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Ye, Fei; Huang, Guangyu; Zhan, Yuanzhu; Li, Yina

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Factors Mediating and Moderating the Relationships Between Green Practice and Environmental Performance: Buyer-supplier Relation and Institutional Context

Abstract – Drawing on social exchange theory and institutional theory, this paper extends the literature on sustainable operations by examining the mediating and moderating effects of buyer-supplier relation and institutional context on the relationships among internal green practice, external green practice and environmental performance. The study analyzes data from 440 firms in three categories of market (the institutional context): industrialized Western, emerging Western and emerging Asian markets. Both internal green practice and external green practice have positive direct impacts on firms' environmental performance. More specifically and interestingly, external green practice partially mediates the relationship between internal green practice and environmental performance, and this process is moderated by the quality of the buyer-supplier relation. A higher quality of buyer-supplier relation helps to achieve a better outcome. In addition, the examined relationships vary between the emerging market and developed market: that is, they depend on the institutional context. The findings have implications for both practitioners and policymakers on how to improve environmental performance through leveraging green practice and buyer-supplier relation and what policies on green supply chain management might best be used in different markets.

Index Terms – Internal green practice, external green practice, environmental performance, buyer-supplier relation, institutional context

I. INTRODUCTION

Responding to the increasing concerns regarding global warming and energy scarcity, many firms have adopted green practice to reduce the environmental impact of their operations and products. These green practice can be categorized as internal and external [1]-[4]. Internal green practice refers to the green activities within the firm's area of control [5], while external green practice consists of a series of activities undertaken by the firm to promote and monitor the environmental performance of its suppliers (e.g., green supplier certification, direct investment and joint environmental plans) [3], [6]-[8]. Examples are abundant. Procter & Gamble has established environmental sustainability goals titled "Ambition 2030", which include not only green practice implemented within the firm, but also multiple tools to monitor its suppliers' environmental performance [9].

The environmental benefits associated with internal and external green practice have been subject to a substantial amount of research; however, contrasting results have been obtained. Some studies provide evidence that external green practice can directly improve the firm's environmental performance, or act as an essential mediator in the link between internal green practice and environmental performance [2], [5], [10], [11], while others do not [1], [12]. Some real-world case examples demonstrate that external green practice is not always effective. For instance, Apple was in trouble over a pollution incident caused by its suppliers' environmentally irresponsible behavior despite its efforts to assess its suppliers' environmental management (<http://tech.hexun.com/2011/applesuppliers/>). The inconsistent results in both research and practice may have arisen because some unique factors that affect and moderate the implementation and effectiveness of green practice were neglected. This gives rise to the

following principal research questions: Do internal green practice impact firms' environmental performance directly, or indirectly through external green practice? More importantly, given the complex links between internal green practice, external green practice and environmental performance, and the inconsistent research findings, what factors do in fact affect these relationships?

To address these research questions, this study builds on social exchange theory and institutional theory to extend the literature on sustainable operations by incorporating two important factors: buyer-supplier relation and institutional context. Whether these two factors moderate the relationships among internal green practice, external green practice and environmental performance has seldom been considered in the literature. *First*, drawing on social exchange theory, we propose a novel moderated mediation framework to examine the link between internal and external green practice and environmental performance in the presence of buyer-supplier relation. Though buyer-supplier relation has been widely investigated in supply chain management research, this is not the case in research on green supply chain management [1], [13], [14]. Buying firms are more likely to invest in extending green practice to those suppliers with which they have good relationships. That is, a firm with a higher-quality buyer-supplier relation is more likely to help its suppliers to gain the ability and willingness to invest in environmental management; it might do so through effective information sharing and collaboration [1], [13], [14]. Therefore, we propose a conceptual framework in which the employment of external green practice is the mediator of the contribution of internal green practice to environmental protection, and the quality of buyer-supplier relation is a moderator of any such mediating effect.

Second, previous studies have looked at a single institutional context, which means they neglected contextual differences. Based on institutional theory, the adoption and effectiveness of green practice depend on the pressure exerted by regulation, society and the market [15]. However, institutional pressures for environmental protection may vary across countries. For example, the European Union has set strict standards for manufacturers and supply chain managers to maintain a high level of environmental sustainability [16], while in emerging markets, China for example, firms tend to address environmental issues differently than firms in developed economies because they have their own unique political and social systems [17]. Therefore, it is not clear whether the relationships among a firm's internal green practice, external green practice and environmental performance vary across different institutional contexts.

Third, this proposed framework proved to be rewarding, as the important effects of buyer-supplier relation and institutional context would not be recognized otherwise. Overall, the statistical results strongly suggest that internal green practice can affect firms' environmental performance not only directly but also indirectly via external green practice. More specifically and interestingly, this process is moderated by the buyer-supplier relation. A higher quality of buyer-supplier relation can help suppliers to gain the capability and willingness to invest in environmental management, which will enhance the firm's environmental performance in turn. A cross-institutional comparison among industrialized Western, emerging Western and emerging Asian markets reveals that the relationships between green practice and environmental performance vary across different institutional contexts. The findings advance our understanding of the effectiveness of internal and external green practice and help to explain

the inconsistent conclusions of previous studies. The findings shed light on how managers in emerging markets and developed markets can improve their environmental performance through internal and external green practice, and leverage the buyer-supplier relation to achieve a better outcome. They will also be valuable to policy makers, especially those in emerging Asian markets, to move forward on legislation and policies related to green supply chain management.

The remainder of this paper is structured as follows. Section II provides a literature review and develops the conceptual framework and research hypotheses. Section III presents the research method and details the collection and analysis of data. Section IV reports the statistical results. The discussion and implications are provided in Section V, followed by the conclusions in Section VI. The detailed measurements are presented in the Appendix.

II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

A. Green practice and environmental performance

With increasing environmental pressures from multiple stakeholder groups, firms are pressurized and motivated to integrate green practice into their business operations [18], [19]. In particular, as one of the primary stakeholders, consumers' environmental concern motivates firms to take more responsibility for being environmentally-friendly. For instance, with the growth of ethical consumerism [20], a large number of firms are being driven to adopt environmental production methods, such as organic production [21], [22]. To meet the environmental needs of stakeholders, firms not only implement internal green practice, but also external green practice to make their operations green and more sustainable.

Internal green practice improve the firm's environmental performance through reducing waste gas, wastewater, solid waste, and the quantities of toxic and harmful materials used in the production processes [5]. De Giovanni [10] argued that internal environmental management, such as using green raw materials, having a green purchasing policy and adopting green technology, leads to a reduction in environmental pollution. Yu and Ramanathan [23] analyzed survey data from the UK and found that green operations practices can improve environmental performance. According to Gualandris and Kalchschmidt [1], sustainable process management implemented within firms can improve their social and environmental performance. Al-Sheyadi *et al.* [24] found that adopting proactive internal environmental practices, such as material reduction and environmental management systems, results in better environmental performance.

In addition, a firm's success in preventing pollution depends on its supply network [5]. A firm's external green practice, such as supplier certification, supplier collaboration and direct investment, can extend environmental responsibility to its suppliers, which will eventually contribute to its own environmental performance [11], [25], [26]. For instance, Apple implemented external green practice, such as conducting energy audits, implementing energy training and supervising energy efficiency projects, to make its Chinese suppliers more energy efficient, and these efforts prevented emissions of more than 150000 metric tons of carbon dioxide equivalents (CO₂e) in 2015 [27]. Therefore, we hypothesize that:

Hypothesis 1 *Internal green practice has a direct positive impact on the firm's environmental performance.*

Hypothesis 2 *External green practice has a direct positive impact on the firm's environmental performance.*

B. Internal green practice and external green practice

A firm can strictly control the effects of its internal processes (e.g. production, transportation and delivery) and products on the environment by adopting internal green practice. However, the effectiveness of the firm's internal green practice will be significantly influenced by any non-environmental behaviors on the part of its suppliers [5]. For instance, if raw materials purchased from suppliers are not environmentally-friendly, green production will not be achieved. Therefore, firms investing in internal green practice are more likely to extend the green practice to their suppliers [28]. In addition, researchers have suggested that implementing internal green practice helps a firm gain the capabilities, such as vertical coordination capabilities [29], to cooperate with its supply chain partners in order to green the entire supply chain [10]. Agyabeng-Mensah *et al.* [11] argued that the existence of internal green practice serves as a prerequisite for firms to cooperate with supply chain partners on the implementation of green practice. Wong *et al.* [30] found that the implementation of green supplier and customer integration can be driven by green internal integration. Drawing on the above discussion, we propose that:

Hypothesis 3 *Internal green practice has a direct positive effect on external green practice.*

Although the firm's environmental performance will be influenced by the adoption of both internal and external green practice, the ways such influence is exerted differs between the two. On the one hand, because environmental protection is increasingly emphasized in the manufacturing sector, firms have increased their direct investment in reducing environmental pollution from their products and processes [31]. For companies, implementing internal green practice is an effective method to meet the requirements of supply chain management and

legislation and to achieve their own environmental targets [10]. On the other hand, the adoption of internal green practice may contribute to green performance by influencing external green practice. As discussed above, internal green practice may cascade down to external green practice because suppliers' environmental problems will affect the realization of a firm's targets for environmental protection. Thus, we propose that internal green practice will influence the firm's environmental performance partly through external green practice.

***Hypothesis 4** External green practice partially mediates the relationship between internal green practice and the firm's environmental performance.*

C. The moderating role of the buyer-supplier relation

Although firms that implement internal green practice may have a greater capability to extend green practice to their suppliers, this may fail to materialize unless the firm is willing to collaborate with its suppliers. Social exchange theory, which analyzes the voluntary value exchanges of actors who are rational and aim to maximize their benefits in a social system [32], suggests that a higher-quality partnership between the firm and supplier helps to increase communication and knowledge sharing [33]. Research has demonstrated that supply chain partnership is not only effective in developing internal environmental behavior, but is also the key to developing external environmental behavior, such as sharing best practices with partners [34]. Thus, the buyer-supplier relation should not be ignored when testing the link between the internal and external dimensions of green practice.

The buyer-supplier relation refers to multi-organization social processes in which parties interact, exchange information, and develop new and novel relationships based on mutual dependencies, exchanges, and mutual problem-solving [35]. According to Li and Lin [36], the

key elements of buyer-supplier relation are trust and effective information sharing. For example, buying firms are more likely to invest in extending green practice to those suppliers with which they have good relationships, given that implementing external green practice necessarily involves sharing information with suppliers, including strategy, operational, and market information. Bhatt *et al.* [14] emphasized the importance of capacity development for environmental management. Also, effective buyer-supplier relation can promote knowledge transfer, thereby helping suppliers to gain the ability and willingness to invest in environmental management [13]. Thus, firms that have adopted internal green practice are more willing to adopt external green practice when they have high-quality buyer-supplier relation. In contrast, those firms without a good relationship with their suppliers are less likely to invest in extending green practice to their suppliers. Hence, we expect that the employment of external green practice is the mediator of the contribution of internal green practice to environmental protection, and the quality of the buyer-supplier relation is a moderator of any such mediating effects.

Hypothesis 5 *The positive effect of internal green practice on external green practice will be stronger when the quality of buyer-supplier relation is higher.*

So far, we have provided a theoretical basis for the mediating role of external green practice as well as the moderating effect of buyer-supplier relation in the link between the internal and external dimensions of green practice. Based on these rationales, we propose a moderated mediation model (as shown in Fig. 1.). buyer-supplier relation moderates the indirect positive impact of internal green practice on environmental performance through external green practice. The theoretical basis of Hypotheses 4 and 5 suggests that by enhancing the link

between the internal and external dimensions of green practice, the quality of the buyer-supplier relation influences the degree to which internal green practice promote environmental performance. Thus, we further advance:

Hypothesis 6 *The indirect positive effect of internal green practice on environmental performance via external green practice will be stronger when the quality of the buyer-supplier relation is higher.*

D. The moderating role of institutional context: Emerging market vs. developed market

Institutional theory suggests that the sources of institutional pressures are multiple, and fall within the regulatory, the normative and the cognitive domains [37]. All these institutional pressures will influence the implementation and effectiveness of green practice and differ among developed and emerging markets. In the domain of regulatory pressures, which are the government regulations, laws and political structures that govern an industry [37], there are many more voids related to environmental protection in developing countries than in industrialized countries [38]. For instance, firms facing weak environmental regulations in regions like West and East Africa will be unlikely to set strict standards to promote green practice in their supply chains [39]. Managing the environmental performance of suppliers is a particular challenge for firms whose suppliers are located in emerging markets [40], where regulations are not well implemented, and, in the short term, managers perceive that adopting environmental practices has only a marginal impact on financial performance. Consequently, many buying firms in industrialized countries are increasingly concerned about environmental problems and impose strict environmental requirements before signing contracts with suppliers from emerging countries [41].

The normative domain involves the norms and values that organizations are expected to respect. People in emerging countries generally place more value on improving basic living conditions or accelerating economic development [38] than on the implementation of green practice. Husted [15] found that economic development is a key element to improve the social capacity of a country for environmental sustainability; that capacity comprises social models of skills, attitudes and networks that help to address environmental challenges.

In the area of cognitive pressures, which refer to developing a dominant strategic approach and avoiding uncertainty through social interactions between business and community participants [42], if a firm is located in a country with a culture that values uncertainty avoidance it will be more inclined to implement green practice to reduce environmental pollution, because such social responsibility can help to reduce uncertainty [43]. Unlike industrialized Western countries with mature markets, many emerging markets have higher uncertainties (albeit alongside high market growth potential) [44] and pose a great threat to the environment on account of the lack of environmental awareness [45]. Based on these discussions, we propose that:

***Hypothesis 7** The relationships between internal green practice, external green practice and environmental performance will vary across developed and emerging markets.*

E. Conceptual framework

Fig. 1. outlines the framework of the research. This study classifies green practice into internal and external green practice, and investigates their effects on environmental performance. More specifically, we consider the moderation effect of buyer-supplier relation and the context effect between developed markets and emerging markets.

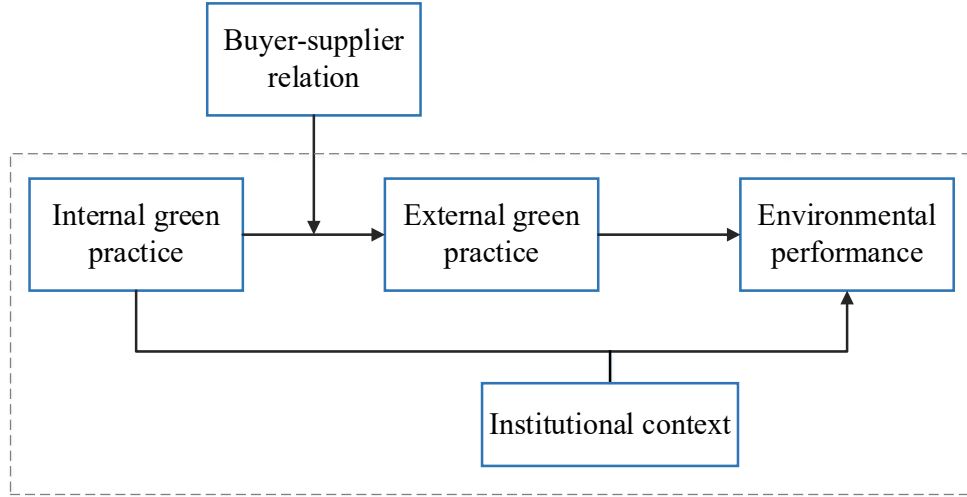


Fig. 1. Conceptual framework

III. METHODOLOGY

A. Data collection and sample

We used survey data from the Global Manufacturing Research Group (GMRG), which is an association of academics from different countries dedicated to researching and improving global manufacturing practices (<http://gmr.org/>), to test our hypotheses. The GMRG has collected five rounds of worldwide surveys since 1985. The survey instruments contain not only a mandatory component that covers firms' basic characteristics, internal performance and competitive goals, but also design modules for testing specific operations and supply chain management theories. As the GMRG has conducted multiple rounds of surveys around the world, the survey questionnaire has been continuously adapted and improved on the basis of well-grounded theories and industrial interviews.

The data used in this study is from the fifth round of the GMRG survey (2011 to 2014) of manufacturing enterprises in more than 20 countries. The target respondents of the GMRG were plant managers from manufacturing industries, as they were deemed to have an in-depth and

comprehensive understanding of the plant's operations. The plant managers were encouraged to obtain information from other functions to complete the survey more accurately. The majority of the data were collected electronically, through web surveys and email. More information on the GMRG and the survey is available at <http://gmrg.org/>. Various studies on the basis of the fifth-round GMRG data set have been published, covering topics such as supply chain collaboration, operations strategy and green operations (e.g., [3], [5], [46]).

Excluding countries with very small sample sizes, this study uses detailed data on 440 firms belonged to eight countries. Following previous studies, we divide the eight countries into three categories, namely industrialized Western market, emerging Western market and emerging Asian market, to test the cross-institutional context effect [47], [48]. Table I shows the demographic characteristics of the survey sample.

TABLE I
SAMPLE DISTRIBUTIONS

	N	%		N	%
Institutional context			Number of employees		
Industrialized Western market			≤ 50	143	32.5
<i>USA</i>	74	16.8	51-200	143	32.5
<i>Australia</i>	15	3.4	201-500	77	17.5
<i>Ireland</i>	22	5.0	>500	77	17.5
Emerging Western market			Total	440	100
<i>Poland</i>	73	16.6	Years of work experience		
<i>Croatia</i>	109	24.8	≤ 2	28	6.4
<i>Hungary</i>	21	4.8	2-5	78	17.8
Emerging Asian market			5-10	155	35.2
<i>China</i>	58	13.2	>10	145	32.9
<i>Vietnam</i>	68	15.5	Missing response	34	7.7
Total	440	100	Total	440	100
Industry sector					
Apparel, other finished products and textile				31	7
Chemicals and allied products				20	4.5
Electronic and other electrical equipment and components, except computer equipment				43	9.8

Fabricated metal products, except machinery and transportation equipment	52	11.8
Food and kindred products	52	11.8
Industrial and commercial machinery and computer equipment	26	5.9
Lumber and wood products, except furniture	22	5
Miscellaneous manufacturing industries	27	6.2
Primary metal industries	20	4.5
Rubber and miscellaneous plastics products	37	8.5
Stone, clay, glass, and concrete products	20	4.5
Others	90	20.5
Total	440	100

B. Measurements

The measurements used in this research include: internal green practice, external green practice, buyer-supplier relation and environmental performance. All measurements are developed on the basis of well-grounded theories and industrial interviews. The GMRG adopted the same survey procedure in each country. To ensure that questionnaire items had the same meaning in different language environments, the questionnaire was translated from English into the mother tongue of each survey country and then back-translated. As Song et al. [3] detail, the GMRG process includes efforts to reduce social desirability bias.

The construct “internal green practice” was measured by four items regarding the firm’s green activities within its areas of control (controlling the environmental impacts of its products and processes, setting environmental goals and ensuring their achievement through a systematic approach), which were developed based on studies by Curkovic and Melynk [49] and Zhu *et al.* [50]. The construct “external green practice” was measured by three items regarding activities undertaken by the firm to enhance its suppliers’ commitment and ability to improve their environmental performance (green vendor certification, green investment, green collaboration), which were adapted from Ketokivi and Schroeder [51]. Four items were developed to measure the firm’s own environmental performance, including reducing waste and emissions, as well as

reducing energy and water consumption. The items were adapted from Zhu *et al.* [50] to fit the context of the survey. The measurement items for the buyer-supplier relation are modified from Choi *et al.* [52] to capture the quality of and satisfaction with the partnership. All items were measured by the GMRG on a seven-point Likert scale (All of the measures for the constructs are presented in full in the Appendix). We also included firm size as a control variable in the hypotheses testing procedure, which is measured as the natural logarithm of the number of employees.

C. Measurement assessment

The reliability and validity of the measurements of constructs are examined through confirmatory factor analysis (CFA). The indices of goodness-of-fit ($\chi^2(58)=173.926$, $\chi^2/df=2.999$, IFI=0.978, CFI=0.978, TLI=0.971, and RMSEA=0.067) (Table II) indicate good model fit and confirm each construct's unidirectionality in our model [53]. We then use CFA again and the Harman's single-factor test [54] to test for potential common method bias. Podsakoff and Organ [55] suggested that substantial common method bias exists if a single factor that can explain all or most of the variables. The results show that compared with the four-factor measurement model, the one-factor model has a worse fit ($\chi^2(65)=1931.205$, CFI=0.648, TLI=0.578, RMSEA=0.256), which indicates that the problem of common method variance is not of concern.

TABLE II
MEASUREMENT ASSESSMENT

Construct	Measure	Mean	S.D.	Factor loadings	Cronbach's α	CR	AVE
Environmental performance (EP)	EP1	4.375	1.647	0.863	0.924	0.924	0.753
	EP2	4.268	1.652	0.88			
	EP3	4.479	1.629	0.881			

	EP4	4.184	1.699	0.842			
Internal green practice	IGP1	4.304	1.623	0.895	0.963	0.966	0.877
(IGP)	IGP2	4.361	1.598	0.938			
	IGP3	4.301	1.624	0.981			
	IGP4	4.291	1.603	0.931			
External green practice	EGP1	3.727	1.905	0.651	0.769	0.776	0.537
(EGP)	EGP2	2.668	1.651	0.738			
	EGP3	3.018	1.68	0.802			
buyer-supplier relation	BSR1	4.918	1.471	0.978	0.957	0.957	0.918
(BSR)	BSR2	4.931	1.523	0.938			

Notes: Model fit indices: $\chi^2(58) = 173.926$; $\chi^2/df = 2.999$; CFI=0.978; IFI=0.978; TLI=0.971; RMSEA=0.067

Also, the Cronbach's alpha values of the four latent constructs range from 0.769 to 0.963, all above the threshold of 0.700 [56], which indicates acceptable reliability. In addition, the value of each construct's composite reliability ranges from 0.776 to 0.966, over the commonly used benchmark of 0.700 [57], which means that these measurements have sufficient internal consistency.

Two methods are used to evaluate the convergent validity of constructs in this study. First, the value of each multiple-item construct's average variance extracted (AVE) is over the commonly used benchmark of 0.500 [58]. Second, all factor loadings are greater than the commonly used threshold of 0.500, which indicates that convergent validity is confirmed [59]. Furthermore, Table III shows that the correlation coefficients between constructs are less than the square roots of the corresponding AVE, which further indicates that these constructs have a high degree of discriminant validity [58].

TABLE III
BASIC STATISTICS AND CORRELATIONS

Constructs	Mean	S.D.	1	2	3	4
1. Environmental performance	4.326	1.495	0.868			

2. Internal green practice	4.314	1.529	0.693***	0.937		
3. External green practice	3.138	1.449	0.343***	0.329***	0.732	
4. buyer-supplier relation	4.925	1.466	0.556***	0.555***	0.191***	0.958

Notes: N=440; ***, **, * represent p-value of 0.01, 0.05, and 0.1, respectively.

Diagonal values are the square roots of AVEs and off-diagonal values are the correlation coefficients between constructs

IV. RESULTS

A. Descriptive statistics and correlation analyses

An overview of the correlations between four constructs as well as their means and standard deviations is given in Table III. As Table III shows, internal green practice is positively correlated with external green practice ($r=0.329^{***}$) and environmental performance ($r=0.693^{***}$). Moreover, external green practice is positively correlated with environmental performance ($r=0.343^{***}$). These results provide initial support for Hypothesis 1, Hypothesis 2, and Hypothesis 3. In addition, all seven models' variance inflation factor (VIF) is less than the commonly used threshold of 10.000 [60], which indicates that there is no serious multicollinearity issue (as shown in Table IV).

TABLE IV
RESULTS OF HIERARCHICAL REGRESSION ANALYSIS

	External green practice			Environmental performance			
	1	2	3	4	5	6	7
Firm size	0.009 (0.042)	0.009 (0.042)	-0.038 (0.041)	-0.016 (0.038)	-0.016 (0.032)	-0.018 (0.037)	-0.017 (0.032)
buyer-supplier relation	0.179*** (0.050)	0.043 (0.058)	0.118** (0.058)	0.522*** (0.045)	0.212*** (0.044)	0.484*** (0.052)	0.207*** (0.044)
Internal green practice		0.237*** (0.052)	0.225*** (0.051)		0.542*** (0.040)		0.515*** (0.041)
External green practice						0.221*** (0.042)	0.113*** (0.037)

buyer-supplier relation×			0.154***				
Internal green practice			(0.029)				
Constant	2.216*** (0.379)	1.863*** (0.379)	1.574*** (0.372)	1.831*** (0.340)	1.025*** (0.292)	1.363*** (0.343)	0.814*** (0.297)
R ²	0.031	0.075	0.132	0.270	0.484	0.310	0.495
ΔR ²	0.027	0.068	0.124	0.267	0.480	0.306	0.490
ΔF	7.106***	11.832***	28.438***	80.773***	105.799***	65.441***	106.600***
Highest VIF	1.167	1.601	1.704	1.167	1.601	1.201	1.603

Notes: N=440; ***, **, * represent p-values of 0.01, 0.05, and 0.1, respectively.

Standard errors are given in parentheses.

B. Regression analyses for the mediator effect

We use hierarchical multiple regression analysis to examine the proposed hypotheses and report the results in Table IV. The research results demonstrate that both internal green practice and external green practice have significant effects on the firm's environmental performance ($\beta=0.515^{***}$ and $\beta=0.113^{***}$, respectively, as shown in Model 7 of Table IV), supporting Hypothesis 1 and Hypothesis 2. Moreover, Model 2 reveals a positive relationship between internal and external green practice ($\beta=0.237^{***}$), supporting Hypothesis 3.

In order to test whether internal green practice also contributes to environmental performance by strengthening external green practice (Hypothesis 4), we conduct Baron and Kenny's [61] four-step analysis. Firstly, internal green practice (i.e., the independent variable) significantly and positively affects environmental performance, the dependent variable ($\beta=0.542^{***}$, Model 5). Secondly, external green practice (i.e., the mediator) positively affects environmental performance ($\beta=0.221^{***}$, Model 6). Thirdly, internal green practice significantly and positively contributes to external green practice ($\beta=0.237^{***}$, Model 2). Finally, we compare the contribution of internal green practice to environmental performance before and after the entry of external green practice into the model. From Model 5 to Model 7,

the contribution of internal green practice to environmental performance decreases (β goes down from 0.542 to 0.515). In addition, we adopt the Sobel test [62] to determine whether a mediation effect exists. The result of the test is $Z=2.537(p<0.01)$, which supports Hypothesis 4, as external green practice partially mediates the contribution of internal green practice to environmental performance.

C. Moderated mediation effect

Hypothesis 5 predicts that buyer-supplier relation moderates the impact of the internal dimension of green practice on the external dimension. As shown in Table IV, the interaction between internal green practice and buyer-supplier relation ($\beta=0.154^{***}$, Model 3) is positively related to external green practice. To aid interpretation, we use Aiken and West's [63] procedure to plot the interaction effect of internal green practice and buyer-supplier relation on external green practice. Fig. 2. shows that the impact of the internal dimension of green practice on the external dimension is stronger when the quality of the buyer-supplier relation is higher than when it is lower. Thus, Hypothesis 5 is supported.

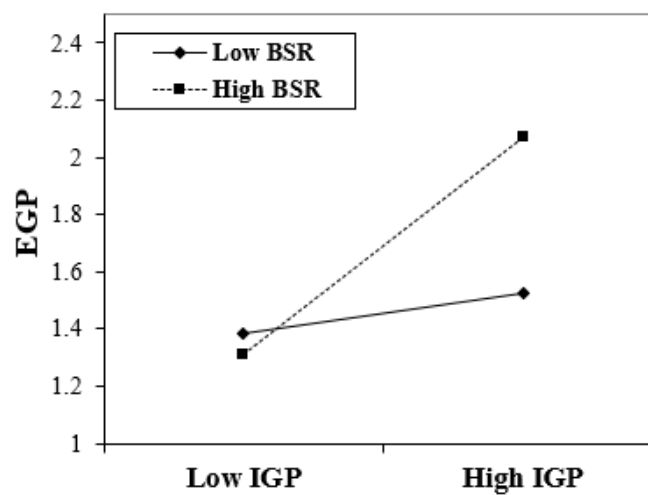


Fig. 2. Moderating effect of buy-supplier relation on the relationship between internal green practice and external green practice

Note: IGP= internal green practice; EGP= external green practice; BSR= buyer–supplier relation

Hypothesis 6 predicts that the indirect contribution of internal green practice to environmental performance varies as a function of the quality of buyer-supplier relation. The PROCESS macro [64] for SPSS that allows the analysis of moderated mediation is conducted to test this hypothesis. As Table V shows, the indirect contribution of internal green practice to environmental performance via external green practice is positive among firms with middle-quality (0.031, CI: 0.012 to 0.059) and high-quality (0.059, CI: 0.025 to 0.105) buyer-supplier relations but is not significantly different from zero among those with low-quality (0.001, CI: -0.022 to 0.023) buyer-supplier relations. What is more, the index for moderated mediation is significant (0.020, CI: 0.008 to 0.035). These findings provide full support for Hypothesis 6.

TABLE V
RESULTS OF THE ANALYSIS OF THE INDIRECT EFFECT AND THE MODERATED
MEDIATION EFFECT

Mediator	buyer-supplier relation	Indirect effect	S.E.	95% confidence interval	
				Lower	Upper
External green practice	Low (-1 SD)	0.001	0.011	-0.022	0.023
	Middle (Mean)	0.031	0.012	0.012	0.059
	High (+ SD)	0.059	0.019	0.025	0.105

Note: Results of the analysis of the indirect effect

Mediator	Moderator	Index	S.E.	95% confidence interval	
				Lower	Upper
External green practice	buyer-supplier relation	0.020	0.007	0.008	0.035

Note: Results of moderated mediation analyses

Note: 5000 bootstrap samples.

D. Cross-institutional context comparison

To analyze the moderating role of the institutional context, we tested the contributions of

internal and external green practice to firms' environmental performance across the three categories of market: industrialized Western, emerging Western and emerging Asian market. Firstly, we compare the means of the key variables in different categories through the ANOVA test. As Table VI shows, the mean values of all constructs differ significantly across groups. More specifically, firms in the emerging Asian market differ significantly from firms in both Western categories on the dimensions of internal green practice and environmental performance; furthermore, firms in emerging the Western market differ significantly from firms in the industrialized Western market and emerging Asian market on the dimension of external green practice.

TABLE VI
MEANS AND STANDARD DEVIATIONS

Construct	Industrialized		Emerging		Emerging		ANOVA
	Western market		Western market		Asian market		Sign.
	Mean	S.D.	Mean	S. D.	Mean	S..	
Internal green practice	4.331 ⁽³⁾	1.496	4.813 ⁽³⁾	1.361	3.496 ^(1,2)	1.473	<.001
External green practice	2.628 ⁽²⁾	1.559	3.534 ^(1,3)	1.329	2.949 ⁽²⁾	1.361	<.001
Environmental performance	4.378 ⁽³⁾	1.467	4.719 ⁽³⁾	1.324	3.649 ^(1,2)	1.553	<.001
Firm size	5.149 ^(2,3)	1.429	3.696 ^(1,3)	1.289	6.035 ^(1,2)	1.576	<.001

Note: The numbers in the parentheses represent the number of groups in which the current group is significantly different: (1) Industrialized Western market; (2) Emerging Western market and (3) Emerging Asian market.

Again, we use the PROCESS macro for SPSS [64] to conduct tests for a mediation effect (Model 4) among the three categories of market. As Table VII shows, for the industrialized Western market group, internal green practice has a significant direct effect on external green practice ($\beta=0.208^{**}$, Model 1), and both internal and external green practice positively and significantly affect environmental performance ($\beta=0.536^{***}$ and $\beta=0.260^{***}$, Model 2). Thus, internal green practice also contributes to environmental performance by promoting external

green practice (0.054, CI: 0.009 to 0.123). For the emerging Western market group, internal green practice positively and significantly affects external green practice ($\beta=0.339^{***}$, Model 3). However, although the internal green practice positively affects environmental performance ($\beta=0.503^{***}$, Model 4), external green practice has no significant impact on it ($\beta=0.076$, Model 4). Therefore, internal green practice does not have a significant indirect impact on environmental performance through external green practice (0.026, CI: -0.015 to 0.082). For the emerging Asian market group, internal green practice also does not have a significant indirect impact on environmental performance through external green practice (0.013, CI: -0.007 to 0.064). Specifically, the internal green practice is not significantly related to external green practice ($\beta=0.110$, Model 5), while both internal and external green practice positively and significantly affect environmental performance ($\beta=0.669^{***}$ and $\beta=0.117^{***}$, Model 6).

TABLE VII
RESULTS OF MULTIPLE GROUP ANALYSES

Sample 1: Industrialized Western market (N=111)

Predictors	Model 1	Model 2
	External green practice β (SE)	Environmental performance β (SE)
Constant	-0.1093(0.586)	1.319(0.447) ***
Firm size	0.357(0.098) ***	0.011(0.079)
Internal green practice	0.208(0.094) **	0.536(0.073) ***
External green practice		0.260(0.073) ***
R ²	0.176	0.463
Mediator	Bootstrap indirect effects on environmental performance (through external green practice)	
	Indirect Effect (S.E.)	LLCI ULCI
External green practice	0.054(0.029)	0.009 0.123

Sample 2: Emerging Western market (N=203)

Predictors	Model 3	Model 4
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	External green practice β (SE)	Environmental performance β (SE)
Constant	2.461(0.377) ***	1.854(0.367) ***
Firm size	-0.151(0.069) **	0.046(0.062)
Internal green practice	0.339(0.066) ***	0.503(0.062) ***
External green practice		0.076(0.063)
R ²	0.121	0.310
Mediator	Bootstrap indirect effects on environmental performance (through external green practice)	
	Indirect Effect (S.E.)	LLCI ULCI
External green practice	0.026(0.023)	-0.015 0.082

Sample 3: Emerging Asian market (N=126)		
Predictors	Model 5	Model 6
	External green practice β (SE)	Environmental performance β (SE)
Constant	2.128(0.740) ***	2.318(0.554) ***
Firm size	0.072(0.087)	-0.224(0.062) ***
Internal green practice	0.110(0.093)	0.669(0.068) ***
External green practice		0.117(0.065) *
R ²	0.012	0.605
Mediator	Bootstrap indirect effects on environmental performance (through external green practice)	
	Indirect Effect (S.E.)	LLCI ULCI
External green practice	0.013(0.018)	-0.007 0.064

Note: 5000 bootstrap samples. LLCI and ULCI = Lower limit and Upper limit of bootstrap confidence interval

V. DISCUSSION AND IMPLICATIONS

A. Summary of results

The statistical results lend support to all the proposed hypotheses. The following subsections set out and discuss these results in more detail.

1) Internal green practice, external green practice and environmental performance

Our results support Hypothesis 1 and Hypothesis 2: The adoption of both internal and

external green practice can improve the firm's environmental performance. In addition, Hypothesis 3 and Hypothesis 4 are also supported. That is, a firm's implementation of internal green practice can motivate it to exert more efforts to extend the green practice to its supply network, and, consequently, contribute to environmental performance by strengthening its external green practice. Therefore, external green practice play a "partial" mediation role between firms' internal green practice and environmental performance.

2) The moderating role of buyer-supplier relation

The statistical results suggest that the quality of the buyer-supplier relation not only moderates the direct effect of the internal dimension of green practice on the external dimension, but also moderates the indirect contribution of internal green practice to environmental performance through external green practice. That is, Hypothesis 5 and Hypothesis 6 are supported. The higher the quality of the buyer-supplier relation is, the stronger will be the positive link between internal and external green practice, and the stronger will be the indirect positive impact of internal green practice on environmental performance via external green practice. These findings help to explain the inconsistent results in both research and practice and why some external green practice help to achieve better environmental performance while others do not.

3) The moderating role of institutional context

The multiple group analyses suggest that Hypothesis 7 is supported. In the industrialized Western market, internal green practice not only posts a direct impact on environmental performance, but also affects environmental performance indirectly through external green practice. In the emerging Western market, even though a firm's implementation of internal

green practice contributes to both external green practice and environmental performance, a firm's external green practice has no link with environmental performance. One reason for the latter finding may be that firms in the emerging Western market are relatively small (59% of them have fewer than 50 employees and 88.2% have fewer than 200 employees), and small firms lack negotiating power. Interestingly, in the emerging Asian market, although a firm's internal green practice has a direct effect on environmental performance, it does not affect external green practice and will not indirectly contribute to environmental performance through external green practice. These findings suggest that in the emerging Asian market, firms do not emphasize external green practice as part of their green strategy, despite the fact that their suppliers are likely to have violated many environmental regulations, which might affect their green reputation.

B. Theoretical implications

Leveraging a multi-theoretic approach, this study builds on social exchange theory and institutional theory to increase our understanding of the link between green practice and environmental performance, and provides novel findings.

With the social exchange theory lens, we contribute to the literature by highlighting that the impact of green practice on the firm's environmental performance is complex and cannot be clearly articulated without considering the moderating role of the buyer-supplier relation, which is seldom examined in other studies. We demonstrate that the buyer-supplier relation can be an important factor that moderates the direct and indirect relationships among internal green practice, external green practice and environmental performance. With a higher-quality relationship with suppliers, firms are more inclined to implement external green practice, and

can help to strengthen the indirect contribution of internal green practice to environmental performance via external green practice. Without the firm building high-quality relation with supply chain partners, external green practice will be difficult to extend from the internal dimension.

With the institutional theory lens, we propose that the strategic implementation of green practice hinges on the institutional context, such as regulatory, social and market forces, thus incorporate the institutional context as another important moderator. This point is seldom investigated in other studies due to the need for cross-national data. This approach proved to be rewarding, as the distinct effect of the institutional context would not be recognized otherwise. The comparison across institutional contexts suggests that green practice, especially the external dimension, differ across industrialized Western, emerging Western and emerging Asian markets. Although the effect of internal green practice on environmental performance is similar in all three markets, the links between external green practice and environmental performance and between the internal and external dimensions of green practice differ. This implies that all firms, in whatever market, emphasize internal green practice, but firms in different markets focus on external green practice to different extents and therefore realize either positive or no improvements in external green practice. These findings advance the understanding of the contingency effect on the link between green practice and environmental performance in differentially industrialized regions.

C. Managerial Implications

This study also offers several managerial implications for both supply chain managers and policy makers. First, managers not only should realize the relationship between internal and

external green practice, but also their roles in enhancing environmental performance. Though internal green practice always result in better environmental performance, the external ones do not. Therefore, managers should decide how to invest resources and efforts to these two dimensions of green practice and start with the internal ones. Then, when they extend the internal green practice to the external ones, they should never ignore the importance of developing collaborative relations with suppliers. High-quality buyer-supplier relation strengthens the indirect contribution of a firm's implementation of internal green practice to environmental performance via external green practice.

Second, it is important for managers in different markets (developed market vs. emerging market) to take account of local values (environmental as well as others) and regulations to guide them in implementing green practice and making appropriate decisions. Thus, the implementation of external green practice in the emerging Asian market should be adapted to the local institutional context, and the smooth implementation of external green practice should be promoted through some additional strategies, such as developing collaborative relationships with suppliers. Especially in China, where *guanxi* plays a pivotal role in building and maintaining business relationships, the role of the buyer-supplier relation should never be neglected in green supply chain collaboration [65].

Third, our study also offers some implications for policymakers, especially those in the emerging Asian market. Compared with the industrialized Western and emerging Western markets, firms in the emerging Asian market tend to ignore the effect of external green practice, even though suppliers' non-environmental behaviors can seriously damage their sales and reputation. Thus, it is urgent for policymakers in the emerging Asian market to move forward

on legislation and policies that incorporate environmental standards into supply chain management. For instance, by learning from industrialized and emerging Western markets, governments in the emerging Asian market can implement some strategic incentives for business to adopt green practice, such as tax benefits, subsidies and so on.

VI. CONCLUSIONS

To explain the inconsistent conclusions with respect to the links among internal green practice, external green practice and environmental performance, this study integrates social exchange theory and institutional theory to examine the mediating and moderating roles of buyer-supplier relation and institutional context. Based on a sample of 440 firms from three categories of market (industrialized Western, emerging Western and emerging Asian), we find that a firm's environmental performance would be improved by adopting internal and external green practice, and external green practice plays a partial mediation role in the link between internal green practice and environmental performance. More specifically, the direct and indirect effects process will be affected by the buyer-supplier relation and vary in different institutional contexts. The findings are useful for providing a holistic understanding of firms' green practice, and have implications for how to improve environmental performance through leveraging green practice and the buyer-supplier relation in different markets.

This study has several limitations, the main one being that we have not established causal relationships among the constructs, because we use cross-sectional data rather than longitudinal data. In particular, when assessing the impacts of adopting green practice on environmental performance, it is preferable to have a time lag, because it may take several years to achieve

long-term effects. Thus, future studies could use a time-lagged design or dynamic research. Second, we investigated the moderating effect of buyer-supplier relation and institutional context, and future studies could examine other variables, such as organizational slack and sectoral effects, to enhance the generalizability of our research. Last but not least, we built on social exchange theory and institutional theory, but the use of newer theoretical lenses/frameworks should be explored. For example, green practice is often regarded as time-consuming and expensive, and whether to adopt them is significantly influenced by top managers' environmental attitudes and values [66]. In this regard, behavioral reasoning theory, which determines the relationships among beliefs, reasons, motives, intentions, and behavior [67], could be used to provide a theoretical basis for analyzing top managers' behavior in green operations, and should tease out more interesting findings.

APPENDIX

CONSTRUCTS, MEASUREMENTS AND CITED SOURCES

Constructs and Measurements	Adapted Sources
Environmental performance (EP)	
<i>During the past two years, please indicate the extent to which your plant has performed from an environmental perspective: (1=not at all, 7=great extent)</i>	
EP1: Our company reduces the energy consumption of the facility	Curkovic and Melynk [49]
EP2: Our company reduces the water consumption of the facility	Zhu <i>et al.</i> [50]
EP3: Our company reduces the waste of the facility	
EP4: Our company reduces the emissions of the facility	
Internal green practices (IGP)	
<i>Compared to the leaders in your industry in environmental management, to what extent does your plant engage in the following activities within your facility: (1= far less, 7= far more)</i>	
IGP1: The environmental effect of our company's processes and products is systematically controlled	Ketokivi and Schroeder [51]
IGP2: Our company's environmental goals are set by a systematic approach	
IGP3: Our company's environmental goals are achieved through a systematic approach	

IGP4: Our company demonstrates that environmental goals have been completed through a systematic approach

External green practices (EGP)

During the past two years, to what extent are the following green collaborative practices performed with your plant's suppliers: (1=not at all, 7=great extent)

EGP1: To certify the quality and operations of main suppliers, our company uses the green vendor certification program Zhu et al. [50]

EGP2: Our company makes a direct investment in major suppliers' green activities.

EGP3: Our company regularly holds joint meetings with major suppliers on environmental improvement work.

Buyer–supplier relationship (BSR)

Please indicate your choice on relational performance: (1=not at all, 7=great extent)

BSR1: Main suppliers are generally satisfied with the manufacturer-supplier relationship. Choi et al. [52]

BSR2: We are highly regarded by main suppliers.

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Fei Ye received the Ph.D. degree in management science and engineering from South China University of Technology, Guangzhou, China, in 2003.

He is currently a Professor with the School of Business Administration, South China University of Technology, Guangzhou, China. His research interests include supply chain coordination and optimization, service supply chain, green and sustainable supply chain. He has authored/coauthored articles in refereed journals, including *Journal of Retailing*, *Journal of Service Research*, *Naval Research Logistics*, *European Journal of Operational Research*, *International Journal of Operations & Production Management*, *International Journal of Production Research*, etc.



Guangyu Huang received the master's degree in business administration from South China Normal University, Guangzhou, China, in 2017.

He is currently working toward the Ph.D. degree at the School of Business Administration, South China University of Technology, Guangzhou, China. His research interests include green supply chain management, corporate social responsibility and industrial agglomeration.



Yuanzhu Zhan is currently a lecturer in operations and supply chain management at the University of Liverpool, Liverpool, United Kingdom. His research interests include operations management, big data and analytics, innovation management, and sustainable supply chain management. He has authored/coauthored articles in refereed journals, including *International Journal of Operations and Production Management*, *European Journal of Operational Research*, *International Journal of Production Research*, *International Journal of Production Economics*, *Transportation Research Part E: Logistics and Transportation Review*, *Annals of Operations Research*, and *R&D Management*, etc.



Yina Li received the Ph.D. degree in management science and engineering from South China University of Technology, Guangzhou, China, in 2008.

She is currently a Professor with the School of Business Administration, South China University of Technology, Guangzhou, China. Her research interests include supply chain coordination and optimization, green innovation, and supply chain quality management. He has authored/coauthored articles in refereed journals, including *Journal of Retailing*, *European Journal of Operational Research*, *International Journal of Production Research*, *International Journal of Operations & Production Management*, *International Journal of Production Economics*, etc.