

**An empirical study of green supplier collaboration in the Chinese manufacturing sector: The double-edged sword effect of *guanxi***

**Purpose:** Drawing on institutional complexity, this study explores the interaction effect of formal and informal institutional forces on the adoption of *green supplier collaboration* (GSC) practices by Chinese manufacturing firms.

**Design/methodology/approach:** The paper hypothesizes that the effect of the formal institutional forces on GSC in China is influenced by an informal institutional variable, *guanxi*, which is the interpersonal relationship between employees of the supplier and the manufacturer. To test the conceptual framework, hierarchical moderated regression analyses are conducted using multi-respondent data from 408 randomly sampled manufacturing companies in China.

**Findings:** *Guanxi* has a double-edged sword effect on the adoption of GSC practices. Specifically, *guanxi* reduces the negative impact of the perceived costs and the complexity of regulations on the adoption of GSC practices, but it also weakens the positive effect of suppliers' advice and community pressures on the adoption of GSC practices.

**Research limitations/implications:** Results contribute to supply chain management literature by offering novel theoretical and empirical insights on the Chinese institutional environment governed by both formal and informal institutional variables.

**Practical implications:** Considering *guanxi's* double-edged sword effect on the adoption of GSC, manufacturing companies are advised to carefully leverage their *guanxi* to maintain an institutional and contingent view of the environmental consequences in China.

**Originality/value:** This study empirically examines the effect of formal and informal institutional environments on the adoption of GSC practices in emerging economies.

**Keywords:** Green supplier collaboration; Institutional theory; Chinese manufacturing sector; *Guanxi*; Personal relations; Moderating effect

## 1. Introduction

In the past decades, addressing human-induced environmental issues has been a major global challenge for organisations to gain competitiveness (York et al., 2018). Green collaboration underpins manufacturers' commitments to environmental sustainability, given that most manufacturers often purchase materials and source products from other organisations. Thus, it is essential for firms to collaborate on environmental practices with suppliers, from the design stage to the delivery of the final product, to ensure materials and production processes are green (Wang et al., 2016). In other words, supplier deficiency in green supply chain management (GSCM) can lead to a huge financial and operational impact on focal firms. Therefore, firms are encouraged to adopt green supplier collaboration (GSC) practices to reduce environmental damage while increasing their financial, operational and social performance (Lee, 2015).

The vast and growing manufacturing activities in China, deemed 'the world's factory', have inevitably damaged the country's environment. Home to 7 of the 10 most polluted cities in the world, the Chinese government now exert strict carbon dioxide reduction limits by requiring all manufacturing companies to provide information on the carbon footprint of every product listed on their packaging (MIIT, 2016). Therefore, manufacturing firms have shown increasing attention to joint efforts with suppliers by adopting GSC practices, defined as focal firms' efforts to collaboratively deploy resources and capacities with suppliers in order to jointly develop solutions that reduce the negative impact of manufacturing activities on the environment (Dubey et al., 2015).

Despite a promising outlook, the adoption of GSC practices by Chinese manufacturing firms has not been straightforward due to the country's complex institutional environment. Specifically, firms respond to a formal institutional environment to obtain legitimacy against uncoordinated demands from multiple independent groups (Greenwood et al., 2011), in an

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3 environment that is often conflicted, vague and in flux (D'Aunno et al., 1991). This highlights  
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5 the problem of institutional complexity, which often arises when firms encounter difficulties  
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7 making decisions in incompatible and sometimes conflicting institutional environments  
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10 (Greenwood et al., 2011; Luo et al., 2017). Correspondingly, many management studies  
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12 distinguish the coexistence of formal and informal institutional environments (Deephouse et  
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14 al., 2016; Hearn, 2015; Meyer et al., 2011; Miska et al., 2018). The formal institutional  
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16 environment refers to the multiplicity and diversity of institutional sources that influence firms'  
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18 strategies and control mechanisms, whereas the informal institutional environment reflects  
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20 cultural and behavioural characteristics (DiMaggio and Powell, 1983).  
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24 As an informal institutional force, *guanxi* is described as the cultural characteristic of  
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26 interpersonal relationship ties that affect firms' business decisions and behaviours (Lee and  
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28 Humphreys, 2007; Zhao et al., 2011; Zhou et al., 2014) and collaborations between buyers and  
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30 suppliers (Barnes et al., 2011). Extant research shows that whilst *guanxi* proves to replace the  
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32 effect of organisational trust on driving financial performance in buyer-supplier relationships  
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34 and weakens the negative impact of uncertainty on long-term orientation (Yen and Abosag,  
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36 2016), ignoring *guanxi* and its various effects specific to Chinese institutional environments  
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38 can lead to a failure to adopt GSC practices in China (Lee et al., 2015). In contrast, Cheng et  
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40 al. (2012) indicated that good *guanxi* between a company and its suppliers positively affects  
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42 the sharing of knowledge regarding GSCM practices. Considering these conflicting views, we  
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44 feel it is important to further examine the role of *guanxi*, which is rooted in the informal  
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46 institutional environment, in the adoption of GSC practices in the Chinese manufacturing sector.  
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51 While the research on GSCM recognizes the importance of the formal institutional  
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53 environment, less attention has been paid to the co-existence of multiple and sometimes  
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55 conflicting institutions. Relatively little empirical work has examined the interaction effect  
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57 between formal and informal institutional environments on the development of GSCM, which  
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3 fails to provide a deeper understanding of the mechanisms involved in the complex institutional  
4 environment of the firm. This paper addresses this knowledge gap by investigating the  
5 interaction effects between formal institutional environments (suppliers' advice, community  
6 pressures, competitors' actions, perceived costs and complexity of regulations) and an informal  
7 institutional environments (*guanxi*) on the adoption of GSC practices, using the theoretical  
8 framework of institutional complexity.  
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17 More specifically, this study examines how *guanxi* as an informal institutional variable  
18 interacts with formal institutional forces in the adoption of GSC practices by Chinese  
19 manufacturing firms. Building on Greenwood et al. (2011), this study paints a nuanced picture  
20 on *guanxi* deployment with suppliers, in a manner that is conducive to manifesting the formal  
21 institutional environment for the adoption of GSC practices.  
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29 On the basis of the above discussion, we aim to answer the following research question.

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- Does *guanxi*, as an informal institutional variable, interact with formal institutional forces in the adoption of GSC practices by Chinese manufacturing firms?

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37 By theoretically proposing and empirically showing that *guanxi* is an informal institutional  
38 variable that affects the adoption of GSC practices, this paper contributes to GSCM research  
39 through institutional theory in two ways. First, by investigating institutional complexity  
40 through the interaction between formal and informal institutional forces, the paper  
41 demonstrates how compatible institutional forces positively affect the adoption of GSC  
42 practices. Second, by explaining how *guanxi* as an informal institutional variable interacts with  
43 formal institutional forces, this paper establishes the double-edged sword effect of *guanxi* on  
44 the adoption of GSC practices in China.  
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## 54 55 **2. Literature review and conceptual framework**

### 56 57 **2.1. Green supplier collaboration**

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3 Previous studies emphasised the importance of adopting GSC practices for companies to  
4 truly green their supply chains (Seuring and Müller, 2008; Cheung et al., 2009; Dubey et al.,  
5 2015) to ensure that their products meet the desired environmental standards (Lai and Wong,  
6 2012; Wu et al., 2012). In this study, GSC refers to a firm's collaborative deployment of its  
7 resources and capacities with its suppliers to jointly develop solutions to environmental  
8 problems originating from manufacturing operations (Dubey et al., 2015; Luo et al., 2014).  
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11 From a resource-based perspective, close collaboration between focal firms and their  
12 suppliers can be an effective means of transferring essential resources from focal firms to their  
13 suppliers (Cousins, 1999). Consequently, both focal firms and their suppliers become  
14 increasingly engrossed in sustainability concerns instead of engaging in mere contract-based  
15 collaboration. Previous research showed that inadequate access to resources erects a major  
16 barrier to initiating environmental management (Bansal, 2005; Ramus and Steger, 2000).  
17 Hence, when focal firms and suppliers collaborate in the exchange of available resources, such  
18 collaborations become more effective means of improving environmental performance in  
19 GSCM (Geffen and Rothenberg, 2000; Lee and Klassen, 2008), addressing the issues caused  
20 by deficient internal resources (Large and Thomsen, 2011).  
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## 23 **2.2. Institutional complexity**

24 Since the seminal work of DiMaggio and Powell (1983), the research on institutional theory  
25 has focused on how institutional pressures shape an organisation's behaviour and decisions.  
26 Institutional theory is the most commonly used theory in the field of GSCM (Geng et al., 2017).  
27 Previous studies used institutional theory to classify the external antecedents that influence  
28 firms to adopt GSCM practices. These antecedents include coercive pressure from the  
29 government (Birkin et al., 2009; Lee, 2015; Liu et al., 2012), normative pressure from the  
30 market (Huang et al., 2012) and mimetic pressure from competitors (Abdulrahman et al., 2014;  
31 Govindan et al., 2014).  
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3 However, most of the studies in GSCM took an overly simplistic approach, assuming that  
4 those institutional pressures are separate, thereby ignoring institutional multiplicity and  
5 complexity. Only recently have studies started to examine the contradictory effects of complex  
6 institutional forces on a firm's decision making (Luo et al., 2017; Miska et al., 2018).  
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### 12 **2.3. Informal institutional environments**

14 Social norms exert legitimacy pressures on firms to adopt institutionalized practices (Meyer  
15 and Rowan, 1977). Cultural characteristics set a foundation for legitimacy through a culturally  
16 supported base embedded within a particular country or society (Miska et al., 2018). In China,  
17 *guanxi*, as a critical cultural institutional force, has a profound influence on firms' business  
18 decisions and actions (Luk et al., 2008). However, relatively little research discussed the  
19 interaction effect between formal institutions and *guanxi* in GSCM.  
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28 To address this knowledge gap, this paper focuses on the *guanxi* established as an informal  
29 institutional force between a focal company's purchasing manager and its key supplier's sales  
30 representatives, and investigates its interaction with formal institutional environments affecting  
31 GSC. The *guanxi* between purchasing managers and sales representatives is relevant because  
32 these two boundary-spanning personnel are the most engaged in the daily negotiations,  
33 discussions and meetings to facilitate focal firm-supplier collaborations on GSCM (Zhou et al.,  
34 2014; Yen and Abosag, 2016). Although informal, the level of *guanxi* between the two  
35 boundary-spanning personnel can have a significant impact on promoting trust, commitment  
36 and mutual understanding between the firms (Barnes, Yen and Zhou, 2011; Yen and Barnes,  
37 2011). Given the importance of *guanxi* in business relationships and practice adoption, as well  
38 as its over-arching effect on GSCM in China (Geng et al., 2017), this paper argues that *guanxi*  
39 is a significant informal institutional force to be considered when discussing how formal  
40 institutional forces drive GSC between a focal firm and its suppliers in China.  
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### 58 **2.4. Formal institutional environments**

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3 The formal institutional environment refers to the multiplicity and the diversity of  
4 institutional forces that influence firms' strategies and control mechanisms (DiMaggio and  
5 Powell, 1983). One of these forces, supplier's advice, reflects the fact that suppliers are  
6 constantly under pressure to take on a higher green standard to remain competitive and  
7 regulation-compliant and therefore, they are keen to request that focal firms engage in GSC  
8 practices (Zhou et al., 2016) and to provide extensive information to them on adopting greener  
9 environmental practices (Zhu et al., 2005; Zhuang et al., 2014).

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19 The *guanxi* tie between a focal company's purchasing manager and its key supplier's sales  
20 representative is likely to have a positive effect on GSC when the supplier's advice plays a  
21 central role in the focal firms' decision making (Ramus and Steger, 2000). For example, a  
22 supply firm may encourage a focal firm to adopt higher green standards to remain competitive  
23 in the market. When the supplier's sales representative has a high level of *guanxi* with the focal  
24 firm's purchasing manager, the sales representative will have better chance to share  
25 information regularly and offer continuous support to help drive the focal firm's  
26 implementation of GSC practices (Cai and Yang, 2014). Hence, the first hypothesis follows:

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37 *H1. The effect of suppliers' advice on the adoption of GSC practices is moderated by*  
38 *guanxi between boundary-spanning personnel, such that a positive association will*  
39 *become stronger when a high level of guanxi is present.*

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Community pressure is a normative institutional force for the adoption of GSC practices  
(Birkin et al., 2009). Although previous studies show that community pressures do not affect  
the adoption of GSCM practices in China (Liu et al., 2012), empirical evidence collected from  
outside of China offers contradictory conclusions by showing that community pressures  
increase the adoption of GSC (Mohanty and Prakash, 2013). Such contradictions could be  
attributed to the primary role of communities, which is to raise concerns that companies'  
activities are harming the environment, rather than to lobby for GSCM practices (Liu et al.,

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3 2012). Nevertheless, considering the increasing environmental damage due to over-production  
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5 in China, community pressures are a potential formal institutional force to drive GSC practices.  
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8 Strong *guanxi* between boundary-spanning personnel may negatively moderate the  
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10 relationship between community pressures and GSC adoption; when purchasing managers are  
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12 excessively involved in their interpersonal relationships with sales representatives (Park and  
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14 Luo, 2001), they may lose their objectivity in evaluating suppliers' green standards (Opper et  
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16 al., 2017). The fear of risking *guanxi* ties or damaging established long-term relationships with  
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18 key suppliers' representatives may influence the focal firm's willingness to consider new GSC  
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20 practices (Zhou et al., 2016). Such conflicts of interest create institutional complexity, which  
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22 is particularly challenging when firms face two largely incompatible logics (Greenwood et al.,  
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24 2011). When a purchasing manager gets too comfortable with a sales representative, a  
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26 phenomenon called 'collective blindness' may occur (Villena et al., 2011). In this situation, the  
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28 purchasing manager is unlikely to consider alternative views that drive GSC, in favour of  
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30 protecting *guanxi*. Consequently, such *guanxi* reduces the focal firm's scope for creative  
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32 thinking, continuous learning and willingness to contemplate new ideas on GSC practices,  
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34 (Zhou et al., 2016). Therefore, the second hypothesis follows:  
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40 *H2. The effect of community pressures on the adoption of GSC practices is moderated by*  
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42 *guanxi between boundary-spanning personnel, such that a positive association will become*  
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44 *weaker when a high level of guanxi is present.*  
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47 Competitors in the same industry have the most visible commonalities with focal  
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49 companies in terms of operations, and they play key roles for companies that engage in GSC  
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51 practices. Normative institutions encourage organisations to learn from the actions of  
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53 successful competitors in the same industry (Zhu, Sarkis and Lai, 2013), whilst mimetic  
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55 institutional forces occur due to market uncertainty that encourages imitation (DiMaggio and  
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57 Powell, 1983). Chinese manufacturers often exchange ideas and learn from their competitors  
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3 to gain a better competitive advantage in the global market (Birkin et al., 2009; Liu et al., 2012).  
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5 Hence, many Chinese joint venture firms have adopted GSCM practices after observing their  
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7 Western parent companies benefiting from such adoption (Zhu et al., 2013). When a focal firm  
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9 perceives increased pressure from its competitors in the market, it will attempt to mimic their  
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11 advances and strategic moves (Cao et al., 2015). This explains why a focal firm is more likely  
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13 to engage in GSC practices to stay competitive and ahead of the race.  
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17 However, when a purchasing manager becomes excessively concerned about his/her  
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19 *guanxi* with sales representatives, the focal firm may lose its impartiality with regard to  
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21 evaluating a supplier's green performance (Luo et al., 2012). Collective blindness (Villena et  
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23 al., 2011) may lead to firms' reluctance to initiate new changes and standards in fear of  
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25 damaging their *guanxi* (Zhou et al., 2016). As a result, the dilemma caused by institutional  
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27 complexity emerges for many Chinese managers (Zhao et al., 2008): generating optimal  
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29 solutions is often difficult due to the need to avoid potential conflicts that may hinder their  
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31 *guanxi* with various stakeholders. Accordingly, the third hypothesis follows:  
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35 *H3. The effect of competitors' actions on the adoption of GSC practices is moderated by*  
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37 *guanxi between boundary-spanning personnel, such that a positive association will become*  
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39 *weaker when a high level of guanxi is present.*  
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43 Perceived costs are among the key uncertainties that hinder companies from going green  
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45 (Abdulrahman et al., 2014; Govindan et al., 2014). The more uncertainty a supplier perceives,  
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47 the less likely it is to adopt new practices (DiMaggio and Powell, 1983). When suppliers realise  
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49 that a specific GSC practice can be easily copied by fellow competitors, it is questionable  
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51 whether this practice can contribute to competitive advantage and financial performance.  
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55 When a supplier perceives that the adoption of green practices is highly costly, it may  
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57 become less willing to adopt them. However, this uncertainty may be reduced by strong *guanxi*  
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59 ties between boundary-spanning personnel (Yen and Abosag, 2016). In other words, such  
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3 *guanxi* assures suppliers of the focal firm's commitment to GSC (Dubey et al., 2015); hence,  
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5 the high cost associated with the adoption of greener practices is perceived as less risky (Park  
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7 and Luo, 2001). Consequently, focal firms may naturally find it easy to reduce the risk  
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9 associated with the high cost of adopting GSC practices. A strong *guanxi* tie with suppliers  
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11 could increase companies' confidence in such a collaboration, as *guanxi* prioritizes long-term  
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13 relationships. Therefore, these formal and informal institutional forces are opposing yet  
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15 harmonizing, not contradictory, in this setting. Therefore, the fourth hypothesis follows:  
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19 *H4. The effect of perceived costs of adopting GSC practices is moderated by guanxi*  
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21 *between boundary-spanning personnel, such that a negative association will become*  
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23 *weaker when a high level of guanxi is present.*  
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27 Although government regulations often impose GSC, the complexity of the regulations is  
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29 usually regarded as a barrier, not an enabler to the adoption of green practices in emerging  
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31 economies (Abdulrahman et al., 2014). Loose government regulations and inconsistent law  
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33 enforcement contribute to the slow adoption of environmentally friendly practices in China.  
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35 Whilst the fast-changing regulations hinder the adoption of GSC practices by Chinese  
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37 manufacturers (Abdulrahman et al., 2014), *guanxi* is often employed as a remedy to overcome  
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39 such regulatory complexity (Chen et al., 2011). Hence, *guanxi* would weaken the negative  
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41 relationship between the complexity of regulations and the adoption of GSC practices for three  
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43 reasons. First, companies in China often rely on their *guanxi* with suppliers to acquire valuable  
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45 information about the adoption of GSC practices (Luk et al., 2008). Second, strong *guanxi* may  
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47 facilitate communications, negotiations, coordination and information exchange (Zhuang et al.,  
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49 2014) when focal companies adopt GSC practices. Third, inter-organisational collaboration  
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51 over GSC practices requires trust and credibility between the focal company and its suppliers  
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53 (Zhu et al., 2010b).  
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3 In the Chinese context, the interpersonal trust of *guanxi* between the purchasing manager  
4 and the supplier's representative is often a more powerful insurance than a formal contract  
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6 (Yen and Barnes, 2011). Therefore, the fifth hypothesis follows:  
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10 *H5. The effect of the complexity of regulations on the adoption of GSC practices is*  
11 *moderated by guanxi between boundary-spanning personnel, such that a negative*  
12 *association will become weaker when a high level of guanxi is present.*  
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17 These five hypotheses are presented in Figure 1. The first sign in brackets next to each  
18 hypothesis suggests the direction of the relationship, and the second sign suggests the  
19 moderating effect of *guanxi* on that relationship. For example, in H1, a positive relationship  
20 from suppliers' advice to GSC practices is hypothesized, and *guanxi* will strengthen this  
21 positive relationship, whereas in H2, a positive relationship from community pressures to GSC  
22 practice is hypothesized, and *guanxi* will weaken this positive relationship.  
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31 *[Insert Figure 1 about here]*

### 32 **3. Methods**

#### 33 **3.1. Sampling**

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35 In line with previous research on GSCM (Zhu et al., 2011), we considered manufacturing  
36 companies that produce goods using labour and machines, tools and chemical and biological  
37 processing or formulations. We collected data from manufacturing firms with an environmental  
38 management certification (ISO 14000 or Green Label), located in the major coastal regions:  
39 Jiangsu, Guangdong, Shandong and Shanghai. These four regions capture the economic and  
40 geographic diversity of the manufacturing sector in China, cover China's most polluted areas  
41 and are closely scrutinized by Chinese environmental agencies (Liu, 2014). Companies in eco-  
42 industrial parks with ISO 14000 or Green Label certification were chosen because they are  
43 more likely to have embarked on adopting GSC practices (Zhu and Geng, 2013).  
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#### 56 **3.2. Measures**

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3 The adoption of GSC practices was measured as an endogenous construct assessing  
4 collaboration activities with suppliers (adapted from Zhu et al., 2005). The exogenous  
5 constructs for formal institutional forces included suppliers' advice, competitors' actions,  
6 community pressures, perceived costs and complexity of regulations. The measurement tool  
7 for the suppliers' advice was adapted from Miao et al. (2012) and Zhu et al. (2005). The  
8 construct measuring competitors' actions was adapted from El Tayeb et al. (2010). The  
9 community pressures construct was adapted from Liu et al. (2012) and measured pressures  
10 from neighbouring communities and the media. Perceived costs of adoption include costs  
11 associated with capital investment, hazardous waste disposal, human resources recruitment and  
12 switching to a new system for adopting GSC practices (Min and Galle, 2001). Complexity of  
13 regulations was measured using the level of government support, with three items from  
14 Abdulrahman et al. (2014) and two items from Chen et al. (2011) that evaluate the levels of  
15 economic and regulatory support by the government for resolving environmental issues. The  
16 level of *guanxi* was measured based on the closeness of the relationship and the frequency with  
17 which favours are exchanged between the focal firm's purchasing manager and their supplier's  
18 sales representative (Luo et al., 2014; Yen et al., 2011). The full list of measurement items is  
19 provided in Appendix A, Table A.1.

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22 Control variables were used to account for extraneous influences of the incremental  
23 improvement in the overall 'prediction' of the regression model (Carlson and Wu, 2012).  
24 Therefore, the primary purpose of the control variable in this study is to offer a meaningful  
25 improvement in the variance accounted for by the model (Carlson and Wu, 2012). Previous  
26 studies indicated that firm size is a significant factor influencing the adoption of environmental  
27 practices (Mohanty and Prakash, 2013). Thus, firm size was controlled using the guidance  
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of Statistics, 2006), which classifies companies with 1000 employees as large, 300 to 1000 employees as medium, 21 to 299 employees as small and fewer than 20 employees as micro.

### 3.3. Pilot study

A questionnaire survey was first developed in English and then translated into Chinese. Back-translation was used to check the proficiency of the translated version, which led to rewording several questions to improve their accuracy. Subsequently, a pilot study with 52 companies in Suzhou Industrial Park was conducted from July to August 2015 to check the clarity of the questionnaire. We selected Suzhou Industrial Park because it is in the Yangtze River Delta and represents a high degree of economic growth. According to Bryman and Bell (2014), researchers must compile a small group of participants who resemble the population from which the sample for the complete study will be drawn to maximize the benefits of pilot testing. Therefore, with regard to the participants, we approached only managers who currently hold positions in the supply chain (e.g. operations manager, purchasing manager and supply chain manager) as key informants, as they will have good knowledge about supply chain activities and be familiar with their suppliers.

Participants were briefed to focus on their GSC practices with their largest supplier and their *guanxi* with that supplier's sales representative (Barnes et al., 2011). In this pilot study, the construct of perceived costs had a low Cronbach's alpha (0.364). This was possibly because the questions pertaining to this construct were modified from previous studies (e.g. Abdulrahman et al., 2014; Govindan et al., 2014) where the measurement scale ranged from 'strongly agree' to 'strongly disagree'. In the current study, the scale for the perceived costs of adopting GSC practices were changed to 'not very costly', 'not costly', 'normal', 'costly' and 'very costly' to avoid the influence of negative statements on respondents' opinions. To address this issue, three bilingual experts who work at manufacturing companies reviewed the Chinese version of the questionnaire. Following their advice, the measurement scale was changed to

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3 'very cheap', 'cheap', 'normal', 'expensive' and 'very expensive' to help respondents better  
4 distinguish the ratings. Finally, face-to-face discussions were held with 10 managers who  
5 completed the pilot survey to ensure the wording and the content changes were understandable  
6 and relevant to practices in China.  
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### 12 **3.4. Data collection**

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14 Sanjintong<sup>1</sup> database was used to obtain the contact details of the supply chain managers  
15 and CEOs/presidents of the manufacturing companies in the target industrial park. In this way,  
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17 2143 companies were identified from 11 industrial parks in 4 locations, as follows:  
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- 21 • **Jiangsu:** Suzhou Industrial Park; Suzhou Hi-tech Industrial Zone; Wuxi New District  
22 Eco-industry Park; Yangtze River International Chemical Industrial Park  
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- 24 • **Guangdong:** Guangzhou Economic & Technical Development Zone  
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- 26 • **Shandong:** Weifang Binhai Economic-Technological Development Area; Yantai  
27 Economic & Technological Development Area  
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- 29 • **Shanghai:** Shanghai Xinzhuang Industrial Park; Caohejing Hi-Tech Park; Shanghai  
30 Chemical Industrial Zone; Minhang Economic & Technical Development Zone  
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38 The questionnaire was conducted in two parts to reduce the common method bias by  
39 targeting two informants in each firm (Guide and Ketokivi, 2015). Part I focused on the  
40 organisational characteristics, formal institutional forces and adoption of GSC practices, based  
41 on their relationship with the largest supplier. This part was sent to key informants who held  
42 senior positions in the firm's supply chain function and had a good understanding of the  
43 company's internal and external processes, including the supply chain manager, CEO/president,  
44 vice president and director of marketing and purchasing. They were targeted because senior  
45 management usually plays a vital role in the design of a firm's environmental policy (Chan et  
46 al., 2012). Part II of the questionnaire specifically focused on *guanxi* and targeted purchasing  
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<sup>1</sup> <http://sanjintong.net/>

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3 managers who directly interact with the largest suppliers' representatives and are therefore  
4  
5 most knowledgeable about the focal firm's *guanxi* ties with suppliers (Luo et al., 2014; Zhou  
6  
7 et al., 2014).  
8  
9

10 The data was collected in two rounds: 1) from November 10, 2015, to December 31, 2015,  
11  
12 and 2) from January 15, 2016, to February 15, 2016. Emails were sent to 1000 randomly  
13  
14 selected individuals working in companies located in the 11 industrial parks listed above. The  
15  
16 website randomizer<sup>2</sup> was used for random selection of participants. Part I had 230 responses  
17  
18 and Part II had 270 responses, which were then combined by company name, leading to 217  
19  
20 complete pairs at the end of Round 1. In the second round, 50 companies that had filled out  
21  
22 only Part II in the first round were approached. In addition, another 1000 randomly selected  
23  
24 companies were emailed after excluding 98 companies that had already responded, resulting in  
25  
26 a total of 1902 invitations. In total, 936 responses were collected for Part I and Part II, leading  
27  
28 to 410 complete responses. This represents a response rate 21.6%. (410/1902) which compares  
29  
30 favourably with previous surveys on GSCM (Zhu et al., 2005). Removing two univariate  
31  
32 outliers in community pressures and competitors' actions, 408 responses were used for the  
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34 analysis.  
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#### 40 **4. Analyses and results**

##### 41 **4.1. Reliability and construct validity tests**

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44 Initially, the endogeneity of the exogenous variable was tested. The formal institutional  
45  
46 variables are exogenous to the adoption of GSC practices. For the issue of reverse causality, a  
47  
48 systematic literature review of 42 papers in emerging markets confirmed that formal  
49  
50 institutional forces can shape the adoption of GSC practices both theoretically and empirically,  
51  
52 but not the other way around (Geng et al., 2017a). The presence of endogeneity was tested  
53  
54 statistically by conducting the Hausman test (Ketokivi and McIntosh, 2017). Formal  
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60 <sup>2</sup> <https://www.randomizer.org>

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2  
3 institutional forces and the adoption of GSC practices were regressed on the control variable  
4  
5 of firm size, and whether the residual from a regression of GSC practices on the exogenous  
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7 variables had a significant coefficient when added to the original model was tested (Dong et  
8  
9 al., 2016). Secondly, augmented regressions were performed by using the residuals as  
10  
11 additional independent variables. The results showed that the parameters estimated for the  
12  
13 residuals in the augmented regression were not statistically significantly different from zero.  
14  
15 Therefore, endogeneity was concluded to be absent and the results were consistent with the  
16  
17 conceptual model. Table 1 shows the descriptive statistics of the sample.  
18  
19  
20

21  
22 *[Insert Table 1 about here]*

23 To evaluate measurement validity, we assessed internal consistency and convergent  
24  
25 validity. Table 2 presents the mean, the standard deviation and the correlations between the  
26  
27 constructs. For example, GSC practices has a mean value of 3.6, where 3 = Have a plan for the  
28  
29 implementation and 4 = In the process of the implementation.  
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32  
33 *[Insert Table 2 about here]*

34 Table 3 presents factor loadings, Cronbach's alpha, composite reliability scores and the  
35  
36 average variance extracted (AVE) for each construct. The factor loading of each item ranged  
37  
38 from 0.46 to 0.77, and all loadings were statistically significant ( $p < 0.001$ ), suggesting  
39  
40 convergent validity (Wang et al., 2016). The Cronbach's alpha coefficients (ranging from 0.580  
41  
42 to 0.827) and composite reliabilities (ranging from 0.645 to 0.771) suggested adequate  
43  
44 reliability (Liu et al., 2016). In general, researchers agree that Cronbach's alpha value should  
45  
46 be above 0.70 (Hair et al., 2010). According to Nunnally and Bernstein (1994), Cronbach's  
47  
48 alpha is sensitive to the number of items in a construct. For example, the value of Cronbach's  
49  
50 alpha can increase when the number of items for measuring a construct increases, even with  
51  
52 the same degree of inter-correlation. Therefore, a Cronbach's alpha value of 0.60 (Hair et al.,  
53  
54 2014) or 0.50 (Nunnally and Bernstein, 1994) can be acceptable, especially in exploratory  
55  
56 research or for constructs with a small number of indicators (Hair et al., 2010; Grafton et al.,  
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2010; Cortina, 1993). The lowest AVE was greater than the shared variance of each construct with other constructs (Hair Jr and Lukas, 2014). Thus, these results support convergent validity.

[Insert\_Table\_3\_about\_here]

#### 4.2. Statistical modelling

Hierarchical moderated regression analyses were used to test the hypotheses because the proposed model contains interaction terms between institutional forces and the adoption of GSC practices. This type of modelling allows comparisons across different models to determine whether the hypothesized independent and moderator variables explain the dependent variable (adoption of GSC) better than the model with only independent variables. The typical comparison criterion is the coefficient of determination ( $R^2$ ), which needs to be significantly better than a former model to conclude that moderation and interaction exist. According to O'Brien (2007), a moderator is a variable which can affect the direction and strength of the direct relationship between an independent and a dependent variable.

The four-step variance partitioning procedure (Jaccard et al., 2003) was implemented by setting the firm size as the control variable. The variance partitioning procedure includes four steps.

Step 1: One control variable—firm size—was included in the regression.

Step 2: Five institutional forces—suppliers' advice, community pressures, competitors' actions, high perceived costs and complexity of regulations—were included in the regression.

Step 3: The moderator variable *guanxi* was included in the regression.

Step 4: Five interactions—suppliers' advice  $\times$  *guanxi*, community pressures  $\times$  *guanxi*, competitors' actions  $\times$  *guanxi*, perceived costs  $\times$  *guanxi* and complexity of regulations  $\times$  *guanxi*—were included in the regression.

To reduce multicollinearity, the 'mean-centring' technique was employed through the use of deviation scores for the independent variables and moderators (Zhu and Sarkis, 2007). In

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2  
3 this study, the maximum variance inflation factor (VIF) value in all regression models was 1.2,  
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5 which indicates that multicollinearity was not a concern because the VIF values were below  
6  
7 the threshold of 5 (O'Brien, 2007). Therefore, the underlying assumption of multiple regression  
8  
9 analysis was not violated. However, although the mean-centring technique is a commonly used  
10  
11 tool for reducing multicollinearity, Echambadi and Hess (2007) indicated that this technique  
12  
13 does not help alleviate the issue of multicollinearity. They argued that the issue of  
14  
15 multicollinearity cannot be remedied after data collection in most cases. Therefore, two  
16  
17 strategies were used to reduce the threat of multicollinearity by carefully designing the study  
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19 before data collection. First, data regarding *guanxi* were collected separately to isolate the  
20  
21 moderator variable and reduce the potential multicollinearity (Grewal et al., 2004). Second, the  
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23 sample size was increased through a second round of data collection to address the loss of  
24  
25 power associated with multicollinearity. Table 4 shows the results of the hierarchical  
26  
27 moderated regression models. Model 1 includes only the control variable. Model 2 adds the  
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29 independent variables and Model 3 adds the moderator. Model 4 features all interaction terms.  
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36 In Model 1, the control variable firm size accounted for 18% of the variance in the adoption  
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38 of GSC practices, with a statistically significant and positive effect ( $\beta = 0.136, p < 0.005$ ). In  
39  
40 Model 2, inclusion of the 5 institutional forces increased the  $R^2$  to 35.1%. Two of the  
41  
42 institutional forces (suppliers' advice and community pressures) had statistically significant  
43  
44 and positive effects on the adoption of GSC practices. However, the effects of competitors'  
45  
46 actions and perceived costs on the adoption of GSC practices were not statistically significant.  
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48 Moreover, the complexity of regulations had a statistically significant and negative effect on  
49  
50 the adoption of GSC practices ( $\beta = -0.443, p < 0.001$ ). In Model 3, inclusion of *guanxi* as the  
51  
52 moderator increased the  $R^2$  to 36.7%. *Guanxi* has a statistically significant and positive effect  
53  
54 on the adoption of GSC practices ( $\beta = 0.180, p < 0.001$ ). In Model 4, the  $R^2$  increased to 36.8%  
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56 with the inclusion of interaction terms.  
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[Insert Table 4 about here]

Table 4 shows that the results are consistent across the 4 models and Model 4 improves Models 1–3 by showing that moderating effects exist owing to the collective incremental F value for the regression and the statistically significant beta values of the interaction terms (O'Brien, 2007).

### 4.3. Hypothesis testing

To show the moderating effect of *guanxi*, this construct was split into high (one standard deviation or more above the mean) and low (one standard deviation or more below the mean) levels (Aiken et al., 1991). Formal institutional forces were discretized similarly into high and low. Then, the effects of the formal institutional forces on the adoption of GSC practices were estimated at the two levels of *guanxi* and the corresponding formal institutional force. The results are illustrated in Figure 2.

[Insert Figure 2 about here]

Note that the interaction effect for competitors' actions was not statistically significant, so it is not included in this stage of analysis. The moderator analysis (Table 4, Model 4) shows that *guanxi* has a negative and statistically significant impact on the effect of suppliers' advice on the adoption of GSC practices ( $\beta = -0.240, p < 0.05$ ).

At high levels of *guanxi*, the effect of suppliers' advice on the adoption of GSC practices is weaker (Figure 2a). Therefore, H1 is rejected. *Guanxi* negatively and statistically significantly moderates the relationship between community pressures and the adoption of GSC practices ( $\beta = -0.114, p < 0.05$ ). The effect of community pressures is higher under low *guanxi* (Figure 2.b), which means pressure from the community on the adoption of GSC practices becomes stronger with a lower level of *guanxi*. The interaction between competitors' actions and *guanxi* is not statistically significant ( $\beta = -0.09, ns$ ). Thus, *guanxi* does not moderate the relationship between competitors' actions and the adoption of GSC. Therefore, H3 is rejected. *Guanxi* positively and statistically significantly moderates the relationship

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3 between perceived costs and GSC adoption ( $\beta = 0.103, p < 0.05$ ). Figure 2.c shows that the  
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5 negative effect between perceived costs and the adoption of GSC practices is reduced when the  
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7 level of *guanxi* is high. Therefore, H4 is supported. Finally, *guanxi* positively and statistically  
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9 significantly moderates the relationship between the complexity of regulations and GSC  
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11 adoption ( $\beta = 0.45, p < 0.05$ ). When the level of *guanxi* is low, the complexity of regulations  
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13 has a stronger effect on the adoption of GSC practices (Figure 2d). However, when *guanxi* is  
14  
15 high, the negative impact of the complexity of regulations on GSC becomes weaker. Therefore,  
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17 H5 is supported. Below is a summary of the moderation results:  
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- 21 • **H1:** *Guanxi* strengthens the positive effect of suppliers' advice on GSC adoption: Rejected.
- 22  
23 • **H2:** *Guanxi* reduces the positive effect of community pressures on GSC adoption:  
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25 Supported.
- 26  
27 • **H3:** *Guanxi* reduces the positive effect of competitors' actions on GSC adoption: Rejected.
- 28  
29 • **H4:** *Guanxi* reduces the negative effect of perceived costs on GSC adoption: Supported.
- 30  
31 • **H5:** *Guanxi* reduces the negative effect of complexity of regulations on GSC adoption:  
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33 Supported.  
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## 38 5. Discussion

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40 By testing the moderation effect of an informal institutional force—*guanxi*—on the  
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42 adoption of GSC practices, this paper provides a deeper understanding of GSC adoption in  
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44 China through the lens of institutional complexity. *Guanxi* significantly moderates the relations  
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46 between four of the five formal institutional forces and the adoption of GSC, contributing to  
47  
48 the debate on institutional environment in GSCM (Zhu et al., 2005).  
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51  
52 Previous *guanxi* literature indicated that when a company invests in building *guanxi* ties  
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54 with a supplier, the company is more likely to cooperate or better integrate with the supplier,  
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56 given that strong *guanxi* ties promote frequent communications and information sharing  
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58 between them (Ramus and Steger, 2000; Cai and Yang, 2014). However, in our study, we found  
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3 that *guanxi* between a supplier's sales representative and the focal firm's procurement manager  
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5 negatively moderates the effect of the suppliers' advice on the adoption of GSC. This may be  
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7 because *guanxi* could also be utilized as a defensive mechanism to diffuse supplier-initiated  
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9 GSC practices that are deemed irrelevant and costly by the focal firm. Hence rather than seeing  
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11 *guanxi* as a facilitator that promotes a GSC initiative, a procurement manager's *guanxi* with  
12  
13 the supplier's sales representative may be employed by the focal firm's senior management as  
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15 a way to block changes or buffer the pressure initiated by a supplier for GSC investments (Luo  
16  
17 et al., 2014).  
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21  
22 *Guanxi* significantly reduces the positive association between community pressures and  
23  
24 GSC adoption. This observation sheds light on the dark aspects of *guanxi* ties: a strong *guanxi*  
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26 tie between a company and its business partners may lead the company to turn a blind eye to  
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28 non-environmentally friendly practices (Gu et al., 2008). Strong *guanxi* ties between focal  
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30 companies and their suppliers may increase the entry barrier for newcomers to join the network,  
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32 thus limiting the chance of discovering new alternatives and adopting new practices. *Guanxi*  
33  
34 may produce complacency in companies, which is counterproductive to the adoption of GSC  
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36 practices. Moreover, strong *guanxi* with suppliers reduces the negative impact of perceived  
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38 costs on the adoption of GSC practices. This moderation effect could be explained through the  
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40 lens of transaction cost economics, where companies attempt to minimize transaction costs by  
41  
42 building relationships with supply chain partners (Zhou et al., 2016).  
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48 *Guanxi* reduces the negative effect of the complexity of regulations on the adoption of GSC  
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50 practices. In China, regulations have high litigation costs due to inconsistent law enforcement  
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52 (Zhu et al., 2005). Therefore, manufacturing companies in China tend to build *guanxi* ties to  
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54 ensure compliance and reduce the risk of legal problems. Most of the information from the  
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56 Chinese government is disseminated at an uncodified level, leading to potential confusion (Cai  
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3 et al., 2010). Therefore, building strong *guanxi* ties with suppliers can help focal companies  
4  
5 better understand such complex regulations.  
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8 Surprisingly, the results do not support the negative effect of *guanxi* on the relationship  
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10 between competitors' actions and the adoption of GSC practices. Zhu et al. (2013) indicated  
11  
12 that Chinese manufacturers often follow the actions of successful competitors to gain  
13  
14 competitive advantage in the global market. However, companies operating in highly  
15  
16 competitive markets such as China may be willing to adopt practices that can help them  
17  
18 differentiate themselves in their customers' eyes. In this sense, a focal company that sees a  
19  
20 competitor gain an advantage by adopting GSC practices may want to use their *guanxi* tie with  
21  
22 their supplier to obtain state-of-the-art marketing rather than to acquire information from their  
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24 *guanxi* tie about replicating a competitor's actions. However, this finding could be because  
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26 most of the surveyed companies (86.1%) are small and medium (in accordance with Chinese  
27  
28 industry standards); thus, they often have limited human and financial resources for adopting  
29  
30 GSC practices, although they may be willing to imitate their competitors' actions  
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32 (Abdulrahman et al., 2014; Liu et al., 2012). In addition, firms are usually cautious about  
33  
34 communicating their strategic moves with suppliers who also supply their competitors, in order  
35  
36 to avoid leaking strategy and technology information (Cao et al., 2015). Therefore, Chinese  
37  
38 manufacturers cannot implement GSC merely by imitating their competitors' actions if their  
39  
40 suppliers are unwilling to likewise conform to GSC. In this regard, focal companies may  
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42 convince their suppliers to collaborate over GSC through strategic benefits rather than good  
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44 *guanxi* ties (Kirchoff et al., 2016).  
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## 50 51 **6. Conclusions**

### 52 53 **6.1 Theoretical contribution**

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55 This research is one of the first studies to analyse institutional complexity in relation to the  
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57 adoption of GSC. It shows how firms respond to the challenges posed by the coexistence of  
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3 formal and informal institutional forces and provides insights to connect environmental  
4 sustainability and institutional complexity. The findings have three valuable theoretical  
5 implications. The first is that Chinese manufacturing firms respond to formal institutional  
6 forces by deploying an informal institutional variable: *guanxi*. Specifically, when a firm is  
7 faced with institutional multiplicity and complexity, it can respond by leveraging the informal  
8 institutional force such as *guanxi*. The second is that the importance of *guanxi* may decline  
9 even when collaborative decisions require a certain level of social approval. In this study, the  
10 negative role of *guanxi* is observed in the effects of suppliers' advice and community pressures  
11 on the adoption of GSC practices. In this way, a firm can downplay the effect of the formal  
12 institutional forces when the informal institutional force can provide a social guarantee for the  
13 adoption of GSC practices. The reduction of the influence of *guanxi* can be explained by the  
14 managerial cognitive mechanism rather than by changes in the macro-institutional environment.  
15 Third, unlike previous empirical studies, which considered the institutional complexity  
16 between local and central governments (Luo et al., 2017), employees and customers  
17 (Raaijmakers et al., 2015), members' and leaders' emotions (Toubiana and Zietsma, 2017) and  
18 collaboration and formalization (Ramus et al., 2017), our study provides empirical evidence  
19 showing that formal and informal institutional forces can lead to unintended consequences for  
20 GSC. Specifically, we demonstrate that institutional complexity has a double-edged sword  
21 effect with regard to how it shapes a firm's response to GSC. Therefore, we extend the  
22 knowledge on institutional complexity (Greenwood et al., 2011) by identifying the paradoxical  
23 effect of *guanxi*, which is used by firms to cope with formal institutional forces.

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Previous research in the field of GSCM has focused predominantly on formal institutional forces, hence foregrounding firms' adoption of GSCM practices to comply with the need for legitimacy (Cheung et al., 2009; Dubey et al., 2015; Luo et al., 2014). However, the key feature of formal institutional forces is that firms seeking legitimacy tend to adopt sustainable practices

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3 in a symbolic manner without substantive implementation (Luo et al., 2017). Therefore, in this  
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5 study, the conflict between formal institutional forces and the adoption of GSC is further  
6  
7 complicated by incorporating an informal institutional variable: *guanxi*. We find that the  
8  
9 negative impacts of perceived costs and the complexity of regulations on the adoption of GSC  
10  
11 are both reduced by utilizing *guanxi* ties. Interestingly, the informal institutional environment  
12  
13 usually has a negative impact upon firms that received positive impacts from suppliers' advice  
14  
15 and community pressures. These firms do not face the conflict between the need for external  
16  
17 legitimacy and their own internal interest; therefore, they have no need for the uniting *guanxi*  
18  
19 tie. In addition, a strong *guanxi* tie substantially reduced positive impacts, revealing that the  
20  
21 institutional environment is conflicted and complex. Our study thus suggests that the informal  
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23 institutional environment tends to produce double-edged effects on the strategic decisions  
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25 about GSC that occur within the formal institutional environment.  
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31 In addition, the paper contributes to the literature on *guanxi*. Conventional thinking  
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33 assumes that *guanxi* would improve business operations because formal institutional forces are  
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35 underdeveloped in China (Luo et al., 2014). However, the results suggest that the institutional  
36  
37 environment in China is complex and having stronger *guanxi* ties with suppliers may  
38  
39 sometimes hinder the focal firm's adoption of GSC practices, thus highlighting the double-  
40  
41 edged sword effects of *guanxi* on strategic decisions about GSC.  
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## 45 **6.2. Managerial implications**

46  
47 This paper offers several guidelines for supply chain managers and policymakers in China.  
48  
49 First, policymakers should try to reduce regulation complexity to encourage GSC adoption  
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51 without *guanxi*, even though *guanxi* can serve as an alternative governance mechanism to help  
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53 firms reduce these negative complexities and enforce GSC adoption. In doing so, policymakers  
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55 must understand that when firms feel uncertain about regulations, they rely on informal *guanxi*  
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57 rather than on formal regulations in pursuing GSC. This is not a healthy or sustainable choice  
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3 in the business market in the long run. In this regard, policymakers should try to make  
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5 regulations consistent with a firm's environmental preferences to guide manufacturers'  
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7 responses to formal regulations, rather than having them rely on their *guanxi* ties with suppliers.  
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10 Second, these findings have important implications for focal firms who wish to collaborate  
11  
12 on GSC with suppliers. By clarifying this double-edged sword effect, managers now  
13  
14 understand that *guanxi* can moderate both positive and negative institutional forces in GSC  
15  
16 adoption. This means that managers in the focal firm should focus investments in *guanxi* to  
17  
18 facilitate GSC adoption when regulations are complex and the initial costs are very high.  
19  
20 *Guanxi* is crucial for focal firms to communicate and coordinate with suppliers, to overcome  
21  
22 the lack of government regulations. In this regard, a strong *guanxi* tie between a procurement  
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24 manager and a sales manager in China may function as a safeguard that provides an element  
25  
26 of assurance in the adoption of GSC practices. With good *guanxi* ties, then, focal firms are  
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28 more likely to persuade their suppliers to adopt GSC by sacrificing some of their short-term  
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30 benefits to achieve better long-term gains.  
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34  
35 However, strong *guanxi* ties reduce the positive impact of suppliers' advice and community  
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37 pressures. As such, managers should understand that investing in *guanxi* is not the ideal choice  
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39 in pursuing GSC adoption when the environmental advice comes from suppliers who are  
40  
41 experiencing community pressures. Instead, focal firms may consider specific investment in  
42  
43 their Chinese suppliers, such as investing in specific equipment and environmental training, in  
44  
45 promoting GSC to ensure both their first and second tier can be truly green.  
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### 49 **6.3 Limitations and future research directions**

50  
51 In contrast to previous studies on the positive role of *guanxi*, this study finds that *guanxi* has  
52  
53 a double-edged sword effect in the adoption of GSC practices: *Guanxi* both facilitates and  
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55 discourages the adoption of GSC depending on the direction of the forces from formal institutional  
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57 environment as a negatively moderating agency. Further studies should account for *guanxi*'s  
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3 double-edged sword effect to provide novel insights into the relationship between formal  
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5 institutional forces and the adoption of GSCM. We considered *guanxi* only at the interpersonal level  
6  
7 in this study; thus, future research is sorely needed to explore the aggregated effect of *guanxi* at the  
8  
9 firm level (e.g. Geng et al., 2017b). Moreover, the results are valid in the context of China. Given  
10  
11 likely differences in other emerging Asian economies, further research is needed to evaluate  
12  
13 the role of *guanxi* in the implementation of GSC practices, particularly in countries such as  
14  
15 Korea, Malaysia and Thailand. This study does not consider direct causal associations between  
16  
17 variables. Future studies may use longitudinal data to examine the causal relationships between  
18  
19 institutional forces and their effect on the adoption of GSC practices. Finally, future studies  
20  
21 may explore how *guanxi* contributes to the learning process in adopting GSC practices.  
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**Appendix A. Measurement Items**

*[Insert Table A.1 about here]*

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### Tables and Figures of “Does Guanxi support green supplier collaboration?”

Table 1. Sample descriptors

Firm size (employees)		Position in the company (based on Part I)		Ownership	
Less than 20	1.40%	CEO	12.1%	Foreign owners	12.9%
21–299	46.7%	Senior Manager	22.6%	Joint ventures	31.0%
300–1000	38.8%	Middle Manager	46.9%	Private	48.1%
More than 1000	13.1%	Department Manager	18.3%	State-owned	8.10%

Table 2. Descriptive statistics and correlations

	Mean	Std. D	GSC	SA	CP	CA	PC	CR	GX
GSC	3.6	.77215	1.00						
SA	3.9	.59827	.481**	1.00					
CM	3.9	.59203	.357**	.400**	1.00				
CP	4.0	.52304	.530**	.602**	.468**	1.00			
PC	2.4	.52759	-.178**	-.183**	-.142**	-.227**	1.00		
CR	2.0	.54284	-.448**	-.461**	-.368**	-.504**	.366**	1.00	
GX	3.8	.56752	.453**	.487**	.444**	.549**	-.160**	-.402**	1.00

n = 408. All correlations are statistically significant at the  $p < 0.01$  level.

GSC= green supplier collaboration, SA=suppliers' advice, CP=community pressures, CA=competitors' actions, PC=perceived costs, CR=complexity of regulations, GX=Guanxi

**Table 3.** Measurement validity

Constructs	Items	Loading	Cronbach's alpha	Composite Reliability	AVE
Green Supplier Collaboration (GSC)	GSC1	.56	.796	0.765	0.595
	GSC2	.64			
	GSC3	.63			
	GSC4	.61			
	GSC5	.60			
	GSC6	.73			
Suppliers' advice (SA)	SA1	.74	.628	0.751	0.503
	SA2	.62			
	SA3	.51			
	SA4	.77			
Community pressures (CP)	CP1	.69	.631	0.645	0.574
	CP2	.66			
Competitors' actions (CA)	CA1	.58	.580	0.649	0.575
	CA2	.51			
	CA3	.54			
	CA4	.55			
Perceived costs (PC)	PC1	.63	.658	0.771	0.500
	PC2	.64			
Complexity of regulations (CR)	CR1	.61	.684	0.701	0.501
	CR2	.63			
	CR3	.60			
Guanxi (GX)	GX1	.73	.827	0.760	0.565
	GX2	.68			
	GX3	.69			
	GX4	.67			

GX5 .65

**Table 4.** Hierarchical moderated regression analysis for formal institutional forces

Variable entered		GSC practices (N = 408)			
		Model 1	Model 2	Model 3	Model 4
Control	Firm size	.136**	.065	.088*	.088*
Independent	Suppliers' advice (SA)		.183***	.146**	.137*
	Community pressures (CP)		.267***	.210***	.236***
	Competitors' actions (CA)		.033	-.002	.007
	Perceived costs (PC)		-.014	-.009	-.151*
	Complexity of Regulations (CR)		-.433***	-.293***	-.291***
Moderator	Guanxi (GX)			.180***	.182***
Interaction	SA*GX				-.240**
	CP*GX				-.114**
	CA*GX				.090
	PC*GX				.103**
	CR*GX				.045**
F for the regression		4.994**	34.005***	32.290***	21.935***
Adjusted R <sup>2</sup>		.18	.351	.367	.368

The main table contains standardized beta coefficients. \* $p < 0.10$  \*\* $p < 0.05$ . \*\*\* $p < 0.001$ .



**Table A.1. The measurement items**

<b>Green supply chain cooperation GSC</b> (Zhu et al., 2005)
Our company makes sure that our purchased products from key supplier must not contain environmentally undesirable items such as lead or other hazardous or toxic materials
Our company collects information about our key suppliers' environmental aspects, activities, and/or management systems
Our company has an environment audit program for our key supplier's environment management
Our company has an environment audit program for our second-tier suppliers' environment management
Our company requires our key supplier to have a certified environment management standard such as ISO 14001
Our company has frequent face-to-face meetings with our key supplier about environmental issues
<b>Suppliers' advice</b> (Miao et al., 2012; Zhu et al., 2005)
Our key supplier give us advice on developing environmentally friendly goods.
Our key supplier give us advice on developing environmentally friendly production.
Our key supplier gives us advice on developing environmentally friendly packaging.
Our company has environmental partnerships with our key supplier
<b>Competitors' actions</b> (ElTayeb et al., 2010)
Successful firms in our company's industry adopt GSC practices
GSC practices are generally considered in our firm's industry as having considerable marketing benefits
Our competitors' earlier implementations of GSC practices provide a benchmark and guidance for our company's adoption of GSC practices
Competitors have a strong influence on our company's adoption of GSC practices
<b>Community pressures</b> (ElTayeb et al., 2010)
Neighboring communities put pressure on our company about the impact on the environment
The media follow our industry closely about the environmental issue

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4	<b>Perceived costs</b> (Govindan et al., 2014)
5	The costs of the initial capital for implementing GSC with this supplier are
6	
7	The costs of dealing with hazardous waste disposal with this supplier are
8	
9	The costs of recruiting extra human resources for environmental purposes with this supplier are
10	
11	
12	Compared with the return on investment, the costs of the adoption of GSC practices with this supplier are
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16	The costs of switching to the new system for the adoption of GSCM practices with this supplier are
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18	
19	<b>Complexity of regulations</b> (Abdulrahman et al., 2014; Chen et al., 2011)
20	
21	The laws, regulations, and directives on the environment are
22	
23	Government support of economic policies for solving environmental issues are
24	
25	Government support of environmentally friendly policies is
26	
27	Rate the level of economic support related to resolving environmental issues through legal approaches
28	
29	Rate the level of regulatory government support for resolving environmental issues through legal approaches
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31	
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33	<b>Guanxi</b> (Luo et al., 2014; Yen et al., 2011)
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35	Rate the frequency of annual dinners or other social activities between you and your key supplier's rep
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38	Rate the level of the relationship between you and your key supplier's rep
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40	Rate the importance of your key supplier's rep feelings before you make important purchasing decisions
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43	Rate the level of help you would provide to your key supplier's rep when he/she is in need
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45	Rate the frequency of you and your key supplier's rep do favors for each other
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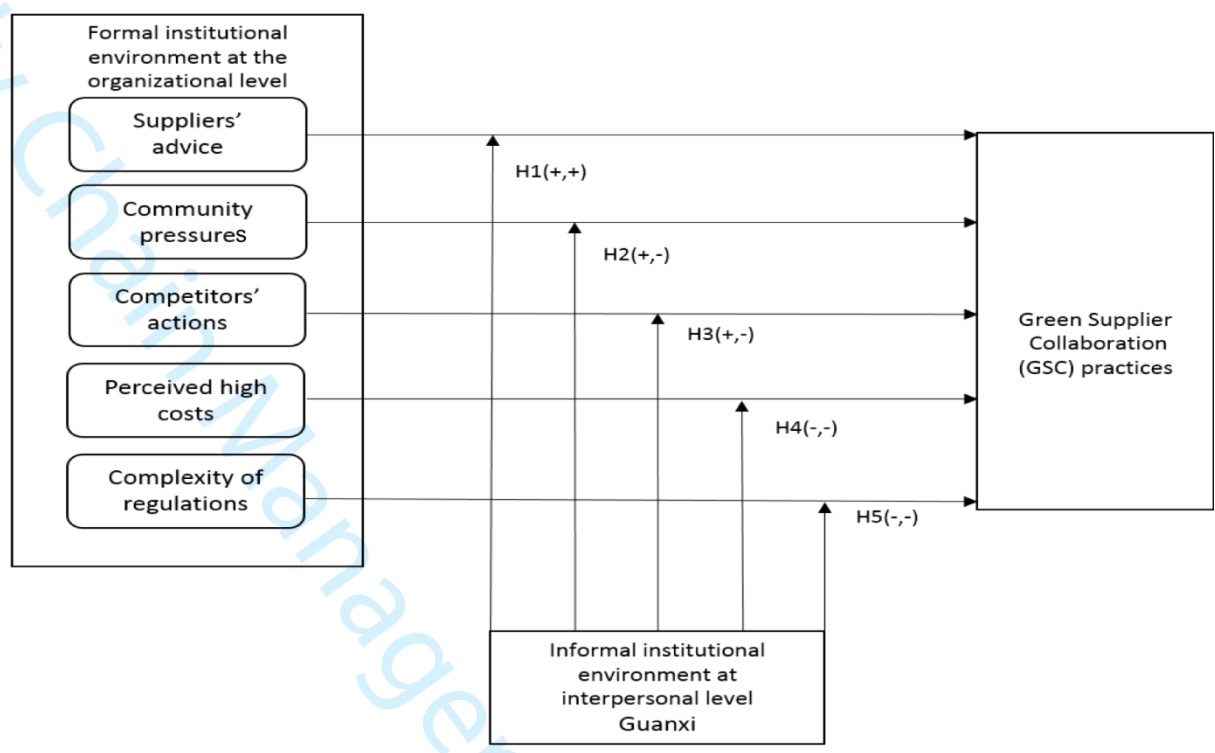
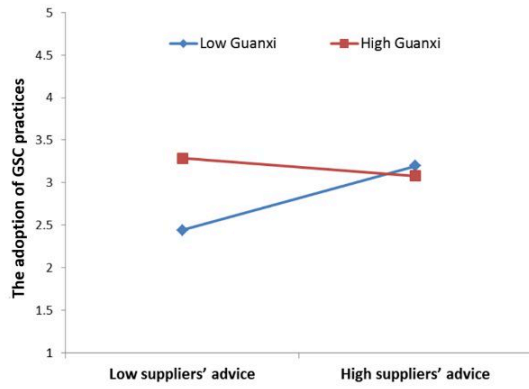
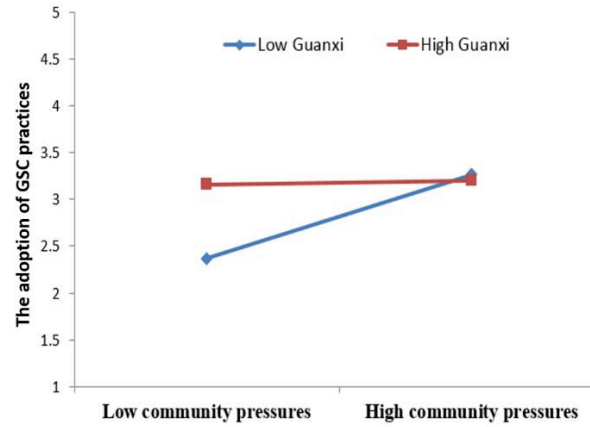


Fig. 1. Conceptual framework.

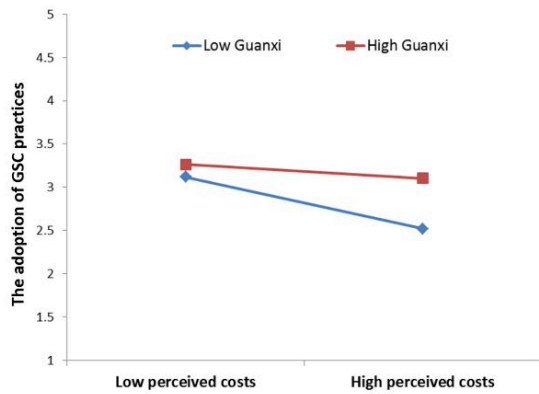
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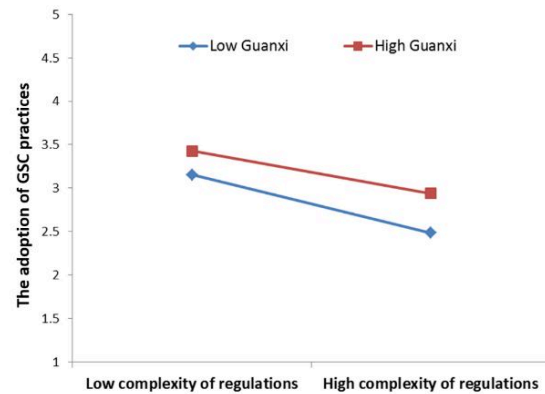
(a) Effect on the suppliers' advices–GSC relationship



(b) Effect on the community pressures–GSC relationship



(c) Effect on the perceived costs–GSC relationship



(d) Effect on the complexity of regulations–GSC relationship

**Fig. 2.** Effects of Guanxi on the relationships between formal institutional forces and GSC practices

# An empirical study of green supplier collaboration in the Chinese manufacturing sector: the double-edged sword effect of Guanxi

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