Strategic sustainable purchasing, environmental collaboration, and organizational sustainability performance: the moderating role of supply base size

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Abstract

Purpose – This paper aims to examines the moderating effect of small vs large supply base size on the relationship between strategic sustainable purchasing (SSP) and organizational sustainability performance (OSP). SSP is conceptualized as a dynamic capability consisting of strategic purchasing and environmental purchasing. Environmental collaboration is conceptualized as a mediator between SSP and OSP. Extant research has not examined the effect of the size of the supply base on the relationship between SSP and OSP.

Design/methodology/approach – The hypothesized relationships are tested using a two-step multi-group analysis in partial least squares-structural equation modeling (PLS-SEM).

Findings – A small supply base size positively moderates the relationship between SSP and environmental collaboration, thus achieving OSP. In contrast, when the supply base is large, strategic purchasing is positively associated with environmental collaboration, while environmental purchasing is negatively related to environmental collaboration. A large supply base has a positive relationship to environmental collaboration and economic sustainability, while the relationship between environmental collaboration and environmental and social performance is not significant.

Practical implications – This research argues that despite the nuances in the moderating effects of small versus large supply base size, managers need to invest in both dynamic and relational capabilities to achieve organizational sustainability.

Originality/value – Scant research is available in supply chain management research that has examined the important effect of the supply base size on the relationship between SSP and OSP. This research aims to fill this gap. The study helps practitioners understand the effects of supply base sizes for their organizations, increase interrelationships among suppliers, reduce the level of differentiation among them, and, thereby, reduce costs and increase revenues.

Keywords Strategic sustainable purchasing, Organizational sustainability performance, Supply base size, Organizational capabilities, Multi-group analysis, Performance, Sustainability, Supplier relationships, Dynamic capabilities

Paper type Research paper

Introduction

In the past decade, strategic purchasing has evolved as an area of interest for sustainability researchers, with the domain of "sustainability" being labeled as "green supply chain" (Bowen *et al.*, 2001; Vachon and Klassen, 2006; Kirchoff *et al.*, 2016), "socially responsible purchasing" (Carter, 2004), and most recently, "closed-loop supply chain" (Lee and Lam, 2012; Bell *et al.*, 2013). Strategic purchasing is an active part of the corporate planning process (Cavinato, 1999), which facilitates beneficial organization – environment alignment (Carter and Narasimhan, 1996) and fosters cross-functional integration among supply chain activities. In contrast, environmental purchasing consists of activities such as reduction, recycling, reuse and substitution of materials. Strategic sustainable purchasing (SSP) in a supply chain combines the concepts of strategic purchasing and environmental purchasing, with the objective of attaining sustainability performance of the firm.

Organizational sustainability performance (OSP) deals with economic, environmental and social aspects of corporate activity, within and outside a market or regulatory framework and includes issues such as revenues, sustained profitability,

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competitive advantage, employee welfare, community programs, charitable donations and environmental protection (Carter and Rogers, 2008). Sustainable sourcing and OSP measurement practices leading to sustainable supply chain management have emerged as significant research areas in the supply chain management literature (Lu *et al.*, 2018; Ni and Sun, 2018; Kähkönen *et al.*, 2018; Montabon *et al.*, 2016; Thomas *et al.*, 2016; Paulraj, 2011; Foerstl *et al.*, 2015). An organization is no more sustainable than its supply chain and the suppliers selected and retained by the company (Krause *et al.*, 2009). The size of the supply base (i.e. the number of suppliers and the level of differentiation and interrelationships among them) plays a critical role in building strong environmental collaboration and organizational capabilities among collaborating firms for achieving sustainability throughout the complex supply chain (Foerstl *et al.*, 2015; Canzaniello *et al.*, 2017; Tse *et al.*, 2016).

A review of extant literature shows that one of the main concerns of purchasing managers is the impact of environmental regulation on purchasing activities (Paulraj, 2011; Foerstl *et al.*, 2015; Stanczyk *et al.*, 2015; Schmidt *et al.*, 2017; Fan and Stevenson, 2018), as well as the idea that environmental purchasing can improve a firm's economic position by reducing disposal and liability costs, conserving resources and improving public image (Carter *et al.*, 2000; Yang *et al.*, 2018). Researchers (Paulraj, 2011; Foerstl *et al.*, 2015) have established positive linkages between firms' supply base size and organizational sustainability to maximize value creation (from sustainable sourcing decisions to actual sustainability) and respond to turbulent business conditions (Carter *et al.*, 2000; Christopher, 2000; Liao *et al.*, 2010; Arora *et al.*, 2016; Schmidt *et al.*, 2017; Kauppi and Hannibal, 2017; Fan and Stevenson, 2018). Others have explored the relationship between supply chain uncertainty and supply base size (Vachon and Hajmohammad, 2016; Tse *et al.*, 2016; Fan and Stevenson, 2018) and the effect of supply base size on innovation strategies of the firm (Ates *et al.*, 2015; Mackelprang *et al.*,2018). Supply base size has long been studied in supply chain literature from many perspectives as it pertains to supply chain risk (Burke *et al.*, 2007; Kalaitzi *et al.*, 2019). However, supply chain management researchers have not examined the effect of the size of the supply base on the relationship between SSP and OSP. Given that the size of the supply base has significant implications for both sustainable purchasing decisions and organizational sustainability, omission of this important variable is a significant gap in the literature. To address this gap, this research examines the moderating effects of supply base size on SSP, environmental collaboration and OSP.

Theoretical background

Terminology and definitions

Table 1 defines key terms related to SSP, organizational capabilities, supply base, environmental collaboration and OSP. These definitions are taken from existing literature.

Supply chain relationships, capabilities and collaboration

Supply chain relationships can be short-term bargaining relationships or *discrete exchanges* between buyers and sellers characterized by limited communication between parties and exclude relational interactions (Ring and van de Ven, 1992). On the other hand, relatively long-term relationships or *relational exchanges* between buyers and sellers involve trust and relationship building over longer periods of time with recurring transactions, long-term investments and mutually beneficial partnerships (Dwyer *et al.*, 1987; Fletcher *et al.*, 2016; Nakamba *et al.*, 2017; Eitiveni *et al.*, 2018). SCM researchers (Crum and Palmatier, 2004; Omar *et al.*, 2012; Tsanos *et al.*, 2014; Arora *et al.*, 2016; Zhang and Cao, 2018; Huang *et al.*, 2020) have focused on coordinated capabilities such as: demand collaboration, supplier-manufacturer-buyer relationships, business-to-business relationships, integration, joint ventures, alliances and networks. In doing so, they characterize collaboration as "cooperative behavior" or "joint decision-making" between companies engaged in interorganizational efforts (Arora *et al.*, 2016). Supply chain collaboration through coordination, adaptation and relationship building affect partner responsibilities in the supply chain along with price-setting and governance mechanisms in inter-firm exchanges. These exchanges further impact trust between partners, setting of joint objectives and relationship-specific investments and reward structures (Arora *et al.*, 2016).

Sustainable supply chains integrate social, environmental and economic objectives in supply chain activities (Gold *et al.*, 2010), which can be achieved by providing and implementing relevant resources and capabilities throughout the supply chain (Bowen *et al.*, 2001; Eitiveni *et al.*, 2018). Sustainable supply chain capability is "[. . .] an organization's capacity to deploy its resources exercised through organizational processes involved in sustainable practices [. . .]" (Kurnia *et al.*, 2014, p. 6) highlighted through SSP. This research conceptualizes SSP as a construct consisting of strategic purchasing and environmental purchasing. Strategic purchasing involves: highlighting strategic (economic and competitive) benefits for the firm that are mutually shared with supply chain members; demonstrating sustained profitability for both the firm and its supply chain partners; and developing and integrating competences of supply chain partners to achieve mutual goals and objectives that are "nonexcludable" and can be shared by all parties (Romer, 1990), thus engendering synergistic, positive-sum gains through collaboration (Madhok and Tallman, 1998; Chen *et al.*, 2015; Fletcher *et al.*, 2016; Nakamba *et al.*, 2017). In a similar vein, environmental (or green) purchasing is "an environmentally conscious purchasing practice that reduces sources of waste and promotes recycling and reclamation of purchased materials without adversely affecting performance requirements of such materials" (Min and Galle, 2001, p. 1222).

This research conceptualizes SSP as a dynamic (firm-specific) capability essential for achieving sustainability. The dynamic capabilities view (DCV) of the firm refers to "the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments" (Teece *et al.*, 1997, p. 516). These capabilities can engender sustainable competitive advantage because they: are not tradable in strategic factor markets, take a long time to develop and are historically based and path dependent and entail socially complex relationships to other organizational

Table 1 Definitions of key terms

Term	Definition	Sources
SSP	SSP is an amalgamation of strategic and environmental purchasing Strategic purchasing is the process of planning, evaluating, implementing and controlling highly important and routine sourcing decisions Environmental purchasing captures purchasing's involvement in supply chain management activities to facilitate recycling, reuse and resource reduction	Foerstl *et al.* (2015); Montabon *et al.* (2016); Carter *et al.* (2000), Rauer and Kaufmann (2015)
Environmental collaboration	Environmental collaboration in the supply chain reflects the direct relationship of an organization with its suppliers to jointly develop environmental solutions	Zhu and Sarkis (2004), Vachon and Klassen (2006); Paulraj (2011); Paulraj *et al.* (2015); Schmidt *et al.* (2017)
Supply base	This term is operationalized as "limited number of suppliers." It reflects the extent to which firms increasingly undertake close, relational contracts with a smaller number of dedicated suppliers	Shin *et al.* (2000); Schmidt *et al.* (2017)
Dynamic capability	Dynamic capability is a firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments	Teece *et al*. (1997); Peng *et al*. (2013); Handfield *et al.* (2015)
Relational capability	Relational capability is a firm's ability to secure and use resources by sharing and collaborating across firms and boundaries	Bowen *et al.* (2001); Fawcett *et al*. (2015)
Sustainability performance	Sustainability performance is an outcome-related term measuring the intersection of economic, environmental and social dimensions	Carter and Rogers (2008), Paulraj (2011); Foerstl *et al.* (2015); Montabon *et al.* (2016); Schmidt *et al*. (2017)

resources (Barney, 1991; Peng *et al.*, 2013; Fletcher *et al.*, 2016; Nakamba *et al.*, 2017; Yang *et al.*, 2018).

Research also suggests that relational capabilities facilitate sustainability (Bowen *et al.*, 2001; Shou *et al.*, 2017). Relational capabilities, also referred to as "relational capital" or "relational resources," help firms access rent-yielding resources through long-term orientation, cooperative partnerships and strategic collaboration (Eisenhardt and Schoonhoven, 1996; Fawcett *et al.*, 2015). Companies such as Toyota effectively cooperate and collaborate with suppliers through dynamic capabilities, enhancing both parties' competitive positions in the industry (Dyer and Nobeoka, 2000). Because these dynamic and relational sustainability initiatives can be risky and resource consuming (often crossing organizational boundaries), an added dimension of "environmental collaboration," along with the nature of the supply base (the number of suppliers in a supply chain), can help firms work more closely with suppliers to gain access to essential relational capabilities (Dyer and Singh, 1998; Paulraj, 2011; Fawcett *et al.*, 2015) and achieve organizational sustainability. OSP stems from the moderating effects of supply base size on SSP and environmental collaboration linkages in the supply chain management environment.

Supply base

Supply bases are critical to the success of sustainable supply chains. Supply base is a system of networked organizations whose activities are coordinated and controlled by the buying firm (Choi and Krause, 2006). A limited number of suppliers and/or a shrinking supply base can sometimes pose upstream and/or downstream supply/demand issues. Therefore, relationship management of supply bases is critical for organizational sustainability (Carter *et al.*, 2000). Focusing on the power of supply bases in ever-changing business environments, Christopher (2000) notes that "it is the ability of the suppliers that limits the ability of a manufacturer to respond rapidly to customer requirements" (p. 43). Companies (e.g. Gap and Cisco) manage their supply bases in ways that maximize value creation by tailoring their supply chains to market conditions and respond to changing customer requirements by customizing products to suit the turbulent environments (Liao *et al.*, 2010; Schmidt *et al.*, 2017). These actions executed by companies are considerably influenced by the number of suppliers or the size of the supply base. The more a focal company decides to purchase components, parts or services instead of making them, the more it becomes dependent of its supply base. The number of suppliers bears on the complexity of the focal firm's supply base while also affecting the sources available to the focal firm. While existing research has not investigated the role of supply base size, we examine the moderating role of supply base size on the relationships among key variables in our conceptualization. Please refer to Appendix for an operational definition and scales used for the "supply base" construct.

Performance metrics

Economic performance in a supply chain can be measured by its impact on purchase cost of raw materials, consumption cost of energy, discharge cost of waste and other financial measures, such as return on investment and earnings per share (Zhu and Sarkis, 2004; Paulraj, 2011; Foerstl, *et al.*, 2015; Montabon *et al.*, 2016; Schmidt *et al.*, 2017). Economic performance measures often span beyond organizational boundaries of the focal firm. Automobile companies such as Hyundai share their best practices of cost reduction with their upstream suppliers and downstream dealers/distributors to create a win-win situation for all entities in the supply chain. The same applies to sharing of best practices to improve environmental and social performance of the supply chain. In the supply chain literature, economic performance has been examined more often than environmental or social performance.

Environmental impact can be defined as a modification of the natural environment due to the actions of an organization (Chardine-Baumann and Botta-Genoulaz, 2014). These

actions may be direct or indirect and they may have a potentially harmful effect. According to extant literature, environmental performance in a supply chain can be measured by its impact on reduction in CO_2 and waste emissions, decrease in environmental accidents and consumption of hazardous material and increase in energy savings because of efficiency improvements (Zhu and Sarkis, 2004; Paulraj, 2011; Foerstl, *et al.*, 2015; Montabon *et al.*, 2016; Schmidt *et al.*, 2017). It is evident that environmental actions of an organization will have an impact beyond the organizational boundaries – on the natural environment and the entire supply chain – both upstream and downstream.

Social performance assesses the social consequences of an organization's activities which affects many stakeholders such as employees, suppliers, customers and society. It can be measured by assessing the impact of improvement in occupational and community health and safety, improvement in stakeholder welfare, etc (Bansal, 2005; Paulraj, 2011; Foerstl *et al.*, 2015; Montabon *et al.*, 2016; Fletcher *et al.*, 2016; Schmidt *et al.*, 2017; Nakamba *et al.*, 2017). Evidently, the construct of social performance goes beyond the organization and dyadic relationships; it spans the entire supply chain including all stakeholders.

Table 2 summarizes important literature that explores the relationship among purchasing, supply base, environmental collaboration and sustainability performance. The table also positions our study in the context of existing research and delineates the incremental contribution.

Conceptual framework and hypotheses development

Figure 1 depicts the hypothesized model illustrating the moderating effects of supply base size (small vs large) on SSP and environmental collaboration linkages for achieving OSP. It examines the moderating effects of supply base size on SSP, environmental collaboration and sustainability (economic, environmental and social) performance of firms.

Moderating effect of supply base on the strategic sustainable purchasing – environmental collaboration link

Chen *et al.* (2004) document how firms with strategic purchasing are able to foster long-term, cooperative relationships and achieve greater responsiveness to the needs of their suppliers. Strategic purchasing is a firm capability to generate more accurate expectations of the future value of a resource (Barney, 2012; Bell *et al.*, 2013; Yang *et al.*, 2018). DCV theory stresses the importance of heterogeneous purchasing capabilities in creating imperfectly competitive strategic factor markets that make competitive advantage in product markets possible (Barney, 2012). Previous research has established that strategic alliances in which partners exchange timely, accurate and relevant information and share critical and sensitive information are more successful than alliances that do not exhibit those communication behaviors (Mohr and Spekman, 1994; Canzaniello *et al.*, 2017). In line with prior research, SSP is envisioned as a reflective higher-order concept encompassing both strategic and environmental purchasing (Carter *et al.*, 2000; Paulraj, 2011).

Environmental collaboration is instrumental in developing and supporting the environmental initiatives and practices of suppliers (Dai *et al.*, 2015; Handfield *et al.*, 2015; Chen *et al.*, 2015) and is based on the relational capability of the firm, in which the firm shares resources across suppliers. SSP is critical to facilitating close interactions with a limited number of suppliers, thus making effective use of the firm's supply base (Cousins, 1999). Firms that foster cooperative relationships with a limited number of suppliers can obtain substantial revenue gains and cost savings (Cooper and Ellram, 1993; Tse *et al.*, 2016).

The supply base comprises the number of suppliers, their interactions and their interrelationships, which vary depending on their organizational culture, size, location, technology, etc (Choi and Krause, 2006). A practice in supply chain management is to adopt supply base reduction strategies (Cousins, 1999) to facilitate closer cooperation between buyer and supplier firms, allowing the buyer to transfer key resources, knowledge and capabilities to the direct or "first-tier" supplier (Lamming, 1993). A strategic partnering approach with a large number of suppliers is a key resource for facilitating strategic purchasing initiatives in green supply management (Terpend and Krause, 2015). In contrast, collaboration between the firm and a limited number of suppliers facilitates communication and information transfer, thus building confidence in inter-organizational relationships to aid in the implementation of environmental purchasing initiatives:

H1. The size of the supply base (small vs large) moderates the relationship between strategic purchasing and environmental collaboration: The larger the supply base, the stronger is the relationship; the smaller the supply base, the weaker is the relationship.

H2. The size of the supply base (small vs large) moderates the relationship between environmental purchasing and environmental collaboration: The larger the supply base, the weaker is the relationship; the smaller the supply base, the stronger is the relationship.

Moderating effect of supply base on the environmental collaboration- organizational sustainability performance link

Many organizations' business models increasingly use environmental aspects of performance in line with the triple-bottom-line concept (Birkin *et al.*, 2009; Kirchoff *et al.*, 2016). Firms trying to improve their OSP may work with suppliers to reduce material toxicity or the amount of packaging used in supplies (Sharfman *et al.*, 2009). The need to go beyond an organization's boundaries highlights the key role of procurement in sustainable development, a notion reflected in the high volume of research related to green supply chain management and sustainable procurement practices (Foerstl *et al.*, 2015; Montabon *et al.*, 2016; Schmidt *et al.*, 2017).

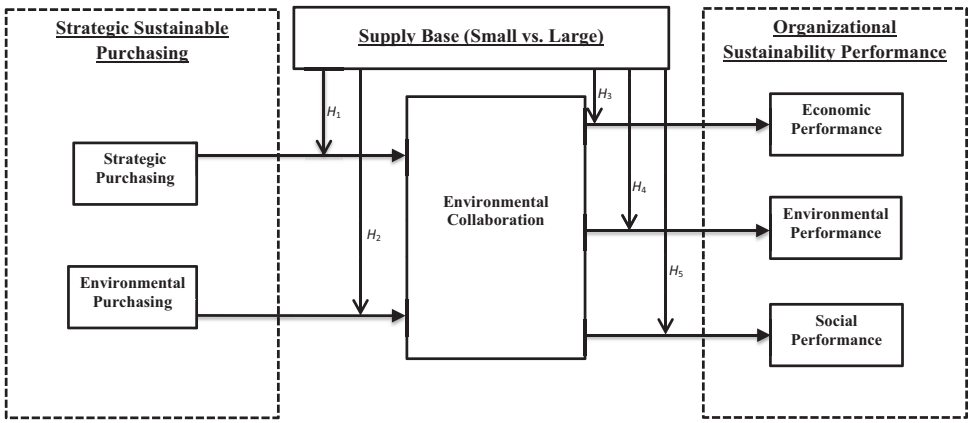
Researchers who invoke transaction cost theory have argued that the reduction of a firm's supplier base and close supplier interactions (environmental collaboration) may expose the firm to transaction-related risk arising from supplier opportunism and loss of flexibility because of high relationship-specific investments (Williamson, 1991). The relational view and the

Table 2 Overview of existing research on the effect of purchasing on sustainability performance

			Variables							
	Study	Main focus/results	Strategic purchasing/ sourcing	Environmental purchasing	Environmental collaboration	Supply base	Economic performance	Environmental performance	Social performance	Method
1	Narasimhan and Das (1999)	Investigates the influence of strategic sourcing and advanced manufacturing technologies on specific manufacturing flexibilities and examines relationships among different flexibilities. The results are tied to manufacturing cost reduction	✓				✓			SEM
2	Shin *et al.* (2000)	Empirically demonstrates that an increase in supplier management orientation improves both suppliers' and buyers' performance					✓			SEM
3	Choi and Hong(2002)	Explores how the structure of supply networks operates. The structure is framed in three dimensions (formalizations, centralization and complexity) that affect one another progressively. Cost consideration appears to be the overarching force that shapes the supply network structure	✓			✓				Case study
4	Chen *et al.* (2004)	Provides support for the links among strategic purchasing, supply management, customer responsiveness, and financial performance of the buying firm	✓			✓	✓			SEM
5	Zhu and Sarkis(2004)	Examines the relationships between green supply chain management practices and performance. In addition, moderating effects of quality management and just-in-time manufacturing operation philosophies shows that in some cases, the inclusion or exclusion of these philosophies might cause worse or better performance			✓		✓	✓		Regression
6	Bansal (2005)	Operationalizes corporate sustainable development and determines its organizational determinants. The findings show that both resource-based and institutional factors influence corporate sustainable development					✓	✓	✓	Regression
7	Krause *et al.* (2009)	Provides direction for future sustainability research, particularly in the context of purchasing and supply chain management	✓				✓	✓	✓	Conceptual
8	Paulraj (2011)	Empirically evaluates the effect of firm-specific resources and/or capabilities on sustainable supply management and sustainability performance. Enviropreneurship and strategic purchasing are, respectively, recognized as firm-specific capabilities and resources that are fundamental to pursuing sustainable supply practices	✓		✓		✓	✓	✓	SEM
9	Foerstl *et al.* (2015)	Explores the drivers and mechanisms of first-tier supplier engagement in sustainable supply chain management	✓	✓			✓	✓	✓	Case study
10	This research	Examines the moderating effect of supply base size (small vs large) on SSP, environmental collaboration and OSP	✓	✓	✓	✓	✓	✓	✓	PLS-SEM

Notes: SSP = strategic sustainable purchasing; OSP = organizational sustainability performance; SEM = structural equation modeling; PLS-SEM = partial least squares-structural equation modeling

Figure 1 Conceptual framework



relational competency perspective uphold the argument that environmental collaboration, close ties with a limited number of suppliers, and increasing investments in relationship-specific assets ultimately foster greater trust, dependability and cooperation among supply chain partners (Dyer and Singh, 1998; Paulraj, 2011; Fawcett *et al.*, 2015).

With purchasing at the beginning of the value chain, a firm's OSP (economic, environmental and social) efforts will likely not be successful without integrating the company's sustainability goals with purchasing activities spanning across organizational boundaries (Walton *et al.*, 1998; Thomas *et al.*, 2016). Effective supply base management results in better supply chain partnerships (Spekman *et al.*, 1998; Handfield *et al.*, 2015; Brahm and Tarzijan, 2016; Canzaniello *et al.*, 2017; Lu *et al.*, 2018; Ni and Sun, 2018; Kähkönen *et al.*, 2018), with large supply bases achieving better economic performance for the firm than small supply bases. In contrast, collaboration with a limited number of suppliers and close interactions play a pivotal role in influencing the social and environmental performance of the firm. Relational view scholars explain that competitiveness arises not from firm but rather interfirm sources of advantage (Dyer and Singh, 1998; Lavie, 2006; Shou *et al.*, 2017). The relational view focuses on pairs of firms that jointly invest in relationships, knowledge and resources to benefit the whole network, collectively leading to organizational performance. As such, this view provides theoretical support for the role of collaborations in a supply chain with the aim to achieve environmental goals and organizational sustainability:

H3. The size of the supply base (small vs large) moderates the relationship between environmental collaboration and economic performance: the larger the supply base, the stronger is the relationship; the smaller the supply base, the weaker is the relationship.

H4. The size of the supply base (small vs large) moderates the relationship between environmental collaboration and environmental performance: the larger the supply base, the weaker is the relationship; the smaller the supply base, the stronger is the relationship.

H5. The size of the supply base (small vs large) moderates the relationship between environmental collaboration and social performance: the larger the supply base, the weaker is the relationship; the smaller the supply base, the stronger is the relationship.

Methodology

To test the conceptual framework, data was collected from supply chain professionals using a questionnaire. In subsequent sections, measures used in the framework, the data collection process and data analysis are discussed.

Measures

The questionnaire consisted of measures from existing literature that were adapted to this study. Following prior research, SSP was conceptualized as a second-order construct reflecting two first-order dimensions: strategic purchasing (Chen *et al.*, 2004; Paulraj, 2011) and environmental purchasing (Carter *et al.*, 2000). Environmental collaboration reflects items measuring the extent to which firms cooperate with suppliers to develop strategic and environmental practices and provide them with equipment, materials, specifications and expertise to achieve environmental goals (Zhu and Sarkis, 2004; Paulraj *et al.*, 2015). "Supply base" was operationalized using items reflecting the extent to which an organization undertakes close, relational contracts with a small or large number of suppliers (Shin *et al.*, 2000; Chen *et al.*, 2004).

Following prior research on sustainable supply chain management (Carter and Rogers, 2008), sustainability performance was modeled as a second-order construct that reflects three dimensions of sustainability, namely, economic, environmental and social. Economic performance was measured with items tapping the dimensions of cost, earnings per share and return on investments (Zhu and Sarkis, 2004; Paulraj, 2011). Environmental performance was measured with items covering improvements along dimensions of air emission, waste, environmental accidents, consumption of hazardous materials and energy savings (Zhu and Sarkis, 2004; Paulraj, 2011). Finally, social performance was measured with items covering improvements along dimensions of social welfare and betterment, community health and safety, risks to

the general public and health and safety of employees (Bansal, 2005; Paulraj, 2011).

Items representing all the theoretical factors were captured with a five-point Likert scale. Firm size is a control factor, and the number of employees and annual revenue were used as measures of firm size. Both variables were operationalized using ordinal scales and included them as dummy variables (the Appendix lists the measures).

Sample and data collection

A Web-based survey questionnaire was constructed as per guidelines provided by Dillman *et al.* (2008). Prior to administering the survey, it was pretested with four supply chain researchers and industry experts for face validity and readability. Feedback from the pretest enabled us to fine-tune the wording of some questions to ensure their correct interpretation and to increase clarity. The revised survey was then distributed to a sample of purchasing practitioners using a web-based survey commercially hosted by SurveyMonkey (www.surveymonkey.com).

The potential respondents were pre-qualified by SurveyMonkey to ensure that they had sufficient knowledge of their firm's purchasing activities. The final list of respondents were employees at various levels in purchasing departments in a variety of industries including food and beverage, consumer products, electronics and computers and pharmaceuticals. All respondents were compensated by SurveyMonkey and no additional compensation was provided by the research team. Each respondent was notified about the survey and an email containing the survey link was distributed to 2,082 respondents. All respondents were sent regular weekly reminders to complete the survey. At the end of six weeks after the initial distribution of the questionnaire, 317 usable surveys were returned, for an overall response rate of 15.2%. Table 3 provides demographic information of the survey respondents. In total, 40.1% of the firms had less than 100 employees, while 37.2% of the firms had more than 500 employees. In total, 27.4% of the firms had annual revenue of more than $100m.

To conduct the multi-group analysis using supply base size, the sample was split into two groups. The first group consisted of companies having a large supply base and the second group contained companies having a small supply base. These two groups were classified according to responses to the supply base scale item "we rely on a [...] number of suppliers" (refer Appendix) on a five-point Likert scale, where 1 and 2 represented *large* and *somewhat large* supply base, 3 represented *neither large nor small* and 4 and 5 represented *somewhat small* and *small* supply base. This resulted in groups of 112 large and 205 small subsample sizes.

Non-response bias

Non-response bias was tested by comparing first 50 responses and last 50 responses in terms of number of employees and annual revenue (Armstrong and Overton, 1977) using a *t*-test to look for statistically significant differences in the responses. No significant differences were found, and therefore, we conclude that non-response bias did not affect the study.

Table 3 Demographics of respondents

	(%)
Number of employees	
Less than 100	40.1
101–200	10.4
201–500	12.3
501–1,000	10.7
1,001–5,000	13.9
More than 5,000	12.6
Annual turnover	
Less than $10m	47.8
$10m to $50m	12.9
$50m to $100m	11.7
$100m to $500m	8.8
$500m to $1bn	7.6
$1bn to $5bn	6.3
more than $5bn	4.7
Industry sector	
Food and beverage	15.8
Consumer products	13.6
Textiles	9.2
Consumer products	6.1
Electronics and computers	5.7
Financial services	3.5
Industrial products	3.2
Pharmaceuticals	3.2
Building material	2.5
Consulting services	2.2
Paper products	2.2
Transportation	1.6
Home improvement	1.6
Other	29.6

Testing for common method bias

To reduce common method bias (Podsakoff and Organ, 1986), strategic purchasing, environmental purchasing and environmental collaboration items preceded the dependent variables measurement items. Furthermore, Harman's one-factor test was used post hoc to examine the extent of the potential bias. After all items were entered into the factor analysis model, seven factors emerged, with the first factor accounting for only 14.1% of the total variance. In addition, no general factor emerged from the factor analysis. Thus, common method variance was not deemed a serious issue in this study.

Data analysis

The conceptual model (Figure 1) was tested by analyzing the data using partial least squares (PLS) following a two-step process. The first step involved assessing the measurement model to evaluate the consistency, reliability and validity of the measures. The second step involved assessing the structural model to evaluate the significance and strength of the path coefficients between the variables.

Measurement model

The psychometric properties of indicator items were assessed in terms of item loadings, composite reliability, convergent

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validity and discriminant validity. Indicator reliability was tested using a bootstrapping procedure with 5,000 randomized samples taken from the original sample and of original cardinality (Henseler *et al.*, 2009). As Table 4 shows, all estimates of the outer loadings exceed the recommended minimum value of 0.7 (except for one indicator of strategic purchasing) and exhibit sufficient *t*-values.

The measurement model did not change when the size of the supply base was taken into account. In other words, factor loadings for the same indicators were invariant between small and large supply base observations, guaranteeing the metric invariance of the model (Afonso *et al.*, 2012; Calvo-Mora *et al.*, 2015). Table 5 reports the metric invariance assessment.

Convergent validity was assessed using the average variance extracted (AVE). As Table 6 shows, the AVE in all cases (for both subsamples) is above the recommended value of 0.5 (Fornell and Larcker, 1981; Henseler *et al.*, 2009), implying that the indicators share more variance with their respective constructs than with the error variances. As illustrated in Table 6, Cronbach's alphas for the constructs are all above the suggested cutoff value of 0.7 (Litwin, 1995), as are the CR values (Bagozzi and Yi, 1988; Henseler *et al.*, 2009). Next, the bootstrapping standard errors for AVE and CR estimates was used to compute a modified Welch test to assess measurement invariance across group-specific path model estimates (Ringle *et al.*, 2011). As Table 6 shows, the results of AVE and CR did not differ significantly between the small and large supply base, thus establishing measure model invariance, which is a necessary condition to compare structural model estimates.

AVE was to evaluate discriminant validity. Table 7 indicates the correlations between the latent variables and the square roots of the AVEs on the diagonal. The square root of AVE in each case is greater than the correlation values in the corresponding rows and columns. This indicates that discriminant validity is well established for all constructs (Fornell and Larcker, 1981; Henseler *et al.*, 2009).

Structural model

After evaluating and assuring measurement model validity, SmartPLS was used to test the structural model. Significance of the hypothesized paths was determined using the *T*-statistic calculated with the bootstrapping technique. The explanatory power of the structural model was assessed according to the variance accounted for by the endogenous variables (Oh *et al.*, 2012). With values of 0.455 (large supply base) and 0.644 (small supply base) for environmental collaboration, 0.610 (large supply base) and 0.410 (small supply base) for economic performance, 0.455 (large supply base) and 0.644 (small supply base) for environmental performance and 0.680 (large supply base) and 0.513 (small supply base) for social performance, the explanatory power of the model was at a satisfactory level. Stone–Geisser criterion Q^2 values were obtained by running blindfolding procedures; these ranged above the threshold value of 0 (i.e. 0.338–0.439), thus establishing the model's predictive relevance (Ringle *et al.*, 2011).

Table 8 shows the PLS results of the theoretical model that contains the moderating construct of supply base. The results include standardized path coefficients and significance based on two-tailed *t*-tests for the small and large supply base. The results for the small supply base indicate that all hypothesized relationships were significant. Specifically, the relationships between strategic purchasing and environmental collaboration ($b = 0.169$, $p < 0.05$), environmental purchasing and environmental collaboration ($b = 0.688$, $p < 0.001$), environmental collaboration and economic performance ($b = 0.640$, $p < 0.001$), environmental collaboration and environmental performance ($b = 0.692$, $p < 0.001$) and environmental collaboration and social performance ($b = 0.716$, $p < 0.001$) all were significant. The results for the large supply base indicated that the relationships between strategic purchasing and environmental collaboration ($b = 0.296$, $p < 0.05$) and environmental collaboration and economic performance ($b = 0.781$, $p < 0.001$) were significant. The relationships between environmental collaboration and environmental performance and environmental collaboration and social performance were nonsignificant. Finally, the relationship between environmental purchasing and environmental collaboration ($b = –0.531$, $p < 0.001$) was negative and significant.

Hypotheses testing and discussion of results

The moderating effect of supply base size on the relationship between strategic purchasing and environmental collaboration was significant for both the large and small supply base. Although the coefficient for the small supply base ($b = 0.169$ $p < 0.05$) was smaller than that for the large supply base ($b = 0.296$ $p < 0.05$), this is directionally consistent with *H1*. The difference between the path coefficients of the two groups was not significant.

When the supply base is small, the relationship between environmental purchasing and environmental collaboration is positive ($b = 0.688$, $p < 0.001$) while for a large supply base, relationship between environmental purchasing and environmental collaboration is negative ($b = –0.531$, $p < 0.001$). Recall that *H2* predicts that the former coefficient is larger than the latter coefficient. While this indeed is true and the difference in coefficients is statistically significant, the coefficient is negative and significant for large supply base. This negative relationship may help explain why firms with a large number of suppliers find it more difficult to coordinate environmental than strategic purchasing initiatives.

The moderating effect of supply base size on the relationship between environmental collaboration and economic performance is significant for both large and small supply bases (large supply base: $b = 0.781$; small supply base: $b = 0.640$; $p < 0.001$). While the smaller coefficient for the small supply base is in line with *H3*, the *p*-value for difference between the path coefficients was not significant (*p*-value = 0.051).

Study results indicate that for the small supply base, there is a positive relationship between environmental collaboration and environmental performance and a positive relationship between environmental collaboration and social performance. For the large supply base, the relationships between environmental collaboration and environmental performance was not significant and relationship between environmental

Table 4 Latent variables' measurement models

Latent variable	Indicator	Small supply base (n = 205) Outer loadings	*t*-value	Large supply base (n = 112) Outer loadings	*t*-value
Strategic purchasing (SP)	Purchasing is included in the firm's strategic planning process	0.827	24.443	0.850	21.431
	The purchasing function has a good knowledge of the firm's strategic goals	0.813	23.116	0.870	31.008
	Purchasing performance is measured in terms of its contributions to the firm's success	0.784	18.695	0.867	30.842
	Purchasing professionals' development focuses on elements of the competitive strategy	0.747	15.667	0.860	28.300
	Purchasing department plays an integrative role in the purchasing function	0.788	17.342	0.871	31.321
	Purchasing's focus is on longer term issues that involve risk and uncertainty	0.754	24.548	0.746	11.471
	The purchasing function has a formally written long-range plan	0.668	15.034	0.759	12.921
	Purchasing's long range plan includes the kinds of materials or services to be purchased	0.787	22.874	0.795	15.554
	Purchasing's long range plan includes various types of relationships to be established with suppliers	0.762	2.254	0.837	20.263
	Purchasing is considered to be a vital part of our corporate strategy	0.774	18.897	0.886	22.818
	The chief purchasing officer has high visibility within top management	0.809	21.096	0.822	16.967
	Top management emphasizes the purchasing function's strategic role	0.795	21.147	0.809	16.484
Environmental purchasing (EP)	Purchases recycled packaging	0.715	13.181	0.721	10.316
	Purchases packaging that is of lighter weight	0.655	8.965	0.824	12.470
	Uses a life-cycle analysis to evaluate the environmental friendliness of products and packaging	0.872	42.072	0.842	26.798
	Participates in the design of products for disassembly	0.873	42.447	0.801	16.509
	Asks suppliers to commit to waste reduction goals	0.864	37.076	0.826	21.358
	Participates in the design of products for recycling or reuse	0.867	42.374	0.758	9.946
Environmental collaboration (EC)	We cooperate with our suppliers to achieve environmental objectives	0.847	32.350	0.847	20.076
	We provide our suppliers with design specification that include environmental requirements for purchased items	0.887	48.552	0.883	30.321
	We encourage our suppliers to develop new source reduction strategies	0.904	56.161	0.881	29.692
	We cooperate with our suppliers to improve their waste reduction initiatives	0.882	38.786	0.864	24.783
	We work with our suppliers for cleaner production	0.893	41.258	0.755	10.336
	We collaborate with our suppliers to provide materials, equipment, parts and/or services that support our environmental goals	0.902	50.487	0.854	21.386
Economic performance (ECP)	Decrease in cost of materials purchased	0.862	25.857	0.861	26.569
	Decrease in cost of energy consumption	0.848	25.615	0.855	22.295
	Decrease in fee for waste discharge	0.837	33.400	0.839	23.613
	Improvement in return on investment	0.869	35.999	0.889	31.087
	Improvement in earnings per share	0.880	46.932	0.828	23.356
Environmental performance (EVP)	Reduction in air emission	0.884	44.276	0.797	16.816
	Reduction in waste (water and/or solid)	0.912	41.998	0.895	25.837
	Decrease in consumption of hazardous/harmful/toxic materials	0.935	79.211	0.866	28.056
	Decrease in frequency for environmental accidents	0.900	42.750	0.894	48.286
	Increase in energy saved due to conservation and efficiency improvements	0.904	36.322	0.796	16.263
Social performance (SLP)	Improvement in overall stakeholder welfare or betterment	0.860	35.642	0.877	30.552
	Improvement in community health and safety	0.918	69.950	0.892	32.864
	Reduction in environmental impacts and risks to general public	0.898	42.333	0.799	11.501
	Improvement in occupational health and safety of employees	0.853	20.797	0.917	43.387
	Improved awareness and protection of the claims and rights of people in community served	0.863	36.151	0.885	30.719

collaboration and social performance was also nonsignificant. These results are consistent with *H4* and *H5*, respectively.

Overall, the results support the core theme of the paper that the size of the supply base has an important moderating role to play in determining the relationship between SSP and organizational performance.

General discussion

Contribution of the research

As mentioned previously, a research gap exists in extant supply chain literature with respect to important effects of supply base size on the relationship between SSP and OSP. In this research the conceptual understanding of the interconnections among

Table 5 Metric invariance assessment multi-group analysis

Latent variable	Indicators	Outer loadings-difference	Parametric test *t*-value	Welch Satterthwait test *t*-value
SP	Purchasing is included in the firm's strategic planning process	0.023	0.424	0.442
	The purchasing function has a good knowledge of the firm's strategic goals	0.056	1.085	1.254
	Purchasing performance is measured in terms of its contributions to the firm's success	0.083	1.379	1.651
	Purchasing professionals' development focuses on elements of the competitive strategy	0.113	1.652	1.998
	Purchasing department plays an integrative role in the purchasing function	0.082	1.272	1.550
	Purchasing's focus is on longer term issues that involve risk and uncertainty	0.008	0.122	0.108
	The purchasing function has a formally written long-range plan	0.091	1.233	1.242
	Purchasing's long range plan includes the kinds of materials or services to be purchased	0.008	0.139	0.135
	Purchasing's long range plan includes various types of relationships to be established with suppliers	0.075	1.357	1.404
	Purchasing is considered to be a vital part of our corporate strategy	0.112	1.808	2.001
	The chief purchasing officer has high visibility within top management	0.013	0.210	0.214
	Top management emphasizes the purchasing function's strategic role	0.013	0.214	0.217
EP	Purchases recycled packaging	0.006	0.071	0.072
	Purchases packaging that is of lighter weight	0.169	1.540	1.725
	Uses a life-cycle analysis to evaluate the environmental friendliness of products and packaging	0.030	0.837	0.810
	Participates in the design of products for disassembly	0.072	1.591	1.370
	Asks suppliers to commit to waste reduction goals	0.038	0.902	0.850
	Participates in the design of products for recycling or reuse	0.109	1.753	1.393
EC	We cooperate with our suppliers to achieve environmental objectives	0.000	0.005	0.005
	We provide our suppliers with design specification that include environmental requirements for purchased items	0.004	0.117	0.112
	We encourage our suppliers to develop new source reduction strategies	0.023	0.759	0.695
	We cooperate with our suppliers to improve their waste reduction initiatives	0.018	0.444	0.428
	We work with our suppliers for cleaner production	0.138	2.261	1.822
	We collaborate with our suppliers to provide materials, equipment, parts and/or services that support our environmental goals	0.047	1.250	1.090
ECP	Decrease in cost of materials purchased	0.001	0.023	0.025
	Decrease in cost of energy consumption	0.007	0.133	0.139
	Decrease in fee for waste discharge	0.002	0.046	0.045
	Improvement in return on investment	0.020	0.508	0.528
	Improvement in earnings per share	0.051	1.414	1.286
EVP	Reduction in air emission	0.087	1.864	1.589
	Reduction in waste (water and/or solid)	0.018	0.451	0.430
	Decrease in consumption of hazardous/harmful/toxic materials	0.069	1.962	1.683
	Decrease in frequency for environmental accidents	0.006	0.199	0.225
	Increase in energy saved due to conservation and efficiency improvements	0.107	2.184	1.965
SLP	Improvement in overall stakeholder welfare or betterment	0.017	0.432	0.449
	Improvement in community health and safety	0.026	0.982	0.872
	Reduction in environmental impacts and risks to general public	0.099	1.693	1.371
	Improvement in occupational health and safety of employees	0.064	1.106	1.383
	Improved awareness and protection of the claims and rights of people in community served	0.023	0.584	0.604

these various elements of supply chains is advanced. More specifically, the findings of the study provide insights for practitioners to understand the effects of supply base sizes on economic, environmental and societal aspects of various approaches to purchasing.

Theoretical implications

First, the results reveal the importance of supply base size on the relationship between SSP and environmental collaboration. Both strategic and environmental purchasing positively and significantly affect environmental collaboration for firms with small supply bases. In contrast, strategic purchasing for firms with large supply bases positively affects environmental collaboration, while environmental purchasing for such firms negatively affects environmental collaboration. The reason behind the former finding is grounded in the relational view, according to which supply chain partners can collaborate more effectively and cooperatively to earn mutually shared supply chain benefits. Often, these benefits are

Table 6 Measurement model statistics for small and large supply base

Latent variable	Quality criterion	Supply base	Original sample	|Diff| means	*t*-value	*p*-value
SP	AVE	Small	0.603	0.089	1.430	0.154
		Large	0.692			
	Composite reliability	Small	0.948	0.016	1.292	0.197
		Large	0.964			
	Cronbach's alpha	Small	0.940	0.019	1.321	0.188
		Large	0.959			
EP	AVE	Small	0.660	0.026	0.447	0.655
		Large	0.634			
	Composite reliability	Small	0.920	0.008	0.386	0.700
		Large	0.912			
	Cronbach's alpha	Small	0.895	0.011	0.365	0.715
		Large	0.884			
EC	AVE	Small	0.785	0.065	1.321	0.187
		Large	0.720			
	Composite reliability	Small	0.956	0.017	1.287	0.199
		Large	0.939			
	Cronbach's alpha	Small	0.945	0.023	1.279	0.202
		Large	0.922			
ECP	AVE	Small	0.738	0.008	0.139	0.890
		Large	0.730			
	Composite reliability	Small	0.934	0.003	0.137	0.891
		Large	0.931			
	Cronbach's alpha	Small	0.912	0.004	0.166	0.868
		Large	0.907			
EVP	AVE	Small	0.823	0.099	1.430	0.152
		Large	0.724			
	Composite reliability	Small	0.959	0.030	1.940	0.052
		Large	0.929			
	Cronbach's alpha	Small	0.946	0.042	1.865	0.062
		Large	0.904			
SLP	AVE	Small	0.772	0.007	0.142	0.887
		Large	0.765			
	Composite reliability	Small	0.944	0.002	0.144	0.886
		Large	0.942			
	Cronbach's alpha	Small	0.926	0.003	0.145	0.885
		Large	0.923			

Note: AVE – average variance extracted

Table 7 Construct correlations and discriminant validity

	Small Ssupply base (*n* = 205)						Large supply base (*n* = 112)					
Construct	**ECP**	**EC**	**EVP**	**EP**	**SLP**	**SP**	**ECP**	**EC**	**EVP**	**EP**	**SLP**	**SP**
ECP	*0.859*						*0.855*					
EC	0.640	*0.886*					0.781	*0.848*				
EVP	0.670	0.692	*0.907*				0.755	0.775	*0.851*			
EP	0.611	0.791	0.632	*0.813*			0.541	0.659	0.551	*0.796*		
SLP	0.727	0.716	0.746	0.634	*0.879*		0.865	0.825	0.867	0.559	*0.875*	
SP	0.594	0.589	0.547	0.611	0.589	*0.777*	0.556	0.544	0.507	0.658	0.558	*0.832*

Notes: Square root of AVE on diagonal in italic face. Off-diagonal elements are the correlations among constructs

driven purely by economic concerns and members' goal to remain profitable in rapidly changing environments.

Second, SSP provides a good "fit" with the firm's strategic sustainability requirements and external environmental contingencies (Dai *et al.*, 2015). Strategic management research highlights the role of strategic purchasing and dynamic and relational capabilities in achieving sustainability performance (Chen *et al.*, 2004; Carter and Rogers, 2008;

Table 8 Structural model estimates for small and large supply base and *t*-test of group differences

Hyphothesis	Structural relation	Supply base	Path coefficient	*t*-value	*p*-value	|Diff| means	*t*-value	*p*-value
H1	SP → EC	Small	0.169	2.227	0.023*	0.127	0.894	0.371
		Large	0.296	2.077	0.038*			
H2	EP → EC	Small	0.688	9.777	0.000***	1.219	9.581	0.000***
		Large	−0.531	4.599	0.000***			
H3	EC → ECP	Small	0.640	14.222	0.000***	0.141	1.960	0.051
		Large	0.781	14.865	0.000***			
H4	EC → EVP	Small	0.692	10.863	0.000***	0.620	6.596	0.000***
		Large	0.072	1.360	0.174			
H5	EC → SLP	Small	0.716	14.375	0.000***	0.650	4.114	0.000***
		Large	0.066	1.560	0.119			

Notes: *Significant at $p < 0.05$; **significant at $p < 0.01$; ***significant at $p < 0.001$

Paulraj, 2011; Lu *et al.*, 2018; Ni and Sun, 2018; Kähkönen *et al.*, 2018) and economic competitive advantage (Dyer and Singh, 1998). Guided by the DCV of the firm with a focus on internal and external competences in rapidly changing environments (Handfield *et al.*, 2015), SSP is considered a dynamic capability. Furthermore, the findings illuminate the role of organizational capabilities and the moderating role of supply base size in achieving organizational sustainability.

Third, strategic purchasing involves building and sustaining competitive advantage for all supply chain partners. Therefore, supply chain members work to attain common and mutually shared visions, goals and objectives; supply chain activities; and functions and systems, to reach better operational efficiency, enhanced customer responsiveness and profitability (Ellram and Liu, 2002; Ketchen *et al.*, 2014). In contrast, environmental purchasing negatively affects environmental collaboration because of sustainability challenges related to managing a large number of competing suppliers, opportunistic behaviors of those suppliers and dilution of (environmental or green) focus and responsibilities, which may lead to low levels of collaboration for environmental issues. In the context of SSP and OSP, this research contributes to and supplements other studies investigating the role of capabilities in supply base management for achieving sustainability (Handfield *et al.*, 2015; Bowen *et al.*, 2001; Paulraj, 2011; Bell *et al.*, 2013). Much of the purchasing and supply management literature on sustainability has focused on economic issues in recycling and reclamation (Schoenherr *et al.*, 2012). However, the time is ripe for researchers to investigate broader managerial concerns, such as the economic, environment and social impact of purchasing decisions (Montabon *et al.*, 2016).

Methodological implications

To understand the group differences between the subsamples of large and small supply base, the model estimates were compared by means of multigroup analysis established in the literature (Sarstedt *et al.*, 2011). This type of analysis helps to test for differences between identical models estimated for different groups of respondents to see if statistically significant differences exist between different groups. Negative and positive group-specific effects may average out when analyzing data at aggregated level which may lead to false conclusions in model relationships, such as suggesting the absence of a significant relationship. Multigroup analysis helps to answer whether differences in subsamples are statistically significant. In our research, we made use of established research methods and used partial least squares multigroup approach which compares each bootstrap estimate of one group with bootstrap estimate of the same parameters in the other group (Hair *et al.*, 2017). Clearly, additional methodological improvements such as industry fixed effects will further advance the supply chain field. Furthermore, collection of longitudinal data to examine the dynamic effects will be useful as well.

Managerial implications

Academic investigation in purchasing and supply management lags industry practice (Schoenherr *et al.*, 2012), thus calling for more empirical investigations of the moderating influence of supply base size on SSP, environmental collaboration and OSP. Environmental purchasing has a positive impact on the financial position of a company (Carter *et al.*, 2000; Rauer and Kaufmann, 2015). The research contributes to the literature in supply base management and its impact on SSP by showing that firms that limit their supply base can reduce transaction costs and increase revenues. For example, Toyota and Honda work closely with their suppliers, starting from the design stage, to win supplier buy-in when changes in production occur (Zhao *et al.*, 2014). Many automobile, technology, electronics and aerospace companies have reduced their supply bases to reduce transaction costs and increase revenues (Gattiker *et al.*, 2014).

In addition to the obvious significance for the focal firm and the supplier, the significance of our findings goes beyond the dyad. For example, from the perspective of OSP, actions not only by first-tier suppliers but even second and third-tier suppliers can cause negative publicity for the buyer firm. For example, in 2007, Mattel had to recall toys from the market after it was reported that the paint on them was contaminated with lead. It was later revealed that the source of contamination was a sub-supplier of Mattel's first-tier supplier (Wilhelm *et al.*, 2016). Later, Mattel implemented several measures to improve economic, environmental and social performance of its entire upstream supply chain. When the supply base is limited, environmental collaboration positively and significantly affects all three dimensions of OSP – economic, environmental and social performance. Conversely, when the supply base is large, environmental collaboration affects only economic performance of the firm. As discussed previously, SSP may contribute to firm performance by affecting its bottom line

(Ellram and Liu, 2002; Kirchoff *et al.*, 2016). With a large supply base, suppliers tend to cooperate and strategically collaborate merely for economic benefits, while environmental and social benefits fall by the wayside. This phenomenon often occurs during turbulent market conditions, when trust and collaboration are based on economic concerns, synergistic benefits of strategic collaboration generating "managerial rents" (Mahoney, 1995; Nakamba *et al.*, 2017) and financial performance of supply chain partners. Adopting the DCV of the firm in the context of sustainability performance enables the organization to successfully adapt to changes in the competitive environment and to quickly reconfigure its supply base to bolster sustainable purchasing's beneficial reactions to changing market forces. Organizations should decide not only when the supply chains need to change but also the kind of changes starting from minor adjustments to major reconfigurations. Thus, the DCV approach is exhibited in our study through critical organizational capabilities of sustainable purchasing as operationalized through different resource configurations (supply base sizes) to enhance organizational performance.

While the optimal number of suppliers is critical for environmental collaboration, some real-world examples prove that having a large supply base can be economically beneficial for focal companies. For example, Honda's supply base includes a much higher number of second- and third-tier suppliers than DaimlerChrysler's supply base, signifying that different companies configure their supply bases differently (Choi and Hong, 2002; Choi and Krause, 2006). Companies that merely reduce their supplier base without making changes to strategic behaviors and mind-sets may fail to achieve sustainability (Chen *et al.*, 2004; Canzaniello *et al.*, 2017). Thus, companies should work to increase interrelationships among suppliers, reduce the level of differentiation among them, and, thereby, reduce costs and increase revenues (Choi and Krause, 2006; Lu *et al.*, 2018).

Categorizing suppliers and products into portfolios is another useful approach in supply management as conceptualized by Kraljic (1983). Portfolio management and selection criteria rely on a set of suppliers having diverse characteristics and competencies that serve the focal organization in a specific way. As per Krajlic's purchasing portfolio, suppliers can be categorized in four quadrants:

1. strategic (high importance product; high complexity of supply market);
2. leverage (high importance product; low complexity of supply market);
3. bottleneck (low importance product; high complexity of supply market); and
4. non-critical (low importance product; low complexity of supply market) (Trautrims *et al.*, 2017; Cox, 2015).

From a sustainability perspective, the three dimensions of sustainability (economic, environmental and social) into supplier selection should be considered in a balanced manner. Determining not just the best supply base but identifying the optimal supplier portfolio by taking sustainability targets and constraints into account is one of the major leverages for achieving sustainable competitive advantage (Neumüller *et al.*, 2016).

The extant supply chain literature has converged to the notion that in the case of supply chains, one size does not fit all (Simchi-Levi *et al.*, 2013; Christopher *et al.*, 2006). This is applicable for supply base size as well. That increasing size of supply base can help some relationships and hinder others from the results in this research show that the overall relationship between purchase organizational attributes and performance is nuanced and context specific. As companies often market multiple products (different products that need different supply chain configurations) in multiple markets (with different customer needs and local regulations), one pathway for companies is to identify a portfolio of supply chain approaches (for example, raw material supply chains may have different constraints and supply base issues compared to service supply chains for offering value added services) while still being governed by a broader set of organizational objectives and principles.

Societal and policy implications

Today, socially conscious companies, customers and governments all over the world are focusing on sustainable supply chains and businesses are looking for ways to implement sustainability throughout their business practices (Fletcher *et al.*, 2016; Nakamba *et al.*, 2017; Eitiveni *et al.*, 2018). Our research findings are not only relevant for companies and industries but also for trade organizations, government entities, policy enforcement entities and the society at large. For example, supply base size is connected with the issues related to decentralization versus concentration. These issues are related to supply chain operations and the risks associated dealing with various supply chain entities. Companies are embracing resiliency in their supply chain management to address raw material and manpower shortages and climate change to improve workforce, local communities and the environment. Jeff Bezos, CEO of Amazon Inc., pledged $10bn for fighting climate change for a better world (Iyengar, 2020). From the public policy angle, government policies can be devised in favor of large companies (to encourage a smaller supply base) or in favor of smaller companies (to encourage a larger supply base). Similarly, local, state and federal governments (Department of Commerce, Environmental Protection Agency) and professional organizations (e.g. Chamber of Commerce, Institute of Supply Management) can encourage better supply chain relationships and collaboration by providing opportunities for interorganizational engagement and for establishing industrywide ethos that favor more socially relevant measures and standards of firm performance. These could take the form of financial incentives (e.g. tax write-offs for environmental projects such as waste reduction) or other means (public recognition of companies performing well on the environmental dimension such as employee welfare and work-life balance).

Limited research is available regarding what capabilities are needed for SSP. Our research attempts to partially fill this gap. Our empirical results show that SSP requires global companies to develop organizational capabilities. We used the DCV theory for developing competitive advantage in heterogeneous purchasing capabilities. Our research shows that companies adopting supply base reduction strategies (Cousins, 1999) build better partnerships between buyer and supplier firms

(Lamming, 1993; Choi and Krause, 2006). SSP facilitates close interactions with a limited number of suppliers (Cousins, 1999) for cost savings. In contrast, large supply bases with a large number of suppliers are preferred by big organizations for facilitating green supply chains (Terpend and Krause, 2015). However, large supply bases require more transparency and better collaboration for business risk management and stakeholder value. Given the complexity of today's supply chains across organizations, it is imperative that organizations should improve environmental, social and governance performance throughout their supply chains. Such improvements will help achieve market differentiation, increase labor productivity, enhance processes and save costs for a positive societal impact.

Future research directions

This study focuses on a sample of supply chain managers across different industries, and thus the findings are likely generalizable to similar firms. Further research could investigate a broader sample of firms, including domestic and international companies, to expand the scope of generalizability. The supply base as the unit of analysis should consider not only the number of suppliers but also the level of differentiation, along with more information about the suppliers such as geographic location, culture, supplier size, unionized or not, technical sophistication and industry (Choi and Krause, 2006). Despite not considering these more granular differences, this study paves the way for researchers and managers to leverage the influence of the supply base size on SSP, environmental collaboration and OSP.

Given that ours is an early work that examines the moderating role of supply base size, future research can tackle additional dimensions of supply chain complexity. Expanding further on supply base, when examining supply base/network, the literature has focused on three major characteristics: centralization, density and complexity (Kim *et al.*, 2011; Tachizawa and Wong, 2015). Examining the individual and joint effects of these characteristics will result in a more fine-grained understanding of supply base size. In addition, future research could focus more broadly on the "complexity" characteristic, which is defined as the product of the number of entities and the number of interactions in a system (Simon, 1991; Tachizawa and Wong, 2015). Thus, the construct of "supply base" in our research can be further expanded to consider various factors such as number of suppliers, relationships among these suppliers and various economic considerations (e.g. multiple price quotes, long-term hedging contracts for supplier selection, etc.). Similarly, consideration of multitier network made up of buyers and tiered suppliers, extending beyond the dyad, who collectively bring the final products (goods and services) to the downstream side of a supply chain (Yan *et al.*, 2015; Reuter *et al.*, 2017) can be examined to obtain a more nuanced understanding of the role of supply base size. Furthermore, examining nonlinear relationships between the variables of interest will offer more nuanced guidance toward an optimal supply base size rather than a large or a small supply base size.

This study offers other avenues for future research as well. For example, researchers could delve into specific industries to compare and contrast the results of "green" and "clean" (Leonidou *et al.*, 2013; Ni and Sun, 2018) versus "other" industries. It would be worthwhile to explore the role of environmental collaboration in these specific sets of industries. Another research area is the effect of the supply base's geographic dispersion (i.e. global vs domestic suppliers). Research could also investigate the role of globalization in SSP and the sustainability performance of the firm. The role of technology and its effect on the relationships explored in this study would offer another fruitful avenue for research. Technological diversity, supplier network density and technological turbulence all affect new product innovation and firm creativity (Gao *et al.*, 2015; Arora *et al.*, 2016; Tse *et al.*, 2016; Kauppi and Hannibal, 2017; Lu *et al.*, 2018). Thus, it would be worthwhile to determine whether these technology factors influence firms' sustainability performance and environmental collaboration.

An emerging trend in the businesses in the past decade is digitalized and platform-based sharing economies, especially, peer-to-peer sharing economies. Under this setup, the boundaries between the service provider, the supplier and the customer may become increasingly fluid. In general, it can be argued that digitalization will reduce the complexities of supply base size. Future research should recognize such nuances in identifying what exactly is or should be the meaning of suppliers and the activities performed by the suppliers. As business models evolve to become more and more diverse and different from existing models, the costs and benefits to the environment arising from the increased use of technology must be carefully examined. While technology-based information transmission appears to be more environmentally friendly (e.g. reduction of paper), the energy costs associated with storage and dissemination of information is increasing as well. It is not far-reaching to expect that in the future, many of the "suppliers" will be suppliers of information, storage facilities and services rather than suppliers of physical goods. The difference in the management of suppliers of information products versus physical products will have significance for understanding the role of supply base size. For example, management of storage costs and coordination costs are more salient for physical products than digital products, thereby reducing the cost of coordination. On the other hand, the potential for the proliferation of digital product suppliers beyond a manageable number (due to low entry barriers) will pose its own unique challenges in terms of supplier evaluation, establishments of standards and management. The relational and operational characteristics of such supply networks (large or small) in the context of physical versus digital products will need fresh thinking in conceptualization and operationalization of the variables discussed in this research.

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Appendix

Table A1 Construct measurement

Label	Item	Source
(1) Strategic purchasing		
SP_1	Purchasing is included in the firm's strategic planning process	Bowen *et al.* (2001), Chen *et al.* (2004); Paulraj (2011); Foerstl *et al.* (2015); Montabon *et al.* (2016)
SP_2	The purchasing function has a good knowledge of the firm's strategic goals	
SP_3	Purchasing performance is measured in terms of its contributions to the firm's success	
SP_4	Purchasing professionals' development focuses on elements of the competitive strategy	
SP_5	Purchasing department plays an integrative role in the purchasing function	
SP_6	Purchasing's focus is on longer term issues that involve risk and uncertainty	
SP_7	The purchasing function has a formally written long-range plan	
SP_8	Purchasing's long range plan includes the kinds of materials or services to be purchased	
SP_9	Purchasing's long range plan includes various types of relationships to be established with suppliers	
SP_{10}	Purchasing is considered to be a vital part of our corporate strategy	
SP_{11}	The chief purchasing officer has high visibility within top management	
SP_{12}	Top management emphasizes the purchasing function's strategic role	
(2) Environmental purchasing (currently, our department. . .)		
EP_1	Purchases recycled packaging	Carter *et al.* (2000), Rauer and Kaufmann (2015)
EP_2	Purchases packaging that is of lighter weight	
EP_3	Uses a life-cycle analysis to evaluate the environmental friendliness of products and packaging	
EP_4	Participates in the design of products for disassembly	
EP_5	Asks suppliers to commit to waste reduction goals	
EP_6	Participates in the design of products for recycling or reuse	
(3) Supply base		
SB_1	We rely on a small/large number of suppliers	Shin *et al.* (2000), Chen *et al.* (2004); Schmidt *et al.* (2017); Fan and Stevenson (2018)
SB_2	We maintain close relationship with a limited pool of suppliers	
SB_3	We get multiple price quotes from suppliers before ordering	
SB_4	We drop suppliers for price reasons	
SB_5	We use hedging contracts in selecting our suppliers	
(4) Environmental collaboration		
EC_1	We cooperate with our suppliers to achieve environmental objectives	Zhu and Sarkis (2004), Vachon and Klassen (2006); Paulraj (2011); Paulraj *et al.* (2015); Schmidt *et al.* (2017)
EC_2	We provide our suppliers with design specification that include environmental requirements for purchased items	
EC_3	We encourage our suppliers to develop new source reduction strategies	
EC_4	We cooperate with our suppliers to improve their waste reduction initiatives	
EC_5	We work with our suppliers for cleaner production	
EC_6	We collaborate with our suppliers to provide materials, equipment, parts and/or services that support our environmental goals	
(5) Economic performance		
ECP_1	Decrease in cost of materials purchased	Zhu and Sarkis (2004); Paulraj (2011); Foerstl *et al.* (2015); Montabon *et al.* (2016); Schmidt *et al.* (2017)
ECP_2	Decrease in cost of energy consumption	
ECP_3	Decrease in fee for waste discharge	
ECP_4	Improvement in return on investment	
ECP_5	Improvement in earnings per share	
(6) Environmental performance		
EVP_1	Reduction in air emission	Zhu and Sarkis (2004), Paulraj (2011); Foerstl, *et al.* (2015); Montabon *et al.* (2016); Schmidt *et al.* (2017)
EVP_2	Reduction in waste (water and/or solid)	
EVP_3	Decrease in consumption of hazardous/harmful/toxic materials	
EVP_4	Decrease in frequency for environmental accidents	
EVP_5	Increase in energy saved due to conservation and efficiency improvements	

(***continued***)

Table A1

Label	Item	Source
7) Social performance		
SLP_1	Improvement in overall stakeholder welfare or betterment	Bansal (2005), Paulraj (2011); Foerstl, *et al.* (2015); Montabon *et al.* (2016); Fletcher *et al.* (2016); Schmidt *et al.* (2017); Nakamba *et al.* (2017)
SLP_2	Improvement in community health and safety	
SLP_3	Reduction in environmental impacts and risks to general public	
SLP_4	Improvement in occupational health and safety of employees	
SLP_5	Improved awareness and protection of the claims and rights of people in community served	

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