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Abstract

Customer pressure has been widely discussed as the primary driver of green supply chain management (GSCM) practices. However, relatively little is known about supplier capabilities as a key mediator for GSCM practice adoption. Drawing from the resource dependence theory (RDT), we investigate how the interplay between customer pressure and supplier capabilities affects GSCM practice adoption along multi-tier supply chains. We test our hypotheses using multiple regression analysis based on a sample of 284 manufacturing firms operating at different tiers of a supply chain. Our results indicate that the supplier capabilities mediate the direct effect of customer pressure on the adoption of GSCM practices for focal firms. Specifically, we find a full mediation effect of supplier capabilities for higher-tier (i.e., OEM and system supplier) firms and a partial mediation effect for lower-tier (i.e., component and raw material) firms. Our findings provide support for the RDT perspective regarding GSCM. The focal firm's adoption of GSCM practices as a response to customer pressure is dependent on the level of green resources and capabilities available from their suppliers. The level of such resource dependence varies between focal firms at higher- and lower-tier positions in a multi-tier supply chain.

Keywords: *green supply chain management, green practices, customer pressure, supplier capabilities, sustainability, multi-tier supply chains*

1. Introduction

Executives are taking action to ensure environmental sustainability, as they are aware that the challenge of 'going green' will largely affect the way firms do business in the future (Lubin and Esty 2010). These actions include green manufacturing, green materials and design, green transportation and logistics, i.e., green supply chain management (GSCM). For example, Canon had achieved a 37.7% improvement in greenhouse gas emissions since 2008 by implementing green manufacturing and reverse logistics (Tsui 2019). Although such good corporate efforts have been made, GSCM adoption remains an issue along multi-tier supply chains with multiple corporate actors involved (Villena 2019; Mena and Schoenherr 2020). In 2019, Apple, Microsoft, Dell and others have faced criticism for the poor environmental, health and safety conditions at several of their lower-tier suppliers, which generate extra costs (e.g., auditing) and reduce stakeholder trust (Lo et al. 2018; Villena and Gioia 2018; Kim, Wagner, and Colicchia 2019; Toh 2019; Villena 2019).

In line with the raised attention, a large body of literature has highlighted the different drivers for the adoption of GSCM practices (Zhu and Sarkis 2004; Srivastava 2007; Lee et al. 2014; Dai, Cantor, and Montabon 2015). Customer pressure is considered one of the main drivers (e.g., Delmas and Montiel 2009; Laari et al. 2016). To provide substantial evidence of GSCM practices, all firms along the supply chain are being pressured by their direct customers (Auger et al. 2010; van Donk et al. 2010). In addition to customer pressure, the green capabilities of a focal firm's direct suppliers also play a pivotal role for a firm's engagement in GSCM practices (Lee and Klassen 2008; Tate, Dooley, and Ellram 2011; Tsui 2019; Green 2020). Similar to customer pressure, each focal firm is dealing with their direct suppliers and therefore the supplier capabilities affect GSCM practices at each stage of a multi-tier supply chain (Foerstl et al. 2015). In this study, for our purpose, we refer to focal firms as manufacturers operating at any of the four positions in Figure 1, who must work with both

suppliers and customers for GSCM (see Figure 1).

[Insert Figure 1 about here]

However, several studies indicate that GSCM practices throughout the supply chain slow down due to insufficient supplier resources or capabilities (e.g., Bové and Swartz 2016; Wang, Modi, and Schoenherr 2020). This is mainly because suppliers with limited resources are more incentivized to allocate their resources to making profits, rather than in complying with green demands by customers. In particular, suppliers from third-world countries lack the necessary capabilities in terms of human resources, monetary funds or operational slack to support the adoption of GSCM practices along the supply chain (Bové and Swartz 2016; Wilhelm et al. 2016b). Moreover, lower-tier suppliers might be inclined to exploit their distant, lower-exposure position to merely satisfy the bare legal minimum of green requirements (Siegel 2009). To our knowledge, very little is known about the effects of suppliers' green capabilities in conjunction with direct customers' pressure on focal firm's internal GSCM practice adoption in the supply chain.

Therefore, the purpose of this study to examine the relationships between customer pressure, supplier capabilities and the adoption of GSCM practices. In this study, we argue that the direct effect of customer pressure on GSCM is dependent on supplier capabilities as a key mediator. Given the inter-organizational nature of a supply chain, the focal firm receives a certain level of customer pressure and is, to some degree, dependent on the (green) supplier capabilities (Gualandris et al. 2015). This applies to retailers and OEMs, as well as first-tier, component and raw material suppliers (Wilhelm et al. 2016b). Based on this inherent interconnectedness and the dependence on (supplier) resources and capabilities in a multi-tier supply chain setting, this study draws from the resource dependency theory (RDT). Specifically, we argue that the focal firms' ability to fulfil the customer demand for GSCM practices is fully or partially dependent on the supplier capabilities. The use of these external capabilities is also

dependent on their own internal investments into GSCM resources and can be combined with the supplier capabilities in the process of GSCM capability accumulation as shown by case research (e.g. Foerstl et al. 2015).

Adopting GSCM is not only an issue for focal firms. Rather, it has become a joint concern for the entire supply chain, increasing the complexity of managing multi-tier supply chains (Tachizawa and Wong 2014; Wilhelm et al. 2016a; 2016b). Nevertheless, the literature suggests that the supplier resources and capabilities related to GSCM practices differ in supply chain tiers (Tachizawa and Wong 2014; Schmidt, Foerstl, and Schaltenbrand 2017). In addition, lower-tier suppliers without high-profile brand names and their products (e.g., raw materials or components) often go unnoticed by the end consumer and other stakeholders (Meinlschmidt, Schleper, and Foerstl 2018). In this study, given the reasons above, we argue that these lower-tier firms naturally react to green customer pressure differently than more upstream firms. Consequently, we explore the potential difference in terms of focal firm's GSCM adoption between higher-tier and lower-tier firms. We develop and test a set of hypotheses using multiple regression analysis on a sample of 284 focal manufacturing firms from German-speaking Europe that are operating at different tiers of a supply chain.

This study adds novel insights to the extant literature on GSCM while making managerial contributions. First, we uncover the mediating role of supplier capabilities in the relationship between customer pressure and the adoption of GSCM practices in multi-tier supply chains. Many prior studies have focused only on either one of the two driving factors (i.e., customer pressure or supplier capabilities) for GSCM. However, this study is among the first to examine the indirect effect of customer pressure through suppliers' green capabilities from an RDT perspective. Second, we further reveal a differential effect of supplier capabilities as a mediator for the adoption of GSCM practices by higher-tier versus lower-tier firms. Specifically, we find a stronger (weaker) mediating effect of supplier capabilities for higher-tier (lower-tier) firms.

In that sense, our findings provide some evidence on why the customer requirements cannot spread equally throughout the multi-tier supply chain. Grounded in the theoretical reasoning of the RDT, we provide guidance to supply chain professionals on managing GSCM practices along multi-tier supply chains.

This article is structured as follows: We begin by discussing the existing and related literature. In Section 3, using RDT, we develop the hypotheses which capture the mediating role of supplier capabilities on the relationship between customer pressure and the adoption of GSCM practices and the differential mediating effect between higher-tier and lower-tier firms in the multi-tier supply chain. Section 4 describes data collection and methodology, which is followed by the results of the analyses. After a discussion of implications for theory and practice in Section 6, we conclude the article with limitations and recommendation for future research.

2. Related literature

2.1. GSCM Practices in Multi-Tier Supply Chains

In this study, we understand GSCM practices as "the integration of green concerns along the supply chain embedded in inter- and intra-organizational practices" (Schmidt, Foerstl, and Schaltenbrand 2017 p. 4). For our purpose, however, we mainly focus on intra-organizational GSCM practices, given that our explanatory variables are associated with inter-organizational GSCM practices. In a sustainability context, GSCM is understood as the application of various resources in novel ways using unique capabilities to produce a product or implement a process with the intent to reduce green impacts (see Srivastava 2007; Prajogo, Tang, and Lai 2014). GSCM practices can affect all firm functions, such as new product development/design, purchasing and sourcing, manufacturing, distribution and delivery (Klassen and Vachon 2003). Research indicates that GSCM practices generally foster both firm sustainability and financial performance (Zhu and Sarkis 2004; Ates et al. 2012).

Practical and academic examples show that focal firms are held accountable for green misconduct in lower-tiers of their supply chain, regardless of their involvement or responsibility (Hartmann and Moeller 2014; Foerstl et al. 2015). This chain liability generates various negative consequences for the firm, including reputational damage and decreasing firm value. For instance, Kim, Wagner, and Colicchia (2019) found that focal firms that are involved in such suppliers' misconducts face an abnormal reduction in shareholder value of 1.00%. Focusing on green issues, Lo et al. (2018) revealed that green incidents caused by Chinese suppliers are associated with a decrease in shareholder value of 1.13%. Given that higher media coverage could reinforce the negative impact (Kölbel et al. 2017), firms must inevitably take responsibility for their supply chain and actively propagate GSCM practices to their supply chain partners, particularly to their lower-tier suppliers (Ayuso, Roca, and Colome 2013; Ehrgott et al. 2013; Wilhelm et al. 2016b).

However, it is only recently that scholars have paid attention to multi-tier supply chains for managing GSCM (Quarshie, Salmi, and Leuschner 2016; Mena and Schoenherr 2020). This trend can be captured by a recent literature review (Tseng et al. 2019), revealing that most of the prior studies have focused on GSCM from downstream firms (also cf. Srivastava 2007; Seuring and Müller 2008; Golicic and Smith 2013). Focal firms likely face many challenges, especially when managing lower-tier supply chain partners. A large number of studies report that such firms monitor their direct suppliers' green compliance; however, oftentimes, these direct suppliers do not demand the same level of compliance from their own (lower-tier) suppliers (e.g., Brockhaus, Kersten, and Knemeyer 2013; Meinlschmidt, Schleper, and Foerstl 2018). Consequently, the adoption of GSCM practices beyond the focal firm boundary remains a prominent topic in research and practice.

2.2. Customer Pressure and Supplier Capabilities

In the literature, two most prominent drivers for GSCM practice adoption are customer pressure

and supplier capabilities (Lo 2013; Prajogo, Tang, and Lai 2014; Paulraj, Chen, and Blome 2017). Using stakeholder and institutional theory, many studies have highlighted the importance of the external stakeholder pressure for GSCM practice adoption (Sarkis, Gonzalez-Torre, Adenso-Diaz 2010). The focal firms' responses to such pressures are dependent on stakeholder saliency, which describes the stakeholder's *power* to assert the claim, the perception of its action's *legitimacy* and the *urgency* of the claim (Mitchell, Agle, and Wood 1997). Green pressure from customers, as a primary stakeholder who possesses all the three attributes, has been known to be linked to the adoption of GSCM practices by firms. Accordingly, there is numerous evidence supporting this direct causal relationship between customer pressure and the adoption of GSCM practices (e.g., Delmas and Montiel 2009; Jira and Toffel 2013; Laari et al. 2016).

Stakeholder environments and saliency differ in the multi-tier supply chain (Chiu and Sharfman 2011; Hoejmose, Brammer, and Milington 2012; Schmidt, Foerstl, and Schaltenbrand 2017). Prior studies have already echoed supplier-related factors that can lead to a different level of response to stakeholder pressure, particularly customer pressure along the supply chain. For example, Hoejmose, Brammer, and Millington (2012) argue and find that the level of engagement with GSCM is greater for firms in business-to-consumer sectors (somewhat downstream) than for firms in business-to-business sectors (somewhat upstream). This difference is especially the case when there are higher levels of supplier trust such as credibility and benevolence. In a similar vein, Schmidt, Foerstl, and Schaltenbrand (2017) focus on supply chain position including suppliers on different tiers that moderates the effects of GSCM practices on firm performance.

Lower-tier suppliers are often small-sized firms that are somewhat shielded from the public and media (Tachizawa and Wong 2014). Compared with higher-tier firms, these firms are generally less exposed to stakeholder pressures, including laws and regulations (Brammer and

Millington 2006; Ehrgott et al. 2013; Lee et al. 2014). Consequently, in response to the pressures imposed on different tiers of the supply chain, firms develop a diverse set of green capabilities (Lo 2013; Lee et al. 2014). Suppliers, even lower-tier suppliers, are no exception. Numerous GSCM studies have documented the green efforts made by these suppliers (e.g., Lee and Klassen 2008; Tate, Dooley, and Ellram 2011; Wong et al. 2012; Nair et al. 2016), which are a prerequisite to the adoption of GSCM practices along the supply chain (Parmigiani, Klassen, and Russo 2011; Sodhi 2015). To our knowledge, there are no studies specifically exploring the interplay of customer pressure and supplier capabilities for different GSCM adoption patterns, which could be a hurdle for "green contagion" in multiple supply chain tiers (Mena and Schoenherr 2020).

While adoption of GSCM practices in the multi-tier supply chain is gaining attention, in practice, the most severe misconducts still happen in the upstream supply chain, beyond the upstream and first-tier level (Foerstl et al. 2015; Wilhelm et al. 2016a; Kim, Wagner, and Colicchia 2019). Again, we argue that this issue has to do with the limited adoption of GSCM practices throughout the supply chain. Thus, additional insights on the intricacies affecting the adoption of GSCM practices throughout complex multi-tier supply chains are needed in the literature. To add to this stream of literature, in this study, we explore the mediating role of supplier capabilities for GSCM adoption in response to customer pressure, particularly its differences between lower- and higher-tier firms.

3. Theoretical Background and Hypotheses

As discussed above, customer pressure and supplier capabilities are considered an important driver for GSCM practice adoption. However, relatively little is known about the interplay of these two main drivers, which is our focus in this study. Therefore, we expand the extant research by investigating whether customer pressure regarding GSCM practice adoption is mediated by the green capabilities of a firm's suppliers. Particularly, we explore whether the

mediating effect of supplier capabilities differs for higher-tier and lower-tier firms throughout supply chains. Figure 2 depicts our conceptual framework, showing that customer's green pressure leads to the adoption of focal firm's GSCM practices hypothetically through direct supplier's green capabilities and this mediating effect will be different in magnitude between higher-tier and lower-tier focal firms.

[Insert Figure 2 about here]

3.1. Resource Dependency Theory and GSCM Practice Adoption

In our study, given the inter-organizational nature of GSCM, we use theoretical reasoning drawing from the RDT to introduce how each firm along a multi-tier supply chain is, to a certain degree, dependent on upstream suppliers' capabilities in their own pursuit of GSCM practices. Design for disassembly, reuse, recycling, recovery of materials, components or parts can be an example, in which each firm cannot achieve such GSCM practice unless the procured items they receive from suppliers are specified to the practice. At the same time, the RDT also provides support to explain why the adoption of GSCM practices through supplier capabilities is enabled to a different degree at higher and lower supply chain tier as a result of green pressure from different customers and the level of resources each firm possess differently along the supply chain.

The RDT proposes that organizational survival is dependent on a firm's ability to acquire, procure and maintain resources from the external environment. For firms that operate in an interdependent supply chain setting, the management of business relationships to upstream and downstream partners in the supply chain is critical for their economic success. As buyers and suppliers develop mutual dependencies, both parties will seek stability in the relationship (Casciaro and Piskorski 2005). Hence, they are willing to invest in innovative resources that potentially foster mutual economic success (Bode et al. 2011). Particularly, prior study has shown that suppliers' innovation capabilities (external to the firm) enhance focal firms'

capabilities (internal to the firm) and performance (Azadegan et al. 2008). Indeed, firms benefit from their access to suppliers' innovation capabilities when combined with the firm's own capability endowments (Weigelt 2013).

When extending RDT to the context of GSCM (Sarkis, Zhu and Lai 2011), it becomes evident that a focal firm's reputation and its public legitimacy is, to a certain degree, dependent on the green conduct of its supplier base. Hence, at each stage of the supply chain, customer pressure is exerted on the direct upstream business partner. This is mostly attributed to the fact that downstream firms are publicly perceived as being able to influence their suppliers. At the same time, each firm has to prevent reputational and economic risks through their own investments in GSCM practices (Schaltenbrand et al. 2015). This is also necessary to outperform firms at the same supply chain position and gain competitive advantages. While the firm's own reputation risk is dependent on upstream supplier capacities, GSCM practice adoption is fostered by suppliers' green capabilities. Recently, it has been established that suppliers support their clients' GSCM practices at the product and process level, thereby supporting the clients in adhering to downstream customer pressure (Tate, Dooley, and Ellram 2011; Foerstl et al. 2015).

3.2. Mediating Role of Supplier Capabilities for GSCM Practice Adoption

Over the past few decades, customer pressure has been considered as one efficient way to foster GSCM practice adoption (Delmas and Montiel 2009; Ayuso et al. 2013; Gualandris et al. 2015; Laari et al. 2016). In this study, based on the RDT, we argue that such pressure-based approaches are limited in terms of the adoption of GSCM practices throughout the supply chain without supplier capabilities. Many studies have shown how green issues emerge from downstream customers and then proliferate through entire supply chains (Nair et al. 2016; Touboulic, Matthews, and Marques 2018; Mena and Schoenherr 2020). However, most of the propagation approach for GSCM practices in the supply chain is to delegate, instead of control

(Choi and Linton 2011). This means that focal firms tend to pass the downstream customer's green pressure to the upstream supply chain partners. In this sense, the limited effect of customer pressure for the green propagation in the supply chain is inevitably likely if there is an absence of suppliers whose resources are available to better align with downstream customers' green demands.

Therefore, supplier capabilities can be discussed as an important missing link for the adoption of GSCM practices in the supply chain. Prior studies suggest that suppliers' green capabilities boost a focal firm's internal sustainability efforts, because such supplier involvement by nature leads to inter-firm collaboration in supply chains (Wang, Modi, and Schoenherr 2020). This is true especially given that focal firms are required to ensure that their procured materials, components or parts from suppliers are environmentally friendly (Wong et al. 2012; Villena 2019) and that if they fail to do so, focal firms are subject to extra costs relating to pertinent supply chain risks (Bové and Swartz 2016; Hartmann and Moeller 2014; Kim, Wagner, and Colicchia 2019).

As discussed, whether or not suppliers adopt GSCM practices is often determined by pressure from their customers. However, suppliers also tend to develop GSCM capabilities, independent of the customer influence (Lee and Klassen 2008; Tate, Dooley, and Ellram 2011; Huq, Chowdhury, and Klassen 2016; Nair et al. 2016; Touboulic, Matthews, and Marques 2018). Such green championing by suppliers (Lee and Klassen 2008), or supplier innovation capabilities (Huq, Chowdhury, and Klassen 2016), is likely to be motivated by the opportunity they identify or anticipate to enhance competitive market positions through leveraging green initiatives in their supply chain operations (Wagner and Bode 2014; Foerstl et al. 2015). These supplier capabilities are a precondition for a focal firm to better respond to external green challenges (Foerstl et al. 2015). In other words, supplier capabilities can explain the process or mechanism through how customer pressure and GSCM practice adoption are related in the

supply chain.

One recent stream of GSCM research reveals that the success of a focal firm's GSCM practices depends on the balance of green pressure from customers and independent supplier capabilities within the supply chain (e.g., Nair et al. 2016; Touboulic, Matthews, and Marques 2018). Their key findings suggest that the adoption of GSCM practices in the supply chain is a supplier-led phenomenon, albeit initially triggered by dominant buying firms like OEMs. We understand the green championing by suppliers, or supplier innovation capabilities, as a form of self-organization that allows the formation of supply chains beyond the pressure-based approach. That is, without integrating the notion of supplier capabilities into the external green influence, customer pressure will be only a partial or unsuccessful driver of GSCM practice adoption for focal firms and therefore throughout supply chains. Given the discussion, we posit the following hypothesis:

H1. In multi-tier supply chains, supplier capabilities mediate the relationship between customer pressure and the adoption of GSCM practices by focal firms.

3.3. Magnitude of the Mediating Effect for Higher-Tier and Lower-Tier Focal Firms

In multi-tier supply chains, higher- and lower-tier firms show different pathways towards greener supply chains. In general, higher-tier firms are rich in resources, as they are large in size (Grimm, Hofstetter, Sarkis 2014; Nair et al. 2016). They are also visible, attracting more attention from the public. This leads to greater exposure to legal and stakeholder scrutiny. This is not the case for lower-tier firms whose resources are limited. Typically, lower-tier firms are small-sized and therefore less visible to the public (Wilhelm et al. 2016a; 2016b; Villena and Gioia 2018). They are thus less susceptible to institutional or stakeholder pressure on sustainability issues (Tachizawa and Wong 2014). In this sense, we can observe two major characteristics for the adoption of GSCM practices in the multi-tier supply chain. First, compared to higher-tier firms, lower-tier firms typically have more limited resources and,

consequently, have a lack of expertise in managing and implementing green requirements from customers. Second, compared with higher-tier firms, lower-tier firms by nature are more passive in terms of going green. In other words, lower-tier suppliers do not likely prioritize GSCM initiatives unless they are pressured by customers to do so.

Consequently, compared to the lower-tiers, higher-tier firms are more active in terms of sensing the green stimuli in their stakeholders, particularly from downstream customers (Nair et al. 2016). Thus, as suppliers, higher-tier firms with more ample resources at command perceive going green as an economic opportunity for continuing contracts or for developing future and new relationships. This makes it possible and easy for focal firms on the higher-tier to simply pass the pressure from customers to their suppliers, while focusing mainly on their own GSCM practices (Lee et al. 2014; Busse, Meinlschmidt, and Foerstl 2017). That is, higher-tier focal firms can depend on the green resources their suppliers possess when responding to external green pressure from downstream customers. Indeed, Wilhelm et al. (2016b) show that such higher-tier suppliers tend to act in a double-agency role, fulfilling a sustainability mission in the supply chain while at the same time propagating that mission to their own network. Hence, these suppliers' involvement is a prerequisite for the focal firms on the higher-tier to achieve their GSCM goals.

In contrast, given the nature of their own supply base, lower-tier firms are rather passive in going green. Furthermore, lower-tier firms have more limited resources to implement GSCM practices than do higher-tier firms. Hence, they likely face difficulty in allocating already limited resources to comply with downstream customers' green demands. This makes it difficult for focal firms on the lower-tier to pass the green pressure to their suppliers. That is, lower-tier focal firms have to ensure that their suppliers comply with green requirements from downstream customers, while at the same time working on their own GSCM practices. Additionally, green championing, which is a form of self-organization that goes voluntarily

beyond customer's green pressure, is not common among lower-tier suppliers (Lee and Klassen 2008; Wilhelm et al. 2016b; Villena and Gioia 2018). In that sense, the involvement of these suppliers in the quest of going green is still necessary but is not a prerequisite for the focal firms on the lower-tier.

The above discussion leads us to envision a difference between the levels of dependence of higher-tier and lower-tier focal firms on the adoption of GSCM practices in the supply chain. Given the different green resources and capabilities available from the suppliers at higher- versus lower-tier stages of the supply chain, we propose a different magnitude of the mediated effect of supplier capabilities on GSCM practice adoption along the supply chain. Specifically, we posit the following hypothesis:

H2. In multi-tier supply chains, the mediating effect of supplier capabilities on GSCM practice adoption will be stronger for higher-tier focal firms than for lower-tier focal firms.

4. Research Methodology

4.1. Data Collection

For the data collection, manufacturing companies operating within any of the multiple supply chain tiers (i.e., focal firms) were considered as unit of analysis. A sample of 750 managers working at manufacturing companies in the German-speaking parts of Europe (Germany, Austria and Switzerland) was randomly drawn from a university's internal executive education database (Schmidt, Foerstl, and Schaltenbrand 2017). We first contacted the managers as firm informants via e-mail and then invited them to participate in an online survey. Excluding invalid contacts, 693 companies received our survey. After a series of follow-up emails and phone calls, 284 usable responses were obtained. This resulted in an effective response rate of 40.98%.

Two techniques were applied to assess nonresponse bias, i.e., extrapolation and the

comparison of respondents to the population (Wagner and Kemmerling 2010). First, answers of early (n_e =168) and late (n_l =116) respondents to the items of our GSCM practice construct were compared, assuming that late respondents possess similar characteristics as non-respondents. We found that the responses of these two samples did not significantly differ at the 5% level. Second, we compared the industry distributions and revenue statistics between the sampling frame, respondents and non-respondents and found no significant differences. The *Z*-values of the Kolmogorov–Smirnov test showed no significant difference between the two groups across the sampled industries (Hair et al. 2010). Overall, nonresponse was not a major problem in our study.

In this study, the sample population includes executives, directors, supervisors and managers as firm informants on the business unit level across different industries. The detailed respondent and firm descriptive characteristics are presented in Appendix 1. We focus on German-speaking countries because the German business environment has been exposed to GSCM practices for a longer period than have other countries, thus ruling out the impact of recency effects on our results (Ehrgott et al. 2013). Moreover, the consumers and businesses in the selected countries are recognized for their green awareness and general demand for corporate citizenship (Maignan and Ferrell 2003), thus promising theoretically interesting and practically insightful findings.

4.2. Measures

The dependent variable, *GSCM practices,* was measured based on a scale adopted from Sarkis, Gonzalez-Torre, Adenso-Diaz (2010). Each of the six items captures the investment of the firm in the adoption of GSCM practices. As noted earlier, contrary to the prior research (Schmidt, Foerstl, and Schaltenbrand 2017), practices at or with suppliers and/or customers were not included since supplier and customer variables are used as explanatory variables to limit endogeneity issues in subsequent statistical analysis. The scales for our independent variable,

customer pressure and the mediator, *supplier capabilities*, were also adopted from the literature (Sarkis, Gonzalez-Torre, Adenso-Diaz 2010; Ates et al. 2012). The customer pressure variable captures the customer demands for GSCM practices, e.g., regarding the firm's performance assessment, evaluation and auditing practices. The supplier capabilities variable assesses the innovativeness of the suppliers' green management programs and the green performance of the supplier's products and processes. All variables were measured on a five point Likert-scale (1 = not at all; 5 = a very great extent).

The respondents also rated their firm's position within the supply chain on a four-option ordinal scale measuring end customer proximity. The differentiation of business as (1) raw material suppliers, (2) component suppliers, (3) system suppliers and (4) manufacturers was adopted from Wynstra, Von Corswant, and Wetzels (2010). By using these positions, we account for the cross-industry nature of our study and different supply chain complexities. Due to its significance, we cross-validated our subjects' supply chain position assessment based on secondary data. Two authors independently categorized each company to one supply chain position based on the 3-digit SIC code in combination with the descriptions of their core business activity provided in the Hoppenstedt firm database. Moreover, information obtainable on the company website was used for further triangulation. In our study, firms were observed on a business unit level. This enabled us to have multiple recipients from different business units from one large manufacturing company. Therefore, the supply chain position can be assessed more precisely, thus avoiding the problem of big multinational companies operating at various stages of the supply chain, at least to a certain extent. Following prior studies, as shown in Figure 1, we group manufacturer (OEM) and system (tier-one) suppliers as *higher-tier* focal firms and component (tier-two) and raw material (tier-three) suppliers as *lower-tier* focal firms (e.g., Schmidt, Foerstl, and Schaltenbrand 2017; Villena and Gioia 2018). Unless otherwise indicated, we will use this grouping for our analysis.

As control variables, we captured *ROI* as a proxy for firm profitability. It was measured on a seven-point Likert-scale relative to competitors (1 = "substantially lower" to 7 = "substantially higher"), adopted from Gonzalez-Benito (2007). We also controlled for *firm size*, operationalized as the number of employees categorized in an 8-level scale (for details, see Appendix 2), and *industry diversity* in terms of customers, competition, processes and products based on Duncan (1972). Given that the level of GSCM adoption in supply chains can differ by *industry type*, we further controlled for this potential using a set of dummy variables with pharmaceutical industry as the base category (see Appendix 1). Table 1 presents the descriptive statistics and correlation results of our main variables used in this study. Table 2 also provides descriptive statistics for the main variables by higher-tier (n = 163) and lower-tier (n = 121) suppliers.

[Insert Table 1 about here]

[Insert Table 2 about here]

4.3. Construct Validation and Bias Assessment

All scales used in this study were established and drawn from the literature. The content validity of the survey was tested in a pilot study among a group of GSCM researchers, as well as practitioners working in the supply chain, purchasing, or green management functions of different companies using the Q-sort method (Bollen 1989). Once the survey data was obtained, using SPSS Statistics/Amos 27, we conducted exploratory factor analysis (EFA). As a result, we found that the EFA loadings of all the indicators were above 0.7 (Hair et al. 2010), indicating no cross-loadings.

All the study scales demonstrate composite reliability with Cronbach's alpha values ranging between 0.747 and 0.887, which is adequate for our scales (Nunnally and Bernstein 1994). Moreover, the average variance extracted (AVE) values of our construct are found to be greater than 50%, indicating adequate convergent validity (Hair et al. 2010). The test results

are summarized in Appendix 2. Finally, the square root of the AVE for each factor was greater than the correlation of the factor with other constructs, supporting discriminant validity, as shown in Table 1.

We sought to ex-ante reduce the impact of common method variance on the results of our study through the careful design of the survey tool. As recommended by Podsakoff et al. (2003), we first queried the control variables, followed by the independent and mediating variables before asking respondents to report on the dependent variable. Moreover, common method bias was assessed by applying Harman's single-factor test. Estimating a confirmatory factor analysis (CFA) revealed that the single-factor model did not fit our data well (χ^2=762.47; χ^2/df=8.47; CFI=0.718; RMSEA=0.162). The CFA including all our latent constructs (theory-based) provides significantly better model fit indices (χ^2=132.147; χ^2/df=1.65; CFI=0.978; RMSEA=0.048). Additionally, we found that modelling the marker variable loadings (Marker: *We must frequently change our marketing practices to keep up with the market and competitors*) onto the substantive (theory-based) indicators does not improve the model fit significantly, indicating no common method bias (theory-based vs. marker-based model) ($\Delta\chi^2$=.02; Δdf=1; χ^2critical=2.97; no difference) (Williams, Hartman, and Cavazotte 2010). Overall, we conclude that in this study, common method bias does not significantly affect our results.

5. Empirical Results

5.1. Mediating Role of Supplier Capabilities

To test our first hypothesis regarding the mediating role of supplier capabilities, we follow the approach suggested by Baron and Kenny (1986). Moreover, we complement the Baron and Kenny approach with mediation test using PROCESS, a macro that is an extension of original mediation testing (Hayes 2017). We utilize multiple regression analyses while controlling for firm size, ROI, industry diversity, industry type and higher-tier (as a binary compared with lower-tier) position as a way to further ensure the validity of our results. Following the common

procedure, we first test the effect of the independent variable on the mediator (1st condition), then on the dependent variable (2nd condition), and finally the effect of both the independent and the mediator on the dependent variable. In the last test, if the effect of the independent variable becomes insignificant in the presence of the mediator, then full mediation occurs. However, if the effect of the independent variable decreases but still remains significant, then partial mediation is observed. Otherwise, there is no mediation (Baron and Kenny 1986).

The test results are summarized in Table 3. The first column shows that customer pressure has a significant and positive effect on supplier capabilities ($\beta = 0.64$, $p < 0.001$), supporting the first condition. The second column indicates that this independent variable has a significant and positive effect on the dependent variable, GSCM practices ($\beta = 0.46$, $p < 0.001$), providing support for the second condition. As shown in the last column of Table 3, however, when the supplier capabilities variable ($\beta = 0.45$, $p < 0.001$) is added as the mediator, the effect of customer pressure diminishes in magnitude (β change to 0.18 from 0.46). This finding was robust to multicollinearity, with all of variance inflation factor values falling between 1 and 3. This result leads us to conclude that there is a partial mediation effect of supplier capabilities for customer pressure on GSCM practice adoption. Overall, the results provide support for our first hypothesis.

[Insert Table 3 about here]

The results of the PROCESS analysis support these findings. As shown in Table 4, for the entire sample, the indirect (mediating) effect of customer pressure on GSCM practice adoption through supplier capabilities is statistically significant at the 0.1% level, with the coefficient of 0.26. We then checked the bias corrected bootstrap confidence interval (CI), which is a recommended method for the inference of an indirect (mediating) effect. As Table 4 illustrates, the 95% bootstrap CI ranges from 0.191 to 0.347, which is well above zero. This result provides further evidence of a mediating effect of supplier capabilities on the customer pressure and

GSCM practice adoption relationship, supporting our above findings shown in Table 3 (Hayes 2017).

[Insert Table 4 about here]

5.2. Difference between Higher-Tier and Lower-Tier Focal Firms

To test our second hypothesis regarding the differential mediating role of supplier capabilities in the multi-tier supply chain, we again estimate a regression model for the split samples: higher-tier and lower-tier groups. The test results for both groups are presented in Table 5. Likewise, we first check the conditions for the mediation effect. As shown in the first two columns for both higher-tier and lower-tier groups, the test results support the first and second conditions for mediation. That is, customer pressure, as the independent variable, is found to have a significant (all at the 0.1% level) and positive effect on both the mediator (for higher-tier: $\beta = 0.69$, for lower-tier: $\beta = 0.62$) and the dependent variable (for higher-tier: $\beta = 0.43$, for lower-tier: $\beta = 0.52$).

[Insert Table 5 about here]

However, when supplier capabilities are added to the model as the mediator in the last column, there is clearly a difference between the estimates for the higher- versus lower-tier group. In terms of higher-tier focal firms, the effect of customer pressure substantially decreases in magnitude (β change = 0.10 from 0.43) and becomes insignificant (i.e., full mediation). On the other hand, for lower-tier focal firms, the effect of customer pressure also somewhat decreases in magnitude (β change = 0.25 from 0.52) but remains significant at the 1% level (i.e., partial mediation). These test results indicate that the magnitude of the mediating effect is greater for higher-tier focal firms than for lower-tier focal firms, supporting our second hypothesis.

These findings are supported by the results of the PROCESS analysis. As Table 4 reveals, for both the higher-tier and lower-tier groups, we find a significant indirect (mediating) effect

of customer pressure on of GSCM practice adoption through supplier capabilities, with the coefficients of 0.29 and 0.26 respectively. Furthermore, we find that a 95% bias-corrected bootstrap CI range for the higher-tier group is 0.167 to 0.427, and for the lower-tier group, it is 0.161 to 0.373, both of which are well above zero. These results support findings for our second hypothesis regarding full and partial mediation effects of supplier capabilities for higher- versus lower-tier suppliers (Hayes 2017).

5.3. Post Hoc Analysis of GSCM Practices

Our dependent variable, GSCM practices, take various forms (e.g., eco-design, see Zhu and Sarkis 2004) but *product* and *process* practices can be one of the main forms (Azadegan and Dooley 2010; Wong et al. 2012; Wagner and Bode 2014; Kach et al. 2016; Kim, Wagner, and Colicchia 2019). Based on the extant studies, we understand that GSCM-product practices relate to new product developments aiming to reduce energy consumption, pollution and waste by means of product design and material use. Furthermore, GSCM-process practices are concerned with all the firm's operational processes, including manufacturing, logistics and lifecycle management, to reduce the impact on the environment by redesigning, integrating and streamlining the firm's processes.

We conduct a post hoc analysis to provide further insights into this subject. First, we split our GSCM practice construct into process and product sub-constructs. We also repeated our tests for ensuring validity and reliability for both. Then, we conducted multiple regression analyses for the dependent variables using the procedure suggested by Baron and Kenny (1986). The test results are demonstrated in Table 6. We find a partial mediating effect of supplier capabilities for customer pressure on the adoption of both process- and product- related GSCM practices. Further, we find a full mediating effect of supplier capabilities for higher-tier focal firms, but only a partial mediating effect of supplier capabilities for lower-tier focal firms. These results also fully confirm our main findings (Tables 3 and 5), indicating that GSCM

practices can take process-product forms but are adopted by similar mechanisms along the multi-tier supply chain.

[Insert Table 6 about here]

6. Discussion

6.1. Theoretical Implications

In the GSCM literature, customer pressure, understood as a pressure-based approach, has been discussed largely as a solution for suppliers' green problems (e.g., Delmas and Montiel 2009; Laari et al. 2016). The key point is that the higher the level of customer pressure, the higher the adoption of GSCM practices by firms throughout the supply chain. Accordingly, our findings provide additional evidence of customer pressure as a major green driver. Building on RDT, however, our findings suggest that this pressure-based approach should not be considered the panacea for GSCM practice adoption in supply chains. Customer pressure influences the adoption of GSCM practices only or at least partly through their suppliers' green capabilities in the supply chain. This phenomenon is particularly relevant for higher-tier focal firms, showing that with supplier capabilities, customer pressure does not facilitate the adoption of GSCM practices.

Therefore, our findings provide support for the RDT perspective regarding GSCM. In other words, the adoption of GSCM practices by focal firms is, to a certain degree, dependent on the level of green resources available from the suppliers. The current GSCM research has paid scant attention to this aspect. There are a few RDT-based GSCM studies (e.g., Brockhaus, Kersten, and Knemeyer 2013; Foerstl et al. 2015; Schaltenbrand et al. 2015); however, they are limited to a generic, simple buyer-supplier relationship in terms of greening supply chains. Our study contributes to the literature by extending the RDT to the adoption pattern of a focal firm's GSCM practices along more complex supply chains. Particularly, our findings suggest that the adoption of firms' GSCM practices is mediated by supplier capabilities and the level of such

firms' resource dependence varies at higher and lower supply chain stages. This revelation has important implications for the use of the RDT in future GSCM studies.

Meanwhile, as with downstream customers, upstream suppliers are seen as 'agents' who can make their own decisions about GSCM practice adoption independent of their customer influence (Lee and Klassen 2008; Tate, Dooley, and Ellram 2011). In this study, we argue that such voluntary efforts are especially the case if they perceive implementing GSCM initiatives as opportunities and can proactively market these benefits to downstream customers (Busse, Meinlschmidt, and Foerstl 2017) and therefore potentially render competitive advantages in the market (Tate, Dooley, and Ellram 2011; Schmidt, Foerstl, and Schaltenbrand 2017). In that sense, our empirical findings – mediating effects of supplier capabilities – support the recent argument that 'going green' (i.e., adoption) in multi-tier supply chains is an emergent phenomenon rather than a top-down control (Nair et al. 2016; Touboulic, Matthews, and Marques 2018).

However, there are conflicting reports regarding the optimal approach to foster GSCM practice adoption along the supply chain. For example, another recent study argues that for managing lower-tier suppliers, focal firms could improve sustainability by exercising more pressure (Villena and Gioia 2018). Based on data from multiple sources, they found that championing for green management, or green management capabilities, is less likely among lower-tier suppliers. This is contrary to some of the earlier findings of GSCM studies that highlight a supplier-led green supply chains (Lee and Klassen 2008; Huq, Chowdhury, and Klassen 2016; Nair et al. 2016; Touboulic, Matthews, and Marques 2018). Our results, however, support the Villena and Gioia's argument, i.e., the necessity of customer pressure, to some extent. Specifically, for lower-tier suppliers, we found that both customer pressure and supplier capabilities are needed for GSCM practice adoption for focal firms and therefore in the multi-tier supply chains (see Table 5).

6.2. Practical Implications

As the findings of this study show, supplier capabilities are a crucial factor for the adoption of GSCM practices, especially for higher-tier focal firms. Thus, one crucial way to facilitate their GSCM practices is to recognize suppliers that can provide "valuable information about the latest manufacturing advances and technological innovations" (Choi and Linton 2011 p. 112). Many scholars argue that focal firms could achieve better greening of their supply chain by learning from their suppliers' practices (e.g., Azadegan and Dooley 2010; Tate, Dooley, and Ellram 2011; Gong et al. 2018). Therefore, for the adoption of GSCM practices throughout supply chains, focal firms should decide the level of resources to commit to searching for suppliers who possess the needed green capabilities. The focal firms also need to balance between absorbing knowledge from and disseminating knowledge to them and the entire supply chain (Meinlschmidt, Foerstl, and Kirchoff 2016).

Moreover, our findings show that customer pressure is important as a green driver. However, for higher-tier focal firms, this pressure-based approach is necessary only until they integrate the supplier's green capabilities into their green sustainability mission. In contrast, for GSCM practice adoption, lower-tier focal firms still respond to pressure from customers, even though they work with their suppliers who may (or may not) possess green capabilities. Hence, managers can see where pressure is needed, or not, in the multiple supply chain tiers. Given that many of the current practices for sustainability rely on their direct suppliers (Tachizawa and Wong 2014; Wilhelm et al. 2016b; Villena 2019), our empirical findings provide the fine granularity of a pressure-based approach for reaching green sustainability goals more effectively in the supply chain.

It is worth highlighting that customer pressure alone is not sufficient for the adoption of GSCM practices. In the worst case, exercising excessive pressure may only lead to a so-called "green bullwhip effect" (Lee et al. 2014) and, thus, potentially create the pertinent supplier

sustainability risks discussed earlier (Kim, Wagner, and Colicchia 2019). Hence, we argue that the managers in focal firms should empower lower-tier suppliers to manage their own sustainability issues, allowing the required green capabilities to emerge in a guided but sustainable fashion. However, this does not necessarily mean that focal firms should take a radical approach to managing lower-tier suppliers based on the "don't bother" (Tachizawa and Wong 2014) or "neglect" strategies (Meinlschmidt, Schleper, and Foerstl 2018). Rather, the focal firms could better achieve sustainability by supporting those suppliers in developing their own green capabilities.

Our above discussion might lead to a question of: How can focal firms make their suppliers capable of going green that ultimately supports the supply chain? A collaborative partnership needs to be encouraged, which has been widely discussed as essential, but easier said than done, for achieving supply chain sustainability (e.g., Brockhaus et al. 2013; Bové and Swartz 2016; Villena and Gioia 2018). Specifically, focal firms should invest in their suppliers for capacity expansion. Offering training for GSCM would be a vital example, in which suppliers can learn how to become more proactive in their practices. On top of that, focal firms need to share their sustainability schema (i.e., norms, beliefs, etc.) with suppliers (Touboulic, Matthews, and Marques 2018). This may be best achieved though having close relationships with the suppliers, which could improve communication efficiency in a complex supply chain (Choi and Linton 2011).

7. Conclusion

Focusing on the interplay between customer pressure and supplier capabilities, we provide empirical evidence regarding the causal mediating mechanism underlying the adoption of GSCM practices for focal firms and therefore along the supply chain. This study is timely, given that GSCM studies have so far reported on how downstream customers can amplify the adoption level, but they are mostly focusing on top-down strategies. Building on the RDT, this

study reveals that the direct effect of customer pressure for GSCM adoption by focal firms throughout the supply chain is only limited without suppliers' green capabilities as a key mediator. Particularly, our study uncovers that such limited effect of pressure-based approaches matters more to the adoption of GSCM practices by higher-tier focal firms than by lower-tier focal firms.

As every study, ours also has limitations that present opportunities for future GSCM research. First, we use data from manufacturing firms in German-speaking countries. The results of our study are thus concerned with GSCM practices in manufacturing-related supply chains in developed countries, which is a limitation to the generalizability. Also, our cross-sectional survey data can be affected by endogeneity. However, we could not find valid instruments for dealing with the potential endogeneity concerns. Given that using invalid instruments could be more problematic (Rossi 2014), we refrained from using the instrument variable estimator. Further, our data comprises single informant survey responses (Krause, Luzzini, and Lawson 2018). While it was also subject to initial tests for unit-nonresponse (Wagner and Kemmerling 2010) and common method biases (Craighead et al. 2011), stricter approaches are always desirable. In summary, while our empirical setting likely provided new insights, we encourage future studies to validate and extend our findings.

Second, we used the notion of customer pressure as a major driver for firms' going green. However, from a broader point of view, they are not the only stakeholder group who can affect or be affected by the green activities of firms. In the GSCM literature, many other stakeholder groups (e.g., government, communities, NGOs/societies) are considered major drivers for change towards sustainability (Sarkis, Gonzalez-Torre, Adenso-Diaz 2010; Sodhi 2015). In that sense, although the effects are considered greatest among all other stakeholder groups (Delmas and Montiel 2009; Jira and Toffel 2013; Laari et al. 2016), customer pressure might not be the sole driver to explain the adoption effect. Thus, future studies may also need to consider

pressure from other stakeholders as drivers that intertwine with the role of supplier capabilities in multi-tier supply chains.

Third, our assumption in this study is that in multi-tier supply chains, higher-tier firms are large-sized with more resources, while lower-tier firms are the opposite. Although this characteristic is general in supply chain sustainability research (Tachizawa and Wong 2014; Wilhelm et al. 2016a; Villena and Gioia 2018) and is also supported by our data (see Table 2), we admit that there can be an exception. For example, in the food sector, lower-tier firms are not necessarily small-sized; sometimes they are larger firms (Cargill, Bunge, etc.) than their direct customers, which may generate an opposite result to our study. Thus, we encourage future studies to investigate this potential.

Fourth, in our post hoc analysis, we divided GSCM practices into its two possible forms, i.e., product and process. Developing and implementing different forms of GSCM practices requires partially different resource inputs and firm capabilities (Wagner and Bode 2014; Foerstl et al. 2015; Kach et al. 2016). Therefore, it was expected to reveal a magnitude of mediating effects different for both forms of GSCM-product and -process practices; yet, we found almost similar results. Firms might be more likely to rely on supplier capabilities for GSCM-process practices (cf. slightly greater magnitude change for GSCM-process practices, as shown in Table 6). However, we can only conjecture this with the limited resulting test statistics, which we leave for future work.

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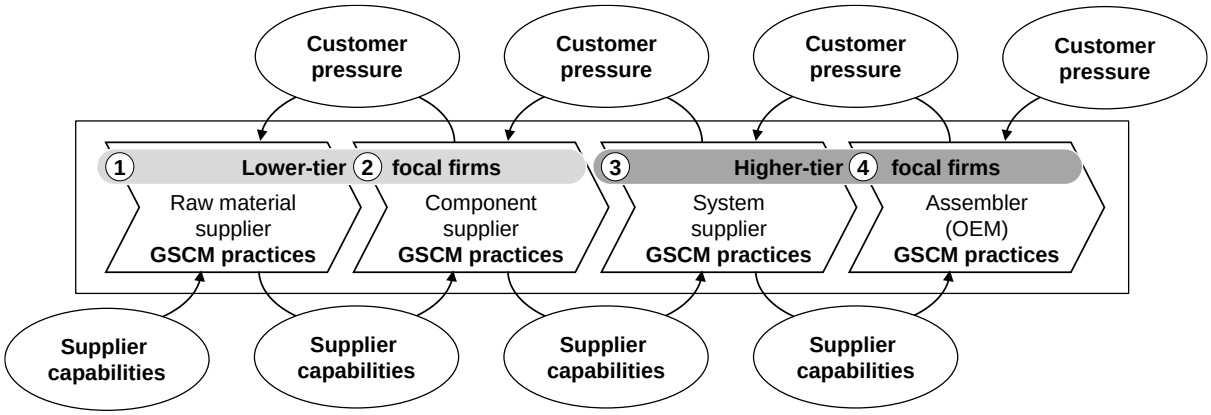

Figure 1. Focal firms along multi-tier supply chains

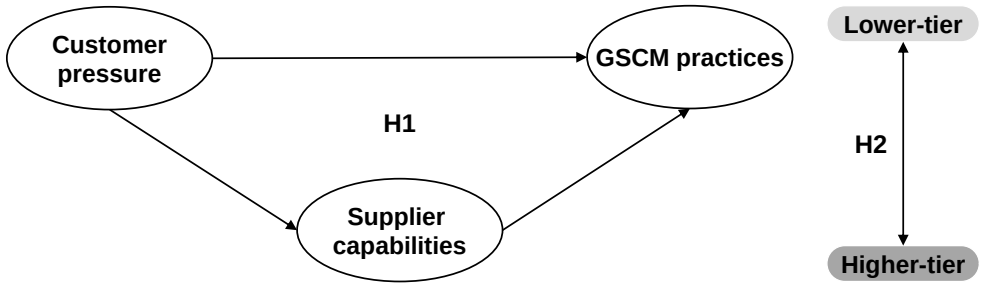

Figure 2. Conceptual framework

Table 1. Descriptive statistics and correlations

Variable	Mean	SD	1	2	3	4	5	6	7
1. GSCM practices	3.18	0.85	*0.75*						
2. Higher–lower tiers	0.57	0.50	0.21*	n/a					
3. Customer pressure	3.00	0.91	0.54*	-0.81	*0.86*				
4. Supplier capabilities	3.03	0.85	0.63*	0.08	0.68*	*0.84*			
5. Firm size	3.85	2.54	0.27*	0.16*	0.08	0.07	n/a		
6. ROI	4.74	1.18	0.17*	0.08	0.23*	0.25*	-0.05	n/a	
7. Industry diversity	3.34	0.81	0.34*	0.14*	0.25*	0.28*	0.02	0.28*	n/a

Notes: $n = 284$; $^{*}p < 0.01$; Square root of AVE is italicized on the diagonal.

Table 2. Descriptive statistics for higher-tier and lower-tier firms

Variable	Higher-tier firms[a] ($n = 163$)		Lower-tier firms[b] ($n = 121$)	
	Mean	SD	Mean	SD
GSCM practices	3.33	0.80	2.98	0.87
Customer pressure	2.99	0.92	3.03	0.90
Supplier capabilities	3.09	0.83	2.95	0.87
Firm size	4.21	2.64	3.37	2.33
ROI	4.82	1.18	4.63	1.17
Industry diversity	3.43	0.74	3.21	0.88

Notes: [a]OEM and system (tier-one) suppliers; [b]Component (tier-two) and raw material (tier-three) suppliers.

Table 3. Mediation analysis results

	Supplier capabilities	GSCM practices	GSCM practices
Constant	0.63**	0.82***	0.54*
Firm size	0.00	0.18***	0.18***
ROI	0.08+	−0.01	−0.05
Industry diversity	0.08+	0.19***	0.15**
Automotive industry	−0.03	0.07	0.08
Chemical industry	0.03	0.09	0.07
Wholesale & trade	0.03	0.03	0.01
Electronic industry	−0.04	−0.02	0.00
Industrial machinery	0.00	0.04	0.04
Transport & logistics	−0.10*	−0.02	0.03
Food & kindred products	−0.04	0.05	0.07
All remaining industry	−0.02	−0.03	−0.02
Higher-tier position	0.08+	0.15**	0.12**
Customer pressure	0.64***	0.46***	0.18**
Supplier capabilities			0.45***
F for the model	20.70***	15.56***	21.56***
R^2 (%)	49.92	42.87	52.88
Adjusted R^2 (%)	47.50	40.12	50.43

Notes: $n = 284$; standardized coefficients are used; $^{+}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table 4. Bootstrapping approach to mediation analysis

	Coefficient	Bootstrap SE	95% bootstrap CI
Full sample firms	0.26***	0.039	0.191 to 0.347
Higher-tier firms	0.29***	0.065	0.167 to 0.427
Lower-tier firms	0.26***	0.054	0.161 to 0.373

Notes: ***$p < 0.001$.

Table 5. Mediation analysis results for higher- and lower-tier firms

	Higher-tier firms			Lower-tier firms		
	SC	GP	GP	SC	GP	GP
Constant	1.01**	1.52***	1.05**	0.55	0.43	0.19
Firm size	−0.02	0.20**	0.21***	0.01	0.17*	0.16*
ROI	0.09	−0.05	−0.09	0.06	0.03	0.01
Industry diversity	−0.01	0.15*	0.15*	0.20**	0.21**	0.12+
Automotive industry	0.07	0.08	0.04	−0.23*	0.05	0.15
Chemical industry	0.00	0.06	0.06	−0.01	0.12	0.13
Wholesale & trade	0.03	0.03	0.01	−0.03	0.03	0.04
Electronic industry	−0.03	0.05	0.06	−0.10	−0.06	−0.01
Industrial machinery	0.04	0.06	0.04	−0.09	0.01	0.05
Transport & logistics	−0.13*	−0.03	0.03	−0.10	0.00	0.05
Food & kindred products	−0.01	0.11	0.11	−0.11	−0.07	−0.02
All remaining industry	−0.03	−0.07	−0.06	−0.10	0.01	0.06
Customer pressure	0.69***	0.43***	0.10	0.62***	0.52***	0.25**
Supplier capabilities			0.48***			0.44***
Observations	163	163	163	121	121	121
F for the model	13.32***	5.93***	8.78***	10.23***	10.79***	14.42***
R^2 (%)	51.59	32.20	43.40	53.20	54.52	63.67
Adjusted R^2 (%)	47.72	26.70	38.40	47.99	49.47	59.25

Notes: GP = GSCM practices; SC = supplier capabilities; standardized coefficients are used; +$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Table 6. Post hoc analysis of green process and product innovations

	GSCM practices: Process[a]						GSCM practices: Product[b]					
	Full sample		Higher-tier		Lower-tier		Full sample		Higher-tier		Lower-tier	
Constant	0.78**	0.49*	1.51***	1.01**	0.54	0.27	0.62*	0.37	1.16**	0.67+	0.25	0.75
Firm size	0.20***	0.19***	0.16**	0.20**	0.22**	0.21***	0.17**	0.16***	0.18*	0.19**	0.15+	0.14+
ROI	0.02	−0.02	0.01	−0.04	0.03	0.01	−0.00	−0.03	−0.05	−0.08	0.05	0.03
Industry diversity	0.21***	0.17***	0.17*	0.18*	0.21**	0.12+	0.14**	0.11*	0.12	0.12+	0.16+	0.09
Automotive industry	−0.02	−0.00	0.01	−0.03	−0.11	−0.01	0.13*	0.15*	0.13	0.09	0.19	0.26*
Chemical industry	0.07	0.05	0.07	0.07	0.01	0.02	0.06	0.05	0.01	0.01	0.15	0.16
Wholesale & trade	−0.04	−0.05	−0.01	−0.03	−0.09	−0.08	0.07	0.06	0.05	0.04	0.13	0.14
Electronic industry	−0.03	−0.01	0.04	0.05	−0.11	−0.07	0.02	0.04	0.07	0.08	0.02	0.06
Industrial machinery	0.00	0.00	0.04	0.02	−0.08	−0.04	0.06	0.06	0.06	0.05	0.09	0.12
Transport & logistics	−0.03	0.02	−0.04	0.03	−0.02	0.02	−0.01	0.03	−0.02	0.04	0.02	0.05
Food & kindred products	−0.00	0.02	0.07	0.07	−0.14+	−0.09	0.08	0.10+	0.12	0.12+	−0.01	0.02
All remaining industry	−0.04	−0.03	−0.01	0.00	−0.14	−0.09	0.03	0.04	−0.04	−0.03	0.16	0.19
Higher-tier position	0.18***	0.14**	-	-	-	-	0.12*	0.09+	-	-	-	-
Customer pressure	0.44***	0.14*	0.40***	0.05	0.52***	0.24**	0.45***	0.21**	0.43***	0.13	0.47***	0.28**
Supplier capabilities		0.47***		0.51***		0.46***		0.37***		0.44***		0.31**
Observations	284	284	163	163	121	121	284	284	163	163	121	121
F for the model	15.02***	21.59***	5.11***	8.23***	10.31***	14.11***	11.86***	14.57***	5.33***	7.34***	7.36***	8.10***
R^2 (%)	41.97	52.92	29.02	41.79	53.38	63.16	36.35	33.29	29.87	39.04	44.99	49.61
Adjusted R^2 (%)	39.17	50.46	23.34	36.71	48.20	58.68	43.12	40.16	24.26	33.72	38.88	43.48

Notes: $n = 284$; [a]Items used for GSCM-process practices are "effective management of environmental risks affecting your business", "improvement of our enterprise's overall environmental situation", and "environmentally friendly manufacturing processes"; [b]Items used for GSCM-product practices are "design for disassembly, reuse, recycling, recovery of material, components, parts", "environmentally friendly product design", and "environmental improvement of packaging and transportation". For the 1st condition for mediation (i.e., the significant effect of customer pressure on supplier capabilities), see the results shown in the first column of Table 3 for full samples, and in the first and fourth columns of Table 5 for higher-tier and lower-tier samples, respectively. Standardized coefficients are used; $^{+}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

APPENDIX

Appendix 1. Respondent and firm demographics

	%	Cum.%		%	Cum.%
Age[a]	49.9	-	**Function**		
Gender			CEO	16.5	16.5
Male	75.4	75.4	Finance	5.3	21.8
Female	24.6	100	Marketing and Sales	14.4	36.2
Nationality			Commercial SCF[b]	27.8	64.0
German/Austrian	87.7	87.7	Technical SCF[b]	21.2	85.2
Other nationality	12.3	100	Other	14.8	100
Education			**Size (# employees)**		
High School	12.7	12.7	<249	28.5	28.5
College	13.7	26.4	250–499	10.6	39.1
Master/Diploma	53.3	79.7	500–999	12.3	51.4
PhD	14.5	94.2	1,000–2,499	10.9	62.3
Industry			2,500–4,999	7.0	69.4
Pharmaceutical industry	14.79	14.79	5,000–10,000	7.7	77.1
Automotive industry	13.38	28.17	10,000–24,999	9.9	87.0
Chemical industry	10.92	39.08	>25,000	13.0	100
Wholesale & trade	9.86	48.94	**Revenue (€ Mio)**		
Electronic industry	8.10	57.04	< 5	14.4	14.4
Industrial machinery	7.75	64.79	5 – 10	6.7	21.1
Transport & logistics	5.63	70.42	10 – 100	19.7	40.8
Food & kindred products	5.28	75.70	100 – 500	20.4	61.2
All remaining (each <5.0%)	24.30	100	500 – 1000	6.0	67.2
			1,000 – 3,000	9.9	77.0
			> 3,000	20.1	97.1

Notes: [a]mean and SD for age; [b]SCF: supply chain function.

Appendix 2. Scale items and standard factor loadings

Construct	Items	Loadings
Dependent Variable		
GSCM practices. To what extent does your firm invest resources (e.g., money and people) in programs in the following areas? *(1=not at all; 5=a very great extent)*		
GSCM practices	Design for disassembly, reuse, recycling, recovery of material, components, parts.	0.691
	Environmentally friendly product design.	0.787
	Effective management of environmental risks affecting your business.	0.734
	Environmental improvement of packaging and transportation.	0.706
	Improvement of our enterprise's overall environmental situation.	0.798
	Environmentally friendly manufacturing processes.	0.777
	Cronbach's Alpha = 0.884; AVE = 0.558	
Position in supply network	Which option best describes your firm's position within the overarching supply network? 1 = OEM 2 = system supplier 3 = component supplier 4 = raw material supplier	n.a.
Independent/Mediating Variable		
Customer pressure. Regarding the environmental activities of your firm's most important direct customers, to what extent do your customers place emphasis on the following practices? *(1=not at all; 5=a very great extent)*		
Customer pressure	Our customers go beyond basic compliance with laws and regulations on environmental issues.	0.704
	Our customers have established environmental impact and performance assessments for their production processes and/or products.	0.913
	Our customers have established environmental performance and commitment evaluations and audits.	0.945
	Cronbach's Alpha = 0.887; AVE = 0.739	
Supplier Capabilities. Regarding the environmental activities of your firm's most important direct suppliers, to what extent do your suppliers place emphasis on the following practices? *(1=not at all; 5=a very great extent)*		
Supplier capabilities	Our suppliers have established long-term environmental management systems.	0.821
	Our suppliers incorporate innovative environmental management programs.	0.892
	Our suppliers have established environmental impact and performance assessments for their production processes and/or products.	0.819
	Cronbach's Alpha = 0.881; AVE = 0.714	
Control Variables		
Return on investment (ROI)	Please value your company's ROI in comparison with those of your competitors. *(1: substantially lower; 7: substantially higher)*	n.a.
Firm size	Measured based on the number of firm employees. (1: <249; 2: 250–499; 3: 500–999; 4: 1,000–2,499; 5: 2,500–4,999; 6: 5,000–10,000; 7: 10,000–24,999; 8: >25,000)	n.a.
Industry Diversity. Please mark the extent to which you agree or disagree with the following statements about the diversity in your organization's industry *(1=strongly disagree; 5=strongly agree)*.		
Industry diversity	In our industry, there is considerable diversity in customer buying habits.	0.658
	In our industry, there is considerable diversity in nature of competition.	0.752
	In our industry, there is considerable diversity in process/product lines.	0.709
	Cronbach's Alpha = 0.747; AVE = 0.496	
Industry type	Please specify the industry you are working in.	n.a.

Notes: All standardized loadings are significant at the $p<0.01$ level.