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A Framework to Identify Influences of Environmental Legislation on Corporate Green Intellectual Capital, Innovation, and Environmental Performance:

A New Way to Test Porter Hypothesis

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ABSTRACT

The aim of this paper is to examine the Porter hypothesis which defines that environmental regulations, under certain circumstances, could have positive effects on corporate environmental and economic performance. The majority of previous studies are based on questionnaire-based surveys, on normative models and on relative information at country level. To overcome some of the weaknesses of previous works, a benchmarking-scoring framework is suggested to draw useful and valuable information from corporate sustainability reports so as to examine the relationships between four dimensions of corporate performance, namely compliance with environmental legislation, green intellectual capital (GIC), environmental innovations, and corporate environmental performance. The proposed framework was applied in a sample of firms which operate in the metal products industry. The findings show that GIC could be a significant mediating factor between environmental legislation and environmental performance of firms. Additionally, it seems that GIC influences innovations and environmental performance.

KEYWORDS

Corporate Environmental Management, Corporate Sustainability, Corporate Sustainability Reporting, Global Reporting Initiative, Green Intellectual Capital

INTRODUCTION

The impacts of firms on the natural environment and local communities have lately gained great momentum in academic and public debate (Vatalis *et al.*, 2011). The severity and magnitude of present environmental harms (e.g. climate change effects and extreme weather events) have led all responsible actors from economic and social systems (e.g. consumers, firms, local authorities and local communities) to undertake their responsibilities (Kassinis and Vafeas, 2006; Wolf, 2014; Wang

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and Sarkis, 2017, Vatalis, 2010). In this context, there are pressures which have either formal forms such as regulations (e.g. environmental taxes, legislations and tradable permits) or informal forms such as reactions of local communities and consumers associations (e.g. products boycotters). In the field of corporate environmental management, there are two basic explanations for firms' attitudes towards the adoption of environmental practices. Specifically, the first explanation is based on the proactive behavior of firms which voluntarily adopt environmental strategies to exploit various potential (financial and non-financial) benefits such as improvement in their reputation, a sustainable competitive advantage, the *"social license to operate"* (mainly for mining industries) and an increase in their profits (Fombrun, 2005; Hiller, 2013). The second explanation is that firms merely adopt environmental management practices as a result of changes in the environmental legislations without investments in new innovations and thus firms fail in gaining other benefits from the adoption of such practices (Chang, 2015; Gürlek and Tuna, 2018).

In this academic landscape, an intermediate trend seems to emerge which places greater emphasis on how environmental legislation could help firms to make new innovations and reap benefits. Specifically, it highlights that under certain conditions environmental regulations could be a good tool to transform a firm from a traditional producer into an environmentally friendly producer which implements operational strategy which leads to innovations and economic benefits (Kagan *et al.*, 2003; Bigliardi *et al.*, 2012; Li and Ramanathan, 2018). Indeed, Porter and van der Linde (1995), supporters of this approach, have stressed that well-designed environmental regulations could play a critical role in delivering win-win solutions for firms (environmental and financial gains). A number of studies have been conducted to shed light on the relationships between environmental regulations and corporate financial and environmental performances (Kagan *et al.*, 2003; Al-Tuwaijri *et al.*, 2004; Schaltegger and Synnestvedt, 2002).

Many of these studies try to build theoretical foundations to explicate and support the assertions of Porter and Van der Linde's hypothesis (known as the Porter hypothesis). In essence, these studies develop normative models to detect potential positive or negative relationships between environmental regulations and corporate environmental and economic performance (Breuer and Lüdeke-Freund, 2014). These models are theoretical representations of various hypothetical propositions and potential relationships under certain circumstances without providing empirical evidence. In this logic, Ambec *et al.* (2013) have provided a hypothetical illustration from *'strict but flexible regulations'* to enhance corporate innovative outcomes which result in improving both corporate environmental and financial performance. Furthermore, the relative literature classifies the Porter hypothesis as *'weak'* and *'strong'*. The former implies that there are only relationships between environmental regulations and corporate innovation, while the latter focuses on the potential links between environmental regulations and corporate environmental and economic performances (Lanoie *et al.*, 2011; Rubashkina *et al.*, 2015; Fabrizi *et al.*, 2018).

Another part of studies is based on various academic fields such as mainstream economics (Crifo and Forget, 2015), management theory (Murty and Kumar, 2003), environmental economic (Ambec and Barla, 2006) and the corporate environmental management (Sánchez-Medina *et al.*, 2015) in order to test the Porter hypothesis empirically. These studies use data from questionnaire-based surveys or real data of firms, such as R&D expenses in environmental practices and environmental patents. However, these studies have some weaknesses due to the fact that they are based on macro-level data (country's level) and also data from questionnaires (i.e. answers from managers or other stakeholders) is not free from bias.

In this context, a benchmarking-scoring framework was developed aiming to investigate the connections between environmental legislation and corporate dimensions such as environmental innovation, GIC and corporate environmental performance. To do so, the proposed framework utilizes information published in corporate sustainability reports which provide access to information regarding the corporate environmental performance, firm's compliance with environmental regulations as well as environmental management practices and innovations. Also, due to the lack of General

Accepted Accounting Principles (GAAP), as happens with general corporate accounting, the proposed framework focuses on the Global Reporting Initiative (GRI) and its sustainability reporting guidelines G4 (GRI, 2013a,b) which provides a common framework for all firms interested in preparing sustainability reports. In particular, sustainability indicators proposed by GRI's G4 guidelines were used to assess corporate environmental performance, while GIC, environmental innovations and the firm's environmental legislation compliance were evaluated by using indicators derived from the relative literature. Finally, in order to test the relationships between environmental legislations and innovations, green intellectual capital and environmental performance, an empirical analysis was carried out in a sample of 15 firms operating in the metal products sector.

The rest of the paper includes three sections. The first section develops the research questions and it presents the proposed framework and the sample of firms used to investigate the research questions. The second section shows the results of the empirical analysis while the final section describes the conclusions and contributions of this paper. Also, it discusses the limitations of this paper which could serve as a base for future research.

RESEARCH METHODOLOGY

The Research Questions

Today, many scholars examine the role of environmental regulations in helping firms to introduce new green innovations (Brunnermeier and Cohen, 2003; Tsalis and Nikolaou, 2017). There are many studies which support that environmental regulations obstruct the economic development of businesses because legislation forces them to spend money on various aspects which are not relevant to their core business goals (Dean and Brown, 1995; Orji, 2019), while other studies maintain that under certain conditions environmental regulations can promote innovations (Porter and Van der Linde, 1995). In many cases this relationship is regarded as a black box without exploring the factors which affect the relationships between innovations and economic and environmental performances. A significant factor which could explain how environmental regulations impact innovations, is the ability of firms to create intellectual capital (Chang and Chen, 2012; Chen, 2008). Given this background, this paper aims at examining the following hypotheses:

H1: There is a relationship between environmental regulations and GIC.
H2: There is a relationship between GIC and environmental performance.
H3: There is a relationship between GIC and environmental innovations.
H4: There is a relationship between environmental innovations and environmental performance.

Benchmarking-Scoring Framework

As mentioned earlier the core part of the research methodology is a benchmarking-scoring framework which is used to gather essential information in order to evaluate various aspects of corporate performance. The outcome of this process provides the necessary inputs for examining the above research questions (hypotheses).

In general, benchmarking techniques are a practical means of analyzing various corporate aspects and practices in order to identify strong and weak aspects of firms' performances. Additionally, they assist in making comparative analysis of corporate performance among firms operating in the same or different sectors (Kemp and Pearson, 2007). The components of the proposed framework are analyzed in the following sections.

Indicators Selection

The selection of indicators has a strong effect on the effectiveness of the proposed framework. In total, 73 indicators were utilized for assessing four dimensions of corporate performance, namely GIC,

Table 1. Environmental performance indicators

ENPER indicators	Description
ENPER_I_1	Total volume or weight of materials used to the production
ENPER_I_2	Percentage of recycled materials used to the production
ENPER_I_3	Total energy consumption within organization
ENPER_I_4	Total energy consumption outside of the organization
ENPER_I_5	Energy intensity ratio
ENPER_I_6	Reduction of energy consumption
ENPER_I_7	Total volume of water consumption
ENPER_I_8	Fresh water sources affected by firms
ENPER_I_9	Total volume of water recycled and reused
ENPER_I_{10}	Management of protected areas and areas of high biodiversity value
ENPER_I_{11}	Impacts of products and services on biodiversity
ENPER_I_{12}	Species affected by corporate operations
ENPER_I_{13}	Direct Greenhouse Gas (GHG) emissions
ENPER_I_{14}	Indirect GHG emissions
ENPER_I_{15}	Other indirect GHG emissions
ENPER_I_{16}	GHG emissions intensity
ENPER_I_{17}	Reduction of GHG emissions
ENPER_I_{18}	Ozone-depleting substances emissions
ENPER_I_{19}	NO_x emissions
ENPER_I_{20}	SO_x emissions
ENPER_I_{21}	Total water discharge volume
ENPER_I_{22}	Total weight of waste by type and disposal method
ENPER_I_{23}	Total Number and volume of significant spills
ENPER_I_{24}	Mitigation strategies for environmental impacts of products
ENPER_I_{25}	Fines and non-monetary sanctions for non-compliance with environmental laws and regulations
ENPER_I_{26}	Environmental impacts of transportation
ENPER_I_{27}	Environmental protection expenditures and investments
ENPER_I_{28}	Supplier environmental assessment
ENPER_I_{29}	Number of grievances about environmental impacts

corporate environmental performance, environmental innovations and corporate compliance with environmental legislation. The majority of the suggested indicators accrue from the relevant literature while the environmental indicators proposed by GRI's G4 (GRI, 2013a, b) were adopted to assess corporate environmental performance. More precisely, 29 environmental indicators (ENVPER_I) were used to assess firms' performance in different corporate environmental aspects such as impacts on natural resources and materials, energy consumption, the level of air emissions (e.g. CO_2 emissions), the influence on biodiversity loss and water consumption (Table 1).

Table 2. Green human capital indicators

GHC indicators	Description
GHC_I_1	Employees' tacit knowledge
GHC_I_2	Employees' explicit knowledge
GHC_I_3	Knowledge transfer and knowledge sharing among employees
GHC_I_4	Certified environmental knowledge of employees
GHC_I_5	Workforce reputation
GHC_I_6	Employees' eco-consciousness
GHC_I_7	Employees' perceptions
GHC_I_8	Generating new ideas and converting consumer needs into new products
GHC_I_9	Staff skill level

Three different sets of indicators were developed to assess the GIC. Each group of indicators was used to evaluate a specific perspective of GIC. Particularly Green Human Capital (GHC), Green Structural capital (GSC) and Green Relational Capital (GRC) are the three perspectives of GIC (Chang and Chen, 2012).

As regards GHC, nine indicators were suggested which measure the knowledge, skills and behavior of employees regarding the protection of environment and the corporate practices to preserve environmental quality (Table 2). Such indicators aim at measuring the tacit knowledge which is very difficult to be identified within an organization (Saint-Onge, 1996; Haldin-Herrgard, 2000; Ambrosini and Bowman, 2001; Vatalis, 2017).

As for the GSC, nine indicators were developed which assess various aspects of corporate environmental strategic practices and the development of internal procedures such as training syllabus, manuals, books and guidelines (Table 3). It mainly measures explicit knowledge which is not affected by changes in the workforce (for example, changes in the rates of new employee hires or employee turnover) (Bontis, 2001; Smith, 2001; Hau *et al.*, 2013).

Table 4 depicts indicators used to assess the GRC. These indicators focus on the relationship between firms and their external stakeholders such as NGOs, suppliers, the financial sector and the local community. In the context of general management and environmental management, the stakeholder theory could explain voluntary social and environmental strategic management actions

Table 3. Green structural capital indicators

GSC indicators	Description
GSC_I_1	Copyright registration
GSC_I_2	Green practices
GSC_I_3	Trademarks
GSC_I_4	Environmental culture
GSC_I_5	Environmental infrastructure/business organization
GSC_I_6	Environmental laboratory of the company
GSC_I_7	Environmental management procedures
GSC_I_8	Environmental strategy
GSC_I_9	Environmental mission/vision

Table 4. Green relational capital indicators

GRC indicators	Description
GRC_I_1	Collaboration with NGOs
GRC_I_2	Collaboration with academic institutions
GRC_I_3	Collaboration with suppliers
GRC_I_4	Collaboration with consumers /customers
GRC_I_5	Collaboration with other companies
GRC_I_6	Collaboration with the government
GRC_I_7	Collaboration with the local community

of firms (Freeman *et al.*, 2004; Steurer *et al.*, 2005; Hansen and Schaltegger, 2016). Particularly, according to the knowledge-based view of firms (Nikolaou, 2017), information and knowledge are necessary strategic factors. Firms should be able to gather and process valuable information from their interactions with stakeholders, such as consumers' needs and preferences for products and services, as well as their cooperation with suppliers and competition issues help them to improve their production and operation procedures.

Corporate environmental innovation (ENIN) was also assessed. Actually, there are three general types of corporate environmental innovations. The first type focuses on product innovations which are associated with eco-design aspects to reduce the effects of products on the natural environment. The second type refers to operational innovations, which includes novel and innovative practices implemented by firms so as to face environmental problems with cost reduction and, the third type focuses on marketing innovation (i.e. green marketing and advertising). Given this background, Table 5 shows eleven indicators which aim to identify new eco-friendly products and services, environmental patents, green R&D expenditure and potential environmental certifications (eco-labels).

Finally, eight indicators were utilized to evaluate the level of compliance of firms with environmental legislation (ENLEG). These indicators refer to issues related to the firms' compliance with the emission limits, mechanical noise, waste management and also legal sanctions (i.e. monetary fines and penalties) (Table 6).

Table 5. Environmental innovation indicators

ENIN indicators	Description
ENIN_I_1	New green products and services
ENIN_I_2	Innovative technologies for wastewater treatment
ENIN_I_3	Innovative technologies to reduce air pollutants
ENIN_I_4	Use of BAT (best available techniques) by the companies
ENIN_I_5	Resources saving and net production procedures
ENIN_I_6	Environmental techniques and tools such as life cycle analysis
ENIN_I_7	Eco-label, environmental claim, environmental statement
ENIN_I_8	Number of patents
ENIN_I_9	Amount of research and development expenditure
ENIN_I_{10}	ISO 14001 or EMAS certification
ENIN_I_{11}	Environmental risk control and monitoring systems

Table 6. Environmental legislation indicators

ENLEG indicators	Description
ENLEG_I_1	Compliance with the emission limits
ENLEG _I_2	Improving energy efficiency and resource efficiency
ENLEG _I_3	Monetary fines due to violation of environmental laws
ENLEG _I_4	Cases of conviction for environmental crimes
ENLEG _I_5	Compliance with the limits of mechanical noise legislation
ENLEG _I_6	Compliance with the requirements for alternative management of packaging
ENLEG _I_7	Compliance with conditions for the proper management of hazardous waste
ENLEG _I_8	Ways of disposal and treatment of industrial waste

Measurement System

The suggested measurement system is based on the scoring techniques which offer a practical way to quantify information and data from corporate sustainability reports (Demertzidis *et al.*, 2015; Nikolaou *et al.*, 2014; Cantele *et al.*, 2018; Tsalis *et al.*, 2017). The advantage of scoring techniques lies in their ability to provide a practical evaluation process which can be used to quantify information regardless of the type of information (i.e. financial or non-financial and quantitative or qualitative) and aspects of corporate environmental performance (such as energy consumption, GHG emission and quality of water discharges). Additionally, scoring scales allow users to calculate an aggregate final score as the sum of the scores from individual indicators which could be used for comparison purposes (Morhardt *et al.*, 2002; Yadava and Sinha, 2016).

As for the proposed methodological framework, two three-point scoring scales, namely Accountability Scoring Scale (ASS) and the Performance Scoring Scale (PSS) used to assess the information published in corporate sustainability reports for each indicator (see Table 7)(Nikolaou and Tsalis, 2013; Tsalis *et al.*, 2018a,b; Tsalis *et al.*, 2019). Particularly, the ASS assesses the quality of the disclosed information for a specific indicator, whereas the PSS estimates the progress of a specific aspect of corporate performance defined by an indicator. It is important to stress that the PSS

Table 7. Scoring scales

Scoring Scales	Score	Description
ASS	**0**	When a specific indicator is not mentioned in the report.
	1	The report provides only qualitative (descriptive) information on how a firm deals with the requirements of a specific indicator. Such type information implies that corporate performance is poor because a firm has not implemented mechanism for measuring the results of its strategic management concerning the aspect of corporate performance defined by the examined indicator.
	2	The report provides quantitative information about a firm's performance in a specific indicator.
PSS	**0**	When a firm's performance in the examined indicator is worse than the previous year or a firm does not provide further information in order to compare firm's performance with the previous year.
	1	When the examined indicator's performance is the same as the previous year.
	2	When the examined indicator's performance is better than the previous year.

is used only when a sustainability report provides numeric (quantitative) data about the performance for a specific indicator.

The outcomes from the evaluation process used to calculate a Composite Performance Score (CPS) for each of the six assessed dimensions of corporate performance. Each CPS is an aggregate score indicating the overall performance of the assessed dimension. Table 8 details the equations used to estimate the composite performance scores.

Sample Selection

The proposed methodology was applied in a sample of firms from the metal products industry. Due to the negative impacts on the environment and the high natural resources usage necessary for their production processes, this sector is regarded as "high profile" firms and they come under intense scrutiny. Thus, firms are expected to disclose complete and comprehensive information about their sustainability performance (Fernandez-Feijoo *et al.*, 2014; Wagner, 2007; Newson and Deegan 2002; Hackston and Milne, 1996; Reverte, 2009; Vatalis and Kaliampakos, 2006). In addition, all sampled firms satisfied three important criteria. Firstly, all firms had to register their sustainability reports in GRI's sustainability disclosure database. Secondly, firms had to upload their sustainability report for four consecutive years (from 2014 to 2017) and thirdly, all reports should be written in English. The final sample includes, 60 sustainability reports published by 15 firms (i.e. 15*4=60) which were carefully read in order to determine the necessary information for the research goals.

Table 8. Composite performance scores

Description	Equations		Max Score
Composite Green Human Capital Score (CGHCS)	$CGHCS = \sum_{i=1}^{9}\left(AI_i + PI_i\right)$	Where *i* is the number of indicators of GHC	36
Composite Green Structural Capital Score (CGSCS)	$CGSCS = \sum_{j=1}^{9}\left(AI_j + PIj\right)$	Where *j* is the number of indicators of GSC	36
Composite Green Relational Capital Score (CGRCS)	$CGRCS = \sum_{k=1}^{7}\left(AI_k + PI_k\right)$	Where *k* is the number of indicators of GRC	28
Composite Green Intellectual Capital Score (CGICS)	$CGICS = CGHCS + CGSCS + CGRCS$		100
Composite Environmental Performance Score(CENPS)	$CENPS = \sum_{l=1}^{29}\left(AI_l + PI_l\right)$	Where *l* is the number of indicators of ENPER	116
Composite Environmental Innovation Score (CENIS)	$CENIS = \sum_{m=1}^{11}\left(AI_m + PI_m\right)$	Where *m* is the number of indicators of ENIN	44
Composite Legal Compliance Score (CLECS)	$CLECS = \sum_{n=1}^{8}\left(AI_n + PI_n\right)$	Where *n* is the number of ENLEG	32

Table 9. The results from the evaluation of sampled sustainability reports

Composite Performance Scores	Number of cases (N=60)		Mean Score
	Performance Below Mean Score(PBMS)	Performance Above Mean Score (PAMS)	
CENPS	27	33	31.88
CGHCS	51	9	8.25
CGSCS	37	23	6.70
CGRCS	18	42	5.80
CGICS	26	34	20.75
CENIS	29	31	9.30
CLECS	32	28	5.27

RESULTS

In this section the main findings from the analysis of sustainability reports are presented. Table 9 details the mean score achieved by the examined firms for each evaluated dimension of corporate performance as well as the number of cases where firms achieve a performance above or below the mean score (PAMS and PBMS, respectively).

As can be seen, the mean score of the CENPS was 31.88 points and in 33 cases (i.e. sustainability reports), the firms achieved a performance above the mean score. With respect to the GIC, 34 cases show that firms have achieved a performance above the mean score of CGICS (20.75 points). Finally, the mean scores of CENIS and CLECS were 9.30 and 5.27 points, respectively.

Spearman's correlation test was used to provide answers to the four research questions concerning the relationships between the assessed dimensions of corporate performance (Table 10). Actually, this is a rank-based non-parametric statistical test, which detects monotonic trends in a time series and measures the strength of association between two random variables X and Y (Schmid and Schmidt, 2007; Yue *et al.*, 2002).

More specifically, the first research question is associated with the relationship between the level of a firm's compliance with environmental legislation (CLECS) and GIC. The findings show that there is a positive correlation between these dimensions of corporate performance (r=0.392, p<0.01). As for the perspectives of GIC, corporate environmental legislation compliance is positively associated with GHC (r=0.301, p<0.05). Also, there is a statistically significant correlation between CLECS and CGRCS (r=0.583, p<0.001) which could be explained by the fact that the relational capital is improved when firms comply with environmental legislations because they gain legitimacy for their daily operations building strong relationships with local communities, government services and consumer associations (Murillo-Luna *et al.*, 2008; Helmig *et al.*, 2016).

The second research question is concerned with the relationship between GIC and environmental performance. In particular, the GHC is positively correlated with environmental performance (r=0.378, p<0.01). It is a rational finding since investments in corporate training programs in environmental issues, which diffuse environmental knowledge within the firm, is expected to have a positive impact on the corporate environmental performance. Moreover, there is a positive association between GRC and environmental performance (r=0.431, p<0.001). This finding is in line with the previous researches which show that collaboration of firms with stakeholders (customers, NGOs, local community) improves corporate environmental performance (Peloza and Falkenberg, 2009; Dimitrova *et al.*, 2007; Nikolaou *et al.*, 2016).

The third research question examines the relationship, between GIC and environmental innovation. The findings indicate that CGICS is positively correlated with CENIS (r=0.599, p<0.001). This

Table 10. Correlation matrix for the assessed dimensions of corporate performance

	CENPS	CGHCS	CGSCS	CGRCS	CGICS	CENIS	CLECS
CENPS	1.000						
CGHCS	.378**	1.000					
CGSCS	-.098	.066	1.000				
CGRCS	.431**	.344**	-.031	1.000			
CGICS	.268*	.432**	.630**	.650**	1.000		
CENIS	.414**	.290*	.385**	.360**	.599**	**1.000**	
CLECS	.727**	.301*	-.107	.583**	.392**	**.546****	1.000

* Correlation is significant at the 0.05 level,** correlation is significant at the 0.01 level (2-tailed).

implies that the creation of GIC is likely to assist firms in creating organizational capabilities and in promoting environmental innovation. Although there is limited research on the links between GIC and environmental innovation, there is substantial evidence for the relationship between general intellectual capital and innovation (Subramaniam and Youndt, 2005; Wu *et al.*, 2008; Delgado-Verde *et al.*, 2016). Hence, this paper could provide the basis for further empirical investigation of the association of GIC and environmental innovation.

The last research question focuses on the relationship between corporate environmental innovation and environmental performance. The result from the Spearman's correlation test shows that there is a statistically significant correlation between these two dimensions of corporate performance (r=0.414, p<0.001). Despite the fact that there is a rational explanation for the positive effects of environmental innovations on corporate environmental performance, it is important to examine it in the context of the proactive stance of firms (Berry and Rondinelli, 1998; Sharma and Vredenburg, 1998; Yang *et al.*, 2019), and the reactive behavior of firms (Chang, 2015). The former trend is associated with win-win results, while the latter focuses only on achieving legislation requirements without innovation or economic benefits (Porter and Van der Linde, 1995).

CONCLUSION

This paper suggests a new methodological framework to examine the Porter hypothesis. It is based on scoring/benchmarking techniques which draw information from corporate sustainability reports. It aims also at examining *'strong'* version of the Porter hypothesis by examining how environmental legislations influence environmental innovations, intellectual capital and environmental performance. Initially, the findings show that environmental legislation may create incentives for corporate environmental innovations. The sampled firms examined seem to face environmental regulations positively since they achieve various types of innovations mainly to comply with them. Additionally, a positive correlation is identified between environmental legislation with green intellectual capital and environmental performance of firms. This may be a consequence of efforts by firms to identify new ways to face environmental regulations mainly to gain a competitive advantage and cost savings.

However, it would be useful if the policy makers carefully design more flexible environmental regulations by imposing incentives for promoting innovation and intellectual capital. This may drive the proactive corporate compliance with environmental regulations, which benefits both the firm and the environment.

A possible key tool for this purpose is the impact assessment of regulations. The 'Better Regulation' tool, used by the Commission (EU) and the Regulatory Impact Assessment (RIA) used by many OECD countries aim to elaborate policy and legislation considering the expected economic,

environmental and social impacts, mitigating unnecessary burdens and red tape for citizens, businesses and public authorities (Golberg, 2018; Schultz *et al.*,2019).

This paper contributes to the general literature in three ways. Firstly, it introduces scoring/benchmarking techniques into the literature on the Porter hypothesis. It turns out to be a good tool to draw useful, valuable and consistent information from the real data of firms. Secondly, it adds valuable insights into the links between environmental regulations and corporate innovations which is considered a necessary piece of the puzzle when testing the Porter hypothesis. Thirdly, the specific methodology can be used as a pattern for companies to organize and disclose better their information about GIC and the other assessed dimensions of corporate performance.

However, a significant limitation is that the economic performance of firms is not taken into consideration in this analysis. Also, the small size of the sample (only 15 firms) is another limitation of this research. Thus, future researches should test these hypotheses in a larger sample of firms from different sectors. Finally, an important weakness is associated with the statistical analysis. For this analysis, methodologies based on structural equation modeling could be another good point for future research.

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