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Article

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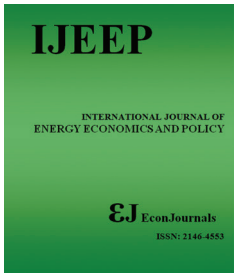

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Environmental Performance Versus Economic-financial Performance: Evidence from Italian Firms

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ABSTRACT

The aim of the study is to evaluate the economic-financial performance of a sample of 236 Italian companies in relation to their environmental performance, measured in terms of CO_2 emissions normalized by company turnover. In addition to the company's economic management, the analysis also considers the equity structure and company liquidity, over a period of 6 years (2008-2013). The analysis involves the creation of four maps of positioning, serving to represent the companies of the sample in relation to their different attitudes: (i) Green efficiency, (ii) operational efficiency, (iii) company profitability, (iv) financial viability, (v) company liquidity. The examination of positioning maps also serves in identifying extreme cases, meaning the totally inefficient and the "virtuous" companies, and for conducting sectoral analyses to evaluate potential relations between company performances and the characteristics of their industrial sector.

Keywords: Environment, CO_2 Emission, Environmental Performance, Economic-financial Performance
JEL Classifications: L6, Q5, Q50, Q51

1. INTRODUCTION

The World Meteorological Organization (WMO) has declared 2015 as the first year in human history that levels of atmospheric CO_2 surpassed 400 parts per million, thus marking the dawn of a new climatic era (WMO, 2016). Global climate is changing more rapidly than foreseen only a few years ago, and it is evident that without management of CO_2 emission it will be impossible to limit the increase in temperatures to 2.0°C below those of the preindustrial era, as had been planned under the 2015 Paris Agreement.

The main cause of global warming is the increasing concentration of greenhouse gases (GHG) (Intergovernmental Panel on Climate Change [IPCC, 2013]). CO_2 is the gas that contributes the most to the greenhouse effect, with the further complication of remaining in the atmosphere and oceans for thousands of years. The CO_2 emitted due to human activities since the industrial revolution has provoked about 1.8°C of global warming. Even if these emissions were halted tomorrow, CO_2 concentrations would remain high for many decades. Given this, the defense of climate stability must begin with the reduction of atmospheric CO_2.

In 1988, the WMO and United Nations Environment Program founded the United Nations IPCC, an international scientific organization charged with studying climate change and its potential environmental and socio-economic impacts. The aims of the IPCC are to evaluate the scientific, technical and socio-economic information useful in understanding global risks, potential impacts, and options for mitigation and adaptation to human-induced climate change. In its recent 5th assessment report, the IPCC presented alarming data (IPCC, 2014). Most seriously, 2000-2010 was the hottest decade ever recorded; sea levels have risen 0.19 m between 1901 and 2010, and on the basis of various models, will rise a further 26-82 cm by 2100. The IPCC predicts that a further temperature increase of more than 2°C is highly probably over the century, beyond which climate change will be irreversible. As a solution to this alarming scenario, the IPCC identifies the transition to a low-intensity carbon economy. The approach is technically achievable, and without excessive economic costs,

even if reductions in world consumption are limited to just 0.6% per year. In contrast, ignoring the obligation of investing in mitigating actions would lead to unsupportable costs of adaptation and reconstruction once the problems reach unmanageable levels. The fact that these figures on costs might be optimistic, particularly over the short term, should not mislead, since these estimates do not consider the potential benefits resulting from the transition towards a green economy, associated with improvements in health, wellbeing, and lifestyles. Moreover, the sustainability of production processes is a growing factor in the competitiveness of companies, especially for those intending to respond to the increasing demand for social and environmental responsibility on the part of the consumer. For this, companies must aim for eco-efficiency in their productive systems (Abdullah et al., 2017; Bernstein et al., 2007; Bradford and Fraser, 2008), meaning the capacity to produce using the least possible raw materials and energy, reducing their impacts in terms of atmospheric emissions and waste production.

In this regard, the European Commission has introduced an eco-management and audit scheme (EMAS): A management instrument for companies and other organizations to evaluate, report, and improve their environmental performance. Companies can adhere to the scheme voluntarily, providing other stakeholders with information on their environmental management. The EMAS regulation recognizes the entirety of ISO 14001 as a reference norm for construction of environmental management systems (EMS), but adds further important responsibilities, such as more employee involvement and dialogue, and preparation of an "environmental statement," which informs the public of the organization's environmental impacts and its actions for improvement of environmental performance.

Implementation of EMAS presumes that the companies develop an EMS, stating objectives, means and operational methods for the systematic, documented management of activities, in a manner to protect the environment and reduce impacts. The adoption of an EMS represents an important strategic choice, with the assumption of responsibilities towards the different interested parties (clients, suppliers, employees, public administrations, credit agencies, etc.) (Bansal and Bogner, 2002; Cogan, 2006; Jiang and Bansal, 2003; Khanna, 2001; Lash and Wellington, 2007; Rondinelli and Vastag, 2000). The goal in assuming an EMS is to foresee the environmental effects of the company's own activities and voluntarily define the aims for continuous improvement.

While the adoption of an EMS will undoubtedly allow the company certain benefits, such as optimization of use of energy resources, better risk management, and better company image, there will evidently be greater costs (hiring and training internal personnel for environmental management, or using external consultants; costs for independent examinations by an EMAS verifier).

At the broader level, actions of environmental innovation and green management can give rise to multiple effects in productive processes and products, leading many researchers to question the link between "green" and economic success. In effect, over the past 20 years, the relation between economic and environmental performances has been widely discussed in the literature (Walley and Whitehead, 1994; Hart and Ahuja, 1996; Klassen and McLaughlin, 1996; Russo and Fouts, 1997; Wagner et al., 2001; 2002; Demirel and Eskin, 2017). One side of the position argues that the improvements in environmental performance gives rise to increased costs and reduce profitability (Jaffe et al., 1995; Walley and Whitehead, 1994). Other authors have shown how the adoption of green management permits cost savings and increased sales, and thus improves economic performance and company competitiveness (Porter and van der Linde, 1995; Trung and Kumar, 2005; Xia et al., 2015).

The empirical literature has examined the question in detail, applying econometric techniques to evaluate the cost of "being green:" In other words, to determine to what extent companies gain (or lose) economic opportunity by improving their environmental performance (Ambec and Lanoie, 2008). However these works again show contrasting results, with some of them finding that environmental strategies generate positive economic implications (Al-Tuwaijri et al., 2004; Dowell et al., 2000; Fujii et al., 2013), while others studies reveal negative effects (Sarkis and Cordeiro, 2001) and still others report no significant correlations (Elsayed and Paton, 2005; Jaggi and Freedman, 1992; Lee, 2012; Telle, 2006).

Concerning environmental performance in terms of CO_2 emissions, various studies in the core literature have demonstrated the existence of an increase in the economic performance of companies subsequent to actions for reduction of emissions (Arimura et al., 2008; Arimura et al., 2011; Iwata and Okada, 2011; Nishitani et al., 2011; Nishitani, 2011; Nishitani and Kokubu, 2012; Welcher et al., 2000; Ziegler, 2005).

The current paper likewise aims to analyze the relations between environmental performance (reduction of CO_2 emissions) and economic-financial performances, in terms of the different aspects of company management: It considers not only economic management, but also the company's capital situation and liquidity.

The original contribution of this work is twofold. First, we extend the analysis of company performance to all aspects of business management, considering indicators of profitability, financing and liquidity. Secondly, we implement the analysis in the Italian industrial sector, considering a sample of 236 firms belonging to 41 industrial sectors over a 6-year period, from 2008 to 2013. To this end, we create maps of positioning serving in comparison of environmental and economic-financial performance, where one dimension represents green management, expressed in terms of CO_2 emissions, and the other dimension is variable indicating the specific economic-financial performance analyzed.

Following this introduction, the next section of the work summarizes the normative framework of international policies and measures for reduction of pollutant emissions. Section 3 describes the sample of companies studied. In Section 4, we present the methodology and map the positioning of the sample companies regarding the selected variables. Section 5 shows the analytical results for the sample as a whole, while Section 6 examines the results from positioning maps for the companies belonging to the different industrial sectors. Section 7 provides the authors' main

findings, particularly concerning the utility of the approach and the possibility of general conclusions concerning environmental strategies and their economic implications.

2. REGULATORY FRAMEWORK

The Kyoto Protocol was the first international agreement to set compulsory limits on GHG emissions. It was signed on 11 December 1997 by more than 160 countries, participating in the Conference of Parties of the United Nations Framework Convention on Climate Change (UNFCCC). The protocol came into force on 16 February 2005, without United States participation.

The target was an overall reduction of 5.2% from 1990 levels, by 2012, with cuts shared among nations depending on their income and degree of industrialization: The most-developed nations were subject to legally obligated, quantified objectives, while for the developing nations (e.g, China, India) the expectations at this stage were to simply strengthen national policies on awareness of the problem.

To obtain greater flexibility in implementation, the protocol introduced the following mechanisms:

- Emissions Trading (ET) (Art. 3): The countries subject to limits who succeed in obtaining excess reductions of emissions can "sell" the surplus to other countries subject to limits, who have not succeeded in reaching their assigned objectives.
- Joint implementation (Art. 6): Groups of countries subject to limits can agree on a different distribution of the obligations from that sanctioned under the protocol, as long as the overall obligations are met.
- Clean development mechanism (Art. 12): Permits companies present in an industrialized company under limits to implement projects for reduction of emissions in countries not subject to the same limits, but where interventions would be more feasible and less costly.

For the European Union the provision was for an 8% cut in emissions (Council of the EU, 2002; Commission of the EU, 2006; 2010); for Italy the reduction was set at 6.5% (Italian Parliament, 2002). EC Directive 2003/87 (European Union ET Scheme - EU ETS) regulates the trading of GHG emission "allowances," where one allowance is the equivalent of one ton of CO_2 emissions (Council of the EU, 2003). For a given period, each plant of all companies subject to Kyoto Protocol obligations is authorized to emit atmospheric gases that do not exceed the cap set for that plant. If in the given period the installation emits a quantity below the cap, the company can sell the unused allowance for CO_2 emissions. Vice versa, if the plant exceeds the CO_2 cap, it can purchase allowances without receiving sanctions. The EU ETS obligations do not apply to hospitals and small emitters, meaning installations with emissions of <25,000 tons of CO_2 equivalents, and in the case of combustion installations, do not apply to those with a nominal thermal power of <35 MW (excluding biomass emissions). The Union Registry for ET European Union Transaction Log, is an online database containing all the operations of issue, issue, holding, transfer, restitution and cancellation of the allowances.

The results of the ETS have exceeded expectations, reaching the emissions reduction objectives in less time than the deadlines imposed by the Kyoto Protocol: Between 1990 and 2012, European emissions of GHGs in fact declined by 18%. For this reason, in 2009 the European Parliament and Council approved the 20-20-20 Climate and Energy Package (Council of the EU, 2009a; 2009b; 2009c; 2009d; 2009e), which defines objectives to be reached over the 2013-2020 period: A 20% reductions in GHGs from 1990 levels; 20% improvement in energy efficiency; a level of 20% renewable energy in total EU consumption (17% for the nation of Italy).

In 2016, procedures were begun for adoption of the European legislative instruments necessary for the objectives to be reached by 2030, which will require a reduction of 40% in GHG emissions and a 27% increase in renewable and energy efficiency.

In the international context, the most recent meeting of the parties to the UNFCCC, held in Paris in 2015, concluded with a binding and universal agreement on climate, accepted by all the nations. The agreement was signed by 177 states and should enter effect before 2020.

3. DATA SET

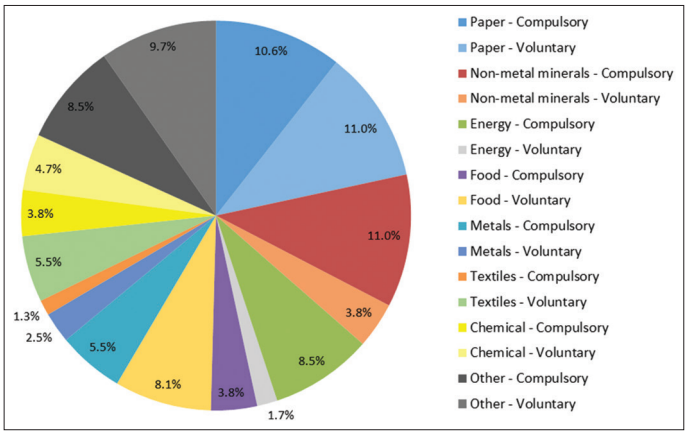
The sample of Italian companies observed in the current work consists of 236 firms listed in the Union Registry for ET. The study considers a period of 6 years, from 2008 to 2013, for a total of 1416 observations. Most of the companies are "major emitters," meaning with emissions of more than 25,000 tons CO_2 equivalent per year. Such firms fall within the regulated market, in which the communication of emissions is compulsory. However, a third of the observed sample has annual emissions below the threshold value for ETS regulation, meaning that they have voluntarily chosen to participate in the ET market.

The observed sample of companies accounts for roughly 21% of the total annual emissions monitored in Italy, which for example amounted to 438 Mt of CO_2 in the year 2013. The remaining share of emissions is from companies for which some of the data necessary for our analyses were not available in the financial statements, or were presented in a manner incompatible with the uniform preparation of the sample.

Concerning the industrial sectors represented in the sample, the companies are from 41 sectors of the ATECO 2007 classification, created by the National Institute of Statistics (ISTAT) for the statistical observation of Italian economic activity.

Figure 1 shows the division of the sample: 51 companies engage in manufacturing of paper and paper products (21.6%); 35 (14.8% of the sample) in production of products from processing of non-metal minerals (including companies active in glass and glass products manufacturing, and ceramics, cement, mortar and plaster production); 28 (11.9% of the sample) in production of food and beverages (food sector); 24 (10.2% of the sample) in production of electrical energy, natural gas, steam and conditioned air (the "energy" sector); 20 in the manufacture of chemical

Figure 1: Percentages of companies entering the Emissions Trading Scheme market as voluntary or mandatory participants: Division of the sample per sector



products (8.5%); 19 in the metallurgical sector (8%), and 16 in textiles (6.8%). The remaining 43 companies belong to "other sectors," including all those ATECO sectors with <10 companies represented in the sample.

4. METHODOLOGY

The aim of the paper is to analyze the relation between the orientation of companies towards green management and the attainment of certain economic and financial performances. For this purpose, we create a map of positioning, which permits comparing environmental and economic-financial performances, where one dimension represents green management, expressed in terms of CO_2 emissions, and the other dimension varies in relation to the specific economic-financial performance under analysis.

Environmental performance is measured in terms of tons of CO_2, as communicated to the Union Registry for ET and normalized on the basis of company turnover. To analyze economic-financial performance of the sample companies, we calculate the four balance sheet ratios that are most representative of company management, thus obtaining four different maps of positioning, described below.

A. Green Efficiency Versus Operational Efficiency

This map represents the companies of the sample, and is intended evaluate if they are more oriented to environmental protection or operational profit, or if in virtuous manner they succeed in reaching both objectives. In this map and the next one, green efficiency is measured in tons of CO_2 (normalized by company turnover), while operational efficiency is estimated by the return on investment (ROI) index, which expresses the return on capital invested, or income from core business operations, regardless of financing conditions and tax policies. As ROI increases, so does efficiency in use of the resources available to the company for producing earnings through core business activities.

B. Green Efficiency Versus Company Profitability

This map relates the company's environmental performance to its profitability, measured in terms of return on equity (ROE), or net income in relation to stockholders' equity. ROE is calculated as the relation between net income achieved over the course of the period and the average value of the company's own capital employed over of the same period. The higher the ratio, the more efficient management is in utilizing its equity base and the better the return is to investors.

C. Green Efficiency Versus Financial Viability

This map positions the companies on the basis of their green approach versus their financial viability, measured by its main indicator, debt/equity ratio (D/E). D/E is calculated as the ratio of net financial liabilities to net equity, and expresses the degree of the company's dependence on external financial sources. It indicates how many times greater the net interest-bearing debt is than the company's equity: The greater the ratio, the higher is the exposure to third parties.

D. Green Efficiency Versus Company Liquidity

This map describes the companies of the sample in respect to both their green management and their liquidity situation. Achieving a sufficient level of liquidity is very important to a company to avoid the risk of serious liquidity crisis, which often represents the onset of company failures. To test company liquidity, we use current ratio (CR), a financial indicator calculated by deriving the proportion of current assets available to cover current liabilities. The indicator expresses the company's capacity to honor short-term obligations, through the financial resources that become available over the same time period. The higher is the CR, the more the company is capable of addressing future expenses (deriving from extinction of short-term debts), with future earnings (arriving in payment of current activities).

On the basis of the existing literature (Pavarani, 2006) and the frequency distribution of the quantities of CO_2 emissions, we divide the observed data on ROI, ROE, D/E, CR and CO_2 in four classes, as shown in Table 1.

Using the indicators described, we developed four positioning maps, which always have average values of CO_2 emissions along the vertical axis, while the horizontal axis is represented by one of the four economic-financial indicators (ROI, ROE, D/E, CR). Using the positioning maps, we can identify which of the companies are virtuous, which ones succeed in obtaining good environmental and economic-financial performance and which companies are totally inefficient, demonstrating high levels of CO_2 emissions and negative balance-sheet indicators. It is also possible to analyze the intermediate situation, meaning the companies that while presenting an unsatisfactory level of economic-financial indicators, obtain good environmental performance and are therefore oriented towards green management. The opposite intermediate case is represented by companies that while not achieving green efficiency (showing high levels of CO_2 emissions), still succeed in obtaining excellent operational efficiency (Map A), or excellent company profitability (Map B), or financial viability (Map C), or good company liquidity (Map D).

The analysis of the positioning maps is twofold: First we show the placing of the entire sample regarding CO_2 and the four dimensions

Table 1: Ranges of economic and financial performance indicators

Range	Performance	ROI (%)	ROE (%)	D/E	CR	CO_2 (t/million €)
1	Poor	ROI<0	ROE<0	D/E≥2	CR<0.9	CO_2>2840
2	Mediocre	0≤ROI<8	0≤ROE<6	1≤D/E<2	0.9≤CR<1.2	1420<CO_2≤2840
3	Good	8≤ROI<10	6≤ROE<8	0.5≤D/E<1	1.2≤CR<2	710<CO_2≤1420
4	Excellent	ROI≥10	ROE≥8	D/E<0.5	CR≥2	0<CO_2≤710

ROI: Return on investment, ROE: Return on equity, D/E: Debt/equity, CR: Current ratio

of economic-financial indicators. Second, we carry out an analysis of positioning on the basis of the main ATECO sectors of the companies. This analysis allows an understanding of whether some sectors show greater concentrations in the quadrant of virtuous companies, and therefore it is the sectoral characteristics that would have positive effect on company performance. Vice versa, the positioning of the companies divided by sector can indicate if the companies of some sectors are completely inefficient, or if they are oriented only to green efficiency, or to the achievement of economic-financial performances.

5. ANALYSIS OF THE ENTIRE SAMPLE

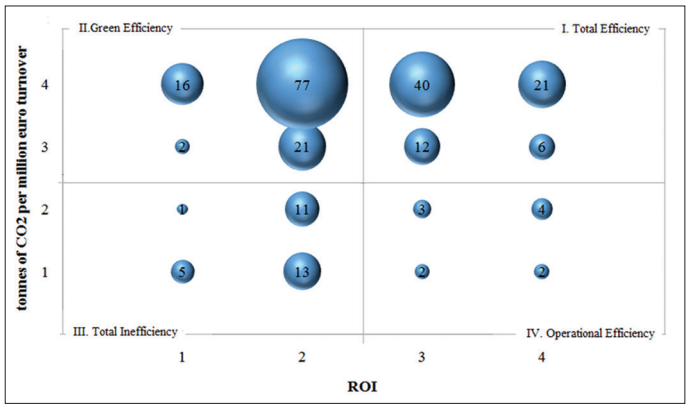
Each of the four positioning maps delineates the following quadrants:

- Quadrant I contains the "virtuous" companies that generate low levels of CO_2 emissions (green efficiency) and have a high average value of ROI (Map A), ROE (Map B) or CR (Map D), or a low average value of D/E (Map C).
- Quadrant II contains the companies which achieve green efficiency but have low levels of operational efficiency (Map A), company profitability (Map B), financial viability (Map C) or liquidity (Map D).
- Quadrant III contains the weakest companies, with a management style that is inefficient in both economic-financial and environmental terms, presenting both high levels of emissions and low levels of ROI (Map A), ROE (Map B) or CR (Map D), or a high level of D/E (Map C).
- Quadrant IV contains the companies that result as environmentally polluting but efficient in terms of operations (Map A), profitability (Map B), financial viability (Map C) or liquidity (Map D).

From Figure 2, we observe that the companies are primarily oriented towards green efficiency, given that 49.1% of the sample falls in Quadrant II. The companies in a state of total inefficiency represent 12.7% of the sample; the share with only operational efficiency is 4.7%; while the companies with best performance (total efficiency) represent a 33.5% share. Only 8.9% of the sample obtains the maximum level of performance, meaning a score of 4 for both ROI (operational efficiency) and emissions (green efficiency).

We note that the absolute majority of sample companies (61.9%) underperform in terms of ROI. At the same time, the majority (82.6%) obtain good performance in terms of green efficiency, positioning in Quadrants I and II (low values of CO_2). The orientation towards green efficiency could be due to the fact that many companies in the sample pursue an ecological vision and have adopted green marketing strategies, including voluntary

Figure 2: Map A



inscription in the European ETS register. As noted above, participation in the registry is optional for companies producing <25,000 tons of emissions per year, yet roughly one third of the sample consists of such firms.

From the analysis of the quadrants on the basis of the companies' main sectors of operation, the results show that in the quadrant of total efficiency, the largest share of companies represented (26.6%) operates in the paper sector, while only 6.3% are energy companies. In the second quadrant (green efficiency), it is again paper companies (25.9%) that primarily reach good environmental performance, while only 1.7% of this sample is from the energy sector. In the third quadrant, (total inefficiency), 50% of the worst companies operate in non-metal minerals production and 30% are energy companies. No company from the food, paper or chemical sectors places among the worst performers. The fourth quadrant, concerning operational efficiency, is primarily composed of energy companies (72.7%), and contains no food or paper companies. In summary, we can point out how the companies that obtain the best performance in both environmental and operational efficiency terms, tend to belong to the paper sector. These results concerning environmental performance should not surprise us. In fact over the past 10-20 years, the paper industry has been reoriented towards sustainable production, using new technologies of cogeneration with significant reductions in CO_2 emissions. However it is interesting to note how the paper industry has not only achieved environmental performance, but also operational results, reaching global efficiency.

In contrast, the sector showing the lowest number of green companies is energy. This result can again be attributed to the sector's structural characteristics, which make it the one with the highest for CO_2 emissions, due to the consumption of natural gas, coal and petroleum products for thermoelectric plants. In reality, the companies belonging to the energy sector are also very present

in the quadrant of completely inefficient companies, meaning that they add scarce performance in operational management to their poor environment results.

Map B confirms that the large part of the companies of the sample have an orientation towards green management: 53.4% reach green efficiency, by positioning in Quadrant II (Figure 3). Companies that are efficient both from the environmental and profitability point of view represent 29.2% of the sample (Quadrant I). We note that 16.5% of the sample obtains the maximum score in terms of both CO_2 emissions and ROE. Moreover, we can confirm that the very large majority of companies show a green orientation: 82.6% obtain good or even excellent environmental performance (Quadrants I and II). In contrast, we can see that the large part of the sample underperforms in company profitability. In fact 64.7% of the sample shows mediocre or even poor ROE (Quadrants II and III), and only 3.4% are oriented exclusively to company profitability (Quadrant IV). The companies in a state of total inefficiency compose 14% of the sample.

The analysis of the Map B quadrants in terms of ATECO sectors reflects that of Map A. Paper is once again the sector presenting the largest number of companies reaching total efficiency (21.7% of the total of companies placing in Quadrant I), while the chemical and energy sectors appear as those with the least number of efficient companies, both representing <6.0%. It continues to be the paper sector that shows the greatest percentage of companies (28.6%) among those achieving green efficiency (Quadrant II), while the sector with the least orientation to green management is again that of energy: Only 2.4% of green companies operate in the energy industry. The quadrant of completely inefficient companies (III) is primarily composed of those in the non-metal minerals and energy sectors (respectively 45.5%, 36.4%), while there are no food or paper companies present. The non-metal minerals sector includes lime and cement production, which results in significant CO_2 emissions, due in part to the high requirements for energy. Consequently, the poor environmental performance of non-metal minerals sector companies could be expected (only 7.1% of the companies that reach green efficiency are part of the sector). The data on total inefficiency are more interesting: A full 45.5% of totally inefficient companies belong to the non-metal minerals sector, showing a relation between negative results in terms of environmental performance and in terms of return on shareholder equity.

As concerns the quadrant of company profitability (IV), the energy companies (62.5%) can be seen as the ones most oriented to obtaining high ROE, while no food, paper or chemical companies are present.

Map C results as the most positive, showing the greatest number of totally efficient companies and the least totally inefficient ones (Figure 4). In fact 57.2% of the sample places in Quadrant I (total efficiency) and a full 30.5% of companies reach maximums in environmental and financial performance. Vice versa, only 4.7% of the sample results as inefficient, placing in Quadrant II. Overall, the companies that have green management, with good or excellent environmental performance, compose 82.6% of total, while 70% of the sample achieve good or excellent financial performance.

Figure 3: Map B

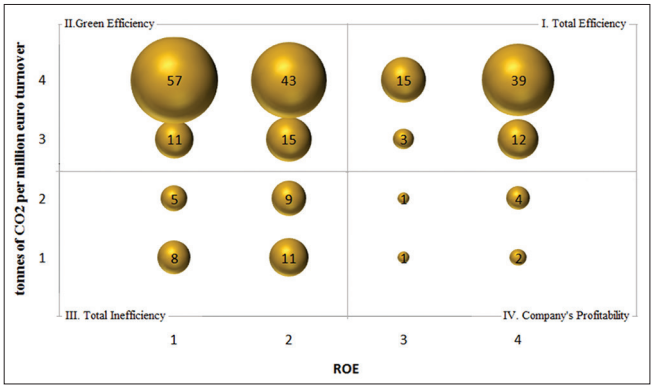
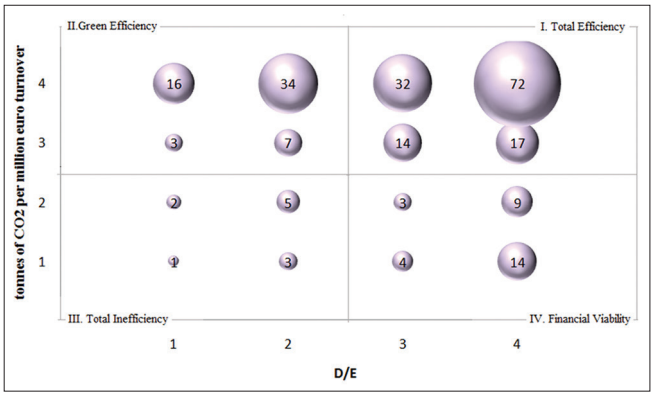


Figure 4: Map C



Therefore we can comprehend that the large part of the companies carry little debt, and demonstrate good financial balance.

The analysis of Map C concerning the ATECO sectors reflects that of the positioning in Maps A and B, as far as Quadrants I and II are concerned. In fact the best-performing sector in both quadrants is again that of paper, while the sector with the worst representation in Quadrant I is energy (only 3.7% of companies with green efficiency operate in energy), and the worst sectors in Quadrant II are energy and non-metal minerals, both at 3.3% of total presence.

The third quadrant, which in Maps A and B registered a prevalence of non-metal minerals companies, now shows a high percentage of energy companies: A full 81.8% of the totally inefficient companies operate in energy. On the other hand, there are no paper or food companies in the totally inefficient quadrant.

In the fourth and final quadrant, which in Maps A and B showed a prevalence of energy-sector companies, in this map presents a majority of companies (46.7%) from the non-metal minerals sector, which denotes a significant self-financing approach (low share of external capital). In this quadrant there are also no companies from the paper or food sectors.

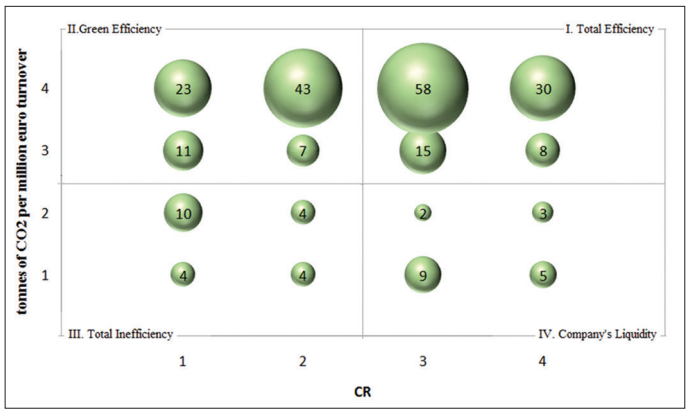
Map D (Figure 5) simultaneously shows environmental performance and company liquidity. We see that 47% of the sample reaches total efficiency, while 35.6% achieve only the green efficiency. Thus at the aggregate level, 82.6% of companies

demonstrate good or excellent performance. From the point of view of company liquidity, cash rich firms compose 55.1% of the sample (Quadrants I and IV). The companies oriented to company liquidity alone (IV Quadrant) represent 8.1% of total sample. Finally, 9.3% of the companies place in Quadrant III, and result as completely inefficient.

Once again, as concerns the analysis for ATECO sectors, Quadrants I and II of this map are similar those of the preceding cases. The sector with the greatest number of efficient companies is paper (26.1%), which is also the one with the greatest number of companies oriented towards green efficiency (26.2%). On the contrary, the energy sector is the one showing the lowest number of companies that are efficient or oriented to green management, respectively 3.7% and 3.3% of the composition of Quadrants I and II.

Concerning the third and fourth quadrants, the composition follows the trend of Map C. In Quadrant III, a full 68.2% of inefficient companies belong to the energy sector, and there is no representation from food or paper companies. In Quadrant IV, 57.9% of the companies most attentive to company liquidity belong to the non-metal minerals sector. No companies from the paper or food sector appear in this quadrant.

Figure 5: Map D



6. SECTORAL ANALYSIS

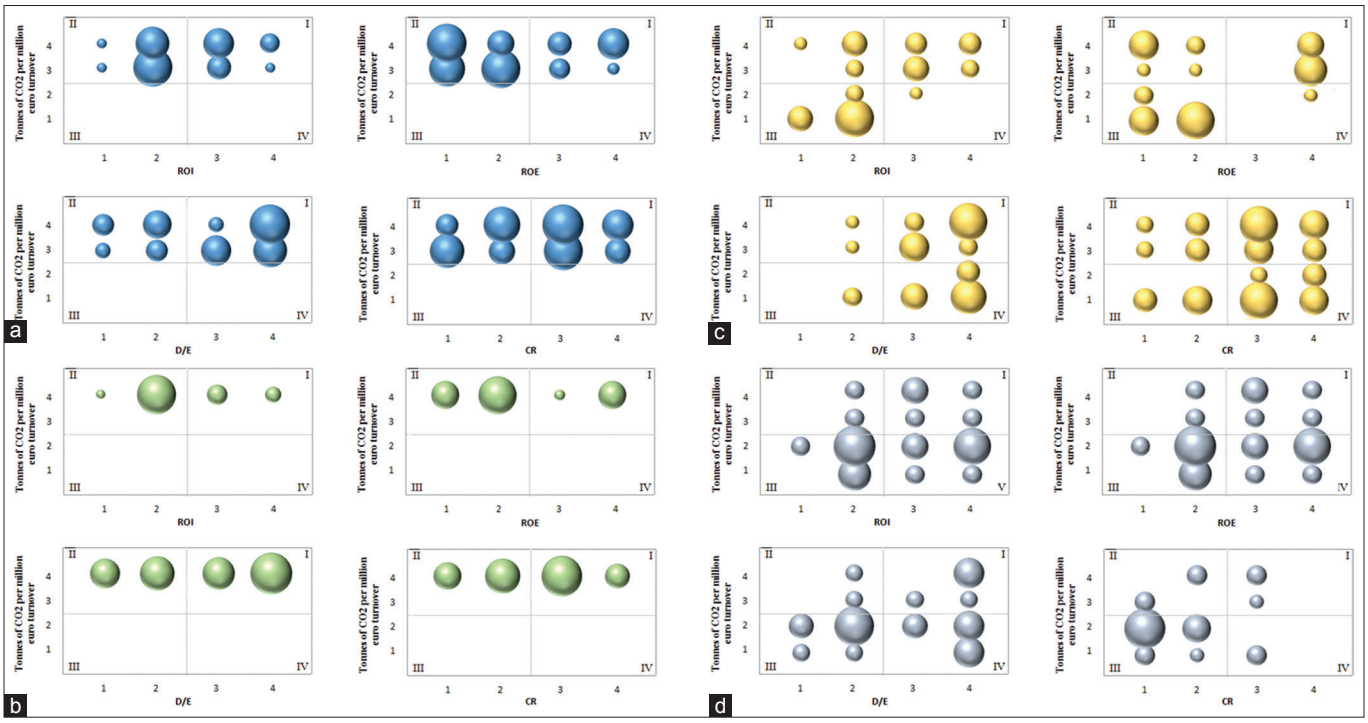
In Figure 6 we see the maps of positioning subdivided by ATECO sectors. In this case we deal with the four most numerous sectors, having more than 20 companies. The objective of the analysis is to reveal the differences deriving from the sectoral structural characteristics, which push the companies towards an orientation of green management rather than towards an economic, financial or assets management inclination.

Observing Figure 6a and b, the sectors that demonstrate a propensity for green management are those that structurally produce less CO_2 emissions: The paper and food industries. It should be noted that the on the basis of ATECO classification, the food industry includes processing and conserving foods but not the primary production, which is in fact a particularly important contributor to GHGs.

The paper and food sectors do not have any companies that place in the third or fourth quadrant, in any of the positioning maps. This observation demonstrates that 100% of food and paper companies achieve good environmental performance.

In more detail, the paper and food sectors, while achieving good environmental performance, show a high percentage of companies that underperform in terms of ROI and ROE. This result could be explained by an ISTAT study on competitiveness of Italian

Figure 6: Maps of positioning for main ATECO sectors: (a) paper, (b) food, (c) non-metal minerals and (d) energy sectors



companies (ISTAT, 2014), which reported that to confront the economic recession beginning in 2008, firms in both the paper and food sectors had acted in the area of profit margins, effectively cutting prices. Concerning the liquidity of companies in these two sectors, the analysis again reveals a significant percentage of companies that underperform in terms of CR. Moreover, symptomatic percentages (19.6% of paper sector; 17.6% of food sector) find themselves in a crisis situation concerning liquidity (CR<0.9), since future revenues deriving from current activities will not be sufficient to cover future outlays for settlement of short-term liabilities.

Concerning debt share, 33.3% of paper companies and 42.9% of food companies attain only poor or mediocre performance, demonstrating a high reliance on external sources of financing.

In all the positioning maps, the non-metal minerals and energy sectors show high percentages of companies (respectively 45.7% and 70.8%) that obtain mediocre or poor environmental performance (Figure 6c and d). This result derives from the configuration of the two sectors, respectively involving cement and thermoelectric plants, both of which are highly polluting.

From the point of view of operational profitability and shareholder equity, the non-metal minerals sector presents a high percentage of companies (42.9%) that position in the worst quadrant. This result could be explained by the ISTAT investigation on competitiveness (ISTAT, 2014), which reported that particularly in more recent years, the non-metal minerals sector had experienced substantial decreases in terms of company turnover. The energy sector follows the same trend: 37.5% of companies are "worst performers" in Map A and a full 50% of companies place as worst in Map B. In fact in recent years the energy sector has also been suffering contraction in profits, primarily from reduction of revenues from energy business units due to higher than average winter temperatures (affecting natural gas and network heating), and from reduction in sale price of electrical energy on wholesale markets.

The non-metal minerals sector achieves good financial and asset performance, in contrast to the results in the area of economic management. In fact 68.5% of non-metal minerals companies have good or excellent liquidity and a full 88.6% have good or excellent financial viability, thus showing an optimal balance between risk and debt capital. In contrast to non-metal minerals companies, energy companies also underperform from the financial and shareholders' equity point of view. In fact in Map C, 45.8% of energy companies demonstrate an unbalanced asset structure, with a D/E ratio >1. This result could in part be justified by the fact that capital-intensive sectors, such as energy, tend to have a high D/E ratio. The more alarming result for these companies concerns liquidity. In Map D, a full 79.2% of companies attain only mediocre or poor performances. In fact 50% of energy companies find themselves in a situation of liquidity crisis, placing below the CR threshold.

In conclusion, the energy sector is the one presenting the worst performances. As regards the environmental performance, must be emphasized that among the many human activities that produce GHGs, the use of energy represents by far the largest source of emissions (Akpan and Akpan, 2012). Actually the energy sector shows the worst performances not only from the point of view of CO_2 emissions, but also for economic, capitalization and financial aspects, thus bringing into evidence a relation between environmental and economic-financial performance.

7. CONCLUSIONS

The latest environmental data demonstrate the urgent need of reduction in CO_2 emissions, without which it would be impossible to counter recent climate changes.

While reduction in CO_2 emissions is clearly desirable for benefits of environmental sustainability, it is also true that from the point of view of companies, the technologies necessary for control of emissions could lead to added costs, and be economically unsupportable. The main literature has analyzed the relation between economic and environmental performances, but fails to arrive at an unequivocal solution. In fact, one side of the doctrine shows that improvement in environmental performance would provoke an increase in costs and reduction in profitability, while another side illustrates that the adoption of green management would permit cost savings and improved economic performance. Finally, a third current of literature would show that there is no significant correlation between environmental and economic performances.

The current work is also aimed at evidencing the potential relationship between economic-financial performance and environmental performance. Differently than the preceding studies, this work analyzes actual company performance, broken down into the different aspects of business management. In fact it considers not only economic management, but also the equity situation and company liquidity of a sample of 236 Italian firms, observed over a period of 6 years (2008-2013).

The analysis of environmental and economic-financial performance has been conducted by means of developing four maps of positioning, capable of representing the sample companies regarding their different attitudes: (i) Green efficiency, (ii) operational efficiency, (iii) company profitability, (iv) financial viability, (v) company liquidity.

Positioning Map A relates green efficiency to operational efficiency (estimated by ROI). From analysis of this map we can demonstrate that 49.1% of the sample reaches green efficiency; 12.7% of the sample companies are in a state of total inefficiency; the share with only operational efficiency is 4.7%, and the companies with best performance (total efficiency) represent a 33.5% share.

Positioning Map B relates environmental performance with company profitability (estimated by ROE). The positioning of the companies in this map resembles that of Map A. This result arises because the companies of the sample carry little debt, and so the trend of ROE tends to follow that of ROI. Map B confirms that the greater part of the sample companies have an orientation to green management: 53.4% achieve green efficiency, while the "virtuous"

companies (efficient in both environmental performance and company profitability) represent 29.2% of the sample. Only 3.4% are exclusively oriented to company profitability, while the companies in a state of total inefficiency represent 14% of the sample.

Positioning Map C, which relates green efficiency with financial viability (measured through D/E ratio) results as the most positive, presenting the greatest number of totally efficient companies and the smallest number of totally inefficient ones. In fact a full 57.2% of the sample place in the "total efficiency" quadrant, while only 4.7% of companies result as inefficient.

Positioning Map D relates green efficiency with company liquidity (measured using CR). From the analysis of the map we can observe that 47% of the sample companies achieve total efficiency, while 35.6% achieve green efficiency alone. Thus at aggregate level, 82.6% of companies achieve good or excellent environmental performance. As concerns company liquidity, cash rich firms compose 55.1% of the sample, while completely efficient companies represent 9.3%.

The analysis of positioning was also carried out for subdivisions of the sample based on industrial sector, to determine the potential relationship between company performances and structural characteristics typical of the sectors.

The results obtained demonstrated that among the different sectors, those of paper and food show a tendency towards green management. The food sector shows a low average level of CO_2 emissions, in part because primary food production activities are not included under the ATECO sector definition. Instead the category includes only processing and conserving, which are much less problematic in terms of GHG production.

The paper sector, in spite of being among those with highest energy consumption, results as one of the best in terms of environmental performance. In fact over the past decade, entrepreneurs in this sector have implemented modernization and updating of their plants (e.g., installing high-yield cogeneration plants) to achieve the shift to green management models.

However it should be noted that while the paper and food sectors obtain good environmental performance, they show high percentages of companies that underperform in terms of ROI and ROE. Also, from the D/E and financial points of view, a significant percentage of these companies are found to be in liquidity crisis, or show a high degree of dependence on external financing.

The non-metal minerals and energy sectors are the ones that show the worst environmental performance. This result arises from the configuration of the two sectors, with structures involving high levels of pollution. However for these two sectors there is also evidence of a correlation between environmental and economic performance. In fact, in terms of operational profitability and shareholder capital, the energy and non-metal minerals sectors present a high percentage of companies that place in the worst quadrant, resulting as completely inefficient.

Contrary to the results for economic management, the non-metal minerals sector achieves good financial and shareholder equity performance. However, as for economic management, the energy companies again underperform from the financial and capital point of view.

In conclusion, the energy sector is the one that presents the worst performances. Moreover, this is true both in terms of green efficiency and in terms of operational efficiency, company profitability, financial viability and company liquidity, therefore demonstrating a positive relation between environmental performance and economic-financial performances.

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