Received: 28 May 2020 | Revised: 30 June 2020 | Accepted: 17 July 2020
DOI: 10.1002/bse.2607

RESEARCH ARTICLE

Business Strategy and the Environment WILEY

The management of sustainable development: A longitudinal analysis of the effects of environmental performance on economic performance

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Abstract

The literature on sustainable development has largely focused on investigating the relationship between companies' environmental and economic performance. However, many aspects remain unexplored, and empirical studies are far from reaching a consensus due to the heterogeneity of the environmental and economic measures and methodologies used. This study contributes to the literature on sustainable development by considering a panel of 998 US companies observed over the period 2003–2017 using both traditional panel data methods and an unconditional quantile regression technique. The empirical evidence confirms that environmental performance, measured in terms of environmental orientation and environmental innovation, positively affects returns on assets and equity. It also demonstrates that these returns change across quantiles and depend on the capacity of green companies to generate the same streams of income as nongreen companies but with less capital. In other words, green firms tend to be more efficient in generating future wealth.

KEYWORDS

environmental innovation, environmental orientation, firm performance, increasing returns, sustainability, unconditional quantile regression

1 | INTRODUCTION

Despite evidence that corporate social responsibility (CSR) is increasingly considered important by both firms and capital market participants (Bowen, 2013; Moon & Parc, 2019), debates persist among researchers regarding the relation between CSR and firm performance (Awaysheh, Heron, Perry, & Wilson, 2020). Corporate governance scholars are increasingly interested in firms' social and environmental performance (EnP). However, empirical research in this area has advanced in an uncoordinated fashion, producing fragmented and contradictory results and a blurring of the different components of CSR (Walls, Berrone, & Phan, 2012). Our paper seeks to address this lack of clarity by dissecting a specific component of CSR and focusing on the relationship between EnP and economic performance (EcP).

Although interest in EnP has increased in recent years, it is not a new phenomenon. The impact of economic activity on the environment had been a major concern since the 1970s when industrial activity began to damage the health and the well-being of people (Hart & Ahuja, 1996). However, a turning point occurred in 1987 when the World Commission on Environment and Development published a report entitled *Our Common Future from One Earth to One World*, which stressed, for the first time, the importance of sustainable development and highlighted the negative effects of industrialization on the environment. In the 1990s, the need to conduct business without compromising future generations gained importance (Sharma & Vredenburg, 1998). Since then, countless environmental protection initiatives have been implemented and environmental sustainability has become a central issue for societies aiming for a transition to sustainable development. Recently, companies have begun to invest in new environmental technologies and processes and in the development of eco-design products as essential components of an overall strategy to enhance environmental protection and generate long-term shareholder value (Elkington, 2002). Enhanced global awareness of climate change and ecosystem degradation has led to the introduction of new production processes and services aimed at preserving natural resources and the environment in general (Dwyer et al., 2009; Linnenluecke, Griffiths, & Winn, 2012). However, investments in sustainable practices need to be aligned with the aim of guaranteeing sustainable EcP, not only to meet investors' expectations but also to ensure on-going business feasibility and the satisfaction of stakeholders (Bartolacci, Paolini, Quaranta, & Soverchia, 2018). A large body of literature has emerged on the relationship between EnP and EcP, but the findings remain inconclusive (Blasi, Caporin, & Fontini, 2018; Linder, Björkdahl, & Ljungberg, 2014). There are several possible explanations for such inconclusive findings in the extant literature (Blasi et al., 2018; Lee & Min, 2015), most of which relate to (1) the heterogeneity of the environmental and economic measures adopted, (2) the specific econometric methodologies used to investigate the relationship, (3) the existence of important differences at industry levels, or (4) the difficulty in establishing a time frame within which to examine the relationship.[1]

Thus, the question of whether it really pays to be green remains unanswered. No existing study has attempted to disentangle the specific effects of EnP on different measures of EcP or observed how these effects change depending on the level of a firm's EcP. Moreover, the existing literature does not address the differences in measures of EnP, which is not composed of a single or even a small number of indicators but rather represents a complex system of category indicators reflecting a firm's orientation toward environmental issues. Finally, while investigating returns on green strategies, we observed a lack of attention to the relationship between a firm's EnP and its efficiency in resource management.

This work adds to the literature in many ways. First, we measure EnP using two aggregate indicators: "environmental orientation" (EO), which refers to a general orientation toward avoiding environmental risks, and, more specifically, "environmental innovation" (EI), which refers to a company's capacity to develop EIs. Second, we investigate whether EnP affects EcP. We measure EcP in terms of both return on assets (ROA) and return on equity (ROE). Third, we investigate the existence of increasing returns from EnP. Fourth, we relate EcP to the resource management ability of green firms and reveal the presence of a double-loop learning process that enables green companies to use resources more efficiently.

From an empirical perspective, this work is based on standard panel data techniques combined with a novel methodological approach. The econometric analysis proceeds as follows. First, we estimate a standard fixed effects (FEs) model that allows us to assess the impact of EnP on average EcP.[2] We then extend the analysis to the entire distribution of our EcP indicators and employ an unconditional quantile regression technique developed by Firpo, Fortin, and Lemieux (2009). Compared with other quantile regression techniques, this methodology allows us to interpret the estimated coefficients in the same way as we do with an ordinary least squares (OLS) estimator. Finally, we repeat our analysis using the single components of ROA and ROE (viz., income and capital measures) as dependent variables. This enables us to enhance our understanding of the modalities through which EnP affects EcP. To address endogeneity issues, we also use an instrumental variable (IV) approach.

Our findings show a generally positive relationship between EnP and EcP. They also prove that EnP affects ROA only if the latter is above a certain minimum threshold (30% of the distribution) and that this impact increases as we move toward the right tail of the ROA distribution. Thus, we observe the existence of increasing returns from EnP for firms with better EcP. These results are generally consistent with those of other studies but provide a more fine-tuned understanding of the relationship between EnP and EcP and partially explain the lack of clarity in previous research. We find that EO only has a negative effect on companies characterized by lower net income. However, this negative effect is overshadowed by the negative effect of the EO on total assets and equity. This means that green companies tend to be more efficient than nongreen ones because they are able to generate the same streams of income with fewer resources or by improving their processes.

This paper is structured as follows. In Section 2, we explain the theoretical background and the hypotheses. Section 3 presents the data, and Section 4 outlines the methodology. Section 5 describes the results. Finally, Section 6 offers a discussion and some conclusive remarks.

2 | THEORETICAL FRAMEWORK AND HYPOTHESES

2.1 | Linking EO and EcP

Although several studies have investigated the relation between EO and EcP, there is a lack of consensus in the interpretation of results, which generates misalignments and hinders generalizability. A small number of scholars, including Friedman (1970) and McGuire, Sundgren, and Schneeweis, (1988), have proposed a negative correlation between EO and EcP, basing their arguments on the additional costs associated with EO investments, which inevitably have a negative impact on EcP in the short term. However, most scholars have found a positive correlation (King & Lenox, 2002; Orlitzky, Schmidt, & Rynes, 2003; Singer, 2018), claiming that a major intervention to reduce environmental impact as part of a proactive environmental strategy can increase a firm's competitiveness because the adoption of green technologies reduces costs in the long run and enables firms to remain competitive in national and global markets (Sharma & Vredenburg, 1998; Russo & Fouts, 1997). Other researchers, such as Hart and Ahuja (1996), have obtained unclear results. Despite this inconsistency in the evidence regarding the connection between EO

[1]The effect of EnP on EcP may be observed either immediately or in a subsequent period. For instance, the reuse of waste in the production process can generate an immediate cost saving (Filbeck & Gorman, 2004; Wagner et al., 2002). In other cases, the company needs time to adapt to new environmental policies, so the effects of EnP on EcP can be evaluated only in the long term (Hart & Ahuja, 1996; Porter & Van der Linde, 1995).

[2]These results are robust to time-invariant firm heterogeneity, such as that resulting from industry characteristics.

and EcP, we contend that the numerous scenarios identified by researchers in which EO leads to improved EcP indicate a positive relation between EO and EcP.

Moreover, no previous research has investigated whether the relationship between EO and EcP is consistent among green firms or whether there are discontinuities in returns from EO. We explore this question using an increasing returns perspective. Increasing returns, that is, positive feedback effects (Arthur, 1990, 1999), play an important role in many markets and firms. In markets, they can result from fashions or fads, technology adoption, or standardization. In firms, they can be attributed to the production and commercialization of information and knowledge-intensive products or to technological process improvements. We focus on firm-based mechanisms of increasing returns and test whether firms that already perform well economically benefit from increasing returns on EO. Inspired by Managi (2006), we expect to verify a Matthew effect whereby "the rich get richer" (Merton, 1988), meaning that firms with higher EcP are more likely to leverage the potential of EO more effectively than firms with lower EcP. Therefore, we formulate the following hypotheses.

Hypothesis 1a. Companies that show a higher EO report better EcP.

Hypothesis 1b. Firms that perform better economically obtain higher returns from an EO.

Another relationship that has yet to be explored is that between EO and resource management abilities. Klassen and Whybark (1999) asserted that a company that is oriented toward a green strategy should implement a pollution-prevention process rather than a pollution-control one by reducing its consumption of energy and raw materials. Strategies that encourage companies to redefine their business in more sustainable and environmentally friendly ways enable organizations to adapt to changes in the overall business environment and are usually associated with lower costs, reduced input, and enhancement of the company's reputation (Aragón-Correa, Hurtado-Torres, Sharma, & García-Morales, 2008; Aragón-Correa & Sharma, 2003; Christmann, 2000). EO can enable companies to have greater control of their costs, input, and energy consumption and may stimulate the introduction of circular economy practices aimed at more efficient and sustainable waste management through reuse and recycling (Gaustad, Krystofik, Bustamante, & Badami, 2018; George, Lin, & Chen, 2015; Ghisellini, Ripa, & Ulgiati, 2018; Urbinati, Chiaroni, & Chiesa, 2017). We, therefore, formulate Hypothesis 2.

Hypothesis 2. Environmentally oriented companies are more efficient in managing resources, generating the same streams of income as other companies with fewer resources.

2.2 | Linking EI and EcP

Green innovation is defined as changes in products, services, or business models undertaken by organizations to sustain their green orientation (Lin, Mohamed, Sambasivan, & Yip, 2019; Tang, Walsh, Lerner, Fitza, & Li, 2018). Green product innovation is associated with product development practices that reduce the quantity of resources used and their environmental impact (Dangelico, 2016; Dangelico & Pujari, 2010; Dangelico, Pujari, & Pontrandolfo, 2017; Lee & Kim, 2011). Green service innovation concerns the introduction of up-to-date and eco-friendly environmental technologies (Martí-Ballester,- 2017); green business model innovation includes all activities that place environmental consciousness at the center of a company's value proposition (e.g., changes in the supply chain and the incorporation of circular economy practices in production and delivery processes) (Agrawal & Bellos, 2017; Henriksen et al., 2012). Existing empirical research on the relation between EI and EcP has generated inconclusive results (Lee & Min, 2015; Tang et al., 2018). A small number of studies have found no differences between green product development and standard product development or even a negative impact of green innovation on financial performance (Driessen et al., 2013; Liu, Dai, & Cheng, 2011; Lee, Cin, & Lee, 2016; Palmer, Oates, & Portney, 1995). A more consistent pool of authors has found that EI is a necessary prerequisite for meeting customer demands and complying with increasingly stringent environmental regulations (Porter & Van der Linde, 2011; Tang et al., 2018). Florida (1996) found a positive association between lean process implementation in manufacturing and the propensity to generate green innovations, suggesting that a combination of the two increases a firm's performance. EI reduces production costs in the long run and increases the demand for green products (Li, Ngniatedema, & Chen, 2017). The most innovative and fast-moving firms benefit from first-mover advantages and can leverage differentiation-driven competitive advantages by reaching an eco-friendly status before the competitors (Chen, 2008; Demirel & Kesidou, 2011).

Moreover, further to the arguments presented above to support Hypothesis 1b, we test whether firms with better EcP obtain increased returns from EI, taking into account the strong relationship between financial assets and research and development (R&D) expenditure. Because innovation is resource consuming and highly uncertain, the associated risks are different for firms with higher EcP than for those with lower EcP. We expect that wealthier firms are generally better placed to select resources and collaborations for innovation purposes, enabling them to obtain increased returns from R&D investments and to implement green technologies and develop new green products more efficiently than less wealthy firms. Therefore, we propose the following hypotheses.

Hypothesis 3a. Companies that engage in EI show higher EcP.

Hypothesis 3b. Firms that perform better economically obtain higher returns from EI.

Studies that support a positive relationship between EI and EcP also stress the positive effects of EI on firm resource management. Porter and Van der Linde (1995) argued that EI leads to more efficient use of raw materials. Such an improvement in the productivity of resources such as water, land, and energy can contribute to reducing resources depletion. Thus, "environmental technological innovation may potentially lead to win-win situations in which improvements in environmental quality and economic growth coexist." (Lin & Zheng, 2016, p. 400). However, EI encompasses more than just green technology (i.e., devices that provide environmentally beneficial effects, including end-of-line interventions such as fume exhaust catalyzers). Rather, it is a strategic enabler of entire value-chain transformations (Andersen, 2008; Kemp, 2010), which can improve the overall efficiency of production and delivery processes through the adoption of circular economy principles and the establishment of green supply chains (De Jesus & Mendonça, 2018). Business model innovation aimed at establishing a circular economy and improving sustainability is becoming increasingly important for sustaining companies' competitive advantage (Pieroni, McAloone, & Pigosso, 2019). Hence, we propose the following hypothesis.

Hypothesis 4. Green innovators manage resources more efficiently, generating the same streams of income as other firms with fewer resources.

3 | DATA

The analysis was conducted on an original database built by triangulating information from two main sources: the MSCI ESG KLD STATS dataset and Thomson Reuters Eikon. The MSCI ESG KLD STATS dataset is an annual dataset consisting of environmental, social, and governance (ESG) performance indicators applied to a universe of publicly traded companies. It was initiated in 1991 and is one of the longest continuous ESG data time series available. Thomson Reuters Eikon is a desktop product that provides an overview of the global real-time financial arena, combining news, information, and insight. It offers balance sheet data from Worldscope; environmental, social, and corporate governance data (ESG-ASSET4); and equity and bond indices. All the financial data used in our study are from the Thomson Reuters Eikon database.

To build our database, we started by selecting all companies belonging to Dataset D of MSCI KLD STATS, which includes large-, mid-, and small-cap US companies and excludes firms operating in certain industries such as alcohol, tobacco, gambling, civilian firearms, military weapons, and nuclear power. Dataset D is composed of 2,400 observations. We cleaned the data (eliminating duplicates and firms that were not followed for the duration of the panel) and retained only firms on which we could retrieve information from Thomson Reuters Eikon. This left us with a sample of 998 firms, which we analyzed in relation to green practices and EcP. The sample consisted of companies from 10 different sectors: basic materials, consumer goods, consumer services, the financial sector, health care, the industrial sector, oil and gas, technology, telecommunications, and utilities. The number of companies within each sector varied. The financial sector had the highest number of enterprises (222 enterprises), followed by the industrial sector (210 enterprises), consumer services (118 enterprises), technology (103 enterprises), consumer goods (101 enterprises), health care (83 enterprises), utilities (49 enterprises), basic materials (47 enterprises), oil and gas (47 enterprises), and telecommunications (8 enterprises).

We performed a longitudinal analysis of detailed company information spanning 15 years from 2003 to 2017.

3.1 | Dependent variables

ROE measures the company's net income divided by its average. It is a measure of the companies' efficiency in generating profits from each unit of shareholder equity (Arlow & Gannon, 1982; Wagner, 2005; Wagner, Van Phu, Azomahou, & Wehrmeyer, 2002).

ROA measures the direct impact of firms' levels of accounts receivable, inventories, accounts payable, cash, and current debts on its operating performance (Barber & Lyon, 1996; Smart, Thirumalai, & Zutter, 2008).

Earnings before interest and taxes (*EBIT*) is a measure of operating profit and is calculated on the basis of business income. It excludes nonbusiness income and expenses (Goldstein, Ju, & Leland, 2001; Gupta & Khare, 2016).

Equity measures the amount of money that would be repaid to a company's shareholders if all assets were liquidated and all of the company's debt was paid off (Hovakimian, Opler, & Titman, 2001).

Total assets measures the economic value of the company's assets. Assets negatively affect companies' ability to borrow. Firm-specific assets cannot be costlessly redeployed for different purposes and, consequently, cannot be used as a guarantee for borrowing (Balakrishnan & Fox, 1993).

3.2 | Independent variables

Environmental orientation (*Env_Orientation*) is an aggregate measure of a firm's environmental impact, which is retrieved from Thomson Reuters ASSET4 (where it is labeled "environmental pillar score"). It is measured in percentage values: the higher the percentage, the greater the firm's efforts to avoid environmental risks and capitalize on environmental opportunities (Ioannou & Serafeim, 2010). The environmental pillar score is composed of three category scores: (1) resource use, (2) emissions, and (3) EI. Resource use reflects a company's performance and its capacity to reduce the use of materials, energy, or water; find more eco-efficient solutions by improving supply chain management; and increase the sustainability of its packaging. Emissions measures a company's commitment to and effectiveness in reducing environmental emissions (calculated in terms of CO_2 and total waste) in its production and operational processes. EI is our second independent variable (see below).

Environmental innovation (Env_Innovation) is the category score of the "environmental pillar score" (retrieved from Thomson Reuters ASSET4) that reflects a firm's capacity to create new market opportunities through new environmental technologies and processes or the

TABLE 1 Descriptive statistics (N = 7,385)

Variable Dependent variables	Mean	SD	Min	First	Second	Third	Max
ROA	7.111	7.054	−24.600	3.840	6.750	10.660	27.800
ROE	16.035	22.582	−76.370	8.550	14.610	22.350	116.380
EBIT (k)	1,155.792	3,042.369	−14,600.000	103.876	328.570	1,034.532	59,900.000
Equity (k)	6,804.927	20,600.000	−989,000.000	859.640	2,234.094	7,178.571	581,000.000
Total assets (k)	20,200.000	45,300.000	134.109	2,068.720	5,253.000	17,100.000	321,000.000
Independent variables							
Env_Orientation	50.382	22.640	2.877	31.838	46.925	68.620	98.888
Env_Innovation	50.207	25.177	0.170	32.653	46.721	69.388	99.755
Control variables							
MKTV	17.097	32.287	0.172	2.139	5.216	15.801	179.868
R&D	3.119	7.211	0	0	0	2.618	54.149
Size	35.952	110.406	0	3.5	10	31.5	2,300
Governance	10.297	2.245	1	9	10	12	26

Note: This table reports the main descriptive statistics (mean, standard deviation, minimum value, first three quartiles, and maximum value) for our dependent and independent variables.

Abbreviations: EBIT, earnings before interest and taxes; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.

development of eco-efficient products or services (Duque-Grisales & Aguilera-Caracuel, 2019). It is measured in percentage values: the higher the percentage, the higher the firm's capacity. This category score is composed of several indicators related to both product and process innovations, including the intensity of environmental R&D investments, the presence of an environmental product innovation policy (e.g., eco-design, life cycle assessment, and dematerialization), the existence of clearly defined objectives and procedures for environmental product and process innovation, the development of eco-friendly products or technologies, and a commitment to reducing animal testing.

3.3 | Control variables

Market value (*MKTV*) is calculated as the share price multiplied by the number of ordinary shares in issue. The number of shares in issue is updated whenever new tranches of stock are issued or after a capital change. MKTV affects the reputation of a firm and clearly influences its EcP (Kim, Li, & Li, 2014).[3]

R&D intensity (*R&D*) is measured as the percentage of revenue invested in R&D. This indicator is usually considered an effective proxy for a company's orientation toward innovation (Apa, De Noni, Orsi, & Sedita, 2018; Chao & Kavadias, 2009).

Size is measured as the sum of the number of the company's full- and part-time employees. The variable excludes seasonal and emergency employees. It can affect resource availability and investment capacity, especially regarding green investments (Drempetic, Klein, & Zwergel, 2019; Duque-Grisales & Aguilera-Caracuel, 2019; Elsayed & Paton, 2005).

Governance style is captured through a measure of board dimension, which is the total number of board members at the end of the fiscal year. The dimension of the board reflects the pool of competencies and knowledge on which the firm can draw when making decisions. It is a measure of inclusiveness and is particularly relevant for stimulating actions aimed at social and environmental sustainability (Duque-Grisales & Aguilera-Caracuel, 2019; Zheka, 2005).

Tables 1 and 2 present the summary statistics and correlation matrix of the variables described above, respectively.

4 | METHODOLOGY

To assess the impact of EnP on EcP, we take advantage of the longitudinal nature of our data. The first step in is to determine the effect of increasing EnP on the mean EcP. In this respect, a standard FE estimator provides estimates that are robust to time-invariant measurement errors and omitted variables. Thus, our first econometric specification is

$$Y_{it} = \alpha_i + \beta Env_{it} + \gamma X_{it} + \varepsilon_{it}, \tag{1}$$

where Y_{it} is the EcP indicator of firm i at time t, α_i is the vector of firm-specific FEs, Env_{it} is a measure of EnP, X_{it} is a matrix of control variables, and ε_{it} is the error term. We use cluster-adjusted standard errors to account for within-firm correlation and heteroskedasticity.

Despite the general consensus in favor of an FE estimator due to its interesting properties, this approach remains vulnerable to time-varying endogeneity. In particular, because we cannot exclude the

[3]It could be argued that even the MKTV represents an outcome variable indicating the firm's performance in stock markets. We test this reasonable hypothesis in the supporting information by regressing the MKTV on our explanatory variables.

TABLE 2 Correlation matrix

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.ROA	1									
2.ROE	0.736***	1								
3.EBIT	0.217***	0.221***	1							
4.Equity	0.021*	0.014	0.553***	1						
5.Total assets	−0.088***	0.020*	0.593***	0.504***	1					
6.Env_Orientation	0.069***	0.103***	0.317***	0.222***	0.307***	1				
7.Env_Innovation	0.040***	0.021*	0.177***	0.130***	0.183***	0.671***	1			
8.MKTV	0.149***	0.170***	0.802***	0.553***	0.630***	0.379***	0.208***	1		
9.R&D	−0.095***	−0.162***	0.033***	0.015	−0.055***	0.079***	0.059***	0.093***	1	
10.Size	0.057***	0.102***	0.384***	0.267***	0.320***	0.246***	0.168***	0.475***	−0.067***	1
11.Governance	−0.022*	0.083***	0.229***	0.199***	0.324***	0.328***	0.156***	0.304***	−0.115***	0.231***

Abbreviations: EBIT, earnings before interest and taxes; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.
*$p < 0.1$. ***$p < 0.01$.

existence of simultaneity between EnP and EcP, a simple FE model may be subject to time-varying endogeneity bias. Therefore, we also consider a fixed-effect instrumental variable (FE-IV) estimator to address time-varying endogeneity.

The validity of this second model relies on the identification of one or more IVs that are (1) correlated with the EnP (instrument relevance) and (2) conditionally uncorrelated with the EcP (exclusion restriction). The availability of one or more instruments allows us to carry out a two-stage least squares (2SLS) analysis in which we first regress the EnP on the IVs and the other controls and then replace the EnP with the first-stage predicted value in our linear model (1).

Our dataset contains two dummy variables satisfying the above conditions. The first variable indicates whether the firm has an environmental management team, and the second variable takes a value of 1 if the company trains its employees on environmental issues and a value of 0 otherwise. We expect these two variables to be strongly correlated with the firm's EnP (instrument relevance), but their effect on the EcP requires the effective implementation of green investments (instrument conditional exogeneity). There are two advantages of using two IVs instead of one: they improve the precision of estimates and allow us to test the exclusion restriction.[4]

Having obtained reliable estimates of the mean returns from EnP, we extend the analysis to consider how EnP impacts each decile of the unconditional distribution of the EcP indicator. In particular, we augment the unconditional quantile regression technique proposed by Firpo et al. (2009) with both FEs and IVs.

The reason we prefer to consider unconditional quantile estimates instead of conditional quantile regressions relates to the interpretation of coefficients. In a conditional quantile regression, we cannot interpret the estimated coefficients as we do with OLS. This is because the conditional distribution of the dependent variable generally differs from the unconditional one. Therefore, we cannot predict the quantile in which the outcome distribution a firm will be before and after an increase in the independent variable. Indeed, the definition of these quantiles also depends on the level of the other covariates. By contrast, in an unconditional quantile regression, we can interpret the coefficients as marginal effects of the independent variable on the dependent one. Thus, our main coefficient corresponds to the effect of a marginal change in EnP on the τ-th quantile of the unconditional distribution of the EcP.

The price we pay for this more straightforward interpretation of results is the complexity of the methodology. The so-called *recentered influence function* (RIF) is at the core of this methodology. In statistics, an influence function is a measure of the dependence of an estimator (q_τ) on a single observation. The RIF is obtained by adding the estimator to the influence function. Formally, the RIF is expressed as

$$RIF(Y;q_\tau,F_Y) = q_\tau + \frac{\tau - \mathrm{I}(Y \le q_\tau)}{f_Y(q_\tau)}, \tag{2}$$

where q_τ is the value of the outcome at the τ-th quantile, $\mathrm{I}(Y \le q_\tau)$ is an indicator function taking value 1 if $Y \le q_\tau$, and F_Y and $f_Y(q_\tau)$ are the cumulative and density functions of Y, respectively. The unconditional quantile estimator proposed by Firpo et al. (2009) can be implemented using an OLS regression in which the dependent variable in the regression is the RIF.[5]

Following Borgen (2016), we account for firm-specific FEs by using a within estimator to regress the RIF on the set of explanatory variables. Finally, we use a control function (CF) method to correct for endogeneity bias. This correction has been widely used in the empirical literature for both conditional and unconditional quantile

[4]In the supporting information (available online), we conducted a battery of robustness checks. These included a generalized method of moments (GMM) estimator to test the validity of our IV estimates. We also considered a dynamic panel data model in which our covariates may affect the dependent variables with some lags. In addition, we provide the IV estimates considering the two instruments separately and a redundancy test. Finally, to include the firm's age as an additional control variable, we considered a correlated random effect (CRE) model in which between effects are separated from within effects. Our main results continued to hold.

[5]For further technical details on unconditional quantile regressions, see Firpo et al. (2009).

regressions (see, e.g., Chesher, 2003; Imbens & Newey, 2009; Lee, 2007; Powell, 2016). This methodology, also known as a two-stage residual inclusion, involves including the error term of the first-stage regression in the second stage of a traditional IV regression. The CF approach relies on the same identification conditions as IV estimates, and, in the case of linear models, mimics the IV estimator (see Wooldridge, 2010).

5 | RESULTS

5.1 | Testing Hypotheses 1a and 3a: The impact of EnP on EcP

Table 3 presents the FE estimates of Equation 1. In Columns 1 and 2, the dependent variable is the ROA, whereas in Columns 3 and

TABLE 3 Model estimation: Economic performance and environmental performance

	ROA		ROE	
Variable	**(1)**	**(2)**	**(3)**	**(4)**
Env_Orientation	0.030*** (0.007)		0.028 (0.027)	
Env_Innovation		0.012** (0.005)		0.005 (0.017)
MKTV	0.055*** (0.012)	0.049*** (0.011)	0.195*** (0.050)	0.189*** (0.048)
R&D	0.124 (0.111)	0.128 (0.111)	0.298 (0.257)	0.303 (0.258)
Size	−0.014** (0.006)	−0.015*** (0.005)	−0.058** (0.027)	−0.058** (0.026)
Governance	0.142** (0.072)	0.160** (0.073)	0.194 (0.245)	0.212 (0.246)
N	7,274	7,274	7,274	7,274
Firm FE	Yes	Yes	Yes	Yes
Within R^2	0.017	0.013	0.015	0.014
Overall R^2	0.503	0.502	0.476	0.476

Note: This table contains the FE estimates of Equation 1. The dependent variable in Columns 1 and 2 is the ROA, whereas Columns 3 and 4 use the ROE. Columns 1 and 3 consider Env_Orientation as main explanatory variable, whereas Columns 2 and 4 consider Env_Innovation. Notice that 111 singletons are dropped. Clustered-robust standard errors are in parentheses.

Abbreviations: EBIT, earnings before interest and taxes; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.

**$p < 0.05$. ***$p < 0.01$.

TABLE 4 Model estimation: Economic performance and Environmental performance (second-stage IV estimates)

	ROA		ROE	
Variable	**(1)**	**(2)**	**(3)**	**(4)**
Env_Orientation	0.055*** (0.015)		0.036 (0.060)	
Env_Innovation		0.104*** (0.030)		0.067 (0.113)
MKTV	0.061*** (0.012)	0.058*** (0.012)	0.197*** (0.054)	0.195*** (0.052)
R&D	0.119 (0.110)	0.119 (0.105)	0.297 (0.257)	0.297 (0.254)
Size	−0.013** (0.006)	−0.014** (0.006)	−0.057** (0.027)	−0.058** (0.027)
Governance	0.126* (0.073)	0.143* (0.077)	0.188 (0.242)	0.200 (0.244)
N	7,274	7,274	7,274	7,274
Firm FE	Yes	Yes	Yes	Yes
Within R^2	0.014	0.070	0.015	0.011
Hansen-J statistic ($df = 1$)	0.001	0.046	0.141	0.169
Hansen-J (p value)	0.976	0.830	0.707	0.681
Endogeneity test (p value)	0.0415	0.0014	0.9045	0.6252

Note: This table reports the second-stage FE-IV estimates of Equation 1. First-stage regressions are in the appendix. The dependent variable in Columns 1 and 2 is the ROA, whereas Columns 3 and 4 use the ROE. Columns 1 and 3 consider Env_Orientation as main explanatory variable, whereas Columns 2 and 4 consider Env_Innovation. Notice that 111 singletons are dropped. Clustered-robust standard errors are in parentheses.

Abbreviations: EBIT, earnings before interest and taxes; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.

*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

4, the dependent variable is the ROE. On average, firms with an EO equal to 1 earn 3% more on ROA than firms with an EO equal to 0 (Column 1). If we consider only EI, we can observe a positive correlation with EcP measured as ROA. We further observe that firms with an EI equal to 1 earn only 1.2% more from ROA than firms with an EI equal to 0 (Column 2). In contrast, the coefficients of both the environmental indicators are positive but statistically insignificant when we consider ROE instead of ROA as the dependent variable (Columns

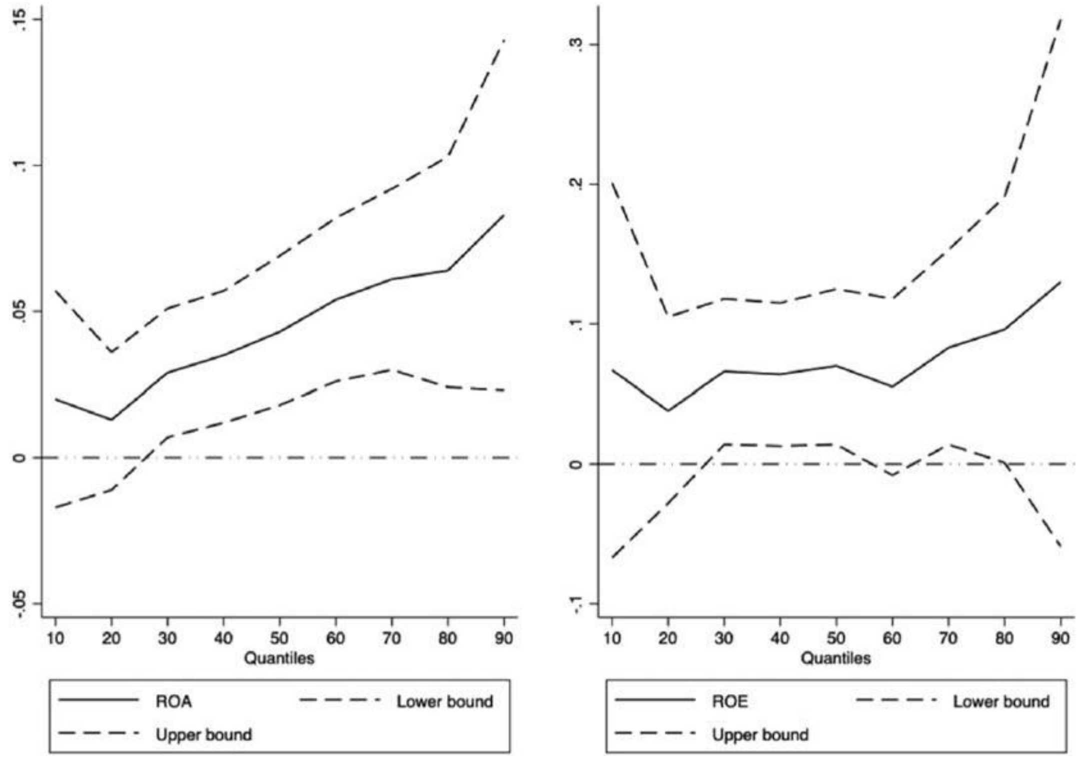

FIGURE 1 Unconditional quantile impact of environmental orientation on ROA (left panel) and ROE (right panel) with 95% confidence interval. ROA, return on assets; ROE, return on equity

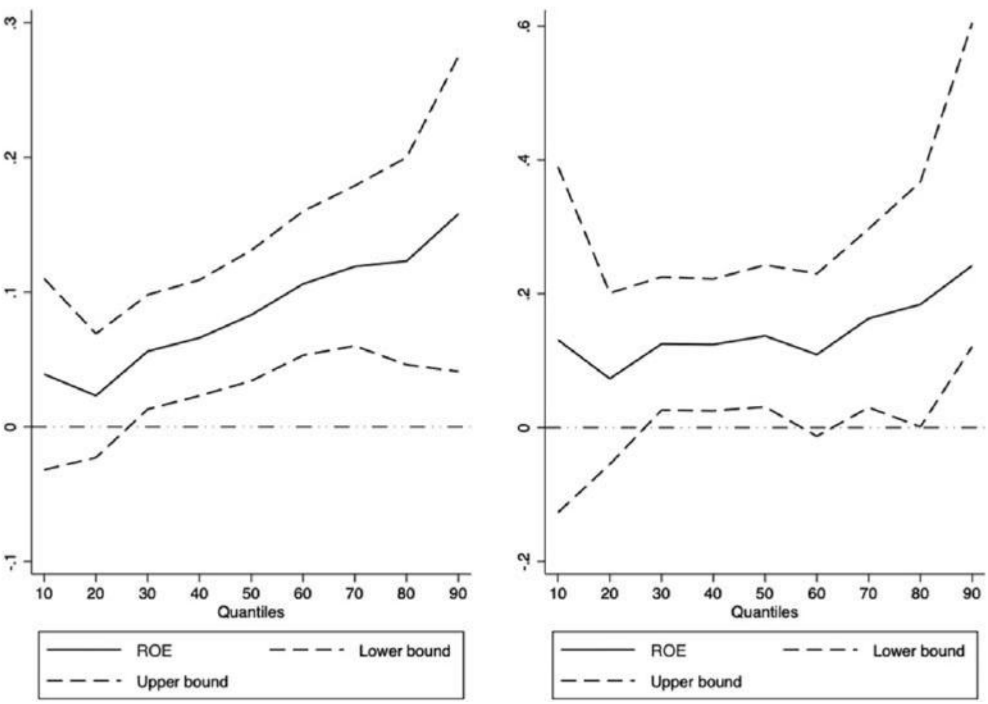

FIGURE 2 Unconditional quantile impact of environmental innovation on ROA (left panel) and ROE (right panel) with 95% confidence interval. ROA, return on assets; ROE, return on equity

3 and 4). In other words, when we control for time-variant and time-invariant characteristics, the EnP is positively correlated with EcP measured as ROA but not as ROE. As expected, we can observe positive correlations between a firm's MKTV on ROA and ROE and between governance style and ROA. Finally, larger firms also exhibit lower performance (ROA and ROE). This result may be associated with the existence of decreasing returns to scale.

This preliminary analysis suggests that Hypotheses 1a and 3a should be confirmed. However, it does not allow us to claim any causal relationship between the environmental indicators and firm performance because, as discussed in the previous section, FE estimates may be biased if there are time-varying omitted variables correlated with the environmental indicators. Therefore, adequately address this issue and test Hypotheses 1a and 3a, we run a second-stage FE-IV regression model, where the instruments are two dummies indicating whether the firm has an environmental management team and an environmental training program, respectively (results in Table 4). The first-stage results can be found in the appendix. The first-stage F-statistic is above 10 in all cases, indicating that the two instruments are relevant (i.e., correlated with the EnP indicators).

The second-stage coefficients confirm the results presented in Table 3, which show that the environmental indicators play a role in determining the average ROA but not the average ROE. It should be noted that the price we pay for using an IV approach is larger standard errors. However, our estimates also show that once we control for time-varying endogeneity, the impact of EnP on ROA is even larger in magnitude, whereas its impact on ROE remains insignificant. Thus, Hypotheses 1a and 3a are confirmed only if ROA is considered a measure of EcP. Moreover, our FE-IV estimates suggest that the effect of EI on average returns on assets is double that of a general measure of EO. According to the Hansen-J test, we cannot reject the null hypothesis of conditional exogeneity for the instruments at any significance level. In other words, we cannot reject the validity of our instruments. The endogeneity test reveals that omitted variables are an issue only when the dependent variable is ROA. This means that any relevant omitted variable must be related to firms' liabilities and that an IV approach is appropriate.[6]

5.2 | Testing Hypotheses 1b and 3b: Increasing returns from EnP

Whereas previous results refer to the impact of EO and EI on average EcP, the results in Figures 1 and 2 extend to the entire distribution of ROA and ROE. It is challenging to analyze the relation between EnP and EcP due to the extreme values that often arise when using variables calculated as ratios, such as ROA and ROE (Certo, Busenbark, Kalm, & LePine, 2020). Thus, an appropriate method to prevent outlier ratios from distorting means and regression results is required. To respond to this issue, we use the unconditional quantile regression technique described in the methodology section and plot the coefficients of EO and EI for each decile of our EcP indicators (see also the estimations reported in full in Tables A1–A4 in the appendix). First, we can observe that both EnP indicators positively affect ROA only when the latter is above a certain critical level (i.e., the third decile). Second, the magnitude of this effect increases with the quantiles of the ROA distribution. Finally, EO and EI also have a positive effect on ROE; in particular, EnP indicators boost ROE when the latter is between the third and the eighth decile of its distribution. Therefore, we can confirm the existence of increasing returns on EO and EI for firms with better EcP, as postulated in Hypotheses 1b and 3b. This also indicates that average estimates are sensitive to outliers. In line with Table 4, we also found that the CF residual is significant mainly for ROA, indicating that endogeneity is a serious issue, especially for liabilities.

5.3 | Testing Hypotheses 2 and 4: EnP and resource management capability

So far we have found that EnP has a positive impact on EcP, measured using standard performance indicators, namely, ROA and ROE. However, these indicators are financial ratios that represent the percentage of net income a company earns in relation to its resources. This means that a firm can be characterized by relatively high ratios because it generates high profits or employs fewer resources or both. Therefore, the positive impact of EnP on EcP may involve an increase in net income or a decrease in total assets (equity). In the first case, the firm is becoming more profitable; in the second case, the firm is becoming an asset-light company.

In this sense, both ROA and ROE are measures of efficiency because they tell us the quantity of resources a firm needs to generate a given income or the amount of profit a firm can earn given a certain stock of resources. Therefore, EnP can affect a firm's efficiency either by increasing its profitability per unit of resources or by decreasing the stock of resources needed to generate a unit of income.

Tables 5 and 6 address this issue using an unconditional interquantile regression method. Specifically, we divided the distributions of ROA and ROE components into two equal parts and carried out an unconditional quantile regression analysis. The first part of the distribution encompasses the first to the fifth decile, whereas the second part of the distribution encompasses the fifth to the ninth decile.

Columns 1 and 2 in both tables show that EnP reduces EBIT only when these earnings are already low, and Columns 3–6 show that EnP hinders a firm's capitalization, in terms of both equity and total assets, when this capitalization is already low. This means that the positive effect of EnP on EcP applies to asset-light companies, making them even lighter. On the one hand, EnP reduces the earnings of less

[6] The endogeneity test is a Durbin–Wu–Hausman test that compares the FE coefficient of the potentially endogenous regressor with the corresponding IV-FE coefficient. Under the assumption that our instruments are valid, the coefficient of the potentially endogenous variable significantly changes when we use an IV-FE approach. Therefore, the test confirms the existence of endogeneity and, hence, the validity of using the IV-FE estimator.

TABLE 5 Model estimation: ROA (ROE) components and environmental orientation (FE-CF unconditional interquantile regressions)

	EBIT		Equity		Total assets	
	(First to fifth)	(Fifth to ninth)	(First to fifth)	(Fifth to ninth)	(First to fifth)	(Fifth to ninth)
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Env_Orientation	−4.843*** (1.029)	19.560 (12.285)	−27.524*** (6.206)	−34.639 (94.106)	−71.199*** (14.954)	−136.726 (178.087)
CF residual	2.757** (1.130)	−16.083 (13.371)	13.420* (7.759)	138.519 (103.581)	48.355*** (17.810)	356.607* (209.707)
MKTV	2.063*** (0.591)	97.074*** (14.957)	8.974** (3.551)	434.147*** (117.755)	18.436** (8.067)	1511.134*** (261.515)
R&D	−2.296 (4.523)	134.631** (54.043)	−15.001 (25.379)	−364.405 (316.473)	−74.964 (56.601)	−711.850 (632.051)
Size	0.682* (0.397)	11.841* (6.172)	6.756** (3.045)	166.887** (70.443)	13.770** (6.873)	374.694** (163.505)
Governance	−12.887** (6.138)	−21.111 (61.658)	−82.447** (32.677)	−415.741 (429.829)	−279.808*** (83.019)	381.739 (942.276)
N	7,274	7,274	7,274	7,274	7,274	7,274
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.027	0.078	0.028	0.071	0.039	0.140
Overall R^2	0.641	0.724	0.661	0.677	0.749	0.794

Note: This table reports the FE-CF unconditional inter-quantile regressions, where dependent variables are the components of ROA (ROE) and interquantile intervals refer to first to fifth deciles and fifth to ninth deciles. In line with Table 1, coefficients are divided by thousand. Clustered-robust standard errors are in parentheses.
Abbreviations: CF, control function; EBIT, earnings before interest and taxes; FE, fixed effect; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

TABLE 6 ROA (ROE) components and Environmental innovation (FE-CF unconditional interquantile regressions)

	EBIT		Equity		Total assets	
	(First to fifth)	(Fifth to ninth)	(First to fifth)	(Fifth to ninth)	(First to fifth)	(Fifth to ninth)
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Env_Innovation	−9.392*** (1.988)	35.813 (23.658)	−53.927*** (12.063)	−69.763 (183.358)	−139.830*** (28.988)	−249.186 (340.440)
CF residual	9.543*** (2.023)	−37.981 (24.058)	55.746*** (12.605)	111.948 (181.851)	140.909*** (29.949)	423.373 (362.612)
MKTV	2.307*** (0.569)	95.870*** (14.721)	10.304*** (3.512)	435.847*** (115.846)	21.876*** (7.910)	1520.019*** (258.608)
R&D	−2.372 (4.538)	135.183** (54.004)	−15.366 (25.606)	−365.695 (317.670)	−75.973 (56.992)	−718.014 (636.193)
Size	0.720* (0.399)	11.662* (6.201)	6.964** (3.034)	167.170** (70.477)	14.324** (6.879)	375.900** (162.890)
Governance	−14.722** (6.152)	−13.416 (60.908)	−92.873*** (32.996)	−428.024 (439.320)	−306.348*** (83.083)	325.766 (934.991)
N	7,274	7,274	7,274	7,274	7,274	7,274
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.024	0.078	0.024	0.070	0.036	0.141
Overall R^2	0.640	0.724	0.659	0.677	0.749	0.794

Note: This table reports the FE-CF unconditional inter-quantile regressions, where dependent variables are the components of ROA (ROE) and interquantile intervals refer to first to fifth deciles and fifth to ninth deciles. In line with Table 1, coefficients are divided by thousand. Clustered-robust standard errors are in parentheses.
Abbreviations: CF, control function; EBIT, earnings before interest and taxes; FE, fixed effect; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

profitable firms; on the other hand, it makes firms lighter in terms of the resources needed for the production process. Tables 3 and 4 and Figures 1 and 2 show that the net effect of EnP on our financial ratios is positive and that, therefore, all firms that gain efficiency from EnP become asset-light companies. In other words, green companies tend to be more efficient than nongreen companies because they can generate the same streams of income while employing fewer resources, as postulated in Hypotheses 2 and 4.

6 | DISCUSSION AND CONCLUSIONS

6.1 | Main findings

Widespread concern regarding environmental degradation has caused companies to introduce new production processes and services aimed at preserving natural resources and the environment in general (Linnenluecke et al., 2012). However, it is not certain whether it pays to be green. In this work, we conduct a sophisticated longitudinal empirical analysis of a large group of US companies to explore the effects of EnP on EcP.

The results generally confirm a positive correlation between EnP and EcP. Our evidence also allows us to disentangle the effects of EO in general from a strong commitment toward sustainability demonstrated by a firm's ability to produce EI. From a methodological point of view, comparing two indicators of EcP (ROA and ROE) enables us to provide novel insights into the relationship between business strategy, environmental impact, and EcP. On average, higher EnP leads to better results in terms of ROA but not in terms of ROE. Therefore, our work contributes to the theoretical understanding of how EO and EI relate to EcP and, due to the rigorous methodological framework applied, provides robust and generalizable results that shed light on a disputed issue previously discussed in the literature but with inconsistent and fuzzy conclusions (Walls et al., 2012).

Moreover, our analysis considers firms' heterogeneity in terms of EcP. By considering the differential impact of green investment on firms with different levels of performance, we discover not only that higher EnP has a positive effect on both ROA and ROE but also that EnP yields increasing returns. This evidence enables us to conclude that EnP works as multiplier for EcP because the future competitiveness of firms is increasingly related to their capacity to proactively address environmental issues. Thus, EnP is inherently connected to sustaining competitive advantage, which suggests that firms should consider resources that enable them to reduce their environmental impact to be strategic resources.

Decomposition of the EcP indicators indicates that green firms show better resource management ability, which allows them to reach the same EcP while exploiting fewer resources. The circular economy argument, which illuminates the advantages of reuse and recycling (Gaustad et al., 2018; George et al., 2015; Ghisellini et al., 2018), contributes to explaining this result. Recent studies have highlighted that circular economy practices not only have a positive effect on the culture of a business but also improve the bottom line (Raworth, 2017). Our results demonstrate that theories developed during the 1970s and 1980s, which predominantly regarded CSR as an additional cost (Friedman, 1970; McGuire et al., 1988) are now outdated and that the transition to an "inclusive" economy not only benefits society in general but also generates profits at the corporate level. If it still holds that environmental investments in general, and EI in particular, require a rethinking of business models with respect to ecological constraints, it emerges that the related increase in costs in the short term is compensated by the profits achievable in the long run (Ghisellini et al., 2018). Our results confirm the importance of adopting circular economy practices, not only to improve the well-being of society but also to achieve sustainable competitive advantages. The empirical evidence supports rethinking the linear economic concept of waste and replacing it with a cradle-to-cradle circular perspective. This was discussed during a circular economy conference (Circularity 19) in Minneapolis on June 18–20, 2019, which emphasized how a circular economy can create profitable opportunities along all parts of the economic spectrum.

6.2 | Managerial and policy implications

The findings of this research are novel and will certainly strengthen the motivation of managers and policy-makers to adopt environmental practices. Enhancing EnP enables firms to reduce the environmental impact of their production processes while engaging in a systematic process of green innovation, which, as our findings demonstrate, can be even more rewarding.

Managers should consider environmental protection measures as opportunities to gain sustainable competitive advantages and introduce EIs, such as those connected to circular economy practices, to reuse or recycle resources. The widespread introduction of cost and benefit measures related to green investments could help managers to evaluate both a company's commitment to environmental practices and the advantages of resource reuse processes (Porter & Van der Linde, 1995). In sum, managers should integrate environmental strategies into their business models, which should be increasingly oriented toward environmental protection.

Our results also have several implications for policy-makers. Policy-makers should take proactive roles in developing relevant environmental regulations to encourage companies to strengthen their commitment to environmental sustainability. It would be beneficial for policy-makers to formulate guidelines for environmental management and identify appropriate incentives at different territorial levels.

6.3 | Limitations and further research

While emphasizing the original contribution of this work, we wish to acknowledge certain limitations. The first relates to the use of an aggregate measure of environmental sustainability taken from

ASSET4. As highlighted in the existing literature, an aggregate measure may be susceptible to subjectivity bias. Ratings are provided by socially responsible professionals who compile qualitative or quantitative data based on their own definitions of CSR (McWilliams, Rupp, Siegel, Günter, & Waldman, 2019). A second limitation relates to the use of accounting-based indicators as dependent variables, which may suffer from inconsistencies due to heterogeneous accounting procedures (Briloff, 1981) and may also be subject to managerial manipulation. In further research, it could be interesting to also consider market-based indicators to capture investors' evaluations of firms' capabilities to increase future revenues.

ACKNOWLEDGEMENTS

We wish to thank the editor and two anonymous reviewers for their comments and suggestions. Silvia Blasi acknowledges financial support from Centro per l'Economia e Tecnica dell'Energia “Levi Cases”, University of Padova.

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REFERENCES

Andersen, M. M. (2008). *Empirical analyses of environmental innovations* (pp. 17–18). Karlsruhe: Workshop Held at Fraunhofer Institute for Systems and Innovation Research ISI.

Apa, R., De Noni, I., Orsi, L., & Sedita, S. R. (2018). Knowledge space oddity: How to increase the intensity and relevance of the technological progress of European regions. *Research Policy*, *47*(9), 1700–1712.

Aragón-Correa, J. A., Hurtado-Torres, N., Sharma, S., & García-Morales, V. J. (2008). Environmental strategy and performance in small firms: A resource-based perspective. *Journal of Environmental Management*, *86*(1), 88–103. https://doi.org/10.1016/j.jenvman.2006.11.022

Aragón-Correa, J. A., & Sharma, S. (2003). A contingent resource-based view of proactive corporate environmental strategy. *Academy of Management Review*, *28*(1), 71–88.

Arlow, P., & Gannon, M. J. (1982). Social responsiveness, corporate structure, and economic performance. *Academy of Management Review*, *7*(2), 235–241.

Arthur, W. B. (1990). Positive feedbacks in the economy. *Scientific American*, *262*(2), 92–99.

Arthur, W. B. (1999). Complexity and the economy. *Science*, *284*(5411), 107–109. https://doi.org/10.1126/science.284.5411.107

Awaysheh, A., Heron, R. A., Perry, T., & Wilson, J. I. (2020). On the relation between corporate social responsibility and financial performance. *Strategic Management Journal*, *41*(6), 965–987.

Balakrishnan, S., & Fox, I. (1993). Asset specificity, firm heterogeneity and capital structure. *Strategic Management Journal*, *14*(1), 3–16.

Barber, B. M., & Lyon, J. D. (1996). Detecting abnormal operating performance: The empirical power and specification of test statistics. *Journal of Financial Economics*, *41*(3), 359–399.

Bartolacci, F., Paolini, A., Quaranta, A. G., & Soverchia, M. (2018). Assessing factors that influence waste management financial sustainability. *Waste Management*, *79*, 571–579. https://doi.org/10.1016/j.wasman.2018.07.050

Agrawal, V. V., & Bellos, I. (2017). The potential of servicizing as a green business model. *Management Science*, *63*(5), 1545–1562.

Blasi, S., Caporin, M., & Fontini, F. (2018). A multidimensional analysis of the relationship between corporate social responsibility and firms' economic performance. *Ecological Economics*, *147*, 218–229. https://doi.org/10.1016/j.ecolecon.2018.01.014

Borgen, N. T. (2016). Fixed effects in unconditional quantile regression. *The Stata Journal*, *16*(2), 403–415.

Bowen, H. R. (2013). *Social responsibilities of the businessman*. Iowa: University of Iowa Press.

Briloff, A. J. (1981). *The truth about corporate accounting*. New York: Harpercollins.

Certo, S. T., Busenbark, J. R., Kalm, M., & LePine, J. A. (2020). Divided we fall: How ratios undermine research in strategic management. *Organizational Research Methods*, *23*(2), 211–237.

Chao, R. O., & Kavadias, S. (2009). R&D intensity and the NPD Portfolio. *Available at SSRN*, 1330154. 664–675.

Chen, Y.-S. (2008). The driver of green innovation and green image–green core competence. *Journal of Business Ethics*, *81*(3), 531–543.

Chesher, A. (2003). Identification in nonseparable models. *Econometrica*, *71*(5), 1405–1441.

Christmann, P. (2000). Effects of “best practices” of environmental management on cost advantage: The role of complementary assets. *Academy of Management Journal*, *43*(4), 663–680.

Dangelico, R. M. (2016). Green product innovation: Where we are and where we are going. *Business Strategy and the Environment*, *25*(8), 560–576.

Dangelico, R. M., & Pujari, D. (2010). Mainstreaming green product innovation: Why and how companies integrate environmental sustainability. *Journal of Business Ethics*, *95*(3), 471–486.

Dangelico, R. M., Pujari, D., & Pontrandolfo, P. (2017). Green product innovation in manufacturing firms: A sustainability-oriented dynamic capability perspective. *Business Strategy and the Environment*, *26*(4), 490–506.

De Jesus, A., & Mendonça, S. (2018). Lost in transition? Drivers and barriers in the eco-innovation road to the circular economy. *Ecological Economics*, *145*, 75–89.

Demirel, P., & Kesidou, E. (2011). Stimulating different types of eco-innovation in the UK: Government policies and firm motivations. *Ecological Economics*, *70*(8), 1546–1557.

Drempetic, S., Klein, C., & Zwergel, B. (2019). The influence of firm size on the ESG score: Corporate sustainability ratings under review. *Journal of Business Ethics*, 1–28.

Driessen, P. H., Hillebrand, B., Kok, R. A. W., & Verhallen, T. M. M. (2013). Green new product development: The pivotal role of product greenness. *IEEE Transactions on Engineering Management*, *60*(2), 315–326.

Duque-Grisales, E., & Aguilera-Caracuel, J. (2019). Environmental, social and governance (ESG) scores and financial performance of Multilatinas: Moderating effects of geographic international diversification and financial slack. *Journal of Business Ethics*, 1–20.

Dwyer, R., Lamond, D., Molina-Azorín, J. F., Claver-Cortés, E., López-Gamero, M. D., & Tarí, J. J. (2009). Green management and financial performance: A literature review. *Management Decision*. 1080–1100.

Elkington, J. (2002). Corporate strategy in the chrysalis economy. *Corporate Environmental Strategy*, *9*(1), 5–12.

Elsayed, K., & Paton, D. (2005). The impact of environmental performance on firm performance: Static and dynamic panel data evidence. *Structural Change and Economic Dynamics*, *16*(3), 395–412.

Filbeck, G., & Gorman, R. F. (2004). The relationship between the environmental and financial performance of public utilities. *Environmental and Resource Economics*, *29*(2), 137–157.

Firpo, S., Fortin, N. M., & Lemieux, T. (2009). Unconditional quantile regressions. *Econometrica*, *77*(3), 953–973.

Florida, R. (1996). Lean and green: The move to environmentally conscious manufacturing. *California Management Review*, *39*(1), 80–105.

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

Friedman, M. (1970). The social responsibility of business is to increase its profits. *Corporate Ethics and Corporate Governance*, 173–178.

Gaustad, G., Krystofik, M., Bustamante, M., & Badami, K. (2018). Circular economy strategies for mitigating critical material supply issues. *Resources, Conservation and Recycling*, *135*, 24–33.

George, D. A. R., Lin, B. C., & Chen, Y. (2015). A circular economy model of economic growth. *Environmental Modelling & Software*, *73*, 60–63.

Ghisellini, P., Ripa, M., & Ulgiati, S. (2018). Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. *A Literature Review. Journal of Cleaner Production*, *178*, 618–643.

Goldstein, R., Ju, N., & Leland, H. (2001). An EBIT-based model of dynamic capital structure. *The Journal of Business*, *74*(4), 483–512.

Gupta, G., & Khare, J. P. (2016). Financial matters in global perspective. In S. S. Bhakar, N. Velankar, H. Saxena, & D. Sharma (Eds.), *Financial matters in global perspective* (pp. 373–377). New Delhi: Bharti Publications.

Hart, S. L., & Ahuja, G. (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.

Henriksen, K., Bjerre, M., Bisgaard, T., Høgenhaven, C., Maria Almasi, A., & Damgaard Grann, E. (2012). *Green business model innovation: Empirical and literature studies*. Nordic Council of Ministers.

Hovakimian, A., Opler, T., & Titman, S. (2001). The debt-equity choice. *Journal of Financial and Quantitative Analysis*, *36*(1), 1–24.

Imbens, G. W., & Newey, W. K. (2009). Identification and estimation of triangular simultaneous equations models without additivity. *Econometrica*, *77*(5), 1481–1512.

Ioannou, I., & Serafeim, G. (2010). *What drives corporate social performance?: International evidence from social, environmental and governance sources*. MA: Harvard Business School Cambridge.

Kemp, R. (2010). Eco-Innovation: Definition, measurement and open research issues. *Economia Politica*, *27*(3), 397–420.

Kim, Y., Li, H., & Li, S. (2014). Corporate social responsibility and stock price crash risk. *Journal of Banking & Finance*, *43*, 1–13.

King, A., & Lenox, M. (2002). Exploring the locus of profitable pollution reduction. *Management Science*, *48*(2), 289–299.

Klassen, R. D., & Whybark, D. C. (1999). The impact of environmental technologies on manufacturing performance. *Academy of Management Journal*, *42*(6), 599–615.

Lee, K., Cin, B. C., & Lee, E. Y. (2016). Environmental responsibility and firm performance: The application of an environmental, social and governance model. *Business Strategy and the Environment*, *25*(1), 40–53.

Lee, K., & Kim, J. (2011). Integrating suppliers into green product innovation development: An empirical case study in the semiconductor industry. *Business Strategy and the Environment*, *20*(8), 527–538.

Lee, K.-H., & Min, B. (2015). Green R&D for eco-innovation and its impact on carbon emissions and firm performance. *Journal of Cleaner Production*, *108*, 534–542.

Lee, S. (2007). Endogeneity in quantile regression models: A control function approach. *Journal of Econometrics*, *141*(2), 1131–1158.

Li, S., Ngniatedema, T., & Chen, F. (2017). Understanding the impact of green initiatives and green performance on financial performance in the US. *Business Strategy and the Environment*, *26*(6), 776–790.

Lin, B. C., & Zheng, S. (2016). A new direction in environmental economics. *Journal of Economic Surveys*, *30*(3), 397–402.

Lin, W. L., Mohamed, A. B., Sambasivan, M., & Yip, N. (2019). Effect of green innovation strategy on firm-idiosyncratic risk: A competitive action perspective. *Business Strategy and the Environment*, *29*(3), 886–901.

Linder, M., Björkdahl, J., & Ljungberg, D. (2014). Environmental orientation and economic performance: A quasi-experimental study of small Swedish firms. *Business Strategy and the Environment*, *23*(5), 333–348.

Linnenluecke, M. K., Griffiths, A., & Winn, M. (2012). Extreme weather events and the critical importance of anticipatory adaptation and organizational resilience in responding to impacts. *Business Strategy and the Environment*, *21*(1), 17–32.

Liu, X., Dai, H., & Cheng, P. (2011). Drivers of integrated environmental innovation and impact on company competitiveness: Evidence from 18 Chinese firms. *International Journal of Technology and Globalisation*, *5*(3–4), 255–280.

Managi, S. (2006). Are there increasing returns to pollution abatement? Empirical analytics of the Environmental Kuznets Curve in pesticides. *Ecological Economics*, *58*(3), 617–636.

Martí-Ballester, C.-P. (2017). Sustainable energy systems and company performance: Does the implementation of sustainable energy systems improve companies' financial performance? *Journal of Cleaner Production*, *162*, S35–S50. https://doi.org/10.1016/J.JCLEPRO.2016.12.015

McGuire, J. B., Sundgren, A., & Schneeweis, T. (1988). Corporate social responsibility and firm financial performance. *Academy of Management Journal*, *31*(4), 854–872.

McWilliams, A., Rupp, D. E., Siegel, D. S., Günter, S. K., & Waldman, D. A. (2019). *The Oxford handbook of corporate social responsibility: Psychological and organizational perspectives*. Oxford University Press.

Merton, R. K. (1988). The Matthew effect in science, II: Cumulative advantage and the symbolism of intellectual property. *Isis*, *79*(4), 606–623.

Moon, H., & Parc, J. (2019). Shifting corporate social responsibility to corporate social opportunity through creating shared value. *Strategic Change*, *28*(2), 115–122.

Orlitzky, M., Schmidt, F. L., & Rynes, S. L. (2003). Corporate social and financial performance: A meta-analysis. *Organization Studies*, *24*(3), 403–441.

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

Pieroni, M. P. P., McAloone, T. C., & Pigosso, D. C. A. (2019). Business model innovation for circular economy and sustainability: A review of approaches. *Journal of Cleaner Production*, *215*, 198–216.

Porter, M. E., & Van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, *9*(4), 97–118.

Porter, M. E., & Van der Linde, C. (2011). *Green and competitive-ending the stalemate*.

Powell, D. (2016). Quantile treatment effects in the presence of covariates. *Review of Economics and Statistics*, 1–39.

Raworth, K. (2017). *Doughnut economics: Seven ways to think like a 21st-century economist*. Chelsea Green Publishing.

Sharma, S., & Vredenburg, H. (1998). Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities. *Strategic Management Journal*, *19*(8), 729–753.

Singer, A. E. (2018). *Business ethics and strategy*. Volumes I and II: Routledge.

Smart, S. B., Thirumalai, R. S., & Zutter, C. J. (2008). What's in a vote? The short-and long-run impact of dual-class equity on IPO firm values. *Journal of Accounting and Economics*, *45*(1), 94–115.

Tang, M., Walsh, G., Lerner, D., Fitza, M. A., & Li, Q. (2018). Green innovation, managerial concern and firm performance: An empirical study. *Business Strategy and the Environment*, *27*(1), 39–51.

Urbinati, A., Chiaroni, D., & Chiesa, V. (2017). Towards a new taxonomy of circular economy business models. *Journal of Cleaner Production*, *168*, 487–498. https://doi.org/10.1016/j.jclepro.2017.09.047

Wagner, M. (2005). How to reconcile environmental and economic performance to improve corporate sustainability: Corporate environmental strategies in the European paper industry. *Journal of Environmental Management*, *76*(2), 105–118.

Wagner, M., Van Phu, N., Azomahou, T., & Wehrmeyer, W. (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.

Walls, J. L., Berrone, P., & Phan, P. H. (2012). Corporate governance and environmental performance: Is there really a link? *Strategic Management Journal*, *33*(8), 885–913.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Zheka, V. (2005). Corporate governance, ownership structure and corporate efficiency: The case of Ukraine. *Managerial and Decision Economics*, *26*(7), 451–460.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Bassetti T, Blasi S, Sedita SR. The management of sustainable development: A longitudinal analysis of the effects of environmental performance on economic performance. *Bus Strat Env*. 2020;1–17. https://doi.org/10.1002/bse.2607

APPENDIX A: ADDITIONAL RESULTS

Tables A1 and A2 report the FE-CF unconditional quantile estimates for the ROA and the ROE, respectively. Here, the main independent variable is EO, and the corresponding coefficients are those used to draw Figure 1. Notice that the coefficient of the control function residual is statistically significant only for the last deciles, indicating that endogeneity is a relevant issue only for top performers.

Tables A3 and A4 differ from Tables A1 and A2 only for the fact that now the main explanatory variable is EI. Conclusions remain qualitatively the same, apart from the higher bias observed when considering EI instead of a more general EO indicator. In line with FE-IV estimates, once we control for simultaneity problems, the impact of EI on the performance is larger than the impact of EO.

TABLE A1 ROA and environmental orientation (FE-CF unconditional quantile regressions)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Env_Orientation	0.020 (0.019)	0.013 (0.012)	0.029*** (0.011)	0.035*** (0.011)	0.043 (0.013)	0.054*** (0.014)	0.061*** (0.016)	0.064*** (0.020)	0.083*** (0.031)
CF residual	0.009 (0.022)	0.003 (0.014)	−0.008 (0.013)	−0.016 (0.013)	−0.014 (0.015)	−0.033** (0.016)	−0.041 (0.018)	−0.060*** (0.022)	−0.075** (0.032)
MKTV	0.040*** (0.011)	0.033*** (0.009)	0.030*** (0.009)	0.034*** (0.010)	0.044*** (0.010)	0.053*** (0.012)	0.049*** (0.013)	0.059*** (0.018)	0.101*** (0.036)
R&D	0.178* (0.105)	0.111* (0.063)	0.125** (0.053)	0.133** (0.058)	0.158** (0.065)	0.224*** (0.074)	0.242*** (0.085)	0.204* (0.109)	0.272 (0.169)
Size	−0.005 (0.003)	−0.006* (0.004)	−0.007 (0.005)	−0.008* (0.005)	−0.014*** (0.005)	−0.018*** (0.007)	−0.019*** (0.006)	−0.021** (0.010)	−0.032** (0.016)
Governance	0.082 (0.090)	0.042 (0.061)	0.050 (0.055)	0.062 (0.052)	0.077 (0.059)	0.074 (0.069)	0.117 (0.079)	0.220** (0.109)	0.289* (0.164)
N	7,274	7,274	7,274	7,274	7,274	7,274	7,274	7,274	7,274
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.006	0.007	0.011	0.012	0.018	0.020	0.017	0.013	0.013
Overall R^2	0.366	0.397	0.458	0.503	0.522	0.528	0.526	0.508	0.464

Note: This table reports the FE-CF unconditional quantile regression estimates of Equation 1 when the dependent variable is the ROA. The column number also indicates the decile considered in the estimates. Notice that 111 singletons are dropped. Clustered-robust standard errors are in parentheses.

Abbreviations: CF, control function; EBIT, earnings before interest and taxes; EF, fixed effect; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.

$^{*}p < 0.1$. $^{**}p < 0.05$. $^{***}p < 0.01$.

TABLE A2 ROE and environmental orientation (FE-CF unconditional quantile regressions)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Env_Orientation	0.067 (0.068)	0.038 (0.034)	0.066** (0.026)	0.064** (0.026)	0.070** (0.028)	0.055* (0.032)	0.083** (0.035)	0.096** (0.048)	0.130 (0.096)
CF residual	0.024 (0.079)	0.018 (0.040)	−0.023 (0.031)	−0.031 (0.030)	−0.036 (0.032)	−0.022 (0.036)	−0.075* (0.039)	−0.105** (0.053)	−0.158 (0.102)
MKTV	0.150*** (0.040)	0.096*** (0.024)	0.081*** (0.019)	0.081*** (0.019)	0.096*** (0.023)	0.115*** (0.026)	0.131*** (0.033)	0.177*** (0.051)	0.277** (0.109)
R&D	0.676* (0.379)	0.276* (0.159)	0.322*** (0.119)	0.340*** (0.116)	0.369***(0.126)	0.382*** (0.144)	0.391**(0.170)	0.431* (0.224)	0.060 (0.317)
Size	−0.018 (0.015)	−0.017* (0.009)	−0.013 (0.008)	−0.015* (0.009)	−0.023** (0.011)	−0.028** (0.011)	−0.036*** (0.012)	−0.038* (0.022)	−0.065 (0.042)
Governance	0.029 (0.338)	0.058 (0.159)	0.128 (0.127)	0.124 (0.124)	0.065 (0.126)	0.193 (0.151)	0.077 (0.187)	0.258 (0.231)	−0.031 (0.467)
N	7,274	7,274	7,274	7,274	7,274	7,274	7,274	7,274	7,274
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.005	0.008	0.011	0.012	0.014	0.015	0.013	0.013	0.009
Overall R^2	0.318	0.357	0.396	0.428	0.458	0.470	0.465	0.470	0.465

Note: This table reports the FE-CF unconditional quantile regression estimates of Equation 1 when the dependent variable is the ROE. The column number also indicates the decile considered in the estimates. Notice that 111 singletons are dropped. Clustered-robust standard errors are in parentheses.
Abbreviations: CF, control function; EBIT, earnings before interest and taxes; EF, fixed effect; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.
$^{*}p < 0.1$. $^{**}p < 0.05$. $^{***}p < 0.01$.

TABLE A3 ROA and environmental innovation (FE-CF unconditional quantile regressions)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Env_Innovation	0.039 (0.036)	0.023 (0.023)	0.056** (0.022)	0.066*** (0.022)	0.083*** (0.025)	0.106*** (0.027)	0.119*** (0.030)	0.123*** (0.039)	0.158*** (0.060)
CF residual	−0.027 (0.036)	−0.018 (0.024)	−0.050** (0.022)	−0.060*** (0.022)	−0.073*** (0.025)	−0.098*** (0.028)	−0.113*** (0.031)	−0.129*** (0.040)	−0.150** (0.062)
MKTV	0.039*** (0.010)	0.032*** (0.009)	0.028*** (0.009)	0.032*** (0.009)	0.042*** (0.010)	0.051*** (0.012)	0.046*** (0.013)	0.056*** (0.017)	0.096*** (0.036)
R&D	0.178* (0.105)	0.111* (0.063)	0.126** (0.053)	0.133** (0.057)	0.159** (0.065)	0.225*** (0.074)	0.243*** (0.085)	0.205* (0.109)	0.274 (0.169)
Size	−0.005 (0.003)	−0.006* (0.004)	−0.007 (0.005)	−0.008* (0.005)	−0.014***(0.005)	−0.018*** (0.006)	−0.019*** (0.006)	−0.021** (0.010)	−0.033** (0.016)
Governance	0.090 (0.089)	0.047 (0.061)	0.061 (0.054)	0.075 (0.052)	0.094 (0.059)	0.094 (0.069)	0.139* (0.080)	0.244** (0.109)	0.320** (0.163)
N	7,274	7,274	7,274	7,274	7,274	7,274	7,274	7,274	7,274
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.005	0.006	0.008	0.010	0.015	0.019	0.016	0.013	0.013
Overall R^2	0.365	0.397	0.457	0.502	0.520	0.528	0.526	0.508	0.464

Note: This table reports the FE-CF unconditional quantile regression estimates of Equation 1 when the dependent variable is the ROA. The column number also indicates the decile considered in the estimates. Notice that 111 singletons are dropped. Clustered-robust standard errors are in parentheses.
Abbreviations: CF, control function; EBIT, earnings before interest and taxes; EF, fixed effect; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.
$^{*}p < 0.1$. $^{**}p < 0.05$. $^{***}p < 0.01$.

TABLE A4 ROE and environmental innovation (FE-CF unconditional quantile regressions)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Env_Innovation	0.131 (0.132)	0.073 (0.065)	0.125** (0.051)	0.124** (0.050)	0.137** (0.054)	0.109* (0.062)	0.163** (0.068)	0.184** (0.093)	0.242 (0.185)
CF residual	−0.092 (0.132)	−0.057 (0.066)	−0.112** (0.052)	−0.111** (0.051)	−0.122** (0.055)	−0.100 (0.063)	−0.159** (0.071)	−0.192** (0.097)	−0.261 (0.191)
MKTV	0.147*** (0.038)	0.094*** (0.023)	0.078*** (0.019)	0.078*** (0.019)	0.093*** (0.022)	0.112*** (0.026)	0.127*** (0.033)	0.171*** (0.051)	0.270** (0.106)
R&D	0.676* (0.378)	0.277* (0.158)	0.323*** (0.119)	0.341*** (0.116)	0.370*** (0.126)	0.382*** (0.144)	0.392** (0.170)	0.433* (0.224)	0.064 (0.318)
Size	−0.019 (0.014)	−0.017* (0.009)	−0.013 (0.008)	−0.016* (0.009)	−0.024** (0.011)	−0.029*** (0.011)	−0.036*** (0.012)	−0.039* (0.022)	−0.066 (0.042)
Governance	0.054 (0.339)	0.073 (0.158)	0.153 (0.127)	0.147 (0.124)	0.090 (0.126)	0.213 (0.150)	0.108 (0.186)	0.29 (0.232)	0.019 (0.469)
N	7,274	7,274	7,274	7,274	7,274	7,274	7,274	7,274	7,274
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.004	0.007	0.010	0.011	0.014	0.014	0.013	0.014	0.009
Overall R^2	0.317	0.356	0.395	0.428	0.457	0.470	0.465	0.470	0.465

Note: This table reports the FE-CF unconditional quantile regression estimates of Equation 1 when the dependent variable is the ROE. The column number also indicates the decile considered in the estimates. Notice that 111 singletons are dropped. Clustered-robust standard errors are in parentheses.

Abbreviations: CF, control function; EBIT, earnings before interest and taxes; EF, fixed effect; MKTV, market value; R&D, research and development; ROA, return on assets; ROE, return on equity.

$^{*}p < 0.1$. $^{**}p < 0.05$. $^{***}p < 0.01$.