Paying or being paid to be green?

Rupali Vashisht* Hector Calvo-Pardo† Jose Olmo‡

Abstract

This paper proposes a system of simultaneous equations in a panel data setting to examine the relationship between corporate financial performance (FP) and corporate environmental performance (EP) for the group of firms comprising the S&P 500 index. The study separates between brown (heavily polluted) and green (less polluting) sectors. Two main findings emerge from this empirical analysis. First, the impact of environmental performance on financial performance is negative for brown firms and positive for green firms. In contrast, the impact of financial performance on environmental performance is positive for brown firms and negative for green firms. Green firms seem to be the winners in this relationship increasing financial performance by reducing investment to be green. Brown firms, on the other hand, need to invest on environmental performance at the expense of financial performance. These results are robust to the presence of sector- and firm-specific fixed effects and alternative estimation methods.

Keywords: Structural Equation Modeling, Environmental Pillar Score, Environmental Disclosure Score, Return on Assets

*Corresponding author: Department of Economics, University of Southampton, University Rd., Southampton, SO17 1BJ, United Kingdom. rupali.vashisht@soton.ac.uk.

†Department of Economics, University of Southampton, University Rd., Southampton, SO17 1BJ, United Kingdom. calvo@soton.ac.uk

‡Department of Economic Analysis, Universidad de Zaragoza, Gran Via 2, 50005, Zaragoza, Spain. jose-olmo@unizar.es, and Department of Economics, University of Southampton, University Rd., Southampton, SO17 1BJ, United Kingdom.

1 Introduction

The world is starting to realize the environmental consequences of conducting business as usual. Regulators and policy makers are, therefore placing more and more stringent pollution abatement requirements on businesses. In the past few decades, the Environmental Protection Agency (EPA) has regulated more than 174 major industrial sources of air toxics, including chemical plants, oil refineries, aerospace manufacturers, and steel mills. Between 1999 and 2011, a number of these regulations became effective. It is expected that these standards will reduce annual toxic emissions by about 1.7 million tons when they are fully implemented. These policies require businesses to invest in pollution abatement technology to reduce their emissions. This seems to be at odds with the idea of profit-making – the primary reason for which businesses exist.

Yet some businesses are going above and beyond the regulatory requirements to improve their environmental performance or reduce toxic emissions. There are several reasons for this. First, investment in pollution abatement enhances operational efficiency leading to improved profits. Pollution can be seen as a waste of resources (such as raw materials and energy). Thus, Porter (1996) suggests that investments made to comply with environmental regulations and policies may lead to a reduction in such wastage and cause an increase in profits so much so that they end up compensating for the compliance costs incurred for wastage disposal. Second, when investors have a preference for green products -as Pastor et al. (2021) find, firms selling these products will see an increase in their profits, and thereby, an increase in their asset prices. Third, socially responsible investments (such as investment in pollution abatement) can reduce the cost of capital for businesses, as the findings of Heal (2005) indicate. Finally, Feldman et al. (1997) observe that firms that make investments to improve their environmental performance signal that they are better protected against other risks such as regulatory or legislation non-compliance. As a result, compliant firms are more trusted by stakeholders when compared to their non-compliant conterparts. All these reasons support investments in environmental performance being conducive to enhanced financial performance (being rewarded or 'paid to be green'), defying the traditionalist view according to which the former are a mere cost to the companies which only contributes to deteriorate their profit margins (or 'paying to be green').

Although many studies including Clarkson et al. (2011) and Hoang et al. (2020) have empirically explored if the traditionalist or pro-environmental investment view holds i.e. 'Does it pay to be green?', only recently Lahouel et al. (2022) have examined the question of 'When does it pay to be green?'. They find that corporate environmental performance (EP) only improves financial performance (FP) up to a certain level, beyond which it ceases to pay to be green, i.e. a non-linear hump-shaped relationship.

Besides acknowledging that the relationship between financial and environmental performance (EP-FP) can be different for different firms, here it is also allowed to differ across sectors (e.g. green versus grey/brown). It is therefore posited that the EP-FP relationship is different for green firms (firms belonging to sectors whose processes are less capital-intensive and are likely to have relatively less direct carbon emissions) and brown firms (firms belonging to sectors whose processes are more capital-intensive and are likely to emit relatively more). The rationale behind this premise is that since firms in green sectors find it easier and cheaper to adopt greener technologies due to lower reliance on capital (property, plant, and equipment), they reap the benefits of going green almost contemporaneously. Firms in brown sectors may need to invest heavily (in capital) to shift their environmentally unfriendly processes towards more pro-environment processes, due to which these firms might not reap the benefits of going green in the short run. Moreover, firms operating in brown sectors are expected to increase investments in environmental initiatives when faced with improved financial performance whereas, firms in green sectors might not do the same. In addition, financial considerations (e.g. accrued costs) are also allowed to determine corporate environmental performance (i.e. FP-EP), alleviating potential endogeneity concerns raised in the literature (Al-Tuwaijri et al., 2004; Hassan and Romilly, 2018).

To investigate if these hypotheses are true, we apply structural equation models (SEM). This approach takes into account the fact that the relationship between EP and FP can be two-way. The method also accommodates the presence of unobserved heterogeneity that is fixed over time but varies across firms and sectors of economic activity. Since this work is an attempt to study the impact of enhancing environmental performance on operational efficiency, financial performance (FP) is measured using operating return on assets (OROA).[1] Environmental performance (EP) is measured using typical measures recently proposed in

[1] An operating return on assets ratio uses operating income in the numerator instead of net income as in the traditional return on assets calculation. It is similar to the traditional ROA ratio in all other respects.

the literature given by Environmental Pillar scores (EPS).

The findings of this analysis indicate that an improvement in FP is associated with a decrease in EP for firms in green sectors. Intuitively, an improvement in FP leading to deterioration in EP suggests that green sectors withdraw their investments from environmental endeavors to spend elsewhere (endeavors that they deem more profitable) - as Aigbedo (2021) explains that diversion of resources to other activities could be the reason behind negative impact of FP on EP. This is more plausible for firms belonging to green sectors as they do not attract regulatory attention (in environmental matters) as much as their brown counterparts. Also, as their activities cause much lower carbon emissions compared to brown sectors, their environmental image is (on average) perceived more positively by customers, investors and other stakeholders. This result also sheds more light on the findings of Clarkson et al. (2011) who find that the profitability of firms is an important determinant of their investment efforts and that uptake of proactive environmental strategies is positively related to firms' profitability. The difference in the impact of FP on EP can be attributed to the fact that Clarkson et al. (2011) analyse the data of four most polluting industries in the US, whereas, in this study, the green and brown sectors are analysed separately.

The results for firms in brown sectors indicate a negative impact of EP on FP. This is expected for brown firms as these firms make relatively large investments to become greener and it may take longer to recover that investment and start earning returns. But FP has a positive impact on the EP of brown firms. This points out the fact that brown firms may be under more scrutiny and pressure (by regulators and stakeholders) compared to green firms, which causes them to invest more heavily in environmental endeavours when they experience growth in financial returns, in line with the findings of Clarkson et al. (2011).

To the best of our knowledge, this is one of the first papers to model the simultaneous EP-FP relationship at the firm level, distinguishing between clean (green) and dirty (brown) sectors. For the effective formulation of policies, it is important to study the differences in the bi-directional EP-FP relationship of green and brown firms as the decision to adopt pro-environmental measures to become greener (captured by the impact of financial performance on environmental performance) to reap the economic benefits of becoming greener (captured by the impact of environmental performance on financial performance) are intertwined. Therefore, the analysis of the two-way EP-FP relationship enables a better understanding of inter-industry differences than comparing the one-way impact of EP on FP (as in Iwata and Okada, 2011; Liu, 2020) across industries. Our empirical analysis considering separately different sectors of economic activity, will allow regulators to design incentive policies as they gain a clearer understanding of the environmental response of specific sectors to improvements in financial performance in addition to financial benefits resulting from improvements in environmental performance.

The ensuing content of the paper is organized in the following manner: Section 2 reviews the relevant literature; Section 3 provides a description of the data used and variables constructed; Section 4 develops hypotheses and specifies the research methodology adopted; Section 5 reports and discusses empirical findings, and Section 6 concludes the paper, highlights the contribution, and discusses the limitations of the study.

2 Review of Literature

2.1 Background on the EP-FP relationship

The relationship between corporate environmental performance (EP) and corporate financial performance (FP) is still ambiguous and there seems to be no consensus among researchers on this relationship. Some literature (Palmer et al., 1995; Lu and Taylor, 2018) points out that improvements in EP worsen FP (traditionalist view), while others such as Klassen and McLaughlin (1996), Hart and Ahuja (1996) or, Al-Tuwaijri et al. (2004) establish that improving EP improves FP (revisionist view). As per the traditionalist view, improvement in environmental performance involves sustainability innovations that are costly, and therefore investment in such innovations leads to a reduction in firms' profitability. On the other hand, the revisionist view reasons that improvement in innovations brought about by investment in sustainable solutions enhances operational efficiency, product quality and brand positioning thereby leading to improved profitability.

The debate is not only limited to the direction of this relationship but also about how this relationship should be determined – if EP affects the FP of a firm contemporaneously or if is there a lagged effect of EP on FP. The meta-analysis of various studies in this field by Hang et al. (2019) provides evidence in support of the Porter Hypothesis (positive impact of improvement in EP on FP) but they argue that the economic returns to improving EP only materialize with a delay of around 2 years. But some researchers provide evidence in support of a contemporaneous relationship between EP and FP, like Al-Tuwaijri et al. (2004). A meta-analysis by Endrikat et al. (2014) also provides evidence for the existence of a concurrent relationship between accounting-based and market-based measures of FP and EP, acknowledging the fact that the existence of such a relationship can be difficult to justify. They argue that factors such as improved management quality or cost savings due to the reduction of costly hazardous materials, render a contemporaneous relationship possible and plausible.

2.2 Variables employed in prior research

Most of the literature makes use of competing measures of FP to gauge how FP responds to changes in EP. The most popular accounting-based measure to establish the EP-FP causal relationship, is Return on Assets (ROA), also used by Choi et al. (2010); Qureshi and Ahsan (2022) or Lahouel et al. (2022). Return on Equity (ROE) has also been used in many studies, e.g. Wagner et al. (2002). Alareeni and Hamdan (2020) use market-based measures of FP, such as Tobin's Q, in conjunction with accounting-based measures. The importance of using both these market-based and accounting-based measures is highlighted by Endrikat et al. (2014). In their meta-analysis, Endrikat et al. (2014) acknowledge that the accounting-based measures of FP such as ROA capture the efficiency with which a firm makes use of its assets to generate value in the short-run while the market-based measures such as Tobin's Q gauge the perceptions regarding the future performance of firms and hence, can proxy for long-term performance of firms. Just like for measures of FP, there are a variety of ways that researchers consider to measure/quantify EP such as greenhouse gas emissions (Hassan and Romilly, 2018; Bolton and Kacperczyk, 2020), waste emissions and water use (Hoang et al., 2020), toxic release inventory (Clarkson et al., 2011), environmental scores published by various databases (Liu, 2020), environmental management initiatives (Klassen and McLaughlin, 1996), or carbon intensity (Pedersen et al., 2021), amongst others.

For this study, Refinitiv's Environmental Pillar Scores have been considered to measure EP, due to its widespread use, increased sophistication, standardization, and its comparability across industries and sectors.

2.3 Issue of reverse causality and endogeneity

Studies such as Hart and Ahuja (1996) and Bhat (1999) have delved into understanding whether it pays to be green i.e. studying the impact of EP on FP. More recently, Riillo (2017) has explored the answer to the question of 'when it pays to be green?'. The recent literature on the relationship between EP and FP points out that not only EP determines FP but that FP also affects EP. Clarkson et al. (2011) explain that adopting a proactive environmental strategy is contingent upon a number of factors, such as financial resources available to a firm and management capability. Liu (2020) also acknowledges this FP-EP reverse causality and works with simultaneous equation models to address the bi-directional relationship between them. Similarly, Al-Tuwaijri et al. (2004) determine the impact of FP on EP and vice-versa using simultaneous equation modelling, enabling them to coherently estimate interrelations among EP, FP, and corporate environmental disclosure (ED). They argue that this joint determination process of the interrelations between EP, FP and ED using simultaneous estimation methods allows them to overcome the issue of endogeneity and is therefore a better way to specify a model aiming to uncover the EP-FP-ED relationship. Hassan and Romilly (2018) have also used simultaneous equation models to determine jointly the EP-FP-ED relationship, although they only allow lagged values of ED and EP to affect FP, ruling out a a contemporaneous relationship between the three variables.

2.4 Factors affecting the EP-FP relationship

The EP-FP relationship is affected by many factors. Alexopoulos et al. (2018)'s findings indicate that firm-specific characteristics and market related characteristics such as societal, cultural and institutional settings impact the linkage between EP and FP. These factors lead to a negative impact of EP on FP and do not yield economic benefits for firms that engage actively in reducing their energy consumption. Dal Maso et al. (2018) demonstrate that stakeholder prioritization and engagement jointly strengthen the EP-FP relationship. López-Gamero et al. (2009) show that firms recognized as earlier environmental performers adopt more proactive environmental management practices, which in turn translate into better financial performance i.e. becoming early a relatively more environmentally proactive firm leads to better financial outcomes. They also show that the impact of environmental protection on environmental performance is positive but also depends on the sector under consideration.

Nakao et al. (2007) argue that since there are many dimensions of environmental and financial performance of firms, concluding on a positive two-way relationship between environmental and financial performance is not appropriate (this may be due to omitted variable bias). So, they compare various dimensions of top scoring firms (as per environmental management survey) before drawing conclusions regarding the direction of the EP-FP relationship. Liu (2020) also addresses the issue of reverse causality between EP and FP. This author employs panel data to construct an auto-regressive cross-lagged model. A company's environmental performance in a given period affects its financial performance in the subsequent period and vice versa. Liu (2020) also finds that the industry or sector to which a company belongs plays an important role in determining the direction of the impact of EP on FP, i.e. the impact of EP on FP is shown to be positive for some companies and negative for others. Iwata and Okada (2011) study the effect of improving environmental performance on financial performance of Japanese clean and dirty manufacturing industries. They find that the impact of improving environmental performance is different for clean and dirty industries.

3 Data and sample selection

The dataset used for this analysis considers the constituents of the S&P 500 index over the period 2011 to 2020. Data are obtained from Bloomberg and Refinitiv Datastream. In particular, Refinitiv provides data on separate components of the Environmental, Social and Governance (ESG) firm scores, and their sub-components 'E','S', and 'G' respectively. This study uses a broader and all-encompassing modern definition of environmental effort by considering the Environmental Pillar Score i.e. the 'E' or EPS of the ESG index rather than traditional indicators of environmental performance such as greenhouse gas (GHG) or toxic waste emissions, that have been previously used by studies for gauging the nature of the EP-FP relationship (Hassan and Romilly, 2018; Al-Tuwaijri et al., 2004; Iwata and Okada, 2011). EPS is employed as a measure of environmental performance by contemporary literature (Lahouel et al., 2022; Dal Maso et al., 2018; Liu, 2020) in this field. EPS is composed using a combination of three sub-scores: a) a resource use score, b) an emission reduction score and c), an innovation score.

This information is merged with data on the Global Industry Classification Standard's (GICS) sector classification of the S&P 500 constituents. There are 11 sectors as per the GICS – Energy, Materials, Industrials, Consumer Discretionary, Consumer Staples, Health Care, Financials, Information Technology, Communication Services, Utilities, and Real Estate. Six Sectors are classified as brown and five as green[2] – as per MSCI ESG Research on Carbon Footprinting (2015) and The MSCI Net-Zero Tracker, October 2021 (A report that gauges the world's listed companies' progress towards reducing climate risk). The estimations of carbon footprint in the MSCI ESG Research report have been done as per scope 1 plus scope 2 emissions[3]. In the MSCI Net-Zero Tracker report, the estimations of the implied temperature increase resulting from activities of each of the GICS sectors have been computed using Scope 1, 2, and 3 emissions. Scope 3 emissions comprise emissions that the companies are indirectly responsible for - such as emissions that result from purchasing, using, and disposing of products from suppliers.[4] To a great extent, these emissions cannot be controlled by companies. Since only Scope 1 and Scope 2 emissions are the emissions that companies can directly control (mostly), they form the primary basis for the classification of firms into green and brown for the purpose of this study. Although, it is worth noting that the inclusion of Scope 3 emissions doesn't alter the classification[5]. The number of firms in each of these sectors has been displayed in Table 1.

The data on the rest of variables in the analysis is retrieved from Bloomberg. Variables

[2]The sectors are ranked from most to least polluting based on their emissions and the top 5 sectors are classified as brown, with the remaining as green.

[3]Scope 1 emissions: all direct GHG emissions from sources owned or controlled by the company, out of total emissions of the MSCI ACWI Index. Some examples include emissions from fossil fuels burned on site, emissions from entity-owned or leased vehicles. Scope 2 emissions: Indirect GHG emissions from consumption of purchased electricity, heat, or steam, and the transmission and distribution (T&D) losses associated with some purchased utilities.

[4]Scope 3 emissions are not produced by the companies themselves i.e these emissions aren't the by-product of the activities carried out by companies' owned or controlled assets.

[5]As a check to determine if the classification is accurate in light of the time period selected, we rank sectors according to the average emissions' intensity ratio (calculated by dividing Scope 1 and Scope 2 emissions by Total Assets) and then classify firms into green and brown sectors. The classification remains unchanged.

Table 1: Classification of sectors in the dataset

Panel A: Brown Firms

Sector	Number of Firms
Utilities	29
Materials	28
Industrials	71
Energy	21
Consumer Discretionary	60
Consumer Staples	32
Total	241

Panel B: Green Sectors

Sector	Number of Firms
Real Estate	29
Information Technology	75
Health Care	64
Financials	67
Communication Services	26
Total	261

Notes: This table presents the classification of sectors in the dataset used for this study. Panel A displays the sectors classified as brown and the number of firms in each of these sectors. Panel B displays the sectors classified as green and the number of firms in each of these sectors.

(other than EPS) employed in this study are Operating Return on Assets (to gauge FP – the second endogenous variable). Cash Flow from Operations to Sales is a performance ratio used to measure a firm's ability to generate cash flow in proportion to its sales (this ratio is used to gauge the efficiency level of firms). Environmental disclosure score (EDS) – this score ranges from 0 to 100, the more the environmental information disclosed the higher the score. The remaining variables in the empirical specification of the model are (respectively proxying for) total assets (firm size), total debt to total assets (firm level of leverage) and capital intensity measured as the ratio of total assets to revenue (another indicator of firm efficiency). The summary statistics (mean, standard deviation, minimum and maximum values) for brown firms (firms in all brown sectors combined) and green firms (firms in all green sectors combined) for all variables employed in this study are presented in Table 2.

The summary statistics show that environmental pillar scores are higher for brown firms than for green firms. This can be attributed to the fact that brown firms are generally under higher regulatory and stakeholder pressure when it comes to environmental performance as opposed to green firms. This is also reflected in the environmental disclosure score – it is substantially higher for brown firms compared to green firms. De Villiers and Van Staden

Table 2: Descriptive statistics for variables

Panel A: Summary statistics for Brown Firms

Variable	Obs	Mean	Std. Dev.	Min	Max
Environmental Pillar Score	2032	49.411	28.272	0	98.546
Operating Return on Assets	2093	10.693	9.875	-74.677	67.124
Cash Flow from Operations to Sales	2110	16.554	13.754	-199.721	77.584
Total Debt to Total Assets	2109	34.508	26.59	0	389.205
Log (Total Assets)	2110	9.696	1.176	4.665	13.437
Sales Growth	2101	4.673	20.979	-83.536	387.227
Capital Intensity	2078	1.916	1.556	0.22	16.474
Environmental Disclosure Score	1958	29.686	20.291	0	84.416

Panel B: Summary statistics for Green Firms

Variable	Obs	Mean	Std. Dev.	Min	Max
Environmental Pillar Score	2185	45.178	28.22	0	97.65
Operating Return on Assets	2304	8.427	9.451	-49.189	83.233
Cash Flow from Operations to Sales	2321	24.89	24.675	-762.291	252.301
Total Debt to Total Assets	2314	25.131	20.223	0	146.606
Log (Total Assets)	2317	9.887	1.747	3.894	15.035
Sales Growth	2316	10.514	32.711	-83.883	1234.344
Capital Intensity	2254	5.316	6.783	0.18	45.249
Environmental Disclosure Score	1973	22.671	19.749	0	89.922

Notes: This table presents descriptive statistics for variables used in this study.

Panel A summarizes the descriptive statistics for data on these variables for brown firms.

Panel B summarizes the descriptive statistics for data on these variables for green firms.

(2011) argue that firms with bad environmental reputation and firms faced with environmental crisis are more likely to disclose environmental information. It is plausible that such firms are more likely to be firms belonging to brown sectors and hence, these firms disclose more as well as pursue higher environmental initiatives to become 'greener'.

4 Hypothesis development and Research methodology

4.1 Hypothesis development

This study seeks to understand 'For whom does it pay to be green?' (EP-FP relationship) as well as 'Who can afford to pay to be green?' (FP-EP relationship) amongst firms. To address these questions, the role of sectors of economic activity in determining the intertwined EP-FP relationship is important. Much of the previous research in this area has focused on devising different methodologies and considering the role of various factors in establishing the relationship between EP and FP.

Very few researchers have explored the impact of belonging to a particular sector on the EP-FP relationship. Liu (2020) conducts a multi-level longitudinal bi-directional analysis and finds that although the impact of EP on FP is heterogeneous across industries and companies, the effect of FP on EP does not vary across industries. Yet, no attempt is made to examine the factors behind the identified heterogeneity, and ultimately responsible for the variation across different industries. Semenova and Hassel (2016) include the industry's environmental risk and environmental policy as a moderating variable in their model that determines the relationship between FP and EP. Qi et al. (2014) show that industry-level environmental performance positively impacts a firm's financial performance. Lucas and Noordewier (2016) explore industry pollution-related factors as moderators in the relationship between FP and EP. They find that relatively dirty and non-proactive industries benefit more (in terms of improved financial performance) from engaging in environmental management practices.

Our contribution to this literature on the impact of sectoral/industrial characteristics on the relationship between EP and FP is threefold. First, by classifying the sectors into brown and green on the basis of carbon intensity, the current study specifies the source of heterogeneity in the results. Second, the simultaneous EP-FP relationship is analysed separately for green and brown firms instead of employing a dummy variable to control for industry membership or including an industry-specific variable (for example, to capture industry-specific environmental risk) as a moderating variable. The separate modeling of the EP-FP relationship across sectors introduces additional flexibility in the value of the model parameters associated to all the covariates than the simple inclusion of a sector-specific fixed effect. Third, the current study also elucidates the sectoral differences in the less explored relationship given by the impact of FP on EP. Therefore, the following hypotheses are tested in the current analysis:

Hypothesis-1: The impact of environmental performance (EP) on financial performance (FP) is negative for brown firms and positive for green firms.

Hypothesis-2: The impact of financial performance (FP) on environmental performance (EP) is positive for brown firms and negative for green firms.

4.2 Empirical Methodology

Structural equation modelling (SEM) is adopted to study the simultaneous effects of EP on FP and FP on EP. As it is established in the literature that not only EP impacts FP but FP also affects EP, structural equation models have been used to deal with this bi-directional relationship. The proposed empirical specification considers nonrecursive structural equation models for parameter estimation in the presence of reverse causality. This choice allows us to accommodate the presence of mutual correlation between the errors of the different equations in the SEM, see Wang and Wang (2019).

4.2.1 Model Specification

As discussed above, it is well-established in the literature that EP and FP cause each other. Therefore, the OROA (FP) is determined by EPS (EP) and controls. And, the EPS (EP) is determined by OROA (FP) and controls. Next, leverage, firm growth, firm size, and efficiency level are employed as controls in equation 1. Leverage is found to have a negative impact on OROA by some studies (Iwata and Okada, 2011; Semenova and Hassel, 2016; Zahid et al., 2020). Firm growth (measured by sales growth) is expected to have a positive impact on its OROA (Lahouel et al., 2022; Wang and Chen, 2022). Firm size is expected to positively influence the OROA, i.e. bigger firms have better ROA (Iwata and Okada, 2011), although other studies point towards the existence of a negative impact of firm size on ROA (Semenova and Hassel, 2016; Hassan and Romilly, 2018; Wang and Chen, 2022). A possibility we allow for is that the impact of firm size on OROA differs across sectors. Finally, the efficiency level is expected to exhibit a positive relationship with operational performance. Two measures of efficiency, namely, capital intensity ratio and cash flow from operations to sales ratio have been employed as measures of efficiency in our empirical specification. A lower capital intensity ratio and a higher cash flow from operations to sales ratio should imply better efficiency. It is expected that capital intensity ratio has a negative impact on OROA and cash flow from operations to sales ratio have a positive impact on OROA. On the other hand Clarkson et al. (2011) finds that EPS is determined by firm leverage, growth and size, and are therefore included in its specification. Leverage is expected to negatively impact the decision to pursue an environmentally proactive strategy while firm growth and size should have a positive impact on the take-up of pro-environmental strategies. Last, the environmental disclosure score is also included, since Lu and Taylor (2018) finds that it positively affects environmental performance, albeit with a lag ((Al-Tuwaijri et al., 2004; Lu and Taylor, 2018).) The reson being that previous years' level of environmental disclosure forms the basis for investor's expectations in the current year. Hence, the following model specification has been employed in this study:

$$\begin{aligned} OROA_{it} = \beta_0 + \beta_1 EPS_{it} + \beta_2 TD/TA_{it} + \beta_3 CapitalIntensity_{it} \\ +\beta_4 ln(TA)_{it} + \beta_5 Cfo/Sales_{it} + \beta_6 SalesGrowth_{it} + \rho_s(\alpha_i) + \mu_t + \epsilon_{it} \end{aligned} \tag{1}$$

$$\begin{aligned} EPS_{it} = \delta_0 + \delta_1 OROA_{it} + \delta_2 TD/TA_{it} + \delta_3 Salesgrowth_{it} \\ +\delta_4 ln(TA)_{it} + \delta_5 EnvDisclScore_{i(t-1)} + \rho_s(\alpha_i) + \mu_t + u_{it} \end{aligned} \tag{2}$$

where, $OROA_{it}$ is the Operating Return on Assets for company 'i' in sector 's' at time 't'; EPS_{it} is the Environmental Pillar Score for company 'i' in sector 's' at time 't'; TD/TA_{it} is the Total Debt to Total Assets ratio for company 'i' in sector 's' at time 't'; $CapitalIntensity_{it}$ is the Total Assets to Total Revenue ratio for company 'i' in 's' sector at time 't'; $ln(TA)_{it}$ is the natural log of Total Assets for company 'i' in sector 's' at time 't'; $Cfo/Sales_{it}$ is the Cash Flow from Operations to Sales ratio for company 'i' in sector 's' at time 't'; $SalesGrowth_{it}$ is the percentage growth in sales of company 'i' in sector 's' at time 't'; $EnvDisclScore_{i(t-1)}$ is the Environmental Disclosure Score for company 'i' in sector 's' at time 't-1'; α_i is shorthand for firm dummies, μ_t is shorthand for year dummies and ϵ_{it} and u_{it} are the error terms.

We impose the exogeneity of the regressors given by the conditions $cov(u_{it}, z_{it}) = 0$ and $cov(\epsilon_{it}, z_{it}) = 0$ (where z_{it} is shorthand for all covariates in the model). Nonrecursive SEM models allow, however, for mutual correlation between the errors of each equation ϵ_{it} and

u_{it}[6]. It is also assumed that errors are serially uncorrelated i.e. $cov(u_{it}, u_{i(t-j)}) = 0$ and $cov(\epsilon_{it}, \epsilon_{i(t-j)} = 0)$. Additionally, it is assumed that ϵ_{it} and u_{it} are normally distributed.

4.2.2 Model Identification

The model is identified if there is at least one solution to the system of equations. Three conditions are required for model identification - in this case:

1) Since this is a non-recursive model where OROA and EPS are determined endogenously implying that OROA and EPS are connected to each other by two unidirectional paths (one originating from OROA and terminating at EPS and the other originating from EPS and terminating at OROA), model estimation would require the use of variables that act as instruments to achieve model identification (Finch and French, 2015; Wang and Wang, 2019) i.e. an instrumental variable should have a direct path to one of the endogenous variables in the feedback loop but it must not have any direct path to the other endogenous variable (Martens and Haase, 2006). Following this, for equation (1) to be identified, at least one instrumental variable must bear a direct impact on OROA but not on EPS, and for equation (2) to be identified, at least one instrumental variable must have a direct impact on EPS but not OROA.

2) The order condition[7] is satisfied i.e. the degrees of freedom should be either zero (just-identified) or greater than zero (over-identified) to have a unique or more than one solution, respectively.

3) The rank condition[8] is satisfied. The rank condition states that any particular equation within a system of G equations is identified if and only if it is possible to construct at least one non-zero determinant of order (G-1) from the coefficients of variables that were excluded from that equation but that were contained in the other equations.

For the first condition to be satisfied, Cfo/Sales ratio and Capital Intensity ratio have been employed as instruments for OROA. Both Cfo/Sales and Capital Intensity ratios are measures of efficiency. Cfo/Sales ratio measures a company's ability to generate cash from

[6] The estimation was carried out using uncorrelated errors too and the results (coefficients and standard errors) were very similar compared to the case with correlated errors with the exception that results for Equation (1) for green firms were distinctive.

[7] The order condition is necessary but not sufficient for identification.

[8] The rank condition is a necessary and sufficient condition for identification.

its sales and it is expected to have a direct effect on OROA while it doesn't necessarily have an impact on the environmental efforts of a company. Similarly, the Capital Intensity ratio, measured as the ratio of assets to revenue, also reflects the efficiency level of a company by gauging its ability to generate revenue using its assets. Capital Intensity ratio is widely used as a determinant of the return on assets of a company (Russo and Fouts, 1997; Rokhmawati et al., 2015), but it doesn't necessarily have a direct impact on environmental performance of a firm[9]. To test the validity[10] of these instrumental variables, over-identification tests are performed using the instrumental variable approach. The over-identification test results confirm the presence of endogeneity, strength of instruments and satisfaction of exclusion restriction in both cases, i.e. for both green and brown firms. The Sargan statistic value confirms that Cfo/Sales and Capital Intensity ratio jointly satisfy the exclusion restriction and the results of the Stock-Yogo test for weak instruments confirm that the selected instruments are strong. These tests provide evidence of appropriate identification of equation (1).

Equation (2) is exactly identified using the lagged environmental disclosure score as instrument for EPS measured at time t. Thus, in contrast to equation (1), conducting formal over-identification tests to prove the validity of the instrument for equation (2) is not possible. Instead, we motivate the choice of the lagged environmental disclosure score as a valid instrument using theoretical insights. The lagged environmental disclosure score directly affects the environmental performance in the current year but does not affect OROA (FP). There are two reasons behind this. First, environmental disclosure may directly affect the market-based measures (such as change in the firm's stock price and firm value, measured by market capitalization) of economic/financial performance as these measures reflect investor perceptions. However, it is unlikely to affect the OROA, which measures the operational efficiency of a firm, which is used as a measure of financial performance

[9] Capital Intensity has been measured as the inverse of the assets turnover ratio and doesn't reflect the capital expenditures of a company to build fixed assets. Therefore, it has not been assumed to influence environmental performance in this analysis and its validity as an instrument for financial performance is formally tested.

[10] An instrument is said to be valid if it 1) affects the independent variable directly and significantly and, 2) doesn't have a direct impact on the dependent variable i.e. if it affects the response variable only through the independent variable.

in our analysis. The market-based measures of economic performance have been used by Lu and Taylor (2018) and Al-Tuwaijri et al. (2004) and hence they include environmental disclosure as a determinant of financial performance. The results of Lu and Taylor (2018) indicate that the lagged environmental disclosure does not have a significant effect on financial performance. Freedman and Jaggi (1982) also show that there is no association between accounting-based measures of financial performance (such as OROA) and environmental information disclosure. Second, there may be an association between environmental disclosure and OROA but there is no direct causal relationship between environmental disclosure and OROA. For example, a firm might improve its environmental performance thereby improving operational efficiency in a given year and hence, disclose more in the same year. In this case, environmental performance may affect environmental disclosure as well as financial performance, but this does not amount to environmental disclosure impacting OROA. Also, these are contemporaneous associations, instead of lagged as we do here.

For the second condition to be satisfied, the number of structural parameters minus the number of reduced form parameters must be either equal to zero (just-identified) or greater than zero (over-identified). In the model above, the structural parameters to be estimated are 13 and the reduced form parameters are 14. Therefore, the degrees of freedom equal one implying that the model is over-identified.

For the third condition to be satisfied, we follow the procedure in Berry (1984) and find that the rank condition satisfies.

4.2.3 Model Estimation

Model estimation has been done using generalized structural equation modelling (GSEM). This method uses maximum likelihood procedures to estimate the model parameters and permits the inclusion of unobservable factors in the model specification. We take advantage of this possibility to account for the presence of fixed effects in a panel data setting. This is done by including dummies as factor variables. Fixed effects in this setting are interpreted as capturing unobserved sources of heterogeneity at the sectoral level. While GSEM enables the inclusion of fixed effects via factor variables, it does not allow computation of fit statistics (such as the chi-squared value, root mean square error of approximation, Tucker-Lewis index, and Comparative Fit Index) that help evaluate the goodness of fit of the model.

The model has been estimated for all brown firms and all green firms separately, pooling across different sectors, which is why fixed effects in this setting are crucial. The estimation is done in three main settings: 1) with sector fixed effects (FEs) 2) with firm FEs (which includes sector FEs) and 3) with firm and time FEs. In the first setting (with sector FEs) - sector dummies are employed, in the second setting (with firm FEs), firm dummies are employed and, in the third setting (with firm and time dummies), firm and time dummies are employed. Finally, the standard errors have been clustered at the firm level to address the possibility of serial correlation among observations of a firm.

5 Results

The results for green firms are reported in Tables 3 and 4. Table 3 reports results for the impact of environmental performance on financial performance, while Table 4 reports on the impact of financial performance on environmental performance. The results indicate that the impact of EP on FP is positive and the impact of FP on EP is negative for green firms. A one-unit increase in EPS leads to a 12.3%, 11.3%, and 7.52% increase in OROA in settings with sector, firm, and firm & time FEs respectively. However, EP is only significant in the first two settings - with sector FEs and firm FEs. On the other hand, FP is not significant in any of the settings, as can be observed from Table 4. Even though the results do not display strong statistical significance, inference about the direction of the effects/sign of the coefficients can be drawn.

The positive coefficient of EP suggests that an improvement in environmental performance translates into financial benefits contemporaneously for green firms. This result is plausible because firms in green industries can enhance their environmental performance with relatively small efforts in terms of financial investments and this translates into an improvement in financial performance. On the other hand, the negative coefficient of FP on the EP equation suggests that there can be a diversion of firms' investment towards endeavours other than the ones that improve environmental performance - endeavours that firms deem more profitable compared to enhancing environmental performance (Aigbedo,

Table 3: Impact of Environmental Performance on Financial Performance: Green Firms

	(1)	(2)	(3)
Dependent Variable: Operating Return on Assets (FP)			
Environmental Pillar Score (EP)	0.123**	0.113**	0.0752
	(0.0530)	(0.0519)	(0.0848)
Cash Flow from Operations to Sales	0.0990***	0.0579*	0.0613*
	(0.0333)	(0.0346)	(0.0333)
Sales Growth	0.0470*	0.0671***	0.0668***
	(0.0242)	(0.0205)	(0.0206)
Total Debt to Total Assets	0.0152	-0.0383	-0.0460
	(0.0301)	(0.0370)	(0.0378)
Capital Intensity	-0.472***	-0.259**	-0.137
	(0.0774)	(0.110)	(0.124)
ln (Total Assets)	-1.078**	-2.642**	-3.073***
	(0.523)	(1.116)	(1.089)
Constant	7.840**	28.63***	34.61***
	(3.784)	(9.040)	(9.910)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 2 (in the system of equations) when SEM estimation is performed using green firms' data. Standard errors are clustered at the firm level to take into account the effects of autocorrelation and heteroskedasticity. The variable of interest here is EPS (EP) and the results indicate that a one point increase in EPS (EP) leads to an increase of 12/3%, 11.3%, and 7.52% in OROA (FP). The results are significant in settings (1) and (2).

*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

2021). Since green firms are faced with lower regulatory attention, they may not prioritize improving their EP like brown firms.

In Table 3, the controls - cash flow from operations to sales, sales growth, total debt to total assets and capital intensity have the expected signs. Size has a negative impact on OROA indicating that smaller firms have better operating financial performance. In Table

Table 4: Impact of Financial Performance on Environmental Performance: Green Firms

	(1)	(2)	(3)
Dependent Variable: Environmental Pillar Score (EP)			
Operating Return on Assets (FP)	-0.473	-0.0103	-0.264
	(0.407)	(0.316)	(0.292)
Total Debt to Total Assets	-0.173**	-0.0669	-0.131**
	(0.0859)	(0.0573)	(0.0585)
Sales Growth	0.0401	-0.0329	-0.0193
	(0.0536)	(0.0276)	(0.0251)
ln (Total Assets)	1.364	7.072***	1.665
	(1.336)	(1.692)	(1.828)
Environmental Disclosure Score	0.482***	0.462***	0.299***
	(0.0922)	(0.0648)	(0.0665)
Constant	25.20*	-53.74***	14.24
	(13.53)	(15.45)	(19.17)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 2 (in the system of equations) when SEM estimation is performed using green firms' data. Standard errors are clustered at the firm level to take into account the effects of autocorrelation and heteroskedasticity. The variable of interest here is OROA (FP) and the results indicate that a one percent increase in OROA (FP) may lead to a decrease in EPS (EP). The coefficients of OROA are insignificant in settings (1), (2), and (3).

*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

4, the controls - leverage, size, and environmental disclosure score have the expected signs while sales growth has negative coefficients in specifications (2) and (3), indicating that firms growing faster perform worse environmentally.

The results for brown firms are reported in Tables 5, for the impact of environmental performance on financial performance, and 6 for the second structural equation. While the impact of EP on FP is negative, the impact of FP on EP is positive. The coefficient of EP in Table 5 is insignificant yet negative in all specifications. Brown sectors suffer a decline in their operating return on assets (FP) when they increase their environmental investments (EP) - at least contemporaneously. This could result from the fact that brown sectors usually require massive investments to alter their processes (as these processes are more capital intensive[11]) to improve their environmental performance (for example, by reducing emissions) and the benefits of doing so are more likely to be realized with a lag rather than contemporaneously. The control variables - cash flow from operations to sales, sales growth and capital intensity have the expected signs. Total debt to total assets ratio (measuring leverage) has a positive coefficient in all three specifications, indicating a positive effect on OROA. Firm size is found to have a negative impact on OROA indicating that larger firms have lower operational efficiency.

The coefficient of FP in Table 6 is found to be positive and significant in the specifications with firm FEs and firm and time FEs indicating that one percent increase in OROA results in 0.50 and 0.38 unit increase in EPS, respectively. These results suggest that when brown firms experience an improvement in their financial performance, they invest more in environmental initiatives. This behaviour of brown firms can be attributed to the strict regulations and further regulatory scrutiny that brown sectors are subject to. These sectors are under more pressure from regulators and stakeholders to improve their environmental performance compared to firms in green sectors, and therefore they are more likely to prioritize investment in environmental initiatives. This is why they invest more in enhancing their EP as soon as their FP improves. The control variables - size and environmental disclosure score, have expected signs while total debt to total assets ratio and sales growth have signs that do not align with expectations. The negative impact of leverage on EP is also different than that of green firms. This dichotomous finding pertaining to leverage may be the result of different approaches of green and brown firms regarding environmental performance. Brown firms' leverage is positively associated with environmental performance as these firms might take on more debt to enhance their environmental performance while highly leveraged green firms' may not prioritize environmental performance and as a result, reduce their environmental efforts.

[11] To verify this, we compute brown and green firms' Capital Expenditure to Sales (Capex/Sales) and Property, Plant, and Equipment to Total Assets (PP&E/TA) ratios, and find that brown firms have higher Capex/Sales and PP&E ratios, on average, relative to green firms.

Table 5: Impact of Environmental Performance on Financial Performance: Brown Firms

	(1)	(2)	(3)
Dependent Variable: Operating Return on Assets (FP)			
Environmental Pillar Score (EP)	-0.0534	-0.0581	-0.121
	(0.0447)	(0.0738)	(0.177)
Cash Flow from Operations to Sales	0.306***	0.306***	0.312***
	(0.0493)	(0.0523)	(0.0552)
Sales Growth	0.0272*	0.0617***	0.0552***
	(0.0160)	(0.0156)	(0.0150)
Total Debt to Total Assets	0.0630**	0.0123	0.0130
	(0.0310)	(0.0545)	(0.0532)
Capital Intensity	-4.175***	-1.845***	-1.816***
	(0.514)	(0.617)	(0.647)
ln (Total Assets)	-1.655***	-2.440*	-2.489*
	(0.514)	(1.291)	(1.377)
Constant	31.25***	37.19***	42.62***
	(4.832)	(11.38)	(13.31)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parentheses) for Equation 1 (in the system of equations) when SEM estimation is performed on brown firms only. Standard errors are clustered at the firm level to take into account the effects of autocorrelation and heteroskedasticity. The variable of interest here is EPS (EP) and the results indicate that the impact of one point increase in EPS (variable of interest) may have a negative impact on OROA (outcome variable). The results are insignificant in settings (1),(2), and (3).
*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Overall, the results indicate that brown sectors and green sectors have opposite bi-directional relationships, lending support to hypothesis i) i.e. that the impact of environmental performance on financial performance is negative for brown firms and positive for green firms and, hypothesis ii), i.e. that the effect of financial performance on environmental performance is positive for brown firms and negative for green firms. It is also evident

Table 6: Impact of Financial Performance on Environmental Performance: Brown Firms

	(1)	(2)	(3)
Dependent Variable: Environmental Pillar Score (EP)			
Operating Return on Assets (FP)	0.577	0.503**	0.378*
	(0.407)	(0.228)	(0.218)
Total Debt to Total Assets	-0.00865	0.0616	0.0161
	(0.0553)	(0.0642)	(0.0512)
Sales Growth	-0.0807*	-0.0481**	-0.0441*
	(0.0425)	(0.0238)	(0.0227)
ln (Total Assets)	4.948**	7.880***	4.754**
	(2.131)	(1.860)	(1.862)
Environmental Disclosure Score	0.378***	0.216***	0.102**
	(0.0717)	(0.0402)	(0.0462)
Constant	-22.52	-32.43	13.27
	(23.19)	(20.72)	(22.19)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parentheses) for Equation 2 (in the system of equations) when SEM estimation is performed on brown firms only. Standard errors are clustered at the firm level to take into account the effects of autocorrelation and heteroskedasticity. The variable of interest here is OROA (FP) and the results indicate that a one percent increase in OROA leads to a 0.58, 0.50, and 0.38 points increase in EPS (EP) in settings (1), (2), and (3) respectively. The coefficients of EPS are significant in settings (2) and (3).

*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

from the results the asymmetry in the relationship between EP and FP for brown and green sectors. For green firms - the impact of EP on FP is stronger (more significant) than the impact of FP on EP, while for brown firms - the impact of FP on EP is stronger (more significant) than the impact of EP on FP.

Although the results for green firms appear weak i.e. they become insignificant when time-fixed effects are accounted for – it is perceptible that the EP-FP bi-directional relationship is completely opposite for brown firms compared to green firms. Turning to the questions 'For whom does it pay to be green?' and 'Who pays to be green?' the results indicate that what can be said with some certainty is that it does not pay to be green (contemporaneously) for brown firms. In contrast, it pays to be green for green firms. And, brown firms pay to be green (contemporaneously) i.e. the costs of becoming greener outweigh the benefits of doing so, while the opposite appears to be true for green firms.

6 An Alternative Estimation Approach

Another full-information technique[12] that is widely used to solve simultaneous equations to address the problem of endogeneity and correlated errors is three stage least squares (3SLS). The 3SLS procedure can be broadly explained in two steps. First, 3SLS estimates the equation disturbances' variance/covariance matrix using residuals from two stage least squares (2SLS). Second, this matrix is used as the sandwich matrix in GLS estimation performed on the set of equations in the system (Paxton et al., 2011). The 3SLS approach has been adopted to gauge the consistency of results across different estimation techniques. Tables 7 and 8 in the appendix report the results for green firms, and Tables 9 and 10 for brown firms.

The analysis of this robustness exercise shows important similarities between the estimates obtained from the SEM approach and 3SLS. The direction and magnitude of the bi-directional effects are very similar for both brown and green firms. The results for green firms in Tables 7 and 8 are comparable with the results from Tables 3 and 4, respectively. The SEM results for green firms indicate that the effect of EP on FP is more significant than the effect of FP on EP - this is evident from 3SLS estimation results as well. Similarly, the results for brown firms in Tables 9 and 10 are comparable to the results in Tables 5 and 6, respectively. The results for brown firms from both estimation methods indicate that the effect of FP on EP is stronger and more significant than the effect of EP on FP.

Lastly, it has been found in the literature that past values of EP affect FP and vice versa. To rule out the possibility of incorrectly capturing the EP-FP contemporaneous relationship, we estimate the following model (with lagged EP and FP added to equation

[12] Full-information techniques make use of all information from all equations in a model of simultaneous equations and, therefore, take into account the correlation between residuals of these equations.

1 and equation2) using 3SLS[13]. The following model is estimated:

$$OROA_{it} = \beta_0 + \beta_1 EPS_{it} + \beta_2 TD/TA_{it} + \beta_3 CapitalIntensity_{it} + \beta_4 ln(TA)_{it} +$$
$$\beta_5 Cfo/Sales_{it} + \beta_6 SalesGrowth_{it} + \beta_7 EPSi(t-1) + \beta_8 OROA_{i(t-1)} + \rho_s(\alpha_i) + \mu_t + \epsilon_{it} \tag{3}$$

$$EPS_{it} = \delta_0 + \delta_1 OROA_{it} + \delta_2 TD/TA_{it} + \delta_3 Salesgrowth_{it} + \delta_4 ln(TA)_{it} +$$
$$\delta_5 EnvDisclScore_{i(t-1)} + \beta_6 EPS_{i(t-1)} + \beta_8 OROA_{i(t-1)} + \rho_s(\alpha_i) + \mu_t + u_{it} \tag{4}$$

The results are reported in the appendices. Table 11 and Table 12 report the results for green firms and Table 13 and Table 14 report the results for brown firms. The findings from this analysis point out that the significant coefficients (for variables of interest) provide similar results to those found in the main SEM model. For example, for brown firms, positive coefficients of FP are significant (Table 14) while for green firms positive coefficients of EP are significant (Table 11). Therefore, the analysis suggests that inclusion of lagged endogenous variables doesn't undermine the contemporaneous impact of EP on FP for green firms and FP on EP on brown firms.

7 Conclusion

This study contributes to the existing body of literature in several ways. First, we find an asymmetric relationship in the relationship between environmental and financial performance for brown and green firms. Green firms seem to be the winners in this relationship, increasing financial performance at the expense of lower required investment to be green. Brown firms, on the other hand, need to invest on environmental performance at the expense of financial performance. These empirical findings (partially) answer the questions of 'For whom does it pay to be green?' and 'Who pays to be green?'.

The results of the analysis can be useful for regulatory bodies and governments. There are long term and short term goals that public policy strives to achieve. Using sector-specific

[13]The model estimation performed using SEM didn't converge. Nonconvergence of the estimation process may be due to a violation of the assumption that predetermined variables are uncorrelated with the residuals - as it is unlikely that lagged endogenous variables are uncorrelated with the error terms. If the assumption of exogeneity of predetermined variables is violated then, the inclusion of such variables can lead to misspecification and hence, nonconvergence.

road maps developed in collaboration with industry is one way to bridge the gap between long-term pledges and short-term action plans. The basic conceptual model developed in this study can be useful for policy makers who seek to formulate sector-specific policy actions to incentivize environmentally friendly corporate behaviour and deter environmentally injurious corporate actions.

Further work should address some of the limitations of the study. First, the basis of classification into green and brown is very broad. Even though largely the brown sectors contain firms that are high emitters (of greenhouse gases) and green sectors are comprised of firms that are low emitters, it is not inconceivable that some firms in brown sectors are green and clean and some firms in green sectors are brown and dirty. Second, the impact of EP and FP on each other have been studied contemporaneously and it is likely that the impact of improved EP takes time to translate into improved FP and vice versa. Furthermore, this lag can be different for green and brown sectors. Lastly, 'E' of ESG may be subject to some degree of effort to 'green wash to appear greener' than actually 'becoming greener'. Hence, addressing these limitations to come up with a clearer classification of brown and green firms and, combining some measures of environmental performance to formulate a more comprehensive indicator of environmental efforts would be welcome in future research.

A Appendix

Table 7: Impact of Environmental Performance on Financial Performance: Green Firms

	(1)	(2)	(3)
Dependent Variable: Operating Return on Assets (FP)			
Environmental Pillar Score (EP)	0.123***	0.113***	0.0752
	(0.0244)	(0.0279)	(0.0475)
Cash Flow from Operations to Sales	0.0990***	0.0578***	0.0613***
	(0.00753)	(0.00789)	(0.00776)
Sales Growth	0.0470***	0.0670***	0.0668***
	(0.0116)	(0.00745)	(0.00743)
Total Debt to Total Assets	0.0152	-0.0383***	-0.0460***
	(0.0125)	(0.0147)	(0.0156)
Capital Intensity	-0.472***	-0.261**	-0.137
	(0.0403)	(0.107)	(0.108)
ln (Total Assets)	-1.078***	-2.638***	-3.073***
	(0.195)	(0.530)	(0.477)
Constant	7.840***	28.60***	33.18***
	(1.487)	(4.272)	(4.183)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 1 (in the system of equations) when 3SLS estimation is performed using green firms' data. The variable of interest here is EPS (EP) and the results indicate that a one point increase in EPS leads to a 12.3%, 11.3% and 7.52% increase in OROA (FP). The coefficient of EPS is significant in settings (1) and (2). *,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 8: Impact of Financial Performance on Environmental Performance: Green Firms

	(1)	(2)	(3)
Dependent Variable: Environmental Pillar Score (EP)			
Operating Return on Assets (FP)	-0.472**	-0.00774	-0.264
	(0.207)	(0.302)	(0.306)
Total Debt to Total Assets	-0.173***	-0.0668	-0.131***
	(0.0409)	(0.0412)	(0.0425)
Sales Growth	0.0400	-0.0330	-0.0193
	(0.0417)	(0.0270)	(0.0270)
ln (Total Assets)	1.365**	7.077***	1.665
	(0.600)	(1.115)	(1.371)
Environmental Disclosure Score	0.482***	0.462***	0.299***
	(0.0403)	(0.0362)	(0.0366)
Constant	25.19***	-53.80***	3.759
	(6.128)	(11.40)	(14.41)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 2 (in the system of equations) when 3SLS estimation is performed using green firms' data. The variable of interest here is OROA (FP) and the results indicate that a one percent increase in OROA leads to a 0.47, 0.008, and 0.26 point decrease in EPS in settings (1), (2) and (3) respectively. The coefficient of OROA is significant in setting (1).

*,**,*** signify the significance levels at 10, 5 and 1% thresholds, respectively.

Table 9: Impact of Environmental Performance on Financial Performance: Brown Firms

	(1)	(2)	(3)
Dependent Variable: Operating Return on Assets (FP)			
Environmental Pillar Score (EP)	-0.0534*	-0.0581	-0.121
	(0.0274)	(0.0543)	(0.145)
Cash Flow from Operations to Sales	0.306***	0.307***	0.312***
	(0.0227)	(0.0263)	(0.0283)
Sales Growth	0.0272***	0.0617***	0.0552***
	(0.0103)	(0.00738)	(0.00862)
Total Debt to Total Assets	0.0630***	0.0123	0.0130
	(0.00777)	(0.0140)	(0.0138)
Capital Intensity	-4.175***	-1.845***	-1.816***
	(0.227)	(0.286)	(0.329)
ln (Total Assets)	-1.655***	-2.440***	-2.489***
	(0.251)	(0.728)	(0.844)
Constant	31.25***	37.19***	41.82***
	(1.969)	(6.140)	(7.074)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 1 (in the system of equations) when 3SLS estimation is performed using brown firms' data. The variable of interest here is EPS (EP) and the results indicate that a one point increase in EPS leads to a 5.34%, 5.81%, and 1.2% decrease in OROA (FP). The coefficient of EPS is significant in setting (1).
*,**,*** signify the significance levels at 10,5 and 1% thresholds, respectively.

Table 10: Impact of Financial Performance on Environmental Performance: Brown Firms

	(1)	(2)	(3)
Dependent Variable: Environmental Pillar Score (EP)			
Operating Return on Assets (FP)	0.577***	0.500***	0.376**
	(0.197)	(0.150)	(0.148)
Total Debt to Total Assets	-0.00862	0.0616**	0.0161
	(0.0304)	(0.0254)	(0.0255)
Sales Growth	-0.0807**	-0.0479***	-0.0440***
	(0.0378)	(0.0170)	(0.0165)
ln (Total Assets)	4.946***	7.873***	4.746***
	(0.894)	(1.064)	(1.125)
Environmental Disclosure Score	0.378***	0.216***	0.102***
	(0.0380)	(0.0230)	(0.0271)
Constant	-22.50**	-32.33**	6.990
	(9.743)	(12.68)	(13.46)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 2 (in the system of equations) when 3SLS estimation is performed using brown firms' data. The variable of interest here is OROA (FP) and the results indicate that a one percent increase in OROA leads to a 0.58, 0.50, and 0.37 point increase in EPS (EP). The coefficient of OROA is significant in settings (1),(2), and (3).

*,**,*** signify the significance levels at 10,5 and 1% thresholds, respectively.

Table 11: Impact of Environmental Performance on Financial Performance (in presence of lagged endogenous variables): Green Firms

	(1)	(2)	(3)
Dependent Variable: Operating Return on Assets (FP)			
Environmental Pillar Score (EP)	0.619**	0.0908*	-0.0114
	(0.258)	(0.0552)	(0.0842)
Cash Flow from Operations to Sales	0.0290***	0.0359***	0.0374***
	(0.00684)	(0.00710)	(0.00684)
Sales Growth	0.0399***	0.0680***	0.0672***
	(0.0126)	(0.00717)	(0.00699)
Total Debt to Total Assets	0.00613	-0.00310	-0.0153
	(0.0117)	(0.0143)	(0.0152)
Capital Intensity	-0.144***	-0.238**	-0.113
	(0.0420)	(0.0978)	(0.1000)
ln (Total Assets)	-0.362**	-1.812***	-2.482***
	(0.150)	(0.470)	(0.445)
Lagged Environmental Performance	-0.575**	-0.0518	0.00532
	(0.241)	(0.0388)	(0.0545)
Lagged Return on Assets	0.753***	0.399***	0.396***
	(0.0263)	(0.0232)	(0.0224)
Constant	-0.285	19.27***	26.55***
	(1.812)	(3.835)	(4.155)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 3 (in the system of equations) when 3SLS estimation is performed using green firms' data. The variable of interest here is EPS (EP) and the results indicate that a one point increase in EPS will lead to a 61.9% and a 9.08% increase in OROA (FP) in settings (1) and (2) and a 0.01% decrease in OROA in setting (3). The coefficient of EPS is significant in settings (1) and (2).

*,**,*** signify the significance levels at 10,5 and 1% thresholds, respectively.

Table 12: Impact of Financial Performance on Environmental Performance (in presence of lagged endogenous variables): Green Firms

	(1)	(2)	(3)
Dependent Variable: Environmental Pillar Score (EP)			
Operating Return on Assets (FP)	-0.529	-0.191	-0.253
	(0.352)	(0.369)	(0.392)
Total Debt to Total Assets	-0.00656	-0.0402	-0.0740**
	(0.0158)	(0.0338)	(0.0347)
Sales Growth	0.0498*	0.00375	0.00543
	(0.0262)	(0.0308)	(0.0318)
ln (Total Assets)	-0.247	2.153**	-0.230
	(0.267)	(1.079)	(1.367)
Environmental Disclosure Score	0.0570***	0.229***	0.155***
	(0.0183)	(0.0300)	(0.0317)
Lagged Environmental Performance	0.925***	0.644***	0.623***
	(0.00956)	(0.0220)	(0.0223)
Lagged Return on Assets	0.430	0.0803	0.0964
	(0.285)	(0.164)	(0.172)
Constant	7.892***	-13.87	11.71
	(2.545)	(10.62)	(13.97)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 4 (in the system of equations) when 3SLS estimation is performed using green firms' data. The variable of interest is OROA (FP) and the results indicate that a one percent increase in OROA leads to a 0.53, 0.19 and 0.25 point decrease in EPS (EP). The results are insignificant in all settings.

*,**,*** signify the significance levels at 10,5 and 1% thresholds, respectively.

Table 13: Impact of Environmental Performance on Financial Performance (in presence of lagged endogenous variables): Brown Firms

	(1)	(2)	(3)
Dependent Variable: Operating Return on Assets (FP)			
Environmental Pillar Score (EP)	-0.146	0.0536	0.0955
	(0.275)	(0.111)	(0.298)
Cash Flow from Operations to Sales	0.100***	0.233***	0.229***
	(0.0178)	(0.0284)	(0.0337)
Sales Growth	0.0475***	0.0800***	0.0740***
	(0.00894)	(0.00760)	(0.00855)
Total Debt to Total Assets	0.0275***	-0.00186	-0.00106
	(0.00634)	(0.0162)	(0.0179)
Capital Intensity	-1.475***	-0.445	-0.420
	(0.185)	(0.288)	(0.306)
ln (Total Assets)	-0.810***	-4.314***	-4.381***
	(0.159)	(0.644)	(0.625)
Lagged Environmental Performance	0.147	-0.0409	-0.0677
	(0.259)	(0.0663)	(0.164)
Lagged Return on Assets	0.642***	0.224***	0.228***
	(0.0215)	(0.0232)	(0.0242)
Constant	12.68***	48.97***	48.56***
	(1.717)	(6.183)	(10.10)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 3 (in the system of equations) when 3SLS estimation is performed using green firms' data. The variable of interest here is EPS (EP) and the results indicate that a one point increase in EPS leads to a 14.6% decrease in OROA (FP) and a 5.07%, and 9.55% increase in OROA. The results are insignificant in all settings.

*,**,*** signify the significance levels at 10,5 and 1% thresholds, respectively.

Table 14: Impact of Financial Performance on Environmental Performance (in presence of lagged endogenous variables): Brown Firms

	(1)	(2)	(3)
Dependent Variable: Environmental Pillar Score (EP)			
Return on Assets (FP)	-0.0216	0.388**	0.318*
	(0.194)	(0.191)	(0.190)
Total Debt to Total Assets	0.00732	0.0670***	0.0371
	(0.00986)	(0.0225)	(0.0229)
Sales Growth	-0.0119	-0.0437**	-0.0335*
	(0.0157)	(0.0193)	(0.0185)
ln (Total Assets)	0.0184	3.260***	1.597
	(0.311)	(1.125)	(1.179)
Environmental Disclosure Score	0.0292**	0.110***	0.0477*
	(0.0127)	(0.0217)	(0.0249)
Lagged Environmental Performance	0.935***	0.567***	0.550***
	(0.00815)	(0.0239)	(0.0241)
Lagged Return on Assets	0.0539	-0.0730	-0.0461
	(0.139)	(0.0654)	(0.0659)
Constant	2.653	-11.95	9.904
	(3.254)	(13.11)	(13.96)
Sector FEs	Yes	Yes	Yes
Firm FEs	No	Yes	Yes
Time FEs	No	No	Yes

Notes: This table contains estimates of coefficients and standard errors (in parantheses) for Equation 4 (in the system of equations) when 3SLS estimation is performed using green firms' data. The variable of interest is OROA (FP) and the results indicate that a one point increase in OROA leads to a 0.22-point decrease in EPS (EP) in setting (1) and a 0.39 and 0.32-point increase in EPS. The coefficients of EPS are significant in settings (2) and (3)

*,**,*** signify the significance levels at 10,5 and 1% thresholds, respectively.

References

Aigbedo, H. (2021). An empirical analysis of the effect of financial performance on environmental performance of companies in global supply chains. *Journal of Cleaner Production 278*, 121741.

Al-Tuwaijri, S. A., T. E. Christensen, and K. Hughes Ii (2004). The relations among environmental disclosure, environmental performance, and economic performance: a simultaneous equations approach. *Accounting, organizations and society 29*(5-6), 447–471.

Alareeni, B. A. and A. Hamdan (2020). Esg impact on performance of us s&p 500-listed firms. *Corporate Governance: The International Journal of Business in Society*.

Alexopoulos, I., K. Kounetas, and D. Tzelepis (2018). Environmental and financial performance. is there a win-win or a win-loss situation? evidence from the greek manufacturing. *Journal of Cleaner Production 197*, 1275–1283.

Berry, W. D. (1984). *Nonrecursive causal models*. Number 37. Sage.

Bhat, V. N. (1999). Does it pay to be green? *International Journal of Environmental Studies 56*(4), 497–507.

Bolton, P. and M. T. Kacperczyk (2020). Carbon premium around the world.

Choi, J.-S., Y.-M. Kwak, and C. Choe (2010). Corporate social responsibility and corporate financial performance: Evidence from korea. *Australian journal of management 35*(3), 291–311.

Clarkson, P. M., Y. Li, G. D. Richardson, and F. P. Vasvari (2011). Does it really pay to be green? determinants and consequences of proactive environmental strategies. *Journal of accounting and public policy 30*(2), 122–144.

Dal Maso, L., F. Mazzi, M. Soscia, and S. Terzani (2018). The moderating role of stakeholder management and societal characteristics in the relationship between corporate environmental and financial performance. *Journal of environmental management 218*, 322–332.

De Villiers, C. and C. J. Van Staden (2011). Where firms choose to disclose voluntary environmental information. *Journal of Accounting and Public Policy 30*(6), 504–525.

Endrikat, J., E. Guenther, and H. Hoppe (2014). Making sense of conflicting empirical findings: A meta-analytic review of the relationship between corporate environmental and financial performance. *European Management Journal 32*(5), 735–751.

Feldman, S. J., P. A. Soyka, and P. G. Ameer (1997). Does improving a firm's environmental management system and environmental performance result in a higher stock price? *The Journal of Investing 6*(4), 87–97.

Finch, W. H. and B. F. French (2015). Modeling of nonrecursive structural equation models with categorical indicators. *Structural Equation Modeling: A Multidisciplinary Journal 22*(3), 416–428.

Freedman, M. and B. Jaggi (1982). Pollution disclosures, pollution performance and economic performance. *Omega 10*(2), 167–176.

Hang, M., J. Geyer-Klingeberg, and A. W. Rathgeber (2019). It is merely a matter of time: A meta-analysis of the causality between environmental performance and financial performance. *Business Strategy and the Environment 28*(2), 257–273.

Hart, S. L. and G. Ahuja (1996). Does it pay to be green? an empirical examination of the relationship between emission reduction and firm performance. *Business strategy and the Environment 5*(1), 30–37.

Hassan, O. A. and P. Romilly (2018). Relations between corporate economic performance, environmental disclosure and greenhouse gas emissions: New insights. *Business strategy and the environment 27*(7), 893–909.

Heal, G. (2005). Corporate social responsibility: An economic and financial framework. *The Geneva papers on risk and insurance-Issues and practice 30*(3), 387–409.

Hoang, T.-H.-V., W. Przychodzen, J. Przychodzen, and E. A. Segbotangni (2020). Does it pay to be green? a disaggregated analysis of us firms with green patents. *Business Strategy and the Environment 29*(3), 1331–1361.

Iwata, H. and K. Okada (2011). How does environmental performance affect financial performance? evidence from japanese manufacturing firms. *Ecological Economics 70*(9), 1691–1700.

Klassen, R. D. and C. P. McLaughlin (1996). The impact of environmental management on firm performance. *Management science 42*(8), 1199–1214.

Lahouel, B. B., Y. B. Zaied, S. Managi, and L. Taleb (2022). Re-thinking about u: The relevance of regime-switching model in the relationship between environmental corporate social responsibility and financial performance. *Journal of Business Research 140*, 498–519.

Liu, Z. (2020). Unraveling the complex relationship between environmental and financial performance a multilevel longitudinal analysis. *International Journal of Production Economics 219*, 328–340.

López-Gamero, M. D., J. F. Molina-Azorín, and E. Claver-Cortés (2009). The whole relationship between environmental variables and firm performance: Competitive advantage and firm resources as mediator variables. *Journal of environmental management 90*(10), 3110–3121.

Lu, L. W. and M. E. Taylor (2018). A study of the relationships among environmental performance, environmental disclosure, and financial performance. *Asian Review of Accounting*.

Lucas, M. T. and T. G. Noordewier (2016). Environmental management practices and firm financial performance: The moderating effect of industry pollution-related factors. *International Journal of Production Economics 175*, 24–34.

Martens, M. P. and R. F. Haase (2006). Advanced applications of structural equation modeling in counseling psychology research. *The Counseling Psychologist 34*(6), 878–911.

Nakao, Y., A. Amano, K. Matsumura, K. Genba, and M. Nakano (2007). Relationship between environmental performance and financial performance: an empirical analysis of japanese corporations. *Business Strategy and the Environment 16*(2), 106–118.

Palmer, K., W. E. Oates, and P. R. Portney (1995). Tightening environmental standards: the benefit-cost or the no-cost paradigm? *Journal of economic perspectives 9*(4), 119–132.

Pastor, L., R. F. Stambaugh, and L. A. Taylor (2021). Dissecting green returns. Technical report, National Bureau of Economic Research.

Paxton, P., J. R. Hipp, S. Marquart-Pyatt, and S. T. Marquart-Pyatt (2011). *Nonrecursive models: Endogeneity, reciprocal relationships, and feedback loops*, Volume 168. Sage Publications.

Pedersen, L. H., S. Fitzgibbons, and L. Pomorski (2021). Responsible investing: The esg-efficient frontier. *Journal of Financial Economics 142*(2), 572–597.

Porter, M. (1996). America's green strategy. *Business and the environment: a reader 33*, 1072.

Qi, G. Y., S. X. Zeng, J. J. Shi, X. Meng, H. Lin, and Q. Yang (2014). Revisiting the relationship between environmental and financial performance in chinese industry. *Journal of environmental management 145*, 349–356.

Qureshi, M. A. and T. Ahsan (2022). Do investors penalize the firms disclosing higher environmental performance? a cross cultural evidence. *Environmental Science and Pollution Research*, 1–14.

Riillo, C. A. F. (2017). Beyond the question "does it pay to be green?": How much green? and when? *Journal of Cleaner Production 141*, 626–640.

Rokhmawati, A., M. Sathye, and S. Sathye (2015). The effect of ghg emission, environmental performance, and social performance on financial performance of listed manufacturing firms in indonesia. *Procedia-Social and Behavioral Sciences 211*, 461–470.

Russo, M. V. and P. A. Fouts (1997). A resource-based perspective on corporate environmental performance and profitability. *Academy of management Journal 40*(3), 534–559.

Semenova, N. and L. G. Hassel (2016). The moderating effects of environmental risk of the industry on the relationship between corporate environmental and financial performance. *Journal of Applied Accounting Research*.

Wagner, M., N. Van Phu, T. Azomahou, and W. Wehrmeyer (2002). The relationship between the environmental and economic performance of firms: an empirical analysis of the european paper industry. *Corporate social responsibility and Environmental Management 9*(3), 133–146.

Wang, J. and X. Wang (2019). *Structural equation modeling: Applications using Mplus*. John Wiley & Sons.

Wang, M.-C. and Z. Chen (2022). The relationship among environmental performance, r&d expenditure and corporate performance: using simultaneous equations model. *Quality & Quantity 56*(4), 2675–2689.

Zahid, M., H. U. Rahman, M. Khan, W. Ali, and F. Shad (2020). Addressing endogeneity by proposing novel instrumental variables in the nexus of sustainability reporting and firm financial performance: A step-by-step procedure for non-experts. *Business Strategy and the Environment 29*(8), 3086–3103.