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A COMPREHENSIVE ANALYSIS OF THE NEXUS BETWEEN ENVIRONMENTAL REPORTING AND MARKET PERFORMANCE OF EUROPEAN COMPANIES

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Abstract

The paper aims to carry out a cross-country analysis of the effects of environmental reporting on company's market performance. For this purpose, we have used a set of data comprising information on industrial companies ranked in top 150 by net sales for the year 2017 and originating from 15 European countries, for the period 2007-2016. The study included both environmental qualitative reporting based on environmental scores calculated by the authors, and reporting combining qualitative and quantitative data. Using a panel data model with fixed effects, the study has shown that there is a positive relation between qualitative environmental information and financial performance, measured by Q-Tobin ratio, which proves the relevance of environmental reporting for increasing the market value of listed companies. Additionally, the usefulness of environmental reporting is high, especially when it includes both non-financial and financial information, in which case investors tend to pay less attention to qualitative information that lose some of its explanatory power on market performance. The results are robust when macroeconomic variables are introduced into the models to reflect the governmental revenues collected from environmental fees and the governmental spending on environmental protection. Therefore, empirical results show that companies may benefit from proactive environmental reporting strategies that could play a significant role in increasing their financial success.

Keywords: environmental disclosure, environmental reporting, environmental score, market performance, Q-Tobin ratio

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1. Introduction

In order to operate, the *economic system* providing the necessary means for a modern standard of living should be supported by the *environmental system*. But the effects of economic operations on the environment are irreversible and cumulative, and the multifunctioning of natural resources generates a diversity of interests in what regards their exploitation (Mironiuc and Huian, 2017; Musu, 2003).

With time, developed countries have become increasingly aware of the need to establish and implement environmental policies at both national and international level to help preserve it. The severity of environmental issues required the need for governmental intervention, which materialized, over the last thirty years, in a series of international agreements and protocols, since the Montreal Protocol (1987) on substances that deplete ozone layer and up to the latest climate change agreement, namely the Paris agreement (2015). Despite these efforts, success has been moderate, global economic activities still not being seen as sustainable, and the pollution remaining an almost incurable disease that may be just alleviated (Büyüközkan and Karabulut, 2018; Commoner, 2003; Santarelli, 2017).

Nevertheless, the occurrence and tightening of environmental regulations have led to increased public awareness towards environment and to ever more sophisticated environmental requirements from the main stakeholders (investors, creditors, business partners, employees etc.). All these have determined

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companies to become more environmentally aware and responsible (Edwards, 1998). Being environmentally responsible means that companies should not be just accountable, but that they should *report information* about the impact of their activities on the environment (Aggarwal, 2013; Guedes et al., 2017). Thus, the obligation of companies to integrate the environmental variable into their own strategy has increased the interest for developing some measuring, control and communication systems, through *reports on environmental performance* to be used by stakeholders and to legitimate the business operations of companies.

Environmental reporting means making available for the general public information related to policies that have been adopted, actions that have been taken and environmental performances that have been achieved by the company during a given time period. This enables companies to benefit from disclosing good performance, but also to avoid the disadvantages of publishing weak performance and adopt long-term strategic responses to environmental issues (Bennet and James, 1999). According to literature, reporting objective and hence higher quality information leads to the obtaining of opportunity costs and of proprietary (including regulatory, contractual and reputational) costs, to winning competitive advantages and thus to improving financial performance (Cormier and Magnan, 2015; Qiu et al., 2016; Russo and Fouts, 1997). For these reasons, companies are stimulated to promote themselves by over-disclosing positive information (Moneva and Cuellar, 2009) and leaving aside the information with potentially negative impact. Information reporting about environmental performance and actions has evolved over time, in terms of both volume and quality, and is now an integral part of the detailed sustainability reports published by large quoted companies (Qiu et al., 2016).

A series of papers on disclosure of environmental information are based on several theoretical frameworks two of which stand out, namely *legitimacy* and *stakeholder theories* (Brooks and Oikonomou, 2018). According to the first theory, company behaviour with regard to environment should match a system of rules, values, beliefs and definitions developed by society (Fazzini and Dal Maso, 2016). This makes the environmental reporting the dynamic result of the social and economic values of the society in which the company operates. According to Qian and Schaltegger (2017), legitimacy is a function of pressure by external stakeholders, as it is often used to explain environmental reporting practices from the social, economic and political points of view. Legitimacy may be considered an intangible asset, an operational resource (Mahadeo et al., 2011) the value of which must be preserved in order to ensure continuous support from society (for instance, under the form of high capital inflows or community acceptance).

The second theory states that companies disclose environmental information to meet the interests of stakeholders. Literature in the field makes reference to stakeholders asking organizations to have an environmentally-friendly behaviour (Moneva and Ortas, 2010) to allow humanity to remain within its planetary borders (Heede, 2014). The theory of stakeholders laid the foundation of a new managerial understanding accepting that the hierarchy of superiors and subordinates is extended through the intervention of stakeholders (Gallego-Álvarez and Ortas, 2017). This theory relies on the basic premise of the company's obligation to meet the needs of all those who have interests in the operations of the company: shareholders, customers, suppliers, employees, government, community, future generations etc. (Aggarwal, 2013). Thus, companies secure the resources and the support they need for survival; moreover, by increasing their efficiency and effectiveness, they improve their financial performance (Dal Maso et al., 2018). Therefore, according to stakeholder theory, environmental reporting needs to be constructed so as to make the information available to stakeholders that have a direct or more important impact on the company.

The nature of the relationship between environmental reporting and financial performance of companies is a controversial issue in literature, being a subject often investigated over the past two decades. Some studies show a positive relationship (Aerts et al., 2008; Clarkson et al., 2013; Cormier and Magnan, 2015; Fazzini and Dal Maso, 2016), whereas others claim that there is a negative relationship, especially in companies operating in environmentally sensitive industries (Aerts and Cormier, 2009; Cormier and Magnan, 2007; Radhouane et al., 2018). A third category of works does not reveal any significant relationship between the two constructs (Moneva and Cuellar, 2009; Qiu et al., 2016).

Our paper fuels this debate by using the two theories mentioned above, namely stakeholder theory and legitimacy, and by selecting qualitative and quantitative environmental information susceptible of having an impact on the nexus between environmental reporting and market performance. In particular, we join the debate by analyzing two research directions on a sample of European industrial companies *over a more recent period* (2007-2016). The first consists of determining *the degree of association between market performance of listed companies and the level of disclosure of qualitative non-financial environmental information*. In this respect, we calculated three scores that reflect the level of disclosure of information on the policies, actions and environmental performance of the analyzed companies as regards: a) the ability to reduce the use of materials, energy and water (*resource use*); b) the commitment and efficiency in reducing emissions generated by company activity (*emissions*); c) the ability to reduce environmental costs through the use of environmentally friendly technologies and eco-designed products (*innovation*). Although Thomson Reuters publishes an Annual Environmental Score incorporating these three dimensions, we chose to break down the three

components to see if and which one is considered by investors to be a predictor of the company's market value. This has been done manually by assigning numerical values to data published by companies (the calculation method is described in detail in the methodology section of the paper). The aim was to investigate whether the more detailed presentation of the main environmental aspects is relevant in assessing companies on the market.

The second goal consists of testing *the usefulness of combining environmental quantitative and qualitative information in assessing the market performance of listed companies*. Since the environmental scores/ratings method is sometimes suspected to be somewhat subjective as the authors set the hierarchy of value or quality of presentations (Aerts et al., 2008), we also introduced quantitative non-financial variables related to total CO_2 emissions and to the waste recycling ratio. The results have confirmed the interest of investors for non-financial environmental information displayed as environmental scores. However, when quantitative information is provided, the usefulness of qualitative information decreases, market performance of companies being significantly more influenced, for example, by the level of CO_2 emissions than by the description of the policies and actions reducing them. The robustness tests have confirmed the earlier results.

The rest of the paper is organized as follows: section 2 deals with the literature review and the development of hypotheses, section 3 describes the empirical approach providing details about the variables used, data sources, descriptive statistics and the econometric specification, section 4 discusses the results, and section 5 concludes the paper.

2. Literature review and development of hypotheses

The extent to which environmental information may lead to improved financial performance has been empirically investigated from several angles. Researchers in strategic management, marketing, environmental economics, finance and accounting have brought to the attention of the public the notions of environmental performance, environmental responsibility and *environmental reporting*.

The motivations behind the reporting of environmental information are numerous and often analyzed in literature (Brooks and Oikonomou, 2018) and they are mainly related to: meeting and exceeding stakeholder expectations; increasing reputation and brand value; gaining legitimacy; increasing transparency and reducing information asymmetry on the capital market; influencing perceptions about the company's financial prospects; improving financial/market performance. The same authors claim that hiding or distorting the truth about environmental performance and actions may be dangerous for companies, as they may become subject to negative publicity, boycott by consumers, or withdrawal of support from environmentally responsible investors.

Although the strategic importance of environmental reporting to external stakeholders is well known, the extent to which it influences the financial performance and/or market value of companies is still unclear (Radhouane et al., 2018). Over time, empirical studies have produced mixed results, demonstrating that the link between them is not known in advance due to their complexity. According to Waddock and Graves (1997), the relationship between the two constructs shows positive, negative or neutral links.

In general, the positive interaction between environmental disclosure and the market value of companies is based on the stakeholder theory (Radhouane et al., 2018). This implies that the interests and goals of shareholders and other stakeholders are not necessarily conflicting, and it is beneficial for the company to engage in responsible environmental actions in order not to lose the support of the rest of the stakeholders. On the other hand, Qian and Schaltegger (2017) argue that providing lots of environmental information is just an attempt to cover up poor environmental performance by companies, which are thus trying to manipulate stakeholders to get their support. The desire to improve their financial performance rather than the earnest intent to reduce their negative impact on the environment is the reason behind reporting this information (Brooks and Oikonomou, 2018). Supporters of the legitimacy theory have shown that environmental reporting is not used by companies with good performance to communicate their achievements, but as a legitimizing tool by poor performers (Qian and Schaltegger, 2017). Thus, the link between environmental reporting and performance does not exist or is negative.

In the first category of studies, Fazzini and Dal Maso (2016) found that the reported environmental qualitative information is *positively* correlated with company market value that increases with a more detailed reporting. Clarkson et al. (2013) reported a positive relation between financial performance and qualitative environmental disclosure measures that proved to be relevant in the prediction of the market price of shares. Aerts et al. (2008) argued that there is a symbiotic link between environmental reporting and stock market concerns. Moneva and Ortas (2008), confirming the results of Lanoie et al. (1998) and Gupta and Goldar (2005), observed that companies having an environmentally-oriented policy (with regard to energy use, gas emissions and waste recycling) have better results than companies adopting weaker environmental policies, as the market penalizes environmentally-unfriendly behaviour. Dasgupta et al. (2006), reporting on enterprises in Korea, underline the decrease in market value of companies failing to comply with the national environmental legislation. Under the influence of stakeholders, companies over time have understood that an ethical behaviour towards stakeholders and

transparency in the disclosure of the impact of their operations on the environment may become means that bring value to the business (Clarkson et al., 2008; Freedman and Jaggi, 2005; Gallego-Álvarez and Ortas, 2017; Gamble et al., 1995).

The strand of literature in the field showing there is a *negative relationship* between environmental disclosures and financial/market performance is also rich. Radhouane et al. (2018) confirm it in the case of French firms operating in highly polluting industries. According to the authors, shareholders have to apply filters to find the usefulness of voluntarily-reported environmental information as it is often used as a management strategy to legitimize the company's operations. Along this line is also the paper of Moneva and Cuellar (2009) arguing that environmental financial variables such as costs and provisions for environment influence negatively company market performance, in case of Spanish Stock Exchange.

In the third category of studies, Qiu et al. (2016) do not find a significant relationship between the reporting of environmental information and firm value, which is explained by the nature of the information provided (more about negative environmental events) and the fields of activity of the analyzed companies (which have a strong impact on the environment). Along the same line, Moneva and Cuellar, 2009 do not find a significant relation between non-financial environmental variables related to the implemented environmental policies and management systems, and the market value of a company. The authors believe that investors treat them with indifference as they are provided voluntarily, and therefore, refer only to projects and objectives that present the company in a positive way. Also, they argue that non-financial reporting is more likely linked to long-term strategic decisions, which is not interesting for the (Spanish) capital market focused on short-term.

The nature of the relationship between the environmental reporting and market performance is influenced by a set of factors. Horváthová (2010) states that the positive relationship has been proven more in cases with qualitative environmental variables, in spite of the fact that these may be very subjective and weakly correlated with the impact of the company on the environment. The type of relation depends also on the econometric method used for data processing: portfolio studies and correlation analyses are more likely to lead to negative results, while multiple regression and panel data techniques do not influence the result. This study uses panel data technique that takes into account omitted variable biases such as unobserved firm heterogeneity.

Various studies use environmental information under the form of aggregated indices/rankings/scores (Aerts et al., 2008; Clarkson et al., 2008; Cormier and Magnan, 2007; Radhouane et al., 2018) that have the capacity of sending simple messages to decision-makers (Büyüközkan and Karabulut, 2018). These indices that are voluntarily disclosed by companies represent an *environmental reporting of qualitative nature.* Research has underlined that environmental reporting should not include only financial information but also non-financial measures that provide the benefit of giving a long-term strategic perspective, in opposition to short-term approaches, and of disclosing aspects ignored by traditional financial reporting (Cormier and Magnan, 2007). This way of quantifying environmental information reported by companies has the advantage of allowing the integration of various types of information in a single figure that ensures comparability in space and enables researchers to use their professional judgment in setting the hierarchy of the quality of the information provided (Aerts et al., 2008).

Environmental scores generally are a proxy for company transparency with regard to environmental reporting. They approximate specific competencies and capabilities (or their lack) developed due to environmental operations of the company (Wagner, 2010), and integrate aspects related to client satisfaction, productivity, quality, and innovation (Henri and Journeault, 2010). Many studies do not use the environmental score in the sense of "as if", but transform it by relating it to the average score of the industry (in multi-sectorial analyses), or to the highest possible score in uni-sectorial analyses (Luo et al., 2015). The last version, also used in this study, is the score showing not only the level of environmental information disclosure but also the quality of presentation, as it considers only data relevant to industry of the companies (Bernardi and Stark, 2017). Therefore, the environmental scores used in this paper outline the implementation or non-implementation of policies related to reuse of materials, waste recycling, energy conservation, pollution reduction or streamlining the life cycle of products, specific to the industrial sector.

Adopting the category of studies expecting positive results, the authors have formulated the first research hypothesis:

H_1: Company market performance is positively influenced by its commitment to report qualitative non-financial environmental information.

It has generally been accepted that stakeholders have different interests with regard to environment (Iwata and Okada, 2011). For instance, pollution for the local community may be more important than other issues, while governmental authorities may focus rather on waste recycling. Therefore, they will exert differently their indirect influence on financial performance of a company on different markets where they operate. This makes us consider both qualitative and quantitative perspectives of environmental reporting in establishing its relation with market performance.

CO_2 emissions generated by burning of fossil fuels is among the causes of global warming and threats towards sustainability. These are often the result of highly-industrialized productive processes, whose outputs are often consumed in other countries than the country of production. The export of goods in

such a context of pollution, from emerging markets to developed countries, consolidates the already existent global disparities in terms of emissions per capita, and shows insufficient regional efforts for decarbonization (Dietz and Rosa, 1997). Besides density of industry and technology, literature also mentions demographic growth, prosperity, trade openness and urbanization as factors having an impact on the emissions of CO_2 (Sharma, 2011).

Green technology innovation, and the potential of developed economies to invest in order to increase energetic efficiency, development of economies based on services and promotion of low technology are seen as alternatives having a role in the CO_2 emission reduction that open perspectives for sustainable development. *Waste recycling* enables cost savings by more efficient use of raw materials and consumables (Montabon et al., 2007).

It also helps the fact that the idea of recycling improves company image that may also increase sales. So, there could be a positive influence of a high recycling rate on market performance. In this context, we have developed the second hypothesis to be tested subsequently:

H_2: Combining environmental qualitative and quantitative non-financial information reported by the company is a determinant factor for its market performance

3. Methodology and data

3.1. Discussion of Variables and Summary Statistics

Table 1 provides a short description of all dependent and independent analyzed variables, grouped into three categories.

Table 1. Descriptions of variables

Variable	***Description and data source***	***Literature***
	I. Quantitative Market and Environmental Measures of Performance	
Tobin's Q Ratio (*Q_Tobin*)	(Market capitalization + Total Liabilities) divided by Total Assets. (Thomson Reuters Eikon database)	Hațegan and Curea-Pitorac (2017); Iwata and Okada (2011); Konar and Cohen (2001); Radhouane et al. (2018); Russo and Fouts (1997); Wagner (2010)
Total CO_2 Emissions per Net Sales Revenue (*COER*)	Total CO_2 and CO_2 equivalents emission in tonnes divided by net sales revenue in million US dollars. (Thomson Reuters Eikon database)	Gupta and Goldar (2005); Lanoie et al. (1998); Moneva and Ortas (2008)
Waste Recycling Ratio (*WRR*)	Total recycled and reused waste produced in tonnes divided by total waste produced in tonnes. (Thomson Reuters Eikon database)	Gupta and Goldar (2005); Lanoie et al. (1998); Moneva and Ortas (2008)
	II. Qualitative Measures of Environmental Performance	
Weight of Resource Use Score (*WRU*)	$WRU = \frac{\sum_{k=1}^{19} q_k}{19}$ where, q_k = numerical value of qualitative ratios from RU category; (Thomson Reuters Eikon database)	Aerts et al. (2008); Fazzini and Dal Maso (2016); Guthrie and Parker (1990); Manes-Rossi et al. (2018); Moneva and Cuellar (2009); Qiu et al. (2016); Radhouane et al. (2018).
Weight of Emission Score (*WE*)	$WE = \frac{\sum_{k=1}^{14} q_k}{14}$ where, q_k = numerical value of qualitative ratios from E category; (Thomson Reuters Eikon database)	
Weight of Innovation Score (*WI*)	$WI = \frac{\sum_{k=1}^{22} q_k}{22}$ where, q_k = numerical value of qualitative ratios from I category; (Thomson Reuters Eikon database)	
	III. Macroeconomic Control Variables	
Environmental Tax Revenue (*ETR*)	Revenues from environmental taxes include taxes on transport, energy, pollution and resources. It presents the proportion of environmental tax revenues in Gross Domestic Product (GDP). (Eurostat Database and OECD Database)	Abdullah and Morley (2014); Freire-Gonzalez (2018)
Environment Protection Government Expenditure (*EPGE*)	Government spending, as a share of GDP, on environment protection includes: waste management, waste water management, pollution abatement, protection of biodiversity and landscape, R&D environmental protection (Eurostat Database and OECD Database)	Pearce and Palmer (2001)

Market performance is illustrated by *Q-Tobin*, a ratio combining accounting variables (total assets and total liabilities) with market variables (market capitalization) and taking into account the company's future long-term growth opportunities (Radhouane et al., 2018). This approach makes it more interesting for measuring the relation between market performance and environmental reporting compared to traditional accounting ratios. Therefore, Wagner (2010) believes that this ratio has higher informative value than *ROA* or *ROE* as it is not affected by the discretion of managers in using accounting regulations, by periods of high inflation or by the use of historical data. *Q-Tobin* also incorporates market estimations, and therefore, is expected to have a different impact compared to purely accounting ratios, being oriented more towards the expected future performance.

Environmental reporting is approximated by quantitative (*COER* and *WRR*) and qualitative (*WRU, WE, WI*) ratios. For quantification, information from Thomson Reuters Eikon database have been used. This information is included in the *Annual environmental score* calculated based on three categories of data provided by companies in their various published reports (annual reports, Corporate Social Responsibility reports, Stock Exchange reports, company web sites, etc.). The three categories are grouped in the above mentioned database to reflect: *use of resources, level of emissions and innovation capacity,* but the score is not published for each category, so we have computed it manually. We chose *to disaggregate* the Annual Environmental Score on the three components: the first category includes 19 ratios, the second one 14, and the third one 22 (Appendix 1).

We have used qualitative metrics expressed as Boolean questions with the value True (T), False (F), or not applicable (NA) that we have converted manually into numerical values, as follows: true– 1 point, false – 0.5 points, NA - 0 points. Therefore, the highest unweighted score for use of resources (RU) is 19, 14 for the level of emissions (E), and 22 for innovation capacity (I). Then, to show the level of disclosure of information on environmental performance by each company, the individual score has been weighted with the highest ratio per category resulting in a weighted ratio (W_i), expressed by the model of the Eq. (1).

$$W_i = \frac{S_i}{n_i} = \frac{\sum_{k=1}^{n_i} q_k}{n_i} \quad (1)$$

where: S_i is the individual score of i category (i = RU, E, I); n_i - the highest number of ratios of i category (19, 14, 22); q_k - numerical value of qualitative ratios of i category (k = $\overline{1, n_i}$).

To reduce biased estimations, two control variables were inserted into the model: public expenditure for environmental protection (*EPGE*) and environmental tax revenue (*ETR)*. *EPGE* is the result of governmental decisions that, in turn, result from political compromise made between the amounts that companies and population are willing to pay (as taxes) for the quality of environment and the requests of the lobby groups (including the government itself). The outcomes of research on the effects of increasing governmental spending for environmental protection on economic growth are ambiguous, rather reporting a negative impact on productivity and economic competitiveness (Pearce and Palmer, 2001). *ETR* is part of the *Resource Efficiency Scoreboard* and monitors the progress towards a resource efficient Europe (i.e. the implementation of the *Europe 2020 Resource Efficient Flagship Initiative*). *ETR* reflects the payments made by companies that run activities causing damages to human health and the environment. Europe 2020 calls for a reorientation of fiscal systems from "goods" (labour or capital) to "bads" (pollution, resource depletion) in order to reach the objective of 'greening' the taxation systems. The tax reform in the area of environment includes measures targeted at reducing the degradation of the environment combined with political economy objectives, being known in the literature as *double dividend hypothesis*. According to Abdullah and Morley (2014), this reform has clear positive effects on the environment but the second dividend (economic growth) depends on the balance between economic losses generated by the introduction or increase of environmental taxes, and the benefits obtained from recycling governmental income (increase of environmental taxes to the detriment of other taxes).

Moneva and Ortas (2008) conclude that European capital markets are not the leaders of sustainable operations, and this is the reason why proactive measures of stakeholders are needed to promote responsible business. In this context, it is expected that investors on capital markets take environmental information into account in evaluating companys' shares (Fazzini and Dal Maso, 2016; Moneva and Cuellar, 2009). Therefore, it is anticipated that environmental variables will be statistically significant. To the contrary, the interpretation of the respective result could be that the environmental information is no longer relevant for company assessment by the market.

Table 2 shows the summary statistics of the companies in the sample for each variable. The results in Table 2 show that companies have the mean value of *Q-Tobin* over 1, of 1.55, which means that the market assesses the company at a higher market value than the value (cost) of replacement of its assets. Therefore, the shares of these companies are overvalued. The average level of CO_2 emissions (*COERln*) has been of 37.33 tonnes/mil $, and the ratio of waste recycling (*WRRln*) had a mean value of 63.43% (figures in Table 2 for the two variables have been log-transformed and later back-transformed).

Table 2. Descriptive statistics

Statistics	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Q_Tobin	1000	0.68	4.73	1.55	0.60
COERln	395	1.02	9.45	3.62	1.32
WRRln	395	2.33	4.60	4.15	0.41
WRU	1000	0.39	0.94	0.70	0.13
WE	1000	0.42	1.00	0.74	0.12
WI	1000	0.27	0.84	0.59	0.07
ETR	1000	1.57	4.74	2.33	0.53
EPGE	1000	0.02	1.70	0.78	0.32

Regarding qualitative environmental ratios, the sample companies report the lowest number of 7.5 indicators related to the use of resources (with a score of 0.39), and 6 for emissions and innovation (the score being 0.42 and 0.27, respectively). The highest possible number of indicators has been reported only in case of emissions (14 – weighted score of 1), the highest value for use of resources being 18 (score of 0.94), and 18.5 for innovation (score of 0.84). The mean number of indicators for which companies provide information is 13.36 (*WRU* mean 0.70), 10.41 (*WE* mean 0.74) and 13.00 (*WI* mean 0.59). Thus, the companies from our sample make more extensive disclosures on emissions and resource use than on environmental innovation.

For control variables, *ETR* mean for the sample is 2.33%, which is a similar to the EU28 mean of 2.39%. In case of *EPGE*, sample mean of 0.78% is much below EU28 mean of 1.70%.

3.2. Data

The initial sample included all industrial companies from top 150 by net sales in Europe for the year 2017 as of Thomson Reuters. Quantitative and qualitative data on the environmental performance of these companies have been extracted from the Thomson Reuters Eikon database. The time frame is 10 years (2007-2016). After excluding companies with no available qualitative data, the sample included 110 companies from 15 European companies, and a number of 1000 annual observations (Appendix 2). To test hypothesis H_2, we started from the same sample of 110 companies, but due to lack of quantitative data regarding *COER* and *WRR*, 46 of 110 companies were eliminated, the final sample including 64 companies from 13 European countries and 395 observations (Appendix 2) for the same period of time (2007-2016).

The necessary data for the calculation of *Q_Tobin* related to market capitalization, total liabilities and total assets have been extracted from annual financial reports of sample companies reported in the Thomson Reuters Eikon database. For macroeconomic control variables, resources from the Eurostat and OECD databases were used.

The selection of sample companies was made by two criteria: *size and business sector*.

Company size is considered a determinant factor for quality and quantity of information provided by published reports about environmental policies and actions (Moneva and Cuellar, 2009). The bigger they are, the more attention they get from mass media and economic and financial analysts, and their reports are certified externally to avoid the problems of illegitimacy, due to which they could lose more than middle or small-sized companies (Dissanayake et al., 2016; Kansal et al., 2014; Kuzey and Uyar, 2017; Legendre and Coderre, 2013; Nazari et al., 2015). The fact that they stir an increased interest in what regards environmental issues is an incentive for behaving well towards the environment but also, an additional pressure for a more detailed approach of the environmental issues in their annual reports.

The second relevant contextual factor refers to the sector in which the company operates. The more polluting it is, the more inclined it is towards strict regulation, and the quantity of environmental information increases (Braam et al., 2016; Burgwal and Vieira, 2014). Industry is, along with oil and gas sector and utilities and telecommunication, one of the sectors providing most environmental information (Fazzini and Dal Maso, 2016).

For these reasons, this study is based on companies from *top 150 of the biggest* European companies by net sales, and from the *industrial sector*, in accordance with their annual financial reports for 2017. The analysed period (2007-2016) had been anterior to entering into force of Directive 2014/95/EU of the European Parliament and of the Council amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups, making the disclosed environmental information not be imposed by the European legislation.

3.3. Econometric specification

To estimate the association between variables, the model in Eq. (2) has been used to test the H_1 hypothesis:

$$Q\_Tobin_{it}=\beta_0+\beta_1 x WRU_{it}+\beta_2 x WE_{it}+\beta_3 x WI_{it}+u_{it} \quad (2)$$

where: Q_Tobin_{it} is the dependent variable for company i in year t; β_i are the coefficients of the regression equation measuring the change of the dependent variable under the influence of the explanatory ones (X_i) (Table 1); u_{it} is the error term.

The model from Eq. (2) has been estimated by the panel fixed effects method which is adequate as it

allows the control of individual unobservable characteristics, leaving space for heterogeneity and individuality (Wooldridge, 2010). Therefore, the sample companies have been analyzed based on their specific features, which limited the omitted variable bias. The general specification of fixed effects model is shown in Eq. (3).

$$Y_{it}=\beta_0+\beta X_{it}+\alpha_i+\gamma_t+\varepsilon_{it} \quad (3)$$

where: Y is the dependent variable for company i in the year t; β_0 is the constant; β are regression coefficients; X_{it} is the time-variant regression matrix; α_i represents the cross-sectional fixed effects (time-invariant individual effects); γ_t are the time-specific fixed effects; ε_{it} is the error term (or the idiosyncratic disturbances). The selection between fixed effects estimation and random effects is made by Hausman test, which is based on the contrasts between the two types of effects (Baltagi, 2008). The test shows that the fixed effects model is more appropriate in this case.

To test H_2, Eq. (4) is estimated:

$$Q\_Tobin_{it} = \beta_0 + \beta_1 \text{ x } WRU_{it} + \beta_2 \text{ x } WE_{it} + \beta_3 \text{ x } WI_{it} + \beta_4 \text{x} COERln_{it} + \beta_5 \text{x } WRRln_{it} + u_{it} \quad (4)$$

where: *COER* and *WRR* are quantitative independent variables (Table 1), the distribution of which is highly skewed. That is why they are log-transformed (*COERln* and *WRRln*). The same estimation method used earlier, the panel fixed effects method is applied in this case.

The robustness testing of the results is made by adding macroeconomic control variables (*ETR* and *EPGE*) into the models from Eq. (2) and Eq. (4).

4. Findings and discussions

The results of the tests ran for Eq. (2) and Eq. (4) are presented in Table 3, which shows that both models have high explanatory power, R^2 having a slightly higher value in case of model 2 that also includes quantitative environmental variables. Regarding the first model, all qualitative variables illustrating the environmental performance are statistically significant showing the interest of investors towards this information deemed useful in assessing the listed companies. In addition, the influence of these predictors of market value is positive, confirming the results of other researchers (Aerts et al., 2008; Clarkson et al., 2013; Cormier and Mangan, 2007; Fazzini and Dal Maso, 2016). Our findings show that investors pay attention to all three dimensions of environmental disclosures, being interested in the company performance in reducing materials use and polluting emissions, as well as in creating new market opportunities through the use of new environmental technologies. These environmental reports are important because they provide existing and prospective shareholders with incremental information not only about expected performance but also about competitiveness, goodwill, or the ability to attract environmentally responsible investors (Radhouane et al., 2018). Therefore, environmental reporting of qualitative non-financial information is useful for investors in assessing future benefits and reducing uncertainty thus contributing to decrease of fears related to investment risks. In this context, hypothesis H_1 is supported.

Table 3. Empirical results for Eq. (2) and Eq. (4)

Variables	*Model 1 (Eq.2)*	*Model 2 (Eq.4)*
Intercept	0.081955 (0.174509)	-0.480380 (0.580953)
WRU	0.858508* (0.155904)	0.602040** (0.281498)
WE	0.547992* (0.199105)	0.389134 (0.331547)
WI	0.780265** (0.338009)	2.625654* (0.889810)
COERln		-0.071564** (0.034272)
WRRln		-0.009625 (0.070844)
Adjusted R^2	*0.788305*	*0.800130*
Total panel observations (unbalanced)	1000	395

*Note: **- statistically significant at 0.05 level, * - statistically significant at 0.01 level; standard errors are presented in parentheses.*

The second model used to test the hypothesis H_2 provides similar results. It is interesting that qualitative information on polluting emissions are not viewed as significant on the capital markets when quantitative information about CO_2 emissions (*COERln*) are also provided. It is noted that quantitative information, also called "hard items" (Qiu et al., 2016) and considered as objective evidence of environmental performance, is deemed useful by investors, reducing information asymmetry and improving a firm's environmental legitimacy. (Cormier and Magnan, 2015). As expected, the relation between this variable and performance is negative, which means that a high impact of polluting emissions on the company leads to decrease of its environmental performance and vice versa. So, companies with less (more) polluting operations, get better (lower) financial results.

This may be explained by the fact that the environmental performance may be viewed as an efficiency measure: a less efficient company pollutes more, so it has a reduced environmental performance (Horváthová, 2010). The results confirm the findings of Iwata and Okada (2011) that the polluting emissions negatively influence the long-term market performance (represented by *Q-Tobin* ratio that considers long-term debts and the assets of this nature). The decrease of the level of emissions increases the value of company assets. The other quantitative information, the waste recycling ratio (*WRRln*), is not a significant predictor of market performance, which confirms the findings of Iwata

and Okada (2011). Therefore, hypothesis H_2 is partially supported.

The results of testing the fixed effects panel models illustrated by Eqs. (2) and (4) are verified for *robustness* by adding control variables (*ETR* and *EPGE*). Table 4 presents similar results to those of Table 3. The sign and sense of variables remain mostly the same.

Table 4. Empirical results for robustness checks

Variables	***Model 1 (Eq.2)***	***Model 2 (Eq.4)***
Intercept	0.472494 (0.214674)	0.040482 (0.550597)
WRU	0.653246* (0.154505)	0.551875** (0.279450)
WE	0.804534* (0.197448)	0.540206 (0.343516)
WI	0.747442** (0.330785)	1.921636** (0.889810)
COERln		-0.061444*** (0.033368)
WRRln		-0.038263 (0.066850)
ETR	0.048115 (0.065177)	0.262142* (0.072806)
EPGE	-0.674565* (0.094973)	-0.927194* (0.208990)
Adjusted R^2	*0.799327*	*0.814563*
Total panel observations (unbalanced)	1000	395

*Note:*** - statistically significant at 0.1 level; ** - statistically significant at 0.05 level; * - statistically significant at 0.01 level; standard errors are presented in parentheses.*

Out of the introduced control variables, only *EPGE* is statistically significant in both models influencing negatively the dependent variable. This result confirms other findings reported by literature (Pearce and Palmer, 2001), which mention that the increase of governmental expenditure for the environment negatively affects company productivity and competitiveness due to increase of environmental regulation requirements.

ETR is a determinant factor only for the second model. Therefore, in case of increase of payments made by companies to state budget as environmental taxes, investors view as more performant the companies providing both qualitative and quantitative information.

5. Conclusions

The paper investigates the nexus between environmental reporting and market performance of companies selected from the biggest 150 industrial European companies by net sales for the year 2017. Our cross-country research is based on a comprehensive measure of environmental reporting, which includes both qualitative and quantitative non-financial information. The final sample comprised 110 companies disclosing qualitative information on their environmental operations, policies and performance over a period of 10 years (2007-2016).

When quantitative information about CO_2 emissions and waste recycling ratio was added to the research, the sample was narrowed down to only 64 companies that report such information, which is surprising for entities that big operating in these industries.

The findings confirm the relevance of environmental information disclosed for capital market participants and they support the *stakeholder theory*, as they prove that objective presentation of environmental information is highly appreciated by investors and helps companies improve their market value. This result matches the findings reported by Aerts et al., 2008; Cormier and Magnan, 2015; Wagner (2010) and Yang et al. (2011). Another finding is that the usefulness of qualitative information is decreasing on the capital market when the reports also disclose quantitative non-financial information, such as CO_2 emissions or waste recycling ratio. Both tested models show results arguing that companies that make extensive environmental information reports have an advantage on the capital market, as they make their stakeholders aware of their actions and performance, which increases their *legitimacy.* The positive relation between environmental reporting and company market value underlines the fact that increasing transparency reduces the risk of incorrect evaluation of share price and increases the reputation capital of the issuing company, contributing to the efficient operation of the market.

The study provides insights on how meeting the financial information needs of financial stakeholders (shareholders) contributes to improving the market value of companies. These insights may be useful for: i) managers as they may help them develop corporate strategies matching the interests of shareholders with community needs and the provisions of national and international environmental regulations; ii) regulation bodies and investors who, by requiring environmental reports and using their information, contribute to the increase of transparency and efficient operation of capital markets; iii) creditors, especially the banks that should consider the environmental performance, together with the financial performance of companies, when granting loans, to motivate companies to have environmentally-responsible behaviour; iv) authorities which by having gained access to information on environmental operations of companies may develop policies aimed to support and consolidate assets and natural resources.

In other words, the findings of this study are relevant for managers, investors and other stakeholders as they show that companies that are proactive in their environmental reporting are not financially penalised by the market. The study has some limitations related to the lack of analysis on the impact of reporting information on social actions of companies on their market performance as sustainable development also includes a social dimension. Consequently, the researched topic remains open, and it is valuable for further analysis.

Appendix 1. List of metrics included in the scores

Metric	*Explanations*
Resource use	
Resource Reduction Policy	Does the company have a policy for reducing the use of natural resources or to lessen the environmental impact of its supply chain?
Policy Water Efficiency	Does the company have a policy to improve its water efficiency?
Policy Energy Efficiency	Does the company have a policy to improve its energy efficiency?
Policy Sustainable Packaging	Does the company have a policy to improve its use of sustainable packaging?
Policy Environmental Supply Chain	Does the company have a policy to include its supply chain in the company's efforts to lessen its overall environmental impact?
Resource Reduction Targets	Does the company set specific objectives to be achieved on resource efficiency?
Targets Water Efficiency	Has the company set targets or objectives to be achieved on water efficiency?
Targets Energy Efficiency	Has the company set targets or objectives to be achieved on energy efficiency?
Environment Management Team	Does the company have an environmental management team?
Environment Management Training	Does the company train its employees on environmental issues?
Environmental Materials Sourcing	Does the company claim to use environmental criteria (e.g. life cycle assessment) to source or eliminate materials?
Toxic Chemicals Reduction	Does the company report on initiatives to reduce, reuse, substitute or phase out toxic chemicals or substances?
Renewable Energy Use	Does the company make use of renewable energy?
Green Buildings	Does the company report about environmentally friendly or green sites or offices?
Environmental Supply Chain Management	Does the company use environmental criteria (ISO 14000, energy consumption, etc.) in the selection process of its suppliers or sourcing partners?
Environmental Supply Chain Monitoring	Does the company conduct surveys of the environmental performance of its supplies?
Env Supply Chain Partnership Termination	Does the company report or show to be ready to end a partnership with a sourcing partner, if environmental criteria are not met?
Land Environmental Impact Reduction	Does the company report on initiatives to reduce the environmental impact on land owned, leased or managed for production activities or extractive use?
Environmental Controversies	Is the company under the spotlight of the media because of a controversy linked to the environmental impact of its operations on natural resources or local communities?
Emissions	
Policy Emissions	Does the company have a policy to improve emission reduction?
Targets Emissions	Has the company set targets or objectives to be achieved on emission reduction?
Biodiversity Impact Reduction	Does the company report on its impact on biodiversity or on activities to reduce its impact on the native ecosystems and species, as well as the biodiversity of protected and sensitive areas?
Emissions Trading	Does the company report on its participation in any emissions trading initiative?
Climate Change Commercial Risks Opportunities	Is the company aware that climate change can represent commercial risks and/or opportunities?
NOx and SOx Emissions Reduction	Does the company report on initiatives to reduce, reuse, recycle, substitute or phase out SOx (sulfur oxides) or Nox (nitrogen oxides) emissions?
Waste Reduction Initiatives	Does the company report on initiatives to recycle, reduce, reuse, substitute, treat or phase out total waste?
e-Waste Reduction	Does the company report on initiatives to recycle, reduce, reuse, substitute, treat or phase out e-waste?
ISO 14000 or EMS	Does the company claim to have an ISO 14000 or EMS certification?
Environmental Restoration Initiatives	Does the company report or provide information on company-generated initiatives to restore the environment?
Staff Transportation Impact Reduction	Does the company report on initiatives to reduce the environmental impact of transportation used for its staff?
Environmental Expenditures Investments	Does the company report on its environmental expenditures or does the company report to make proactive enviornmental investments to reduce future risks or increase future opportunities?
Environmental Investments Initiatives	Does the company report on making proactive enviornmental investments or expenditures to reduce future risks or increase future opportunities?
Environmental Partnerships	Does the company report on partnerships or initiatives with specialized NGOs, industry organizations, governmental or supra-governmental organizations, which are focused on improving environmental issues?
Innovation	
Environmental Products	Does the company report on at least one product line or service that is designed to have positive effects on the environment or which is environmentally labeled and marketed?
Eco-Design Products	Does the company report on specific products which are designed for reuse, recycling or the reduction of environmental impacts?

Metric	*Explanations*
Noise Reduction	Does the company develop new products that are marketed as reducing noise emissions?
Hybrid Vehicles	Is the company developing hybrid vehicles?
Environmental Assets Under Mgt	Does the company report on assets under management which employ environmental screening criteria or environmental factors in the investment selection process?
Equator Principles	Is the company a signatory of the Equator Principles (commitment to manage environmental issues in project financing)?
Environmental Project Financing	Does the company claim to evaluate projects on the basis of environmental or biodiversity risks as well?
Nuclear	Does the company construct nuclear reactors, produce nuclear energy or is active in another way in the nuclear energy industry?
Labeled Wood	Does the company claim to produce, source or distribute wood or forest products that are labeled (e.g. Forest Stewardship Council)?
Organic Products Initiatives	Does the company report or show initiatives to produce or promote organic food or other products?
Product Impact Minimization	Does the company reports about take-back producers and recycling programmes to reduce the potential risks of products entering the environment or does the company report about product features or services that will promote responsible and environmentally preferable use?
Take-back and Recycling Initiatives	Does the company reports about take-back producers and recycling programmes to reduce the potential risks of products entering the environment?
Product Environmental Responsible Use	Does the company report about product features and applications or services that will promote responsible, efficient, cost-effective and environmentally preferable use?
GMO Products	Does the company produce or distribute genetically modified organisms (GMO) or seeds?
Agrochemical Products	Does the company produce or distribute agrochemicals like pesticides, fungicides or herbicides?
Agrochemical 5 % Revenue	Are the revenues generated by the company from agroechemicals like pesticides, fungicides, or herbicides 5% or more of company sales?
Animal Testing	Is the company directly or indirectly involved in animal testing?
Animal Testing Cosmetics	Is the company directly or indirectly involved in animal testing for cosmetics?
Animal Testing Reduction	Has the company established a program or an initiative to reduce, phase out or substitute for animal testing?
Renewable/Clean Energy Products	Does the company develop products or technologies for use in the clean, renewable energy (such as wind, solar, hydro and geo-thermal and biomass power)?
Water Technologies	Does the company develop products or technologies that are used for water treatment, purification or that improve water use efficiency?
Sustainable Building Products	Does the company develop products and services that improve the energy efficiency of buildings?

Note: Source: https://eikon.thomsonreuters.com/index.html (Thomson Reuters Eikon)

Appendix 2. List of countries and number of companies included in the samples

Model 1			*Model 2*		
No. of countries	*Countries*	*No. of companies*	*No. of countries*	*Countries*	*No. of companies*
1	Austria	2	1	Belgium	2
2	Belgium	4	2	Denmark	2
3	Denmark	3	3	Finland	4
4	Finland	4	4	France	9
5	France	19	5	Germany	7
6	Germany	12	6	Ireland	2
7	Ireland	5	7	Italy	2
8	Italy	3	8	Netherlands	6
9	Netherlands	8	9	Russia	1
10	Norway	1	10	Spain	6
11	Russia	1	11	Sweden	5
12	Spain	8	12	Switzerland	4
13	Sweden	10	13	United Kingdom	14
14	Switzerland	8			
15	United Kingdom	22			
	Total	110		Total	64

Note: Source: https://eikon.thomsonreuters.com/index.html (Thomson Reuters Eikon)

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