Corporate environmental responsibility and financial performance: does bidirectional causality work? Empirical evidence from the manufacturing industry

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Abstract

Purpose – *Over the past two decades, scholarly attention has focused mainly on a direct and inverse relationship between corporate environmental responsibility (CER) and corporate financial performance (CFP). This study aims to explore the bidirectional causality hypothesis, as good environmental results can lead to good financial results, which makes it possible to invest more resources in projects that improve environmental performance.*

Design/methodology/approach – *The authors test the bidirectional causality between CER and CFP on a sample of listed Italian manufacturing firms over the 2005-2014 period. The authors use a fixed effect panel data regression and check the robustness of the results with alternative econometric techniques.*

Findings – *Although the findings do not support bidirectional hypothesis, they establish direction/causality from CFP to CER. As a result, environmental responsibility is a consequence of prior financial performance, which supports the slack resources hypothesis.*

Research limitations/implications – *Given that companies' environmental commitment is dictated by economic evaluations or by assessing the availability of resources to invest, it seems that the spread of environmentally responsible behaviours might be supported by different external pressures.*

Originality/value – *The paper provides further insights on sustainability management literature by establishing a bidirectional relationship between firm performance and environmental responsibility.*

Keywords *Corporate financial performance, Bidirectional causality, Corporate environmental responsibility, EMSs*

Paper type *Research paper*

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1. Introduction

Pollution is a global threat that has challenged policy makers and firms to reduce the environmental effects of economic activities (Sarkis, 2001; Shrivastava, 1995). Since the mid-1990s, numerous companies across the globe have adopted a wide range of environmental management tools (EMTs) – including environmental management systems (EMSs) based on ISO 14001 standards or certain European regulations (Eco Management and Audit Scheme [EMAS], defined below), as well as other environmental tools based on numerous ISO standards ranging from eco-labels and declarations to carbon and water footprints – to implement green processes and to develop environmentally friendly products.

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In recent decades, the European Union has confronted the challenge of integrating environmental sustainability with economic goals while encouraging European manufacturing to exploit opportunities to innovate. Firm awareness of the importance of this factor seems to be in a transition phase. As a result of perceiving environmental responsibility as an element that influences business performance, many firms are recognizing their environmental efforts as an important strategic factor. Consequently, a growing number of companies consider expenses to address environmental responsibility not only as a cost but also as an investment that can affect long-term corporate profit, while environmental issues are a part of corporate strategy decisions. From this perspective, it seems that companies are developing a more proactive attitude towards environmental issues, perceiving them as business opportunities rather than as burdens.

Despite the opportunities that may arise from adopting effective EMSs, the relationship between corporate environmental responsibility (CER) and corporate financial performance (CFP) continues to be debated. In the current literature, two main approaches emerge. On one hand, scholars have focused mainly on the direct relationship between environmental responsibility and financial performance, suggesting that a good environmental commitment improves environmental performance, company image and firm reputation (Epstein and Roy, 1998) and, as a consequence, financial results (Fombrun and Shanley, 1990). However, empirical results remain ambiguous and inconclusive, considering that there are good reasons for the existence of both a positive and negative relationship or even that there is no association between the variables. On the other hand, other studies have focused on an inverse relationship between the two variables. Theoretically, the slack resources hypothesis (Waddock and Graves, 1997) supports this latter perspective, because good environmental performance might be understood as a function of prior financial performance. In sum, managers might improve CER and thus bear the costs of such improvements only when the firm has the resources to address these costs.

As these two views are not mutually exclusive, it seems that the analysis of the link between CER and CFP might provide new insights into the issue by exploring the bi-directionality hypothesis of this relationship. Thus, there might be a virtuous circle (Hart and Ahuja, 1996) between environmental responsibility and financial performance, given that an improvement in environmental responsibility can lead to good financial results, which in turn makes it possible to invest more resources and enhance firm environmental performance.

Given that studies on the bidirectional causality between CER and CFP remain limited (Endrikat *et al.*, 2014), this work aims to contribute to the current literature by analysing the virtuous circle between these two variables. However, we address the environmental–financial performance relationship empirically rather than through the lens of corporate or ethical legitimacy.

To test the direction of the relationship between environmental responsibility and firm performance, we deviate somewhat from the current literature and use different statistical techniques. While most studies use cross-sectional data and apply ordinary least squares (OLS) regression techniques, we use a panel data set approach, which provides our estimations with more observations and the advantage of exploiting the information on a cross-sectional level and on a time level. Moreover, we use a panel regression with time and cross-section fixed effects, which allows us to address the risk of inconsistent results due to omitted variables. In addition, to draw causal inferences between our two variables, we measure the independent variable with a time lag so that it precedes the dependent variable.

To test the direct and reverse relationship between CER and CFP, we analysed manufacturing companies listed on the Italian stock market during the 2005-2014 period.

Our results show that firm environmental responsibility, proxied by the presence of EMTs, does not affect future financial performance, but we found that the previous financial results can explain the adoption of environmental management approaches in the subsequent year. Our results are robust to alternative estimation techniques.

The remainder of the paper is structured as follows. In Section 2, we present the theoretical background and conduct a literature review. Next, we present the sample and the methodology used to test the causal directions between CER and CFP. Then, we present and discuss the results. Finally, we draw implications and our conclusions.

2. Literature review

In recent years, the relationship between environmental responsibility and a firm's financial performance or competitiveness has come under greater scrutiny by – and has become the subject of debate in – the academic community (Lioui and Sharma, 2012; Wagner and Schaltegger, 2004; Porter and van der Linde, 1995; Lankoski, 2000; Palmer *et al.*, 1995).

Notwithstanding the tremendous number of scientific publications on the link between environmental responsibility and firm performance, scholars have expressed varying and sometimes contradictory opinions regarding the issue.

Most research in the current literature has focused on the direct relationship between environmental responsibility and firm results. In particular, these studies often analyse whether and to what extent a firm's environmental responsibility influences its financial results. In this context, three major theoretical approaches have been identified in the literature. The traditional view suggests a "negative association" between environmental responsibility and corporate performance. More specifically, this view posits that firms with positive environmental performance suffer competitive disadvantages associated with the higher costs of enhanced environmental performance. As a result, firms that comply with regulations (by increasing expenditures on environmental protection) face higher production costs and are less competitive in domestic and foreign markets. However, the results of many empirical studies are equivocal regarding the nature of these relationships (Gollop and Roberts, 1983; Gray and Shadbegian, 2003; Wagner *et al.*, 2002). The "positive association" approach assumes that improved environmental performance (also induced by regulations) is a potential source of competitive advantage because it can lead to more efficient processes, improvements in productivity, lower costs of compliance and new market opportunities (Testa *et al.*, 2011; Martín-de Castro *et al.*, 2015). For example, Jaffe and Palmer (1997) show that lagged environmental compliance expenditures have a positive impact on firms' future R&D. Furthermore, Porter and van der Linde (1995) suggest that environmental regulation is potentially beneficial to firms. Finally, the "neutral association" approach suggests that there is no causal link between environmental performance and financial performance or that there is insufficient empirical evidence to show that environmental regulation affects international trade, firm and industry productivity and/or business location (Cropper and Oates, 1992; Jaffe and Peterson, 1995; Lee, 2008; Telle and Larsson, 2007).

In sum, extant theoretical analyses argue that corporate environmental protection activities have no automatic (positive or negative) effects on firm performance. Horváthová's (2010) meta-analysis shows that empirical evidence remains inconclusive regarding the relationship between CER and CFP. Also, 50 per cent of studies find a positive impact, and the rest report a negligible or negative impact. Therefore, CER can reasonably be expected to have both positive and negative effects on financial performance.

Although the main line of research in the literature aims to explore whether environmental responsibility is worthwhile, there is a theoretical approach that analyses the inverse relationship between environmental responsibility and firm performance, i.e. that the financial performance determines the degree of commitment to environmental

responsibility. This view has its theoretical grounding in the slack resources hypothesis (Waddock and Graves, 1997) and posits that the availability of resources – resulting from better financial performance – determines a firm's ability to pursue projects that improve its environmental performance. Dooley and Lerner (1994) support this line of research, as they show that economic performance significantly moderates the relationship between chief executive officer (CEO) stakeholder orientation and pollution performance. As a result, when firm performance is better, the relationship between CEO stakeholder orientation and pollution performance is negatively sloped.

Given that these two theoretical approaches are not mutually exclusive, an intriguing but relatively unexplored line of research attempts to determine whether there is a virtuous circle between environmental responsibility and firm performance, i.e. whether such causality is bidirectional. Hart and Ahuja (1996) analyse the direct relationship between emissions reduction and firm performance and show that less-polluting processes lead to better business performance. However, in discussing future research directions, they suggest studying the bidirectional causality hypothesis in further detail. Waddock and Graves (1997) and Makni *et al.* (2009) focus on the relationship between corporate social performance (of which environmental responsibility is a part) and financial performance by analysing the hypothesis of bi-directionality using these variables. These two studies use similar methodological approaches. Although they use a time-lagged independent variable so that the independent precedes the dependent construct, they apply an OLS regression to cross-sectional data. Waddock and Graves (1997) analyse companies listed in the Standard & Poor 500, finding evidence of a significant virtuous circle between corporate social performance and financial performance. Conversely, Makni *et al.* (2009) analyse a sample of Canadian companies and find no significant evidence of bi-directionality between corporate social performance and financial performance. They find that corporate social performance at time ($t - 1$) has a negative effect on financial performance at time t. However, in analysing the individual dimensions of corporate social performance, they show that this negative relationship is mainly due to the negative effect of environmental performance on financial performance.

Therefore, given the still limited empirical evidence on the bi-directionality hypothesis between CER and firm financial performance, we believe that further study is merited. Thus, from this perspective, this paper aims to provide new empirical evidence on this issue by using a methodological approach somewhat different from those applied in similar studies.

2.1 Corporate environmental responsibility and environmental management tools

One of the many challenges within the field of CER is to select and adopt the most appropriate EMTs to improve environmental performance.

The adoption of EMSs as frameworks for integrating corporate environmental protection policies, actions and practices is currently growing among both domestic and multinational companies around the world. Many studies focus on formalised EMSs and their ability to improve organisational environmental performance. In this regard, because some EMSs require strong employee participation and environmental training programmes, many firms report increased employee awareness of the environmental aspects of their jobs and their responsibilities in reducing negative environmental impacts.

An EMS is a structured management tool enabling an organisation to identify, control and reduce the negative environmental impact of its activities to achieve legal compliance and pollution/waste reduction (Sayre, 1996). An EMS involves a sequence of steps ranging from devising an articulated environmental policy and commitments to implementing programmes, plans and activities to improve the effectiveness and efficiency of environmental management. This approach requires the integration of environmental issues into every aspect of business management (Tinsley and Pillai, 2006). When adopting an environmental management approach, organisations choose the approach best suited

to their needs and goals by using a comprehensive toolkit of diversified voluntary instruments based mainly on international standards. The most significant standards in the management and assessment of environmental issues used individually or in an integrated mode can be classified either as "system standards" (EMSs based on ISO 14001:2015 or EMAS based on EU Regulation 1221/2009) or as "product standards" (ISO 14020 series for Environmental Product Label, ISO 14040 series for Life Cycle Assessment, ISO 14067 for the quantification and communication of the carbon footprint, and ISO 14046 related to water footprint assessment).

However, the synergistic integration of various EMTs at the product, process and organisational levels is now used more frequently than before to exploit similarities and potential synergies because the product life cycle perspective can enrich and broaden the scope of an EMS. This innovative approach – also known as the product-oriented environmental management system – can improve the environmental performance of products and is considered an integral part of operations and strategies. The successful implementation by means of systematic procedures requires developing and inserting the system into a routine organisational activity, such as an EMS (Salomone *et al.*, 2013).

The current literature highlights the positive influence of well-designed EMSs on the environmental performance of organisations (Iraldo *et al.*, 2009) and on a growing commitment towards environmental improvement (Darnall *et al.*, 2010), as well as on additional benefits, including enhanced reputation and improved opportunities in international markets (Melnyk *et al.*, 2003). Other studies have found that implementing comprehensive EMTs is particularly important in motivating organisations to adopt measures that improve environmental performance in resource input efficiency overall and, thereby, in waste generation and in pollution reduction (Anton *et al.*, 2004; Schucht, 2000). In addition, these tools can assist managers to identify economical ways of meeting environmental goals, which can result in improved global performance (Johnstone and Labonne, 2009). EMTs typically generate information about regulatory requirements and internal environmental practices, supporting internal agency control issues that may lead to negative environmental impacts (Potoski and Prakash, 2005; Grolleau *et al.*, 2007), and may help risk management regarding environmental accidents (Johnstone *et al.*, 2004).

3. Method

3.1 Sample and data collection

Our research tests the relationship between CER and firm financial performance on a sample of listed Italian manufacturing companies over the 2005-2014 period. It is generally acknowledged that manufacturing activities often have high environmental impact and that regulators have forced manufacturing companies to develop and enhance their environmental sustainability (Klassen and Whybark, 1999; Yang *et al.*, 2010). The companies surveyed were selected with reference to their economic activities, as classified by the Italian Bureau of Statistics. The companies were chosen from among the listed Italian firms that have an activity code corresponding to "manufacturing". On 31 December 2014, 326 companies were listed on the Italian stock market. We found that 70 of those companies (representing our sample) operate in the manufacturing sector.

We collected our data from a variety of databases. From the database of the Italian Stock Exchange, we collected all the demographic information related to the Italian listed firm operating in the manufacturing industry during the time span of our analysis. We used the AIDA financial database from Bureau van Dijk to collect the market value and annual balance sheet data of our firms during each year under investigation. We further checked and supplemented these data by consulting the annual financial statements of each company. Regarding CER, we collected information using a questionnaire administered to the sampled firms.

The data collection returned a strongly balanced panel of 570 yearly observations related to 57 companies.

3.2 Variables

Regarding the variables used in the analysis, we measured CER by observing whether a company adopted a formalised EMT (Al-Najjar and Anfimiadou, 2012; Klassen and McLaughlin, 1996; Testa *et al.*, 2014). A formalised EMT can assist organisations in managing, measuring and improving the environmental aspects of their operations (Sroufe, 2003), reducing the possibility of accidental non-compliance with environmental regulations (Johnstone and Labonne, 2009). In particular, we used a dummy variable that takes the value 1 if company *i* in the year *t* held an environmental tool (i.e. environmental certification such as ISO 14001, EMAS, etc.), and 0 otherwise. We believe that this variable is less affected by the subjectivity of the researcher. Furthermore, it is generally acknowledged that environmental certificates are issued by a competent third party that provides an assessment of conformity to the requirements of a specific standard. In addition, during the period of the certificate's validity, the certifier performs periodic audits to confirm or withdraw certification.

Therefore, for each year included in our analysis, we examined whether a company had a valid environmental certification. This information was obtained from a questionnaire sent to the selected companies. The survey questionnaire was necessary to retrieve data, as company websites in most cases omit information related to environmental policies. The questionnaire was sent to the head of corporate communications and external relations. After outlining the purpose of the investigation and guaranteeing confidentiality with regard to the information collected, we asked the respondents to indicate the type of environmental certification held and the time interval of validity. The questionnaire was mailed to the selected companies, and a follow-up reminder was sent after three weeks. Overall, 57 (81.4 per cent) of the questionnaires were satisfactorily completed. Of the 57 companies that responded to our questionnaire, 49 stated that they have or have had valid environmental certifications. The rest declared that they had never requested or obtained an environmental certification. Nine companies obtained their certifications before 2004 but were still valid in 2013. Also, 40 companies obtained their certification during the time period examined. Finally, 13 companies indicated that they were not interested in participating in this research project.

Regarding company financial performance, we used two indicators: an accounting indicator and a market indicator (King and Lenox, 2002), the earnings before interest, taxes, depreciation and amortization (EBITDA) to total assets ratio and the price to book value [PBV] ratio of equity, respectively. We believe that the first variable might be more appropriate than return on investment (ROI) or return on equity (ROE) because these two indicators are more susceptible to accounting manipulations, such as the evaluation of depreciation (Denis and Kruse, 2000). The PBV ratio is useful for assessing capital-intensive businesses, as it captures market evaluation relative to the potential company growth over its assets in place; thus, it reflects expected future gains (Fenn and Liang, 2001). The PBV ratio was calculated as the ratio of the market value of equity to the book value of equity at the beginning of the fiscal year.

We included several control variables in the analysis. In particular, we considered revenue as an indicator of firm size and the debt/equity ratio as an indicator of firm financial leverage. To control for unobserved heterogeneity, we use a fixed effect model.

In Table I, we show the descriptive statistics. In Table II, we present the correlation matrix.

The correlation matrix shows low levels of correlation between our main variables. Thus, multicollinearity problems in our models are modest.

Table I Descriptive statistics

Variables	*Observation*	*Mean*	*SD*	*Minimum*	*Maximum*
EBITDA/TA	661	0.0679	0.0993	−0.3877	0.4766
D/E	616	0.7671	1.415	0.00	17.995
Revenue (*ln*)	656	11.435	1.826	0.5306	16.184
PBV ratio	518	1.746	1.797	0.001	12.472

Table II Correlation matrix – Pearson coefficients

Variables	*1*	*2*	*3*	*4*
EBITDA/TA (*ln*)	1			
D/E (*ln*)	−0.1373	1		
Revenue (*ln*)	0.2874	0.0582	1	
PBV ratio (*ln*)	0.3899	0.0108	0.0518	1

3.3 Methodology

As noted above, our research problem addresses whether there is a causal relationship between financial performance and environmental certification(s) held by a company and its direction. It should be considered that higher performance and, therefore, a greater availability of financial resources, may be a pre-requisite for investing in improving environmental practices. Concurrently, improving environmental practices can cause company performance variability. Therefore, to answer these questions, we estimate two models:

$$Performance_{i,t} = \beta_i + \beta_1 Certificate_{i,(t-1)} + \beta_y \theta_{i,t} + \beta_j \zeta + \varepsilon_{i,t} \quad (1)$$

This model explains company performance as a function of obtaining an environmental certification and a vector of covariate (θ) and year fixed effects (ζ). To account for the causal relationship between the independent variable and firm performance, we use the independent variable lagged one year (Tebini *et al.*, 2015). To estimate this model, we use a panel model with cross-section and year fixed effects to control for time-invariant unobservable firm characteristics. In this model, β_i are the fixed effects, i.e. the $n - 1$ intercepts are assumed to be fixed, which explains the unobserved heterogeneity between firms.

The second model is the following:

$$Prob(Certificate_{i,t}) = F(\beta_i + \beta_1 Performance_{i,(t-1)} + \beta_y \theta_{i,t} + \beta_j \zeta) \quad (2)$$

This model explains the probability of a company having an environmental certification as a function of the company performance and of a vector of covariates (θ) and year fixed effects (ζ). We control for the causal relationship by considering the variable performance lagged one year. In this model, we also use a panel regression approach with cross-section and year fixed effects. Therefore, $F(.)$ is a conditional logit function, and β_i are the fixed effects, i.e. the $n-1$ intercepts are assumed to be fixed, which explains the unobserved heterogeneity between firms.

Control of heteroscedasticity and serial correlation was undertaken by calculating the robust standard errors for clustered data.

However, to conduct a formal test of the causal relationship between firm performance and environmental responsibility and thus to test the bi-directionality hypothesis, we use the Granger causality approach (Granger, 1969). The idea of Granger approach is that a variable X 'Granger causes' Y if Y can be better predicted using the histories of both X and Y than the history of Y only. In doing so, we estimate two separate vector autoregressions of performance and environmental responsibility (certificate dummy) using a fixed effect model to control for omitted variable bias or unobserved heterogeneity among firms:

$$Performance_{i,t} = \beta_i + \beta_1 Performance_{i,(t-1)} + \beta_2 Certificate_{i,t} + \beta_3 Certificate_{i,(t-1)} + \beta_y \theta_{i,t} + \beta_j \zeta + \varepsilon_{i,t} \quad (3)$$

$$Certificate_{i,t} = \beta_i + \beta_1 Certificate_{i,(t-1)} + \beta_2 Performance_{i,t} + \beta_3 Performance_{i,(t-1)} + \beta_y \theta_{i,t} + \beta_j \zeta + \varepsilon_{i,t} \quad (4)$$

Thus, we estimate a linear model of the impact of lagged values of performance and environmental responsibility on current firm performance (equation [3]) and a linear probability model of the effect of environmental responsibility on its lagged values and those of firm performance (equation [4]). Therefore, with reference to equation (3), if coefficients β_2 and β_3 are significantly different from zero, then we can say that environmental responsibility Granger-causes firm performance (i.e., firm performance can be better predicted using the histories of both environmental responsibility and firm performance than the history of firm performance only). Similarly, regarding equation (4), if coefficients β_2 or β_3 are significantly different from zero, then we can conclude that corporate performance Granger-causes CER. To account for heteroscedasticity and serial correlation, the models are estimated with robust standard errors.

4. Results

In this section, we present the results of our analyses. In Table III, we show the results of equation (1), which is estimated as a panel regression with fixed effects. The dependent variable is firm performance. In Column 1, performance is expressed as the natural log of the EBITDA to total assets ratio, and in Column 2 performance is expressed as the natural log of the PBV ratio.

Although the models are significant (*F*-value = 4.48 $p < 0.1$ per cent for the model in Column 1 and 30.27 $p < 1$ per cent for that in Column 2), it emerges that an environmental certification does not affect company performance ($\beta = -0.007$ $p > 10$ per cent for the model in Column 1 and $\beta = 0.075$ $p > 10$ per cent for that in Column 2).

Table IV contains the estimation of equation (2) shown above. In Column 1, company performance is represented by the EBITDA to total assets ratio, while in Column 2, it is represented as the PBV ratio. The models are highly significant (*Wald* test = 33.53, $p < 0.1$ per cent for the first model and 30.93 $p < 1$ per cent for the second model).

The results show that only the PBV ratio of period ($t - 1$) influences ($\beta = 1.206$, $p < 5$ per cent) the probability of acquiring an environmental certificate at period *t*. The corresponding odds ratio is equal to 3.34, which means that an increase in the PBV ratio multiplies the probability of having an environmental certificate at odds equal to 3.34. By

Table III Results of panel regression with cross-section fixed effects

Dependent: firm performance	*1* Ln*(EBITDA/TA)*	*2* Ln*(PBV ratio)*
Certificate dummy$_{(t-1)}$	−0.007 (−0.32)	0.075 (0.90)
Ln(firm size)	0.065* (2.63)	−0.063 (−0.99)
Ln(leverage)	−0.011 (−1.36)	0.037 (1.47)
Constant	−1.51*** (−5.16)	1.28† (1.72)
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
N	475	402
F-value	4.48***	30.27***
R^2	0.6698	0.7271

Notes: $^{\dagger}p < 10\%$; $^{*}p < 5\%$; $^{**}p < 1\%$; $^{***}p < 0.1\%$; the table shows the coefficients of the fixed-effect panel regression with firm performance as dependent variable. In Column 1, firm performance was measured as the natural log of the EBITDA/TA ratio; in Column 2, we used the natural log of the PBV ratio. Brackets of Columns 1 and 2 show the values of the *t*-statistic. The models were estimated using robust standard errors

Table IV Results of logit fixed effects regression

Dependent: certificate (yes/no)	*1*	*2*
Ln(EBITDA/TA)$_{(t-1)}$	1.034 (0.39)	
Ln(PBV ratio)$_{(t-1)}$		1.206* (2.01)
Ln(Firm size)	0.827† (1.95)	0.563 (0.72)
Ln(Leverage)	0.009 (0.05)	−0.152 (−0.86)
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
N	376	318
Wald $\chi^2_{(11)}$	33.53***	30.93**
Pseudo R^2	0.21	0.2153

Notes: †$p < 10\%$; *$p < 5\%$; **$p < 1\%$; ***$p < 0.1\%$; the table shows the log-odds of the conditional (fixed effects) logit model with Certificate (1/0) as dependent variable. In Columns 1 and 2, the independent variable, firm performance, is measured as the natural log of the EBIT/TA ratio and the natural log of the PBV ratio, respectively, lagged one year. Brackets show the values of the *z*-statistic. The models are estimated using robust standard errors

contrast, no significant relationship exists between the accounting measure of performance expressed as EBITDA/total assets and the probability of obtaining a certificate. Therefore, although firm market performance seems to positively influence the probability that a company acquires an environmental certification, environmental certification does not affect company performance.

Finally, in Table V, we report the results of the Granger causality test. We perform *Wald* tests of the joint significance of the coefficients of the independent value at time *t* and its lagged value at $(t - 1)$ of the respective regression equations (3) and (4).

As shown in Table V, the current and lagged values of firm performance expressed by the PBV ratio have significant explanatory power for predicting current environmental responsibility; the coefficients are jointly significant at the 1 per cent level.

However, current and lagged values for environmental responsibility do not have significant explanatory power for predicting the current firm performance at any level of statistical significance. Therefore, we can conclude that firm performance expressed by the PBV ratio Granger-causes environmental responsibility in our data, whereas the opposite is not true. In other words, because the current and lagged PBV ratios predict current environmental responsibility for our data, the Granger test establishes causality from financial to environmental performance.

5. Robustness check

It is generally acknowledged that testing bidirectional causality between CER and CFP poses an endogeneity problem. Therefore, as a robustness test, we account for the simultaneous causality between firm performance and environmental certification using a two-stage least squares (instrumental variable) approach. This procedure allows for

Table V Results of the test for Granger causation

Dependent	*Null hypothesis*	F-*statistic*
Performance (PBV)	(1) Certificate$_{(t)} = 0$	$F(2, 51) = 0.76$
(current value)	(2) Certificate$_{(t-1)} = 0$	Prob > $F = 0.4734$
Performance (EBITDA/TA)	(1) Certificate$_{(t)} = 0$	$F(2, 55) = 0.13$
(current value)	(2) Certificate$_{(t-1)} = 0$	Prob > $F = 0.8779$
Environmental responsibility	(1) Performance (PBV)$_{(t)} = 0$	$F(2, 51) = 5.57$
(current value)	(2) Performance (PBV)$_{(t-1)} = 0$	Prob > $F = 0.0065$
Environmental responsibility	(1) Performance (EBITDA/TA)$_{(t)} = 0$	$F(2, 55) = 0.18$
(current value)	(2) Performance (EBITDA/TA)$_{(t-1)} = 0$	Prob > $F = 0.8343$

estimates of the true coefficients in spite of endogeneity (Wooldridge, 2002). In particular, regarding equation (2), taking into account the complications from the use of logit models in a panel data set context, we used a simple linear probability model (Wooldridge, 2002, 2010) despite the limitations of this model in this context. We instrumented our endogenous variables (Certificate in equation (1) and Performance in equation (2)) with their own lags (one and two periods).

In Table VI, we show the results of the robustness check regarding our previous findings. The results confirm those in Tables III and IV.

The estimated models are highly significant. The sign and significance of the coefficients of interest are the same as those presented previously. Thus, we can conclude that our results are robust to endogeneity control. Moreover, we highlight that the test for regressors' endogeneity (the *Sargan-Hansen* test in the first part of Table VI and the *Durbin-Wu-Hausman* test in the second part of Table VI) does not reject the null hypothesis that firm performance and the probability of holding an environmental certificate are exogenous.

Finally, we also check for an alternative measure of market performance, the Tobin Q (Marti *et al.*, 2013), and the results are unchanged.

In conclusion, our results show that market performance predicts the adoption of an environmental approach, but the adoption of formalised environmental tools does not affect company performance.

6. Discussion and conclusions

Despite being the topic of several empirical studies and many academic debates over the past 20 years, the connection, if any, between CER and firm financial performance has not

Table VI Results of two-stage least squares regression analysis

Dependent variable: firm performance	Ln*(EBITDA/TA)*	Ln*(PBV ratio)*
Certificate dummy	0.004 (0.12)	0.198 (1.36)
Ln(firm size)	0.066* (2.48)	−0.043 (−0.70)
Ln(leverage)	−0.017 (−1.46)	0.039† (1.66)
Constant	−1.622*** (−13.13)	0.587 (1.00)
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
N	428	374
F-value	5.11***	32.12***
Sargan – Hansen test	0.536	0.158
Dependent: certificate (yes/no)	1	2
Ln(EBITDA/TA)	0.442 (0.48)	
Ln(PBV ratio)		0.301* (2.18)
Ln(firm size)	0.027 (0.40)	0.061 (1.35)
Ln(leverage)	0.004 (0.16)	−0.033† (−1.90)
Constant	0.811 (0.43)	−0.018 (−0.03)
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
N	420	329
Wald test	2739.31***	12453.61***
R^2	0.4815	0.4777
Durbin-Wu-Hausman test	0.390	2.15

Notes: †$p < 10\%$; *$p < 5\%$; **$p < 1\%$; ***$p < 0.1\%$; the table shows the coefficients of the two-stage least squares regression analysis. The first part presents the results of equation (2) with the natural log of firm performance as the dependent variable. Brackets show the values of the *z*-statistic. The second part of the table shows the results of the linear probability model with the certificate dummy as the dependent variable. Brackets show the values of the *z*-statistics. The models were estimated using robust standard errors

been fully established. This study, carried out on listed Italian manufacturing firms over the 2005-2014 period, supports the assumption of a positive link between financial performance and environmental responsibility as proxied by possessing a formalised EMT.

By using different methodological approaches, our research analyses the circular relationship between CFP and CER and shows that the PBV ratio positively impacts the probability that the company will acquire an environmental certification. By contrast, accounting performance seems to have no impact on this probability. It was also found that environmental certification has no impact on either accounting or market financial performance. Therefore, in our results, a bidirectional hypothesis between CER and CFP is not supported, whereas the direction of causality is established from CFP to CER. Thus, these findings contrast both with the widespread view that environmental responsibility is *per se* a beneficial factor for companies that will enhance their performance (Porter *et al.*, 1995) and with the neoclassical "trade-off" argument that the allocation of resources for social purposes and therefore also for environmental impact reduction is a waste of resources (Waddock and Graves, 1997; King and Lenox, 2002). This result could confirm that the costs of implementing sustainable and responsible projects are not always offset by productivity gains or revenues sufficient to generate increases in profit, given that consumers are not always willing to pay a premium price to buy products or services made using green processes (Bush and Wolfensberger, 2011; Parsa *et al.*, 2015). This result is also quite consistent with the literature (Blomgren, 2011; Rojšek, 2001). In particular, Rojšek (2001) shows in its survey that respondents believe that the impact of environmental performance on short-term profit and cost reduction is basically negative, while the impact on the long-term profit and productivity is assessed, on average, between the neither negative nor positive position and the positive position.

By contrast, our tests are consistent with the slack resources hypothesis (Waddock and Graves, 1997). Therefore, we can assume that managers consider projects for increasing CER only when there are enough resources for this cause. Good environmental performance is a consequence of earlier good financial performance.

However, these findings seem to suggest an order of priority of company stakeholders. In other words, only once the expectations of stockholders have been property met does the company address its resources for implementing environment management systems or other instruments to undertake further market purposes. This interpretation would be consistent with Carroll's Pyramid of Corporate Social Responsibility, including, in order, the economic, legal, ethical and philanthropic responsibilities of the firm (Carroll, 1991). Economic responsibilities are the baseline of the pyramid, whereas philanthropic responsibilities are at the top. In summary, the author notes that the corporate social responsibility approach, which also includes environmental responsibility, implies that firms engage in decisions that fulfil these four categories of responsibilities as a whole. However, a hierarchical order of steps to reach the top has emerged.

Given these results, we believe that companies' environmental commitment is dictated by economic evaluations or by assessing the availability of resources to invest, with an awareness that the return on this investment is unclear. Consequently, in the absence of a clear economic advantage, it seems that the spread of environmentally responsible behaviours might be supported by institutional pressures, incentive policies or constriction implemented by various actors (Phan and Baird, 2015), such as the government, lobbyists (environmental associations) or business communities (suppliers, customers, etc.).

6.1 Limitations and further research

Despite these findings, several limitations emerge in our research. First, our sample includes only listed manufacturing companies; therefore, the findings might have limited explanatory capacity on firms that operate in service industries or for unlisted companies. Furthermore, because we focus on Italian companies, the generalizability of our results to other contexts is quite difficult because cross-cultural differences might have a substantial impact on

environmental knowledge, attitudes and behaviours (Laroche *et al.*, 2002). Consequently, further research is necessary to involve a greater number of firms from different industries and to use a cross-country perspective, in particular.

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