

**When suppliers engage in sustainable supply chain management:
How does the stock market react?**

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Abstract

Purpose - Sustainable supply chain management (SSCM), driven by the downstream buyers' power, transfers sustainability responsibilities to the upstream supplier. In contrast to the heavily-focused buyers' perspective in the literature, we investigate how this buyer-driven SSCM influences suppliers' performance, using the measure of stock market reaction.

Design/methodology/approach – Grounded by the resource dependence theory (RDT), we empirically analyze the power effect on suppliers. Event study methodology and regression analysis are used, based on a sample of 1977 paired supplier observations from 1990 to 2016.

Findings – The result suggests that although a negative stock market reaction for suppliers in SSCM exists, the effect is less negative at a high level of buyer and supplier dependence. For the investigation of the 'consolidated SSCM initiative,' where buyers acquire exogenous power by collaboratively managing SSCM with their peers, we uncover that the negative impact of this consolidated SSCM initiative can be mitigated by the high interdependence that generates relational norms in the dyads.

Research limitations/implications – We focus on dyadic relationships. Future research can use our findings to study the SSCM diffusion to lower-tier suppliers.

Practical implications – This paper has good managerial implications for both suppliers and buyers. We propose dependence-based strategies for supplier managers to reduce uncertainty in SSCM. Moreover, buyer managers can use our findings to strengthen suppliers' commitment.

Originality - The novelty of examining the suppliers' perspective contributes to exploring the supply chain impact of SSCM. We extend RDT and show that high dependence is not necessarily detrimental to suppliers in this buyer-driven SSCM context. The interesting finding of interdependence in the context of the consolidated SSCM initiative brings new insights that relational norms constrain the leverage of power in the dyads and are beneficial to the power-disadvantageous suppliers.

1. Introduction

The increasing disclosure of upstream suppliers' environmental and social misconduct has led to societal outcry and the demand for improvement in supply chain sustainability performance. A downstream firm or a 'buyer' (e.g., a retailer or an Original Equipment Manufacturer [OEM]) is frequently held responsible for its upstream suppliers' sustainability performance because of its high profile and close contact at the point of sale (Foerstl et al., 2015). In response, sustainable supply chain management (SSCM) is commonly initiated by buyers. Carter and Rogers (2008) defined SSCM as "the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains (p.368)." In this study, we particularly focus on a 'buyer-driven SSCM' context. The purchasing power of downstream buyers often provides an effective mechanism to initiate upstream suppliers' sustainable operations (Busse, 2016). Thus, SSCM is often operationalized by market-facing buyers who can leverage their power to mandate and support their suppliers' compliance and development of sustainability practices. For example, HP, as a buyer, imposes greenhouse gas emission reduction goals for its first-tier manufacturing and transportation suppliers (Dow Jones Newswires, 2013). We investigate how it influences upstream suppliers (e.g., the first-tier suppliers of HP) when their power-advantaged buyers (e.g., HP) request them to improve sustainability performance.

Extensive research has investigated the impact of SSCM, focused on the firms (i.e., buyers) that mandate SSCM in their supply chain, and confirmed a non-negative impact on buyers (Golicic & Smith, 2013; Schmidt et al., 2017). From a supplier perspective, the extant research primarily focuses on the governance mechanisms to manage suppliers' sustainability development, such as assessment and collaborative (Gimenez & Sierra, 2013; Gimenez & Tachizawa, 2012), formal and informal (Tachizawa & Wong, 2015), buyer-to-supplier and peer-to-peer (Jiang, 2009), and assessment and development (Foerstl et al., 2010). In general, market force (e.g., by power) and relational factor (e.g., by interdependence) are two major governance mechanisms illustrated in the literature. While SSCM governance effectively initiates suppliers' sustainability development, suppliers' genuine commitment is still found to be problematic and controversial in the literature (Foerstl et al., 2015; Touboulic et al., 2014). A potential issue is that, while focusing on buyers,

the unclear impact of SSCM on the suppliers may limit our understanding of the supply chain effect of sustainability initiatives (Pagell & Shevchenko, 2014). Matos et al. (2020) underlined the ‘hidden side’ of SSCM, where unanticipated outcomes and trade-offs have not been fully explored in the literature. To our best knowledge, empirical evidence of the impact of SSCM on the upstream suppliers is under-explored in the literature. The exploration of suppliers’ risks and uncertainty supports the analysis of whether risks/benefits are proportionately distributed over the dyad and, thus, the development of suppliers’ genuine commitment. We intend to cover this research gap by providing empirical evidence from a supplier perspective in this study.

We use Resource Dependence Theory (RDT) as the theoretical lens. We focus on how power-dependence influences business risks and uncertainty for suppliers in SSCM. Power and resource positions can significantly impact the distributions of values and risks in the dyads (Pfeffer & Salancik, 1978), while the development of upstream sustainability attributes may shift the resource position in favor of suppliers as a result of the market stringency of SSCM on buyers (Touboulis et al., 2014). We also investigate the moderating effects of bilateral commercial dependence on safeguarding the suppliers’ investment in SSCM. Moreover, we study an interesting SSCM approach, called the ‘consolidated SSCM initiative,’ where buyers acquire exogenous power by collaborating with their peers in SSCM. We examine the moderating effect of the consolidated SSCM initiative and also its impact on suppliers at greater interdependence in the dyads.

In our analysis, we rely on the stock market reaction for suppliers to their buyers’ SSCM announcements as a measure of the impact of SSCM. We use an event study and the ‘related firms’ method, based on 206 SSCM announcements between 1990 and 2016, identifying 1,977 observations of suppliers affected by the SSCM. We find a negative stock market reaction for suppliers, while buyer and supplier dependence have positive moderating effects. The consolidated SSCM initiative imposes a more negative stock market reaction for suppliers, which, however, can be effectively mitigated by the great interdependence in the dyads.

Our study makes three important contributions. First, we provide novel empirical evidence of how SSCM impacts suppliers. Our study indicates the noticeable business risk of SSCM for suppliers. It highlights the importance of incorporating upstream suppliers’ perspectives in evaluating the supply chain impact of SSCM. Second, we show that the shift of resources position in favor of suppliers, due to the stringency of SSCM, is conditional on dyadic dependence. Contrary to our hypothesis, the result suggests that highly dependent suppliers do not necessarily

bear more risks in this innovative and stringent supply chain development of SSCM. Supplier managers should capture this contextual value of the power-dependence dynamic in the SSCM context and mitigate the risks. Third, we show an interesting interaction of power sources with relational norms. The consolidated SSCM initiative is supposed to be detrimental to suppliers because of buyers' exogenous power, which, however, is less realized in the presence of interdependence that generates relational norms. It highlights the contextual leverage of power and extends RDT. The high market demand for SSCM and relational norms by interdependence constrain the exercise of power in the dyads. Supplier managers should seek to strengthen interdependence as a medium or long-run strategy, in light of the wider adoption of buyers' collaborative SSCM in the industry.

In the following sections, we first present the theoretical foundation of RDT. Then, we develop our hypotheses, focusing on the suppliers' perspective and power-dependence dynamics. In the methodology and result sections, we discuss the use of the supplier sample, the event study methodology, and regression analysis, and report the test results. Finally, we discuss our findings' implications.

2. Theoretical Foundation

We draw upon RDT to analyze the context of buyer-driven SSCM and its impact on suppliers. RDT has been increasingly used to study SSCM and highlights that the power advantage of buyers facilitates the transfer of sustainability responsibilities to the upstream markets of supply chains (Foerstl et al., 2015; Touboulic et al., 2014). We focus on the effect of this power on the distribution of risks and uncertainty in the supply chain dyads and its impact on suppliers.

RDT proposes that dyadic buyer-supplier relationships (BSR) are created because few firms are self-sufficient in terms of strategic and critical resources (Pfeffer & Salancik, 1978). RDT discusses power criticality in managing BSR and businesses' success (Casciaro & Piskorski, 2005). Power is based on resource criticality and the availability of alternatives in dyads (Pfeffer & Salancik, 1978). Powerful firms may exercise power to influence partners' operations to meet their own resource demands and retain value from these exchanges. Less powerful firms are likely to comply to ensure critical resource access.

Strategic use of power can systematically improve supply chain performance (Rossetti et al., 2011). From the operations perspective, power increases the ability to establish supply chain

integration and improve responsiveness to demands. Effective implementation is more likely to rely on a firm's dominant power in its supply chain.

In the SSCM context, the leverage of power is found effective in implementing and transferring sustainability practices to the upstream supply chains (Seles et al., 2016; Touboulic et al., 2014). The stakeholders at the point of sale (e.g., consumers, government, and non-government organizations) traditionally drive sustainability. However, they have insufficient expertise and visibility of upstream suppliers' operations. They, therefore, leverage their power to high-profile retailers and OEMs, and hold them accountable for their suppliers' sustainability performance (Schmidt et al., 2017). These firms bear sustainability risk for suppliers' failure, and thus also leverage power to manage suppliers' commitment. Power-disadvantaged suppliers likely comply with buyers' SSCM mandates to retain legitimacy and resource access (Lee et al., 2014). Buyer-driven SSCM is consistently found to effectively increase suppliers' SSCM investment and adoption of sustainability practices (Foerstl et al., 2015; Touboulic et al., 2014).

From a performance perspective, power significantly influences risks/benefits distributions and performance outcomes in dyads (Casciaro & Piskorski, 2005; Elking et al., 2017). We focus on the buyer-driven SSCM context, grounded by buyers' advantageous power (Busse, 2016; Touboulic et al., 2014), and increasing uncertainty about whether suppliers can safeguard their SSCM investments.

In this study, we examine the impact of power on suppliers by using stock market reaction. The efficient market hypothesis (EMH) (Malkiel & Fama, 1970) supports that stock markets rapidly adjust in response to the news that influences market participants' estimation of how this news affects firms' cash flows and future prospects. When operational practices such as the buyers' SSCM mandates are positively/negatively related to the organizations' operational competence (e.g., suppliers' safeguarding of investment), it results in an increase/decrease in the direct financial metrics (e.g., cash flow). The stock market reaction is the investors' estimate of how the SSCM mandate affects suppliers (e.g., investments, uncertainties, and risks) and changes the present value of expected cash flows, accounting for the dyadic power.

Operations and Supply Chain Management research have widely used stock market reactions to evaluate the impact of supply chain practices (Ding et al., 2018). For instance, Kim et al. (2019) investigated firms' stock market reaction to their suppliers' sustainability risks. Jacobs and Singhal (2020) studied the stock market reaction to the emissions scandal for Volkswagen's suppliers. Lam

et al. (2019b) showed a positive stock market reaction to the supply chain finance initiatives. Liu et al. (2022a, 2022b) analyzed the stock market reactions to the supply chain quality event and blockchain announcements. We follow this stream of literature and relate the stock market reaction for suppliers to their buyers' SSCM announcements and various factors of interest in this study.

3. Hypothesis Development

3.1. The Impact of SSCM on Suppliers

RDT suggests that sharing values depends on supply chain power, while buyers and suppliers combine resources to create value (Kim & Wemmerlöv, 2015). Reputational assets are the most immediate and essential value created by SSCM for supply chains. Other tangible benefits (e.g., cost reductions) are long-term accruals and require substantial investments or radical operational changes (Wu & Pagell, 2011). Suppliers often have low brand recognition (Schmidt et al., 2017). As a result, reputational gains are not likely captured by suppliers but rather by their high-profile buyers. The demands of SSCM on suppliers are heterogeneous, and suppliers cater to a range of corporate customers, meaning that business-to-business reputation gains may be diminished (Gualandris et al., 2015; Schmidt et al., 2017). The cost-efficiency for such reputational gains in the context is low. Suppliers likely rely on buyers to share reputational benefits (e.g., increased sales volume and capital resources). As buyers use power to capture a disproportionate share of values, benefits to suppliers may be limited, while suppliers' investments and risks may increase.

Mandated SSCM differs from voluntary practices as the leveraged power embeds low flexibility and intense external pressure on suppliers to undertake substantial SSCM-related modifications in their production, while environmental and social performance may take time (Wu & Pagell, 2011). Lee et al. (2014) and Seles et al. (2016) found that buyers always intend to buffer their risks of suppliers' commitment with amplified stringency and intensity of sustainability demands on suppliers. Suppliers may have a voluntary investment in sustainability. However, when the buyers' SSCM mandates commonly move beyond the 'low-hanging fruits' (in order to meet buyers' own increasing sustainability demands), there may be a long-term investment of suppliers. Resources used in SSCM compliance in lieu of core activities may generate opportunity costs and challenges to improve operational performance. As investors are risk-averse, the stock market reaction will

be negative, given how it will impact suppliers' future cash flow estimations. Therefore, we hypothesize:

H1a: The stock market reaction for suppliers to their buyers' SSCM announcements is negative.

However, while the buyers' power influences suppliers' risk and investment, the criticality of sustainability performance may constrain buyers' use of power in SSCM. Sustainability performance has been in increasingly strong demand for high-profile and downstream buyers. Sustainability is innovative and disruptive. Buyers must operate with the suppliers to enhance dyadic sustainability performance (e.g., sustainable materials/components). Buyers bear substantial sustainability risks and costs for their suppliers' sustainability failure (Kim et al., 2019). Market boycotts, governmental fines, media disclosure, and investors' risk aversion lead to buyers' financial losses. These forces may alter buyers' perception of suppliers' sustainability commitment as a 'critical resource.' Following RDT, suppliers' improved resource position and the criticality to outcomes may shift the dyadic power in their favor, which constrains buyers from 'realizing' their power in SSCM (Touboulic et al., 2014). Thus, social control and incentives will be major governance forms. Suppliers will benefit and safeguard SSCM investments, leveraging long-term contracts, increased purchasing volume, preferential payment schedules., shared planning, and flexible arrangements. If suppliers capture the benefits, they can improve their operational competence; investors will adjust expectations of future cash flows, giving a positive stock market reaction. Therefore, given the paucity of empirical evidence from a supplier's perspective, we propose a competing hypothesis, which also indicates the controversy of this issue:

H1b: The stock market reaction for suppliers to their buyers' SSCM announcements is positive.

3.2. Dependence in Buyer-Supplier Relationships

One party's power is "equal to and based upon the dependence" on the counterparty (Kim & Wemmerlöv, 2015, p. 105). RDT suggests a bilateral measure of dependence captures how power impacts BSR. Elking et al. (2017) found the different impacts of supplier and buyer dependence on buyers' financial performance in the context of inventory leanness. Kim and Wemmerlöv (2015) showed a significant effect of suppliers' operational competence on buyer dependence,

which, however, is not associated with suppliers' financial performance in contrast to supplier dependence. We follow the literature and investigate buyer and supplier dependence on supplier performance in SSCM.

Dyads face various SSCM benefits (e.g., reputational gains, charging premium prices) and investments (e.g., implementation costs). Suppliers expect buyers to provide financial and technical support to reduce risks and share benefits. Given buyers' resource constraints and stationary investments, all suppliers are unlikely to receive proportionate shares of support and benefit. Higher buyer dependence indicates that a supplier provides a greater percentage of goods/services to its buyer's overall business. Hence, the successful transition to sustainable operations is crucial to maintain the buyer's operations and incentivize the buyer's strategies, e.g., a reward for increased sales or a higher purchasing price to the supplier. Wagner et al. (2021) found that in financial distress, a buyer provides a more cooperative response to its supplier with higher buyer dependence, which ultimately improves supplier performance. Moreover, if the sustainability contributions shift power to suppliers, a buyer's high 'commercial' dependence will facilitate this transition. Therefore, suppliers with high buyer dependence can safeguard investments through the buyer's cooperative response. A high degree of buyer dependence results in risk and value sharing in the dyad. We hypothesize the following:

H2: The stock market reaction for suppliers to SSCM announcements is positively related to buyer dependence.

A supplier highly dependent on the buyer is less likely to safeguard investments. The increased dependence indicates a high commitment to SSCM to maintain the relationship, even in the absence of support. High dependence in an exchange relationship can constrain firms as it generates relationship-specific investment and creates exchange hazards of opportunism (Gulati & Sytch, 2007). When suppliers have high dependence, buyers are likely to retain the most benefits from SSCM. Allowing dependent suppliers to make SSCM investments is capital-efficient for buyers. If sustainability contributions can improve a supplier's resource position in the dyad, the high 'commercial' dependence on the buyer likely offsets enhanced supplier power, maintaining the buyer's dominance. The investment uncertainty for a highly dependent supplier is high, and we therefore hypothesize:

H3: The stock market reaction for suppliers to SSCM announcements is negatively related to supplier dependence.

3.3. The Consolidated SSCM Initiative

We discussed the ‘endogenous power sources’ in H2&3, where the dependence is generated in the endogenous resource exchanges in vertical buyer-supplier relationships. In contrast, we move to discuss that the horizontal consolidation of SSCM governance by buyers establishes an ‘exogenous power source’ of buyers over suppliers, as such power is developed from external mechanisms of buyer-buyer collaborations (rather than resource exchanges). Through RDT, we further consider the impact of such exogenous power increase by buyers on suppliers in this section.

An emerging SSCM governance mechanism is that buyers collaboratively mandate and standardize SSCM practices to the suppliers that they source from. Carter and Rogers (2008) discussed common SSCM auditing procedures where horizontal collaboration between buyers can “allow a single effective supplier sustainability audit to be performed” (p. 367). In this study, we use the ‘consolidated SSCM initiative’ to describe multiple buyers consolidating their SSCM mandates to influence suppliers, highlighting the ‘consolidation-power instrument’ and, to be in line with the group purchasing literature (Nollet & Beaulieu, 2005; Walker et al., 2013). This provides an established theoretical foundation to support our discussion from the suppliers’ perspective through the theoretical lens of RDT.

Group purchasing is defined as “a formal or virtual structure that facilitates the consolidation of purchases for many firms. Consolidation includes bidding, suppliers’ evaluation, negotiation, and contract management” (Nollet & Beaulieu, 2005, p. 12). Buyers consolidate their purchasing volumes by joint forces and increase bargaining power over suppliers, and thus enhance their supplier management. The consolidated SSCM initiative has similar operations attributes to group purchasing, while the focus is on managing sustainability performance through consolidated SSCM, with standardized SSCM by multiple buyers. SSCM’s primary objective is to “enhance collaboration of the buyers in the area of sustainability in the supply chains [...] with a singularity of purpose and a common voice” (P.R. Newswire, 2014).

In contrast to the endogenous power sources (H2&3), we consider that the exogenous power source generated by buyers’ consolidated SSCM creates a more negative impact on suppliers.

From the supplier's perspective, it means more investment and potentially higher business risks. Consolidated SSCM creates institutional pressure through joint force by significant buyers. Sustainability requests have become a stringent qualification in supply markets. This consolidated SSCM initiative triggers fierce competition among suppliers in their sustainability performance and thus imposes higher investments and risks. Moreover, if sustainability attributes reshape the supply chain power in favor of suppliers, an advantageous resource position by a supplier may be largely constrained by buyers' collaborative power. Accordingly, we propose that:

H4a: The stock market reaction for suppliers is negatively associated with the consolidated SSCM initiative.

Nonetheless, the consolidated approach may standardize SSCM compliances and reduce suppliers' investments by the reduced requirement heterogeneity (Carter & Rogers, 2008). Suppliers must disclose different information, meet diverse sustainability expectations, and work on separate audit procedures. In compliance with consolidated SSCM, suppliers can increase operational efficiency by concentrating resources on a single standard. The consolidated approach establishes a transparent and accepted SSCM framework. Commitment to consolidated SSCM supports suppliers to widely disclose sustainability achievements and operational competitiveness. In addition, the standardized SSCM may support suppliers to reshape supply chain power through their sustainability attributes. The commitment and fulfillment to the consolidated SSCM initiative indicate a supplier's operations competence acknowledged by a large group of buyers, providing the supplier with alternative buyers and thus improving its resource position in the supply chain. Due to the opposing arguments, we also propose a competing hypothesis:

H4b: The stock market reaction for suppliers is positively associated with the consolidated SSCM initiative.

3.4. Moderating Effect of Interdependence on the Consolidated SSCM Initiative

In the above discussions on H2&3, we focused on buyer and supplier dependence at the individual level. Previous studies in the literature extended the power mechanism to an interdependence perspective, reflecting the relational norm in the dyads (Kim, 2017; Kim & Wemmerlöv, 2015; Mahapatra et al., 2010). The individual buyer and supplier dependence may not reflect reciprocity and are thus less likely refer to the relational assets in the dyads. We follow

Kim (2017) and define interdependence from a relational perspective as a cohesion of the relationship that captures additional resources generated from trust, embeddedness, and social norms. Casciaro and Piskorski (2005) found that interdependence significantly shapes inter-organizational actions. Kim and Wemmerlöv (2015) discussed the reciprocal view of power by firms, where a firm perceives both own dependence and the other party's dependence in decision-making relating to the dyad. Interdependence demonstrates strong embeddedness and relational norms in a dyadic relationship (Gulati & Sych, 2007). Thus, in the perception of greater interdependence, a power-advantageous party does not necessarily leverage its power, as the strong relational norms increase its confidence in the other party's commitment to the relationship. It, hence, creates mutual benefits for the dyads.

Moreover, a less powerful party needs to strategically adopt structural alternatives to manage interdependence and reduce uncertainty and risk (Mahapatra et al., 2010). One approach is that a less powerful party intentionally structures exchange relationships by developing cooperative norms and informal linkages, increasing a powerful party's relationship-specific assets (Cai & Yang, 2008). One antecedent to establishing such cooperative norms is the great interdependence in the dyad. Thus, great interdependence safeguards a less powerful party's investment and reduces its transaction costs.

Previous studies have found the moderating effect of interdependence in diverse contexts. Mahapatra et al. (2010) found that, in high complexity/short life cycle scenarios, greater interdependence motivates collaborative initiatives and improves relational and operational performance. Diebel et al. (2020) uncovered that suppliers are more likely to mimic their buyers to disclose environmental data at a high level of interdependence. Kim (2017) showed the positive mediating effect of interdependence on buyer concentration (i.e., buyers' power) and suppliers' profitability, motivating us to study this relationship in the SSCM context.

In this study, we are interested in exploring the moderating effect of interdependence on the relationship between the consolidated SSCM initiative and suppliers' performance. We discussed in H4 that the consolidated SSCM mandates by a group of buyers create an exogenous power source and increase the dyadic power in favor of buyers. In contrast, greater interdependence established relational norms and embeddedness in the dyads. At the consolidated SSCM initiative, we consider that greater interdependence can mitigate the potential suppliers' risks despite the increased buyers' power. At a great interdependence, supply chain initiatives and operations are

more likely to focus on mutual development. Hence, it is more meaningful and effective for supply chain dyads to rely on non-coercive influence strategies and motivate a cooperative commitment to SSCM. The proportional distribution of SSCM values and costs is likely to share in the dyads and thus reduce suppliers' risks. Contrarily, low interdependence exposes suppliers to the buyers' strong power position in the consolidated SSCM initiative. The lack of embeddedness reduces dyadic confidence in long-term commitment. Supply chain parties are more likely to depend on coercive strategies to avert their own risks and transaction costs.

H5: Interdependence positively moderates the relationship between buyers' consolidated SSCM initiative and the stock market reaction for suppliers.

Figures 1 & 2 show the conceptual models and hypothesized relationships. To clarify the different theoretical references, we use two conceptual models to demonstrate the main hypothesis of stock market reaction for suppliers and the effects of power-dependence factors through RDT in Figure 1, and the interdependence as a relational factor and its moderating effect in Figure 2, respectively.

<Insert Figure 1 here>

<Insert Figure 2 here>

4. Methodology

We used event study methodology to test H1 and then cross-sectional regression to explore firm-specific characteristics contributing to the magnitude of stock market reaction, testing H2-5. Event study supports exploring the stock market reaction, or 'abnormal returns,' to the firm-specific events (i.e., SSCM in this study), controlling for market and confounding factors (Brown & Warner, 1985).

Figure 2 provides an overview of the data collection process and sampling methods used in this study. We discuss the details of each step in the following sections.

<Insert Figure 3 here>

4.1. Data and Sample

We first collected the announcement in which a buyer requires its suppliers to implement SSCM from major business sources (e.g., P.R. Newswire, Business Wire, Wall Street Journal, Dow Jones Newswire) (i.e., announcement sample). We sampled from 1990 to 2016. Second, we identified the announcing firms' identities (i.e., buyers). Third, we used the 'Compustat segment database' and firms' annual reports to identify the suppliers for which the announcing firm is a major buyer, and that are therefore most affected by SSCM (supplier sample). These suppliers are the primary interest of our study. Fourth, we compiled data (e.g., stock returns and accounting data) and constructed variables to measure the stock market reaction and regression analysis.

All the announcements were screened for direct, explicit, and salient sustainability mandates and, thus, operational impacts on the suppliers. For example, a sample announcement must signal a commitment to managing, auditing, evaluating, assessing, or developing suppliers' environmental and social performance. This criterion excluded many announcements but ensured a clear connection between the announcing firm (i.e., buyer) and the firms studied (i.e., suppliers). We also excluded the announcement made by the same firm within a 20-day period. The final sample consisted of 206 announcements (thus 206 sample buyers). The example SSCM announcements areas follows, where 'IBM,' 'HP,' and 'Procter and Gamble' are defined as the announcing firms or buyers:

IBM (NYSE: IBM) today announced new management system requirements to advance sustainability across the company's global network of suppliers. IBM's "first-tier" suppliers – those firms with which IBM holds a direct commercial relationship – will now be required to establish and follow a management system to address their corporate and environmental responsibilities (P.R. Newswire, 21st, April 2010).

As part of an ongoing effort to improve its product manufacturing and supply chain operations, HP (NYSE: HPQ) today announced a greenhouse gas (GHG) emissions reduction goal for its first-tier manufacturing and product-transportation supply chain partners. HP's goal, a first for the information technology (IT) industry, is to drive a 20 percent decrease in its first-tier manufacturing and product transportation-related GHG emissions intensity by 2020, compared to 2010 (Down Jones Newswire 23rd, September 2013).

The Procter & Gamble Company (NYSE: PG) today announced the launch of the Supplier Environmental Sustainability Scorecard and rating process to measure and improve the environmental performance of its key suppliers. The new scorecard will assess P&G suppliers' environmental footprint and encourage continued improvement by measuring energy use, water

use, waste disposal and greenhouse gas emissions on a year-to-year basis (PR Newswire 12th, May 2010).

4.2. The Supplier Sample

We used the sample of buyers and the COMPUSTAT Segment database to create the supplier sample, which has been widely adopted in previous studies (Barker et al., 2022; Kim, 2017). The database includes information on buyers who represent more than 10% of total sales reported by U.S. public firms, showing a salient BSR and economic link. A sample supplier is the one reporting the announcing firm as a buyer in either of the two fiscal years before the announcement in the database.

While the suppliers' identifiers are clearly given in the Compustat segment database, the reported buyers are identified only by the firm's name or abbreviation, and these may change each year. For example, in the fiscal year 2003, Sanmina Corporation reported 'IBM' as a buyer, but in the same fiscal year, Volterra Semiconductor Corporation listed IBM as 'International Business Mach,' and Mcdata Corporation named IBM as 'Intl Business Machines Corp.' To avoid mismatching the buyer-supplier links, we adopted the well-established algorithm developed by Cohen and Frazzini (2008) and Fee and Thomas (2004); the details are provided in Appendix A, which involve a high degree of manual sorting and checking of data from Compustat to ensure data integrity.

The abnormal returns specific to SSCM announcements may be biased by other confounding events (e.g., earnings announcements, dividend declarations, and mergers/acquisitions). We searched in the same business sources for the confounding events relating to every supplier observation in our sample. A supplier observation was excluded if a confounding event was identified in three days centered on the announcement days. 120 supplier observations were excluded because of the confounding events. The final supplier sample was made up of 1,977 supplier observations in the analysis.

Table 1 presents descriptive statistics for the 1,977 supplier observations out of 206 SSCM announcements. Panel A shows the year distribution of SSCM announcements. Panel B shows data from two subsamples. There are 98 SSCM announcements made jointly by buyers and their peers to collaboratively mandate SSCM to their suppliers, or a 'consolidated SSCM initiative,' where 561 out of 1,977 suppliers (28%) in our sample were found to comply with this consolidated SSCM initiative. An example consolidated SSCM announcement is below:

“At least six of the world's largest companies, including Procter & Gamble Co. (P.G.), Unilever PLC (U.L.), Tesco PLC (TSCDY) and Nestlé SA (NSRGY), will announce Tuesday that they are banding together to press their suppliers to release data about their carbon emissions and climate-change-mitigation strategies. The move affects plants churning out everything from T-shirts to cocoa beans to razors (Dow Jones News Service, 8th, October 2007).”

114 SSCM announcements were related to the environmental dimension of SSCM (e.g., pollution and deforestation prevention, reduction of carbon emission, packaging, and waste). 1,107 out of 1,977 suppliers (56%) in our sample were found to be requested to improve environmental performance.

Panel C shows the industry distribution of the suppliers. The top industries are Electronic Equipment, Business Services, Food Products, Computers, Automobiles, and Consumer Goods.

Panel D reports the selected financial characteristics of the sample supplier observations. The mean values of annual sales and the total assets were US\$ 4,334 million and US\$ 5,546 million, respectively. The mean values of market capitalization and employee numbers in our supplier sample are US\$ 6,363 million and 15,000, respectively. These data show our sample suppliers were smaller firms. On average, 20.58% of a supplier’s sales provide 2.08% of an announcing buyer’s cost of goods sold (COGS), as represented by the suppliers’ sales to buyers and the input of buyers from suppliers.

<Insert Table 1 here>

4.3. Analytical Techniques

4.3.1. *Estimating Abnormal Returns and Statistical Tests.* We used the Fama-French-momentum model (Carhart, 1997; Fama & French, 1993), adjusting multiple factors and widely used in testing the U.S. sample, as follows:

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_1 R_{mt} - \hat{\beta}_2 SMB_t - \hat{\beta}_3 HML_t - \hat{\beta}_4 UMD_t, \quad (1)$$

where AR_{it} is the abnormal return for stock i at day t ; R_{it} is actual stock return; R_{mt} is market return; SMB_t is the size factor (small- vs large-cap stocks); HML_t is the book-to-market factor; and UMD_t

is the momentum factor representing prior returns. Using ordinary least squares (OLS) regression, the intercept and coefficients are estimated using a 200-day estimation window ending 10 days before the announcement dates. We required at least 40 return observations during this estimation window. All data were from the University of Chicago’s Center for Research in Security Prices database.

We calculated the cumulative abnormal returns (CARs) by aggregating the mean abnormal returns in a three-day event window, the prior day (day -1) through to the day after the event (day 1), giving day (-1,1) that captures information releases over the time horizons and commonly used in literature.

We derived multiple suppliers from single announcing firms in our sample. The estimated CARs for suppliers may be biased by a cross-sectional correlation between sample suppliers. Therefore, we used the ‘time-series standard deviation test’ by Brown and Warner (1985) to account for the potential bias (also called ‘crude dependence adjustment’). Moreover, we used two non-parametric tests, the binomial sign test and the Wilcoxon signed-rank, as the robustness tests.

We also followed the literature (Brown et al., 2009; Fee & Thomas, 2004) and used a portfolio approach to correct for the cross-sectional correlation bias. First, we estimated the individual supplier’s CAR. Second, we calculated the equally weighted portfolio CAR for the suppliers of each announcing firm. Third, the mean CAR was estimated using the average of all portfolio CARs in the supplier sample.

4.3.2. Regression Specification. The estimated suppliers’ individual CAR (-1,1) was used as the dependent variable in the cross-sectional regression to understand determinants, controlling for the impact of other variables. Following Elking et al. (2017), we used two regression models consistent with our conceptual models in Figures 1 & 2. In H2-4, we focus on the sources of endogenous (buyer and supplier dependence) and exogenous (the consolidated SSCM initiative) power, and their impacts on suppliers through the theoretical lens of RDT. Therefore, we constructed Equation (2) to test the direct impacts of Buyer Dependence, Supplier Dependence, and the Consolidated SSCM Initiative on the stock market reaction for suppliers:

$$CAR_i = \alpha + \beta_1 BDS_i + \beta_2 SDB_i + \beta_3 CONSOLIDATED_SSCM_i + \gamma * X_i + \varepsilon_i, \quad (2)$$

where CAR_i is the cumulative abnormal return for *supplier i* in the event window (-1,1); BDS_i is the dependence of the buyer on supplier *i*; SDB_i is the dependence of supplier *i* on its buyer; $CONSOLIDATED_SSCM$ is a dummy variable equal to 1 if *supplier i* complies with the consolidated SSCM initiative (i.e., its buyer's joint SSCM mandate with peers), otherwise 0; X_i is a set of control variables, and ε_i is the error term.

In H5, our theoretical focus is on the moderating effect of interdependence and, thus a relational factor (in contrast to power sources as H2-4). To provide clear theoretical and statistical inferences, we then used Equation (3) to test the moderating effect of Interdependence on the relationship between the Consolidated SSCM Initiative and the stock market reaction for suppliers.

$$\begin{aligned}
 CAR_i = & \alpha + \beta_1 INTERDEPENDENCE_{ij} + \beta_1 CONSOLIDATED_SSCM_i \\
 & + \beta_3 INTERDEPENDENCE_{ij} \times CONSOLIDATED_SSCM_i \quad (3) \\
 & + \gamma * X_i + \varepsilon_i,
 \end{aligned}$$

where $INTERDEPENDENCE_{ij}$ is the interdependence between the buyer *j* and supplier *i*; $INTERDEPENDENCE_{ij} \times CONSOLIDATED_SSCM_i$ is the interaction term testing the main moderating effect.

4.3.3. Independent Variable Construction. Data for the variables are from the Compustat database and through coding the SSCM announcements.

Following the literature (Elking et al., 2017; Jacobs & Singhal, 2020), we measured buyer and supplier dependence in Equations (4) and (5), respectively,

$$BDS_{ci} = \frac{S_{ci}}{COG_c}, \quad (4)$$

where BDS_{ci} is dependence of buyer *c* on supplier *i*, S_{ci} is the sales of supplier *i* to buyer *c* in the most recent fiscal year before the announcement date, and COG_c is the cost of goods sold (COGS) by buyer *c* at the same fiscal year ending date. We used the logarithm form of BDS to reduce the influence of outliers.

$$SDB_{ci} = \frac{S_{ci}}{S_i}, \quad (5)$$

where $SDB_{ci(1)}$ is dependence of supplier i on buyer c , and S_i is supplier i 's total sales in the most recent fiscal year prior to the announcement date.

We estimated the interdependence using the supplier and buyer dependence measures in Equations (4) & (5). We followed Gulati and Sytch (2007) and used the additive approach of the interdependence measure. We aggregated it by taking the sum of supplier dependence and buyer dependence. We then centered the interdependence measure by subtracting the sample mean to avoid the multicollinearity issue. This approach is in line with our theoretical discussion of embeddedness in the supply chain dyads and our sample attributes of, in general, unbalanced power-dependence account (i.e., higher supplier dependence than buyer dependence, as shown in Panel D Table 1). We acknowledge the alternative and multiplicative approach of interdependence measure (e.g., Kim, 2017). In particular, note that Gulati and Sytch (2007) discussed the trade-offs of additive and multiplicative approaches. The authors found that the additive approach is more accurate to describe interdependence, where unbalanced power-dependence between supplier and buyers is present in the dataset. Our additional estimations show that the median (mean) value of interdependence using additive and multiplicative approaches is 17.54% (21.58%) and 0.02% (0.42%), respectively. It is more likely that the additive approach describes the accurate interdependence measure, following our sample attribute (in our sample, mean buyer dependence is 20.58% and mean supplier dependence is 2.07%, and the mean difference between supplier dependence and buyer dependence is 17.42%). We, therefore, opted to use the additive approach in this study.

To operationalize the variable of the consolidated SSCM initiative, we coded an SSCM announcement if it specifies a joint and collaborative SSCM initiative by a group of buyers or addresses a buyer joining this collaboration. We defined each group member as an announcing firm (i.e., a buyer) used to derive the supplier sample. We created a binary variable and assigned a code of 1 to a supplier whose buying partner participates in the consolidated SSCM initiative, and, otherwise, 0 to a supplier.

4.3.4 Control Variables. In the regression analysis, we controlled for firm-level factors of market-to-book ratio, financial leverage, and buyers' past sustainability performance. At the industry level,

we controlled for industry competitiveness, munificence, and dynamism. We also controlled the environmental dimension of SSCM, year and industry effect in the regression model. The explanatory effects of these factors are established in previous event studies and SSCM research (Jacobs et al., 2022; Kim et al., 2019; Lam et al., 2019a).

Market-to-book ratio is measured by the book value of equity divided by the market value of equity. Financial leverage is measured as the debt-to-equity ratio. We controlled for the sustainability performance of buyers. A sustainable buyer has a relatively high commitment to SSCM and thus seriously manages its supplier compliance. We used the 'ESG Score' from the Thomson Reuters Refinitiv Eikon database (Refinitiv Eikon, 2021). The ESG score is an overall sustainability scale of firms ranging from 0 to 100. It is composed of three pillars, 'Environmental,' 'Social,' and 'Governance,' adjusted by industries and country of incorporation. The ESG score provides a rigorous measure of firms' sustainability performance and is used in the literature of sustainability-related studies (Duque-Grisales & Aguilera-Caracuel, 2021; Reber et al., 2021).

Following Zhan et al. (2021), we calculated industry competitiveness by using one minus the sum of the squared market shares of industry peer firms that have the same three-digit Standard Industry Classification (SIC) code as the sample suppliers. Industry munificence refers to the level of resources available in the markets for the industry (Lam et al., 2019a), and dynamism indicates the degree of market instability and fast changes (Azadegan et al., 2013). Both are important market factors found in the literature. We followed Azadegan et al. (2013) and Lam et al. (2019a) and measured industry munificence and dynamics using the anti-log of coefficients and anti-log of standard errors obtained by regressing sales and operating incomes against the time of moving 5-year windows. Specifically, we first calculated the industry sales and operating income in each of the 4-digit SIC codes of our supplier sample. Second, we ran two regressions using the natural logarithm of industry sales and the natural logarithm of industry operating income, respectively, against time over a 5-year period prior to each announcement date. Third, we calculated the anti-log of coefficients from two regressions and used the average value as the measure of industry munificence. Finally, we multiplied this measure by -1 to indicate munificence with a low value and market hostility with a high value. We used the anti-log of standard errors and the average value of those from two regressions to measure industry dynamism.

We controlled the effect of the environmental dimension of SSCM. There have been tangible, mature, and diverse measures/practices in the development of environmental elements over the

decades (Touboulic & Walker, 2015). Buyers' mandates on environmental dimensions of SSCM may be more sophisticated and thus more comprehensively influence suppliers' operations. We created a binary variable and assigned a code of 1 to a supplier that followed an environmental SSCM announcement, and otherwise 0.

We controlled for the year effect by using three year dummies as Panel A in Table 1. We assigned 1 to a supplier if its buyer's announcement was made in 1990~2004, 2005~2010, and 2011~2016, respectively. The reason for this design is that we relied on Kyoto Protocol as a significant global sustainability initiative that entered into force in 2005. We set the pre-Kyoto period as 1990-2004. The remaining time was divided equally to give an even distribution of observations.

Finally, we controlled for the industry effect. We created a binary variable for each of the six top industries, as shown in Panel C of Table 1. We assigned 1 to a supplier if its four-digit SIC code is one of these industries, following Fama and French (1997).

4.3.4. Analysis. We used robust regression (MM-estimation) to correct the bias of outliers and influential observations in our dataset. We identified the observations that are either outliers (the studentized residual is outside a ± 2 range) or have high leverage (over three times the average hat value) (Fox & Weisberg, 2010), which violates the assumption of normality in OLS estimation and thus bias the results of statistical analysis. Robust regression uses weighted least squares, minimizing the weight applied to outlying observations in calculating coefficients and enhancing the results' reliability (Cohen et al., 2003). Leone et al. (2019) replicated published studies and found that robust regression outperforms the other common methods, providing a theoretically appealing approach to address outlying observations. Robust regression allows us to maintain the outlying influential observations while minimize their influence on the analysis; it results in valuable insights as these remain accounted for by the models, which is useful and found to outperform OLS regression when the dataset bears the issues of outliers and influential observations (Panagopoulos et al., 2019). It has been widely used in the literature (Almudena et al., 2020; Jakob et al., 2022), especially in those studies related to stock market performance (Keval & Harris, 2022; Leon et al., 2021). We, therefore, opted to use robust regression in this study to correct the bias.

All variance inflation factors (VIFs) are below 3 in our regression models, and thus multicollinearity is not a concern. Table 2 presents the descriptive statistics and Pearson correlation between all variables used in the regression analysis.

<Insert Table 2 here>

5. Results

5.1. Stock Market Reaction for Suppliers (H1)

Panel A of Table 3 reports the stock market reaction or CAR for suppliers using 1977 supplier observations. Our main event window is the three-day period at (-1, 1).

The results indicate a negative stock market reaction for suppliers to their buyers' SSCM announcements. The mean and median CAR (-1,1) is -0.38% and -0.32%, respectively, both significant at the 1% level. 55% of suppliers had a negative CAR, significant at the 1% level.

As discussed in Section 4.3.1, we used a portfolio approach to check the robustness of the results. Panel B of Table 3 reports the results of using 206 equal-weighted portfolios. The mean and median value of the (-1,1) portfolio CARs is -0.64% and -0.45%, significantly at 5% and 1% levels, respectively. Over 60% of portfolios had a negative CAR, significantly at the 5% level. The results confirm that investors believe suppliers experience increased uncertainty and risks when their buyers initiate SSCM. Thus, H1a is supported.

<Insert Table 3 here>

5.2. Regression Analysis Results (H2-5)

Table 4 and Table 5 report the results for H2-5, using weighted least squares and suppliers' individual CAR (-1,1) as the dependent variable. Due to missing data in independent and control variables, there are 1035 supplier observations in Models 1 and 834 in Models 2-4.

In Table 4, Model 1 includes only control variables. We rely on the results in Model 2 to test the direct effects of Supplier Dependence, Buyer Dependence, and the Consolidated SSCM Initiative as in Equation (2). First, we predict a positive relationship between 'Buyer Dependence' and the stock market reaction for suppliers. We find marginal support for H2 ($\beta=0.0027$, $p<0.1$),

showing that investors believe a supplier with higher buyer dependence can mitigate its risks and reduce investment in SSCM. Second, interestingly, contrary to our argument and hypothesis, Supplier Dependence is positively associated with the stock market reaction for suppliers ($\beta=0.0258$, $p<0.05$). All else being equal, it indicates lower uncertainty and risks for a supplier who has higher dependence on its buyer in SSCM. Thus, H3 is not supported. Taking both positive effects of buyer and supplier dependence, it infers that both sources of dependence are important factors to reduce suppliers' uncertainty in the SSCM context. Third, we find that the 'Buyer Consolidated SSCM Initiative' is negatively associated with the stock market reaction for suppliers ($\beta= -0.0089$, $p<0.05$). The result indicates a higher level of risk for a supplier when its buyer initiates SSCM collaboratively with peers. Hence, H4a is supported.

We use the results in Table 5 to test the moderating effect of interdependence on the relationship between the consolidated SSCM initiative and stock market reaction for suppliers, as in Equation (3). Model 3 tests the direct effects of two explanatory variables, namely, Interdependence and Consolidated SSCM Initiative. The estimated coefficient of Interdependence is positive and marginally significant ($\beta= 0.0217$, $p<0.1$). The estimated coefficient of the consolidated SSCM initiative is consistently negative and significant ($\beta= -0.0086$, $p<0.05$). Model 4 includes the interaction term of Consolidated SSCM Initiative with Interdependence. The direct effect of the consolidated SSCM Initiative is consistently negative and significant ($\beta=-0.0071$, $p<0.05$). The estimated coefficient of Interdependence \times BCS is positive and significant, and the coefficient size is large in contrast to other variables in the model ($\beta= 0.0612$, $p<0.01$). In H5, we hypothesized the positive moderating effects of interdependence. The result supports H5, indicating that a high level of interdependence mitigates the negative impact of the consolidated SSCM Initiative on the stock market reaction for suppliers.

The interaction plot in Figure 3 is based on the estimates reported in Table 5. The numeric conditioning predictor of Interdependence is evaluated at five equally spaced values in the data, demonstrating the low level to high level of interdependence from left to right on the horizontal axis. At a low level of interdependence, suppliers who comply with the consolidated SSCM initiative (the dashed line) experience a more negative stock market reaction than those at individual buyers' SSCM initiatives (the solid line). As interdependence increases, the stock market reaction for suppliers is increasingly positive. The effect size is significantly strong,

showing the remarkable moderating effect of interdependence to mitigate the negative impact in the context of the consolidated SSCM initiative.

<Insert Table 4 here>

<Insert Table 5 here>

<Insert Figure 4 here>

6. Summary, Implications, and Limitations

In this study, we focus on the buyer-driven SSCM context and investigate its impact on upstream suppliers. Using the event study approach with a sample of 1977 supplier observations from 1990 to 2016, we find an overall negative stock market reaction for suppliers, revealing the increasing risks and uncertainty for suppliers in SSCM. Moreover, we find that a high buyer dependence has a positive effect on the stock market reaction for suppliers. The result, nonetheless, is marginally significant and should be explained with caution. Interestingly, while we predict that the highly dependent suppliers are at high risk in line with RDT, contrary to our hypothesis, we find a stronger stock market reaction for suppliers with high dependence. This suggests that either form of bilateral dependence improves investors' confidence that suppliers can safeguard and benefit from their SSCM investments. We also investigate an emerging SSCM mechanism, the 'consolidated SSCM initiative,' where a group of buyers collaboratively request SSCM to increase the buyers' power. We uncover that the negative impact of this consolidated SSCM initiative is strongly mitigated by interdependence in the dyads. This finding indicates stronger relational norms and embeddedness as a result of interdependence effectively mitigate suppliers' risks. It provides empirical evidence on the contextual effect of power and extends RDT.

6.1. Academic Contributions

Our study has important academic contributions. First, the novelty of studying the suppliers' perspective contributes to the operations management literature of SSCM. The major interest in the SSCM literature has remained on the buyers' perspective and found, in general, a non-negative impact on buyers (Busse, 2016; Golicic & Smith, 2013). The lack of the suppliers' perspective

conceals the supply chain effect of SSCM. Our study thus explores the ‘hidden side’ of SSCM (Matos et al., 2020). The negative stock market reaction for suppliers shows the suppliers’ uncertainty and uneven distribution of investment as well as risks in the dyads. This finding suggests the importance of incorporating the upstream suppliers’ perspective to evaluate the supply chain impact of SSCM. Otherwise, it would be restricted to exploring the insights of SSCM and response strategies when these risks emerge.

Second, our findings of buyer and supplier dependence show conditional contributions of sustainability attributes to the shift of resource position in favor of suppliers. Touboulic et al. (2014) discussed that, in the high demand for supply chain sustainability attributes, buyers view suppliers’ sustainability commitment as a ‘critical resource,’ which increases suppliers’ power. Our results show such a shift in power conditionally accrues at a high level of bilateral ‘commercial dependence.’ Suppliers can strategically manage either dependence to improve their resource position through sustainability investment. While the positive effect of buyer dependence is consistent with RDT, the increase in buyer dependence requires suppliers’ long-term supply chain configuration. Contrarily, suppliers may strategically strengthen their dependence on buyers as a short-run strategy to deal with the risks and uncertainty in SSCM. In the perception of high supplier dependence, the cooperative commitment in the dyads effectively supports suppliers to develop their sustainability attributes. It subsequently changes the resource position in the long run.

Third, our finding on the consolidated SSCM initiative provides a novel contribution to studying power-dependence in SSCM. Our result shows a negative stock market reaction for suppliers. It provides initial evidence of the impact on supply chain dyads in the consolidated SSCM context, where suppliers mostly bear a large portion of investment and risks. The result supports the consolidated SSCM initiative as an exogenous power source, shifts power in favor of buyers, and imposes detrimental effects on suppliers. While the standardized practices in the consolidated SSCM initiative may reduce suppliers’ investment, the power disadvantage of suppliers outweighs the potential benefits. This result further evidences the importance of considering power-dependence in SSCM.

In this paper, we follow the group purchasing literature (Nollet & Beaulieu, 2005; Walker et al., 2013) to define the novel approach of the consolidated SSCM initiative. Our study hence extends the group purchasing literature to the SSCM context. Nollet and Beaulieu (2005) discussed from the group purchasing perspective that buyers’ leverage of power and excessive control of

purchasing costs increases suppliers' risks (e.g., fierce competition on cost reduction). Many suppliers may not be able to meet the overly demand on low purchasing prices (or sustainability attributes in our study) and do not have enough sales volume and thus withdraw from the markets. Our result shows the consistent performance implication of SSCM in supply chain relationships. It encourages researchers to explore the theoretical foundation from the group purchasing literature to further study the power dynamics in the SSCM context.

Last but not least, we reveal the moderating effect of interdependence on the consolidated SSCM initiative. The novelty of our study is to provide scientifically sound empirical evidence from the upstream supplier perspective, confirming the effectiveness of interdependence in an adverse supply chain scenario. The consolidated SSCM initiative exposes suppliers to a high level of risk. Nonetheless, greater interdependence results in strong supply chain embeddedness and commitment, and thus inversely changes the effect of consolidated SSCM on suppliers' performance. It also infers that the primary objective of consolidated SSCM is potentially converted from a power instrument (i.e., buyers' gain of power) to a cooperative and social control mechanism, when greater interdependence exists. This provides a novel insight into the development of relational norms in SSCM. In SSCM literature, mutual reinforcing and informal linkages are increasingly advocated (Foerstl et al., 2015; Touboulic et al., 2014). However, suppliers are skeptical of relationship-specific investments, fearing resource constraints in dyads. Our results indicate such relational norms of SSCM can be established by highly interdependent dyads using the consolidated SSCM initiative. On the one hand, the greater interdependence effectively safeguards suppliers' investment despite the shift of power in favor of buyers. On the other hand, the consolidated SSCM initiative standardizes sustainability practices in supply markets, and improves firms' sustainability expertise and transparency through the intersection of vertical and horizontal collaborations.

6.2. Theoretical contributions to RDT

Our study provides a theoretical contribution to RDT by revealing the contextual effect of power-dependence in SSCM from a supplier's perspective. RDT suggests power-dependence affects the outcomes of relationships, where a party with a dependence advantage can safeguard its investment and have more favorable performance outcomes (Casciaro & Piskorski, 2005; Pfeffer & Salancik, 1978). We find that supplier dependence is positively related to suppliers' stock market reaction. This shows a counter-effect to RDT that high dependence on their buyers

does not necessarily yield a higher risk from the suppliers' perspective. We argue that this results from the contextual effect of SSCM. Increasingly, there is evidence of the dynamics of bilateral dependence due to moderating effects, such as inventory leanness (Elking et al., 2017) and operational competence (Kim & Wemmerlöv, 2015). When supplier dependence is high, multiple factors constrain buyers' 'realization' of power in dyads. SSCM also shows this contextual effect on power. We reveal that the disproportionate distribution of risk and investment in supply chain dyads increases suppliers' uncertainty. Meanwhile, buyers bear substantial sustainability risks for their suppliers' failures (Kim et al., 2019). When observing suppliers' financial loss and thus the scarcity of the surplus resources needed to maintain their long-run sustainability commitment, buyers may constrain their power leverage and willingly share the investment in the supply chain dyads. Highly dependent suppliers, to which buyers dominate in the relationship, are less likely to opportunistically take advantage of buyers' SSCM investment. To safeguard this investment, buyers are more likely to opt to constrain the leverage of power on highly dependent suppliers.

These findings extend RDT and indicate that high dependence does not necessarily yield an unfavorable relationship outcome in the SSCM context. It supports the literature that contextual factors (e.g., the stringent demands of SSCM and the sustainability risks) may constrain the party with (economic) advantages from realizing their power. In turn, a power-disadvantaged supplier can reduce their uncertainty.

Interestingly, the inference of the positive effect of supplier dependence may be consistent with the bargaining power theory discussed in the finance literature. Bargaining power theory refers that a less powerful supplier that shows scarcity of its resources to its buyer can fortify its resource position in the dyad, as it is meaningless for a powerful buyer to leverage its power in negotiation with the supplier that does not have surplus resources available (Oliveira et al., 2017). This theory has been confirmed in the context of leveraged buyouts (Brown et al., 2009), an increase in financial leverage (Oliveira et al., 2017), and the supply of trade credits (Fabbri & Klapper, 2016). Similarly, we uncover a negative stock market reaction for suppliers in SSCM (thus a potential increase of suppliers' resource scarcity, especially from a capital market perspective). A powerful buyer may have to constrain its power against a highly dependent supplier, according to the bargaining power theory. Since the buyer's leverage of power on a resource-scare supplier is meaningless, it explains a less negative stock market reaction for a highly dependent supplier, as found in our study. While our focus in this study is not on this, the finding of a positive impact on

highly dependent supplier in SSCM may raise interest and further examination in bargaining power theory in the future research.

Our study on the moderating effect of interdependence uncovers an interesting effect in the interaction of power sources and relational norms. Buyers' collaborative SSCM is supposed to increase a supplier's vulnerability by undermining its power position. In contrast, interdependence establishes relational norms in the dyads (Gulati & Sytch, 2007). Our result shows that power is less realized in the presence of relational norms in SSCM. We discussed above the constraint in leverage of power as the extension of RDT. Our finding indicates the relational norms that generated from interdependence also reduce the willingness of supply chain dyads to exercise their power. While earlier studies traditionally focus on firms' capacity to exploit the power and secure financial benefits, our result suggests contradictory effects of relational norms on the power sources from the upstream suppliers' perspective. Our study highlights the incorporation of relational norms in analyzing power dynamics in the supply chain dyads.

6.3. Implications for Practice

Supplier managers are not necessarily concerned with high dependence when the downstream buyers request them to implement sustainability practices. In ordinary supply chain initiatives (i.e., in the absence of SSCM), supplier managers commonly have concerns with unfair profit sharing and inequity as a result of the increased relationship-specific investments and high dependence on buyers (Um & Oh, 2020). In the SSCM context, we show the beneficial effect of such high dependence. High-profile downstream buyers have increasing stringency in developing supply chain sustainability attributes. Such stringency is converted to strong cooperative supply chain commitments, especially in the perception of high supplier dependence, where suppliers' reliability and credibility are highly regarded. Supplier managers should effectively capture this contextual value of power-dependence dynamics. One approach is to promptly establish social control and inform linkage through strategic information sharing and collaborative product and process design in SSCM. In contrast to other supply chain practices that may require the long-run development of informal governance in the dyads, the high innovativeness and stringency of SSCM provide supplier managers with a channel to achieve cost-efficient outcomes in the short run.

Moreover, the medium- and long-run strategies for supplier managers are to increase buyers' purchasing volume and relationship-specific investment, and strengthen interdependence. The

increased buyer dependence is useful to further reduce uncertainty and risk in SSCM. More meaningfully, it contributes to the growing interdependence. It is expected that complexity and modern sustainability development (e.g., carbon neutrality in Scope 3) increasingly requires buyers' collaborative SSCM to acquire managerial and knowledge expertise. Hence, the consolidated SSCM initiative will be more widely adopted. Our study provides supplier managers with clear evidence that, in the context of the consolidated SSCM initiative, the mitigating effect of interdependence is salient, while supplier managers may experience significant shareholder loss at a low level of interdependence. In the perception of the increasing interdependence in the medium and long run, supplier managers should effectively secure relational norms in the dyads and constrain the buyers' leverage of power.

It also requires innovative design and cooperative measures by buyer companies and governments to mitigate the overall business risks of SSCM to suppliers. We observe that the sample SSCM announcements primarily focus on the operational level of how buyers manage their suppliers' sustainability performance, exposing their SSCM efforts to the markets. Such operational-level SSCM restricts the potential of buyers' support to suppliers, due to the concern about their own idiosyncratic investments. We suggest that SSCM should be designed at a strategic level, where supply chain sustainability innovation is effectively used as a business strategy to, for example, develop supply chain resilience. It is more likely to integrate suppliers' perspective and develop a 'supply chain orientation' that focuses on achieving overall outcomes of the supply chain in SSCM. At such strategic-level SSCM, buyers are more likely to proactively state the financial incentives and technological support in announcing SSCM. It not only effectively secures the suppliers' commitment and thus reduces buyers' sustainability risks but reduces the suppliers' investments and uncertainty in SSCM.

6.4. Limitations and Future Research

There are inevitable trade-offs and limitations. Our sample included only U.S. public firms, which helped create a large and paired sample of supply chain dyads. Future research can further test our findings in a different market, such as an emerging market, where the stringency of SSCM mandates has a different scale from that in the U.S. market. Moreover, our study was based on a dyadic relationship, which validates the salient economic and operational bond between announcing firms and their suppliers, as supported by the event study literature. Future research can work on exploring the impact on lower-tier suppliers. The findings of this study can be a useful

reference, as first-tier suppliers that we focus on have a significant bridging role in further supply chain sustainability diffusion. This will require mining additional secondary data sources (e.g., Bloomberg SPLC) and carefully pairing further upstream supply chain relationships. Furthermore, we looked at the stock market reaction for suppliers, following the efficient market hypothesis. Future research can evaluate the operating performance of suppliers as an alternative measure. Due to the challenges in using a sample of related firms (e.g., suppliers), researchers may use the difference-in-differences approach, where the focus can be on a single and significant event and its impact on a specific group of suppliers, and meanwhile, large panel data can be used. This will substantially support the estimation and tests on suppliers' operating performance.

Appendix A - Matching buyer-supplier links in the Compustat segment database

The buyers' reported names were first matched according to the order and number of letters of announcing firms' names. In the case that an almost certain match could be established, the supplier data (e.g., identifiers and the percentage of sales to the buyers) were collected from the database. For instance, most of the suppliers reported Ford Motor Company as 'Ford MTR'. The firms that reported Ford MTR as a significant buyer were considered to be a candidate for observation in the supplier sample.

Second, if uncertainty in the match existed, we examined the annual reports (10-k form) of the supplier reporting the ambiguous buyer's name in the U.S. Securities and Exchange Commission (SEC) EDGAR filing based on the CIK code¹. Unless the annual report clearly described the same buyer's identity as that of the announcing firm, the supplier was excluded from the sample. For example, the initial search on the announcing firm 'Sprint Nextel' yielded a firm 'Telenav INC' reporting 'Sprint' as its buyer in the Compustat segment database. The annual report of Telenav in the most recent fiscal year ending date prior to the announcement date (i.e., 30th June 2012 in this case) stated that "Revenue related to services provided through Sprint Nextel Corporation, or Sprint, comprised 37%, 42%, and 55% of revenue for fiscal 2012, 2011 and 2010." Consequently, Telenav was included as one of the supplier observations for the announcement made by Sprint Nextel.

Third, if an announcing firm is the subsidiary of a public-traded firm, only announcing firms' (i.e., the subsidiary) names were searched in the Compustat segment database because the impact of SSCM was likely to be only on the suppliers to the subsidiary rather than the overall suppliers to the parent company. For instance, the announcing firm Pratt & Whitney is a subsidiary of United Technologies. Suppliers who reported 'Pratt & Whitney' as buyers were included in the sample of suppliers, and the suppliers reporting 'United Technologies' as the buyer were excluded.

Fourth, if an announcing firm clearly indicated that the SSCM announcement applied to the overall suppliers, including the suppliers of its subsidiaries, and the subsidiaries' identities were given in the announcement, the suppliers reporting the subsidiaries as buyers were also included

¹ Central Index Key (CIK) is a number given to a company by the SEC to identify the filings. Compustat segment database gives a clear CIK number of each reporting firm (i.e., supplier).

in the sample. For example, since a Wal-Mart announcement stated, “The new program requires Wal-Mart and Sam's Club beef suppliers to implement controls [...],” the suppliers reporting Wal-Mart and Sam’s club, respectively, as buyers were both included in the sample.

We conservatively included supplier data from the Compustat segment database in the supplier sample, although discretion was applied to the match by using the references discussed above. While some reported buyer-supplier links were coded as a possible match, these data were excluded from the final sample. The principle of this research (when collecting the supplier sample from the Compustat segment database) was to reduce uncertainty by excluding supplier data, as the potential cost of mismatching a buyer-supplier link is greater than the potential cost of failing to match a link (Fee & Thomas, 2004).

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