

This is an Open Access document downloaded from ORCA, Cardiff University's institutional repository: <https://orca.cardiff.ac.uk/id/eprint/182239/>

This is the author's version of a work that was submitted to / accepted for publication.

Citation for final published version:

Liu, Zhen-yuan (Ralph), Li, Yu-min, Tse, Ying Kei (Mike) , Tan, Kim Hua and Kumar, Ajay 2026. Hiding in the supply chain: Investigating supplier eco-innovations when buyer and supplier have common owners. *Technological Forecasting and Social Change* 222 , 124409. 10.1016/j.techfore.2025.124409

Publishers page: <http://dx.doi.org/10.1016/j.techfore.2025.124409>

Please note:

Changes made as a result of publishing processes such as copy-editing, formatting and page numbers may not be reflected in this version. For the definitive version of this publication, please refer to the published source. You are advised to consult the publisher's version if you wish to cite this paper.

This version is being made available in accordance with publisher policies. See <http://orca.cf.ac.uk/policies.html> for usage policies. Copyright and moral rights for publications made available in ORCA are retained by the copyright holders.



# **Hiding in the supply chain: Investigating supplier eco-innovations when buyer and supplier have common owners**

## **Abstract:**

Common owners along the supply chain (COSC) indicate shareholders who simultaneously hold the equity stakes of upstream suppliers and downstream buyers. Despite the burgeoning interest in COSC's influences on supply chain actors' practices, its impact on supplier eco-innovations remains unexplored. Drawing on resource dependence theory, this paper proposes a set of competing hypotheses to critically investigate the relationship between COSC and supplier eco-innovations and the moderating roles of suppliers' internal environmental awareness and external legitimate pressure. Analysing a unique dataset of 1,841 buyer-supplier pair-year observations of Chinese A-share listed firms between 2003 and 2021, we find that COSC functions as a new form of shadow governance within the supply chain to hamper supplier eco-innovations. However, such the negative effect can be converted into positive ones when suppliers obtain higher environmental awareness, encounter more stringent environmental regulations, and receive intensified media coverage. The results remain robust under various robustness checks, yielding important implications for managerial practice and policy development.

**Keywords:** Common ownership, Eco-innovations, Buyer-supplier relationship, Resource dependence theory

## 1. Introduction

Firms are eagerly collaborating with partners in the supply chain to develop eco-innovations. When confronted with climate change risks and the global goal of carbon neutrality, firms, especially suppliers, are motivated by their stakeholders (i.e., buyers, investors, governments, and media) to reduce carbon emissions and environmental damage, wherein eco-innovations play a critical role. For instance, CATL, Tesla's predominant battery supplier in China, accounting for approximately 70% of Tesla's battery procurement volume in its Shanghai Gigafactory, has pioneered eco-innovations in Lithium Iron Phosphate battery production and closed-loop recycling systems. The supplier-driven eco-innovations reduced Tesla's battery unit costs by 8% while achieving a 15.2% reduction in cradle-to-gate carbon emissions across the battery supply chain, as quantified through life-cycle assessment following ISO 14067 standards<sup>1</sup>. Indeed, taking the supply chain optimisation-based perspective, a nascent study of Song et al. (2023) empirically identified the pivotal nature of supplier eco-innovations in reducing carbon emissions along the entire supply chain.

Although eco-innovation developments achieve the reduction goal through transitioning suppliers towards circular production modes to meet the legitimate requirements, suppliers are increasingly dependent on external stakeholders, especially buyers, to bestow vital resources, including technological knowledge, market preferences, and prompt end-user feedback (Hofman et al., 2020; Viale et al., 2022; Zubeltzu-Jaka et al., 2018). On the other hand, buyers may prioritise profitability and market shares brought by supplier eco-innovations rather than genuinely addressing environmental concerns (Hofman et al., 2020). Meanwhile, buyers may face the risk of asset devaluation if supplier eco-innovations are too radical. For example, a newly launched eco-part-embedded product can render existing products outdated or less eco-friendly, leading to a loss of market share and eventual obsolescence. In these situations, buyers would leverage resource advantages to make suppliers focus on innovations that expand market shares and boost profitability instead of eco-innovations, triggering opportunistic behaviours that lead to further

---

<sup>1</sup> Source: BloombergNEF at <https://about.bnef.com/blog/us-ev-credit-rules-favor-home-teams-snub-overseas-players>

holdup issues and inhibit supplier eco-innovations (Chen, 2024). Therefore, how to cultivate a reliable and stable buyer-supplier relationship turns out to be the core issue in the development process of supplier eco-innovations.

A surge of recent research has shed light on common owners along the supply chain (COSC hereafter) and their effects on strengthening the buyer-supplier relationship. COSC refers to shareholders who simultaneously hold the equity stakes of both upstream suppliers and downstream buyers (Cheung et al., 2020). For instance, BlackRock holds significant shares in Ford Motor Company, while it is also the largest shareholder of Goodyear Tire, one of Ford Motor Company's major tire suppliers. In China, the past decade has witnessed a marked proliferation of COSC, a trend propelled by institutional investors' sector concentration strategies and retail investors' increasing awareness of risk diversification. Statistical evidence shows that approximately 14.4% of Chinese A-share listed firms had common owners with at least one supplier between 2009 and 2020 (Xu, 2023). Notably, within China's institutional landscape dominated by relational governance, firms' business operations and resource acquisition remain profoundly shaped by social networks such as COSC. Occupying the crucial position in the supply chain network, COSC would curb opportunistic behaviours among its portfolio firms through aligning supply chain goals, enhancing mutual trust, and promoting information sharing between suppliers and buyers (Freeman, 2023). In this sense, COSC forges more stable buyer-supplier relationships that benefit suppliers' market performance (Cheung et al., 2020; Fang and Zhang, 2024), increase buyers' relationship-specific investments (Jang et al., 2024), mitigate the bullwhip effects along the supply chain (J. Chen et al., 2024), and curtail supply chain partners' earning management (Gao et al., 2024).

Nevertheless, COSC also exerts a form of shadow governance over the decision-making of commonly held suppliers and customers (Nili and Hwang, 2020; Tian et al., 2024). Rather than directly engaging in firm management, COSC influences coordination and collaboration among supply chain partners via more covert means, such as private communications, board voting, shareholder proposals, and executive appointments (Chen and Cao, 2025; Tian, 2025; Yao et al.,

2024; Ye and Yu, 2024). Although existing literature acknowledges certain merits of such shadow governance, little is known about whether and how COSC affects supplier eco-innovations. This is particularly critical given that COSC may also leverage its resource advantages to coercively restrain portfolio firms from pursuing practices that conflict with its value maximisation objectives (DesJardine, Grewal, et al., 2023). Taking the new energy vehicle industry for example, Toyota's major shareholders secured the success of the Prius hybrid model in North America by pressuring suppliers to prioritise hybrid technology over more ecologically advanced electric vehicle investments. While Chen (2024) suggests that COSC encourages supplier general innovations by sustaining relationship-specific investments and facilitating effective information exchanges with buyers, there remains a lack of balanced insights into how COSC influences supplier eco-innovations. This gap is noteworthy given the significant disparities between eco-innovation and general innovation as well as the pillar functions of eco-innovation in achieving circular economy transition (Bammens and Hünermund, 2020). Moreover, prior literature also indicates that a firm's internal and external characteristics, such as awareness of environmental issues and legitimate pressure, also spur its efforts in eco-innovation developments. Therefore, we further explore how suppliers' internal environmental awareness and external legitimate pressure moderate the effect of COSC on supplier eco-innovations. To sum up, we attempt to address two research questions as follows:

***RQ1:*** Whether and how do COSC influence supplier eco-innovations?

***RQ2:*** How do suppliers' internal environmental awareness and external legitimate pressure affect the relationship between COSC and supplier eco-innovations?

To answer these questions, we draw upon resource dependence theory (RDT) to propose a set of competing hypotheses that critically explore the influence of COSC on supplier eco-innovations from both enhancing and hampering perspectives. RDT suggests that firms rely on stakeholders in their business networks to acquire vital resources for innovation and operations, resulting in either mutual dependence or power imbalance among various parties, which can either enhance or hinder multi-actor collaborations, respectively. In this sense, the enhancing perspective suggests that

COSC can facilitate effective and efficient information exchange along the supply chain, providing technological spillover and in-time market demands for suppliers to foster eco-innovations. Conversely, the hampering perspective indicates that COSC would exercise its coercive power to hinder supplier eco-innovation endeavours that may devalue buyers' assets, especially considering COSC's inherent profit-seeking nature and value-maximising orientation (DesJardine, Shi, et al., 2023; Kochhar and David, 1996). Utilising a novel and multi-sourced dataset containing 1,841 buyer-supplier pairs of listed firms in China over 2003-2021, we adopt panel data regression models with fixed effects to examine our contentions empirically. The analysis results demonstrate that COSC discourages suppliers from developing eco-innovations, lending more support to the hampering perspective. More importantly, the moderating analysis results show that this negative relationship can be converted into positive ones when suppliers possess higher environmental awareness, encounter more stringent environmental regulations and receive more intensive media coverage. These findings are still robust to a battery of examinations, including alternative variable measurement, alternative sample regression, and the propensity score matching method.

This research attempts to cross-fertilise the nascent studies at the intersection of common ownership and supplier eco-innovations in the supply chain context. First, we identify the downside of COSC in influencing portfolio firms' practices. Based on discussions from prior literature regarding the beneficial effects of common ownership (Chen, 2024; Cheung et al., 2020; DesJardine, Shi, et al., 2023; Ye and Yu, 2024), we provide more balanced insights into COSC by revealing how this new form of shadow governance impedes supplier eco-innovations. Second, we also advance the exploration of supplier eco-innovations antecedents by investigating the COSC effect. We also shed light on how suppliers can reduce dependency on COSC to spur eco-innovations. Third, our research can inspire future studies to extend RDT applications by exploring the influences of common ownership. Through the theoretical lens of RDT, we probe into the moderating effects of both suppliers' autonomy and legitimate pressure that counter COSC to operate behind the scenes. These findings provide meaningful insights for both managers and

policymakers when achieving circular economy (CE) transition and chasing the net-zero goal through eco-innovation developments.

The remainder of our research is arranged as follows. In Section 2, we review existing relevant literature and theoretical backgrounds, based on which we develop hypotheses in Section 3. Section 4 illustrates the data collection process, variable measurements and analysis strategies. Section 5 reports the analysis results and robustness checks. In Section 6, we discuss our findings, conclude this study and indicate the limitations that could be addressed by future research.

## **2. Literature review and hypothesis development**

### **2.1 Supplier eco-innovations**

Eco-innovation plays a crucial role in facilitating the transition to a circular economy (CE). Defined as the “new or improved socio-technical solutions that preserve resources, mitigate environmental degradation, and allow recovery of value from substances already in use in the economy” (de Jesus and Mendonça, 2018), eco-innovation essentially echoes the goals of CE transition that achieve both environmental resilience and economic growth. After identifying eco-innovation as the critical enabler for the CE transition, business and management scholars are striving to explore how to propel eco-innovations from multiple levels, particularly following Kesidou and Demirel's (2012) seminal work that derives eco-innovation drivers from demand, organisational and regulatory factors (de Jesus et al., 2019; Demirel and Danisman, 2019; Janahi et al., 2023; Sehnem et al., 2022; Triguero et al., 2022).

To cope with the escalating environmental pressure in the CE transition, firms are extraordinarily dependent on critical actors in their supply chain network to develop eco-innovations (Janahi et al., 2023), given that eco-innovations require an expanded knowledge base along the supply chain (Demirel and Kesidou, 2019; Hofman et al., 2020). Recent research emphasises supplier eco-innovations since suppliers occupy a high proportion of innovation activities in the supply chain (more than 69% in China) (Dai et al., 2015; Fan et al., 2022; Hofman et al., 2020). Collaborating with supply chain partners to develop eco-innovations enhances

suppliers' productivity by reducing production costs and increases their legitimacy by mitigating environmental damages and meeting stakeholder expectations.

More importantly, supplier eco-innovations also benefit buyers by not only bringing higher market shares by catering to end-users upgrading environmental needs, but also sharing buyers' burden of carbon emissions. From the supply chain optimisation-based perspective, Song et al. (2023) found that eco-innovations curb greenhouse gas emissions along the entire supply chain by relocating emissions from buyers to more innovative suppliers. In this sense, buyers would be more motivated to support supplier eco-innovations by providing vital resources, including timely market information and feedback, technological solutions, and relationship-specific investment. On the other hand, buyers' market orientation towards profits and marginal revenues shapes their resource allocations on supplier R&D investment and innovations (Guo et al., 2023; Kim and Zhu, 2018; Krolkowski and Yuan, 2017). When confronted with potential losses resulting from supplier eco-innovations, buyers' potential opportunistic behaviours may lead to an unstable buyer-supplier relationship, triggering holdup issues and further inhibiting supplier eco-innovations. Therefore, how to cultivate a reliable and stable buyer-supplier relationship influences supplier eco-innovations profoundly.

## **2.2 Common owners along the supply chain (COSC)**

Nascent research reveals the effect of common ownership on strengthening the buyer-supplier relationship (Cheung et al., 2020; Fang and Zhang, 2024; Freeman, 2023; Xu, 2023). COSC refers to shareholders who simultaneously hold a high proportion of equity stakes of both upstream suppliers and downstream buyers. Figure 1 illustrates common owners in the context of supply chain. Unlike general investors, COSC intends to maximise the joint value of its portfolio rather than solely from one party in the supply chain. Hence, COSC occupies the pivotal network position to undertake external monitoring and curb opportunistic behaviours by fostering commitments, collaboration and coordination among supply chain partners. For example, COSC could bring suppliers into buyers' boards, accessing suppliers with buyers' decision-making processes promptly and effectively (Ambulkar et al., 2023). In doing so, Cheung et al. (2020) found that

COSC boosts suppliers' profitability significantly. Sampling from U.S. listed supplier firms, Gao et al. (2024) uncovered that COSC curtails suppliers' engagement in upward earnings management via enhancing buyer-supplier relationships. Chen (2024) pinpointed the positive effect of COSC on improving supplier innovation performance by integrating factors of both technological pushes and market pulls.

**[Insert Figure 1 Here]**

Although existing studies provide fresh insights into COSC, there remains a shortage of literature investigating the effect of COSC on supplier eco-innovations. Specifically, we still do not know whether and how COSC influences supplier eco-innovations. Moreover, little research has probed the supplier characteristics when examining COSC effects, such as supplier internal environmental awareness and external legitimate pressure in eco-innovations. Therefore, we also expect to advance the ongoing discussions regarding how suppliers' internal autonomy and external legitimacy condition the effect of COSC on supplier eco-innovations.

### **2.3 Resource dependence theory**

Resource dependence theory (RDT) suggests that firms are dependent on external actors in their networks and business environment (e.g., buyers, suppliers, investments, governments) to acquire vital resources for survival, given that firms can not obtain all the resources and abilities to achieve desired goals and competitive advantages (Drees and Heugens, 2013; Hillman et al., 2009; Pfeffer and Salancik, 1978). In this sense, firms engage in inter-organisational arrangements to reduce resource uncertainties and maintain stable resource flows, which establishes the dominant role of RDT in investigating inter-organisational relationship management and the buyer-supplier relationship management in particular (Cao et al., 2024; Jajja et al., 2017; Lin and Deng, 2024). More recent research in RDT disentangles two distinct theoretical dimensions from firms' interdependence, i.e., mutual dependence and power imbalance (X. Chen et al., 2024; J. Wu et al., 2023).

Specifically, *mutual dependence* refers to the sum of interdependence between two parties, emphasising the embeddedness in an inter-organisational relationship that expedites the value-generating process through mutual trust, collaborations and information sharing. For instance, Jajja et al. (2017) found that the mutual dependence on innovation focus between buyers and suppliers fosters a stable buyer-supplier relationship, significantly boosting buyer business performance. By contrast, *power imbalance* highlights the asymmetric resource dependencies among different parties, suggesting that firms with resource edges would have coercive power to reap benefits from and control resource-disadvantaged ones. In this sense, we draw upon these two distinct theoretical dimensions of RDT to critically examine the effects of COSC on supplier eco-innovations by proposing a set of competing hypotheses.

### **3. Hypothesis development**

#### **3.1 The influence of COSC on supplier eco-innovations: enhancing perspective**

Drawing upon the theoretical construct of mutual dependence sourced from RDT, we argue that COSC can promote supplier eco-innovations, given that supplier eco-innovations meet COSC expectations of maximising the joint value of portfolios in the supply chain. Extensive studies revealed that supplier eco-innovations not only boost suppliers' operational efficiency through reusing and recycling production materials but also increase buyers' inventory turnover via adapting their products to market environmental preferences (Bag et al., 2022; Demirel and Danisman, 2019; Gnekpe and Plantec, 2023; Kiefer et al., 2019), increasing the market value of both suppliers and buyers. Meanwhile, supplier eco-innovations also bolster the reduction of carbon emissions across the entire supply chain (Song et al., 2023), benefiting all actors in the supply chain by meeting the requirements of the net-zero goal in the CE transition. COSC could achieve higher investment returns, as supplier eco-innovations help target firms in the portfolio avoid hefty fines for violating environmental regulations.

However, supplier eco-innovations depend on both technological-push and demand-pull resources acquired through strengthening mutual dependence among stakeholders. COSC could achieve such an increase in mutual dependence between suppliers and buyers via at least two ways.

First, COSC informs suppliers with effective and efficient market feedback from the demand side. Occupying the core position in the supply chain network, COSC has lower costs in collecting information from buyers and suppliers, enabling suppliers to solicit buyers' and even end-consumers' feedback promptly (Gao et al., 2024). Such an advantage of capturing market preferences can forcefully pull suppliers to adjust their directions in the eco-innovation development process and overcome market uncertainty. At the same time, buyers' valuable market insights also accommodate suppliers with feasible technological solutions that promote eco-innovation explorations. Fan et al. (2022) indicated that the solid buyer-supplier relationship provides suppliers with sufficient information and resources to explore market knowledge, technology, and products, thereby laying the foundation for suppliers' exploration and innovation.

Second, COSC also improves the stability of buyer-supplier relationships through an external monitoring mechanism. Particularly, COSC fosters mutual trust and dependence among buyers and suppliers, which adequately restricts opportunistic behaviours in the supply chain (Cheung et al., 2020; Gao et al., 2024). In this sense, suppliers can launch more relationship-specific investments in eco-innovations regardless of holdup issues. Buyers are also more willing to share and even transfer techniques and knowledge with their suppliers, especially in the strengthened buyer-supplier relationship constructed by COSC. Prior studies also demonstrate that COSC fosters patent citations between suppliers and buyers, thereby accelerating the dissemination of innovation knowledge within the supply chain (Chen, 2024; Freeman, 2023). These technological resources and investments indeed push supplier eco-innovations. Based on the discussions regarding COSC's motivations and functions above, we propose:

***H1(a): COSC enhances supplier eco-innovations.***

### **3.2 The influence of COSC on supplier eco-innovations: hampering perspective**

On the other hand, resource dependency also fosters power imbalances among different actors, wherein resource providers can exploit their coercive power to influence and even manipulate the behaviours of resource recipients. In the context of supply chain, more recent studies leverage

power imbalance to investigate how the asymmetry of resource dependency influences supplier decision-making processes and behaviours (Gorton et al., 2023; Liu et al., 2022). Specifically, when suppliers depend on supply chain partners to acquire resources, these external actors harness suppliers to serve their interests by threatening suppliers without providing any resources. The more vital and irreplaceable resources are, the more powerfully external actors dominate suppliers. Also, utilising meta-analysis to compare different forms of inter-organisational arrangements through the lens of RDT, Drees and Heugens (2013) revealed that ownership-based arrangements are more prone to depriving focal firms of autonomy in the decision-making process, as ownership-based ones can exert coercive power to achieve their profit-seeking goals. In this vein, we argue that COSC could implement coercive power to hamper supplier eco-innovations, as eco-innovations may fail to realise their set goal of maximising portfolio returns in the short term.

First, COSC prefers suppliers' behaviours that could bring returns instantly. For instance, DesJardine, Grewal, et al. (2023) pinpointed that common owners are more willing to propel target firms' financial material CSR practices than non-financial ones, as the former can defend systematic risks in a particular industry and then derive profits for common owners. Although supplier eco-innovations bring potential profits through fulfilling market demands and legitimate expectations, their inherent high failure risks, unstable returns, significant externalities and organisational adaptation costs have underlying conflicts with COSC's profit-seeking goals (Demirel and Kesidou, 2019; Hofman et al., 2020; Kesidou and Demirel, 2012; Kiefer et al., 2019; Sehnem et al., 2022; Viale et al., 2022). When perceiving suppliers' relevant decisions and behaviours as opposed to profit-seeking goals, COSC may curb and even deprive suppliers of autonomy in eco-innovations to maintain the maximisation of portfolio returns.

Second, buyers also pay closer attention to market shares instead of addressing environmental concerns when compared with suppliers (Hofman et al., 2020). Hence, overly radical supplier eco-innovations prompt buyers to undertake the risks of losing existing market shares and accelerate the depreciation of their assets (Chen, 2024). All these potential losses resulting from supplier eco-innovations make COSC suffer from obtaining short-term profits. Considering the inherent risk of

eco-innovations and buyers' potential losses, COSC would take advantage of its coercive power to hamper supplier eco-innovations. Taking the new energy vehicle industry as an example, the tremendous success of the Prius, a hybrid vehicle model by Toyota, in North America, motivated Toyota and its shareholders to pressure suppliers to invest in hybrid models rather than in ecological technology for electric vehicles and their supplied components. Therefore, we propose our hypothesis regarding the effect of COSC on supplier eco-innovations from the power imbalance perspective as follows:

***H1(b): COSC hampers supplier eco-innovations.***

### **3.3 Moderating roles of supplier internal autonomy and external legitimacy**

Apart from the essential resources dependent on external entities to acquire, prior studies in RDT suggest that firms' autonomy and legitimacy also determine their decision-making and practice implementations (Abdurakhmonov et al., 2021; Drees and Heugens, 2013). In particular, firms' internal autonomy in addressing environmental issues cultivates the corresponding capabilities that overcome various resource constraints during the CE transition. Indeed, Pinkse et al. (2023) propose that social-cognition capability is the critical enabler for unlocking eco-innovations to achieve the net-zero goal. In the meantime, extant studies demonstrate the roles of external legitimate pressure in propelling firms to adopt substantial environmental practices in decarbonisation, such as eco-innovations (Kesidou and Demirel, 2012; Ren et al., 2023; Yousaf et al., 2023). In this respect, we reckon that the effects of COSC on supplier eco-innovations may vary according to suppliers' internal autonomy and external legitimacy. Specifically, we emphasise contingent factors of supplier characteristics that may internally and externally moderate the effect of COSC on supplier eco-innovations, including supplier environmental awareness, supplier environmental regulation and supplier media coverage.

#### **3.3.1 Supplier environmental awareness**

Supplier environmental awareness refers to the degree of suppliers' attention on environmental protection issues (Demirel and Kesidou, 2019; Kiefer et al., 2019; Shu et al., 2020).

Specifically, suppliers with higher environmental awareness are more likely to develop and implement proactive and substantial environmental practices. After acquiring resources from COSC, suppliers with higher awareness would mobilise more resources into eco-innovations, which is motivated by their autonomy and orientations in addressing environmental issues. In this sense, higher supplier environmental awareness strengthens the positive effects of COSC on supplier eco-innovations. On the other hand, if COSC discourages eco-innovations, suppliers with higher environmental awareness strive to overcome resource limitations in the inputs, processing, and outputs of eco-innovations. They may even proactively look for other buyers who can accommodate their autonomy in pursuing eco-innovations (Hofman et al., 2020). Based on the discussions above, we then propose:

***H2(a): Supplier environmental awareness strengthens the positive effect of COSC on supplier eco-innovations.***

***H2(b): Supplier environmental awareness suppresses the negative effect of COSC on supplier eco-innovations.***

### **3.3.2 Supplier external legitimacy**

Governments enforce environmental regulations that require firms to conduct environmentally responsible operations compulsorily, monitoring firms to mitigate their environmental impacts (Doran and Ryan, 2012; Kesidou and Demirel, 2012). For instance, the Chinese Environmental Protection Bureau initiated the Cleaner Production Audit (CPA) programme in 2004, promoting firms to transit towards environmental and circular production (Cui et al., 2022). Firms failing to meet the CPA requirements will be subject to more stringent green and ecological auditing, warnings, fines and even shutdowns.

We argue that the stringency of environmental regulation moderates the COSC effect on supplier eco-innovations. With the increasing stringency of government environmental regulations, suppliers would undertake more forceful legitimate pressure resulting from governments' greater environmental monitoring and scrutiny efforts. Suppliers are thereby motivated to engage in eco-innovations to comply with institutional requirements. In this sense, COSC will bolster supplier

eco-innovations to achieve its profit-seeking goal, especially considering suppliers' operational risks of violating stringent environmental regulations. By contrast, lower stringency of environmental regulations weakly propels suppliers with COSC to spur eco-innovations, which makes suppliers suffer fewer losses even if they fail to achieve the requirements. This illustrates that the effects of COSC on supplier eco-innovations depend on the stringency of environmental regulations. We thereby propose:

***H3(a): Supplier environmental regulation reinforces the positive effect of COSC on supplier eco-innovations.***

***H3(b): Supplier environmental regulation diminishes the negative effect of COSC on supplier eco-innovations.***

Extant studies have also identified media coverage as the essential social monitoring mechanism that complements government regulations (Campbell, 2007; Cheung et al., 2020; Ren et al., 2023). With limited attention, external stakeholders and the public can be thoroughly informed of firms' practices via media exposures and visualisations. Therefore, a firm will be scrutinised and monitored by more external entities when it receives more media coverage, forming higher legitimate pressure for its responsible business operations (Tang and Tang, 2016; Yousaf et al., 2023).

Supplier media coverage refers to the volume of media coverage a supplier receives. With intensified coverage, suppliers' behaviours can be visualised under the media spotlight, leading to greater scrutiny of stakeholders and the public. Suppliers are inclined to satisfy social norms and expectations by implementing environmentally friendly practices, such as eco-innovations. Meanwhile, COSC would encourage suppliers with higher media coverage to take social responsibility. Otherwise, the increasing media coverage regarding supplier misconduct in environmental protection could not only deprive suppliers of their legitimate status but also attribute such misconduct to the incompetence of their buyers and COSC (Jacobs and Singhal, 2020). Therefore, we propose:

*H4(a): Supplier media coverage bolsters the positive effect of COSC on supplier eco-innovations.*

*H4(b): Supplier media coverage weakens the negative effect of COSC on supplier eco-innovations.*

Figure 2 depicts the conceptual research model of this study.

**[Insert Figure 2 Here]**

## **4. Methodology**

### **4.1 Samples and data collection**

To examine the hypotheses proposed in this study, we construct the sample based on Chinese A-share listed firms between 2003 and 2021 for the following reasons. On the one hand, China attracts global investors' attention in supply chain investment as it is one of the largest emerging economies and the world's factory. On the other hand, the Chinese government is actively reducing carbon emissions and transitioning towards the circular economy. Especially after COP 26, President Xi reaffirmed China's commitment to achieving the goal of carbon neutrality by 2060. Therefore, both growing investment expectations and the urgency of attaining net-zero goals in China give us a unique context to test our hypotheses. We drew on previous studies to screen our sample firms as follows: (1) eliminated sample firms in the financial industry; (2) excluded firms with special treatment (ST) as the risk of delisting influences these firms' operations; (3) dropped observations with missing information of all the variables in our regression models. We identified 1,937 listed firms after applying the criteria above.

To identify the COSC, the very first step is to identify the dyadic buyer-supplier pair of Chinese A-share listed firms. Following Cao et al. (2024) and Feng and Zhu (2024), we utilised the China Stock Market & Accounting Research (CSMAR) database to acquire the sample firms' shareholder and buyer data. As CSMAR started to disclose listed firms' top ten shareholders' data

in 2003, we set our observation window from 2003 to 2021. Furthermore, it is not mandatory in China to accurately disclose a firm's top 5 buyer names. Certain firms try to anonymously articulate their buyers' names in the forms of "buyer 1, buyer 2, buyer 3, buyer 4, buyer 5" or "buyer A, buyer B, buyer C, buyer D, buyer E". However, without the buyer's accurate names, we cannot identify whether a sample supplier firm has common ownership with its buyers. In this sense, we only retained the sample firms that disclosed at least one listed buyer's name. Afterwards, our final sample consists of an unbalanced panel of 827 listed firms and 1,841 firm-year observations. We also matched and merged the available data from multiple secondary databases for the sample firms. Specifically, we acquired eco-innovation data from the Green Patent Research Database developed by the Chinese Research Data Services Platform (CNRDS), media coverage data from the News Database in CNRDS, and other firm-level data from CSMAR. All continuous variables are winsorised by 1% and 99% to avoid the influence of extreme values.

## 4.2 Measures

### 4.2.1 Dependent Variable

**Supplier eco-innovations (*SEI*).** Supplier eco-innovations refer to eco-friendly innovations in suppliers' products and production processes (Kesidou and Demirel, 2012). Existing studies used surveys and eco-innovation disclosure in the European Union (Colombo et al., 2019) to measure eco-innovations. However, such measures may introduce subjective bias, as firms tend to overstate their environmental responsibilities (Berrone et al., 2013). Therefore, we follow Li et al. (2023) to access the Green Patent Research Database in CNRDS and then utilised the total number of ecological patent applications of a supplier  $i$  in year  $t$  to measure supplier eco-innovations, token as  $SEI\_ttl_{it}$ . Eco-innovations can also be divided into radical and incremental eco-innovation. The former entails the introduction of alternatives or completely new organisational techniques, products, processes or marketing. And incremental eco-innovation refers to the gradual modification or redesign of organisations and products. One notable advantage of utilising CNRDS is that it also categorises ecological patents into radical patents (radical innovation) and incremental patents (incremental innovation) based on their innovativeness. Therefore, we further

built  $SEI_{radi_{it}}$  and  $SEI_{incre_{it}}$  to measure supplier  $i$  radical and incremental eco-innovations in year  $t$ , respectively. To avoid the estimation errors caused by variable deviations, we took the natural logarithm of one plus eco-innovation patents to measure each type of supplier eco-innovations above.

#### 4.2.2 Independent Variable

**COSC ( $COSC\_Dummy$ ).** We follow prior literature to define COSC as the presence of shareholders who simultaneously hold the equity of a supplier and its buyers (Gao et al., 2024). Even though most of the existing studies on COSC are set in the U.S. context, and measure COSC using the indicator variable (Cheung et al., 2020; Gao et al., 2024), these works have only focused on common institutional investors in the supply chain. We expanded this base by defining the top 10 shareholders as the common owners in the supply chain. Following Gao et al. (2024) to measure COSC using the dummy variable, we first acquired the top 10 shareholders of both a supplier and its buyers from CSMAR. Then, we identified COSC as a situation in which at least one shareholder simultaneously holds the equity of a supplier and its major buyers (the top 5 buyers). Afterwards, we construct the dummy variable  $COSC\_Dummy_{it}$  that indicates supplier  $i$  in year  $t$  has common ownership with its buyers with the value of 1 and otherwise with the value of 0. Figure 3 demonstrates the identification process of COSC in this study.

**[Insert Figure 3 Here]**

#### 4.2.3 Moderators

**Supplier environmental awareness ( $SEA$ ).** Supplier environmental awareness refers to suppliers' perception and attention regarding environmentally relevant behaviours. Prior studies strive to abstract a firm's attention and perception towards a specific issue through text mining its Management Discussion and Analysis (MD&A) in annual reports. For example, Chen et al. (2023) constructed a measure of trade policy effect uncertainty using natural language processing algorithms to analyse the Management Discussion and Analysis (MD&A). Liang et al. (2023) also

utilised the tone of forward-looking disclosures embedded in the MD&A to reflect firms' managerial expectations. In this vein, we followed Chen et al. (2023) to conduct textual analysis to statistically count the environment-related keywords in MD&A to portray the suppliers' environmental awareness. Specifically, we construct a word bag of environmental awareness based on the WinGo Textual Analytics Database (Chen et al., 2023) and utilise the ratio of environmental awareness keywords to the total number of keywords in MD&A as the proxy variable of suppliers' environmental awareness. We thereby built the variable  $SEA_{it}$  to measure supplier  $i$  environmental awareness in year  $t$ .

**Environmental regulation (ER).** In China, the Ministry of Environmental Protection (MEP) has initiated the Cleaner Production Audit (CPA) programme nationwide since 2004 (Cui et al., 2022). When mandated to participate in the CPA programme, firms would be confronted with much more stringent environmental regulations, including green auditing and pollution monitoring, throughout their production and operations processes compared to those that are not. In this case, we followed Liu et al. (2023) to construct a dummy variable  $ER_{it}$  that indicates a sample supplier  $i$  in the year  $t$  enlisted in the CPA programme with a value of 1 and otherwise with a value of 0.

**Supplier Media coverage (SMC).** In this study, we specified media coverage as the frequencies of media coverage that a sample supplier  $i$  receives in the year  $t$ , and then labelled it as  $SMC_{it}$ . With the advent of the new media era, media governance has increasingly evolved into an indispensable part of the social system. Its role in regulating corporate behaviour has attracted extensive attention from scholars. Compared with traditional media, online media using the internet as the platform has more substantial communication power and influence, promptly giving full play to the media effect. Media coverage is reflected by the yearly newspaper articles mentioning the sample supplier names (Zyglidopoulos et al., 2012). Therefore, we obtained supplier media coverage data from the News Database of Chinese Listed Companies in the CNRDS, which leverages artificial intelligence algorithms to collect and analyse news of Chinese public firms. Referring to Kim et al. (2019) and Ren et al. (2023), we used the logarithmic form of one plus the total number of online news articles that mention the firm's name (or stock name,

stock code, or name abbreviation) during the observation period as the proxy variable for supplier media coverage.

#### 4.2.4 Control variables

We also draw on existing studies to control for both firm-level factors and corporate governance characteristics that may influence supplier eco-innovations (Wang et al., 2022; X. Wu et al., 2023). Zubeltzu-Jaka, Erauskin-Tolosa, & Heras-Saizarbitoria (2018) point out that firm-specific features are the main determinants of eco-innovation, larger and more profitable companies have a greater volume of human and financial resources to invest in eco-innovation strategies (Horbach, 2008; Kesidou and Demirel, 2012; Rehfeld et al., 2007), then we control firm size (*Size*), leverage (*Lev*), growth (*Growth*) and profitability (*Roa*) of sample firms through obtaining relevant data from CSMAR. Different ownership types exhibit a heterogeneous preference for environmental strategies (García-Sánchez et al., 2020; Pan et al., 2021), then we control for ownership concentration (*Top1*), institutional ownership (*Inst*) and the nature of property rights (*SOE*). Further, the board of directors approves business strategies and protects stakeholders' and shareholders' interests (Prado-Lorenzo and Garcia-Sanchez, 2010). Consistent with previous studies (Chen et al., 2022; Haque and Ntim, 2020), we capture sample firms' corporate governance characteristics through controlling board number (*Board*), board independence (*Indep*) and the existence of dual roles (*Dual*). Table 1 demonstrates the categories, measurements and data sources of all variables in this study.

**[Insert Table 1 Here]**

#### 4.3 Model specifications

We construct two groups of panel data-based regression models to test the proposed hypotheses. Specifically, the first group model aims to testify the positive or negative effect of COSC on supplier eco-innovations according to H1:

$$SEI_{i,t+1} = \beta_0 + \beta_1 COSC\_Dummy_{i,t} + \beta_j Controls_{i,t} + Ind_i + Year_t + \varepsilon_{i,t} \quad (1)$$

In this Model (1),  $\beta_1$  delineates the effect of COSC on supplier eco-innovations, the direction of which helps us to identify whether COSC enhances (H1(a)) or hampers (H1(b)) supplier eco-innovations. Further, the next group of regression models aims to delve into the roles of supplier environmental awareness (H2), environmental regulation stringency (H3) and supplier media coverage (H4) in moderating the relationship between COSC and supplier eco-innovations.

$$\begin{aligned} SEI_{i,t+1} = & \beta_0 + \beta_1 COSC\_Dummy_{i,t} + \beta_2 Moderator_{i,t} \\ & + \beta_3 COSC\_Dummy_{i,t} \times Moderator_{i,t} \\ & + \beta_j Controls_{i,t} + Ind_i + Year_t + \varepsilon_{i,t} \end{aligned} \quad (2)$$

$Moderator_{it}$  in Model (2) is a vector containing all the moderators in this study. Therefore, the interaction item coefficient,  $\beta_3$  estimates the moderating effects of supplier environmental awareness, environmental regulation and media coverage on the COSC-Supplier eco-innovation relationship. Meanwhile,  $Controls_{it}$  in each model group indicate the firm-level control variables we adopted in this study. We also control the industry and time fixed-effect by supplementing  $Ind$  and  $Year$  in each regression model. To address the reverse causality problem, we follow extant studies to lag the supplier eco-innovations by one period ( $t+1$ ). In addition, we estimate heteroscedasticity robust standard errors clustered at the firm level to control for residuals that may be correlated over time.

## 5. Results

### 5.1 Descriptive statistics and correlation matrix

Table 2 presents the descriptive statistics of all the variables before put into the regression model. The mean value of  $SEI\_ttl$  is 0.417, suggesting that suppliers in our sample apply for an average of about 1.5 eco-innovation patents per year. The mean value of  $COSC\_dummy$  is 0.116, indicating that about 12% of our firm-year observations have COSC. The other variables are within a reasonable range of values. Table 2 also reports the correlation matrix of the variables used in the regression analyses. In addition, we perform variance inflation factor (VIF) tests to assess whether there are serious multicollinearity problems. The results of the VIF test indicate no severe multicollinearity problem exists in our analysis models since all the values are less than 2.

[Insert Table 2 Here]

## 5.2 Regression results

Table 3 reports the analysis results of the regression models proposed above. Model 1 in Table 3 presents the effect of COSC on supplier eco-innovations, while columns (2)-(3) further demonstrate the COSC effect on the radical and incremental types of supplier eco-innovations. The coefficients of *COSC\_dummy* of Model 1 are all significantly negative, supporting H1(b) that the presence of COSC hampers supplier eco-innovations. Specifically, the magnitude of the coefficient in column (1) ( $\beta_{(1)} = -0.106$ ,  $p < 0.05$ ) reveals that supplier eco-innovations decrease by about 23% when there exists COSC. The magnitude of the coefficients in columns (2)-(3) ( $\beta_{(2)} = -0.070$ ,  $p < 0.05$ ;  $\beta_{(3)} = -0.064$ ,  $p < 0.05$ ) reveals that COSC leads to about 25% and 23% reduction in supplier radical and incremental eco-innovations, respectively. Such results correspond with DesJardine, Grewal, et al. (2023)'s arguments that the profit-seeking goal of common ownership motivates portfolio firms to conduct symbolic CSR practices rather than substantial ones like eco-innovations, even though COSC may strengthen the buyer-supplier relationship. These results also echo the theoretical predictions of RDT that ownership-based inter-organisational arrangements could leverage their resource advantages to implement coercive power and then deprive target firms of autonomy in decision-making and practices.

Furthermore, the coefficients of the interaction terms across all columns in Models 2-4 indicate the moderating roles of supplier environmental awareness, environmental regulation stringency, and supplier media coverage, respectively. Specifically, the coefficients of the interaction term *COSC\_dummy*×*SEA* in column (4) ( $\beta_{(4)} = 0.095$ ,  $p < 0.10$ ) and column (5) ( $\beta_{(5)} = 0.105$ ,  $p < 0.05$ ) are all significantly positive, whereas the coefficient in column (6) is not significant. These results suggest that the negative effects of COSC on supplier eco-innovations can be converted into positive ones by increasing supplier environmental awareness. In other words, when a supplier focuses on addressing environmental issues, it will devote more resources acquired from external factors to radical eco-innovations, which could diminish the coercive powers of COSC.

Columns (7)-(12) report how the legitimate pressures sourced from external monitoring mechanisms moderate the relationship between COSC and supplier eco-innovations. Specifically, the coefficients of the *COSC\_dummy*×*ER* interaction term are significantly positive in column (7) ( $\beta_{(7)}=0.207, p<0.05$ ) and column (8) ( $\beta_{(8)}=0.179, p<0.01$ ) while not significant in column (9). These results suggest that strict environmental regulations substantially moderate the COSC-supplier eco-innovations relationship by prompting suppliers to focus on radical eco-innovations instead of incremental ones. By contrast, the coefficients of *COSC\_dummy*×*MC* interaction terms in column (10) ( $\beta_{(10)}=0.083, p<0.10$ ) and column (12) ( $\beta_{(12)}=0.056, p<0.10$ ) are significantly positive, while those in column (11) are insignificant. These results demonstrate that supplier media coverage could also relieve the negative effects of COSC on supplier eco-innovations. However, when suppliers receive more media coverage, COSC would motivate them to do more incremental eco-innovations rather than radical ones. This divergence stems from a distinct institutional logic. Suppliers adopt radical eco-innovation under government regulations to avoid penalties and align with long-term policy shifts (Acemoglu et al., 2012; Berrone et al., 2013), whereas media coverage drives incremental eco-innovation through reputational risks, prompting symbolic adjustments for short-term legitimacy.

**[Insert Table 3 Here]**

### **5.3 Robustness check**

We also conducted a battery of robustness checks to confirm our findings by using additional measures and methods.

*The alternative measure of COSC.* We used the number of common owners in the buyer-supplier relationship as the proxy variable to measure COSC (*COSC\_Num*). In the main regression, we only adopted the dummy variable of COSC to indicate whether common ownership exists in the supply chain. However, *COSC\_Num* further delineates the number of common owners between a sample supplier and its major buyers at the annual level, reflecting the degree to which COSC influences suppliers. Then, we re-estimated two groups of models in this study. Panel A of Table 4 shows the results. Specifically, Columns (1)-(3) still indicate the significantly negative effects of

COSC on supplier eco-innovations, which is consistent with the results of the main analysis. Meanwhile, the interaction coefficients between COSC and supplier environmental awareness, supplier environmental regulation stringency and supplier media coverage across columns (4)-(12) demonstrate the same analysis results as the main regression. These results also consistently support all the hypotheses proposed in this study.

*Alternative sub-samples.* Given that suppliers in the manufacturing industry are more active in eco-innovations, we segmented our sample to focus only on the manufacturing sector, thereby reducing noise in the analysis. Panel B of Table 4 shows the results of sub-sample regressions in only manufacturing sectors. Specifically, the coefficients in Columns (1)-(3) support the significantly negative influence of COSC on supplier eco-innovations ( $\beta_{(1)}=-0.166$ ,  $p<0.01$ ;  $\beta_{(2)}=-0.109$ ,  $p<0.01$ ;  $\beta_{(3)}=-0.097$ ,  $p<0.05$ ), confirming the results of the main analysis. Also, the interaction coefficients between COSC and supplier environmental awareness across columns (4)-(6), as well as the interaction coefficients between COSC and supplier environmental regulation across columns (7)-(9), are still consistent with the main regression results. However, the interaction terms between COSC and supplier media coverage in the manufacturing industry have no significant effect on supplier eco-innovations.

**[Insert Table 4 Here]**

*Endogeneity.* To mitigate the potential endogeneity that arises from the systematic differences between firms with COSC and other firms, we employ the propensity score matching (PSM) method to match COSC firms with non-COSC firms. This approach allows us to include some covariates that affect the probability of being a treated firm. Specifically, treatment and control groups were set according to whether the firm was under COSC. All control variables were used for 1:1 nearest neighbour matching. Panel A of Table 5 shows the results of PSM regressions. Specifically, the results across columns (1)-(3) support a negative and significant relationship between COSC and supplier eco-innovations ( $\beta_{(1)}=-0.198$ ,  $p<0.01$ ;  $\beta_{(2)}=-0.153$ ,  $p<0.01$ ;  $\beta_{(3)}=-0.095$ ,  $p<0.10$ ). In this sense, H1 is consistently supported.

We also conducted the Heckman two-stage procedure to overcome the potential endogeneity caused by sample selection bias. Specifically, we constructed the Probit regression model to calculate the Inverse Mills Ratio (*IMR*) using all control variables of the lag period and the independent variable of the current period. Then, we added it to the baseline model as a control variable for testing. Table 6 shows that the coefficients are negative and statistically significant ( $\beta_{(1)}=-0.147, p<0.05$ ;  $\beta_{(2)}=-0.080, p<0.10$ ;  $\beta_{(3)}=-0.107, p<0.10$ ), which are consistent with the main analysis results.

**[Insert Table 5 Here]**

#### **5.4 Further analysis**

So far, we have confirmed that the presence of COSC inhibits supplier eco-innovations. However, we still do not know whether such an effect impacts suppliers' achievement of net-zero goals and portfolio returns. Therefore, we will further explore the impact of COSC on suppliers' environmental and economic performance.

Referring to Haque and Ntim (2020), we use the natural logarithm of one plus the total carbon emissions as the proxy variable for suppliers' environmental performance (*Carbon*). Total carbon emissions are the sum of four dimensions: combustion and fugitive emissions, production process emissions, waste emissions, and emissions due to land use change (e.g., forest conversion to industrial land). Referring to Zheng and Iatridis (2022), we use profitability as the proxy variable for suppliers' economic performance (*Roa*). Then, the sample is divided into two groups of high and low supplier eco-innovations to explore the effect of COSC on suppliers' carbon emissions and firm value in period  $t+1$ . The results are shown in Table 6. Columns (1)-(2) present the effect of COSC on suppliers' environmental performance, while columns (3)-(4) further demonstrate the COSC effect on suppliers' economic performance. Specifically, the coefficient of *COSC\_dummy* is significantly positive in the low supplier eco-innovations group ( $\beta_{(2)} = 0.181, p < 0.01$ ;  $\beta_{(4)} = 0.014, p < 0.05$ ) and not statistically significant in the high supplier eco-innovations group. The result suggests that COSC inhibits supplier eco-innovations and increases their carbon emissions to maximise portfolio returns in the short term.

[Insert Table 6 Here]

## **6. Discussion and conclusion**

This study explores whether and how COSC affects supplier eco-innovations. Drawing upon two distinct theoretical dimensions from resource dependence theory (i.e., mutual dependence and power imbalance), we propose a set of competing hypotheses regarding the potentially positive or negative effect of COSC on supplier eco-innovations. The empirical analysis results lend more support to the hampering perspective that COSC significantly discourages supplier eco-innovations. More importantly, we further uncover that the negative effect of COSC on supplier eco-innovations disappears and can be converted into positive ones when suppliers have higher environmental awareness, encounter more stringent environmental regulations and receive intensified media coverage. Therefore, our study has essential and manifold theoretical and practical implications.

### **6.1 Theoretical implications**

First, we contribute to the emerging literature of common ownership by exploring the effects of COSC on supplier eco-innovations. Existing studies mainly concentrate on the bright sides of COSC, wherein COSC strengthens the buyer-supplier relationship and further improves suppliers' behaviours and performance, such as earning management, general innovation, operational efficiency, and trade credits (Chen, 2024; Gao et al., 2024; Tian, 2025; Tian et al., 2024; Yao et al., 2024). In doing so, COSC could yield maximised returns from firms in their supply chain portfolio. However, to the best of our knowledge, prior studies pay no attention to supplier eco-innovations, the importance of which has been widely acknowledged by facilitating the achievement of the net-zero goal as well as transitions towards the circular economy (de Jesus et al., 2019; de Jesus and Mendonça, 2018; Kiefer et al., 2021; Sehnem et al., 2022). Our analysis results uncover the role of COSC working as a form of “shadow governance” in affecting suppliers' environmentally responsible behaviours. One possible explanation for this finding could be the primary goal of COSC in seeking short-term profits. Occupying an essential position in the supply chain network, COSC acquires and leverages resources from both upstream suppliers and downstream buyers.

Such resource advantages give COSC the coercive power to influence and even control supplier behaviours. Considering the high risks and uncertain returns inherent in eco-innovation developments, COSC could implement coercive power to hamper supplier innovations by terminating any resource-providing, which is fatal to supplier eco-innovations. This finding extends DesJardine, Grewal, et al. (2023)'s conclusion from the vertical view of the supply chain that common owners prefer symbolic CSR practices to cope with external pressure instead of substantial ones that benefit the environment and society. Meanwhile, most prior studies are based on the empirical evidence from North America rather than emerging economies like China. Considering the role of world manufacturer that China plays in the global supply chain management and the rapid development of Chinese capital markets over the last decade, these findings above could deepen our understanding regarding how COSC influences supplier responsible behaviour in the specific context of circular transitions in emerging economies. To sum up, our study enriches the extant discussions by highlighting the downside of COSC in supplier eco-innovations and supplementing novel evidence from the emerging economy.

Second, this research contributes to the ongoing discussions regarding supplier eco-innovations within the context of the buyer-supplier relationship (Acebo et al., 2021; Hofman et al., 2020; Janahi et al., 2023; Song et al., 2023; Viale et al., 2022). Recent research recognised the essence of supplier eco-innovations that enable all actors in the supply chain to reduce their carbon emissions (Song et al., 2023). On the other hand, suppliers depend on reliable and stable relationships with buyers and other supply chain partners to acquire resources and capabilities for developing eco-innovations, such as market information, end-user feedback, specific technological investment, and technological solutions. However, prior studies indicate that downstream buyers or customers focus on market shares rather than genuinely addressing environmental issues, as overly radical supplier eco-innovations may alter end consumers' acceptance of new eco-technology-embedded products and expose buyer firms to a significant risk of losing market share. When confronted with the resource restrictions of COSC, our moderating analysis reveals the essential enablers of supplier autonomy (i.e., supplier environmental awareness) and legitimacy

that enhance supplier radical eco-innovations. These findings also echo existing arguments that social cognition capabilities can improve the firms' environmental orientation and motivate firms to devote more resources to substantial environmental practices (Demirel and Kesidou, 2019; Scarpellini et al., 2020; Shu et al., 2020). Therefore, we contribute to the literature on supply chain collaboration for developing eco-innovations by indicating the specific mechanisms wherein suppliers could effectively improve their eco-innovations outputs by countering resource dependence on buyers and COSC.

Third, this study also contributes to the theoretical extension of RDT. By extending RDT into a less-examined context of COSC, we answer the call of J. Wu et al. (2023) developed arguments regarding how COSC affects supplier eco-innovations from mutual dependence and power imbalance views. Drawing upon these two distinct dimensions of RDT, we provide balanced insights into the effects of COSC on supplier eco-innovations critically. Our results confirm that COSC inhibits supplier eco-innovations, propelling the applications of RDT in critically analysing how such a novel inter-organisational arrangement utilises its power imbalance to affect suppliers' decisions and behaviours. Moreover, we also apply theoretical constructs derived from RDT to explore how suppliers' internal autonomy and external legitimacy condition the effect of COSC on supplier eco-innovations, which has been overlooked by extant literature investigating common ownership influences. Thanks to the theoretical constructs of autonomy and legitimacy in RDT that may reduce firm resource dependency (Drees and Heugens, 2013), we find the hampering effects of COSC on supplier eco-innovations could be inverted into enhancing ones when suppliers have higher environmental awareness, more stringent environmental regulations and more media coverage. These findings conform to the ongoing discussions regarding the role of firms' internal environmental awareness (Demirel and Kesidou, 2019; Hofman et al., 2020; Liu et al., 2023; Pinkse et al., 2023) and external monitoring mechanisms in propelling eco-innovations (Gnekpe and Plantec, 2023; Janahi et al., 2023; Kiefer et al., 2021; Ren et al., 2023). In this sense, our study encourages future research to leverage RDT to explore further conditions that may curb the potential detrimental effects of COSC and other inter-organisational arrangements.

## 6.2 Practical implications

Our findings provide essential insights for suppliers prioritising eco-innovations to achieve the net-zero goal. As the shadow force hidden in the supply chain, COSC hampers supplier eco-innovations and increases carbon emissions. Suppliers should be cautious of their common ownership with buyers, primarily through improving their environmental awareness. For instance, upgrading environmental management systems (Shu et al., 2020) and adopting interactive communications (Liu et al., 2023) can equip suppliers with higher environmental awareness. Meanwhile, COSC should strategically prioritise sustainable investment by leveraging its pivotal position. Specifically, COSC, working as the supply chain orchestrator, could cultivate and deepen mutual dependence among supply chain target firms, thereby fostering eco-innovations rather than pursuing short-term profit maximisation. Such strategic reorientation would generate long-term returns, particularly as global capital markets increasingly focus on ESG initiatives, climate risk mitigation, and biodiversity conservation.

More importantly, our study also identifies two external monitoring mechanisms (i.e., stringent environmental regulations and intensified media coverage) that can mitigate the negative effects of COSC on supplier eco-innovations and even reverse them into positive outcomes. However, it is notable that these two are applicable external monitoring mechanisms. Specifically, our results indicate that stringent environmental regulations significantly promote radical eco-innovations by suppliers, whereas media coverage only improves incremental ones. This finding underscores the importance of adopting dynamic regulatory portfolios that integrate government mandates with market-based incentives to balance the influence of COSC on supplier eco-innovations. For example, policymakers could enact targeted environmental regulations to constrain the unsustainable practices of COSC, while media outlets could amplify scrutiny of their unethical behaviours. In doing so, external monitoring mechanisms could have real effects on spurring eco-innovations in the supply chain and further cope with the urgent need to achieve the net-zero goal.

### **6.3 Limitations and future research**

Akin to prior research, this paper also has several limitations that future studies could address. First, although we have examined how COSC affects supplier eco-innovations, future research could further extend our study by exploring the other potential influences of COSC on both buyer and supplier behaviours in the CE transition. Considering the vital positions COSC occupies in the supply chain networks, more recent research suggests that the potential asymmetry affects both buyers and suppliers. Thus, we encourage future research to delve into both the mutual dependence and power imbalance generated by COSC, getting more critically informed of such a novel inter-organisational arrangement. Second, we only identify three main contingent factors moderating the COSC and supplier eco-innovations relationship. Future studies could also employ RDT to explore further boundary conditions for the effects of COSC, which will provide more valuable and profound implications for CE transition. Finally, our samples are only based on the Chinese context. Although the Chinese context is unique and essential due to the role of the world factory as well as the urgency of carbon neutrality goals, collecting data from just one country may deprive the generalisation of our findings, especially considering the net-zero goal and CE transition across the world. Future studies could further test our arguments and conclusions by expanding the research contexts, especially by combining multinational data and evidence.

## References:

- Abdurakhmonov, M., Ridge, J. W., & Hill, A. D. (2021). Unpacking firm external dependence: How government contract dependence affects firm investments and market performance [Article]. *Academy of Management Journal*, 64(1), 327-350. <https://doi.org/10.5465/AMJ.2018.0067>
- Acebo, E., Miguel-Dávila, J. Á., & Nieto, M. (2021). External stakeholder engagement: Complementary and substitutive effects on firms' eco-innovation [Article]. *Business Strategy and the Environment*, 30(5), 2671-2687. <https://doi.org/10.1002/bse.2770>
- Acemoglu, D., Aghion, P., Bursztyn, L., & Hemous, D. (2012). The environment and directed technical change [Review]. *American Economic Review*, 102(1), 131-166. <https://doi.org/10.1257/aer.102.1.131>
- Ambulkar, S., Arunachalam, S., Bommaraju, R., & Ramaswami, S. (2023). Should a firm bring a supplier into the boardroom? [Article]. *Production and Operations Management*, 32(1), 28-44. <https://doi.org/10.1111/poms.13823>
- Bag, S., Dhamija, P., Bryde, D. J., & Singh, R. K. (2022). Effect of eco-innovation on green supply chain management, circular economy capability, and performance of small and medium enterprises [Article]. *Journal of Business Research*, 141, 60-72. <https://doi.org/10.1016/j.jbusres.2021.12.011>
- Bammens, Y., & Hünermund, P. (2020). Nonfinancial Considerations in Eco-Innovation Decisions: The Role of Family Ownership and Reputation Concerns [Article]. *Journal of Product Innovation Management*, 37(5), 431-453. <https://doi.org/10.1111/jpim.12550>
- Berrone, P., Fosfuri, A., Gelabert, L., & Gomez-Mejia, L. R. (2013). Necessity as the mother of 'green' inventions: Institutional pressures and environmental innovations [Article]. *Strategic Management Journal*, 34(8), 891-909. <https://doi.org/10.1002/smj.2041>
- Campbell, J. L. (2007). Why would corporations behave in socially responsible ways? An institutional theory of corporate social responsibility [Review]. *Academy of Management Review*, 32(3), 946-967. <https://doi.org/10.5465/AMR.2007.25275684>
- Cao, Z., Kim, D. Y., Mu, Y., & Singhal, V. (2024). Toward suppliers' corporate social responsibility performance: the role of relationship dependence [Article]. *International Journal of Operations and Production Management*, 44(2), 538-561. <https://doi.org/10.1108/IJOPM-08-2022-0540>
- Chen, D., Hu, N., Liang, P., & Swink, M. (2023). Understanding the impact of trade policy effect uncertainty on firm-level innovation investment [Article]. *Journal of Operations Management*. <https://doi.org/10.1002/joom.1285>
- Chen, J., Kim, S., Srinivasan, D., & Zhou, Y. (2024). Can Common Institutional Investors in Supply Chains Decode the Bullwhip Effect? Evidence From Order Backlog Mispricing [Article]. *Journal of Accounting, Auditing and Finance*. <https://doi.org/10.1177/0148558X241229508>
- Chen, X. (2024). Common ownership along the supply chain and supplier innovations [Article]. *Pacific Basin Finance Journal*, 87, Article 102478. <https://doi.org/10.1016/j.pacfin.2024.102478>

- Chen, X., Pan, X., & Sinha, P. (2022). What to green: Family involvement and different types of eco-innovation [Article]. *Business Strategy and the Environment*, 31(5), 2588-2602. <https://doi.org/10.1002/bse.3045>
- Chen, X., Yang, Y., & Wei, J. (2024). How do New Ventures Thrive in Ecosystem Venturing: The Impacts of Alliance Strategy and Technology Interdependence [Article]. *Journal of Management Studies*. <https://doi.org/10.1111/joms.13063>
- Chen, Y., & Cao, S. (2025). How customer digital orientation drives supplier green and low-carbon efforts: The roles of supplier dependence and common ownership [Article]. *International Journal of Production Economics*, 287, Article 109680. <https://doi.org/10.1016/j.ijpe.2025.109680>
- Cheung, Y. L., Haw, I. M., Hu, B., Swink, M., & Zhang, W. (2020). Common institutional investors and supplier performance in supply chains [Article]. *Journal of Operations Management*, 66(6), 670-696. <https://doi.org/10.1002/joom.1089>
- Colombo, L. A., Pansera, M., & Owen, R. (2019). The discourse of eco-innovation in the European Union: An analysis of the Eco-Innovation Action Plan and Horizon 2020 [Article]. *Journal of Cleaner Production*, 214, 653-665. <https://doi.org/10.1016/j.jclepro.2018.12.150>
- Cui, J., Dai, J., Wang, Z., & Zhao, X. (2022). Does environmental regulation induce green innovation? a panel study of Chinese listed firms [Article]. *Technological Forecasting and Social Change*, 176, Article 121492. <https://doi.org/10.1016/j.techfore.2022.121492>
- Dai, J., Cantor, D. E., & Montabon, F. L. (2015). How Environmental Management Competitive Pressure Affects a Focal Firm's Environmental Innovation Activities: A Green Supply Chain Perspective [Article]. *Journal of Business Logistics*, 36(3), 242-259. <https://doi.org/10.1111/jbl.12094>
- de Jesus, A., Antunes, P., Santos, R., & Mendonça, S. (2019). Eco-innovation pathways to a circular economy: Envisioning priorities through a Delphi approach [Article]. *Journal of Cleaner Production*, 228, 1494-1513. <https://doi.org/10.1016/j.jclepro.2019.04.049>
- de Jesus, A., & Mendonça, S. (2018). Lost in Transition? Drivers and Barriers in the Eco-innovation Road to the Circular Economy [Article]. *Ecological Economics*, 145, 75-89. <https://doi.org/10.1016/j.ecolecon.2017.08.001>
- Demirel, P., & Danisman, G. O. (2019). Eco-innovation and firm growth in the circular economy: Evidence from European small- and medium-sized enterprises [Article]. *Business Strategy and the Environment*, 28(8), 1608-1618. <https://doi.org/10.1002/bse.2336>
- Demirel, P., & Kesidou, E. (2019). Sustainability-oriented capabilities for eco-innovation: Meeting the regulatory, technology, and market demands [Article]. *Business Strategy and the Environment*, 28(5), 847-857. <https://doi.org/10.1002/bse.2286>
- DesJardine, M. R., Grewal, J., & Viswanathan, K. (2023). A Rising Tide Lifts All Boats: The Effects of Common Ownership on Corporate Social Responsibility [Article]. *Organization Science*, 34(5), 1716-1735. <https://doi.org/10.1287/orsc.2022.1620>

- DesJardine, M. R., Shi, W., & Cheng, X. (2023). The New Invisible Hand: How Common Owners Use the Media as a Strategic Tool [Article]. *Administrative Science Quarterly*, 68(4), 956-1007. <https://doi.org/10.1177/00018392231192863>
- Drees, J. M., & Heugens, P. P. M. (2013). Synthesizing and Extending Resource Dependence Theory: A Meta-Analysis [Article]. *Journal of Management*, 39(6), 1666-1698. <https://doi.org/10.1177/0149206312471391>
- Fan, Q., Wang, T., & Tang, L. (2022). Use or nonuse? The role of possessed power and realized power on innovation [Article]. *Journal of Purchasing and Supply Management*, 28(3), Article 100754. <https://doi.org/10.1016/j.pursup.2022.100754>
- Fang, S., & Zhang, R. Z. (2024). Vertical shareholding during supply chain shocks [Article]. *Economics Letters*, 235, Article 111566. <https://doi.org/10.1016/j.econlet.2024.111566>
- Feng, Y., & Zhu, Q. (2024). How do customers' environmental efforts diffuse to suppliers: the role of customers' characteristics and suppliers' digital technology capability [Article]. *International Journal of Operations and Production Management*. <https://doi.org/10.1108/IJOPM-08-2023-0668>
- Freeman, K. M. (2023). Overlapping Ownership Along the Supply Chain [Article]. *Journal of Financial and Quantitative Analysis*. <https://doi.org/10.1017/S0022109023001266>
- Gao, L., Han, J., Kim, J. B., & Pan, Z. (2024). Overlapping institutional ownership along the supply chain and earnings management of supplier firms [Article]. *Journal of Corporate Finance*, 84, Article 102520. <https://doi.org/10.1016/j.jcorpfin.2023.102520>
- García-Sánchez, I. M., Aibar-Guzmán, C., & Aibar-Guzmán, B. (2020). The effect of institutional ownership and ownership dispersion on eco-innovation [Article]. *Technological Forecasting and Social Change*, 158, Article 120173. <https://doi.org/10.1016/j.techfore.2020.120173>
- Gnekpe, C., & Plantec, Q. (2023). Regulatory push-pull and technological knowledge dynamics of circular economy innovation [Article]. *Technological Forecasting and Social Change*, 196, Article 122767. <https://doi.org/10.1016/j.techfore.2023.122767>
- Gorton, M., Kastenhofer, K., Lemke, F., Esquivel, L., & Nicolau, M. (2023). Resource Dependencies and the Legitimatization of Grocery Retailer's Social Evaluations of Suppliers [Article]. *Journal of Business Ethics*. <https://doi.org/10.1007/s10551-023-05509-7>
- Guo, B., Li, X., Liu, T., & Wu, D. (2023). Supplier-supplier coopetition and buyer innovation: a perspective of learning and competitive tension within the focal buyer's supplier network [Article]. *International Journal of Operations and Production Management*, 43(9), 1409-1433. <https://doi.org/10.1108/IJOPM-06-2022-0363>
- Haque, F., & Ntim, C. G. (2020). Executive Compensation, Sustainable Compensation Policy, Carbon Performance and Market Value [Article]. *British Journal of Management*, 31(3), 525-546. <https://doi.org/10.1111/1467-8551.12395>

- Hillman, A. J., Withers, M. C., & Collins, B. J. (2009). Resource dependence theory: A review [Review]. *Journal of Management*, 35(6), 1404-1427. <https://doi.org/10.1177/0149206309343469>
- Hofman, P. S., Blome, C., Schleper, M. C., & Subramanian, N. (2020). Supply chain collaboration and eco-innovations: An institutional perspective from China [Article]. *Business Strategy and the Environment*, 29(6), 2734-2754. <https://doi.org/10.1002/bse.2532>
- Horbach, J. (2008). Determinants of environmental innovation-New evidence from German panel data sources [Article]. *Research Policy*, 37(1), 163-173. <https://doi.org/10.1016/j.respol.2007.08.006>
- Jacobs, B. W., & Singhal, V. R. (2020). Shareholder Value Effects of the Volkswagen Emissions Scandal on the Automotive Ecosystem [Article]. *Production and Operations Management*, 29(10), 2230-2251. <https://doi.org/10.1111/poms.13228>
- Jajja, M. S. S., Kannan, V. R., Brah, S. A., & Hassan, S. Z. (2017). Linkages between firm innovation strategy, suppliers, product innovation, and business performance: Insights from resource dependence theory [Article]. *International Journal of Operations and Production Management*, 37(8), 1054-1075. <https://doi.org/10.1108/IJOPM-09-2014-0424>
- Janahi, N. A., Durugbo, C. M., & Al-Jayyousi, O. R. (2023). Critical network factors for eco-innovation in manufacturing: A Delphi study from a triple helix perspective [Article]. *Business Strategy and the Environment*, 32(6), 3649-3670. <https://doi.org/10.1002/bse.3320>
- Jang, I. J., Minnick, K., & Nemani, A. (2024). Safeguarding proprietary information in the supply chain and relationship-specific investments [Article]. *Financial Review*. <https://doi.org/10.1111/fire.12391>
- Kesidou, E., & Demirel, P. (2012). On the drivers of eco-innovations: Empirical evidence from the UK [Article]. *Research Policy*, 41(5), 862-870. <https://doi.org/10.1016/j.respol.2012.01.005>
- Kiefer, C. P., del Río, P., & Carrillo-Hermosilla, J. (2021). On the contribution of eco-innovation features to a circular economy: A microlevel quantitative approach [Article]. *Business Strategy and the Environment*, 30(4), 1531-1547. <https://doi.org/10.1002/bse.2688>
- Kiefer, C. P., González, P. D. R., & Carrillo-hermosilla, J. (2019). Drivers and barriers of eco-innovation types for sustainable transitions: A quantitative perspective [Article]. *Business Strategy and the Environment*, 28(1), 155-172. <https://doi.org/10.1002/bse.2246>
- Kim, D. Y., & Zhu, P. (2018). Supplier dependence and R&D intensity: The moderating role of network centrality and interconnectedness [Article]. *Journal of Operations Management*, 64, 7-18. <https://doi.org/10.1016/j.jom.2018.11.002>
- Kim, J. B., Li, L., Yu, Z., & Zhang, H. (2019). Local versus non-local effects of Chinese media and post-earnings announcement drift [Article]. *Journal of Banking and Finance*, 106, 82-92. <https://doi.org/10.1016/j.jbankfin.2019.05.008>
- Kochhar, R., & David, P. (1996). Institutional investors and firm innovation: A test of competing hypotheses [Article]. *Strategic Management Journal*, 17(1), 73-84. [https://doi.org/10.1002/\(sici\)1097-0266\(199601\)17:1<73::aid-smj795>3.3.co;2-e](https://doi.org/10.1002/(sici)1097-0266(199601)17:1<73::aid-smj795>3.3.co;2-e)

- Krolikowski, M., & Yuan, X. (2017). Friend or foe: Customer-supplier relationships and innovation [Article]. *Journal of Business Research*, 78, 53-68. <https://doi.org/10.1016/j.jbusres.2017.04.023>
- Li, M., Cao, G., Cui, L., Liu, X., & Dai, J. (2023). Examining how government subsidies influence firms' circular supply chain management: The role of eco-innovation and top management team [Article]. *International Journal of Production Economics*, 261, Article 108893. <https://doi.org/10.1016/j.ijpe.2023.108893>
- Lin, S., & Deng, J. (2024). Does supplier concentration impede firms' digital innovation? A resource dependence perspective [Article]. *International Journal of Production Economics*, 273, Article 109276. <https://doi.org/10.1016/j.ijpe.2024.109276>
- Liu, G., Aroean, L., & Ko, W. W. (2022). Power, shared goals and supplier flexibility: a study of the HUB-and-spoke supply chain [Article]. *International Journal of Operations and Production Management*, 42(2), 182-205. <https://doi.org/10.1108/IJOPM-08-2021-0538>
- Liu, Z., Han, S., Yao, M., Gupta, S., & Laguir, I. (2023). Exploring drivers of eco-innovation in manufacturing firms' circular economy transition: an awareness, motivation, capability perspective [Article]. *Annals of Operations Research*. <https://doi.org/10.1007/s10479-023-05473-5>
- Nili, Y., & Hwang, C. (2020). Shadow governance [Review]. *California Law Review*, 108(4), 1097-1146. <https://doi.org/10.15779/Z385D8NF8J>
- Pan, X., Sinha, P., & Chen, X. (2021). Corporate social responsibility and eco-innovation: The triple bottom line perspective [Article]. *Corporate Social Responsibility and Environmental Management*, 28(1), 214-228. <https://doi.org/10.1002/csr.2043>
- Pfeffer, J., & Salancik, G. R. (1978). *The External Control of Organizations: A Resource Dependence Perspective*.
- Pinkse, J., Demirel, P., & Marino, A. (2023). Unlocking innovation for net zero: constraints, enablers, and firm-level transition strategies [Article]. *Industry and Innovation*. <https://doi.org/10.1080/13662716.2023.2269112>
- Prado-Lorenzo, J. M., & Garcia-Sanchez, I. M. (2010). The Role of the Board of Directors in Disseminating Relevant Information on Greenhouse Gases [Article]. *Journal of Business Ethics*, 97(3), 391-424. <https://doi.org/10.1007/s10551-010-0515-0>
- Rehfeld, K. M., Rennings, K., & Ziegler, A. (2007). Integrated product policy and environmental product innovations: An empirical analysis [Article]. *Ecological Economics*, 61(1), 91-100. <https://doi.org/10.1016/j.ecolecon.2006.02.003>
- Ren, S., Huang, M., Liu, D., & Yan, J. (2023). Understanding the Impact of Mandatory CSR Disclosure on Green Innovation: Evidence from Chinese Listed Firms [Article]. *British Journal of Management*, 34(2), 576-594. <https://doi.org/10.1111/1467-8551.12609>
- Scarpellini, S., Valero-Gil, J., Moneva, J. M., & Andreaus, M. (2020). Environmental management capabilities for a "circular eco-innovation" [Article]. *Business Strategy and the Environment*, 29(5), 1850-1864. <https://doi.org/10.1002/bse.2472>

- Sehnm, S., de Queiroz, A. A. F. S. L., Pereira, S. C. F., dos Santos Correia, G., & Kuzma, E. (2022). Circular economy and innovation: A look from the perspective of organizational capabilities [Article]. *Business Strategy and the Environment*, 31(1), 236-250. <https://doi.org/10.1002/bse.2884>
- Shu, C., Zhao, M., Liu, J., & Lindsay, W. (2020). Why firms go green and how green impacts financial and innovation performance differently: An awareness-motivation-capability perspective [Article]. *Asia Pacific Journal of Management*, 37(3), 795-821. <https://doi.org/10.1007/s10490-018-9630-8>
- Song, S., Dong, Y., Kull, T., Carter, C., & Xu, K. (2023). Supply chain leakage of greenhouse gas emissions and supplier innovation [Article]. *Production and Operations Management*, 32(3), 882-903. <https://doi.org/10.1111/poms.13904>
- Tang, Z., & Tang, J. (2016). Can the Media Discipline Chinese Firms' Pollution Behaviors? The Mediating Effects of the Public and Government [Article]. *Journal of Management*, 42(6), 1700-1722. <https://doi.org/10.1177/0149206313515522>
- Tian, H. (2025). Vertical common ownership, supply chain relationship and expected crash risk [Article]. *International Journal of Operations and Production Management*. <https://doi.org/10.1108/IJOPM-02-2024-0150>
- Tian, H., Wang, J., & Wu, S. (2024). Supply chain vertical common ownership and cost of loans [Article]. *Journal of Corporate Finance*, 89, Article 102677. <https://doi.org/10.1016/j.jcorpfin.2024.102677>
- Triguero, Á., Cuerva, M. C., & Sáez-Martínez, F. J. (2022). Closing the loop through eco-innovation by European firms: Circular economy for sustainable development [Article]. *Business Strategy and the Environment*, 31(5), 2337-2350. <https://doi.org/10.1002/bse.3024>
- Viale, L., Vacher, S., & Bessouat, J. (2022). Eco-innovation in the upstream supply chain: re-thinking the involvement of purchasing managers [Article]. *Supply Chain Management*, 27(2), 250-264. <https://doi.org/10.1108/SCM-11-2020-0591>
- Wang, H., Masi, D., Dhamotharan, L., Day, S., Kumar, A., Li, T., & Singh, G. (2022). Unconventional path dependence: How adopting product take-back and recycling systems contributes to future eco-innovations [Article]. *Journal of Business Research*, 142, 707-717. <https://doi.org/10.1016/j.jbusres.2021.12.057>
- Wu, J., Yu, L., & Khan, Z. (2023). How Do Mutual Dependence and Power Imbalance Condition the Effects of Technological Similarity on Post-acquisition Innovation Performance Over Time? [Article]. *British Journal of Management*, 34(1), 195-219. <https://doi.org/10.1111/1467-8551.12575>
- Wu, X., Li, Y., & Feng, C. (2023). Green innovation peer effects in common institutional ownership networks [Article]. *Corporate Social Responsibility and Environmental Management*, 30(2), 641-660. <https://doi.org/10.1002/csr.2379>
- Xu, Y. (2023). Common ownership along supply chain and trade credit: Evidence from China [Article]. *Finance Research Letters*, 56, Article 104111. <https://doi.org/10.1016/j.frl.2023.104111>

- Yao, S., Guo, X., Sensoy, A., Goodell, J. W., & Cheng, F. (2024). Collusion or governance? Common ownership and corporate risk-taking [Article]. *Corporate Governance: An International Review*, 32(4), 645-669. <https://doi.org/10.1111/corg.12562>
- Ye, C., & Yu, L. H. (2024). Common Ownership and Goodwill Impairments [Article]. *Corporate Governance: An International Review*, 32(6), 1016-1034. <https://doi.org/10.1111/corg.12581>
- Yousaf, U. B., Tauni, M. Z., Yousaf, I., & Su, N. L. (2023). Board competence and green innovation—Does external governance matter? [Article]. *Business Strategy and the Environment*. <https://doi.org/10.1002/bse.3641>
- Zheng, L., & Iatridis, K. (2022). Friends or foes? A systematic literature review and meta-analysis of the relationship between eco-innovation and firm performance [Article]. *Business Strategy and the Environment*, 31(4), 1838-1855. <https://doi.org/10.1002/bse.2986>
- Zubeltzu-Jaka, E., Erauskin-Tolosa, A., & Heras-Saizarbitoria, I. (2018). Shedding light on the determinants of eco-innovation: A meta-analytic study [Article]. *Business Strategy and the Environment*, 27(7), 1093-1103. <https://doi.org/10.1002/bse.2054>
- Zyglidopoulos, S. C., Georgiadis, A. P., Carroll, C. E., & Siegel, D. S. (2012). Does media attention drive corporate social responsibility? [Article]. *Journal of Business Research*, 65(11), 1622-1627. <https://doi.org/10.1016/j.jbusres.2011.10.021>

**Table 1 Variable definition and measurement**

| Variable                               | Symbol            | Measurement                                                                               | Data source                                      |
|----------------------------------------|-------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------|
| <i>Dependent variables</i>             |                   |                                                                                           |                                                  |
| Supplier eco-innovations (total)       | <i>SEI_ttl</i>    | The natural logarithm of one plus the number of supplier ecological patents.              | Chinese Research Data Services Platform (CNRDS)  |
| Supplier eco-innovations (radical)     | <i>SEI_radi</i>   | The natural logarithm of one plus the number of ecological invention patents.             |                                                  |
| Supplier eco-innovations (incremental) | <i>SEI_incre</i>  | The natural logarithm of the number of one plus ecological utility patents.               |                                                  |
| <i>Independent variables</i>           |                   |                                                                                           |                                                  |
| COSC                                   | <i>COSC_dummy</i> | Whether there is an overlap between the top 10 shareholders of the supplier and the buyer | China Stock Market & Accounting Research (CSMAR) |
| <i>Moderator variables</i>             |                   |                                                                                           |                                                  |
| Supplier environmental awareness       | <i>SEA</i>        | The number of environmental cognition keywords / the total number of keywords in MD&A     | WinGo Textual Analytic Database                  |
| Supplier media coverage                | <i>MC</i>         | The natural logarithm of one plus the number of supplier news coverage                    | CNRDS                                            |

|                                   |           |                                                                |       |
|-----------------------------------|-----------|----------------------------------------------------------------|-------|
| Supplier environmental regulation | <i>ER</i> | Whether the firm enlisted in the CPA programme during the year | CSMAR |
|-----------------------------------|-----------|----------------------------------------------------------------|-------|

***Control variables***

|                              |               |                                                                         |       |
|------------------------------|---------------|-------------------------------------------------------------------------|-------|
| Firm size                    | <i>Size</i>   | The natural logarithm of one plus total assets.                         |       |
| Leverage                     | <i>Lev</i>    | Total liabilities/total assets                                          |       |
| Growth                       | <i>Growth</i> | The annual growth rate of firms' revenue                                |       |
| Profitability                | <i>Roa</i>    | Net income/total assets                                                 |       |
| Ownership concentration      | <i>Top1</i>   | The percentage of the largest shareholder holdings                      | CSMAR |
| Institutional ownership      | <i>Inst</i>   | The percentage of institutional investors' holdings                     |       |
| The nature of property right | <i>Soe</i>    | If the firm is state-owned, the value is 1; 0 otherwise                 |       |
| Board numbers                | <i>Board</i>  | The natural logarithm of one plus board numbers                         |       |
| Board independence           | <i>Indep</i>  | The number of independent directors/total number of directors           |       |
| The existence of dual roles  | <i>Dual</i>   | If the board chairman and CEO are the same, the value is 1; 0 otherwise |       |

---

**Table 2 Descriptive statistics and correlation matrix**

| Variables         | N     | Mean   | SD    | <i>SEI_ttl</i> | <i>SEI_radi</i> | <i>SEI_incre</i> | <i>COSC_dummy</i> | <i>Size</i> | <i>Lev</i> | <i>Growth</i> | <i>Roa</i> | <i>Top1</i> | <i>Inst</i> | <i>Soe</i> | <i>Board</i> | <i>Indep</i> | <i>Dual</i> |
|-------------------|-------|--------|-------|----------------|-----------------|------------------|-------------------|-------------|------------|---------------|------------|-------------|-------------|------------|--------------|--------------|-------------|
| <i>SEI_ttl</i>    | 1,841 | 0.417  | 0.573 | 1              |                 |                  |                   |             |            |               |            |             |             |            |              |              |             |
| <i>SEI_radi</i>   | 1,841 | 0.249  | 0.407 | 0.899***       | 1               |                  |                   |             |            |               |            |             |             |            |              |              |             |
| <i>SEI_incre</i>  | 1,841 | 0.255  | 0.415 | 0.891***       | 0.633***        | 1                |                   |             |            |               |            |             |             |            |              |              |             |
| <i>COSC_dummy</i> | 1,841 | 0.116  | 0.320 | 0.020          | 0.0240          | 0.016            | 1                 |             |            |               |            |             |             |            |              |              |             |
| <i>Size</i>       | 1,841 | 21.786 | 1.202 | 0.271***       | 0.259***        | 0.237***         | 0.257***          | 1           |            |               |            |             |             |            |              |              |             |
| <i>Lev</i>        | 1,841 | 0.410  | 0.224 | 0.059**        | 0.052**         | 0.064***         | 0.073***          | 0.420***    | 1          |               |            |             |             |            |              |              |             |
| <i>Growth</i>     | 1,841 | 0.304  | 0.706 | 0              | 0.022           | -0.023           | 0.021             | -0.044*     | 0.009      | 1             |            |             |             |            |              |              |             |
| <i>Roa</i>        | 1,841 | 0.036  | 0.070 | 0.044*         | 0.040*          | 0.027            | 0.029             | -0.010      | -0.451***  | 0.018         | 1          |             |             |            |              |              |             |
| <i>Top1</i>       | 1,841 | 0.354  | 0.150 | 0.083***       | 0.083***        | 0.079***         | 0.123***          | 0.224***    | -0.029     | 0.006         | 0.151***   | 1           |             |            |              |              |             |
| <i>Inst</i>       | 1,841 | 0.455  | 0.252 | 0.092***       | 0.085***        | 0.096***         | 0.155***          | 0.388***    | 0.158***   | -0.039*       | 0.113***   | 0.512***    | 1           |            |              |              |             |
| <i>Soe</i>        | 1,841 | 0.392  | 0.488 | 0.091***       | 0.085***        | 0.079***         | 0.190***          | 0.421***    | 0.335***   | -0.026        | -0.101***  | 0.231***    | 0.443***    | 1          |              |              |             |
| <i>Board</i>      | 1,841 | 8.891  | 1.630 | 0.068***       | 0.063***        | 0.058**          | 0.100***          | 0.253***    | 0.125***   | -0.064***     | -0.003     | 0.053**     | 0.230***    | 0.303***   | 1            |              |             |
| <i>Indep</i>      | 1,841 | 0.369  | 0.052 | 0.041*         | 0.051**         | 0.015            | -0.053**          | 0.021       | 0.015      | 0.003         | -0.006     | 0.012       | -0.105***   | -0.080***  | -0.426***    | 1            |             |
| <i>Dual</i>       | 1,841 | 0.239  | 0.427 | -0.015         | 0.016           | -0.054**         | -0.087***         | -0.197***   | -0.200***  | -0.005        | 0.083***   | -0.048**    | -0.216***   | -0.277***  | -0.201***    | 0.161***     | 1           |

Note: This table shows the Pearson correlation coefficients. Statistical significance at the 10%, 5%, and 1% levels are indicated by \*, \*\*, and \*\*\*, respectively

Table 3 Regression results

|                                | Model 1 (H1)    |                 |                  | Model 2 (H2)     |                  |                  | Model 3 (H3)     |                  |                  | Model 4 (H4)    |                 |                  |
|--------------------------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-----------------|-----------------|------------------|
|                                | <i>SEI_ttl</i>  | <i>SEI_radi</i> | <i>SEI_incre</i> | <i>SEI_ttl</i>   | <i>SEI_radi</i>  | <i>SEI_incre</i> | <i>SEI_ttl</i>   | <i>SEI_radi</i>  | <i>SEI_incre</i> | <i>SEI_ttl</i>  | <i>SEI_radi</i> | <i>SEI_incre</i> |
|                                | (1)             | (2)             | (3)              | (4)              | (5)              | (6)              | (7)              | (8)              | (9)              | (10)            | (11)            | (12)             |
| <i>COSC_dummy</i>              | <b>-0.106**</b> | <b>-0.070**</b> | <b>-0.064**</b>  | <b>-0.291***</b> | <b>-0.280***</b> | <b>-0.077</b>    | <b>-0.200***</b> | <b>-0.150***</b> | <b>-0.098**</b>  | <b>-0.517**</b> | <b>-0.315**</b> | <b>-0.341**</b>  |
|                                | (-2.479)        | (-2.228)        | (-2.003)         | (-2.587)         | (-3.421)         | (-0.934)         | (-3.928)         | (-4.274)         | (-2.570)         | (-2.489)        | (-2.107)        | (-2.190)         |
| <i>SEA</i>                     |                 |                 |                  | 0.050**          | 0.025            | 0.046***         |                  |                  |                  |                 |                 |                  |
|                                |                 |                 |                  | (2.078)          | (1.422)          | (2.604)          |                  |                  |                  |                 |                 |                  |
| <i>COSC_dummy</i> × <i>SEA</i> |                 |                 |                  | <b>0.095*</b>    | <b>0.105**</b>   | <b>0.008</b>     |                  |                  |                  |                 |                 |                  |
|                                |                 |                 |                  | (1.663)          | (2.468)          | (0.187)          |                  |                  |                  |                 |                 |                  |
| <i>ER</i>                      |                 |                 |                  |                  |                  |                  | -0.213***        | -0.127***        | -0.154***        |                 |                 |                  |
|                                |                 |                 |                  |                  |                  |                  | (-6.559)         | (-5.439)         | (-6.330)         |                 |                 |                  |
| <i>COSC_dummy</i> × <i>ER</i>  |                 |                 |                  |                  |                  |                  | <b>0.207**</b>   | <b>0.179***</b>  | <b>0.073</b>     |                 |                 |                  |
|                                |                 |                 |                  |                  |                  |                  | (2.402)          | (2.826)          | (1.135)          |                 |                 |                  |
| <i>MC</i>                      |                 |                 |                  |                  |                  |                  |                  |                  |                  | 0.038**         | 0.040***        | 0.011            |
|                                |                 |                 |                  |                  |                  |                  |                  |                  |                  | (2.007)         | (2.935)         | (0.815)          |
| <i>COSC_dummy</i> × <i>MC</i>  |                 |                 |                  |                  |                  |                  |                  |                  |                  | <b>0.083*</b>   | <b>0.050</b>    | <b>0.056*</b>    |
|                                |                 |                 |                  |                  |                  |                  |                  |                  |                  | (1.921)         | (1.568)         | (1.711)          |
| <i>Size</i>                    | 0.141***        | 0.097***        | 0.085***         | 0.135***         | 0.093***         | 0.083***         | 0.149***         | 0.101***         | 0.092***         | 0.125***        | 0.083***        | 0.079***         |
|                                | (9.564)         | (8.875)         | (7.795)          | (8.399)          | (7.713)          | (6.963)          | (10.075)         | (9.229)          | (8.401)          | (8.356)         | (7.486)         | (7.080)          |
| <i>Lev</i>                     | -0.040          | -0.025          | -0.019           | -0.047           | -0.034           | -0.027           | -0.027           | -0.019           | -0.008           | -0.039          | -0.025          | -0.018           |

|                              |           |           |           |           |           |           |           |           |           |           |           |           |
|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                              | (-0.524)  | (-0.444)  | (-0.358)  | (-0.567)  | (-0.553)  | (-0.462)  | (-0.362)  | (-0.341)  | (-0.146)  | (-0.509)  | (-0.439)  | (-0.337)  |
| <i>Growth</i>                | 0.024     | 0.022     | 0.009     | 0.029     | 0.027*    | 0.012     | 0.013     | 0.016     | 0.001     | 0.023     | 0.021     | 0.009     |
|                              | (1.390)   | (1.643)   | (0.790)   | (1.553)   | (1.892)   | (0.914)   | (0.793)   | (1.200)   | (0.115)   | (1.325)   | (1.574)   | (0.743)   |
| <i>Roa</i>                   | 0.392*    | 0.193     | 0.250     | 0.357     | 0.167     | 0.232     | 0.393*    | 0.196     | 0.247*    | 0.367*    | 0.169     | 0.242     |
|                              | (1.781)   | (1.199)   | (1.640)   | (1.439)   | (0.918)   | (1.366)   | (1.816)   | (1.239)   | (1.649)   | (1.665)   | (1.046)   | (1.588)   |
| <i>Top1</i>                  | 0.167     | 0.119     | 0.104     | 0.198*    | 0.130     | 0.141     | 0.185*    | 0.129     | 0.119     | 0.200*    | 0.152*    | 0.115     |
|                              | (1.553)   | (1.505)   | (1.287)   | (1.694)   | (1.507)   | (1.612)   | (1.744)   | (1.635)   | (1.494)   | (1.842)   | (1.907)   | (1.413)   |
| <i>Inst</i>                  | 0.041     | 0.049     | 0.028     | 0.059     | 0.067     | 0.039     | 0.038     | 0.048     | 0.024     | 0.026     | 0.031     | 0.024     |
|                              | (0.617)   | (1.019)   | (0.566)   | (0.819)   | (1.315)   | (0.721)   | (0.579)   | (1.019)   | (0.489)   | (0.385)   | (0.650)   | (0.490)   |
| <i>Soe</i>                   | 0.045     | 0.032     | 0.012     | 0.044     | 0.028     | 0.012     | 0.059*    | 0.042     | 0.021     | 0.050     | 0.037     | 0.014     |
|                              | (1.300)   | (1.235)   | (0.462)   | (1.175)   | (0.989)   | (0.437)   | (1.738)   | (1.631)   | (0.811)   | (1.453)   | (1.426)   | (0.538)   |
| <i>Board</i>                 | 0.009     | 0.009     | -0.000    | 0.006     | 0.009     | -0.006    | 0.011     | 0.009     | 0.001     | 0.009     | 0.008     | -0.001    |
|                              | (0.902)   | (1.112)   | (-0.020)  | (0.537)   | (0.971)   | (-0.665)  | (1.051)   | (1.194)   | (0.165)   | (0.817)   | (1.018)   | (-0.068)  |
| <i>Indep</i>                 | 0.267     | 0.267     | -0.019    | 0.279     | 0.345     | -0.093    | 0.186     | 0.218     | -0.075    | 0.208     | 0.213     | -0.043    |
|                              | (0.919)   | (1.198)   | (-0.088)  | (0.864)   | (1.381)   | (-0.395)  | (0.649)   | (0.985)   | (-0.354)  | (0.708)   | (0.948)   | (-0.199)  |
| <i>Dual</i>                  | 0.026     | 0.049**   | -0.023    | 0.021     | 0.050*    | -0.029    | 0.037     | 0.057**   | -0.015    | 0.020     | 0.046*    | -0.026    |
|                              | (0.789)   | (2.088)   | (-0.956)  | (0.592)   | (1.930)   | (-1.128)  | (1.165)   | (2.430)   | (-0.659)  | (0.617)   | (1.937)   | (-1.102)  |
| <i>Constant</i>              | -3.852*** | -2.694*** | -2.210*** | -3.258*** | -2.345*** | -1.852*** | -3.933*** | -2.715*** | -2.306*** | -3.611*** | -2.481*** | -2.106*** |
|                              | (-10.882) | (-9.915)  | (-8.803)  | (-9.417)  | (-8.899)  | (-7.176)  | (-10.540) | (-9.661)  | (-8.711)  | (-10.028) | (-8.906)  | (-8.332)  |
| <i>Industry fixed effect</i> | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       |
| <i>Year fixed effect</i>     | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       |
| Observations                 | 1,841     | 1,841     | 1,841     | 1,590     | 1,590     | 1,590     | 1,841     | 1,841     | 1,841     | 1,837     | 1,837     | 1,837     |

|           |       |       |       |       |       |       |       |       |       |       |       |       |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| R-squared | 0.190 | 0.173 | 0.156 | 0.193 | 0.179 | 0.163 | 0.209 | 0.187 | 0.175 | 0.194 | 0.179 | 0.159 |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

---

Note: T-values in parentheses. Statistical significance levels: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.10. Robust standard errors adjusting for firm clustering.

Table 4 Robustness check results for alternative measures and sub-samples

|                                             | Model 1 (H1)                       |                                   |                                    | Model 2 (H2)                    |                                  |                                | Model 3 (H3)                     |                                   |                                | Model 4 (H4)                     |                                  |                                  |
|---------------------------------------------|------------------------------------|-----------------------------------|------------------------------------|---------------------------------|----------------------------------|--------------------------------|----------------------------------|-----------------------------------|--------------------------------|----------------------------------|----------------------------------|----------------------------------|
|                                             | <i>SEI_ttl</i>                     | <i>SEI_radi</i>                   | <i>SEI_incre</i>                   | <i>SEI_ttl</i>                  | <i>SEI_radi</i>                  | <i>SEI_incre</i>               | <i>SEI_ttl</i>                   | <i>SEI_radi</i>                   | <i>SEI_incre</i>               | <i>SEI_ttl</i>                   | <i>SEI_radi</i>                  | <i>SEI_incre</i>                 |
|                                             | (1)                                | (2)                               | (3)                                | (4)                             | (5)                              | (6)                            | (7)                              | (8)                               | (9)                            | (10)                             | (11)                             | (12)                             |
| <i>Panel A: Alternative measure of COSC</i> |                                    |                                   |                                    |                                 |                                  |                                |                                  |                                   |                                |                                  |                                  |                                  |
| <i>COSC_Num</i>                             | <b>-0.071**</b><br><b>(-2.043)</b> | <b>-0.046*</b><br><b>(-1.705)</b> | <b>-0.050**</b><br><b>(-1.972)</b> | -0.254**<br>(-2.574)            | -0.237***<br>(-3.279)            | -0.068<br>(-0.966)             | -0.157***<br>(-3.514)            | -0.111***<br>(-3.462)             | -0.080**<br>(-2.437)           | -0.474***<br>(-2.849)            | -0.311**<br>(-2.573)             | -0.302**<br>(-2.480)             |
| <i>SEA</i>                                  |                                    |                                   |                                    | 0.049**<br>(2.051)              | 0.024<br>(1.405)                 | 0.046***<br>(2.595)            |                                  |                                   |                                |                                  |                                  |                                  |
| <i>COSC_Num</i> × <i>SEA</i>                |                                    |                                   |                                    | <b>0.087*</b><br><b>(1.819)</b> | <b>0.093**</b><br><b>(2.559)</b> | <b>0.009</b><br><b>(0.275)</b> |                                  |                                   |                                |                                  |                                  |                                  |
| <i>ER</i>                                   |                                    |                                   |                                    |                                 |                                  |                                | -0.213***<br>(-6.566)            | -0.126***<br>(-5.408)             | -0.154***<br>(-6.332)          |                                  |                                  |                                  |
| <i>COSC_Num</i> × <i>ER</i>                 |                                    |                                   |                                    |                                 |                                  |                                | <b>0.165**</b><br><b>(2.405)</b> | <b>0.138***</b><br><b>(2.654)</b> | <b>0.054</b><br><b>(1.078)</b> |                                  |                                  |                                  |
| <i>MC</i>                                   |                                    |                                   |                                    |                                 |                                  |                                |                                  |                                   |                                | 0.037**<br>(1.964)               | 0.039***<br>(2.868)              | 0.011<br>(0.792)                 |
| <i>COSC_Num</i> × <i>MC</i>                 |                                    |                                   |                                    |                                 |                                  |                                |                                  |                                   |                                | <b>0.080**</b><br><b>(2.308)</b> | <b>0.054**</b><br><b>(2.102)</b> | <b>0.050**</b><br><b>(1.963)</b> |
| <i>Controls</i>                             | Yes                                | Yes                               | Yes                                | Yes                             | Yes                              | Yes                            | Yes                              | Yes                               | Yes                            | Yes                              | Yes                              | Yes                              |
| <i>Industry fixed effect</i>                | Yes                                | Yes                               | Yes                                | Yes                             | Yes                              | Yes                            | Yes                              | Yes                               | Yes                            | Yes                              | Yes                              | Yes                              |

|                                                |                  |                  |                 |                |                |                |                 |                 |                 |                |                |                 |
|------------------------------------------------|------------------|------------------|-----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|
| <i>Year fixed effect</i>                       | Yes              | Yes              | Yes             | Yes            | Yes            | Yes            | Yes             | Yes             | Yes             | Yes            | Yes            | Yes             |
| Observations                                   | 1,841            | 1,841            | 1,841           | 1,590          | 1,590          | 1,590          | 1,841           | 1,841           | 1,841           | 1,837          | 1,837          | 1,837           |
| R-squared                                      | 0.189            | 0.171            | 0.156           | 0.193          | 0.179          | 0.163          | 0.209           | 0.186           | 0.175           | 0.195          | 0.179          | 0.159           |
| <b><i>Panel B: Alternative sub-samples</i></b> |                  |                  |                 |                |                |                |                 |                 |                 |                |                |                 |
| <i>COSC_dummy</i>                              | <b>-0.166***</b> | <b>-0.109***</b> | <b>-0.097**</b> | -0.437**       | -0.388***      | -0.139         | -0.371***       | -0.247***       | -0.211***       | -0.187         | -0.105         | -0.094          |
|                                                | <b>(-2.774)</b>  | <b>(-2.624)</b>  | <b>(-2.108)</b> | (-2.207)       | (-3.111)       | (-0.890)       | (-5.049)        | (-5.453)        | (-3.665)        | (-0.642)       | (-0.503)       | (-0.412)        |
| <i>SEA</i>                                     |                  |                  |                 | 0.015          | 0.000          | 0.020          |                 |                 |                 |                |                |                 |
|                                                |                  |                  |                 | (0.537)        | (0.020)        | (0.961)        |                 |                 |                 |                |                |                 |
| <i>COSC_dummy×SEA</i>                          |                  |                  |                 | <b>0.119*</b>  | <b>0.126**</b> | <b>0.010</b>   |                 |                 |                 |                |                |                 |
|                                                |                  |                  |                 | <b>(1.733)</b> | <b>(2.091)</b> | <b>(0.142)</b> |                 |                 |                 |                |                |                 |
| <i>ER</i>                                      |                  |                  |                 |                |                |                | -0.227***       | -0.135***       | -0.163***       |                |                |                 |
|                                                |                  |                  |                 |                |                |                | (-6.796)        | (-5.615)        | (-6.476)        |                |                |                 |
| <i>COSC_dummy×ER</i>                           |                  |                  |                 |                |                |                | <b>0.414***</b> | <b>0.280***</b> | <b>0.231***</b> |                |                |                 |
|                                                |                  |                  |                 |                |                |                | <b>(3.646)</b>  | <b>(3.475)</b>  | <b>(2.624)</b>  |                |                |                 |
| <i>MC</i>                                      |                  |                  |                 |                |                |                |                 |                 |                 | 0.044*         | 0.046***       | 0.013           |
|                                                |                  |                  |                 |                |                |                |                 |                 |                 | (1.857)        | (2.684)        | (0.757)         |
| <i>COSC_dummy×MC</i>                           |                  |                  |                 |                |                |                |                 |                 |                 | <b>0.006</b>   | <b>0.001</b>   | <b>-0.000</b>   |
|                                                |                  |                  |                 |                |                |                |                 |                 |                 | <b>(0.093)</b> | <b>(0.011)</b> | <b>(-0.000)</b> |
| <i>Controls</i>                                | Yes              | Yes              | Yes             | Yes            | Yes            | Yes            | Yes             | Yes             | Yes             | Yes            | Yes            | Yes             |
| <i>Industry fixed effect</i>                   | Yes              | Yes              | Yes             | Yes            | Yes            | Yes            | Yes             | Yes             | Yes             | Yes            | Yes            | Yes             |
| <i>Year fixed effect</i>                       | Yes              | Yes              | Yes             | Yes            | Yes            | Yes            | Yes             | Yes             | Yes             | Yes            | Yes            | Yes             |

|              |       |       |       |       |       |       |       |       |       |       |       |       |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Observations | 1,207 | 1,207 | 1,207 | 1,030 | 1,030 | 1,030 | 1,207 | 1,207 | 1,207 | 1,203 | 1,203 | 1,203 |
| R-squared    | 0.123 | 0.112 | 0.094 | 0.122 | 0.117 | 0.091 | 0.157 | 0.137 | 0.124 | 0.126 | 0.118 | 0.095 |

---

Note: T-values in parentheses. Statistical significance levels: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.10. Robust standard errors adjusting for firm clustering.

**Table 5 The results of propensity score matching method and Heckman two-stage procedure**

|                                                            | <i>SEI_ttl</i>                                 | <i>SEI_radi</i>                                | <i>SEI_incre</i>                               |
|------------------------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|
|                                                            | (1)                                            | (2)                                            | (3)                                            |
| <b><i>Panel A: PSM results</i></b>                         |                                                |                                                |                                                |
| <i>COSC_dummy</i>                                          | <b>-0.198<sup>***</sup></b><br><b>(-3.013)</b> | <b>-0.153<sup>***</sup></b><br><b>(-3.026)</b> | <b>-0.095<sup>*</sup></b><br><b>(-1.947)</b>   |
| <i>Controls</i>                                            | Yes                                            | Yes                                            | Yes                                            |
| <i>Industry fixed effect</i>                               | Yes                                            | Yes                                            | Yes                                            |
| <i>Year fixed effect</i>                                   | Yes                                            | Yes                                            | Yes                                            |
| Observations                                               | 365                                            | 365                                            | 365                                            |
| R-squared                                                  | 0.328                                          | 0.311                                          | 0.271                                          |
| <b><i>Panel B: Heckman two-stage procedure results</i></b> |                                                |                                                |                                                |
| <i>COSC_dummy</i>                                          | <b>-0.147<sup>**</sup></b><br><b>(-2.538)</b>  | <b>-0.080<sup>*</sup></b><br><b>(-1.800)</b>   | <b>-0.107<sup>***</sup></b><br><b>(-2.639)</b> |
| <i>IMR</i>                                                 | 0.086<br>(0.595)                               | 0.061<br>(0.551)                               | 0.080<br>(0.820)                               |
| <i>Constant</i>                                            | <b>-4.045<sup>***</sup></b><br><b>(-4.326)</b> | <b>-2.962<sup>***</sup></b><br><b>(-3.968)</b> | <b>-2.264<sup>***</sup></b><br><b>(-3.714)</b> |

|                              |       |       |       |
|------------------------------|-------|-------|-------|
| <i>Control Variables</i>     | Yes   | Yes   | Yes   |
| <i>Industry fixed effect</i> | Yes   | Yes   | Yes   |
| <i>Year fixed effect</i>     | Yes   | Yes   | Yes   |
| Observations                 | 793   | 793   | 793   |
| R-squared                    | 0.209 | 0.180 | 0.174 |

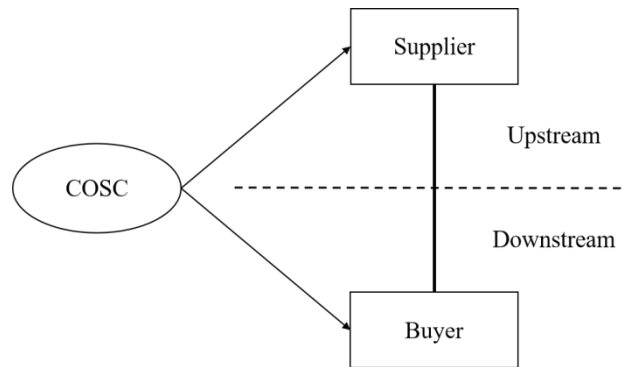
---

Note: T-values in parentheses. Statistical significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ . Robust standard errors adjusting for firm clustering.

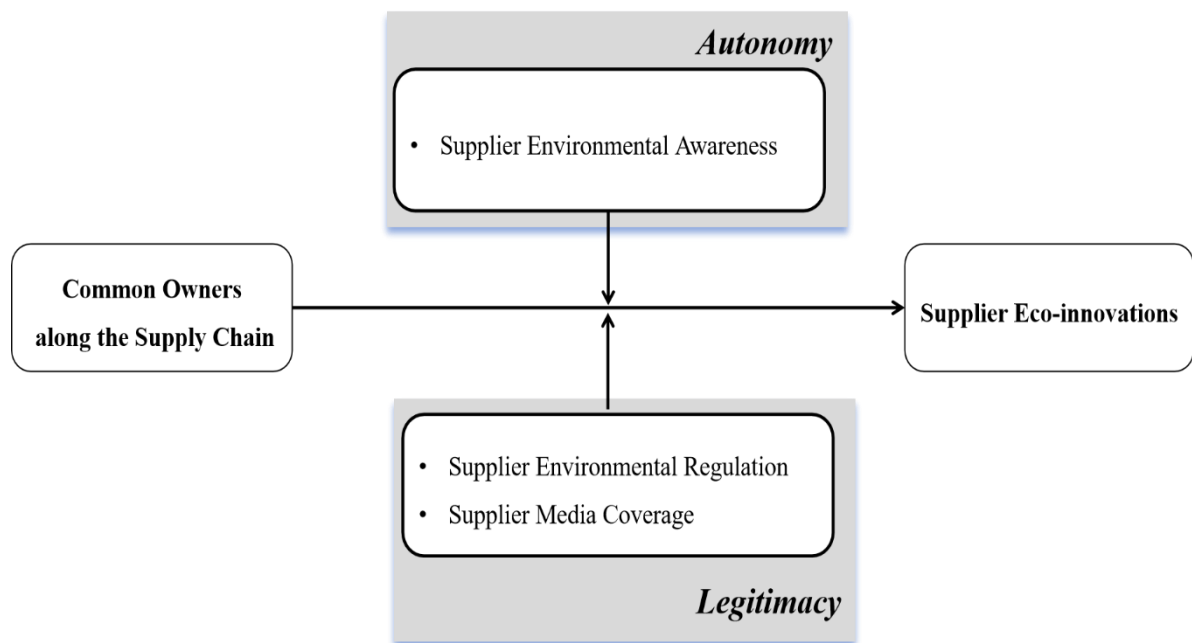
**Table 6 Further analysis**

|                              | <i>Carbon</i>                      |                                              | <i>Roa</i>                        |                                             |
|------------------------------|------------------------------------|----------------------------------------------|-----------------------------------|---------------------------------------------|
|                              | (1)                                | (2)                                          | (3)                               | (4)                                         |
|                              | High_SEI                           | Low_SEI                                      | High_SEI                          | Low_SEI                                     |
| <i>COSC_dummy</i>            | <b>0.127</b><br><b>(1.627)</b>     | <b>0.181<sup>***</sup></b><br><b>(2.945)</b> | <b>-0.002</b><br><b>(-0.318)</b>  | <b>0.014<sup>**</sup></b><br><b>(2.560)</b> |
| <i>Size</i>                  | 0.906 <sup>***</sup><br>(24.897)   | 0.894 <sup>***</sup><br>(27.600)             | 0.003<br>(1.142)                  | 0.005<br>(1.602)                            |
| <i>Lev</i>                   | 1.497 <sup>***</sup><br>(7.584)    | 1.413 <sup>***</sup><br>(8.996)              | -0.107 <sup>***</sup><br>(-7.343) | -0.114 <sup>***</sup><br>(-6.494)           |
| <i>Growth</i>                | -0.090 <sup>**</sup><br>(-2.303)   | -0.043<br>(-1.029)                           | 0.009 <sup>***</sup><br>(2.766)   | 0.014 <sup>***</sup><br>(3.914)             |
| <i>Roa</i>                   | 3.095 <sup>***</sup><br>(4.062)    | 3.002 <sup>***</sup><br>(4.899)              | -<br>-                            | -<br>-                                      |
| <i>Top1</i>                  | 0.461 <sup>**</sup><br>(2.024)     | 0.067<br>(0.361)                             | 0.009<br>(0.529)                  | 0.018<br>(0.981)                            |
| <i>Inst</i>                  | 0.235 <sup>*</sup><br>(1.652)      | 0.254 <sup>**</sup><br>(2.459)               | 0.035 <sup>***</sup><br>(3.272)   | 0.029 <sup>***</sup><br>(2.710)             |
| <i>Soe</i>                   | -0.063<br>(-0.971)                 | -0.045<br>(-0.690)                           | -0.004<br>(-0.693)                | -0.010 <sup>*</sup><br>(-1.806)             |
| <i>Board</i>                 | 0.019<br>(1.055)                   | -0.009<br>(-0.551)                           | -0.002<br>(-1.181)                | 0.000<br>(0.102)                            |
| <i>Indep</i>                 | 0.346<br>(0.517)                   | 0.449<br>(0.792)                             | -0.088<br>(-1.563)                | 0.080<br>(1.618)                            |
| <i>Dual</i>                  | -0.125 <sup>*</sup><br>(-1.734)    | -0.017<br>(-0.331)                           | 0.003<br>(0.638)                  | -0.002<br>(-0.374)                          |
| <i>Constant</i>              | -8.911 <sup>***</sup><br>(-12.806) | -8.059 <sup>***</sup><br>(-8.680)            | 0.001<br>(0.018)                  | -0.103<br>(-1.463)                          |
| <i>Industry fixed effect</i> | Yes                                | Yes                                          | Yes                               | Yes                                         |
| <i>Year fixed effect</i>     | Yes                                | Yes                                          | Yes                               | Yes                                         |
| Observations                 | 527                                | 791                                          | 773                               | 1,064                                       |
| R-squared                    | 0.865                              | 0.784                                        | 0.189                             | 0.247                                       |

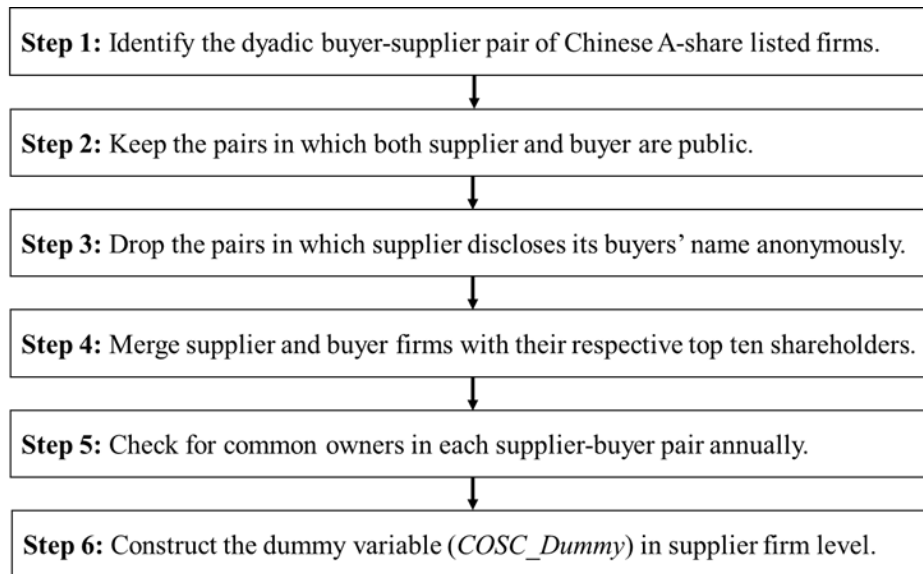
Note: T-values in parentheses. Statistical significance levels: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.10. Robust standard errors adjusting for firm clustering.



**Figure 1** The illustration of common ownership along the supply chain (COSC)



**Figure 2.** The conceptual research model



**Figure 3 The identification process of COSC**