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Green supply chain management drivers, practices and performance: A comprehensive study on the moderators

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ABSTRACT

The growing level of attention toward global warming, reduction of non-renewable resources and pollution calls manufacturing firms to implement sustainable, and specifically green initiatives into their supply chains (Green Supply Chain Management, GSCM). So far, too little studies have provided clear empirical evidence on the actual impact of these initiatives on firms' performance, especially within the European manufacturing context, and on the actual impact of possible drivers on the implementation of the above-mentioned initiative. Thus, the aim of this study is to analyse possible moderation factors that affect the relationships between drivers-practices and practices-performance through a survey carried out in 169 Italian manufacturing firms belonging to a range of different sectors. The moderation analysis shows that some drivers strongly influence the relationships between drivers-practices and practices-performance, and a few contributions from the existing literature are challenged and discussed. Our findings may be particularly interesting for managers and supply chain specialists, as well as for policymakers, who could be inspired by the role of particular drivers on the implementation of GSCM practices, and by the level of performance achievable thanks to the adoption of a set of green practices. As for the academic impact, the issue has been tackled for the first time in an attempt of a comprehensive view, which paves the way to a number of research lines to further investigate both the confirmed and unconfirmed moderations, so as to understand the related rationales in the comprehensive view proposed by the authors.

1. Introduction

Sustainability in the operations, as a balance between the economic, environmental and social dimensions, has become more accepted knowledge as a crucial element for production and consumption (UN, 2019). Expanding sustainability understanding across the supply chain (SC) has been recognised not only as promising but also as an effective approach bringing innovation and practice into industrial operations (Silvestre and Tîrca, 2019; Jadhav et al., 2019; Taghikhah et al., 2019). This can be noted from recent research with customers and final consumers developing a growing environmental awareness pushing toward green products (Dubey et al., 2015a,b), while community and NGOs mobilize public opinion and the media in favour of or against a firm's environmental policies (Chien and Shih, 2007; Mathiyazhagan et al., 2015).

With respect to the very crucial – and potentially even more crucial for the competitiveness and survival of companies and SCs – issue of the intersection between environmental and economic pillars for production and SCs (Sarkis and Zhu, 2018), green supply chain management (GSCM) has been acknowledged as an important business strategy to improve eco-sustainability, to respond to the already mentioned firm stakeholders' driver and to achieve corporate profit and market share objectives by reducing environmental risks and impacts (Zhu et al., 2008b). GSCM integrates environmental thinking (Srivastava, 2007) into SC management, ranging from product design (Kannan et al., 2014), material sourcing and selection (Govindan et al., 2013; Hashemi et al., 2015), manufacturing processes (Zhu and Geng, 2013), delivery of the final product (Sarkis, 2017) as well as end-of-life management of the product after its useful life (Cucchiella et al., 2015; Rehman and Shrivastava, 2011). A significant number of GSCM studies have focused their attention on the identification of key stakeholders'

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Abstract

The growing level of attention toward global warming, reduction of non-renewable resources and pollution calls manufacturing firms to implement sustainable, and specifically green initiatives into their supply chains (Green Supply Chain Management, GSCM). So far, too little studies have provided clear empirical evidence on the actual impact of these initiatives on firms' performance, especially within the European manufacturing context, and on the actual impact of possible drivers on the implementation of the above-mentioned initiative. Thus, the aim of this study is to analyse possible moderation factors that affect the relationships between drivers-practices and practices-performance through a survey carried out in 169 Italian manufacturing firms belonging to a range of different sectors. The moderation analysis shows that some drivers strongly influence the relationships between drivers-practices and practices-performance, and a few contributions from the existing literature are challenged and discussed. Our findings may be particularly interesting for managers and supply chain specialists, as well as for policymakers, who could be inspired by the role of particular drivers on the implementation of GSCM practices, and by the level of performance achievable thanks to the adoption of a set of green practices. As for the academic impact, the issue has been tackled for the first time in an attempt of a comprehensive view, which paves the way to a number of research lines to further investigate both the confirmed and unconfirmed

moderations, so as to understand the related rationales in the comprehensive view proposed by the authors.

Keywords: Green Supply Chain Management; Driver; Practice; Performance; Moderator.

Highlights

- A number of possible moderators have been identified from the extant literature
- The moderators have been tested through a survey in 169 Italian manufacturing firms
- Many relationships among GSCM drivers, practices and performance are moderated

1 Introduction

Sustainability in the operations, as a balance between the economic, environmental and social dimensions, has become more accepted knowledge as a crucial element for production and consumption (UN, 2019). Expanding sustainability understanding across the supply chain (SC) has been recognised not only as promising but also as an effective approach bringing innovation and practice into industrial operations (Silvestre and Tîrca, 2019; Jadhav et al., 2019; Taghikah et al., 2019). This can be noted from recent research with customers and final consumers developing a growing environmental awareness pushing toward green products (Dubey et al., 2015), while community and NGOs mobilize public opinion and the media in favour of or against a firm's environmental policies (Chien and Shih, 2007; Mathiyazhagan et al., 2015).

With respect to the very crucial – and potentially even more crucial for the competitiveness and survival of companies and SCs – issue of the intersection between environmental and economic pillars for production and SCs (Sarkis and Zhu, 2018), green supply chain management (GSCM) has been acknowledged as an important business strategy to improve eco-sustainability, to respond to the already mentioned firm stakeholders' driver and to achieve corporate profit and market share objectives by reducing environmental risks and impacts (Zhu et al., 2008b). GSCM integrates environmental thinking (Srivastava, 2007) into SC management, ranging from product design (Kannan et al., 2014), material sourcing and selection (Govindan et al., 2013; Hashemi et al., 2015), manufacturing processes (Zhu and Geng, 2013), delivery of the final product (Sarkis, 2017) as well as end-of-life management of the product after its useful life (Cucchiella et al., 2015; Rehman and Srivastava, 2011). A significant number of GSCM studies have focused their attention on the identification of key stakeholders' drivers and their influence on GSCM initiatives adoption (Ahi and Searcy, 2013;

Hassini et al., 2012). Furthermore, in the literature, there is a number of contributions discussing whether the implementation of environmental SC practices leads to enhanced firm performance (for a recent review see, e.g., Tseng et al., 2019). Literature has also offered a variety of mathematical models and tools to address the sustainability issues in SC management, given the higher complexity involved (Bai and Sarkis, 2018; Sarkis et al., 2019) Nevertheless, so far there is too little consensus – mainly due to lack of empirical evidence – over the factors moderating relationships between drivers and practices, as well as between practices and performance, leading to vague and ambiguous conclusions. Indeed, the role of important moderators, such as, e.g., firm size, sector, in the relationships between pressures and GSCM practices and performance has received less attention from scholars, especially in regard to empirical investigations.

Additionally, as recently observed by Koberg and Longoni (2019), who have analysed a rigorous systematic literature review of articles focused on sustainable supply chain management in global supply chains, there has been a growing interest on the topic starting from the seminal articles on sustainability in global supply chains (Gereffy et al., 2001; Humphrey and Schmitz, 2001). Nevertheless, the interest of those scholars seems to be more focused on the modes of sustainability governance, which attracted the interest of recent research as well (e.g., Bush et al., 2015). Then some authors, by taking inspiration from those pioneers, have highlighted that a silo perspective, when looking at green, lean and global value chains, impedes the scope needed to gain a holistic perspective over the topic, missing a strategic perspective (Mollenkopf et al., 2010).

Yet, in order to improve the sustainability of the industrial sector, the interest of academia should equally be devoted to non-global value chains, in most cases characterised by local Small- and Medium-sized Enterprises (SMEs), since they may yield to additional insights (Morali and Searcy, 2013), and have been scarcely investigated (Aboelmaged and Hasmem, 2019), with a few recent exceptions such as, e.g., UK manufacturing SMEs (Kumar et al., 2018). In fact, so far, no empirical studies have been conducted in this area in Italy, which represents the second-largest manufacturing European economy. Therefore, enhanced knowledge in this area could be beneficial also for industrial decision-makers and policy-makers aiming at fostering the transformation towards increased sustainability in the SC.

The remainder of the paper is structured as follows: Section 2 will present and discuss the research framework and hypotheses, based on Scopus-indexed journal papers and on well-acknowledged sources, so as to ensure the quality (and the validity) of the research; Section 3 will detail the research methodology, whilst in Section 4 we present and discuss the findings of our empirical research. We conclude the manuscript with important remarks for academia, industry and policy-makers, as well as study limitations and further research in Section 5.

2 Research framework and hypotheses

2.1 Research framework

Operations and supply chain management scholars and policy-makers have shown an increased interest so far in GSCM for the manufacturing industry (Fahimnia et al., 2015). As shown by recent reviews (Reddy Maditati et al., 2018), there is a consistent growth of contributions in the evaluation of GSCM practices and performance (Tseng et al., 2019), with a great focus on SMEs in developing economies (Mafini and Loury-Okoumba, 2018).

Several papers deal with the identification of drivers and pressures (e.g., Chien and Shih, 2007; Holt and Ghobadian, 2009), which promote the implementation of GSCM, with particular attention on their level of importance among different sectors (e.g., Dubey et al., 2015; Zhu et al., 2007a). Recent work has been undertaken to propose a systematic approach of a structural framework for drivers to GSCM, in the field chemical industry in Bangladesh (Shohan et al., 2019). Authors have used several methods (e.g., DEMATEL) to find the influential factors in selecting GSCM practices (Mumtaz et al., 2018).

Literature has also widely discussed barriers to the adoption of GSCM practices (e.g., Drohomeretski et al., 2014). In this regard, recent studies have investigated critical barriers in GSCM with a number of approaches: among the others, Pareto analysis (Kaur et al., 2019) as well as DEMATEL (Kaur et al., 2018), but also recently in Asia using interpretative structural modelling (Saeed et al., 2018; Majumdar and Sinha, 2019). Further, scholars developed a detailed qualitative model to analyse practices in the context of GSCM (Sellitto et al., 2019).

Moreover, several studies identified the most implemented GSCM practices (e.g., Holt and Ghobadian, 2009) and the degree of improvement of firm performance, associated with a specific practice implementation, from an economic (e.g., Laosirihongthong et al., 2013; De Giovanni and Vinzi, 2012; Lee, 2008), environmental (e.g., Zhu and Sarkis, 2004; Zhu and Sarkis, 2007) and operational (e.g., Kim et al., 2011; Lee et al., 2012; Zhu et al., 2013; Yu et al., 2014) viewpoint. Recently, research in Vietnamese construction materials manufacturing enterprises has found a positive relationship between green distribution and environmental management, also indicating that applying GSCM practices would improve enterprise's sustainable performance (Le, 2020).

In previous GSCM literature, the words "driver" and "pressure" have been largely found (Sarkis et al., 2011). While "driver" is typically used when referring to internal actions that lead the company to adopt a particular green practice, "pressure" is used, instead, when referring to an external factor that imposes to the company to implement green practices, independently on the willingness of the firm (e.g., Zhu and Sarkis, 2004). Hence, drivers seem to be more related to a proactive implementation of GSCM, whilst pressures refer to a reactive one. Since the paper aims at understanding which factors lead the implementation of GSCM practices

and the related impact on performance, rather than the distinction between proactive and reactive behaviour, in this article, by “driver” we refer in general to a factor leading to adopt a particular GSCM practice.

Investigation of drivers for the adoption of green practices arises from a number of external and internal groups or “stakeholders” (Zhu et al., 2005), such as regulatory entities (Giunipero et al., 2012), competitors, internal factors, supply chain members (customers and suppliers) (Santos et al., 2019), community groups, product and internal process, as well as from organizational culture which let firms behave in an environmentally right way (Hsu et al. 2013). Fostering the implementation of a specific green practice is a way for a company to respond to the aforementioned drivers, achieving certain objectives and performance (Walker et al., 2008). As Green et al. (2012) note, firms are adopting GSCM practices in response to stakeholder demands for environmentally sustainable products and processes.

Literature has mainly categorised GSCM practices into internal (Internal Environmental Management – IEM; Eco Design - ECO) and external ones (Cooperation with Customers - CC; Green Purchasing – GP; Investment Recovery - IR). Internal practices occur within the firm, while external practices are related to interaction with supply chain partners (De Giovanni and Vinzi, 2012; Zhu et al., 2013). In particular, internal GSCM practices reflect a firm’s decisions to act in an environmentally friendly way, while external GSCM practices typically require some level of cooperation with other stakeholders. In these terms, literature has also distinguished external GSCM practices on the basis of two different approaches, which a certain firm can utilize when interacting with a certain partner: collaborative and monitoring approaches (Green et al., 2012; Tachizawa et al., 2015; Laari et al., 2016).

Recently, authors have examined whether internal and external GSCM practices have the same (or different) kinds of pressures (Saeed et al., 2018), and widely discussed about the relationships between practices and pressures (Singh et al., 2019), also quite recently in developing countries (e.g., Zhang et al., 2020). Finally, authors have started to explore, through cluster analysis, a different grouping of practices (according to collaboration, innovation, operation and mitigation), but the literature in this regard is far from being mature (Sellitto et al., 2019).

Furthermore, greening the SC has emerged as a valuable effective possibility for organizations to enhance economic, operational and environmental performance (that is still the most used taxonomy for GSCM performance, stemming from Rao and Holt, 2005; Zhu et al., 2007a). Specifically, environmental performance relates to the ability of manufacturing firms to reduce air emissions, effluent waste, and solid wastes and the ability to decrease consumption of hazardous and toxic materials. Economic performance relates to the manufacturing firm’s ability to reduce costs associated with purchased materials, energy consumption, waste treatment, waste discharge, and fines for environmental accidents and to

the additional cost due to the greater initial investment for environmental management initiatives, cost of environmental certifications (e.g., ISO 14001), higher cost of buying environment-friendly materials, components, and products (Choi et al., 2017). Finally, operational performance relates to the manufacturing firm's capabilities to more efficiently produce and deliver products to customers. Interestingly, authors have recently tried to provide a holistic conceptual framework for the assessment of GSCM performance, integrating the aforementioned categories with organizational and marketing performance (Kazancoglu et al., 2018) but such attempt represents a preliminary work that does not clearly encompass a viable road map for effective implementation and investigation in empirical studies.

Literature providing evidence as to which GSCM practices have influence over supply chain performance is flourishing (e.g., Azevedo et al., 2011; Al-Sheyadi et al., 2019; Zhu and Sarkis, 2004), gaining popularity with a sharp growth after 2010 (Tseng et al., 2019).

Aware of the existence of several classifications, with different viewpoints, strengths and weaknesses (e.g., Rahman et al., 2014; Geng et al., 2017; Younis et al., 2016; Vanalle et al., 2017), in our study we have adopted the well-structured decoupled (drivers-practices, then practices-performance) research framework (Figure 1) stemming from Zhu et al., 2007a, on the basis of which several authors built their researches and related considerations; this framework is still the most mentioned in the literature, thus enabling us to compare our findings with previous contributions.

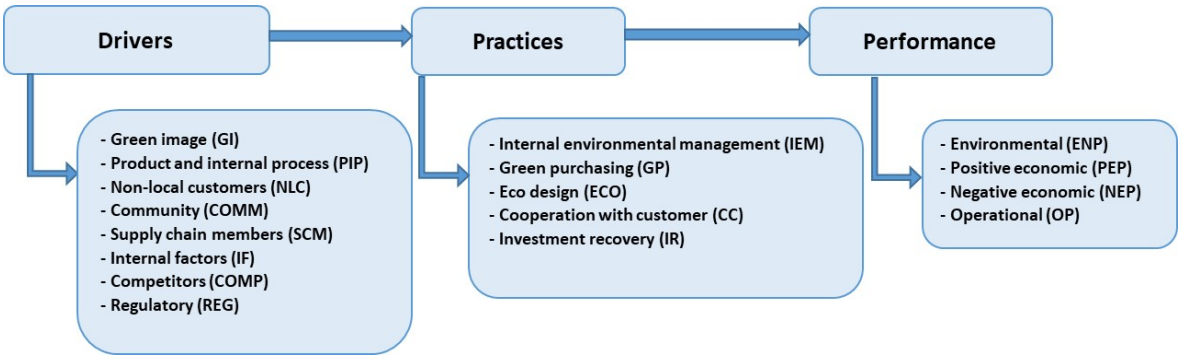

Figure 1. Research framework.

A vast number of papers have been published on this topic (a review was already available in 2011, Sarkis et al., and further papers have been published since then), yet these papers highlight the relevance of different drivers on different practices, then different performance, originating an inconsistent body of knowledge. In fact, in this area, several papers have explored the influence of green practices on supply chain performance in different contexts and by adopting different research methods (such as case study approach in the Portuguese automotive supply chain – Azevedo et al., 2011 –, interpretative structural modelling in

manufacturing firms in India – Diabat and Govindan, 2011 –, exploratory studies in Chinese SMEs – Kumar et al., 2019 –), creating – de facto – a portfolio of context-dependent results.
One way-out might be the inclusion of mediating and moderating factors in the framework (the well-structured decoupled research framework based on Zhu et al., 2007a), so as to extend its validity and its related results. As a matter of fact, a few very recent studies have discussed the mediating effect of some factors in explaining the relationships between GSCM practices and performance (e.g., Abu Seman et al., 2019; Jermsittiparsert et al. 2019a).
Still, there is very little and scattered literature dealing with a number of likely moderators potentially playing significant and meaningful roles on the relationships drivers-practices, then practices-performance. This paper is intended to contribute to filling this gap.
The set of moderators included in the investigation has been crafted taking into consideration the fact that when defining what a driver vs. a moderator is, literature has not shown for every concept exclusive directions. As per the purpose of this study, the role of several moderators is to be investigated, then taking them from a broad set of previous studies. As an example, both “ISO 14001” and “Institutional requirements” (detailed in the following) have been often considered drivers; yet, to mention a few, in the milestone paper by Zhu and Sarkis (2007) “market, regulatory, and competitive institutional pressures” were used as moderators to “examine the relationships between GSCM practice, environmental and economic performance”. Among these, Zhu and Sarkis specifically mention “regulatory pressures as a moderator” referring also to ISO 14001 certification. Again, in Dubey et al. (2015), as also noted by Kazancoglu et al. (2018) the authors adopt institutional pressure as a moderator variable when they “examine the effects of supplier relationships management and total quality management on environmental performance under the impact of leadership and institutional pressures” (Kazancoglu et al., 2018). Additionally, as recently noted by Fang and Zhang (2018) also referring to previous literature, “substantive moderators on the practice-performance relationship include industry type, ISO certification and export orientation”. Similarly, Foo et al. (2019) consider “institutional pressures” as a moderator variable, when analysing “the relationship between green-purchasing capabilities and practices”.
The final set of likely moderators included in the research is reported and detailed in the following.

2.1.1 Drivers and Practices relationship

The literature has identified a number of potential groups of drivers influencing organizational adoption of internal or external GSCM and other environmental management practices (Zhu et al., 2005). Research, in terms of which drivers specifically allow the implementation of a

certain practice, does not seem to converge toward a unique direction. However, empirical evidence shows that, generally, drivers lead firms to the implementation of green practices, moving these enterprises toward sustainability. The difficulty of finding a unique result is likely due to several factors influencing the relationship between drivers and practices. Generally, researchers seem to agree upon the fact that regulatory entities (e.g., Luthra et al., 2016), internal factors within the firms (e.g., Chan et al., 2012) and supply chain members (e.g., Caniels et al., 2013) are the most effective drivers leading to the implementation of various GSCM practices. According to Testa and Iraldo (2010), the "reputation-strategy", i.e. the strategy to develop a green image of a firm, is the most important driver leading to a higher implementation of GSCM practices. Hsu et al. (2013) have rather identified competitor pressure as the most important driver for all the practices' implementation, followed by customer pressure. More recently, results from an international study across several companies indicate that both cost drivers and customer drivers significantly affect the adoption of either internal and external GSCM practices, with effect on environmental performance (Wang et al., 2018). Nevertheless, as aforementioned, scholars have not drawn a convergent conclusion.

2.1.2 Practice and performance relationship

The academic debate has made its first steps toward understanding which are the most effective GSCM practices able to bring the greatest benefits in terms of increased firm performance. In this regard, recent studies have contributed to the comprehension of the influence of such practices on the firm. Generally, several authors in different contexts (Chien and Shih, 2007; Younis et al., 2016; Liu and Chang, 2017) argue that the implementation of GSCM practices improve both economic and environmental performance, giving strong support to the claim that a "win-win" situation (i.e. both improvements of economic and environmental performance) is achievable by the implementation of GSCM practices, even during the last economic crisis (Pais Seles et al., 2019). Interestingly, research has empirically investigated the impact of sustainable supply chain management practices on supply chain dynamic capabilities and enterprise performance, finding a significant positive relationship and effect among them (Hong et al., 2018).

Despite the high initial investments for GSCM practices adoption, the benefits, such as saving energy, reducing waste and increasing operational efficiency and customer image, can outweigh the costs (Chu et al., 2017). Instead, according to Lee et al. (2012), no interaction between GSCM implementation and business performance has been found, supporting other authors, according to whom no "win-win" situation is achievable in the manufacturing industry.

Again, in literature, a consensus over the most effective practices to bring performance improvements cannot be found.

2.2 Moderating effect

Researchers have highlighted several factors that may influence the relationships between drivers and practices (Schrettle et al., 2014) and practices and performance (Miroshnyenko et al., 2017; Rahman et al., 2014; Zhu and Sarkis, 2007; Zhu and Sarkis, 2004). In some cases, the concept of moderator has not been specifically mentioned: authors have shown that the adoption of practices (for sustainable supply chain management) may vary according to its coherence with the local institutional environment (Acosta et al., 2015), therefore inferring the effect of this as moderator (as detailed in the following).

Hajikhani et al. (2012) suggest the possibility of investigating such factors as moderators. Geng et al. (2017) pointed out that, in empirical studies, moderating variables are often taken from control variables. Chan et al. (2012) illustrate the possibility of investigating some contextual factors as moderators. Benito and Benito (2006) provide a list of variables that seem to influence the decision to implement environmental practices. Similarly, de Sousa Jabbour et al. (2013) offered empirical evidence over a series of factors affecting the adoption of GSCM practices in Brazil, including company size, previous experience with an environmental management system. Recently, Fang and Zhang (2018) have reviewed the performance of GSCM, also looking at the test of some moderators (among which, industry type and ISO certification).

Taking inspiration from previous literature contributions, this research proposes a list of possible moderators and their effect on the previously described relationships (as shown in Figure 2). The aim of this research is to focus on the confirmation of moderation effects of some factors, which have already been proposed in the literature, or to give stronger confirmation in a different context (Italian/European) of previous evidence. This is the reason why some moderators are considered as affecting only one relationship, while others both of them.

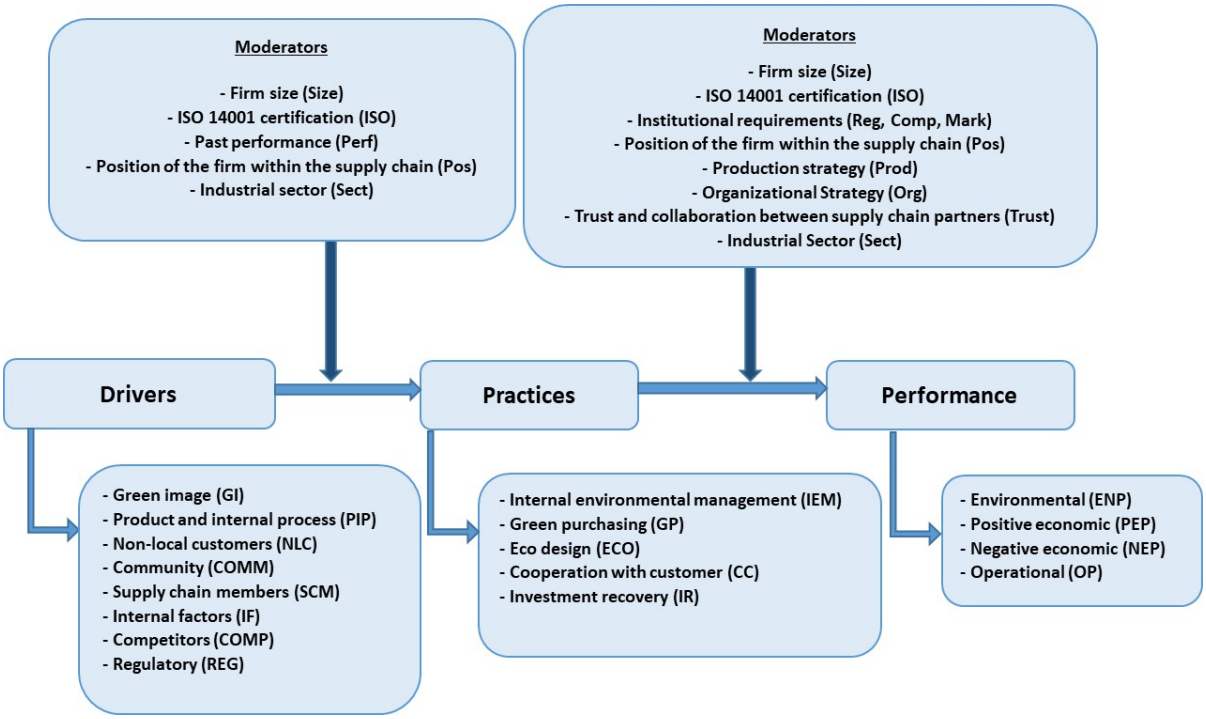

Figure 2. Research framework containing moderators.

2.2.1 Size of the firm

Firm size was considered by previous studies either as a control variable (Younis et al., 2016; Zhu and Sarkis, 2004; Zhu et al., 2008a; Lee, 2008, Khor et al., 2016, Tan et al., 2016), contextual factor (Choi et al., 2017) or an exogenous variable (Testa and Iraldo, 2010). Holt and Ghobadian (2009) propose studying firm size as a moderator without testing it in their research. Zhu and Sarkis (2007) suggest that firm size may affect most relationships between GSCM practice and performance. Min and Galle (2001) confirm the importance of size in the adoption of environmental practices in the purchasing function. Schrettle et al. (2014) indicate that the drivers-practices relationship may be also moderated by firm size. Starting new strategic initiatives is resource-intensive, not only financially, but also from a human resources point of view (Lee et al., 2012), so that again referring to firm size. Apart from a different level of resource capability between smaller and larger firms, historically, SMEs have not been subject to regulatory oversight and community/NGOs pressure (Benito and Benito, 2006) to the same extent as the latter. Stemming from these considerations, we can formulate the following hypotheses to be tested:

- H1.1 “Firm size” moderates the relationship between drivers and practices;
- H1.2 “Firm size” moderates the relationship between practices and performance.

In this study, EU recommendation 2003/361 was followed for the classification of the firms based on their size. Accordingly, we have considered “Firm size” as a multi-categorical moderator made of four levels: (i) micro-sized firm (n. of employees < 10), (ii) small-sized firm

(10 =< n. of employees < 50), (iii) medium-sized firm (50 =< n. of employees < 250), (iii) large firm (number of employees > 250).

2.2.2 ISO 14001

Wu et al. (2012) propose that future research should consider environmental certifications as a control variable in the analysis of the relationships between GSCM drivers and GSCM practices. In Younis et al. (2016), environmental management system (EMS) certification has been used as a control variable, with the authors underlining the need for further investigation on the impact of EMS certifications, such as ISO 14001, on different firms' performance dimensions. Geng et al. (2017) recently discussed an open research opportunity: "is ISO 140001 a moderator between practices and performance?" The authors state that in Asian Emerging Economies (AEE) manufacturing firms are able to benefit from the GSCM practices even without adopting ISO certification. Recently, Rasit et al. (2019) have preliminarily explored the extent of GSCM practices through the possession of ISO 14001 in Malaysian SMEs, but too little has been said in this regard.

According to these considerations, it follows that:

- H2.1 "ISO 14001" moderates the relationship between drivers and practices;
- H2.2 "ISO 14001" moderates the relationship between practices and performance.

In this research, we have considered ISO 14001 as a dichotomous moderator, with "Yes ISO 14001 certification" or "No ISO 14001 certification" as the two possible values.

2.2.3 Past performance

According to Schrettle et al. (2014), strategic decision-making has a powerful impact on the future of a firm and is characterized by a high level of complexity. The way decisions are usually made is by looking deeply at the past performance of the organization. When a firm achieves optimal outcomes, it tends to stick with its past business model because managers believe strongly in the correctness of the current strategy. This is the primary cause of the tendency of certain firms to persist with their obsolete business model, despite environmental changes over the recent years. When poor past performance is achieved, firms tend to re-evaluate their current strategy and move toward innovative business models. Being GSCM a relatively new and innovative topic, past performance may influence the business decision of the top management to move toward sustainability within the supply chain. Accordingly, the past performance of a firm can be investigated as a moderator between drivers and practices (Schrettle et al., 2014). We can state, according to the literature, that:

- H3.1 "Past performance" moderates the relationship between drivers and practices.

In this study, “Past performance” is considered a dichotomous moderator, which considers the perception of the company/supply chain performance and its trend in the last 3 years. The two categories of the moderator assigned are low performance and high performance.

2.2.4 Institutional requirements

Institutional requirements (typically named “institutional pressures” in literature; in this article, we refer to it as “institutional requirements” so as to keep it a neutral item) are based on the Institutional Theory, which asserts that environmental alignment by a firm may be influenced by three different kinds of requirement: normative, coercive and mimetic (Zhu et al., 2010 refer to them specifically dealing with GSCM). Stakeholders with decisional power, such as government and environmental regulations, exert coercive requirements. Normative requirements, instead, are brought by external stakeholders who have a direct or indirect interest in the organization (e.g., customers and consumers). Finally, mimetic requirements occur when an organization imitates the actions of successful competitors in the industry (Zhu et al., 2013; Zhu et al., 2010). In the literature, there is evidence of institutional requirements studied as moderators (Wu et al., 2012; Chan et al., 2012; Zhu and Sarkis, 2007). For this reason, we can state that:

- H4.1 “Institutional requirements” moderate the relationship between practices and performance.

In this research, in order to assess the entity of moderation, we have carefully followed the classification previously described, leading to several continuous moderators. Coercive requirements by Governments are measured through “regulatory institutional requirement”, which includes both national and local environmental regulations and national and local resource-saving and conservation laws. Mimetic requirements by competitors are measured through “Competitive intensity institutional requirement”, which includes the level of replaceability of the firm in the supply chain, the level of eco-friendliness of the supply chain with respect to the competitors and the level of normative environmental impact with respect to the competitors. Lastly, normative requirements by customers and consumers are measured through “Marketing institutional requirement” that includes exports, sales to foreign customers and environmental regulations of exporting countries.

2.2.5 Position of the firm within the supply chain

In literature, there is evidence that the position of the firm within the supply chain may be considered as a moderator, especially in the traditional supply chain management (Cook et al., 2011, Leem and Rogers, 2017). According to Cook et al. (2011), different positions in the supply chain do not look at practices in the same way and, accordingly, the relationship

between practices and performance may change. Similarly, Leem and Rogers (2017) point out that a different position inside the supply chain moderates the relationship between the social capital construct and firm performance. The difference between being an OEM or a supplier has been considered also by Thun and Muller (2010). OEMs are, usually, firms acting in an international arena, whilst many of their suppliers are domestic companies. We propose, along with similar considerations made in the field of traditional supply chain management, that the position of the firm within the supply chain may moderate the relationship between GSCM practices and firms' performance. In addition, this research explores the possibility, taking inspiration by the consideration of Thun and Muller (2010), that the "position of the firm within the supply chain" moderates also the relationship between drivers and practices. Therefore, the following hypotheses are formulated:

- H5.1 "Position of the Firm within the supply chain" moderates the relationship between drivers and practices;
- H5.2 "Position of the Firm within the supply chain" moderates the relationship between practices and performance.

In this study, "Position of the firm" has been studied as a multi-categorical moderator, with three possible values: "First-tier supplier", "Second-tier supplier" and "Original equipment manufacturer".

2.2.6 Production strategy

Zhu and Sarkis (2004) suggest exploring the possibility that different production strategies act as moderators between GSCM practices and performance. Dallasega et al. (2015) have explored this issue for the construction sector, but, to the best of our knowledge, no one has so far explored this possibility in the manufacturing industry. In doing so, the classification of Wortmann (1983) may help distinguish between several cases. The ETO (Engineer-To-Order) industry requires that every product is almost unique based on specific customer needs. The results of such supply chains are long lead times, inefficient material handling and high and uncontrolled levels of WIP (Work-In-Progress), which can cause problems in the sustainability of the supply chain. The MTS (Make-To-Stock) industry is completely different: MTS production strategy requires that every product is produced on forecasted demand, the product is thus highly standardized and produced in large volumes. For this reason, lower lead times, much-controlled level of WIP and material handling are achieved by these firms. Therefore, stemming from the literature, the following hypothesis may be expressed:

- H6.1 "Production strategy" moderates the relationship between practices and performance.

In this research, “Production strategy” has been studied as a multi-categorical moderator. There are four possible values of this moderator: “MTS” (Make-To-Stock), “MTO” (Make-To-Order), “ATO” (Assemble-To-Order) and “ETO” (Engineer-To-Order).

2.2.7 Organizational strategy

In Laosirihongthong et al. (2013), the organizational strategy is considered as a control variable, where the potential impacts of GSCM practices on the outcome variable (performance) may be influenced by organizational strategy. In particular, two types of organizational strategies are considered: (i) “Low-Cost” strategy, in which organizations may find difficulty in adopting GSCM practices with consequences on the outcomes achieved; (ii) “Quality & Time-based” strategy where, instead, the organization focuses more on quality and time. Zhu and Sarkis (2004) posit that the degree of performance improvements is, in part, dependent on two factors: Quality management (QM) and Just-in-Time (JIT) program adoptions in manufacturing organizations. QM and JIT are studied as moderating factors between GSCM practices and performance. More recently, Jermsittiparsert et al. (2019b) analysed the moderating role of Total Quality Management (TQM) practices in the electronic industry of Thailand. Hence, this study hypothesizes that:

- H7.1 “Organizational Strategy” moderates the relationship between practices and performance.

This study considers “Organizational strategy” as a multi-categorical moderator according to the level of Total Quality Management (TQM) present in the enterprises. Hence, there are three possible values of this moderator: “Low TQM”, “Medium TQM” and “High TQM”.

2.2.8 Trust, cooperation and information sharing

According to Abdullah et al. (2017), GSCM requires firms to cooperate with other organizations in order to establish commitment, long-term relationships and trust. Trust enables collaboration between supply chain partners and enhances their commitment and investments to implement GSCM practices (Agi and Nishant, 2017). Successful GSCM implementation depends on the tightness of the trust relationship and on how securely product and risk information are shared among the partners (Kim et al., 2011). When a longstanding relationship of trust is established, companies would like to share professional knowledge and collaborate more efficiently and more flexibly (Singh et al., 2016; Laosirihongthong et al., 2013). Good partner relationships between supply chain members may help the performance implications of the GSCM practices (Rahman et al., 2014). Hence, trust and cooperation between supply chain partners enhance the overall performance of a firm. Choi and Hwang (2015) suggest that firms with high levels of collaborative capability are likely to achieve better

performance from the implementation of GSCM programs. Therefore, according to the literature:

- H8.1 “Trust, cooperation and information sharing” moderate the relationship between practices and performance.

In this research, “Trust and Collaboration” is considered as a continuous moderator taking into account *(i)* the way of interaction between the firms in the whole supply chain, *(ii)* the level of information sharing between the firms in the whole supply chain and *(iii)* its trend in the last 3 years.

2.2.9 Manufacturing sector

In the literature, the need for investigation of GSCM among different sectors has been justified as a simple generalization of the results (Tachizawa et al., 2015; Younis et al., 2016; Yu et al., 2014; Lee et al., 2012): if the results are valid also in other sectors, authors can generalize the validity of their framework and their hypotheses. Actually, different sectors present different levels of pollution (Zhu et al., 2007a; Holt and Ghobadian, 2009; Benito and Benito, 2006), different levels of attention on green environment due to stricter law (Zhu et al., 2007a; Zhu and Sarkis, 2006), different development of specific GSCM practices (Zhu and Sarkis, 2006; Laosirihongthong et al., 2013) and different drivers that lead to implementation of GSCM (Zhu and Sarkis, 2006; Somsuk and Laosirihongthong, 2017). Moreover, the relationship between practices and performance seems to be dependent on the sector (Zhu et al., 2007a; Zhu and Sarkis, 2004): some are pioneers in GSCM implementation (Thun and Muller, 2010; Zhu et al., 2007a), while others are still laggards. Petrochemical companies were usually more environmentally sensitive than other sectors and thus made greater environmental disclosures. According to Benito and Benito (2006), the oil, chemical and paper industries are, e.g., among the sectors associated with the poorest environmental performance and the greatest environmental risk. Zhu and Sarkis (2007) and Zhu et al. (2008a) suggest investigating “industry type” as a control variable. In this research, “Manufacturing sector” has been proposed as moderator. Hence:

- H9.1 “Manufacturing sector” moderates the relationship between drivers and practices;
- H9.2 “Manufacturing sector” moderates the relationship between practices and performance.

“Manufacturing sector” is studied as a multi-categorical moderator made of 9 levels: (i) “Food and Beverage”; (ii) “Machinery-Automotive-Metals”; (iii) “Wood and Furniture”; (iv) “Textile”; (v) “Chemical”; (vi) “Electronics and Electrical”; (vii) “Rubber and Plastic”; (viii) “Petroleum”; (ix) “Paper”.

3 Methodology

3.1 Survey development

The data were collected through questionnaires sent to 3,053 Italian manufacturing companies belonging to a range of sectors, registered on the AIDA (Analisi Informatizzata Delle Aziende) database, managed by Bureau van Dijk Electronic Publishing, which combines high-quality information with innovative software for searching and manipulating data.

The research framework and the related questionnaire, inspired by the work of Zhu & Sarkis (2004) and fine-tuned following to later pertinent literature (particularly, Zhu et al., 2007), were shared with a panel of experts from industry (3 senior consultants), so as to check the content validity; the survey then underwent a pilot test (not included in the usable sample) as performed in Zhu et al. (2005).

More specifically, the content validity has been assured by both reviewing the existing literature (and basing the research on a well agreed, not yet challenged, framework such as the one in Zhu et al., 2007a) and using experts' opinions (the above-mentioned 3 senior consultants) on all the included constructs (as in Parast and Golmohammadi, 2019).

The final version of the questionnaire consists of 111 questions divided into four sections: (1) Business information of the companies and supply chains; (2) GSCM drivers; (3) GSCM practices; and (4) GSCM performance. The first section contains 34 questions addressing the general information of the firm and of its business. The other three sections regard GSCM pressures, GSCM practices and GSCM performance. The respondents had to answer using a 5-point Likert scale to measure: the level of GSCM pressure, the level of implementation of GSCM practices and the change in performance related to GSCM practices adoption.

As for the data gathering, an e-mail explaining the purpose of the study and the survey questionnaire was sent to all the sampled firms, in Italian. Then, the questionnaire was administered in two runs, thus obtaining 169 usable responses, for a response rate of 5.54%. The survey constructs' internal consistency has been validated by computing the Cronbach's alphas, whose values are above the limit of 0.70 established by Nunnally (1978).

3.2 Preliminary data analysis

According to Fairchild and MacKinnon (2009), assumptions of the moderation model include ordinary least square (OLS) regression assumptions. Therefore, in the dataset, there should be no significant outliers, high leverage points or highly influential points. In order to do that, Mahalanobis's distance (Rousseeuw and Van Zomeren, 1990), Cook's distance (Hair et al., 1998) and Leverage's distance (Belsley et al., 1980) have been checked. Furthermore, in moderation analysis, the data must not show multicollinearity, which occurs when there are two or more independent variables that are highly correlated with each other. A mean centring

of the independent variables (IVs) has been processed before the interaction term is calculated, according to Irwin and McClelland (2001), who stated that mean centring variables is helpful in multiple regression in order to reduce and/or eliminate multicollinearity.

3.3 Testing for moderation

In order to test for moderation effects, this study used the macro "PROCESS v3" (Hayes, 2017), given the simplicity in testing for moderation, especially for variables that are not continuous (Hayes and Montoya, 2017). The moderation analysis developed follows the guidelines provided by Hayes (2012). According to Fairchild and McQuillin (2010), power is often low in moderation analyses because of the small effect sizes that are typically observed. Reviews of substantive literature demonstrate that interaction effects in real data typically explain between 1% and 3% of the variance in the dependent variable. Thus, interactions explaining even 1% of the variance may be meaningful and they have been considered in this study. All the p-values, R^2 and ΔR^2, which come from the moderation analysis, are compared with the ones coming from similar works (Zhu and Sarkis, 2007; Choi and Hwang, 2015). For this reason, this study takes into consideration only models with:

- Overall model R^2 >.10 and p-values p<.10; and
- ΔR^2 due to interactions >.01 with p-values p<.10.

3.4 Descriptive statistics of the sample

Our sample is located in Italy, which represents the second European major manufacturing economy (Eurostat, 2018a). Additionally, companies are mainly located in the Lombardy region (Northern Italy), that has the fifth largest GDP among European regions (Eurostat, 2018b) and represents one-fifth of the National GDP. Moreover, "Lombardy's production system is still one of the most developed in Italy and Europe: at the end of 2012 there were 71.2 enterprises per 1000 inhabitants, one of the highest rates of entrepreneurship in Europe (43.8 enterprises per 1000 inhabitants), of which more than 99% were small and medium-sized enterprises." (Eurostat, 2018b).

Below, we report some major statistics (Figure 3) describing our sample according to the main sector, firm size, production strategy and position of the firm in the supply chain.

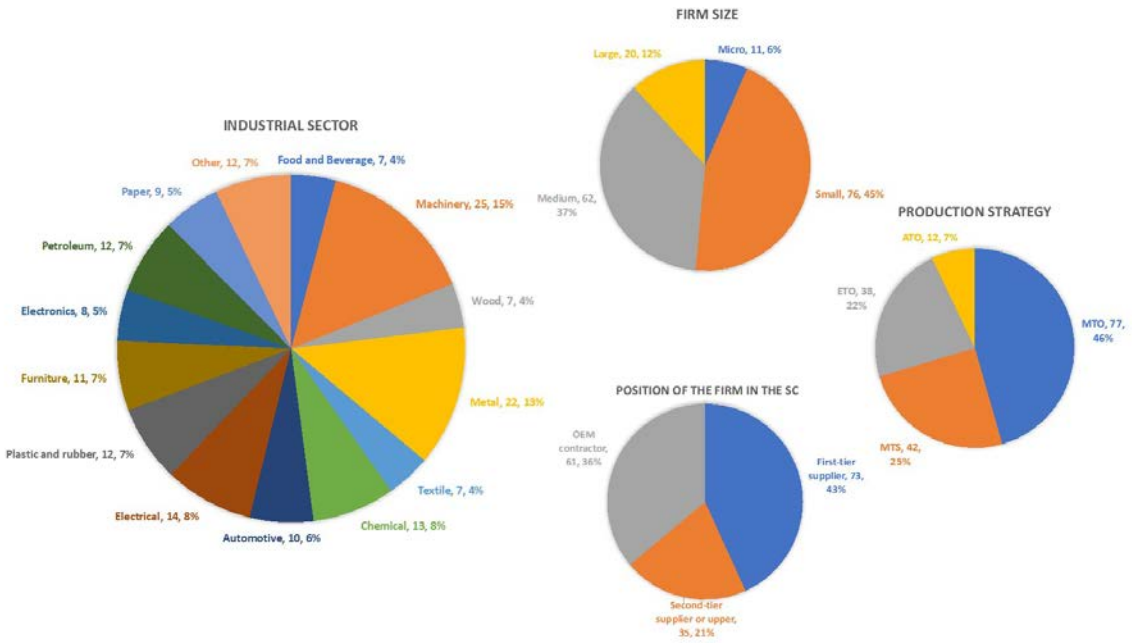

Figure 3. Descriptive statistics of the sample by sector, firm size, production strategy and position of the firm in the supply chain.

The sample is heterogeneous in terms of manufacturing sectors. Moreover, we can find companies belonging to sectors with traditionally greater environmental impact (e.g., chemical, petroleum products, plastics). Nevertheless, given that a specific figure on the environmental impact of the production for each company could not be collected, we have not considered this element as a moderating factor. Concerning the firm size, more than 80% of our sample is composed by SMEs, plus 6% are micro-enterprises. Given that the study exclusively focuses on the manufacturing industry (thus excluding the service sector), we accepted that the sample may not necessarily reflect the overall distribution of enterprises of the region. When it comes to the production strategy, the sample is composed of a consistent share of MTO companies (46%), but the presence of MTS ones is relevant as well (25%). Further, the remaining 29% is composed by either ETO (22%) or ATO (7%) companies. Finally, we had 73 companies (43%) being first-tier suppliers, about one-third of the companies considered as OEM contractors (36%), with a non-negligible share of second-tier suppliers (21%).

4 Results and discussion

4.1 Results

Tables 1 and 2 present the results of the interaction effects for the moderators. As shown in Table 1, “Firm size” moderates only the relationship between drivers-practices. Looking at

Table 2, the only significant moderation due to the firm's size, in the case of practices-performance, is present for IEM and positive economic performance. Thus, the hypothesis H1.1 is accepted, while H1.2 is rejected. Based on the findings shown in Table 1, hypothesis H2.1, according to which ISO 14001 moderates the relationship between drivers-practices, is confirmed. Instead, H2.1 is rejected: firms with ISO 14001 certification are able to benefit from positive economic performance (Table 2). "Past performance" strongly moderates the majority of the relationships between IEM and GSCM practices: for this reason, H3.1 is accepted. Regarding the institutional requirement moderator, all the three components "Regulatory", "Competitive intensity" and "Marketing" show high moderation effect on various relationships between practices and performance (Table 2), thus, H4.1 is accepted. "Position of the firm within the supply chain" strongly moderates the drivers-practices relationship, and, for this reason, H5.1 is accepted. Instead, no sign of moderation is detected for this moderator on the relationship practices-performance, leading to the rejection of H5.2 (Table 2). Rather, "Production strategy" moderates the relationship between practice and performance (Table 2), hence H6.1 is accepted. "Organizational strategy" moderates some of the GSCM practices and positive economic performance relationships and, for this reason, this result leads to the confirmation of H7.1 (Table 2). "Trust, Collaboration and Information sharing" moderates practices-performance relationship, confirming hypothesis H8.1 made previously. Finally, "Manufacturing sector", as shown in Tables 1 and 2, seems to moderate both the relationships drivers-practices and practices-performance, leading to the confirmation of both the hypotheses H9.1, and H9.2. Table 3 resumes all the moderation results found during this analysis and, therefore, the framework containing the moderators (Figure 4) can be settled, accordingly.

Table 1 - Moderation analysis of each driver/pressure on each specific practice for each moderator. The overall model R^2, F and p-value and the R^2-change due to the interaction, i.e. the amount of variance on the dependent variable due to the interaction, are reported.

<< Table 1>>

Table 2 - Moderation analysis of each practice on each specific performance for each moderator. The overall model R2, F and p-value and the R2-change due to the interaction, i.e. the amount of variance on the dependent variable due to the interaction, are reported.

<< Table 2 >>

Table 3 – Hypotheses and results summary.

<< Table 3 >>

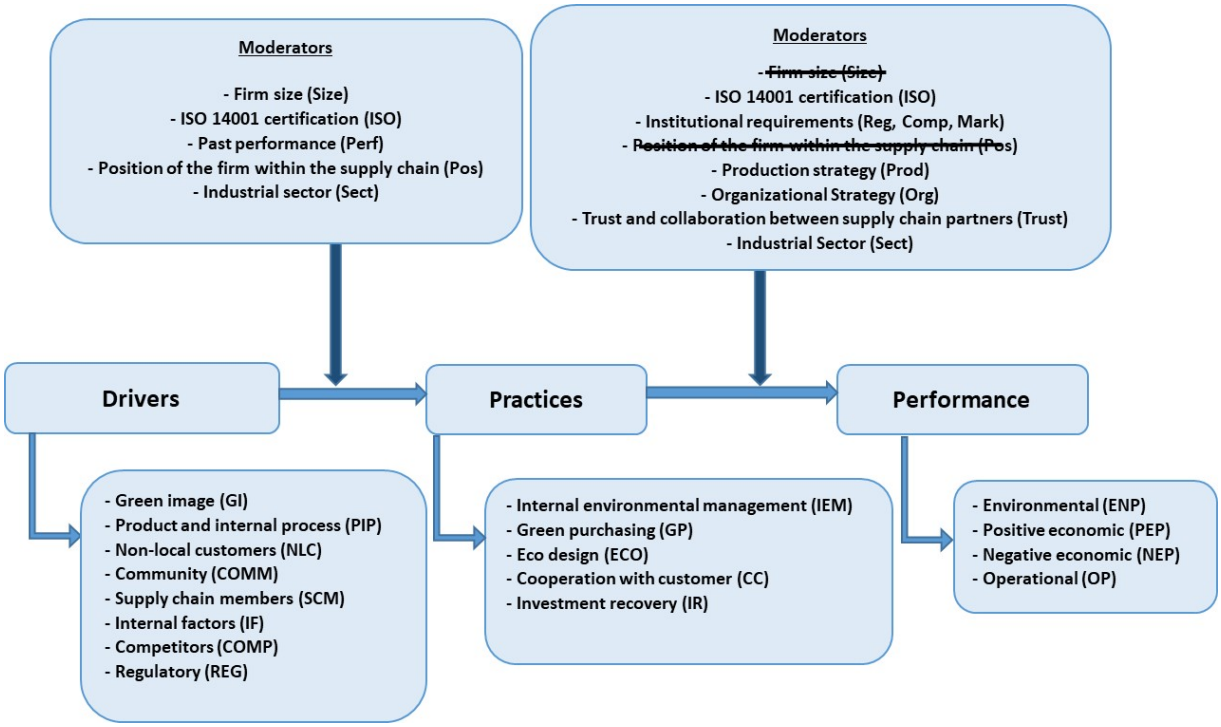

Figure 4. Final framework after moderation analysis.

4.2 Discussion of the moderating factors

4.2.1 Firm size

Firm size strongly affects the drivers-practices relationship (Figure 5). In particular, micro-sized companies present the greatest effect of the drivers on the implementation of GSCM practices, differently from the majority of the evidence in previous literature (Labonne, 2006) (Figure 5,a, b and c). Their growing awareness regarding environmental sustainability thanks to the governmental supports (Lee, 2008), their willingness to move toward environmental sustainability as an arm to be more competitive (Zhu et al., 2010; Hsu et al., 2013) and their fear to be fined due to regulatory violations (Schrettle et al., 2014) could all be possible justifications of this result. In contrast, larger firms show a mixed positive-negative effect of drivers/pressures on green practices implementation (Figure 5). While large-sized companies are pushed to improve their general environmental situation from their willingness to establish a stronger green image in the market, the effect of regulatory pressures (Figure 5,b) and competitors (Figure 5,c) on GSCM implementation shows a negative impact, differently from previous literature (Labonne, 2006). Such difference could be explained by the greater autonomy of larger enterprises in implementing GSCM and, in turn, being less influenced by competitors or regulatory entities (Zhu et al., 2010). Regarding the moderation effect of “Firm size” on the practices-performance relationship, only IEM and positive economic performance show a statistically significant result. In particular, the highest IEM implementation means the highest positive economic performance for all the categories (Figure 5,d). In previous

literature, internal environmental management has been associated with a decrement of economic outcomes of a firm, mainly due to the initial cost of the investment. Instead, the result of this study implicates that smaller and micro firms could obtain positive economic performance from IEM implementation, confirming other research in the Chinese packaging industry (Kumar et al., 2019). Being IEM a practice that plays a primary role in the GSCM implementation (Zhu et al., 2010), this result seems to show the importance of adopting green practices in order to achieve higher positive economic performance. Furthermore, the findings from our research, spanning over the wide spectrum of full size, seem to differ from other studies – focused on the 500 largest companies listed in the Financial Times – where the size of the companies positively moderate the relationship between environmental regulations and green innovation (Borsatto and Amui, 2019).

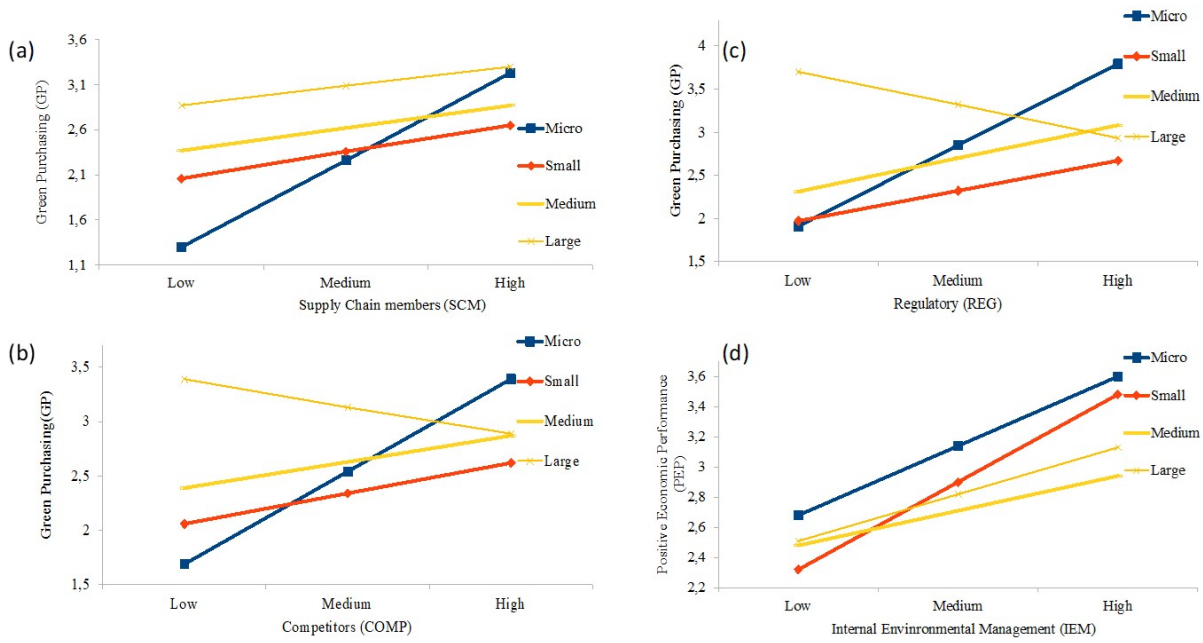

Figure 5. Effect of firm size moderation. Conditional effect (simple slopes analysis) of: (a) Supply chain members on Green Purchasing; (b) Regulatory on Green Purchasing; (c) Competitors on Green Purchasing; (d) Internal Environmental Management on Positive Economic Performance.

4.2.2 Presence of ISO 14001 certification

The presence of the ISO 14001 certification shows a positive effect on the drivers-practices relationship (Figure 6). In particular, all the drivers seem to have a stronger effect on the green purchasing practice implementation when ISO 14001 certification is present (e.g., Figure 6,a). This certification establishes the necessity of companies to constantly audit their suppliers (Vanalle et al., 2017), which probably explains this result. Furthermore, the practices-performance relationship is also influenced by this certification. The positive effect of

drivers/pressures on the other practices is well documented also in Rahman et al. (2014), according to whom the ISO 14001 certified companies were selected because they were expected to adopt green initiatives within their operations as part of the certification requirements. In previous literature, ISO 14001 or similar EMS certifications have been pointed out as obstacles to the implementation of GSCM mainly due to the cost of the certifications (Vanalle et al., 2017; Drohomeretski et al., 2014). The result achieved in this research, instead, underlines the positive effect of the adoption of green practices on the positive economic performance, suggesting a further possible positive income if they are implemented under the presence of ISO 14001 certification (e.g., Figure 6,b). In this regard, we can find confirmation in the recent findings of the study by Rasit et al. (2019) highlighting the importance of ISO 14001 certification as a crucial element to support the adoption of GSCM and deal with environmental issues. The results are also in contrast with Geng et al. (2017), according to whom manufacturing firms are able to benefit from the GSCM practices with or without adopting ISO certification, whilst they find confirmation in previous research by Azevedo et al. (2011) on Portuguese automotive supply chain. No statistically significant results have been found for other types of performance, differently from previous literature, especially in relation to environmental outcomes (Vanalle et al., 2017). The presence of low performance perceived by the enterprises increases the effect of Product and internal process, Regulatory, Competitors, Supply Chain members, and Green Image on IEM (e.g., Figure 6,c). This is in line with the evidence previously reported, where GSCM is mostly implemented in enterprises that do not achieve satisfactory results (Schrettle et al., 2014). As somehow expected, only the relationship between drivers and internal environmental management is moderated by “Past performance”: IEM is not only the most implemented practice (Holt and Ghobadian, 2009; Zhu et al., 2005; Zhu and Sarkis, 2006; Zhu et al., 2013), but it plays a primary role in the implementation of the GSCM in the whole supply chain. Indeed, without first addressing their own IEM practices, it is hard to extend environmental practices to suppliers and customers (Zhu et al., 2010). Furthermore, IEM seems to represent a prerequisite that allows firms to acquire knowledge, competence and expertise on environmental management and to become greener (De Giovanni and Vinzi, 2012).

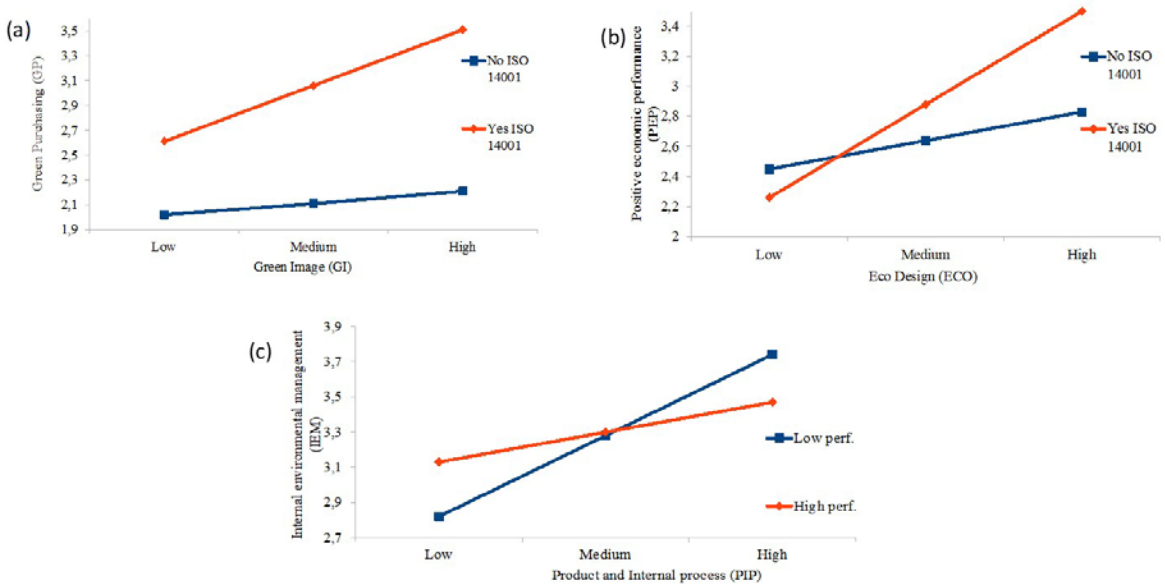

Figure 6. Effect of ISO 14001 moderation. Conditional effect (simple slopes analysis) of: (a) Green Image on Green Purchasing; (b) Eco-Design on Positive Economic Performance; (c) Product and Internal process on Internal Environmental Management.

4.2.3 Institutional requirements

Higher regulatory institutional requirement perceived by the enterprises increases the effect of IEM, ECO and CC practices on positive economic performance (Figure 7). These results are not aligned with previous findings by Zhu and Sarkis (2007) where, under higher regulatory pressure, companies budget additional financial resources for green initiatives that hurt economic performance. This study, instead, shows that positive economic performance is achieved at a higher level when regulations act more strongly on the enterprises (Figure 7,a), confirming research recently conducted in the fertilizing industry (Singh et al., 2019) and in the automotive industry (Zhang et al., 2020). A possible explanation could be that firms, when facing higher pressure from external regulations, may try to increasingly meet the requirements sought-after by the government, so to avoid facing fines and gaining positive economic outcomes (Lee et al., 2012). In this research, when high regulatory pressure can be found, companies respond with a higher implementation of certain green practices (CC, ECO) that lead to better environmental outcomes, which is in line with previous research (Zhu and Sarkis, 2007) and more recent studies where, with stronger environmental regulations, companies extend the set of implemented GSCM practices (Li et al., 2019). Under higher competitive intensity, we have a stronger effect of GSCM practices (IEM, GP, ECO) on positive economic performance and of IEM on operational performance. To the best of our knowledge, no one has previously found statistically significant results on the improvements of the operational performance under high competitive pressure (Figure 7,b). In a business with high

competition, firms tend to produce more efficiently and deliver products to customers improving their satisfaction. In contrast with Chan et al. (2012), no moderating effect by competitive intensity between customer cooperation and performance improvement is detected. Moreover, under high pressure from competitors, through implementing GP, IEM and ECO, companies seem to more likely achieve better economic performance (e.g., Figure 7,c). The existence of institutional market pressures influences organizations to achieve better environmental performance, especially when such pressures can cause the adoption of eco-design, collaboration with customers and investment recovery practices, as recently observed by other research (Ahmed et al., 2019) in Pakistan. A possible explanation of this result may be that, similarly to the Chinese manufacturing case (Zhu and Sarkis, 2007), Italian companies tend to achieve better environmental outcomes when pressed by foreign customers. Findings are also in line with a pioneering study of Zhu et al. (2007b) in a Chinese automobile engine manufacturer, with a direct positive relationship between increasing pressures and nascent GSCM practices.

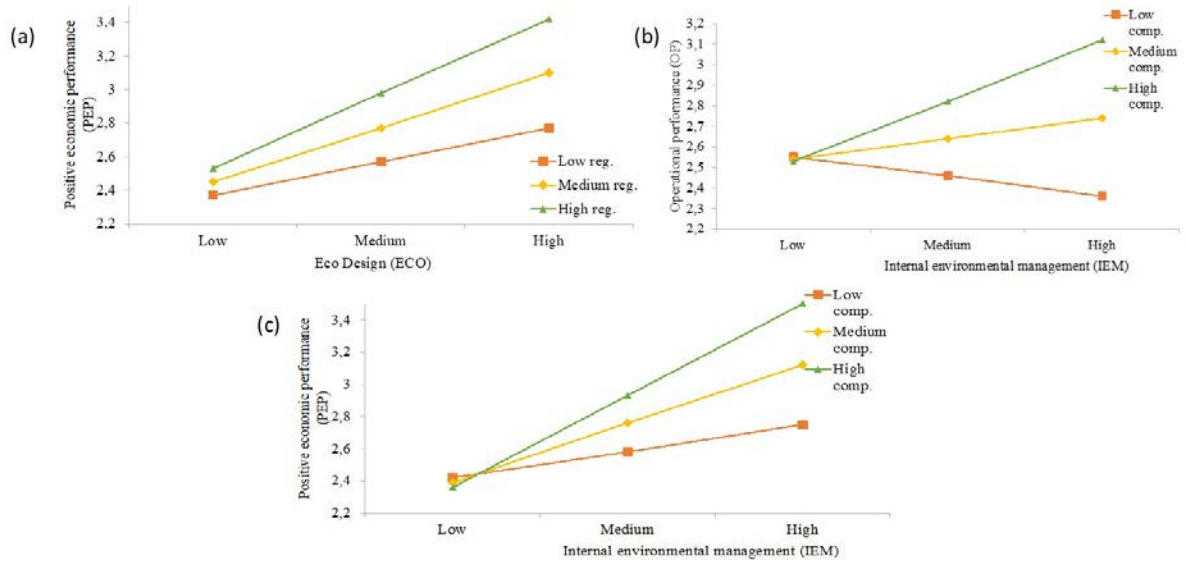

Figure 7. Effect of Institutional requirements moderation. Conditional effect (simple slopes analysis) of: (a) Eco-Design on Positive Economic Performance; (b) Internal Environmental Management on Operational performance; (c) Internal environmental management on Positive Economic Performance.

4.2.4 Position of the firm within the supply chain

According to the results coming from "Position of the firm within the supply chain" moderator (Figure 8), being an OEM implies a higher effect of the drivers on the practices (e.g., Figure 8,a). This result may be due to the higher level of pressure these enterprises are subject to with respect to 1st and 2nd-tier suppliers. In this perspective, Holt and Ghobadian (2009) argued

that “distance” to the end consumer may be an influential factor for GSCM implementation. The only exception is found in the effect of NLC on IEM (Figure 8,b), where being a 1st or 2nd supplier has a stronger effect than being an OEM. These results may be explained by the fact that, thanks to sales to foreign customers and export pressure, usually smaller firms (1st and 2nd suppliers) are influenced more to implement green initiatives, which starts with IEM implementation (Rahman et al., 2014). To some extent, our findings confirm the results of a previous investigation (Cook et al., 2011) where, according to the position in the SC, specific GSCM practices may be more extensively and deeply applied.

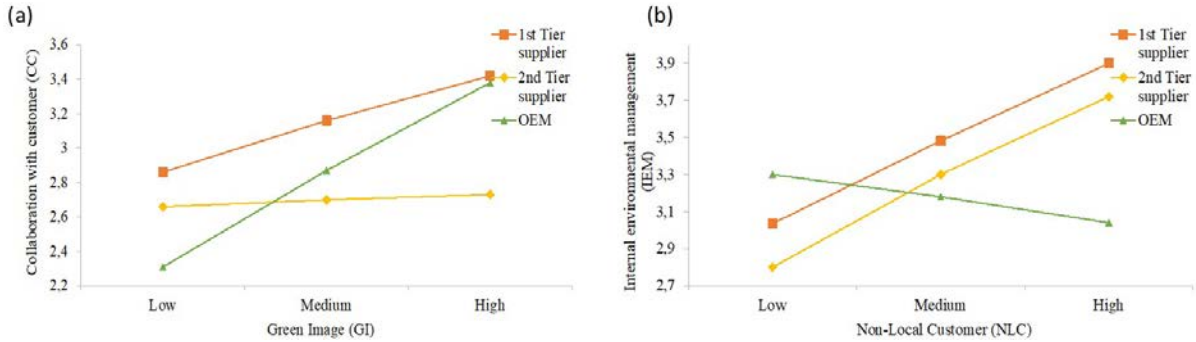

Figure 8. Effect of Position of the firm moderation. Conditional effect (simple slopes analysis) of: (a) Green Image on Collaboration with customers; (b) Non-Local customer on Internal environmental management.

4.2.5 Production strategy

Looking at the moderation results of “Production strategy”, in firms adopting the ETO production approach, the effect of GSCM practices (GP, ECO, CC) on Environmental Performance and of IEM, GP, ECO and CC on Positive economic performance is higher (Figure 9). Thus, this research stimulates managers of ETO companies to implement GSCM practices at a higher level (e.g., Figure 9,a). Besides this improvement of both economic and environmental performance, this study shows that under an ETO strategy, the effects of ECO and GP on negative economic outcomes are the highest within all the strategies (e.g., Figure 9,b). If green purchasing does not show any correlation with negative economic performance in literature, the impact of eco-design on the financial budget is well known. Eco-Design requires significant initial capital investments (Zhu and Sarkis, 2007) and methodologies demanding further development and improvement (Green et al., 2012b), but, at the same time, can result in cost reductions such as decreases in expenses for energy consumption (Zhu et al., 2013). Nevertheless, as this paper is one of the first exploratory studies specifically investigating the moderation role offered by the production strategy, further research is highly recommended.

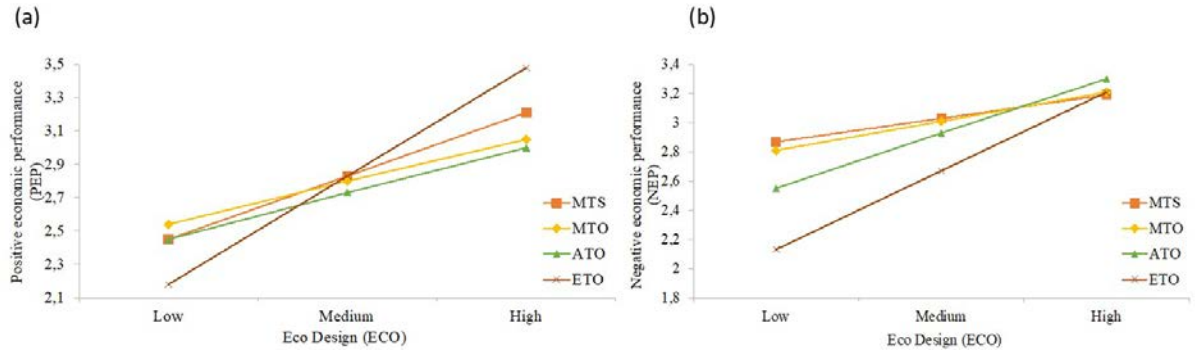

Figure 9. Effect of Production strategy moderation. Conditional effect (simple slopes analysis) of: (a) Eco-design on Positive economic performance; (b) Eco-design on Negative economic performance.

4.2.6 Organizational strategy

Organizational strategy seems to moderate only the relationship between some practices (IEM, GP and ECO) and Positive economic performance (e.g., Figure 10). The analysis shows a very strong effect of the high level of TQM on improving positive economic performance, which aligned to previous literature (Jermsittiparsesert et al., 2019b; Laosirihongthong et al., 2013; Zhu and Sarkis, 2004). "Trust, collaboration and information sharing" moderates only the relationship between some practices (GP and CC) and Environmental performance, as found by previous research (Rahman et al., 2014). The only exception comes from Choi and Hwang (2015), where no significant moderating effect of collaboration is detected for environmental performance. An important implication from this research is that managers and supply chain specialists can incentivize information sharing and level of trust with their partners in order to achieve better environmental outcomes.

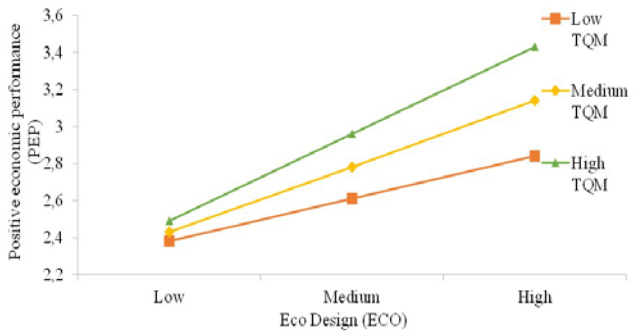

Figure 10. Effect of Organizational strategy moderation. Conditional effect (simple slopes analysis) of Eco-design on Positive economic performance.

4.2.7 Manufacturing sector

“Manufacturing sector” moderates both the relationships between drivers-practices and practices-performance. A specific manufacturing sector possesses its own characteristics and, for this reason, it is influenced in different ways by several drivers to implement, in its supply chain, certain green initiatives. Under high community pressure, textile enterprises show the greatest effect of the drivers on the practices’ implementation (Figure 11,a). As depicted in Wu et al., (2012), who consider Taiwan’s textile and apparel industry, communities strongly push this manufacturing sector to have a more corporate social responsibility (CSR) and to protect the environment from pollution. Under high regulatory pressure, the Petroleum sector undergoes higher GSCM implementation. Petrochemical firms are enterprises under the radar of regulatory entities due to their high level of pollution (Zhu et al., 2007a). This sector responds to the high pressure of regulations with the implementation of GP and ECO (Figure 11,b). Further, our findings look overall aligned with research conducted in French supply chains (Stekelorum et al., 2018), where the activity sector seems to affect the perception of internal barriers.

Similarly, the impact of GSCM practices on firm performance also differs according to the manufacturing sector considered. Regarding the environmental performance, “paper”, “petroleum” and “chemical” firms are the sectors that, through high GSCM implementation (Figure 11,c), achieve better environmental outcomes. Regarding economic performance, the “petrochemical” sector obtains better economic results thanks to green initiatives in its supply chain (Figure 11,d). Regarding operational performance, the results of this study confirm previous research on the strong and significant relationship between intra-organizational environmental management and operational performance. In particular, the effect of IEM on OP appears very strong in textile firms, and a negative effect is present, instead, in the food & beverage manufacturing sector (Figure 11,e).

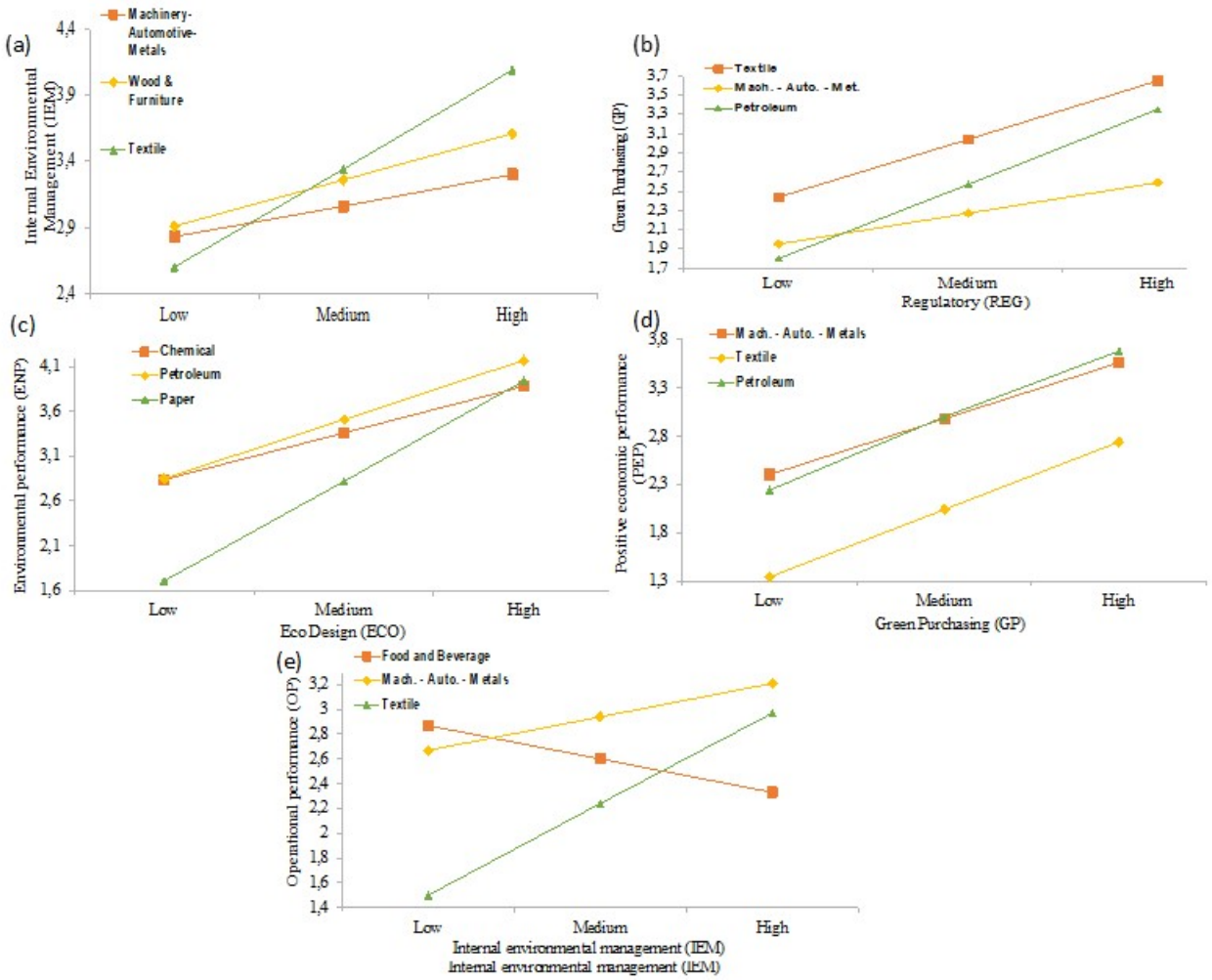

Figure 11. Effect of manufacturing sector moderation. Conditional effect (simple slopes analysis) of: (a) Community on Internal Environmental Management; (b) Regulatory on Green Purchasing; (c) Eco-design on environmental performance; (d) Green Purchasing on Positive Economic performance; (e) Internal environmental management on Operational performance.

5 Conclusions

Recently, the importance of GSCM has received considerable attention due to climate change issues, pollution and degradation of natural resources. Our research attempted to contribute to the discussion by investigating the role of several moderators in the relationships between GSCM drivers-practices and practices-performance within Italian manufacturing enterprises. Based on the elements emerged from this research, from a theoretical perspective, previous frameworks present in literature have been modified to account for the effect of several moderators affecting the aforementioned relationships. The main contribution of this work is the empirical exploration of the relationships between drivers-practices and practices-performance, which have shown mixed results in the literature or have just been formulated theoretically, by considering the effect of moderators in these relationships in a European

manufacturing context, which so far has been almost neglected, yet being very significant at a worldwide level.

In terms of results, the present research reveals that “Firm size”, “ISO 14001 certification”, “Past performance”, “Institutional requirement”, “Position of the firms within the supply chain”, “Production strategy”, “Organizational strategy”, “Trust, Collaboration and Information sharing between partners” and “Manufacturing sector” strongly influence the relationships between practices-performance and drivers-practices. As for the comparison against the extant literature, whilst in previous papers, internal environmental management was associated with a decrease in economic performance, our study has shown that smaller firms could achieve better economic performance from adopting internal environmental management. Moreover, an element of novelty of the present study is the improvement of the operational performance under higher competitive pressure, which resulted in statistically significant and quite original findings compared to previous research. Further, our findings interestingly note that practices such as information sharing and improved level of trust with partners may have a relevant role in improving environmental outcomes. Additionally, we note a strong and significant relationship between intra-organizational environmental management and operational performance.

In terms of impact, our findings may be particularly interesting for managers and supply chain specialists, as well as for policy makers, who could be inspired by the role of particular drivers on the implementation of GSCM practices, and by the level of performance achievable thanks to the adoption of a set of green practices. As for the academic impact, the issue has been tackled for the first time in an attempt of a comprehensive view, which paves the way to a number of research lines to further investigate both the confirmed and unconfirmed moderations, so as to understand the related rationales in the comprehensive view we proposed.

In terms of limitations to this study, since data were collected from a single country (Italy), results might differ in other contexts, particularly when it comes to the institutional (regulatory) setting. Further, this study is based on the perception of respondents. Despite self-reported survey data are commonly used in literature to measure performance (thus making this study consistent with previous literature) we have not collected real economic data nor indexes. Therefore, this perception could exceed or underestimate the real performance achieved by the firm.

In addition to the study limitations that naturally offer opportunities for further research, we want to conclude by sketching additional research directions. Firstly, we believe additional

insights may come from the application of a similar approach in other industrial contexts, simultaneously testing all the possible hypotheses of moderation between drivers, GSCM practices and performance (instead of decoupling drivers-practices and practices-performance, as in this paper and the extant literature), together with the analysis of the adoption of GSCM practices (with drivers and performance) in production contexts with different environmental impact of single companies and supply chains. Secondly, as indicated by very recent research, the effect of additional moderators could prove interesting such as, e.g., the role of social control and environmental dynamism (Zhang et al., 2019), or that of supplier involvement (Chen et al., 2019). More generally, future study could more deeply delve into exploring the collaboration with supply chain partners (Tseng et al., 2019), given that a link between the implementation of GSCM practices and performance would be misleading without considering the specific position of a company in the SC, as revealed by our study and previous research (Cook et al., 2011). Similarly, by involving and leveraging on additional stakeholders such as, e.g., local communities, the diffusion of more sustainable SCM practices could be fostered (Golini et al., 2017). Further insights could also come by further exploring the moderating role of SC traceability in the relationships between GSCM and environmental performance that, so far, have brought results contrary to the expectations (Cousins et al., 2019). Thirdly, concerning the set of performance, further research could expand the set of indicators of sustainability by including the impact of GSCM practices also on social performance ones, as well as further exploring the connection between quality, lean and green practices for sustainable performance (Henao et al., 2019; Yu et al., 2019; Farias et al, 2019). Fourthly, further research could explore the relationship between GSCM and SSCM practices with SC dynamic capabilities. In this area, preliminary studies indicated a significant positive effect of SSCM practices on SC dynamic and innovative capabilities, and in turn a positive contribution to the three sustainability dimensions (Hong et al., 2018; Adenbajo et al., 2018), but more empirical research would be needed.

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Table 1 - Moderation analysis of each drivers/pressures on each specific practice for each moderators. The overall model R^2, F and p-value and the R^2-change due to the interaction, i.e. the amount of variance on the dependent variable due to the interaction, are reported.

		IEM			**GP**			**ECO**			**CC**			**IR**		
		R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value
GI	Size	.232 .022	12.33 3.19	<.001 <.05	.184 .037	9.92 5.86	<.001 <.001	.194 .045	9.91 5.50	<.001 <.005						
	ISO				.353 .029	30.98 8.52	<.001 <.005				.172 .019	10.43 3.20	<.001 <.10			
	Perf	.201 .028	15.55 6.65	<.001 <.05												
	Pos				.155 .019	6.34 2.73	<.001 <.10				.141 .030	5.47 2.42	<.001 <.10			
	Sect	.311 .046	8.21 2.55	<.001 <.05	.259 .028	7.53 2.09	<.001 <.05				.218 .057	7.18 4.27	<.001 <.001			
PIP	Size															
	ISO				.374 .050	38.96 13.94	<.001 <.001									
	Perf	.149 .023	10.58 6.65	<.001 <.05												
	Pos										.185 .041	9.51 5.01	<.001 <.01			
	Sect	.232 .024	7.04 3.02	<.001 <.005							.279 .068	5.97 3.28	<.001 <.001			

NLC	Size															
	ISO				.338 .052	26.09 13.73	<.001 <.001									
	Perf															
	Pos	.116 .052	4.28 4.75	<.001 <.01												
	Sect	.184 .042	5.49 3.02	<.001 <.01												

		IEM			**GP**			**ECO**			**CC**			**IR**		
		R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value
COMM	Size															
	ISO				.356 .033	46.71 10.18	<.001 <.005	.128 .017	12.91 3.20	<.001 <.10						
	Perf															
	Pos															
	Sect	.138 .022	16.62 6.20	<.001 <.001	.250 .053	16.39 5.17	<.001 <.001	.161 .074	3.78 3.47	<.001 <.001	.152 .028	6.87 1.79	<.001 <.10			
	Size				.198	9.03	<.001							.117	3.92	<.001

					.031	5.86	<.05							.079	2.44	<.001
	ISO				.399	46.42	<.001				.225	14.58	<.001			
					.050	16.76	<.001				.022	3.77	<.10			
S	Perf	.139	8.01	<.001												
C		.024	4.27	<.05												
M	Pos										.197	9.68	<.001			
											.035	3.57	<.05			
	Sect	.257	5.57	<.001				.170	3.61	<.001						
		.056	2.50	<.05				.030	2.03	<.05						
	Size										.134	3.58	<.001			
											.058	2.67	<.05			
	ISO				.331	27.52	<.001									
					.050	16.76	<.001									
I	Perf															
F	Pos															
	Sect	.349	10.75	<.001	.224	4.68	<.001									
		.066	5.66	<.001	.039	3.12	<.005									

	IEM	**GP**	**ECO**	**CC**	**IR**

		R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value
COMP	Size				.197 .062	9.76 5.83	<.001 <.001	.182 .032	8.30 3.15	<.001 <.05						
	ISO				.354 .014	30.31 3.25	<.001 <.10									
	Perf	.111 .026	5.97 3.96	<.001 <.05												
	Pos															
	Sect															
REG	Size	.261 .058	21.73 12.94	<.001 <.001	.250 .057	11.44 4.85	<.001 <.005	.352 .075	19.08 8.26	<.001 <.001						
	ISO				.366 .024	40.55 7.30	<.001 <.01									
	Perf	.178 .011	14.91 3.96	<.001 <.10												
	Pos										.195 .020	9.69 2.50	<.001 <.10			
	Sect	.234 .041	5.20 3.15	<.001 <.005	.275 .063	7.06 2.06	<.001 <.05	.304 .062	5.94 4.45	<.001 <.001	.255 .080	6.47 3.77	<.001 <.001			

Table 2 - Moderation analysis of each practice on each specific performance for each moderator. The overall model R2, F and p-value and the R2-change due to the interaction, i.e. the amount of variance on the dependent variable due to the interaction, are reported.

			IEM			**GP**			**ECO**			**CC**			**IR**		
			R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value
ENP		Size															
		Iso															
		Pos															
		Sect							.341 .027	9.36 1.98	<.001 <.10						
EP	**PEP**	Size	.246 .027	8.70 2.18	<.001 <.10												
		Iso				.271 .031	33.08 9.78	<.001 <.005	.216 .040	17.30 9.11	<.001 <.005	.211 .022	17.03 4.16	<.001 <.005			
		Pos															
		Sect	.253 .022	4.26 2.01	<.001 <.05	.348 .037	8.70 2.07	<.001 <.05									

NEP	Size															
	Iso															
	Pos															
	Sect							.230 .056	4.06 2.85	<.001 <.005	.230 .065	4.06 3.38	<.001 <.005			
OP	Size															
	Iso															
	Pos															
	Sect	.161 .037	8.76 2.85	<.001 <.001												

		IEM			**GP**			**ECO**			**CC**			**IR**		
		R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value
ENP	Trust				.258 .012	21.92 3.32	<.001 <.10				.217 .012	14.74 3.00	<.001 <.10			
	Reg							.309 .010	30.17 4.54	<.001 <.05	.248 .015	21.75 4.02	<.001 <.05			

	Comp														
	Mark							.353 .011	42.24 3.31	<.001 <.10	.223 .019	20.21 6.04	<.001 <.05	.128 .034	9.49 7.36	<.001 <.01
EP	Trust														
PEP	Reg	.259 .015	20.88 4.57	<.001 <.05				.208 .021	18.01 7.75	<.001 <.01	.223 .020	19.22 6.49	<.001 <.05		
	Comp	.268 .047	26.21 12.72	<.001 <.001	.272 .014	26.24 4.78	<.001 <.05	.252 .026	19.08 5.89	<.001 <.05					
	Mark							.223 .014	18.30 3.10	<.001 <.10				.170 .053	14.38 14.19	<.001 <.001
NEP	Trust														
	Reg														
	Comp														
	Mark	.190 .015	10.07 3.47	<.001 <.10											
OP	Trust														
	Reg														

	Comp	.102 .045	8.93 9.24	<.001 <.005													
	Mark																

			IEM			GP			ECO			CC			IR		
			R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value	R^2 ΔR^2	F	p-value
ENP		Prod				.294 .037	13.64 3.98	<.001 <.01	.305 .039	14.55 4.21	<.001 <.01	.208 .029	7.68 2.55	<.001 <.10			
		Org.															
EP	**PEP**	Prod	.233 .021	7.43 2.15	<.001 <.10	.268 .025	10.94 2.61	<.001 <.10	.182 .028	6.92 2.16	<.001 <.10	.236 .065	13.45 8.50	<.001 <.001			
		Org.	.235 .027	17.20 9.76	<.001 <.005	.257 .013	23.08 4.69	<.001 <.05	.192 .016	13.23 3.64	<.001 <.10						
	NEP	Prod				.230 .025	9.73 2.15	<.001 <.10	.182 .031	7.59 2.19	<.001 <.10						
		Org.															
OP		Prod										.126 .073	6.90 8.73	<.001 <.001			
		Org.															

Table 3 – Hypotheses and results summary.

Moderator	Drivers-Practices	Practices-Performance
1. Firm size	H1.1 supp. (moderation)	H1.2 no supp. (no moderation)
2. ISO14001 certification	H2.1 supp. (moderation)	H2.2 supp. (moderation)
3. Past performance	H3.1 supp. (moderation)	-
4. Institutional requirements	-	H4.1 supp. (moderation)
5. Position of the firm within the supply chain	H5.1 supp. (moderation)	H5.2 no supp. (no moderation)
6. Production strategy	-	H6.1 supp. (moderation)
7. Organizational strategy	-	H7.1 supp. (moderation)
8. Trust, collaboration and information sharing	-	H8.1 supp. (moderation)
9. Industrial sector	H9.1 supp. (moderation)	H9.2 supp. (moderation)