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The impact of supply chain pressure on cross-functional green integration and environmental performance: an empirical study from Chinese firms

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Abstract
Our research is designed to uncover the influence of institutional pressure from supply chain partners on cross-functional green integration (CFGI) and environmental performance. We applied structural equation modeling (SEM) using data from 206 Chinese manufacturers to test the conceptual model. Our findings demonstrate that firms are influenced by supply chain partners to perform CFGI. However, the effects differ when suppliers and customers exert different types of pressure. Specifically, both customer coercive and mimetic pressure show positive effects on CFGI, whereas suppliers' exerting such pressure does not take effect or even backfires. Contrary to the effects of coercive and mimetic pressure, supplier normative pressure facilitates CFGI, but customer normative pressure does not play a role. In addition, our findings indicate that CFGI (especially for green strategy alignment and process coordination) is critical to environmental performance. This paper provides fruitful insights into the institutional theory by showing the causes of isomorphism from a supply chain perspective.

Keywords Institutional pressure · Supply chain partners · Cross-functional integration · Green management · Environmental performance · Structural equation modelling (SEM)

1 Introduction

With increasing public attention to environmental problems over the past decades, firms are facing pressure from different stakeholders to go green and reduce environmental harm, especially in the manufacturing industry (Nath and Ramanathan 2016; Kitsis and Chen 2019; Pan et al. 2020), as the manufacturers are deemed as major polluters and hold responsibility for the exhaustion of resources (Zhu and Sarkis 2007). They are investing more enterprise resources to reduce pollution and save energy. For example, Ford has promised to invest $11.4 billion in the development of new energy vehicle technology, Tesla invests $12.7 million in environmental protection in the Shanghai Gigafactory production line optimization project, accounting for 7.08% of the total investment, and Apple has announced a carbon removal initiative called "Restore Fund", which will invest $200 million to achieve carbon neutrality. Therefore, the issue of "how to effectively implement green management practices to improve environmental performance" has aroused a wide discussion among both managers and researchers.

Many studies have examined the effect of different approaches to being green on environmental performance, including eco-design (Zailani et al. 2012), reverse logistics (Ye et al. 2013), green innovation (Zhu et al. 2017), internal green financial policies (Zhu et al. 2012) and green information system (Gholami et al. 2013). In particular, the cross-functional approach, defined as involving different functions in collaborative green initiatives (Han and Huo 2020), is receiving recent attention (Zhu et al. 2012, 2013). The approach emphasizes coherent efforts from different functional departments given that green goals could hardly be attained in isolation. For instance, the R&D unit needs to carry out products' green design, in order to reduce waste.

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The financial unit is supposed to make a budget for green objectives such that green management activities receive financial support. And the strategy unit should make long-term plans for the realization of green goals. In other words, it will be much easier for firms to achieve an objective when different functions are geared towards a common goal and join in collaborative efforts. Cross-functional green integration (CFGI), as a cross-functional approach to pursuing green (Wu 2013; Song et al. 2017; Wong et al. 2020b), defines three collaborative green practices among different functions, including the strategic level (green strategic alignment) and the operational level (green process coordination and information sharing) (Flynn et al. 2010; Wong et al. 2015). However, whether and how CFGI benefits corporate environmental performance as an integrated approach remains unexamined. Such a research gap may impede our understanding of the effective approaches to achieving environmental performance.

The existing literature on green management has identified that external pressure is one of the most important antecedents for firms to be green. The institutional theory explains why pressure matters for firms to behave in a certain way. Coercive, normative, and mimetic pressure creates institutional isomorphism that leads firms to adopt similar practices (DiMaggio and Powell 1983; Sarkis et al. 2011). Yet, some questions remain to be answered: Where does the institutional pressure come from? Do different types of pressure exert similar impacts on corporate green management practices? More importantly, could the pressure prompt firms' internal functions to unite in green efforts?

Supply chains have become the most important network for most firms. Considering that a manufacturer operates in self-centered networks with its major supply chain partners, it could be impacted by its partners' orientations and practices to improve its relationship performance (Wu and Fu 2018; Liu et al. 2021). In the context of green management, Walmart pushes its suppliers to use eco-friendly packages to cut waste (Agarwal et al. 2018). Apple requires its Chinese suppliers to use renewable energy to achieve carbon neutrality in its supply chain and product life cycle. Akzo Nobel, a world-famous paint company actively engages in sustainable development, urging its customers to become green. In fact, with the increase of global manufacturing outsourcing to Asian countries, manufacturing firms from China and other Asian emerging economies are under growing green pressure from the supply chains of developed countries (such as Europe and the US), thereby increasing the attention of Asian emerging countries to environmental protection in recent years (Geng et al. 2020; Li et al. 2020; Nath et al. 2021; Zhang 2021; Tarraco et al. 2023). However, our review of existing studies finds that few scholars have paid attention to different forms of institutional pressure from the supply chain when studying the drivers of corporate green management. Thus, we draw from the framework of the institutional theory and probe into how institutional pressure from supply chain partners impacts CFGI in Asian emerging economies.

To conclude, we put forward two major research questions. *RQ1*: How does institutional pressure from supply chain partners affect CFGI? *RQ2*: How do the three dimensions of CFGI affect environmental performance? We conduct a survey among Chinese manufacturers and apply SEM to test the conceptual model. Our study contributes to both the literature and practices in several ways. First, this research is one of the first attempts to investigate the concept of cross-functional integration within the green management domain and contributes to the green supply chain management (GSCM) and supply chain integration (SCI) literature. Second, this study further contributes to the GSCM literature by building a framework for examining supply chain institutional pressure, CFGI, and environmental performance. Third, our research contributes to the institutional theory by uncovering new insights into the application of the theory in the supply chain context. In practice, on the one hand, this paper provides guidelines for stakeholders in the supply chain to appropriately exert green pressure on manufacturers. On the other hand, it enables manufacturers to deeply realize the importance of CFGI and helps them identify how to optimize the allocation of internal resources to improve environmental performance.

The rest of the study is arranged as follows. We present the theoretical foundation and hypotheses development about the antecedents and consequences of CFGI in the next section. In Sect. 3, we interpret the methodology and results. Then, research findings and implications are discussed. Finally, conclusions and limitations are depicted.

2 Literature review and hypotheses development

2.1 Cross-functional green integration

Pagell (2004) defines cross-functional integration (CFI) as a process of interdepartmental collaboration and interaction in which diverse departments work towards a common organizational goal. It emphasizes setting joint goals (Kahn and Mentzer 1996; Stank et al. 2001), collectively organizing functional activities (Croxton et al. 2001; Chen et al. 2009), and keeping mutual information exchange (Swink and Schoenherr 2015).

Previous studies have noted that CFI is crucial to the improvement of firm performance, including operational performance (da Silva Poberschnigg et al. 2020), financial performance (Swink and Schoenherr 2015), and innovation performance (Genc and Di Benedetto 2015; Yang and Tsai 2019). CFI may become key to the success of organizational green management.

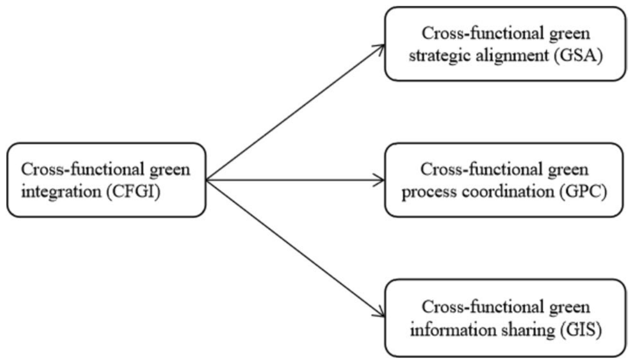


Fig. 1 The concept of CFGI and its three constructs

Following the definition of internal green integration (Han and Huo 2020), we define cross-functional green integration (CFGI) as a strategic collaboration between different departments to jointly integrate environmental concerns into internal activities to lower environmental impacts and increase ecological efficiency at multiple levels: green strategic alignment, green process coordination, and green information sharing (Flynn et al. 2010; Sarkis et al. 2011; Wu 2013). Specifically, CFGI is classified into three subdimensions: cross-functional green strategic alignment (GSA), cross-functional green process coordination (GPC), and cross-functional green information sharing (GIS) (Han and Huo 2020). GSA refers to the alignment of the functional green strategy with the corporate green strategy, and it requires a common understanding of the environmental plans or goals at the strategic level across functions and employees (Vachon and Klassen 2008; Flynn et al. 2010). Both GPC and GIS are at the operational level. GPC refers to cross-functional green collaboration at all stages of product life cycles to address environmental issues and reduce environmental impact (Ryoo and Koo 2013), stretching from eco-design, cleaner production to green delivery and reverse logistics (Koufteros et al. 2005; Wong et al. 2015). GIS is exchanging green-related timely requirements, information, and data across functions to ensure every party is aware of the joint environmental efforts (Wong et al. 2015). Figure 1 illustrates the concept of CFGI and its three constructs. This paper attempts to explain how different dimensions of CFGI contribute to environmental performance.

2.2 Supply chain green pressure

Based on the institutional theory, organizations are influenced by three forms of isomorphic pressure, namely, normative, coercive, and mimetic pressure, to adopt organizational practices for the purpose of obtaining resources and legitimacy (Hirsch 1975; Meyer and Rowan 1977; DiMaggio and Powell 1983; Zucker 1987). Table 1 summarizes the definitions of institutional pressure in extant literature. Specifically, mimetic pressure stems from uncertainties in most situations, especially when the link between means and ends is unclear (DiMaggio and Powell 1983). In a competitive and turbulent market, organizational goals are often ambiguous. Firms tend to imitate other organizations, particularly those closely associated with them, such as their suppliers and customers, in answer to the uncertainty (DiMaggio and Powell 1983). By doing so, firms minimize first-mover risks and experimentation costs (Lieberman and Montgomery 1988).

Coercive pressure is exerted by organizations which a focal firm is dependent on (DiMaggio and Powell 1983; Teo et al. 2003; Liu et al. 2010). For example, when a powerful member favors a new technology, it may push its partners to adopt the technology. The dependent partner would call attention to the power asymmetry and be aware of the consequences of not adopting this technology. Therefore, the dependent party is inclined to obey its powerful partner's request (Teo et al. 2003; Liu et al. 2010). Coercive pressure often presents in relational channels among members in a supply chain, exerted by powerful supply chain partners (Teo et al. 2003; Liu et al. 2010). For example, if a customer controls crucial resources that are needed by a manufacturer, requirements from the customer would be coercive. The manufacturer has to comply with the demands to secure survival (John et al. 2001; Teo et al. 2003; Liu et al. 2010).

Table 1 Definitions of institutional pressure in extant literature

Institutional pressure	Definition	Reference
Mimetic pressure	Mimetic pressure is defined as the tendency of organizations to model themselves after other organizations that they perceive to be successful when faced with uncertainty	DiMaggio and Powell (1983); Kauppi and Luzzini (2022)
Coercive pressure	Coercive pressure is defined as pressures exerted on organizations by other organizations upon which they are dependent	DiMaggio and Powell (1983); Kauppi and Luzzini (2022)
Normative pressure	Normative pressure is defined as influences arising from professional standards and norms that make organizations become like other professional organizations in their field	DiMaggio and Powell (1983); Kauppi and Luzzini (2022)

Normative pressure roots in professionalization, which is the pressure to behave according to the partners with expertise (DiMaggio and Powell 1983; John et al. 2001). It forms collective expectations which define legitimate and appropriate behaviors in the specific organizational environment (DiMaggio and Powell 1983; Liu et al. 2010). Gradually, the expectations turn into latent and informal shared norms via inter-organizational channels. Firms comply with the shared norms to ensure their positions and maintain legitimacy within the specific organizational network (DiMaggio and Powell 1983; John et al. 2001; Zsidisin* et al. 2005; Liu et al. 2010). Normative pressure can also come from supply chain partners because their frequent transactions facilitate the transmission and assimilation of expertise and norms.

In terms of green management, we note that the institutional theory is widely applied to understand how external pressure impacts firms' green practices (Sarkis 2012). Appendix A summarizes the existing studies on the relationship between institutional pressure and diverse corporate green management practices, including eco-innovation (Yang et al. 2019a; Huang et al. 2022; Roh and Yu 2023), green manufacturing (Zhu 2016; Zhang 2021; Tarraco et al. 2023), green information system practices (Gholami et al. 2013; Carberry et al. 2019; Nguyen et al. 2023), pollution control (Simpson and Sroufe 2014; Choudhary et al. 2022), reverse logistics (Ye et al. 2013; Khor et al. 2016; Castro-Lopez et al. 2023), and investment recovery (Zhu and Sarkis 2007; Wu et al. 2012). Concerning the sources of the pressure, previous literature has mainly identified several external stakeholders, including the government and regulators, the market and public, the industry associations and community, and the competitors (Zhu 2016; Chu et al. 2018; Geng et al. 2020; Yang and Kang 2020; Lui et al. 2021; Nath et al. 2021; Bag et al. 2022).

However, there is an absence of focus on institutional pressure from the perspective of the supply chain. Only a few of the studies have investigated the pressure from both upstream and downstream supply chains, but they failed to distinguish the divergence in each supply chain side (Gadenne et al. 2009; Seles et al. 2016; Testa et al. 2018). Although both suppliers and customers are crucial stakeholders in the supply chain, they operate in different ways in shaping the manufacturers' green management practices, as suppliers controlling the acquisition of key materials and customers determining products orders (Marculetiu et al. 2023). Understanding what exactly forms of institutional pressure from the supply chain motivates firms to engage in green management practices can lead to greater adoption of these practices, and meanwhile, more positive impacts for stakeholders in the supply chain (Vidal et al. 2023). Therefore, we further explore whether different forms of institutional pressure from suppliers and customers would play distinct roles in facilitating corporate green management.

In this paper, we highlight the importance of supply chain green pressure for manufacturing firms in Asian emerging economies, such as China, given that they are under increasing green pressure from the supply chains of developed countries (Zhu and Sarkis 2007; Adebanjo et al. 2016). In conclusion, we examine the influence of three forms of institutional pressure from supply chain partners on CFGI and environmental performance among Chinese manufacturing firms.

2.3 Hypotheses development

2.3.1 The influence of mimetic pressure on CFGI

According to institutional theory, mimetic pressure is defined as the tendency of organizations to copy the successful practices of other organizations when faced with uncertainty, especially with those in close contact (DiMaggio and Powell 1983; Kauppi and Luzzini 2022). It is doubtful whether green management works or pays for firms (Han and Huo 2020). The ambiguity creates an incentive to imitate other firms, especially firms that have gained success in adopting green practices. Due to the frequent transactions in the supply chain, firms have easy access to imitate their supply chain partners' green practices.

Specifically, first, the need to follow successful practices of supply chain partners facilitates a common environmental goal across different functions (Stank et al. 2001; Ellinger et al. 2006). According to the alignment theory, the effectiveness of green goals is determined by the extent to which the functional green strategy is aligned with the corporate green strategy (Chorn 1991). Different functions should evaluate how the strategic goal is aligned and make mutual adjustments to ensure that they are united towards a common strategic objective (Oliva and Watson 2011). Second, imitating supply chain partners' practices requires firms to optimize the flow of green practices from a process perspective, instead of only implementing green practices in specific departments (Stadtler 2005; Chen et al. 2009; Handfield et al. 2015). The green process coordination requires functions to develop a mutual understanding of each other's capabilities and activities (Ryoo and Koo 2013). According to Wong et al. (2015) and Ryoo and Koo (2013), green activities should be managed holistically with cross-functional efforts, ranging from eco-design, cleaner production to green delivery and reverse logistics. Third, exchanging green-related information among different functions develops a well-grounded infrastructure for green practices. For instance, it ensures that green processes are synchronized timely and guarantees balanced green investments among different functions (Oh et al. 2012; Williams et al. 2013). It also enhances the transparency of waste, emissions, and capital flows inside a firm by gathering information for environmental control (Loeser et al. 2017). Therefore, we propose that,

H1(a-c): Supplier mimetic pressure is positively associated with cross-functional green strategic alignment, green process coordination, and green information sharing.
H2(a-c): Customer mimetic pressure is positively associated with cross-functional green strategic alignment, green process coordination, and green information sharing.

2.3.2 The influence of coercive pressure on CFGI

Coercive pressure refers to the pressure exerted by the powerful companies that the focal company relies on (DiMaggio and Powell 1983; Teo et al. 2003; Liu et al. 2010). Coercive pressure can take effect through relational channels among network members. We suggest that coercive pressure from supply chain partners impacts firms' adoption of CFGI, as suppliers and customers are resource dominant organizations (Kauppi and Luzzini 2022). The power advantage of suppliers/customers arises when the manufacturers rely on them (Teo et al. 2003). For instance, suppliers could control critical raw materials or knowledge such that the manufacturers are trapped by switch dependence (Teo et al. 2003). Customer demand could be a powerful force since the orders are key to survival (Agarwal et al. 2018). The resource dominant firms that have adopted green management may urge their trading partners to go green for their own benefits or convenience. For example, HP demands suppliers to set green goals of emission reduction to meet its carbon targets (Villena and Dhanorkar 2020).

Specifically, suppliers may coercively require the manufacturers to go green by resorting to means such as increasing material prices and shrinking supply amounts. Similarly, customers may resort to coercive means such as withdrawing orders and switching partners. To satisfy the requirements of supply chain partners, different functions need to work together to align their green strategies and jointly fight against possible threats (Whitelock 2012). Second, managing cross-functional green processes during the product life cycle, such as reducing packaging, pollution abatement, and energy conservation, can effectively improve environmental performance and satisfy the requirements of customers (suppliers). Third, sharing green-related information across functions can ensure that green activities of different functions are carried out at the same pace as well as improve organizational capabilities for tracking and reporting the progress in green activities (Loeser et al. 2017). Besides, GIS enables fast responses to meet the needs of supply chain partners for green products or services (Bergenwall et al. 2012). Therefore, we propose that,

H3(a-c): Supplier coercive pressure is positively associated with cross-functional green strategic alignment, green process coordination, and green information sharing.

H4(a-c): Customer coercive pressure is positively associated with cross-functional green strategic alignment, green process coordination, and green information sharing.

2.3.3 The influence of normative pressure on CFGI

Normative pressure is defined as the influence of professional standards and norms that assimilate organizations (DiMaggio and Powell 1983; Kauppi and Luzzini 2022). A focal firm may refer to the standards and norms for decisions and behaviors as the social expectation of legitimate actions (DiMaggio and Powell 1983). Normative pressure has been proven to impact firms through dyadic relationship channels (Teo et al. 2003). We propose that normative pressure stems from the situation where suppliers (customers) actively join environmental-friendly industry groups, or widely take green practices as social norms and internalize the value into corporate policy or daily routines. As there are frequent transactions in the supply chain, the purchasing or sales department would be most convenient to be influenced by supply chain partners' green activities.

Specifically, when the purchasing or sales departments perceive the norms and values of being green from the supply chain, they could internalize such values in other departments by aligning functional green goals with corporate green strategy and calling for cross-functional efforts towards the green goals (Huo et al. 2021). Second, the coordination of green activities across different departments is the key to acting according to the social norms. The practice can reduce the consumption of resources during production processes through the promotion of process reengineering. Third, exchanging green-related information timely can ensure the accuracy of knowledge grasped by each department and the consistency of action in order to quantify emissions and track resource and energy flows (Loeser et al. 2017). Therefore, we propose that,

H5(a-c): Supplier normative pressure is positively associated with cross-functional green strategic alignment, green process coordination, and green information sharing.
H6(a-c): Customer normative pressure is positively associated with cross-functional green strategic alignment, green process coordination, and green information sharing.

2.3.4 The influence of CFGI on environmental performance

Environmental performance is mainly relevant to decreasing waste discharge and reducing the usage of harmful substances (Zhu et al. 2005). A lot of studies have reported that green management is effective in improving environmental performance. (Yang et al. 2013; Geng et al. 2017). For instance, Yang et al. (2013) find that in the container shipping context, internal environmental activities are beneficial to the environment. Wong et al. (2020a) indicate that implementing green management plays a positive role in environmental performance in both small and large firms. Besides, abating waste has been proved to bring substantial environmental performance (Zhu et al. 2005). However, some also show that environmental management does not necessarily impact environmental performance. For instance, Laosirihongthong et al. (2013) suggest proactive environmental activities, including eco-design, and reverse logistics cannot make a significant environmental improvement. Shi et al. (2018) divide green management practices into technical core operation and administrative planning operation and further find the former could benefit the environment, while the latter cannot.

In fact, these studies mainly focus on general environmental practices, while CFGI represents the integration of different functions to jointly engage in green management from the aspects of strategy alignment, process coordination, and information sharing. Therefore, we believe that CFGI ensures top-down organizational commitment to environmental improvement. Specifically, GSA facilitates extensive attention to environmental protection inside the firm and enables an integrated effort across functions to work towards green goals (Pagell and Wu 2009; Graham 2018). It removes the functional barriers and leads to increased efficiency and flexibility (Whitelock 2012; Huo et al. 2021). Second, GPC enables the manufacturers to reduce hazardous emissions and material consumption through process reengineering across functions (Chen et al. 2006; Chiou et al. 2011; Wu 2013). It facilitates green practices throughout the product life cycle to reduce the negative environmental impact (Wong et al. 2011; Grimm et al. 2022). Third, GIS helps functions share green-related real-time data and track the production information timely, thus facilitating rapid response and reducing errors and waste (Han and Huo 2020). It can also quantify emissions and resource consumption, as well as provide evidence for environmental-oriented control and adjustment (Loeser et al. 2017). Therefore, we propose that,

H7(a-c): Cross-functional green strategic alignment, green process coordination, and green information sharing are positively associated with environmental performance.

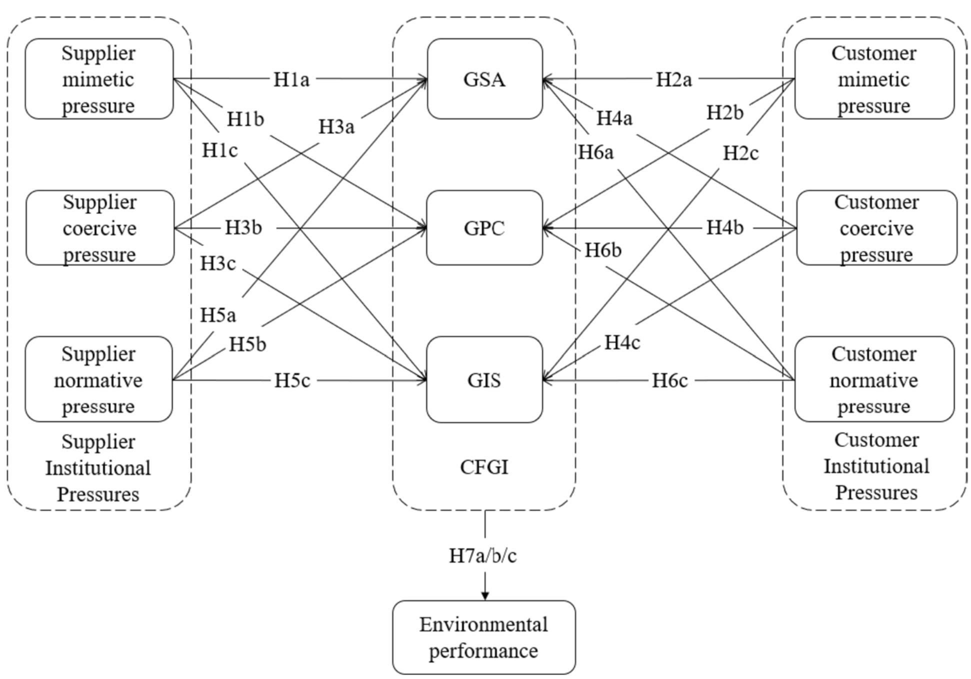
Figure 2 illustrates the research framework and hypotheses.

3 Methodology

3.1 Measures

According to previous studies and interviews with managers, we developed measurements for the constructs. First, we formed initial measurements from prior research and translated them into Chinese. Second, two translators retranslated the Chinese version into English independently to guarantee consistency. Finally, we carried out a pretest with 18

Fig. 2 The research framework



business managers to evaluate the clarity of the wording. Building upon the interviews with them, we made modifications to the questionnaire to ensure the comprehensibility of all measurements. The seven-point Likert scale (1 = strongly disagree to 7 = strongly agree) was applied to capture informants' perceptions of all constructs (i.e., supply chain institutional pressure, cross-functional green integration practices, and environmental performance). We show the details of measurement items in Appendix B.

The measurements for supply chain institutional pressure were adapted from Tate et al. (2014), Liu et al. (2010), Teo et al. (2003), and Liang et al. (2007). Specifically, the items for the supplier (customer) mimetic pressure reflected the perceived usefulness and profitability of green management by major suppliers (customers). The items for the supplier (customer) coercive pressure evaluated the perceived requirements of green practices by major suppliers (customers) and the possibility of losing products/raw materials orders without compliance. The items for the supplier (customer) normative pressure measured the perception of whether green management was widely adopted and well integrated with the major suppliers' (customers') daily practices. The major supplier/customer refers to the one that supplies/purchases the most valuable products to/from the manufacturer (Zhao et al. 2011).

The measurements for cross-functional green practices were based on Wong et al. (2015), Flynn et al. (2010), and Vachon and Klassen (2006). Five items were applied to evaluate cross-functional green strategic alignment, reflecting the degree to which green strategy was internalized among departments. Four items were adopted to measure cross-functional green information sharing, including the types, channels, timeliness, and traceability of green information exchange among departments. As for cross-functional green process coordination, we used five items to demonstrate cross-functional green coordination in the process of product design, manufacturing, product delivery, recycling, and waste disposal.

Following Zhu and Sarkis (2004), we included four measurement items for environmental performance, namely waste emission, energy and hazardous material consumption, and environmental accident frequency.

3.2 Sampling and data collection

Given that China is an uneven developing economy, our sample was collected from different representative regions in China, including the Bohai Bay Economic Rim, Yangzi River Delta, Pearl River Delta, and other regions including Northeast and Midwest China (Zhao et al. 2006). Based on the contact information in the National Bureau of Statistics of China (Li et al. 2020), we randomly contacted 2820 firms, of which 812 firms agreed to participate. The sample firms were from diverse industries, including automobiles, electronics, food, apparel, and other industries. We requested each sample firm to provide a key informant to participate, who should have a full understanding of green practices in the supply chain. Their titles included CEO/president, vice president, marketing director, purchasing director, or supply chain manager. We mailed the questionnaires to the key informants and promised that the data would only be used for research. We also increased the response rate through email reminders and phone follow-ups (Flynn et al. 2010). After the completion of the questionnaire with good quality, we provided the respondents with some rewards for their time and efforts. Ultimately, 298 out of 812 firms returned questionnaires, and 206 usable questionnaires were retained after excluding samples with missing values, representing a response rate of 25.4% (based on the number of questionnaires sent out).

Table 2 provides the profiles of sample firms and informants in terms of industries, regions, number of employees, ownership, the position of respondents, and the tenure of the current position in the firm. The sample firms mainly come from the engineering, mechanical, and metal industry (40.8%), followed by the electrical and electronics industry (19.4%) and the apparel and textiles industry (10.2%). 35.4% of the companies are located in the Bohai bay economic rim, 24.8% are in the Yangzi River delta, 19.9% are in the Pearl River delta, and 19.9% are in other areas in China. About 60% of the sample firms are small and medium-sized (< 500) companies, whereas 40% are large enterprises (> 500). More than half of the companies are privately-owned.

In terms of informant profiles, 76.2% of the respondents are middle managers (e.g., managers of purchasing, marketing, production, and other operations related positions), 22.3% are top managers (e.g., presidents, CEO, director, and deputy of these positions), and 1.5% are in other positions (e.g., purchaser and salesman). And 76.7% of them have worked for more than 5 years at their current positions in the company. Their positions and service years ensure that they are qualified to answer these questions.

3.3 Non-response bias and common method bias

Non-response bias exists widely in questionnaire surveys (Armstrong and Overton 1977). Since there are 514 out of the 812 firms that did not return questionnaires, it is necessary to test non-response bias in this study. We compared non-responding and responding companies regarding regions, firm age, employees, ownership, and fixed assets to check the potential non-response bias (Schilke 2014). The t-statistics results revealed that there were no significant differences at 0.05 level of significance. Therefore, non-response bias could be ignored.

Table 2 Sample profiles

Firm profiles	Percentage		Percentage
Industry		***Region***	
Engineering, Mechanical & Metal	40.8%	Bohai Bay Economic Rim	35.4%
Electrical & Electronics	19.4	Yangzi River Delta	24.8
Apparel & Textiles	10.2	Pearl River Delta	19.9
Petrochemicals & Chemicals	7.8	Other areas in China	19.9
Cigarettes, Alcohol, Beverage & Food	6.3		
Building Materials	4.9		
Printing & Publishing	4.4		
Plastics & Rubber	3.9		
Medicals & Pharmaceutical	2.4		
Number of employees		***Ownership***	
5,000 or more	4.4%	Privately-owned	53.9%
1,000–4,999	18.4	Foreign-owned	19.4
500–999	18.0	State-owned	16.0
200–499	34.0	Joint venture	10.7
100–199	23.3		
50–99	1.0		
<50	1.0		
Informant profiles			
Tenure of the current position in firm (years)		***Position of respondent***	
≥ 16	18.0%	Middle manager	76.2%
11–15	18.9	Top manager	22.3
6–10	39.8	Others	1.5
2–5	23.3		
≤ 1	0		

We separated conceptually related variables and cautiously arranged the items' order when designing the questionnaire to reduce informants' consistent tendency, which can effectively avoid potential common method bias (Podsakoff and Organ 1986; Podsakoff et al. 2003). Subsequently, according to Sanchez and Brock (1996), we applied LISREL software to conduct confirmatory factor analysis with Harman's one-factor test and loaded all the indicators on the same factor. The model fit indices were Chi-square (χ^2) = 3404.51 with a degree of freedom = 600, normed fit index (NFI) = 0.79, comparative fit index (CFI) = 0.80, non-normed fit index (NNFI) = 0.79, standardized root mean square residual (SRMR) = 0.13, and root mean square error of approximation (RMSEA) = 0.21, which were worse than those of the measurement model (Hu and Bentler 1999). The results proved that common method bias was not a serious issue.

4 Research results

4.1 Reliability and validity

To examine the reliability and validity of the constructs, first, we calculated the composite reliability (CR), average variance extracted (AVE), the values of Cronbach's α, and corrected item-total correlation (CITC) in Table 3. The values of CR and Cronbach's α of all constructs were more than 0.80, which demonstrated adequate reliability (Flynn et al. 1990).

Then, we linked each item to its corresponding variable and ran a confirmatory factor analysis model to assess the validity of all the constructs. The model fit indices were χ^2 (549) = 833.25, NFI = 0.97, CFI = 0.99, NNFI = 0.99, SRMR = 0.039, and RMSEA = 0.046, suggesting that the model was acceptable (Hu and Bentler 1999). All factor loadings were more than 0.50 and the corresponding t-values were more than 2.0 (Appendix B), which ensured convergent validity (Fornell and Larcker 1981). Furthermore, all constructs' AVE values were more than 0.50 as shown in Table 3, further verifying convergent validity (Koufteros et al. 2007).

Finally, we compared the correlation coefficients between each key variable and other variables with the square roots of AVE to assess discriminant validity. According to Fornell and Larcker (1981), as the square roots of AVE were greater than their correlations (as shown in Table 4), discriminant validity was ensured.

Table 3 Reliability analysis

Construct	No. of items	Cronbach's alpha	CITC range of the underlying items	Composite reliability	AVE
GSA	5	0.920	0.648–0.740	0.924	0.709
GIS	4	0.922	0.713–0.790	0.923	0.749
GPC	5	0.913	0.612–0.727	0.914	0.680
Customer mimetic pressure	3	0.911	0.764–0.793	0.912	0.774
Customer coercive pressure	2	(0.820**)[a]	-	0.901	0.819
Customer normative pressure	4	0.939	0.755–0.825	0.940	0.797
Supplier mimetic pressure	4	0.934	0.750–0.807	0.937	0.788
Supplier coercive pressure	3	0.906	0.756–0.777	0.906	0.763
Supplier normative pressure	2	(0.746**)[a]	-	0.856	0.748
Environmental performance	4	0.819	0.399–0.692	0.828	0.556

**$p < 0.01$

[a]is the Pearson correlation coefficient between the two measurement items. (Since CCP and SNP only have two measurement items, we reported Pearson correlation coefficients instead of alpha values and there is no CITC in this case.)

4.2 Hypotheses testing

To test our hypotheses, we employed structural equation modeling (SEM) and used LISREL software with the maximum likelihood estimation method. SEM is suitable for testing a proposed model by simultaneously assessing latent variables and relationships between all the variables (Sarkis et al. 2010; Simpson 2012). The goodness of fit indices of the structural model were χ^2 (555) = 838.33, NFI = 0.97, CFI = 0.99, NNFI = 0.99, SRMR = 0.041, and RMSEA = 0.046, which is acceptable according to Hu and Bentler (1999). The SEM results with the significant paths' standardized coefficients are shown in Fig. 3, and the results of the hypotheses testing are listed in Table 5.

As shown in the results, supplier and customer institutional pressure plays different roles in cross-functional green integration. Supplier normative pressure is more important than customer normative pressure. The results show that supplier normative pressure has a positive influence on three dimensions of CFGI (i.e., for GSA, $\beta = 0.61$, p-value < 0.05; for GIS, $\beta = 0.68$, p-value < 0.05; for GPC, $\beta = 0.69$, p-value < 0.05), while customer normative pressure has no significant impact on CFGI (p-value > 0.1). In contrast, coercive pressure is more important on the customer side than on the supplier side. Customer coercive pressure improves three dimensions of CFGI (i.e., for GSA, $\beta = 0.46$, p-value < 0.01; for GIS, $\beta = 0.31$, p-value < 0.05; for GPC, $\beta = 0.59$, p-value < 0.001), while supplier coercive pressure

Table 4 Correlations, means, and standard deviations

	1	2	3	4	5	6	7	8	9	10
1. GSA	**0.84**									
2. GIS	0.81**	**0.87**								
3. GPC	0.75**	0.73**	**0.82**							
4. Customer mimetic pressure	0.54**	0.55**	0.53**	**0.88**						
5. Customer coercive pressure	0.56**	0.52**	0.58**	0.71**	**0.90**					
6. Customer normative pressure	0.54**	0.54**	0.54**	0.79**	0.75**	**0.89**				
7. Supplier mimetic pressure	0.56**	0.52**	0.45**	0.59**	0.54**	0.62**	**0.89**			
8. Supplier coercive pressure	0.40**	0.43**	0.28**	0.45**	0.46**	0.50**	0.65**	**0.87**		
9. Supplier normative pressure	0.53**	0.54**	0.43**	0.52**	0.47**	0.59**	0.77**	0.74**	**0.86**	
10. Environmental performance	0.42**	0.34**	0.42**	0.32**	0.30**	0.30**	0.31**	0.17*	0.25**	**0.75**
Mean	4.89	4.82	5.29	4.94	4.84	4.96	4.77	4.43	4.68	5.86
S.D	1.203	1.309	1.107	1.295	1.436	1.326	1.248	1.519	1.339	0.832

Square roots of AVE are shown on the diagonal of the matrix in bold

Inter-construct correlations are shown off the diagonal

*$p < 0.05$; **$p < 0.01$

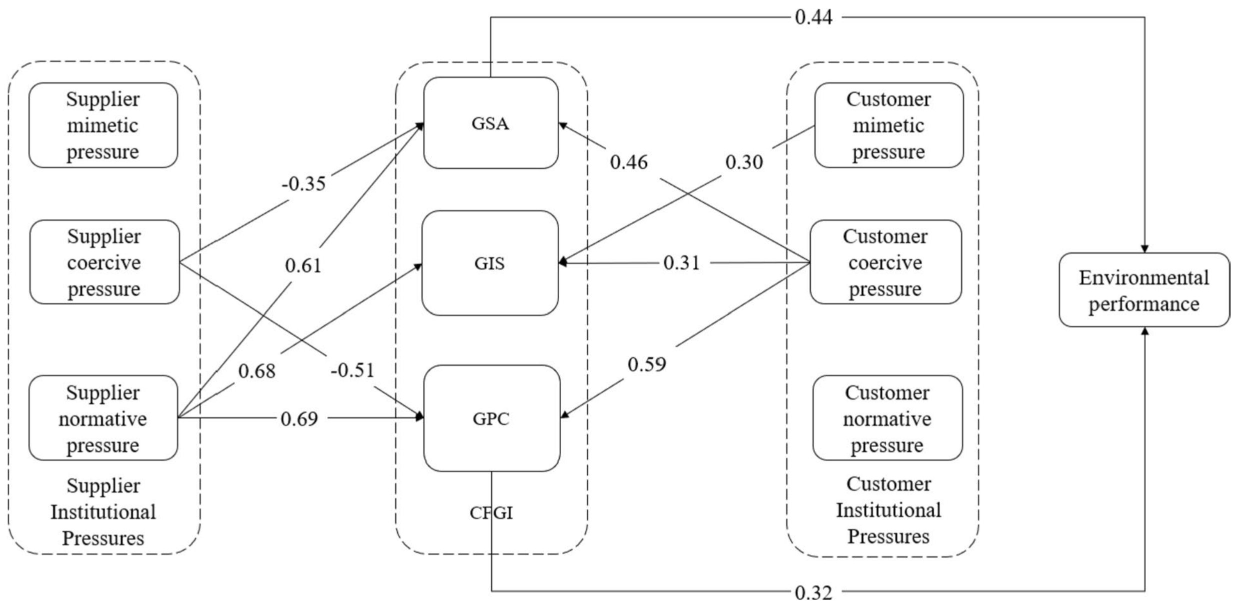


Fig. 3 SEM results

even has a negative effect on cross-functional green strategic alignment (β = -0.35, p-value < 0.05) and green process coordination (β = -0.51, p-value < 0.01), with no significant influence on green information sharing (p-value > 0.1). As for mimetic pressure, only customer mimetic pressure is found to have a significant positive impact on cross-functional green information sharing (β = 0.30, p-value < 0.05). When considering and comparing the three kinds of

Table 5 Results of hypotheses tests using SEM

Hypotheses	Standardized coefficient (t-value)	Results
Supplier mimetic pressure → GSA (H1a)	0.08(0.44)	Rejected
Supplier mimetic pressure → GPC (H1b)	-0.10(-0.53)	Rejected
Supplier mimetic pressure → GIS (H1c)	-0.15(-0.86)	Rejected
Customer mimetic pressure → GSA (H2a)	0.18(1.23)	Rejected
Customer mimetic pressure → GPC (H2b)	0.20(1.30)	Rejected
Customer mimetic pressure → GIS (H2c)	0.30^{*} (1.98)	Supported
Supplier coercive pressure → GSA (H3a)	-0.35^{*} (-2.10)	Rejected
Supplier coercive pressure → GPC (H3b)	-0.51^{**} (-2.81)	Rejected
Supplier coercive pressure → GIS (H3c)	-0.22(-1.26)	Rejected
Customer coercive pressure → GSA (H4a)	0.46^{**} (3.23)	Supported
Customer coercive pressure → GPC (H4b)	0.59^{***} (3.91)	Supported
Customer coercive pressure → GIS (H4c)	0.31^{*} (2.19)	Supported
Supplier normative pressure → GSA (H5a)	0.61^{*} (2.23)	Supported
Supplier normative pressure → GPC (H5b)	0.69^{*} (2.32)	Supported
Supplier normative pressure → GIS (H5c)	0.68^{*} (2.38)	Supported
Customer normative pressure → GSA (H6a)	-0.20(-1.09)	Rejected
Customer normative pressure → GPC (H6b)	-0.19(-0.98)	Rejected
Customer normative pressure → GIS (H6c)	-0.16(-0.85)	Rejected
GSA → Environmental performance (H7a)	0.44^{*} (2.20)	Supported
GPC → Environmental performance (H7b)	0.32^{*} (2.19)	Supported
GIS → Environmental performance (H7c)	-0.25(-1.40)	Rejected

$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

institutional pressures together, the customer side is more positive than the supply side on facilitating CFGI. In addition, the cross-functional green strategic alignment ($\beta = 0.44$, p-value < 0.05) and green process coordination ($\beta = 0.32$, p-value < 0.05) are verified to improve environmental performance, whereas green information sharing does not have a significant effect (p-value > 0.1).

5 Discussion

We summarize the major findings in two aspects: the effect of supply chain institutional pressure on CFGI and the effect of CFGI on environmental performance, which answers the two main research questions respectively.

5.1 The impact of supply chain institutional pressure on CFGI

In line with the previous studies on the relationship between institutional pressure and corporate green management (Schoenherr et al. 2014; Zhu 2016; Nath et al. 2021), our results find that different forms of institutional pressure (i.e., mimetic, coercive, and normative pressure) play different roles in impacting CFGI. The results uncover that the manufacturer responds differently to the pressure from suppliers and customers. This leads to a more diverging influence of three forms of institutional pressure, which is a significant finding that has received scarce attention in the prior work.

Specifically, concerning mimetic pressure, we find that none of the impacts of the supplier side on CFGI is significant and that customer mimetic pressure only facilitates cross-functional green information sharing. The results show the minimal effect of supply chain mimetic pressure compared with coercive and normative pressure. Although this finding is unexpected, it is partially supported by previous studies. We lend some evidence from Gholami et al. (2013) to explain this finding. Firms tend to imitate others with similar business scopes and equivalent market positions (e.g., competitors). Despite that supply chain partners may have successful experience in green practices, it is challenging to replicate their success in environmental initiatives due to the significant differences in core business and operational models between manufacturers and their customers and suppliers. This view has been validated by Zhu and Geng (2013), their study on Chinese manufacturers revealed that mimetic pressure from competitors is the primary factor driving firms to adopt environmental-friendly practices. Similarly, we only observe that customer mimetic pressure promotes manufacturers' green information sharing, which represents a small-scale input by Chinese manufacturers in green infrastructure (Seles et al. 2016).

Turning to coercive pressure, the findings suggest that customer coercive pressure has a positive influence on all three dimensions of CFGI, while supplier coercive pressure even plays a negative role in cross-functional green strategic alignment and green process coordination, with no significant impact on cross-functional green information sharing. First, the results from the customer side are consistent with prior research. For example, Seles et al. (2016) and Whitelock (2012) argue that coercive pressure from customers is the main pressure behind the implementation of green practices. Since downstream parties are normally more powerful than upstream parties in the supply chain (Ha et al. 2011; Hingley et al. 2015; Talay et al. 2018), the manufacturers need to mobilize green efforts across functions to meet the requirements of environmental products or services from customers. On the contrary, as suppliers are the power disadvantaged party (Sutton-Brady et al. 2015), the coercive green pressure from the supplier side is less likely to take effect. Even worse, manufacturers may perceive the suppliers as offenders (Frazier and Summers 1986; Scheer and Stern 1992). Thus, it could be difficult to identify and internalize the value of CFGI from suppliers (Raghunathan 1999; Subramani 2004), resulting in negative attitudes towards green strategic alignment and process coordination inside the firm.

Another contrasting but interesting finding is observed for normative pressure. We find that normative pressure from the supplier side positively impacts all three dimensions of CFGI, but none of the impacts of customer normative pressure is significant. We propose a tentative explanation for this finding. First, it is known that firms usually pay more attention to upstream green activities given that they are often held accountable for upstream unsustainable behaviors (Han and Huo 2020). For example, the Volkswagen emissions scandal had a significant negative impact on its customers' shareholder value (Jacobs and Singhal 2020). As a result, firms are more susceptible to the normative green pressure from suppliers rather than customers. Second, when suppliers actively engage in green management and integrate environmental awareness into corporate values, the manufacturers are more motivated to conduct CFGI as they have easier approaches to green energy and raw materials (Schmidt et al. 2017). However, customers may adopt green practices owning to environmental requirements from the market, which does not directly impact the manufacturers. Besides, as the customers are usually regarded as the party with more resources and capabilities (Talay et al. 2018), their adopted green norms may be perceived as beyond the manufacturers' capabilities.

5.2 The impact of CFGI on environmental performance

Our findings show that CFGI contributes to corporate environmental performance, indicating that close collaboration among different functions is crucial to being green (Zhu et al. 2013; Shi et al. 2018). Specifically, cross-functional green strategic alignment and green process coordination have significant positive impacts on environmental performance, whereas green information sharing does not take effect.

These results are supported by previous research. First, some scholars have uncovered that proactive environmental strategies such as eco-design and the alignment of functional green goals and corporate green strategy play a positive role in corporate sustainable capabilities (Whitelock 2012; Graham 2020; Tarraco et al. 2023). Second, green process coordination enables manufacturers to improve efficiency through process reorganization across functions and facilitates green practices throughout the product life cycle, thus reducing emissions and resource consumption and benefiting the environment (Loeser et al. 2017; Grimm et al. 2022). Ryoo and Koo (2013) also propose that green process coordination with manufacturing/marketing departments has a positive impact on environmental performance. Third, the environmental impact of cross-functional green information sharing does not verify our hypothesis. Gholami et al. (2013) point out that the adoption of strategic-oriented green information systems is positively related to environmental performance, whereas adopting for direct pollution-prevention does not have an effect. Similar to their finding, we suggest that green information sharing at the operational level does not directly improve environmental performance. Its effect may be observed in the long-run.

6 Conclusion

6.1 Theoretical contribution

This study makes several theoretical contributions. First, our research contributes to the literature on GSCM and SCI. Based on the definitions of internal green integration and cross-functional integration provided by previous scholars (Pagell 2004; Han and Huo 2020), we establish the definition of cross-functional green integration (CFGI), and further categorize CFGI into three dimensions, including cross-functional green strategic alignment, green information sharing, and green process coordination. This paper extends previous studies that define internal green integration as an aggregated construct (Wu 2013; Graham 2018; Liu et al. 2018) or concentrate on only a single dimension (Whitelock 2012; Ryoo and Koo 2013; Loeser et al. 2017).

Second, our study contributes to the institutional theory by uncovering how institutional pressure from the supply chain affects CFGI and provides new insights into the application of the institutional theory in the supply chain context. Our results suggest that supply chain green pressure matters for CFGI, but the pressure from the supplier and customer sides play distinctive roles. The coercive and mimetic pressure from customers and the normative pressure from suppliers are the main drivers for green integration across functions. This finding answers the question of how different forms of institutional pressure from upstream and downstream the supply chain influence corporate green management, which remains unexamined in extant literature.

Third, this study also contributes to the GSCM literature by providing empirical evidence in the context of Chinese manufacturing firms about the importance of CFGI. Our results prove that the internal green integration (i.e., green strategic alignment and process coordination) is beneficial to environmental performance, while the influence of green information sharing may take time to work, thus not significant in the short term.

6.2 Practical implication

Our paper also has several practical implications. On the one hand, we show that CFGI contributes to corporate environmental performance, which reminds managers to realize the importance of CFGI and helps them identify how to optimize the allocation of internal resources to improve environmental performance. The findings illustrate the first steps for initiating internal green efforts are to align the functional green goals with corporate green strategy and to coordinate with corporate business processes for the purpose of raising efficiency and reducing emissions.

On the other hand, we provide guidelines for stakeholders in the supply chain to appropriately exert green pressure on manufacturers. They should be aware that different forms of green pressure play significant but different roles. First, as for customers, employing coercive green pressure is the most effective way. For example, customers could incorporate environmental requirements for products and services into the contracts and reduce orders if the manufacturer fails to meet environmental standards. Besides, advertising their own successful experiences in green management to exert mimetic green pressure would also take effect. Second, we suggest the suppliers actively participate in environmental industry associations, incorporate green goals into corporate values, and transmit expertise about green management through professionals. However, the suppliers should be cautious about exerting coercive pressure because it can be counterproductive. Moreover, a possible problem is that suppliers have limited resources themselves and may lack the motivation to go green. Therefore, policymakers should actively promote an environmental-friendly industry alliance upstream of the supply chain, as well as strengthen the supervision of suppliers' green behaviors, thereby benefiting the whole supply chain.

6.3 Conclusion, limitation, and future research

Using survey data from Chinese manufacturing firms, our study examines how different forms of institutional pressure from the supply chain affect cross-functional green integration and environmental performance based on institutional theory. We make contributions to both the GSCM and SCI literature and provide practical implications for managers. However, we admit that there are still some limitations and possibilities for future research.

First, this paper focuses on the manufacturing firms in China. As an emerging economy in Asia, the green management practices in Chinese companies are not as mature as those in developed countries. According to Tarraco et al. (2023), the institutional environment for green is different in developed and emerging economies. Manufacturing firms in developed countries mainly face consumer green pressure, while those in emerging countries are subject to more influence from upstream supply chains. Future research can re-examine the relationship proposed in this paper in the context of developed countries.

Second, our paper did not measure power asymmetry in the supply chain, albeit that we employed this logic to explain the contrasting effects of institutional pressure from suppliers and customers. Future research could collect bilateral data from both the supplier and customer sides to analyze the influence of power asymmetry in the relationship.

Third, we used environmental performance as the outcome variable in this study. It would also be interesting to focus on other sustainable performances such as social and economic performance. Scholars could examine the impact of institutional pressure from the supply chain on corporate green management and other firm performances in the future.

Fourth, although environmental performance may take time to realize, the conceptual model was tested by cross-sectional data. Longitudinal data can be applied to investigate the relationship between CFGI and environmental performance over time in future studies.

Appendix A. Studies on the relation between institutional pressure and green management practices

Institutional pressure	Position	Corporate green management practices	Country	Reference
Institutional pressure (buyers and suppliers)	Antecedent	Environmental practices	The US	Vidal et al. (2023)
Institutional pressure (governments)	Antecedent	Green product innovation Green process innovation	South Korea	Roh and Yu (2023)
Regulatory pressure Consumer pressure	Antecedent	Green manufacturing	Germany, the US., Brazil, and India	Tarraco et al. (2023)
Customer pressure Green reputation pressure	Antecedent	Environmental management system	Ten countries	Nguyen et al. (2023)
Coercive pressure (regulations and public organizations) Mimetic pressure (competitors) Social pressure (customers and suppliers)	Antecedent	Circular economy adoption	Spain	Castro-Lopez et al. (2023)
Mimetic pressure (competitors)	Moderator	Green innovation	China	Huang et al. (2022)
Regulatory pressure Stakeholders pressure Market pressure	Antecedent, moderator	Corporate environmental responsibility	China	Hu et al. (2022)
Institutional pressure (regulations, competitors and industry)	Antecedent	Reducing single use plastic	India	Choudhary et al. (2022)

Institutional pressure	Position	Corporate green management practices	Country	Reference
Coercive pressure (buyers and regulations) Mimetic pressure (competitors) Normative pressure (buyers, suppliers and industry)	Antecedent	Eco-innovation	South Africa	Bag et al. (2022)
Coercive pressure (regulations) Mimetic pressure (competitors) Normative pressure (industry)	Antecedent	SMEs' pro-environmental operations	China	Zhao and He (2022)
Formal environmental institutional pressure (legal systems and regulators) Informal environmental institutional pressure (nongovernmental stakeholder groups)	Antecedent	Firms' participation in Voluntary Environmental Programs (VEPs)	The US	Tashman et al. (2022)
Regulative pressure (laws or regulations) Normative pressure (public norms)	Antecedent	Clean production	China	Zhang (2021)
Coercive pressure (buyers, third-party auditors, industry-based consortium platforms, and government agencies) Mimetic pressure (competitors) Normative pressure (cross-sector institutional actors)	Antecedent	Implementing sustainable supply management (SSM)	Bangladesh	Nath et al. (2021)
Government pressure Nongovernment organizations (NGOs) pressure Competitive Pressure	Moderator	Adopting energy-efficient systems (EES)	The US	Lui et al. (2021)
Social pressure (community, financial institutions, market, and regulatory institutions)	Antecedent	Environmental commitment Sustainable supply chain design	Europe	Centobelli et al. (2021)
Mimetic pressure (successful competitors)	Antecedent	The adoption of environmental management system	The US	Yang and Kang (2020)
Market pressure Cost pressure Export pressure	Antecedent	External improvement practice Internal improvement practice Ecology practice	China	Li et al. (2020)
Competitive pressure	Antecedent	The adoption of proactive environmental strategy The implementation of upstream environmental practices with suppliers	UK	Graham (2020)
Community pressure Competitor pressure Cost pressure Regulations pressure	Antecedent	The adoption of green supplier collaboration practices	China	Geng et al. (2020)

Institutional pressure	Position	Corporate green management practices	Country	Reference
Coercive pressure (legal) Mimetic pressure (market) Normative pressure (governmental interference)	Moderator	Strategic environmental management	China	Yang et al. (2019b)
Perceived business pressure Perceived social pressure	Antecedent	Managerial focus on proactive environmental strategy	China	Yang et al. (2019a)
Government pressure Customer pressure	Antecedent	Green culture Green practices	China	Li et al. (2019)
Regulative pressure Normative pressure Cultural-cognitive pressure	Antecedent	The adoption of green IS practices	The US	Carberry et al. (2019)
Public pressure Industries and trade pressure Community environmental groups pressure Financial institutions pressure Shareholder pressure Customer and supplier pressure	Antecedent	The internalization of environmental management systems	The EU	Testa et al. (2018)
National policy pressure Regional market pressure	Antecedent	Administrative environmental planning Technical core environmental practice	China	Shi et al. (2018)
Government pressure Customer pressure	Antecedent	The implementation of ISO 14001	Greece	Iatridis and Kesidou (2018)
Regulatory pressure Customer pressure Competitive pressure	Antecedent	Green innovation	China	Chu et al. (2018)
Regulatory pressure Market pressure Suppliers Pressure	Antecedent	GSCM adoption	The US	Agarwal et al. (2018)
Coercive pressure (governmental requirements) Normative pressure (market or the public) Mimetic pressure (competitors)	Antecedent	Implementing sustainable production	China	Zhu (2016)
Regulatory pressure Customer pressure Supplier pressure	Antecedent	Internal environmental management practices, cooperation with customers, and green purchasing	Brazil	Seles et al. (2016)
Regulatory pressure Ownership pressure	Moderator	Reverse logistics	Malaysian	Khor et al. (2016)
Regulatory pressure Customer pressure Social pressure	Antecedent	Sustainability management initiatives	China, India, and Malaysia	Adebanjo et al. (2016)
Coercive pressure (government) Normative pressure (social groups) Mimetic pressure (competitors)	Antecedent	The adoption of sustainable supplier development practices	Global	Sancha et al. (2015)

Institutional pressure	Position	Corporate green management practices	Country	Reference
Regulative pressure (customers, governments, employees) Normative pressure (media, competitors, consumers, interest groups)	Antecedent	Pollution control Policies Pollution prevention	The US	Simpson and Sroufe (2014)
Coercive pressure (government) Normative pressure (society) Mimetic pressure (Industry)	Antecedent; Moderator	Environmental sourcing practices Environmental supplier collaboration	The US	Schoenherr et al. (2014)
Pressures from headquarters Pressures from local environment	Antecedent	Green purchasing practices of subsidiary	Global	Hsu et al. (2014)
Coercive pressure (regulations) Normative pressure (social groups) Mimetic pressure (competitors)	Antecedent	Coercive or cooperative green supply chain practices	UK	Hoejmose et al. (2014)
Public authorities pressure Environmental covenants pressure Communities and environmental organizations pressure Supply chain partners pressure Branch organizations pressure	Antecedent	Externally-oriented environmental management	Netherlands	Grekova et al. (2014)
Coercive pressure (environmental regulations) Normative pressure (customer and market) Mimetic pressure (competitors)	Antecedent	External GSCM practices Internal GSCM practices	China	Zhu et al. (2013); Zhu and Geng (2013)
Coercive pressure (government regulations) Normative pressure (customers) Mimetic pressure (competitors)	Antecedent	Reverse logistics implementation	China	Ye et al. (2013)
Coercive pressure (regulations) Normative pressure (customer and society) Mimetic pressure (competitors)	Antecedent	Green purchasing; design-for-environment; reverse logistics	Malaysia	Hsu et al. (2013)
Coercive pressure (regulations and trading partners) Mimetic pressure (competitors and trading partners)	Antecedent	Green IS adoption for pollution prevention Green IS adoption for product stewardship Green IS adoption for sustainable development	Malaysia	Gholami et al. (2013)
Regulatory pressures (governments) Normative pressures (NGOs)	Antecedent	Environmental innovation	The US	Berrone et al. (2013)

Institutional pressure	Position	Corporate green management practices	Country	Reference
Regulatory pressure Customer pressure	Antecedent	Eco-design	Malaysia	Zailani et al. (2012)
Regulatory pressure Customer pressure	Antecedent	Green purchasing	Taiwan	Yen and Yen (2012)
Market pressure Regulatory pressure Competitive pressure	Moderator	Green purchasing Cooperation with customers Eco-design Investment recovery	Taiwan	Wu et al. (2012)
Regulatory pressure Disposal cost pressure Customer pressure	Antecedent	Waste reduction (pollution) Waste reduction (cost)	The US	Simpson (2012)
Customer pressure Economic pressure Regulatory pressure	Antecedent; Moderator	Green logistics management	China	Lai and Wong (2012)
Clients pressure Government pressure Shareholders pressure Workers pressure Society pressure	Antecedent	Eco-design Source reduction Environmental management system	Spain	Sarkis et al. (2010)
Customer pressure Regulatory pressure	Moderator	Proactive environmental strategy	New Zealand	Menguc et al. (2010)
Regulatory pressure Customer pressure Supplier pressure	Antecedent	Environmental system practices Environmental conservation practices Environmental support practices	Australia	Gadenne et al. (2009)
Market pressure Non-market pressure	Antecedent	The adoption of ISO 14001 environmental management standard The participation in government voluntary environmental programs	The US	Delmas and Toffel (2008)
Market pressure Regulatory pressure Competitive pressure	Moderator	Internal environmental management Green purchasing Eco-design Cooperation with customers Investment recovery	China	Zhu and Sarkis (2007)
Supply chain pressure (supplier and competitor) Cost related pressure Market pressure Regulatory pressure	Antecedent	Internal environmental management External GSCM Eco-design Investment recovery	China	Zhu et al. (2005)

Appendix B. Measurements

Items	Loadings	T-value
Cross-functional green strategic alignment *(*Vachon and Klassen 2006; Flynn et al. 2010; Wong et al. 2015*)*		
GSA1 Functional green strategies are well aligned with corporate green strategy	0.84	-
GSA2 We have cross-functional green goals and objectives	0.85	15.10
GSA3 Functional green strategies and goals are communicated to all employees	0.81	14.01
GSA4 Functional green strategies are frequently reviewed and revised together	0.86	15.33
GSA5 Environmental policies (e.g., green objectives, actions, performance measurements) are established for internal departments	0.85	15.03
Cross-functional green information sharing *(*Vachon and Klassen 2006; Flynn et al. 2010; Wong et al. 2015*)*		
GIS1 Green data sharing among internal functions (e.g., emission data; energy consumption data)	0.85	-
GIS2 Internal functions establish communication channels to share green information	0.87	16.47
GIS3 Internal functions can search for green-related operational data in real-time	0.89	17.07
GIS4 Internal functions can track green information of products (from raw materials to end products) in real-time	0.85	15.74
Cross-functional green process coordination *(*Vachon and Klassen 2006; Flynn et al. 2010; Wong et al. 2015*)*		
GPC1 Internal functions incorporate environmental issues in the product design process (e.g., reduce material/energy consumption; increase the use of environment-friendly materials)	0.83	-
GPC2 Internal functions incorporate environmental issues in the manufacturing process	0.85	14.95
GPC3 Internal functions incorporate environmental issues in the delivery process	0.85	14.79
GPC4 Internal functions establish a recycling process for used and defective products	0.78	13.10
GPC5 Internal functions improve the process to better manage the disposal of industrial wastes (e.g., wastewater, gas, and residue)	0.81	13.89
Customer mimetic pressure *(*Teo et al. 2003; Liang et al. 2007; Liu et al. 2010; Tate et al. 2014*)*		
CMP1 Our main customers have perceived green management favorably	0.88	-
CMP2 Our main customers that have adopted green management benefited greatly	0.88	17.47
CMP3 Our main customers that have adopted green management are more competitive	0.88	17.35
Customer coercive pressure *(*Teo et al. 2003; Liang et al. 2007; Liu et al. 2010; Tate et al. 2014*)*		
CCP1 We may not retain our main customers without conducting green management practices	0.92	16.61
CCP2 We may lose orders from our main customers without conducting green management practices	0.89	15.93
Customer normative pressure *(*Teo et al. 2003; Liang et al. 2007; Liu et al. 2010; Tate et al. 2014*)*		
CNP1 Green management practices have been widely adopted by our main customers currently	0.89	-
CNP2 Our main customers actively participate in industry groups that encourage improved environmental practices	0.90	19.32
CNP3 Our main customers have a clear policy statement regarding their commitment to the environment	0.87	17.95
CNP4 Our main customers actively combine environmental certification into daily operations	0.91	19.66
Supplier mimetic pressure *(*Teo et al. 2003; Liang et al. 2007; Liu et al. 2010; Tate et al. 2014*)*		
SMP1 Our main suppliers have perceived green management favorably	0.87	-
SMP2 Our main suppliers that have adopted green management benefited greatly	0.90	18.12
SMP3 Our main suppliers that have adopted green management are more competitive	0.89	17.68
SMP4 Our main suppliers' experience in green management has reference value to us	0.89	17.63
Supplier coercive pressure *(*Teo et al. 2003; Liang et al. 2007; Liu et al. 2010; Tate et al. 2014*)*		
SCP1 The main suppliers, who are vital to us, hotly wish us to conduct green management practices	0.90	16.22
SCP2 Requirements of environmental certification (such as ISO14000) by the main suppliers	0.87	15.30
SCP3 Our main suppliers will reduce supply if we do not conduct green management practices	0.85	14.85

Items	Loadings	T-value
Supplier normative pressure *(*Teo et al. 2003; Liang et al. 2007; Liu et al. 2010; Tate et al. 2014*)*		
SNP1 Our main suppliers actively participate in industry groups that encourage improved environmental practices	0.87	15.23
SNP2 My major suppliers have a clear policy statement regarding their commitment to the environment	0.86	14.95
Environmental performance *(*Zhu and Sarkis 2004*)*		
ENP1 We reduce waste (air, water, and/or solid) emission	0.79	-
ENP2 We decrease the consumption of hazardous/harmful/toxic materials	0.86	12.16
ENP3 We decrease the frequency of environmental accidents	0.78	11.24
ENP4 We decrease energy consumption	0.50	6.98

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Data Availability The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Declarations

Conflict of interest All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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