP variables/FP variables and a set of control variables. It should be noted that the current study has not take into account the role of control variables in the analysis.

Since it is only possible to observe how the independent variables could explain a dependent variable (y), there is always a chance of influencing the results by unseen factors. Therefore, counterfactual models can help the researcher to understand causal effects (Morgan and Winship, 2007). Endogeneity occurs in cases where the independent variable in a regression model is associated with the error term or some causality between dependent and independent variables. Omitted variables, measurement errors and simultaneity are key sources of endogeneity (Wooldridge, 2001).

Table 7 indicates the research method employed by each study and how studies are dealing with endogeneity in their research. We found that studies employed various regression models such as multivariate regression models, OLS models, Random-effects and Fixed-effects models and GMM more often.

As far as we concern, 58% (47 out of 80 studies) of studies do check for endogeneity. Reviewed studies are dealing with endogeneity in various ways. Seven studies which are (Brouwers et al., 2018; Iwata and Okada, 2011; Lioui and Sharma, 2012; Post et al., 2011; Shahab et al., 2018; Wagner, 2005) use fixed-effects model to control for omitted variables. Also, the random-effects model employed by (Elsayed and Paton, 2005; Frias-Aceituno et al., 2014; Horváthová, 2012; Nishitani and Kokubu, 2012; Post et al., 2014; Rassier and Earnhart, 2010; Wagner, 2010) to control for omitted variables. Hausman test employed by studies using fixed-effect and random-effect models (Brouwers et al., 2018; Elsayed and Paton, 2005; Horváthová, 2012; Lee et al., 2016; Lioui and Sharma, 2012; Rassier and Earnhart, 2010; Wagner, 2005). Granger Causality is used as a way to deal with endogeneity in three studies (Hassan and Romilly, 2018; Nakao et al., 2007; Qiu et al., 2016). Three studies are using instrumental variables to deal with endogeneity which is (Böhringer et

15

al., 2012; Hibiki and Managi, 2010; Qi et al., 2014). This approach is based on the generalised method of moments (GMM). Finally, lagged variables used by 27.5% (22 out of 80 studies) studies to deal with endogeneity (see (Li, 2013) for detailed information). 42.5% (34 out of 80) studies do not check for endogeneity. A few of these studies only analyse one year of data, and therefore, testing endogeneity is not applicable.

Table 7. Research Methodology and dealing with endogeneity

Paper	Research Methodology	Dealing with endogeneity
(Alexopoulos et al., 2018)	GMM model	Lagged variables
(Brouwers et al., 2018)	Fixed-effect instrumental variable (FE-IV) methodology	2SLS, Hausman test
(Cucchiella et al., 2018)	OLS	Instrumental variables
(Elmagrhi et al., 2018)	OLS regression, GMM	GMM instrumental variables
(Shahab et al., 2018)	Fixed-effect regression	Instrumental variables
(Zou et al., 2018)	Generalized least squares regression	No
(Hassan & Romilly, 2017)	OLS, GLS models	Granger causality
(Fan et al., 2017)	Random effects model	Yes
(Capece et al., 2017)	Regression model	No
(Bergmann et al., 2017)	Multivariate regression	Lagged variables
(Li et al., 2017)	Regression model	No
(Li et al., 2017)	Regression model	No
(Yadav et al., 2017)	Multivariate regression	Lagged variables
(Trumpp & Guenther, 2017)	Panel data regression	Lagged variables
(Song et al., 2017)	Regression model	Lagged variables
(Lewandowski, 2017)	OLS regression	Lagged variables
(Lee et al., 2016)	OLS regression	Hausman test
(Glass et al., 2016)	Binomial regression with fixed effects	No
(Qiu et al., 2016)	Regression analysis (Tobit, OLS)	Granger causality
(Mandojona et al., 2015)	Moderated hierarchical regression model	No
(Plumlee et al., 2015)	Regression model	No
(Liao et al., 2015)	Multivariate regression	No
(Gallego-Alvarez, et al., 2015)	Random effects model	No
(Chen et al., 2015)	Correlation	No
(Muhammad et al. 2015)	Panel data regression	Lagged variables
(Lee et al. 2015)	Fixed effect model	The employed model
(Amran et al. 2014)	Content analysis, Multiple linear regression	No
(Chen et al., 2014)	Content analysis, 1-way ANOVA, Correlation	No
(Frias-Aceituno et al., 2014)	Logistic regression methodology, Tobit regression	Random-effect model
(Goktan, 2014)	Multivariate hierarchical regression	No
(Lewis et al., 2014)	Logistic regression	Lagged variables
(Post et al. 2014)	Negative binomial regression, Logistic regression, Sobel test, bootstrapping approach, content analysis	Random-effect model, Lagged variables
(Qi et al., 2014)	GMM model	GMM instrumental variables
(Zou et al. 2014)	Content analysis, Feasible Generalised Least Squares (FGLS) regression	Lagged variables, the employed model
(Forsman, 2013)	Friedman test, Wilcoxon Signed Rank test, Mann-Whitney	No
(Fuji et al., 2013)	Regression model	Lagged variables
(Iatridis, 2013)	OLS regression	Lagged variables
(Meng et al.,2013)	Content analysis, Tobit Model	No
(Sariannidis et al., 2013)	GARCH model	Lagged variables
(Alvarez, 2012)	Linear regression, Ordinary least squares(OLS)	Lagged variables
(Ameer & Othman, 2012)	Content analysis, Mann–Whitney U tests, Regression	Lagged variables
(Bohringer et al., 2012)	OLS, LSDV, GMM DIF	Lagged variables
(Barnett & Salomon 2012)	OLS regression	Lagged variables
(Hatakeda et al., 2012)	Regression model	Lagged variables
(Hofer, C. et al.,2012)	Structured content analysis, Binominal generalised	Lagged variables
(Horvathova, 2012)	Random effects model	Hausman test, Lagged variables
(Lioui & Sharma, 2012)	Fixed effect model	Hausman test, Lagged variables
(Nishitani & Kokubu, 2012)	The Random effect instrumental variable model (RE-IV)	The Employed model

Paper	Research Methodology	Dealing with endogeneity
(Walls et al.,2012)	Multilevel analysis, Poisson regression	No
(Cong & Freedman, 2011)	OLS regression	No
(De Villiers et al., 2011)	Logistic regression	Two-stage least squares
(Fisher-Vanden & Thorburn, 2011)	Regression analysis, Portfolio analysis, Event studies, Weighted least square (WLS)	No
(Iwata & Okada, 2011)	Fixed effects model	The Employed model
(Post et al. 2011)	Regression model	No
(Rassier & Earnhart 2011)	Pooled OLS, Fixed effects model	Fixed effects model
(Hibiki & Managi, 2010)	GMM model	Simultaneous estimation, Lagged variables
(Jacob et al., 2010)	Event study, Ordinary Least Squares regression	No
(Lundgren & Olsson 2010)	Event study, Ordinary Least Squares regression	No
(Monteiro & Aibar-Guzmán 2010)	Content analysis, Stepwise regression	No
(Prado-Lorenzo & Garcia-Sanchez 2010)	Regression model	No
(Rassier & Earnhart 2010)	Random effects model	Hausman test, the Employed model, lagged variables
(Wagner, 2010)	Random effects model	Lagged variables, the employed model
(Berrone & Gomez-Mejia, 2009)	Fixed effects model, Tobit analysis	The employed model
(Elsayed & Paton, 2009)	Random effects model	The Employed model, Lagged variables
(Cordeiro & Sarkis 2008)	OLS regression	No
(Lucas & Wilson, 2008)	Regression model	No
(Sharfman & Fernando 2008)	Regression model	Lagged variables
(Stanny & Ely 2008)	Binary Logit regression	No
(Yamaguchi, 2008)	Event study with OLS and the EGARCH(1,1) model	No
(López et al. 2007)	Regression, Mann–Whitney	No
(Nakao et al, 2007)	Multiple linear regression	Granger causality
(Brammer & Pavelin, 2006)	Regression model	No
(Cole et al. 2006)	OLS regression	No
(Cormier et al. 2005)	OLS regression	Lagged variables
(Elsayed & Paton 2005)	Random effects model	Hausman test, the Employed model, Lagged variables
(Gupta & Goldar, 2005)	Event studies, OLS regression	No
(Hassel et al.,2005)	Regression model	No
(Wagner, 2005)	Fixed effects model	Hausman test, the Employed model
(Al-Tuwaijri et al. 2004)	Three-stage least squares (3SLS)	The employed model
(Clarkson et al. 2004)	Pooled GLS technique	No
(Filbeck & Gorman, 2004)	OLS regression	No

3.5   Findings

Overall, reviewed studies analyse a number of hypotheses about the link between EP and FP. The first observation is that the direction of analysis which is either from EP to FP or from FP to EP. Figure 2 presents the distribution of the direction of analysis in the reviewed studies in this research.

While 46 studies examine various hypotheses on the link from EP to FP (EP->FP) and they try to answer the question whether it pays to be green, 26 studies analyse the possibility of the link from FP to EP (FP->EP). Besides, there are six studies, which examine a number of hypotheses in both directions from EP to FP and FP to EP.
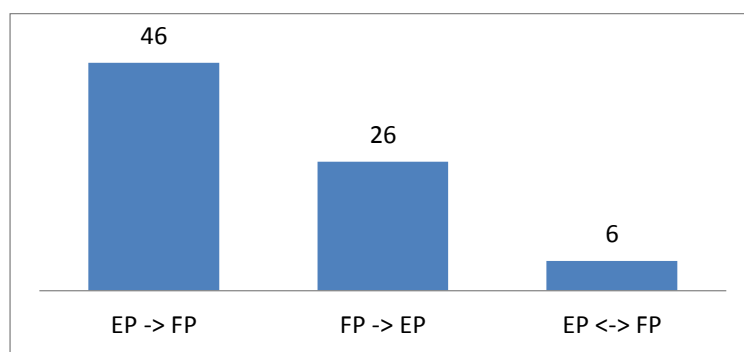
Figure 1. Distribution of analysis directions

Among this set of studies that use secondary datasets, we can see four studies, which are mainly focused on the comparison of the financial performance of two groups of firms with different environmental behaviour. This includes green management firms vs. Non-green management firms (Goktan, 2014); socially responsible vs socially irresponsible firms (López et al., 2007); firms belonging to DJSI vs DJGI (Sariannidis et al., 2013), and the Global most sustainable firms or DJSI firms (Ameer and Othman, 2012).

Also, there are five studies using an event study to estimate market value impacts using the announcement of environmental events. There is only one study, which finds the negative effect of the environmental incident on firm value (Lundgren and Olsson, 2010). The majority of studies examine the announcement of process-related initiatives of environmental performance. However, they report both positive (Gupta and Goldar, 2005; Jacobs et al., 2010; Yamaguchi, 2008) and negative (Fisher-Vanden and Thorburn, 2011; Gupta and Goldar, 2005) impact on firms' market value.

Despite the differences in employed research methodology in examining the impact of FP on EP, 93 hypotheses support positive relationship which supports Revisionist view (Porter Hypotheses), 62 hypotheses support negative relationship which supports Traditionalist view (Walley and Whitehead, 1994), and only 4 hypotheses provide support for curvilinear relationships respectively. Moreover, 19 hypotheses report no correlation or insignificant results. Besides, those studies examining the impact of EP on FP are supporting the Slack Theory by (Waddock and Graves, 1998). According to the slack theory, the superior FP results in available resources (slacks) that allow firms to invest in environmental activities and management.

As is discussed before, there is not any general relationship between EP and FP. Table 8 attempts to show some of the general patterns among findings of previous studies using data mining techniques such as clustering and classification.

4   Discussion

This study presents an overview of 98 empirical studies conducted on the relationships between EP and FP from 2004 to 2018. The study expands the view of this relationship from research methodology points of view, which concentrates on the data sources, characteristics of the data sample, EP profile, FP profile, data analysis method(s) and endogeneity and finally findings. Table 9 summarises the key points highlighted concerning the discussed methodological artefacts.

18

Table 8. List of general rules between findings

Note: **A**: Accounting-based variable, **M**: Market-based variable, **O**: Organisational-based variable.
ED: Environmental disclosure, **EP**: Environmental performance, **EM**: Environmental management.
+and -: the results obtained for the tested hypothesis. EP→ FP: examine the impact of Environmental Profile on Financial Profile, FP --> EP: examine the impact of Financial Profile on Environmental Profile.

FP --> EP
1) Country= US, sectors= All sectors: O → ED (results= Positive (52.9%))
2) Country= US, sectors= All sectors : M → EM (results= Positive)
3) Country= US, sectors= High Pollution: M → EP (results= Negative (100%))
4) Country= non-US, sectors= High Pollution: O → ED (results= Positive (64.3%))
5) Country= non-US, sectors= All sectors: A → EM (results= Negative (50%))
6) Country= Europe, sectors= All sectors: A → EM (results= Negative (83.3%))
7) Country= Asia, sectors= High Pollution: O → ED (results= Positive (70.4%))

EP --> FP
1) Country= US, sectors= All sectors : O → ED (results= Positive)
2) Country= US, sectors= Low Pollution: EM → A (results= Positive (100%))
3) Country= US, sectors= All sectors: EM → O (results= Negative (100%))

To begin with, the definition of environmental profile and financial profile are specified. Then data-related characteristics such as sample size, industrial sector, market index, country coverage, type of data sources for EP and FP, and finally the replicability of analysis are examined and compared. The issue of replicability and comparability mainly arises from datasets. Studies using primary or mixed datasets generally suffer from lack of dataset availability, and therefore, data sample selection is difficult while it is possible to obtain data sources for those studies using secondary datasets and build the same data sample.

Also, it is necessary to define both EP and FP constructs as both are multidimensional and there are some variables to represent those constructs. Regarding FP variables, ROA and ROE are the most popular accounting-based variables, Tobins' Q is the most popular market-based variable, and finally, board characteristics are the most common FP variable in the organisational-based group. Similarly, EP construct could be Environmental Management, Environmental Performance and Environmental Disclosure. This research specifies a subcategory of Environmental disclosure called "environmental disclosure quality" which captures the quality of released information rather than just releasing the information regarding the toxic emissions. Moreover, Environmental Performance could also be considered as input-based and output-based variables. It is clear that all studies have focused on air emissions. The research could focus on other aspects of climate change and environmental pollution and covers not only air pollution, but also water, and soil/ land pollution as well.

The direction of analysis in previous studies is mainly from EP to FP, which reveals the interest of researchers on the influences of EP on FP. Overall; it is not easy to draw a conclusion on positive or negative effect from EP on FP. The majority of previous studies in this domain have been published in accounting and finance journals. These studies mainly have employed regression models to fit a linear or sometimes non-linear relationship. While both EP and FP are multidimensional, studies are also limited to select a set of variables and therefore, fail to capture the full picture in EP-FP

19

relationship. Indeed, machine learning allows richer modelling of dependencies and identifying patterns beyond boundaries of linearity or even continuity of boundaries.

Table 9. Summary of key findings

Dimension	Key points
Data sources	• Data source availability (secondary dataset, survey/interview) • Data set structure (structured, unstructured, both)
Data Sample	• Data set • Time span • Sample size • Covered industrial sector • Covered market index • Country/ region coverage
Replicability	• Whether the study is replicable and comparable based on the characteristics of the data source and data sample
EP Profile	• Environmental Management • Environmental Performance • Environmental Disclosure
FP Profile	• Accounting-based variables • Market-based variables • Organisational-based variables
Research Methodology	• Statistical method • The justification for appropriateness of the chosen method
Endogeneity	• Type of endogeneity (omitted variables, simultaneity, measurement errors) • Dealing with endogeneity using appropriate research methodology
Findings	• Direction (EP -->FP or FP -->EP) • Supporting hypothesis (+, -, insignificant)

This study contributes to enriching the domain knowledge by providing comprehensive insight to the literature examining the relationship between EP and FP. This study has shed some light on the relationship between EP and FP by focusing on the data as a unit of analysis. This study attempts to clarify the mixed results between EP and FP by providing insights into the data related problems such as unavailable data and misspecification of EP and FP variables. The contribution of this study is to minimise the inconsistency in using terminologies. To be more specific, this study defines EP and FP and provides the classifications for each of them. This classification helps in recognising the key area that associate and affect EP-FP relationship. This study supports Lankoski (2008) argument which emphasis "A further breakthrough was the '**it depends' hypothesis** by Reinhardt (1998), recognising that the relationship is not likely to be universally either negative or positive, but that its nature depends on the specifics of each situation.". This could be a guideline for researchers and practitioner to build their understanding by focusing on the right EP and FP variables and compare their findings with the appropriate set of previous studies. This is more important when we are focusing on a specific country or sector.

5   Conclusions and future works

During the last four decades, an increasing number of empirical studies examine EP-FP relationship, and they report inconsistent results. Despite the number of existing theories, conceptual frameworks and empirical studies, the results are inconclusive. This research stream has been

looked at as a black box. When to some extent, the input variables are specified and the output variable sets out to an environmental variable, or financial variable depends on the research question. While the analysis process and employed research methodology are not clearly stated. Unfortunately, relatively little research has sought to examine the EP-FP relationship considering methodological issues which directly affects the results. Previous meta-analysis studies consider a number of measurement issues and show a modest positive relationship between EP and FP. This study concludes by discussing the significant challenges that literature on EP-FP relationships faces. These challenges form the methodological point of view are dataset criteria, data sample characteristics and data analysis methods. With these challenges in mind, the literature should focus on methodological issues to be able to offer theoretical advancement in future.

This study focuses only on the findings that directly depict the relationship between EP and FP. The interdependencies, mediation or moderation findings need to be addressed in future research. It is expected that studies clearly explained the process of data sources selection, data sample, choices of EP and FP variables. In this way, it would be easier to replicate the study and compare the results. In addition, studies employ various research methodologies such as regression analysis, fixed-effect, random-effect model and structured equation modelling. We recommend examining the influence of the research methodology and analysis method on the EP-FP relationship.

Moreover, each study employs a set of control variables. The common ones are firm size, industrial sector and country. Since control variables strongly influence the results, future research is necessary to investigate the control variables. In addition, sometimes some variables like firm size are used as control variable while in other studies they are the main variables. It is evident that each industrial sector has its regulations in relation to EP, now the question is that "is it enough to include the firms' sector as a (control) variable to the analysis, or it would be better to focus on specific sectors and investigate the variables which are specific to that sector?" Finally, studies rely on various theories, such as agency theory, institutional theory, resource-based theory, and slack resource theory. Therefore, it is recommended to examine that the EP-FP results are in response to which theories.

6 Funding sources

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21

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