Firm environmental performance under scrutiny: The role of strategic and organizational orientations

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ABSTRACT

Reducing firm environmental burden is not easy. Thus, several studies investigated the antecedents of good firm environmental performance, however providing contrasting results, focusing on specific categories of antecedents, and often relying on subjective performance measures. This study overcomes these gaps by jointly considering the effects of different firm strategic and organizational orientations on several dimensions of environmental performance, objectively measured. Through the analysis of 269 large global companies included in the Newsweek Green Ranking, we found that: both market and environmental management orientations have a positive effect on carbon, energy, and water productivity; green supply chain management orientation has a positive influence on waste and water productivity; technology orientation negatively affects carbon and waste productivity. Based on these findings, we advise managers that strategic and organizational orientations do not affect all types of environmental performance in the same way, thus calling for caution when they are designed for environmentally-friendly purposes.

Keywords: environmental performance; market orientation; technology orientation; environmental management orientation; green supply chain management orientation; sustainable development

Introduction

Nowadays many companies have become conscious of the need to drive their business in a sustainable way, hence devoting increasing efforts to achieve better environmental performance (e.g., Porter and Reinhardt, 2007). However, most of them fail to do that because companies often do not recognize that environmental sustainability is not just a mere adaptation to current environmental requirements but it necessitates a board engagement, looking at the whole value chain and involving the whole organization (Bhattacharya and Polman, 2017; Adams et al., 2016). In other words, improving environmental performance requires shifting from a responsive approach towards the implementation of proactive strategic and organizational orientations with a focus on environmental and social issues (Hart, 1997; Stadtler and Lin, 2017).

Accordingly, on the one hand, it has been argued that environmental performance can be defined as *"the outcome of a firm's strategic activities that manage (or not) its impact on the natural environment"* (Walls *et al.,* 2012:891). As a result, drawing upon the management literature (e.g., Hurley and Hult, 1998), recent research on environmental sustainability has devoted particular attention to the role played by firms' strategic orientations, in that they reflect what *"priorities are made, how the company defines its operations and how customers are viewed"* (Jansson *et al., 2017*:70; see also Adams et al., 2016). On the other hand, it is worth mentioning that strategic orientations mainly refer to the general culture in an organization. Rather, companies also have to decide on the actual guidance directing strategy implementation (i.e., organizational orientation), which entails the execution of proper approaches (e.g., specific management systems procedures and planning) within the organization (Engert and Baumgartner, 2016). Thereby, so far, several studies have analyzed the influence of different strategic and organizational orientations on firm environmental performance (e.g., Annandale et al., 2004; González-Benito and González-Benito, 2008; Testa et al., 2014; Zhu and Sarkis, 2004; Zobel, 2016). However, a review of these studies highlights some contrasting results, revealing different effects of the same strategic/organizational orientation on a given environmental performance. Moreover, no study simultaneously considers the effect of different types of orientations to environmental management on firm environmental performance despite their pivotal role in the domain of environmental sustainability. These issues are further exacerbated by the fact that most of this research lacks objective measures of environmental performance, different measures of environmental performance (ranging from specific dimensions to composite indicators) are used in each study, and most contributions limit data to major sub-sectors or industry clusters. These shortcomings prevent us from having a clear and robust picture of the effects of strategic and organizational orientations on environmental performance at the firm level.

In order to overcome limits of previous studies and provide a more comprehensive overview of the topic, this research follows claims of more detailed cross-sectoral firm-specific data and analyses and aims at:

- understanding the influence of different types of strategic and organizational orientations on firm environmental performance;
- understanding whether this influence changes based on the type of environmental performance that is measured.

In the literature, two main strategic orientations can be distinguished: technology orientation and market orientation (e.g., Hurley and Hult, 1998; Luukkonen, 2002). Technology orientation is the tendency to support new ideas, the adoption of new technologies (Chen et al., 2014; Hurley and Hult, 1998), and the use of the latest technological advancements in new products and processes (Zhou et al., 2005). Therefore, strong emphasis is posed on R&D activities, the support for innovative ideas, and the rapid integration of new methods and solutions into a firm's procedures (Ardito et al., 2015; Gatignon and Xuereb, 1997). Instead, market orientation means tracking and responding to the continuously evolving customer needs and expectations (Jaworski and Kohli, 1993). Thus, it refers to "*the organization-wide generation of market intelligence, dissemination of the intelligence across departments, and organization-wide responsiveness to it*" (Jaworski and Kohli, 1993:53). These strategic orientations are deemed to be very relevant for environmental sustainability since they allow firms to respond to the two major driving forces promoting green management, i.e., (1) regulations concerning environmental protection and (2) customers' environmental consciousness (e.g., Albort-Morant *et al*., 2016). Notably, both of them ask firms to understand and answer to the growing need of green technologies, environmentally-friendly products, and more sustainable production processes, as well as to meet and cope with the increasing customer demand for more environmentally-friendly attitudes, hence making technology and market orientations of foremost importance in environmental management studies.

In terms of organizational orientation, companies may choose two different (although not mutually-exclusive) approaches: internally-oriented or externally-oriented (Darnall *et al*., 2008; Eggers and Kaplan, 2009; Florida and Davison, 2001). In the environmental sustainability domain, the internally-oriented approach refers to environmental management practices developed within the firm (Martín-de Castro et al., 2015; Testa et al., 2014); that is, the environmental management orientation. Specifically, environmental management orientation can be conceived as a proactive approach to environmental management and has been defined as an orientation that includes "*system analysis and planning, organizational responsibility, and management controls*" (Klassen, 2001:257). These elements mainly correspond to the parts of environmental management systems

(EMS), such as the policy and planning, implementation and operations, and checking and correction elements of ISO 14000 (Clements, 1997; Klassen, 2001). The externally-oriented approach refers to the involvement of external actors in the implementation of environmental management practices, as in the case of sustainable supply chains (Gold et al., 2010; Harms et al., 2013; Vachon and Klassen, 2008; Wittstruck and Teuteberg, 2012); that is, the green supply chain management orientation. Specifically, green supply chain management orientation can be defined as *"a set of business philosophy and practices intended to control and support improvement of environmental results in a supply chain"* (Kim *et al.,* 2011*:*286). Stated differently, it is the application of a supply chain orientation – i.e., *"the recognition by a company of the systemic, strategic implications of the activities and processes involved in managing the various flows in a supply chain"* (Mentzer, 2001, p. 14) – for environmental purposes. Environmental management orientation and green supply chain management orientation are often complementary for firms adopting environmental strategies (Darnall *et al*., 2008) and are very relevant to cope with the changes needed both inside and outside the firm to become environmentally sustainable (Judge and Elenkov, 2005; Nidumolu *et al*., 2009). Due to the highlighted relevance of each of the above strategic (technology and market) and organizational (environmental management and green supply chain management) orientations for companies embracing environmental sustainability, this research deeply analyzes the effects of each of them on firm environmental performance.

To this purpose, a sample made of 269 large global companies, included in the Newsweek Green Ranking (NGR) 2014, is analyzed. Data for environmental performance (namely, carbon, energy, waste, and water productivity) have been collected from the NGR database, whereas data for strategic and organizational orientations have been collected through the content analysis of firms' environmental/sustainability/corporate social responsibility reports. A series of regression analyses have been conducted to test the effect of the different types of strategic and organizational orientations on the different dimensions of environmental performance of firms.

This paper adds to previous studies on the relationship between firms' orientations and environmental performance by reconciling contrasting results, focusing on multiple categories of strategic and organizational orientations, as well as on diverse types of environmental performance, and relying on less subjective measures for the empirical analysis. From a managerial standpoint, managers are advised that the considered firms' orientations do not affect all types of environmental performance in the same way, thus providing insights about the necessity of diversified approaches for targeting the improvement of specific types of environmental performance.

The paper is structured as follows. In the next section, the theoretical framework is reported, with a review of the most important studies on the links between firm strategic and organizational orientations and environmental performance; moreover, the research model is presented. Then, methodological details are provided and results described. Finally, discussions and conclusions are reported.

Theoretical framework and research model

Strategic orientation

Technology orientation and environmental performance

Prior research (Chen et al., 2014; Horbach, 2008) argued that firms with an environmental focus can achieve better environmental performance if they pursue a technology-oriented strategy. Indeed, the transition towards environmentally-friendly corporations requires firms to shift away from practices that are not resource-efficient and design eco-friendly products (e.g., Adams et al., 2016; Dangelico, 2016). However, this goal is achievable only if companies devote remarkable attention to attaining the technical and knowledge resources needed for alternative solutions in designing new products, operations, and industrial processes related to green initiatives (e.g., Dangelico et al., 2017; Song and Yu, 2017). Accordingly, Arora and Cason (1996) and Cole et al. (2005) revealed that R&D intensive firms more easily meet environmental regulations and reduce pollution emissions by reaping the benefits deriving from the most recent technological advancements (see also Etzion, 2007). Similarly, Rennings and Rammer (2009) found that firms with a focus on product/process innovations also achieve energy and/or material savings. In addition, as a kind of strategic orientation, technology orientation, together with environmental responsiveness, affects corporate culture (Adams et al., 2016), thus favoring an environment conducive to learning and the implementation of innovative ideas into standard operational use, with the goal of drastically cutting the impact of firms' activities on the natural environment and stimulating sustainable practices among organizational members (Varadarajan, 2017).

However, some studies went against the notion that the higher the technology orientation the better firm environmental performance. They postulated about a negative relationship between an environmental technology-oriented strategy and the achievement of good environmental performance. This lies in the fact that technology orientation is a continuous process of selection and implementation of the most recent technological solutions (Zhou et al., 2005). That is, firms tend to repeatedly move into new technological domains and engage in organizational renewal as the new technical solutions are integrated within the firms' processes (Costa et al., 2015). As a consequence, even though fewer inputs are usually required, the achievement of more sustainable production processes may not occur because those processes never stabilize due to the fast pace of technological change and limitations in the learning capabilities of firms' employees (Oltra and

Saint Jean, 2009; Sagar and van der Zwaan, 2006). In line with this reasoning, Sagar and van der Zwaan (2006) proved that it is not uncommon that being devoted to implementing ever-new technologies comes with some failure effects on firm performance. These include higher resource depletion during the trial-and-error process characterizing uncertain innovative efforts. Furthermore, it is worth mentioning that private returns of eco-innovative activities are often lower than the social benefits they provide due to market failure effects (Rennings, 2000), whereby firms are discouraged to combine their R&D efforts with sustainable business practices. Therefore, technology generation and utilization may be hampered, so more time is needed to actually see the results of a technology-oriented strategy, at least for environmental purposes (Alkemade and Suurs, 2012), ultimately limiting the greening of firms' production and, hence, environmental performance.

Market orientation and environmental performance

In today's economic landscape, market orientation will likely represent a key determinant of positive environmental performance. Indeed, customers' concerns about the environment are growing, and so their demand for environmentally-friendly business practices (e.g., Dangelico and Pujari, 2010; Oltra and Saint Jean, 2009). In turn, customers' pressure towards the reduction of firms' environmental impacts is rising and manifests through behaviors like the boycott of perceived "grey" products and public campaigns against companies (e.g., Ottman, 1997). Thereby, in order to avoid building a negative image with regard to their customers and incurring in disadvantageous selective shopping, market-oriented firms tend to implement proactive environmental strategies and establish new cultural and operational values that are conductive to the reduction of their environmental burden (Darnall et al., 2010). Accordingly, González-Benito and González-Benito (2008) revealed that a high market orientation leads to practices aimed at limiting energy consumption and fostering recycling, among others; Kammerer (2009) also showed that firms that care about customers' benefits from environmentally-friendly products (i.e., those more energy and material efficient and less toxic) actually engage in environmentally-friendly behaviors. Ultimately, customers' requirements have been identified as one of the main sources of the implementation of environmental strategies and innovations, so driving firms to better environmental performance (Jansson *et al.*, 2017). The automotive industry is a very-well known example in this sense. Indeed, it is a sector that is under the pressure of customers for more eco-friendly attitudes and whose companies consider market information as a key to be more receptive to the demand of customers and enhance their market position. Thus, according to Segarra-Oña et al. (2014), automotive firms tend to improve process efficiency and cut water consumption, energy usage, and pollution emissions to demonstrate their environmental responsiveness (even though their empirical analysis does not let us clearly disentangle the effects of market orientation on each environmental performance indicator).

In addition, Chen et al. (2015) and Green et al. (2015) postulated that a market-oriented strategy increases firms' willingness to comply with emission and waste regulations, thus making them less air-pollutant and more careful about waste production. Moreover, Boons et al. (2013) highlighted that market orientation may let companies identify novel green niches. This, in turn, represents an opportunity to increase environmental awareness, with the aim of establishing a solid market leadership. Further support for the positive effect of market orientation on environmental performance lies in the literature on corporate social responsibility (CSR) given that environmental proactiveness is considered as a part of CSR. That is, since customers better evaluate responsible firms and improving environmental performance contributes to this evaluation, firms more market-oriented will likely manifest better environmental performance (Pekovic *et al*., 2016).

Organizational orientation

Green supply chain management orientation and environmental performance

Over time, companies can develop a specialized network of suppliers and build a more focused and competitive set of core competencies (Lorenzoni and Lipparini, 1999), which on turn lead to better firm performance (Prahalad and Hamel, 2006). Mirroring this approach into the environmental sustainability domain, it is likely that companies with a higher supply chain orientation will be more capable to direct their supply chain efforts/practices on exchanging knowledge and building core competencies related to green materials, components, packaging, and processes. These environmental knowledge and competencies will, thus, lead to improved environmental performance. Accordingly, Kim *et al*. (2011) highlighted that green supply chain management orientation aims at controlling and supporting environmental performance improvements along the whole supply chain. As such, it can be expected to be an important antecedent of better firm environmental performance. Indeed, the capability to ensure that all actors along the supply chain make their operations environmentally-friendly is essential for making a company really sustainable (Nidumolu *et al*., 2009).

According to the foregoing discussion, several studies in the literature emphasized that adopting a supply chain orientation and including environmental issues into supply chain practices are positively linked to environmental performance. Diniz and Fabbe-Costes (2007) argued that supply chain management and supply chain orientation are key success factors in sustainable development projects in developing countries. However, the study evaluated whether the analyzed projects were successful or not, without a specific focus on environmental performance. Other studies tested the influence of green supply chain management on specific measures of environmental performance. For instance, Zhu and Sarkis (2004) found that external green supply chain management practices (including cooperation with suppliers for environmental objectives and cooperation with customers for eco-design or green packaging) lead to better environmental performance (measured as one factor made of six items, including reduction of air emission, waste water, and solid wastes). Vachon and Klassen (2008) showed that collaborations with suppliers on environmental issues lead to improved manufacturing performance (in terms of quality, delivery, and flexibility) and environmental performance (measured through a perceptual scale with three items on solid waste disposal, air emissions and water emissions compared to major competitors). Albino et al. (2012b) revealed that environmental collaborations along the supply chain lead to better firm environmental performance, in terms of management of its environmental footprint and environmental reputation (as measured by the Newsweek's 2010 Green Ranking). Green supply chain practices are also associated with environmental performance of products since they are positively linked to green product development (Albino et al., 2009; Albino et al., 2012a).

Environmental management orientation and environmental performance

Environmental management orientation, being a proactive approach favoring the adoption of EMS (Klassen, 2001), should be expected to lead to improved firm environmental performance. However, nonetheless the widespread diffusion of EMS and the growing number of studies investigating the effects of these systems on firm environmental performance, contrasting results have been provided. Due to these inconsistent results, many scholars called to deepen this area of research (Gomez and Rodriguez, 2011; Heras-Saizarbitoria and Boiral, 2013; Testa et al., 2014).

To this aim, Zobel (2016) conducted a study on the influence of ISO 14001 certified EMS on the rate of improvement of environmental performance in different areas (air emissions, water consumption, resource use, energy use, and waste as reported in firms' environmental reports), finding no statistically significant differences between certified and non-certified firms. However, results hint that EMS-adopting firms perform better in energy use and waste production, while non-EMS-adopting firms seem to perform better in air emissions (without statistical significance probably due to the use of a limited data set). Considering a large sample of SMEs, Graafland and Smid (2016) empirically proved that the adoption of ISO 14001 certifications results in less energy consumption, waste production, and water consumption. Similar results were obtained by Daddi et al. (2011) who, based on a sample of Italian firms belonging to different industries, focused on the effects of EMAS certification on the variation of environmental performance in different areas (water consumption, electric energy, total energy, and waste as reported in third party validated statements). The authors found that EMAS certification, in most cases, has positive effects on environmental performance variation, even in the short term. However, differences can be acknowledged among diverse environmental performance indicators: water consumption and waste production are more positively influenced by the introduction of an EMS, while energy consumption seems not to be affected. Furthermore, Testa et al. (2014) analyzed the effect of EMAS and ISO 14001 certifications on the reduction of CO_2 emissions in Italian energy intensive plants, finding that having a certified EMS positively affects environmental performance both in the short and in the long run, even though in the short term weaker benefits derive from EMAS than ISO 14001. Zhu and Sarkis (2004) found that internal environmental management (including ISO 14001certification or the existence of an EMS) leads to better environmental performance (measured as one factor made of six items, including reduction of air emission, waste water, and solid wastes). Hertin et al. (2008), through a large study of European companies operating in different industries, examined the link between EMS certification and several areas of environmental performance (such as air emissions, water consumption, energy consumption, for which data were collected from firm reports, national pollution inventories, and questionnaires), showing that the link is weak. Indeed, the adoption of EMS has a positive effect only on the performance trend of a small minority of environmental performance indicators and only for three out of the five studied industries.

Adding a time perspective to the relationship between EMS and environmental performance, Russo (2009) investigated the effects of an ISO 14001 certified EMS on the reduction of toxic emissions by electronic manufacturing facilities, finding that early adoption of ISO 14001 and experience with this standard are positively linked to lower emissions. Even with regard to the effect of EMS on green product innovation, there are some contrasting results in the literature. On the one hand, some studies highlighted that the existence of an EMS (Albino et al., 2009; Albino et al., 2012a; Leenders and Chandra, 2013; Rehfeld et al., 2007) and the learning processes activated by the EMS (Rennings et al., 2006) positively impact on the development of green products, while other studies found that having an EMS di per se is not significant (Rennings et al., 2006; Wagner, 2008; Wagner, 2009).

In this study, the effect of each type of strategic and organizational orientations on environmental performance will be investigated. In Figure 1 the theoretical framework of this study is depicted. Per each construct, or group of constructs, the most relevant sources are reported. On each arrow connecting two constructs, the most relevant studies investigating the relationship between them (or useful to hypothesize it) are reported, with the indication of the type of relationship found or suggested (positive, negative, non-significant).

<Insert Figure 1 about here>

Methods and data

The NGR is the data source used to select the companies to include in our study. We considered the 2014 NGR, which measures the environmental performance of 500 large global companies. Specifically, from the NGR, we collected information about firms' carbon productivity, energy productivity, waste productivity, and water productivity referred to 2012 (which is the most recent period considered by the 2014 NGR). However, the NGR does not include data about firms' orientations (i.e., technology orientation, market orientation, green supply chain management orientation, and environmental management orientation). In order to collect these data, we used content analysis of firms' environmental/sustainability/corporate social responsibility reports referred to the year 2011 (e.g., Albino et al., 2009; Albino et al., 2012b; Dangelico, 2015). We looked one year backward respect to 2012 because we focused on the environmental performance of firms for the year 2012, and it is reasonable to assume that 2012 performance are the result of actions made early in time. We were able to find useful reports for 269 companies. These firms constituted our final sample. For each of them, we also collected some additional information (i.e., year of incorporation, profits, revenues, and number of employees) from the reports or supplementary sources, such as the Financial Times, Fortune 500, Forbes Global 2000, and firms' balance sheets. Since for some companies the NGR does not provide one or more environmental performance measures, in our analyses (see Section 4), the sample size changes according to the availability of the environmental performance measure under consideration.

Variables

Dependent Variables

We considered a set of four dependent variables (DVs), each of which represents a different type of environmental performance. The four DVs are *Carbon productivity*, *Energy productivity*, *Waste productivity*, and *Water productivity.* All the DVs are provided by the NGR and measured, for each firm, as follows:

$$Carbon\ productivity = \frac{\text{Revenue (\$US)}}{\text{Total greenhouse gas emissions (CO2e)}};$$

$$Energy\ productivity = \frac{\text{Revenue (\$US)}}{\text{Total energy consumption (CO2e)}};$$

$$Waste\ productivity = \frac{\text{Revenue (\$US)}}{\text{[Total waste generated (metric tonnes) – waste recycled/reused (metric tonnes)]}};$$

$$Water\ productivity = \frac{\text{Revenue (\$US)}}{\text{Total water use (m3)}}.$$

The values are corrected and normalized with respect to the sector each firm belongs to[1]. Each metric can, thus, assume continuous values between zero and one. That is, the DVs range between zero and one.

Independent variables

The four independent variables (IVs) of this study (i.e., *Technological orientation, Market orientation, Green supply chain management orientation,* and *Environmental management orientation*) are computed all in the same way. For the sake of brevity, we explain the general process to operationalize them. First, we defined a set of keywords representing each IV. Table 1 reports the set of identified keywords for each IV. Second, for each firm and for each IV, we counted the number of times each keyword related to the IV under consideration is present in the firm's report and, then, we calculated the sum (e.g., Albino *et al.*, 2009; Dangelico, 2015). Finally, we divided this sum by the total number of words of the firm's sustainability report and multiplied by 100, thus having a percentage measure. This allowed us to get measures that are not influenced by the total length of the reports and that reflect the level of relevance given by each company to the specific dimension.

<Insert Table 1 about here>

As an example, to calculate the value of *Market Orientation* for Starbucks, we examined the company's sustainability report and counted the number of times the words "market", "user", "consumer", and "customer" (see Table 1) appear within the full text of the report. The word "market" appears 11 times, the word "user" appears 0 times, the word "consumer" appears 3 times,

[1] More details about the methodology and how each metric is computed are available at http://www.newsweek.com/2014-newsweek-green-rankings-243744.

and the word "customer" appears 25 times. Afterward, we summed the occurrences of each word; the total is equal to 39. Then, we divided this sum by the total number of words of the report (9,080) and multiplied the resulting value by 100. After this process, we set *Market Orientation* equal to 0.43 for Starbucks. The same procedure was followed to operationalize *Market Orientation* for the other companies. With regard to the other IVs, we followed the same procedure but changed the keywords according to the IV under consideration.

Control variables

Other variables were included to increase the reliability of our model. First, we controlled for the firm age (*Age*), measured as the natural logarithm of the difference, in years, between 2011 and the year of incorporation. Since the skewness and kurtosis for this variable indicated a significant departure from normality, we performed a logarithmic transformation, which allowed us to correct for this issue. Second, we included the variables *Employees* and *Revenues* to account for company size in 2011. Specifically, *Employees* is the natural logarithm of the number of employees working for a company, and *Revenues* is the natural logarithm of company sales. Third, we added the variable *Profits*¸ measured by normalizing a firm's profits in 2011 with respect to the sample mean, so that risks of violating normality assumption are reduced (e.g., Chang, 1995). Finally, industry dummies were considered to control for sectorial effects. These dummies refer to all the sectors where the sample firms operate, as revealed by the NGR, namely energy, consumer discretionary, healthcare, industrials, information technology, materials, telecommunication services, utilities, and consumer staples. The sector energy was the omitted category.

Model specification

The DVs of this study range between zero and one, hence falling into the category of limited dependent variables (LDVs) (Long, 1997). In this case, the Tobit model is considered the best econometric approach to obtain reliable results. Indeed, other econometric approaches (e.g., OLS) generate inconsistent parameter estimates, thus being considered as less than ideal (e.g., Long, 1997; Wiersema and Bowen, 2009; Wooldridge, 2012). Furthermore, the IVs, as well as the variables *Profits* and *Employees,* presented some severe outliers, which may undermine the consistency of results. Therefore, following previous studies (e.g., Bromiley and Harris, 2014; Castellaneta and Gottschalg, 2016), we managed outliers by winsorizing (see Wilcox, 2012) at the 4% (2% from the bottom and 2% from the top) and so run Tobit regressions with the winsorized variables.

Results

Table 2 shows descriptive statistics and pairwise correlations, with values below 0.70, hence limiting multicollinearity concerns (Cohen et al., 2013). Table 3 presents results of the Tobit regression. Each model in Table 3 refers to one of the defined DVs (*Carbon productivity, Energy productivity, Waste productivity, and Water productivity*).

<Insert Table 2 and Table 3 about here>

Concerning the control variables, Table 3 reveals that firm age is never a predictor of environmental performance, whereas the number of employees negatively affects carbon (β=-0.049, $p<0.05$) and water productivity (β=-0.076, $p<0.01$). Instead, revenues are positively associated with water productivity (β=0.050, $p<0.10$), and profits positively influence waste productivity (β=0.265, $p<0.05$). Finally, industrials, information technology, and utilities are the sectors that mainly present significant changes respect to the energy one. Indeed, industrials and information technology have positive effects on carbon and water productivity; information technology also has a positive effect on energy productivity. By contrast, utilities has a negative effect on all the DVs, except for waste productivity; in addition, telecommunication positively influences energy productivity. Overall, it appears that only three out of eight sectors play a relevant role in predicting environmental performance when compared to the energy one.

With regard to the IVs, according to Model 1, technology orientation is negatively related to carbon productivity (β=-0.511, $p<0.05$), as opposed to market orientation and environmental management orientation, which both have a positive effect (β=0.190, $p<0.01$ and β=1.826, $p<0.01$, respectively). Instead, green supply chain management orientation seems not to have a significant influence on carbon productivity. Model 2 reveals that energy productivity is only affected by market orientation and environmental management orientation, as their coefficients are positive and significant (β=0.164, $p<0.01$ and β=1.006, $p<0.10$, respectively). Differently, Model 3 provides evidence that market orientation and environmental management orientation do not predict waste productivity; rather, this is sustained by green supply chain management orientation (β=0.197, $p<0.05$) and lessened by technology orientation (β=-0.039, $p<0.10$). Finally, results from Model 4 show that water productivity is positively influenced by market orientation (β=-0.185, $p<0.01$), environmental management orientation (β=2.111, $p<0.01$), and green supply chain management orientation (β=0.187, $p<0.05$), whereas technology orientation does not have a significant effect.

For robustness, we constructed the IVs and re-run the proposed models on the basis of reports related to the year 2010, hence increasing the time lag between IVs and DVs. Under this specification, results for carbon, energy, and water productivity are mostly confirmed. Main differences are that the effect of technology orientation on carbon productivity and the effect of green supply chain management orientation on water productivity loose significance, however maintaining the same signs[2]. Concerning waste productivity, since the sample size for this DV resulted too small to have a significant model after using the 2010 reports, we believe a reliable comparison cannot be made.

Discussion and conclusions

This study strongly contributes to advance existing knowledge on the relationships between firms' orientations and their environmental performance. Existing studies have provided so far a fragmented picture of the phenomenon (focusing on specific types of firms' orientations and/or on specific dimensions of environmental performance) and have revealed contrasting and inconsistent results. Further, many of them have used aggregate measures of environmental performance, so making it impossible to understand the effect on single dimensions of environmental performance, or perceptual scales of environmental performance, which limit the reliability and comparability of data.

To the best of our knowledge, this study is the first one to jointly consider different company's orientations (both strategic and organizational) and their effect on several dimensions of environmental performance, objectively measured. In detail, we found that technology orientation has a non-significant effect on energy and water productivity and a negative effect on carbon and waste productivity. This result recalls studies against the (probably over-simplistic) notion that more technological knowledge directly leads to better environmental performance (Oltra and Saint Jean, 2009; Sagar and van der Zwaan, 2006). Indeed, more time is likely needed to fully appreciate the beneficial effect of investments in innovation and R&D on environmental performance (Alkemade and Suurs, 2012). Or, an extensive endeavor on the development and utilization of the latest technologies ultimately reduce the possibility to achieve efficiency in firm procedures. Another possible explanation could be that innovative efforts by companies may have been devoted mainly to product rather than process innovations, so not directly impacting on processes' environmental performance. In any case, future studies should delve into the role of technology orientation by analyzing potential moderating or mediating effect on its relationship with environmental performance (e.g., focus on product vs. process innovation and R&D strategies).

[2] Full details of the models are available from the authors upon request.

This study also contributes to advance knowledge on the debated relationship between market orientation and environmental performance. We offer evidence that having a strong market orientation is very important for firms that aim at achieving high environmental performance. In fact, this type of strategic orientation displays a positive and significant impact on all types of considered performance, except waste, for which there is a non-significant, however positive, effect. This result provides support to previous studies' findings. For instance, Kammerer (2009) revealed that market orientation leads to more environmentally-friendly behaviors, González-Benito & González-Benito (2008) found that a high market orientation has a positive effect on energy consumption and recycling, and Chen et al. (2015) showed that market orientation makes firms less air-pollutant and more careful about waste production. Notwithstanding the analyzed studies also have methodological limitations that may have affected the reliability of their results, hence requiring further confirmation. Indeed, although focusing on different types of environmental performance, many studies employed performance indicators that were self-assessed and not verified (even with a sampling procedure) by the authors (González-Benito and González-Benito, 2008; Chen et al., 2015; Green et al., 2015). Further, Kammerer (2009) and Segarra-Oña et al. (2014) not only relied on self-assessed measures but also focused on one sector only (i.e., appliance manufacturing and automotive), and the empirical analysis was ultimately based on a composite index that does not allow disentangling the effects of market orientation on each type of environmental performance. Instead, through a large scale investigation, objective measures, and using quantitative analysis, our study adds robustness to previous studies' results and, being cross-industry, achieves a higher degree of generalizability.

Furthermore, concerning the effect of green supply chain management orientation, this study found that it has a positive and significant effect on waste and water productivity, so providing further support to previous studies' results finding a positive link between green supply chain practices and environmental performance (e.g., Zhu and Sarkis, 2004; Vachon and Klasse, 2008; Albino et al., 2012b) Conversely, the effect of green supply chain management orientation on both carbon and energy productivity is non-significant. This may occur because more time could be needed to fully appreciate the benefits deriving from green supply chain practices on carbon and energy footprints. Unfortunately, it is not possible for us to make more detailed comparisons of our results with those of reviewed studies, since these used composite indicators of environmental performance where the different areas are not distinguished.

Finally, this study contributes to the growing body of knowledge on the link between environmental management orientation and environmental performance, which has provided contrasting or inconsistent findings. We found a positive and significant effect on all types of environmental performance, except waste (for which there is a non-significant effect), so providing support to previous studies, finding an overall positive relationship between EMS and environmental performance (e.g., Daddi et al., 2011; Testa et al., 2014; Zhu and Sarkis, 2004). However, some differences can be found with regard to specific areas of environmental performance. For example, Daddi et al. (2011) proved that water consumption and waste production are the dimensions more positively affected by the introduction of EMS, while energy consumption seems not to be influenced. These differences with our results can be due to the fact that Daddi et al. (2011) analyzed the effect of the introduction of a certified EMS (i.e., EMAS) on the variation of environmental performance, while, in our study, we do not measure the existence/introduction of a specific type of certified EMS; rather, we capture the overall level of relevance of the EMS within the firm (as manifest from its report) and rely on static measures of environmental performance related to a specific year. Other reviewed studies highlighted a weak or non-significant effect of the existence of a certified EMS on environmental performance (Hertin et al., 2008; Zobel, 2016). Jointly considering these studies' results with those of our study suggests that it is not (or not only) the possession of an EMS certification (which can be driven by several types of reasons) which makes the difference but the level of firm commitment to really embrace environmental sustainability into internal management practices. Further research would be needed to verify this statement, simultaneously measuring in the same sample the existence of both a certified EMS and the firm orientation towards it.

It should be noticed that each type of strategic and organizational orientation has similar effects on both carbon and energy productivity, confirming that these two dimensions are strictly related (e.g., Dangelico and Pontrandolfo, 2015). This suggests that, when formulating environmental strategies, companies should jointly consider these two areas of environmental performance to create synergies among planned actions.

From a managerial point of view, this research advises managers that they should invest in environmental activities both internal to the firm (implementing environmental management systems) and external to the firm (developing green supply chain practices) since these affect different dimensions of environmental performance. Regarding strategic orientation, results are mixed. While market orientation shows a clear positive influence on three out of four environmental performance dimensions, hence suggesting that managers constantly invest in understanding market needs, technology orientation displays a negative effect on two of them. This second counterintuitive result calls for caution when investing in green innovation, since it is very important to invest in the right direction, and managers should be aware that the positive effects of investments will not likely display in the short term. In sum, managers are advised that the considered firms' orientations to environmental sustainability do not affect all types of environmental performance in the same way, thus providing insights about the necessity of diversified approaches for targeting the improvement of specific types of environmental performance.

This study has some limitations that should be acknowledged. First of all, while measures for environmental performance are secondary data, we created our own measures for strategic and organizational orientations collecting data from sustainability reports, through the use of keywords. Although this could seem to provide measures that are highly dependent on what companies want to communicate to stakeholders, it is coherent with what we aim at measuring: "orientation". Further, normalizing collected keywords for each type of orientation per the total number of words allowed us to shed light on the relative importance given by the company to the investigated type of orientation. Second, our findings suggest that the beneficial effects of firm orientation may not be fully appreciated in the short term; however, we provide results based on causal relationships between variables considering a one-year time lag. Therefore, although we already proved that our findings are robust to a two-year time lag, future studies could explore which environmental performance are more subject to temporal issues and to what extent. Finally, since this study focused on large companies, future studies should consider samples of companies with different sizes, in order to understand whether the obtained results can be generalized to other populations.

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Tables

Technology orientation	Market orientation	Environmental management orientation	Green supply chain management orientation
Research and Development	*Market*	*EMS*	*Supply*
R&D	*User*	*Environmental Management System*	*Buyer*
Innovation	*Consumer*	*ISO 14001*	*Retailer*
New Product	*Customer*	*Environmental Management and Audit Scheme*	*Supplier*
New Process		*EMAS*	
New Technology			
Patent			

Table 1. List of keywords for each type of orientation

	Min	Max	Mean	S.D.	1	2	3	4	5	6	7	8
1-Age	0	5.20	3.53	1.08	1							
2-Employees	8.26	12.93	10.95	1.16	0.145*	1						
3-Revenues	8.23	12.80	10.33	1.01	0.064	0.676**	1					
4-Profits	0	.564	.111	0.126	0.097	0.350**	0.577**	1				
5-Technology orientation	0	.289	.081	0.076	0.024	0.088	0.069	0.063	1			
6-Market orientation	.04	1.13	.428	0.273	-0.030	0.096	-0.066	-0.143*	-0.104	1		
7-Environmental Management orientation	0	.086	.018	0.022	-0.008	-0.028	-0.005	-0.127*	0.100	-0.108	1	
8-Green Supply Chain Management orientation	0	.854	.208	0.187	0.069	0.219**	0.111	0.008	0.236**	0.085	0.140*	1

Table 2. Descriptive statistics and pairwise correlations
N=269; *p<0.05; **p<0.01

	Model 1 (Carbon productivity)	Model 2 (Energy productivity)	Model 3 (Waste productivity)	Model 4 (Water productivity)
Firm age	-0.001	0.006	0.024	0.002
	(0.013)	(0.014)	(0.016)	(0.014)
Employees	-0.049**	0.008	0.016	-0.076***
	(0.020)	(0.019)	(0.021)	(0.025)
Revenues	0.033	-0.016	-0.062	0.050*
	(0.023)	(0.025)	(0.027)	(0.028)
Profits	0.170	-0.010	0.265**	0.217
	(0.133)	(0.157)	(0.153)	(0.159)
Technology orientation	-0.511**	-0.315	-0.039*	-0.254
	(0.225)	(0.261)	(0.258)	(0.218)
Market orientation	0.190***	0.164***	-0.042	0.185***
	(0.052)	(0.052)	(0.070)	(0.050)
Environmental management	1.826***	1.006*	-0.401	2.111***
orientation	(0.513)	(0.591)	(0.660)	(0.705)
Green supply chain	0.039	-0.012	0.197**	0.187**
management orientation	(0.085)	(0.092)	(0.089)	(0.087)
Consumer discretionary	0.834	0.070	0.087	0.131*
	(0.055)	(0.059)	(0.056)	(0.067)
Healthcare	0.106	0.080	-0.119*	0.040
	(0.073)	(0.078)	(0.064)	(0.074)
Industrials	0.106**	-0.013	0.046	0.231***
	(0.051)	(0.056)	(0.064)	(0.066)
Information technology	0.148**	0.141*	0.073	0.143*
	(0.066)	(0.075)	(0.074)	(0.085)
Materials	0.046	0.023	0.065	0.080
	(0.068)	(0.068)	(0.084)	(0.077)
Telecommunication services	0.043	0.118**	0.042	0.064
	(0.051)	(0.059)	(0.070)	(0.063)
Utilities	-0.110*	-0.12*	-0.039	-0.184***
	(0.058)	(0.063)	(0.080)	(0.052)
Consumer staples	0.002	-0.032	-0.170	0.055

	(0.049)	(0.055)	(0.061)	(0.063)
Constant	0.512***	.386**	.766***	0.522**
	(0.179)	(0.169)	(.228)	(0.216)
F	3.07***	2.45***	2.41***	6.32***
Log pseudolikelihood	41.33	18.00	8.90	23.37
Observations	255	251	196	211

Table 3. Tobit results (with robust standard errors)
*p<0.10; **p<0.05; ***p<0.01