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WHO BENEFITS MORE FROM SUPPLY CHAIN ALLIANCES? CUSTOMERS OR SUPPLIERS

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Abstract. Existing research provides limited evidence on the impact of supply chain relationships on the financial performance of upstream and downstream firms. Taking the recent proliferation of supply chain alliances between Chinese listed companies as an opportunity, we study the impact of supply chain alliances on the performance of customers and suppliers as well as the underlying mechanisms at play. We focus on Chinese A-share listed companies from 2001 to 2021 and use announcements issued by the listed companies to identify whether they have established a supply chain alliance with another listed company. The announcements come from the information disclosure system of listed companies of the Shenzhen Stock Exchange and the Shanghai Stock Exchange. Finally, we obtained 148 pairs of supply chain alliances which formed by 231 listed companies and involved 296 announcements of supply chain alliances. By using the propensity score matching method and difference-in-differences regressions, we find that supply chain alliances can alleviate friction between customers and suppliers and significantly improve the efficiency of working capital used by both customers and suppliers. Supply chain alliances increase suppliers' inventory turnover and accounts receivable turnover, and reduce cash holdings, while supply chain alliances improve customer raw material turnover, and reduce accounts payable turnover. Moreover, the economic impact of supply chain alliances on customers and suppliers is asymmetric. Suppliers benefit more from alliances relative to customers, as evidenced by significant improvements in their financial performance and significantly reduced performance volatility. The "inherent differences" in market power and market value between customers and suppliers can have considerable asymmetries on economic consequences. We divide firms in a pair of supply chain alliances by market power and market value. The magnitude of the financial performance accruing from an alliance is considerably higher for the lower-market-power firm than for the higher-market-power firm. The magnitude of the financial performance accruing from an alliance is considerably higher for the lower-market-value firm than for the higher-market-value firm. Additionally, vertical supply chain alliances can significantly improve firm performance and reduce performance volatility compared to horizontal supply chain alliances. This paper provides new empirical evidence for our insight into the economic consequences of supply chain alliances and their boundary conditions.

Keywords: supply chain alliances, supplier, customer, working capital, financial performance.

JEL Classification: G33, G34, L22.

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1. Introduction

In the 21st century, competition is no longer limited to inter-firm rivalry but extends to competition between supply chains (Christopher, 1992). In the current "VUCA" (volatile, uncertain, complex, and ambiguous) environment characterized by the global spread of COVID-19, rising trade protectionism, and escalating geopolitical conflicts, the tension in global supply

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chains has highlighted the importance and necessity of ensuring their security and stability. Consequently, the enhancement of resilience and security of the supply chains has emerged as a critical issue that needs to be addressed by the business community and academia (Grossman et al., 2023; Elliott et al., 2022; Alfaro-Ureña, et al., 2022; Crosignani et al., 2023).

In response to the "VUCA" environment and to ensure the security and stability of supply chains, relationships between firms have gradually shifted from traditional short-term transactional relationships to long-term strategic alliances. The emergence of sticky customer-supplier relationships has become a prominent feature in the global value chain (World Bank, 2020).

The literature states that supply chain alliances (SCAs hereinafter) are customer-supplier long-term alliances, characterized by continuity between firms operating in adjacent value chain stages (Cannavale et al., 2021). A growing literature has examined various effects of customer-supplier relationships on corporate decisions, such as capital structure decisions (Kale & Shahrur, 2007; Banerjee et al., 2008), relationship-specific investments (Kale, 2010), cross-ownership (Fee et al., 2006), knowledge spillovers (Isaksson et al., 2016; Aggarwal, 2020), and innovation (Chu et al., 2019). Due to data limitations, the existing literature has largely overlooked an essential impact of SCAs: their real effects on the financial performance of customers and suppliers. In this paper, we study how SCAs affect the financial performance of customers and suppliers. Specifically, we focus on who can benefit more from SCAs, customers or suppliers, and corresponding boundary conditions.

Since 2018, a significant increase in SCAs between customers and suppliers has been observed among listed companies in China, such as Guangzhou Automobile Group Co., Ltd. (601238), and iFlytek Co., Ltd. (002230), China Western Construction Group Co., Ltd. (002302) and Anhui Conch Cement Co., Ltd. (600585), indicating a rapid growth trend (see Figure 1). Therefore, taking advantage of the widespread occurrence of SCAs among the Chinese listed companies in recent years, this study explores the impact of SCAs on the financial performance of both customers and suppliers, along with their underlying mechanisms.

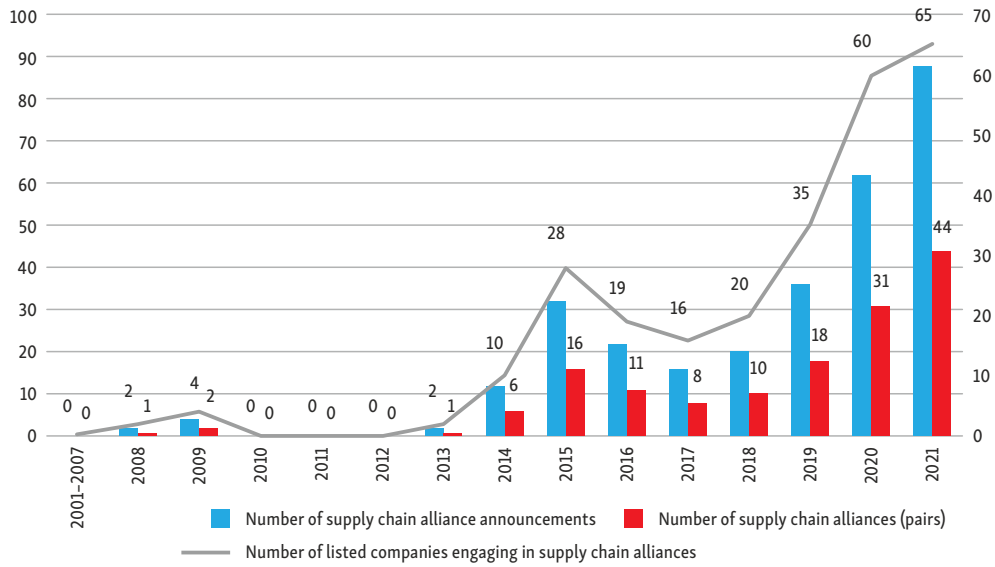

Figure 1. The trend of supply chain alliances among the Chinese listed companies

Generally, companies' formation of strategic alliances is a result of adapting to the external environment and seeking advantages while avoiding risks. Unlike other types of strategic alliances, such as R&D alliances, SCAs are long-term and stable alliances established by customers and suppliers to mitigate market friction through cooperation contracts. For customers, establishing alliances with suppliers aims to reduce transaction costs and ensure a reliable supply source. For suppliers, forming alliances with customers allows them to secure stable and dependable sales markets. As a result, SCAs significantly reduce transaction costs and information asymmetry between customers and suppliers (Williamson, 1991; Baiman & Rajan, 2002; Kepler, 2021), which thereby achieves mutual complementarity and risk sharing, and leads to a "win-win" situation.

The natural demand-supply relationship between customers and suppliers, formed through the exchange of goods and services, renders SCAs particularly susceptible to the impact of supply-demand contradictions. Consequently, these contradictions have far-reaching implications for the alliance and economic consequences between customers and suppliers. SCAs are often characterized by inherent demand-supply contradictions and opportunistic behavior from both sides (Hart, 1988; Oxley, 1997), as well as conflicts between cooperation and competition (Das & Teng, 2000). As a result, SCAs frequently experience high failure rates (Dyer et al., 2001) and significant instability (Wang & Zajac, 2007). The attainment of intended goals and win-win outcomes is not always guaranteed (Kale & Singh, 2009), and instead, the interests of alliance partners can be severely compromised (Kale et al., 2002; Lerner & Malmendier, 2010). Therefore, it is crucial to empirically study whether SCAs between customers and suppliers can achieve mutual benefits and win-win outcomes, which is the central focus of this paper.

This paper contributes to two aspects. First, our research contributes to the literature on corporate finance from the perspective of an industrial organization. Customers and suppliers are crucial stakeholders for firms, and a close customer-supplier relationship serves as an essential substitute for vertical integration, reducing transaction costs and agency costs (Coase, 1937; Williamson, 1991). Therefore, the relationship between a firm and its customers/suppliers has a profound impact on corporate financial policies, such as investment and financing policies (Titman & Wessels, 1988; Kale & Shahrur, 2007; Banerjee et al., 2008) and tax planning (Cen et al., 2017). However, due to data limitations, existing research has provided little evidence on the impact of supply chain relationships on the asymmetric performance of upstream and downstream firms. Our study extends this literature by focusing on the asymmetric performance of SCAs in the context of China. Our evidence suggests that strategic alliances between customers and suppliers not only affect a company' s cash policy and working capital efficiency, but also have asymmetric effects on the financial performance of upstream and downstream firms.

Second, this paper contributes to the study of synergies in strategic alliances from the perspective of customer-supplier relationships. Boundary changes have profound economic implications for firms (Coase, 1937), and alliances greatly expand the boundaries of firms, inevitably leading to significant economic impacts. Although economic theories suggest that pursuing synergies is the original intention behind forming alliances (Li et al., 2019), the specific sources of synergies (Sheen, 2014) and how strategic alliances can better achieve synergies in practice have remained challenging questions for academia. Due to data limitations,

previous research could only observe one party of the alliance with publicly available data or data obtained through questionnaires (Fudge Kamal et al., 2021; Lumineau & Oliveira, 2018), making it impossible to analyze the performance changes of both alliance parties empirically. In an alliance, the positive performance trend of one party does not necessarily indicate the creation and realization of synergies. It may result from that party's gains achieved by appropriating the value of the alliance partner, leading to losses for the other party. Therefore, research has not yet examined whether strategic alliances formed by customers and suppliers can achieve synergies. As a special type of strategic alliance, SCAs inherently involve the contradiction between customers and suppliers. This paper investigates the variations in performance of customers and suppliers engaged in SCAs. It provides a fundamental initial insight into whether and how SCAs can realize synergies and identifies the origins of these synergies.

The main findings of this paper are as follows: First, SCAs can alleviate friction between customers and suppliers and significantly improve the efficiency of working capital utilization for both parties. Specifically, SCAs can increase inventory turnover and accounts receivable turnover for suppliers while reducing their cash holdings. Additionally, SCAs can enhance customers' raw material turnover and reduce accounts payable turnover.

Second, the economic impact of SCAs on customers and suppliers is asymmetric. Suppliers benefit more from SCAs, as evidenced by significant improvements in their financial performance and reduced performance volatility.

Third, there exists a "large customer-small supplier" alliance in SCAs. Customers tend to select suppliers with lower financial risks and higher R&D investment as their alliance partners, while suppliers choose customers with ample cash flow as their alliance partners.

Fourth, the "inherent differences" in market power and value between customers and suppliers lead to asymmetric economic consequences. After allying, the lower-market-power partner in an SCA experiences better financial performance and lower performance volatility. Similarly, the partner with smaller-market-value achieves better financial performance and lower performance volatility.

Fifth, compared to horizontal SCAs, vertical SCAs significantly improve firms' financial performance and reduce performance volatility.

The rest of the paper is organized as follows. Section 2 provides a review of the literature and develops the research hypothesis. Section 3 describes the research design. Section 4 reports our empirical results. Section 5 examines customers' and suppliers' "inherent differences" and asymmetric performance. Section 6 explores the different economic consequences of horizontal SCAs and vertical SCAs. Section 7 provides a conclusion. Section 8 proposes practical suggestions and managerial implications.

2. Literature review and hypotheses development

2.1. SCAs and working capital for customers-suppliers

Recently, the enhancement of resilience and security of the supply chains has emerged as a critical issue that needs to be addressed by the business community and academia (Grossman et al., 2023; Elliott et al., 2022; Alfaro-Ureña et al., 2022; Crosignani et al., 2023). SCAs, which

are strategic alliances based on the supply chain, impact the working capital of customers and suppliers by improving supply chain management efficiency. For suppliers, establishing alliances with customers allows them to become critical suppliers tailored to the specific needs of their customers (Gereffi, 2020). This provides products and services that are more targeted, thereby significantly reducing downstream demand uncertainty. In addition, if a supplier's production is disrupted due to the slow collection of receivables and poor liquidity, this can affect the supply to the customer, which is particularly detrimental to the partner customer. The customer will promptly pay the partner supplier's accounts payable to avoid such a situation. Supply chain alliances can, therefore, improve working capital efficiency by accelerating sales of suppliers' products and shortening the recovery cycle of accounts receivable, which thereby reduces unnecessary defensive risk cash holdings.

By partnering with suppliers, customers can share their demand plans (Patatoukas, 2012), and suppliers can then respond quickly to tailor them in terms of price, quality, specifications, and delivery times (Gereffi, 2020). Thus, SCAs allow customers to secure a reliable source of raw materials, significantly reduce the risk of shortages and losses and increase raw material turnover. In addition, customers will have greater flexibility in their repayment methods due to the commercial credit provided by suppliers, which facilitates smoother cash flow turnover. Therefore, SCAs can improve the working capital efficiency of customers. Based on this, we propose the following hypothesis.

H1: *SCAs can improve working capital efficiency for both customers and suppliers.*

2.2. SCAs and financial performance for customers-suppliers

SCAs profoundly impact the financial performance of customers and suppliers in the following ways. Firstly, SCAs establish long-term cooperative relationships between customers and suppliers with complex market relations, which greatly reduces transaction costs and information asymmetry between customers and suppliers (Coase, 1937; Williamson, 1991). This results from customers and suppliers pursuing higher resource allocation efficiency and is the main reason for the synergies generated by SCAs. Furthermore, close customer-supplier relationships encourage customers and suppliers to invest in relationship-specific capital, equipment, and knowledge (Titman & Wessels, 1988; Kale & Shahrur, 2007; Isaksson et al., 2016; Aggarwal, 2020). Hart and Moore (1990) pointed out that suppliers in cooperative relationships usually provide highly customized inputs to customers based on repeated transactions without complete contracts. Therefore, SCAs can increase the participation of customers and suppliers in the product development process, shorten the product development cycle, reduce costs in the supply chain, and enhance their respective production capabilities, which thereby improves firm performance.

Secondly, the resource-based view suggests that SCAs are essential for customers and suppliers to access complementary resources (Gulati, 1998; Mitsuhashi & Greve, 2009). For companies, products and resources are two sides of the same coin. Most products require multiple resources for creation, and most resources can create various products (Wernerfelt, 1984). SCAs can effectively increase a company's resource accumulation without reducing its resource stock. Therefore, customers and suppliers benefit from the spillover effects of resources within SCAs (Dussauge et al., 2004; Boone & Ivanov, 2012).

Thirdly, SCAs improve customer-supplier financial performance by enhancing supply chain resilience. Supply chain resilience is the ability of the supply chain system to recover to its original state or adjust to an ideal state after shocks (Christopher & Peck, 2004). It reduces risks such as geopolitical conflicts, network attacks, energy interruptions, financial crises, natural disasters, and pandemics (National Science & Technology Council, 2022) through interdependent systems capable of withstanding various external shocks. Therefore, actively building supply chain resilience is crucial for ensuring the security and stability of the supply chain, and SCAs play a vital role in this regard. Alliance partners provide flexibility and adaptability when market demand changes and are willing to respond quickly to unexpected situations, which helps companies recover from unforeseen shocks. Thus, SCAs are critical for shaping supply chain resilience and improving supply chain management efficiency.

In addition, SCAs can reduce business risks for customers and suppliers. On the one hand, companies can alleviate competition with peer firms through SCAs (Eisenhardt & Schoonhoven, 1996). On the other hand, companies can adjust their production activities based on the number of orders through SCAs. For suppliers, forming SCAs increases the level of strategic and operational information sharing between companies (Eckerd & Hill, 2012). Customers become proactive in order placement, reducing the "bullwhip effect" and decreasing the accumulation of funds and performance volatility. For customers, SCAs provide better planning for raw material procurement, allowing customers to set optimal order quantities based on their own needs and enjoy discounts in raw material costs. Based on this, we propose the following hypothesis.

H2: *SCAs can enhance the financial performance of both customers and suppliers and reduce performance volatility for both parties.*

2.3. SCAs and asymmetric performance for customers-suppliers

Examining the symmetry of returns is a crucial issue in studying inter-organizational relationships. A notable trend is the rapid growth of SCAs between large, well-established firms and small, growing firms. The literature term these alliances involving disparately sized firms as asymmetric alliances (Kalaignanam et al., 2007; Cannavale et al., 2021). This "inherent difference" largely determines the asymmetry in value distribution during the evolution of alliances. Examining a sample of 60 joint ventures, McConnell and Nantell (1985) observe that the smaller firm's investors receive larger abnormal returns, but the absolute gains in shareholder value for both partners are more or less equivalent. Likewise, Chan et al. (1997) conclude that while smaller partners experience larger abnormal returns than do larger partners, the magnitudes of the gains are roughly equal. In addition, Kalaignanam et al. (2007) further argue that small firms have higher financial returns in new product development alliances than large firms.

However, Alvarez and Barney (2001) argue that in many cases, the larger partner appropriates much of the economic value created by smaller/entrepreneurial and larger firms. Thus, although studies have identified asymmetries in the financial gains of alliances, there have been many contradictions and debates about the distribution of financial profits between the larger

and smaller partners. Furthermore, existing empirical studies mainly focus on asymmetries in the short-term market reactions of alliance firms and have not yet examined whether the long-term financial performance of alliance firms also exhibits asymmetry. It is worth noting that in SCAs among listed companies in China, there exists a partner relationship of "large customers-small suppliers" (see Table 9), and it is worth studying whether this leads to asymmetry in financial performance generated by SCAs. Based on this, we propose the following hypothesis.

H3: *SCAs exhibit asymmetric firm performance due to market power and market value of alliance partners.*

2.4. Vertical SCAs vs. horizontal SCAs

Based on the similarities and differences in the partners' industries, alliances can be classified into two types: vertical and horizontal (Boone & Ivanov, 2012). We believe that vertical SCAs are different from horizontal SCAs and have different economic consequences for the following reasons. Firstly, horizontal SCAs involve more competition, while vertical SCAs involve more cooperation. Cooperation and competition are the apparent contradictions within alliances (Das & Teng, 2000). Firms compete intensely due to similar business domains, which often leads to more "learning races" among alliance partners (Hamel, 1991; Runge et al., 2022; Lavie et al., 2022). Although competitors may form alliances to reduce competitive interdependence, the ultimate goal of each partner is to increase its market power at the expense of the other firm in the future because firms with similar business domains have a high tendency to engage in interfirm competition (Dussauge et al., 2004). As a result, horizontal SCAs introduce goal misalignment, highlighting the tension between personal and expected benefits (Yang et al., 2015). When firms in the same industry form SCAs, issues of potential asymmetric benefits and appropriation become particularly prominent, hindering the creation and realization of synergies.

Secondly, horizontal SCAs exhibit a greater imbalance between long-term and short-term orientations. The conflict between long-term and short-term orientations is the primary source of alliance instability (Das & Teng, 2000). Alliances with short-term orientations are viewed as transitional organizations that emphasize short-term results. Conversely, alliances with long-term orientations are seen as at least semi-permanent economic entities that emphasize more patience and commitment. If the alliance is predominantly short-term oriented, it will give rise to more exploitation and opportunism among alliance partners, inhibit mutual trust, and result in behavior such as underinvestment and non-fulfillment of commitments. Therefore, alliances among firms in the same industry lead to a focus on "learning races" and pursuing short-term gains surpassing the cooperative partners, which results in the loss of long-term alliance benefits. Consequently, horizontal SCAs and vertical SCAs have different contradictions and conflicts, which leads to different economic consequences. Based on this, we propose the following hypothesis.

H4: *Compared to horizontal SCAs, vertical SCAs can generate better firm performance.*

3. Research design

3.1. Identification and sample selection of SCAs

This study focuses on Chinese A-share listed companies from 2001 to 2021. And we use announcements issued by the listed companies to identify whether they have established an SCA with another listed company. If the announcement contains the following elements: (1) it is clear that both parties will engage in deep supply chain cooperation; (2) an accurate purchase and sales plan is agreed on (i.e., the specific goods to be purchased and sold as well as the quantity and other information are indicated); (3) the specific rights and obligations of both parties to the alliance in terms of supply chain activities are agreed on; (4) it is agreed that under the same market conditions, the alliance partner will be preferred as a supplier/customer; (5) it is agreed that the firm will use its advantages to agree to help the alliance partner develop upstream/downstream markets; (6) agree to include the strategic partner in the firm' s supplier/customer list, which we define as a SCA. Listed companies that provide goods or services or are in the upstream market are defined as suppliers. In contrast, listed companies that purchase goods or services or are in the downstream market are defined as customers.

The SCA announcements come from the information disclosure system of listed companies of the Shenzhen Stock Exchange and the Shanghai Stock Exchange. We followed the steps in Table 1 to identify SCA and obtained 148 pairs of SCAs formed by 231 listed companies, involving 296 SCA announcements.

Table 2 reports the annual distribution of SCAs among Chinese A-share listed companies from 2001 to 2021. From 2001 to 2007, there were very few SCAs. However, Table 2 shows that the number of SCAs and companies participating in an SCA grew steadily from 2013 to 2021.

Table 1. Identification of SCAs among Chines listed companies

Items	Number of Alliance Announcements	Number of Companies
Alliance announcements issued by A-share listed companies from 2001 to 2021	6251	1936
Plus: Splitting announcements involving three or more alliance parties	1187	—
Minus: Strategic alliance announcements signed with related companies	136	—
Terminated strategic alliance announcements	121	—
Strategic alliance announcements with government or non-profit organizations as alliance partners	1359	—
Strategic alliance announcements with non-A-share listed companies as alliance partners	5074	—
Strategic alliance announcements not related to SCA	402	—
Strategic alliance announcements in the SCA involving mutual sales	50	37
SCAs among A-share listed companies	296 (148 pairs)	231

Table 2. Sample distribution by year

Year	Number of SCA Announcements	Number of SCAs (Pairs)	Number of Listed Companies with a SCA	Number of Suppliers	Number of Customers
2001–2007	0	0	0	0	0
2008	2	1	2	1	1
2009	4	2	4	2	2
2010	0	0	0	0	0
2011	0	0	0	0	0
2012	0	0	0	0	0
2013	2	1	2	1	1
2014	12	6	10	5	5
2015	32	16	28	15	14
2016	22	11	19	10	10
2017	16	8	16	8	8
2018	20	10	20	10	10
2019	36	18	35	18	18
2020	62	31	60	29	31
2021	88	44	65	38	34
Total	296	148	231#	127#	119#

Note: # indicates the exclusion of companies with multiple SCAs from 2001 to 2021.

The number of SCAs (Pairs) and the number of companies with SCA increased from 1 and 2 in 2013 to 44 and 65, respectively, in 2021. By 2021, 231 A-share-listed companies had formed 148 pair SCAs.

3.2. Model design and variable definition

In line with related studies (Bena & Li, 2014; Li et al., 2019), we use the DID method to estimate the effect of SCAs on customers and suppliers and PSM to minimize endogeneity problems. We regard the formation of the SCA as an event. Companies with an SCA are included in the treatment group, and companies without an SCA are included in the control group. In terms of PSM, we use one-to-one nearest-neighbor matching with the replacement for each company in the treatment group.

The formation of SCAs is not random (Mitsuhashi & Greve, 2009; Boone & Ivanov, 2012), and firms self-select into SCAs. To test the existence of a self-selection problem, in the first step, we run logit and probit regressions of an indicator variable that equals 1 if a particular firm year is classified as treated (and 0 otherwise) on our matching variables, including all the independent variables. The results (see Table A1 in the Appendix) show that the firm size (*Size*), ownership nature (*SOE*), financial leverage (*Lev*), the largest shareholder (*First*), CEO duality (*Duality*), investment opportunities (*Tobin's Q*) and current ratio (*LDR*) affect the decision of a company to form an SCA. Therefore, it is necessary to use the PSM method to relieve the endogenous problem.

In the second step, we construct a control sample of firms that are matched to the treated firms along with a set of relevant, observable characteristics measured in the year before

the formation of SCA. To ensure the assumption of parallel trend and common-support, the matching variables include Industry, firm size (*Size*), ownership nature (*SOE*), financial leverage (*Lev*), the largest shareholder (*First*), investment opportunity (*Tobin's Q*), CEO duality (*Duality*), and current ratio (*LDR*). After PSM matching, the common-support of DID are satisfied, shown in Table 4.

Thirdly, the DID regression analysis is carried out. It should be noted that because a small number of companies in the treatment group have had two or more SCAs, we consider multiple SCAs as a treatment effect. The test models are as follows:

$$WCT_{it} / RST_{it} / RMT_{it} / TRAP_{it} / TAR_{it} / Cashhold_{it} = \alpha_0 + \alpha_1 Post_{it} + \alpha_2 SCA_i \times Post_{it} + \alpha_3 X_{it} + \alpha_4 YearFE_t + \alpha_5 FirmFE_i + \xi_{it}; \quad (1)$$

$$Growth_{it} / RP_{it} / NP_{it} = \beta_0 + \beta_1 Post_{it} + \beta_2 SCA_i \times Post_{it} + \beta_3 X_{it} + \beta_4 YearFE_t + \beta_5 FirmFE_i + \xi_{it}; \quad (2)$$

$$Vol(\mathrm{Rev}_{it}) / Vol(NCF_{it}) = \eta_0 + \eta_1 Post_{it} + \eta_2 SCA_i \times Post_{it} + \eta_3 X_{it} + \eta_4 YearFE_t + \eta_5 FirmFE_i + \xi_{it}. \quad (3)$$

Model (1) is used to examine the impact of SCAs on corporate working capital. Following the related literature (Patatoukas, 2012; Opler et al., 1999), we use working capital turnover (*WCT*) and cash holdings (*Cashhold*) as proxy variables for the efficiency of working capital utilization. We furthermore analyze the raw material turnover (*RMT*) and accounts payable turnover (*TRAP*) for customers, and inventory turnover (*RST*) and accounts receivable turnover (TAR) for suppliers.

Model (2) is used to examine the impact of SCAs on firm performance. We use revenue growth (*Growth*), net profit margin (*RP*), and net profit (*NP*) as proxy variables for financial performance.

Model (3) is used to examine the impact of SCAs on performance volatility. Following the related literature (Kothari et al., 2002), we use the standard deviation of revenue over three years (*Vol* (*Rev*)) and the standard deviation of net cash flow over three years (*Vol* (*NCF*)) as proxy variables for performance volatility.

The regression coefficient of interaction *SCA* × *Post* reflects the difference in working capital, financial performance, and performance volatility between the treatment and control groups before and after the events. Specifically, if the SCA improves the working capital and financial performance level, the interaction's regression coefficients α_2 and β_2 will be significantly positive. Specifically, if the SCA decreases the level of the performance volatility, the regression coefficient η_2 of the interaction will be significantly negative.

X is a vector of control variables. Following the related literature (Robinson, 2008; Boone & Ivanov, 2012), X includes the firm size (*Size*), ownership nature (*SOE*), financial leverage (*Lev*), CEO duality (*Duality*), firm's life cycle (*Age*), investment opportunities (*Tobin's Q*), independent directors (*Indep*), earnings per share (*EPS*), and current ratio (*LDR*). We also control double fixed effects (*YearFE* and *FirmFE*). Specific definitions and measurements of the variables in the model are shown in Table 3. We did the test using Stata 17.0. Financial data and firm characteristic data are obtained from the Wind Database.

Table 3. Variable definitions

Variable	Symbol	Definition
Supply chain alliance among listed companies	*SCA*	Dummy variable equals to one if the listed company has formed an SCA with another listed company and zero otherwise
The periods before and after the formation of SCA	*Post*	Dummy variable equals to one in the year the company forms an SCA and in the subsequent years and zero otherwise
Working capital turnover	*WCT*	Revenue / (Average current assets – average current liabilities)
Inventory turnover	*RST*	Cost of goods sold / (Average inventory balance), where average inventory balance = (Beginning inventory balance + ending inventory balance) / 2
Raw material turnover	*RMT*	Cost of goods sold / (Average raw materials balance), where average raw materials balance = (Beginning raw materials balance + ending raw materials balance) / 2
Accounts receivable turnover	*TAR*	Revenue / Average accounts receivable balance, where average accounts receivable balance = (Beginning accounts receivable balance + ending accounts receivable balance) / 2
Accounts payable turnover	*TRAP*	Revenue / Average accounts payable balance, where average accounts payable balance = (Beginning accounts payable balance + ending accounts payable balance) / 2
Cash holdings	*Cashhold*	*Cashhold* is measured as cash-to-assets and marketable securities divided by total book assets
Revenue growth	*Growth*	Growth = (Revenue of current year – Revenue of previous year) / Revenue of previous year
Net Profit margin	*RP*	Net profit / Revenue
Net Profit	*NP*	Total profit – Income tax expense
Volatility of revenue	*Vol*(*Rev*)	Standard deviation of firm revenue for three years $\times 10^{-9}$
Volatility of net cash flow	*Vol*(*NCF*)	Standard deviation of firm operating cash flow for three years $\times 10^{-9}$
Firm life cycle	*Age*	Age of the company, *Age* = (current period- establishment date)/365
Firm size	*Size*	Natural logarithm of total assets of the company at the end of the year
Investment opportunity	*Tobin's Q*	The ratio of market value to book assets at the end of the year of the previous period
Ownership nature	*SOE*	Dummy variable equals to one if the company is a state-owned firm and zero otherwise
Largest shareholder	*First*	The shareholding ratio of the largest shareholder
CEO duality	*Duality*	Dummy variable equal to one if the CEO is also the chairman and zero otherwise
Independent directors	*Indep*	Proportion of independent directors of the company
Earnings per share	*EPS*	Earnings per share for the current year
Financial leverage	*Lev*	The asset-liability ratio = total liabilities / total assets
Current ratio	*LDR*	The current ratio = current assets / current liabilities
Year effects	*YearFE*	Year fixed effect
Firm effects	*FirmFE*	Firm fixed effect

Table 4. T-test of the mean of covariates before and after PSM

Variables	Before PSM			After PSM		
	Treatment	Control	Mean Difference	Treatment	Control	Mean Difference
Size	22.6351	22.0027	0.6324***	22.6351	22.6359	–0.0008
SOE	0.2445	0.3466	–0.1021***	0.2445	0.2494	–0.0049
Lev	0.4460	0.4727	–0.0267	0.4460	0.5781	–0.1321
First	0.3218	0.3513	–0.0294***	0.3218	0.3211	0.0007
Indep	0.3756	0.3779	–0.0024	0.3756	0.3784	–0.0029
Duality	0.3812	0.2916	0.0896***	0.3812	0.3655	0.0157
Age	17.9063	17.3345	0.5718	17.9063	18.6225	–0.7162
EPS	0.5480	0.3918	0.1562**	0.5480	0.4927	0.0552
Tobin's Q	2.1503	2.8354	–0.6852	2.1503	2.3553	–0.2050
LDR	2.0809	2.6892	–0.6084**	2.0809	2.1804	–0.0995
No. of Firms	231	4361	—	231	231	—

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01.

Table 4 presents a t-test of the mean of covariates before and after PSM. The data in Table 4 indicates that before PSM matching, significant differences exist between the treatment and control firms in terms of company asset size (*Size*), ownership nature (*SOE*), ownership of the largest shareholder (*First*), CEO duality (*Duality*), earnings per share (*EPS*), and liquidity ratio (*LDR*). According to Table 4, after PSM matching, all important firm characteristics between the treatment and control firms are insignificant before participating in the SCAs.

4. Empirical results and analysis

4.1. Descriptive statistics

All continuous variables are winsorized at the 1% and 99% levels to reduce the influence of outliers. Table 5 shows descriptive statistics. The data in Table 5 show that the mean values of working capital turnover (*WCT*), sales growth (*Growth*) and net profit margin (*RP*) for the treatment group are greater than those of the matched control group (2.152 > 1.668; 0.253 > 0.192; 0.052 > –0.196). Additionally, the mean values of cash holdings (*Cashhold*), operating revenue volatility (*Vol* (*Rev*)), and net cash flow volatility (*Vol* (*NCF*)) for the treatment group is lower than those of the matched control group (0.196 < 0.197; 2.485 < 2.811; 0.687 < 0.893). This preliminarily indicates that the treatment group's working capital utilization, firm performance and performance volatility are better than the control group's.

Table 5. Descriptive statistics of variables

Variables	Group	N	Mean	SD	Min	Max	Median
WCT	Treatment	2400	2.152	17.05	–82.48	86.32	1.662
	Control (Before)	36236	2.076	13.04	–57.95	73.48	1.335
	Control (After)	2679	1.668	15.82	–82.48	86.32	1.324
Cashhold	Treatment	2400	0.196	0.138	0.013	0.697	0.159
	Control (Before)	36236	0.204	0.152	0.0109	0.724	0.161
	Control (After)	2679	0.197	0.138	0.0121	0.689	0.16
Growth	Treatment	2400	0.253	0.488	–0.591	3.043	0.164
	Control (Before)	36236	0.203	0.551	–0.659	3.963	0.117
	Control (After)	2679	0.192	0.459	–0.591	3.043	0.12
RP	Treatment	2400	0.052	0.549	–15.2	14.18	0.0781
	Control (Before)	36236	0.0545	0.244	–1.55	0.573	0.0684
	Control (After)	2679	–0.196	11.75	–533.6	109.7	0.0688
NP	Treatment	2400	0.9	3.091	–2.07	22.51	0.157
	Control (Before)	36236	0.354	1.051	–1.737	7.352	0.103
	Control (After)	2679	1.05	2.913	–2.07	22.51	0.171
Vol(Rev)	Treatment	2275	2.485	6.466	0.00666	45.18	0.444
	Control (Before)	34121	1.103	2.848	0.00553	20.69	0.257
	Control (After)	2576	2.811	7.058	0.00666	45.18	0.376
Vol(NCF)	Treatment	2275	0.687	1.735	0.00419	12.37	0.156
	Control (Before)	34121	0.383	0.884	0.00349	6.241	0.108
	Control (After)	2576	0.893	2.001	0.00419	12.37	0.153
RST	Treatment	2400	20.04	75.55	0.137	582.9	5.878
	Control (Before)	36210	20.5	79.58	0	683.3	5.253
	Control (After)	2679	17.01	59.21	0.137	582.9	5.134
RMT	Treatment	2400	108.4	430.6	1.896	3247	14.70
	Control (Before)	36236	152.5	735.1	0	6092	12.82
	Control (After)	2679	90.11	379.9	1.896	3247	12.51
TAR	Treatment	2400	33.05	90.21	0.703	588.4	6.887
	Control (Before)	36236	44.53	176.4	0.329	1451	5.665
	Control (After)	2679	26.62	44.9	0.703	588.4	4.677
TRAP	Treatment	2400	7.316	9.256	0.348	62.37	4.361
	Control (Before)	36236	8.35	13.22	0.377	98.72	4.661
	Control (After)	2679	7.297	8.949	0.348	62.37	4.521
Size	Treatment	2400	22.48	1.459	19.2	26.81	22.31
	Control (Before)	36236	22.03	1.307	19.26	26.06	21.86
	Control (After)	2679	22.61	1.644	19.2	26.81	22.32
SOE	Treatment	2400	0.305	0.461	0	1	0
	Control (Before)	36236	0.353	0.478	0	1	0
	Control (After)	2679	0.43	0.495	0	1	0

End of Table 5

Variables	Group	N	Mean	SD	Min	Max	Median
Lev	Treatment	2400	0.442	0.198	0.0596	0.955	0.446
	Control (Before)	36236	0.434	0.221	0.0501	1.031	0.422
	Control (After)	2679	0.459	0.213	0.0596	0.955	0.456
First	Treatment	2400	0.344	0.15	0.0721	0.756	0.323
	Control (Before)	36236	0.349	0.151	0.0876	0.756	0.328
	Control (After)	2679	0.343	0.158	0.0721	0.756	0.328
Duality	Treatment	2400	0.323	0.468	0	1	0
	Control (Before)	36236	0.287	0.452	0	1	0
	Control (After)	2679	0.309	0.462	0	1	0
Indep	Treatment	2400	0.372	0.0495	0.308	0.571	0.357
	Control (Before)	36236	0.378	0.0554	0.333	0.571	0.364
	Control (After)	2679	0.378	0.0568	0.308	0.571	0.364
Age	Treatment	2400	16.77	6.086	4	34	17
	Control (Before)	36236	17.38	5.887	4	32	17
	Control (After)	2679	17.42	6.008	4	34	17
EPS	Treatment	2400	0.471	0.743	–1.766	3.766	0.345
	Control (Before)	36236	0.373	0.627	–1.748	2.897	0.281
	Control (After)	2679	0.476	0.768	–1.766	3.766	0.315
Tobin's Q	Treatment	2400	2.15	1.467	0.846	10.98	1.693
	Control (Before)	36236	2.111	1.478	0.863	10.05	1.636
	Control (After)	2679	2.097	1.725	0.846	10.98	1.505
LDR	Treatment	2400	2.27	2.159	0.284	14.31	1.574
	Control (Before)	36236	2.536	2.777	0.238	17.81	1.643
	Control (After)	2679	2.12	2.246	0.284	14.31	1.467

4.2. The impact of SCAs on working capital for customers-suppliers

Table 6 presents the impact of SCA on working capital for customers-suppliers. On the supplier side, the results of Model (1) to (4) show that the regression coefficients of interaction *SCA* × *Post* are all significant (3.113, 13.558, 26.553 and –0.020, respectively). This means that, compared with suppliers without an SCA, suppliers experience a significant improvement in their working capital turnover (*WCT*), inventory turnover (*RST*), and accounts receivable turnover (*TAR*) after entering into an SCA. Furthermore, compared with suppliers without an SCA, suppliers' cash holdings (*Cashhold*) are significantly reduced after entering into an SCA. This result suggests that SCAs enhance the efficiency of working capital utilization for suppliers compared to those without an SCA.

Regarding customers, the results of Model (6) and (7) show that the regression coefficients of interaction *SCA* × *Post* are all significant (2.602 and –1.897, respectively). This indicates that, compared with customers without an SCA, customers experience a significant improvement in their raw material turnover (*RMT*) and accounts payable turnover (*TRAP*) after entering into an SCA. Additionally, SCAs do not significantly impact customers' cash holdings. These findings

demonstrate that SCAs alleviate friction between customers and suppliers, and significantly improve the efficiency of working capital utilization for both parties.

Based on the empirical results in Table 6, it can be found that the SCAs improve working capital for customers-suppliers. Hence, these results support Hypothesis 1.

Table 6. The impact of SCAs on working capital for customers-suppliers

Variables	Supplier				Customer			
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
	WCT	RST	TAR	Cashhold	WCT	RMT	TRAP	Cashhold
SCA × Post	3.113*	13.558*	26.553**	–0.020**	2.512	2.602*	–1.897***	–0.018
	(0.069)	(0.064)	(0.017)	(0.014)	(0.132)	(0.069)	(0.000)	(0.178)
Post	–0.536	–17.142*	–19.411*	0.016**	–1.486	–1.084	1.068**	0.016
	(0.763)	(0.067)	(0.061)	(0.022)	(0.348)	(0.280)	(0.023)	(0.157)
Size	–1.120	–0.819	–5.885	–0.007*	1.391	2.746*	–0.136	–0.000
	(0.309)	(0.811)	(0.218)	(0.056)	(0.116)	(0.097)	(0.563)	(0.976)
SOE	0.372	5.859	0.031	–0.036**	–1.151	0.282	3.454***	0.017
	(0.776)	(0.475)	(0.995)	(0.024)	(0.659)	(0.856)	(0.001)	(0.524)
Lev	6.226	–30.929	5.487	–0.004	–4.172	4.107	–1.457	–0.070
	(0.280)	(0.290)	(0.800)	(0.811)	(0.413)	(0.296)	(0.291)	(0.164)
First	0.566	6.037	1.985	–0.079***	–1.096	3.106	5.569***	0.007
	(0.946)	(0.874)	(0.933)	(0.005)	(0.865)	(0.527)	(0.002)	(0.888)
Indep	7.832	–5.679	28.499	–0.048	11.132	–4.838	3.142	–0.044
	(0.461)	(0.865)	(0.482)	(0.353)	(0.457)	(0.618)	(0.360)	(0.621)
Duality	0.373	5.357	–0.991	0.016***	0.775	0.853	0.229	0.026***
	(0.819)	(0.213)	(0.782)	(0.006)	(0.647)	(0.601)	(0.555)	(0.005)
Age	1.714**	4.799	11.876	0.021***	–0.220	0.123	0.085	0.030**
	(0.015)	(0.170)	(0.475)	(0.001)	(0.686)	(0.787)	(0.878)	(0.037)
EPS	0.901	–0.054	1.096	0.014***	1.433	0.878	–0.198	0.023***
	(0.189)	(0.960)	(0.749)	(0.000)	(0.247)	(0.292)	(0.419)	(0.000)
Tobin's Q	0.005	–0.834	–2.678	0.002	0.751*	0.048	–0.206	0.003
	(0.991)	(0.383)	(0.202)	(0.328)	(0.074)	(0.856)	(0.132)	(0.372)
LDR	–0.026	–3.184	–1.197	0.036***	0.165	0.396	0.391***	0.026***
	(0.892)	(0.175)	(0.283)	(0.000)	(0.477)	(0.131)	(0.000)	(0.001)
Constant	7.469	7.440	43.696	0.100	–30.59	–63.586	5.101	–0.145
	(0.742)	(0.942)	(0.804)	(0.308)	(0.132)	(0.122)	(0.491)	(0.427)
YearFE and FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	2551	2551	2551	2551	2762	2762	2762	2762
No. Treatment Observations	1251	1251	1251	1251	1290	1290	1290	1290
No. Control Observations	1300	1300	1300	1300	1472	1472	1472	1472

End of Table 6

Variables	Supplier				Customer			
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
	WCT	RST	TAR	Cashhold	WCT	RMT	TRAP	Cashhold
No. Treatment Firms	127	127	127	127	119	119	119	119
No. Control Firms	126	126	126	126	120	120	120	120
F-statistics	1.357**	0.856*	1.366**	68.428***	1.224**	0.863***	3.710***	11.219***
Prob> F	0.025	0.067	0.020	0.000	0.019	0.000	0.000	0.000
Adj. R2	0.009	0.018	0.024	0.430	0.011	0.064	0.036	0.308

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. The numbers in parentheses represent robust p-values.

4.3. The impact of SCAs on financial performance for customer-supplier

Table 7 shows the impact of SCA on the financial performance for customers-suppliers. On the supplier side, the results of Model (1) to (3) show that the regression coefficients of interaction *SCA* × *Post* are all significantly positive (0.132, 0.448 and 0.258, respectively). This indicates that, compared with suppliers without an SCA, suppliers experience significant improvements in their sales growth (*Growth*), operating profit margin (*RP*), and net profit (*NP*) after entering into an SCA. This result suggests that SCAs improve financial performance for suppliers compared to those without an SCA.

In contrast, regarding customers, the results of Model (4) to (6) show that the regression coefficients of interaction *SCA* × *Post* are not significant (0.065, 0.127 and 0.034, respectively). Comparison between models (1) and (4), (2) and (5), (3) and (6), respectively, suggest that the treatment effect is only significant in suppliers.

The results in Table 7 imply that there is an asymmetric performance between customers and suppliers in the SCAs, whereby suppliers benefit more significantly than customers in terms of their financial performance.

4.4. The impact of SCAs on performance volatility for customers-suppliers

Table 8 reports the impact of SCAs on performance volatility for customers-suppliers. On the supplier side, the results of Model (1) to (2) show that the regression coefficients of interaction *SCA* × *Post* are all significantly negative (–2.580 and –0.524, respectively). This indicates that, compared with suppliers without an SCA, suppliers experience a significant decrease in the volatility of their revenue (*Vol* (*Rev*)) and net cash flow (*Vol* (*NCF*)) after entering into an SCA. This result suggests that SCAs reduce performance risks for suppliers compared to those without an SCA.

On the other hand, for customers, the results of Model (3) to (4) show that the regression coefficients of interaction *SCA* × *Post* are not significant (–0.459 and –0.283, respectively). Comparison between models (1) and (2), (3) and (4), respectively, suggests that the treatment effect is only significant in suppliers.

Table 7. The impact of SCAs on financial performance for customers-suppliers

Variables	Suppliers			Customers		
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	Growth	RP	NP	Growth	RP	NP
SCA × Post	0.132***	0.448**	0.258**	0.065	0.127	0.034
	(0.001)	(0.025)	(0.049)	(0.271)	(0.169)	(0.852)
Post	–0.071**	–0.465***	–0.318***	–0.032	0.053	–0.160
	(0.047)	(0.008)	(0.006)	(0.623)	(0.520)	(0.213)
Size	0.122***	–0.445***	0.126**	0.359***	–0.285***	0.382***
	(0.000)	(0.000)	(0.030)	(0.000)	(0.000)	(0.002)
SOE	–0.238***	–1.017***	0.039	0.022	0.900***	–0.151
	(0.003)	(0.004)	(0.862)	(0.877)	(0.000)	(0.710)
Lev	0.370***	2.301***	–0.632*	1.108***	–0.785***	–0.574*
	(0.000)	(0.000)	(0.053)	(0.000)	(0.001)	(0.097)
First	0.054	–2.072***	–0.374	0.569	–0.493	–1.941**
	(0.706)	(0.006)	(0.444)	(0.164)	(0.125)	(0.023)
Indep	–0.737***	–0.259	0.566	–0.879*	0.190	1.388
	(0.005)	(0.842)	(0.506)	(0.066)	(0.758)	(0.625)
Duality	0.053*	0.206	–0.022	0.075	–0.108*	–0.209
	(0.077)	(0.170)	(0.827)	(0.141)	(0.099)	(0.110)
Age	–0.018	0.022	–0.199*	0.107*	–0.069	0.242***
	(0.593)	(0.902)	(0.089)	(0.058)	(0.492)	(0.009)
EPS	0.103***	0.291***	1.133***	0.334***	0.087**	1.534***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.030)	(0.000)
Tobin's Q	–0.004	–0.083*	0.096***	–0.073***	0.068***	–0.024
	(0.669)	(0.097)	(0.003)	(0.000)	(0.002)	(0.589)
LDR	0.013*	0.036	0.018	–0.013	0.117***	–0.019
	(0.063)	(0.322)	(0.442)	(0.170)	(0.000)	(0.285)
Constant	3.039***	9.173***	–1.426	6.553***	6.779***	–10.014***
	(0.000)	(0.000)	(0.364)	(0.000)	(0.000)	(0.000)
YearFE and FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	2551	2551	2551	2762	2762	2762
No. Treatment Observations	1251	1251	1251	1290	1290	1290
No. Control Observations	1300	1300	1300	1472	1472	1472
No. Treatment Firms	127	127	127	119	119	119
No. Control Firms	126	126	126	120	120	120
F-statistics	11.586***	3.780***	41.952***	7.336***	11.995***	4.756***
Prob> F	0.000	0.000	0.000	0.000	0.000	0.000
Adj.R^2	0.113	0.040	0.315	0.147	0.114	0.413

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. The numbers in parentheses represent robust p-values.

The results in Table 8 highlight the asymmetric performance between customers and suppliers in the SCAs, whereby suppliers benefit more significantly than customers in terms of their performance volatility.

Table 8. The impact of SCAs on customer-supplier performance volatility

Variables	Suppliers		Customers	
	Model (1)	Model (2)	Model (3)	Model (4)
	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)
SCA × Post	–2.580***	–0.524**	–0.459	–0.283
	(0.008)	(0.018)	(0.402)	(0.286)
Post	1.175	0.183	–0.083	0.072
	(0.147)	(0.333)	(0.863)	(0.732)
Size	2.085***	0.385***	2.024***	0.687***
	(0.000)	(0.000)	(0.000)	(0.000)
SOE	–3.145	–0.722	–0.853	–0.288
	(0.206)	(0.170)	(0.348)	(0.386)
Lev	0.517	0.684**	0.496	0.668
	(0.836)	(0.047)	(0.728)	(0.122)
First	–1.529	–0.706	–3.310**	–0.508
	(0.646)	(0.326)	(0.043)	(0.262)
Indep	–7.049	0.880	–11.376***	–0.105
	(0.270)	(0.726)	(0.001)	(0.952)
Duality	–0.127	0.022	0.226	0.009
	(0.769)	(0.901)	(0.570)	(0.952)
Age	0.354	–0.492	0.225	–0.222
	(0.538)	(0.393)	(0.698)	(0.510)
EPS	1.942***	0.336**	1.152***	–0.006
	(0.004)	(0.016)	(0.000)	(0.972)
Tobin's Q	–0.006	0.014	0.087	0.061
	(0.969)	(0.595)	(0.522)	(0.133)
LDR	0.145*	0.056***	0.149	0.114***
	(0.071)	(0.003)	(0.203)	(0.004)
Constant	–43.864***	–4.368	–39.093***	–12.543**
	(0.001)	(0.449)	(0.000)	(0.012)
YearFE and FirmFE	Yes	Yes	Yes	Yes
No. Observations	2416	2416	2649	2649
No. Treatment Observations	1179	1179	1228	1228
No. Control Observations	1237	1237	1421	1421
No. Treatment Firms	127	127	119	119
No. Control Firms	126	126	120	120
F-statistics	4.481***	4.088***	11.752***	3.551***
Prob> F	0.000	0.000	0.000	0.000
Adj.R^2	0.224	0.158	0.110	0.131

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. The numbers in parentheses represent robust p-values.

5. "Inherent differences" between customers and suppliers and asymmetric performance

5.1. "Inherent differences" between customers and suppliers in SCAs

To further explore the impact of SCAs on the financial performance of customers-suppliers, we analyzed the characteristics of customers and suppliers. Panel A data in Table 9 shows significant differences between customers and suppliers when forming SCAs. Specifically, customers tend to be older (i.e. The median value of age of supplier and customer is 17 and 18, respectively), have larger asset sizes (i.e. The mean value of size of supplier and customer is 22.57 and 23.16, respectively; the median value of size of supplier and customer is 22.23 and 23.02, respectively), higher market values (i.e. The mean value of market value of supplier and customer is 3.47 and 6.36 billion, respectively; the median value of market value of supplier and customer is 0.10 and 0.16 billion, respectively), and more abundant cash flows than suppliers (The median value of net operating cash flow of supplier and customer is 2.4 and 4.6 billion, respectively). Additionally, suppliers exhibit lower financial leverage and higher research and development intensity than customers.

Panel B data in Table 9 further supports the findings, indicating that larger customers dominate customer-supplier alliances in terms of asset size, age, market value, market power, financial leverage, and operating cash flows.

Table 9. Inherent differences between customers and suppliers in SCAs

Panel A Differences between customers and suppliers						
Variable	Mean			Median		
	Supplier	Customer	Difference	Supplier	Customer	Difference
Age	16.92	17.94	–1.02 (0.140)	17	18	–1** (0.028)
Size	22.57	23.16	–0.59*** (0.000)	22.23	23.02	–0.79*** (0.001)
Market Value (Billion)	3.47	6.36	–2.89** (0.049)	0.10	0.16	–0.60* (0.065)
Market Power	0.026	0.025	0.01** (0.01)	0.004	0.006	–0.002** (0.014)
Leverage	0.42	0.48	–0.06*** (0.000)	0.41	0.51	–0.10** (0.015)
Net Operating Cash Flow (Billion)	18.15	30.97	–12.82 (0.156)	2.40	4.60	–2.20** (0.020)
Net Operating Cash Flow/ Total Assets	0.05	0.06	–0.01 (0.174)	0.05	0.06	–0.01 (0.372)
Research and Development Expenditure/Total Assets	0.029	0.023	0.006* (0.079)	0.023	0.022	0.001 (0.375)
No. Observations	148	148	—	148	148	—
No. Treatment Firms	127	119	—	127	119	—

End of Table 9

Panel B Who is larger in the customer-supplier alliance?						
Variable	Supplier Larger		Customer Larger		Total	
	Pairs	Percentage	Pairs	Percentage	Pairs	Percentage
Asset Size	56	37.84	92	62.16	148	100.00
Age	71	47.97	77	52.03	148	100.00
Market Value	58	39.19	90	60.81	148	100.00
Market Power	64	43.24	84	56.76	148	100.00
Leverage	53	35.81	95	64.19	148	100.00
Net Operating Cash Flow	60	40.54	88	59.46	148	100.00

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. The values in the table represent firm characteristics in the year before forming the SCA; Market Power refers to the proportion of the company's revenue to the total revenue of its industry.

Therefore, it can be observed that there exists a "big customer-small supplier" relationship within SCAs. Customers tend to select suppliers with lower financial leverage and higher research and development intensity as their alliance partners, while suppliers choose customers with abundant cash flows as their alliance partners.

5.2. Market power of supply chain partner and asymmetric performance

We explore whether the treatment effects vary with the market power of supply chain partners. According to the related literature (Kalaignanam et al., 2007), we divide a pair of supply chain partners into two groups in terms of their market power ("MP = 1" vs. "MP = 0"). Then we repeat the same PSM and DID procedures in the primary regression. To make our results robust, based on the method of Bena and Li (2014), we re-examine the moderating effect of the firms' market power by using difference-in-difference-in-difference regressions.

Table 10. Market power of supply chain partners and firm performance

Variables	Lower Market Power (MP = 1)			Higher Market Power (MP = 0)					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)
	Growth	RP	NP	Growth	RP	NP	Growth	RP	NP
SCA × Post × MP							0.133**	0.290*	0.316*
							(0.035)	(0.091)	(0.061)
SCA × Post	0.154***	0.431**	1.278**	0.031	0.023	0.398	0.013	0.039	-0.175
	(0.004)	(0.033)	(0.039)	(0.586)	(0.452)	(0.206)	(0.729)	(0.661)	(0.107)
Post × MP							–0.010	–0.213	–0.705***
							(0.835)	(0.189)	(0.000)
Post	–0.036	–0.222	–0.767*	0.012	0.037	–0.408			
	(0.492)	(0.224)	(0.070)	(0.835)	(0.317)	(0.167)			

End of Table 10

Variables	Lower Market Power (MP = 1)			Higher Market Power (MP = 0)					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)
	Growth	RP	NP	Growth	RP	NP	Growth	RP	NP
Size	0.250***	–0.558***	1.339***	0.267***	-0.016	0.379***	0.272***	–0.342	0.325***
	(0.000)	(0.000)	(0.003)	(0.000)	(0.679)	(0.008)	(0.000)	(0.166)	(0.000)
SOE	–0.118	0.719***	–0.396	–0.166	–0.015	–0.875**	–0.155*	0.396	–0.554***
	(0.153)	(0.006)	(0.753)	(0.127)	(0.449)	(0.042)	(0.057)	(0.274)	(0.000)
Lev	0.881***	–1.348***	–2.108**	0.609*	–0.270*	–1.216	0.784***	–0.974*	0.217
	(0.000)	(0.004)	(0.047)	(0.075)	(0.063)	(0.224)	(0.000)	(0.089)	(0.102)
First	–0.175	–1.324*	–3.272*	0.848*	–0.156	–2.503**	0.341	–0.730	–0.967***
	(0.453)	(0.058)	(0.075)	(0.070)	(0.538)	(0.015)	(0.199)	(0.152)	(0.002)
Indep	–0.535	–0.769	0.673	–0.254	–0.111	–1.202	–0.353	–0.428	–0.920
	(0.159)	(0.576)	(0.813)	(0.705)	(0.394)	(0.612)	(0.440)	(0.504)	(0.123)
Duality	0.003	–0.574***	0.289	0.015	–0.089	0.387	0.004	–0.328	0.233***
	(0.941)	(0.000)	(0.451)	(0.805)	(0.323)	(0.345)	(0.912)	(0.139)	(0.001)
Age	0.118*	0.060	0.055	0.147**	0.043**	–0.174	0.087**	0.005	0.098***
	(0.079)	(0.754)	(0.916)	(0.028)	(0.016)	(0.194)	(0.026)	(0.937)	(0.000)
EPS	0.385***	0.951***	7.840***	0.241***	0.155***	2.830***	0.300***	0.559	1.318***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.007)	(0.000)	(0.000)	(0.104)	(0.000)
Tobin's Q	–0.060***	–0.267***	0.290**	–0.053**	–0.017	0.060	–0.054***	–0.174	0.055***
	(0.000)	(0.000)	(0.029)	(0.028)	(0.468)	(0.274)	(0.000)	(0.336)	(0.003)
LDR	–0.008	0.005	–0.103*	–0.042**	–0.003	0.040	–0.018*	–0.003	0.029***
	(0.392)	(0.831)	(0.069)	(0.028)	(0.569)	(0.285)	(0.064)	(0.958)	(0.002)
Constant	4.268***	12.013***	–28.150***	4.284***	0.078	–5.521	4.913***	7.910	–7.736***
	(0.000)	(0.000)	(0.007)	(0.000)	(0.916)	(0.112)	(0.000)	(0.161)	(0.000)
YearFE and FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	2505	2505	2505	2497	2497	2497	5002	5002	5002
No. Treatment Observations	1291	1291	1291	1197	1197	1197	2488	2488	2488
No. Control Observations	1214	1214	1214	1300	1300	1300	2514	2514	2514
No. Treatment Firms	127	127	127	111	111	111	231	231	231
No. Control Firms	127	127	127	111	111	111	231	231	231
F-statistics	9.320***	8.819***	10.871***	7.144***	4.420***	5.273***	12.833***	2.275***	5.937***
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adj.R^2	0.181	0.088	0.525	0.125	0.043	0.467	0.142	0.066	0.375

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. The numbers in parentheses indicate robust p-values. MP is a dummy variable, where MP = 1 indicates the supply chain partner with lower market power, and MP = 0 indicates the supply chain partner with higher market power.

Table 10 shows the results of the moderating effect of the firm's market power. The results of models (1) to (3) show that the regression coefficients of interaction *SCA* × *Post* are both significantly positive (0.154, 0.431 and 1.278, respectively), while the regression coefficients of the interactions *SCA* × *Post* in models (4) to (6) are not significant (0.031, 0.023 and 0.398, respectively). The comparison of models (1) with (4), (2) with (5), and (3) with (6) suggests that the treatment effect is significant exclusively in firms with lower market power.

Moreover, the results of models (7) to (9) show that the regression coefficients of interaction *SCA* × *Post* × *MP* are significantly positive (0.133, 0.290 and 0.316, respectively), indicating that our inferences are robust.

Therefore, the results in Table 10 show that market power of firm has a positive moderating effect on firm performance after participating in the SCAs. Hence, these results verify Hypothesis 3.

Table 11. Market power of supply chain partners and performance volatility

Variables	Lower Market Power (MP = 1)		Higher Market Power (MP = 0)			
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)
SCA × Post × MP					–0.072*	–0.35[7]**
					(0.068)	(0.014)
SCA × Post	–0.595**	–0.387**	–0.430	–0.286	0.022	0.006
	(0.014)	(0.047)	(0.498)	(0.304)	(0.396)	(0.946)
Post × MP					–0.018	–0.086
					(0.460)	(0.325)
Post	0.313	0.238*	0.335	0.120		
	(0.144)	(0.070)	(0.537)	(0.580)		
Size	1.278***	0.378***	1.909***	0.537***	0.157***	0.426***
	(0.000)	(0.000)	(0.003)	(0.001)	(0.000)	(0.000)
SOE	–0.348	–0.203	0.211	–0.284	–0.012	–0.265**
	(0.259)	(0.157)	(0.805)	(0.289)	(0.694)	(0.019)
Lev	1.424***	0.560**	–2.039	0.862**	0.045	0.744***
	(0.005)	(0.010)	(0.466)	(0.046)	(0.396)	(0.000)
First	–0.252	0.814	–0.080	0.964	0.002	0.988***
	(0.759)	(0.224)	(0.972)	(0.191)	(0.976)	(0.001)
Indep	0.507	0.142	0.856	0.896	0.143	0.473
	(0.751)	(0.815)	(0.862)	(0.731)	(0.330)	(0.372)
Duality	–0.057	0.090	0.372	0.108	0.017	0.082
	(0.730)	(0.224)	(0.404)	(0.698)	(0.280)	(0.174)
Age	0.033	0.046	0.501**	0.197***	0.034	0.079
	(0.899)	(0.458)	(0.011)	(0.008)	(0.197)	(0.336)
EPS	0.901***	0.097	1.763***	0.174	0.120***	0.161***
	(0.000)	(0.213)	(0.000)	(0.266)	(0.000)	(0.000)

End of Table 11

Variables	Lower Market Power (MP = 1)		Higher Market Power (MP = 0)			
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)
Tobin's Q	0.151***	0.022	0.040	0.044	0.014***	0.022
	(0.002)	(0.184)	(0.710)	(0.274)	(0.002)	(0.235)
LDR	0.049**	0.010	–0.024	0.125***	0.005*	0.036***
	(0.040)	(0.347)	(0.761)	(0.000)	(0.093)	(0.002)
Constant	–27.986***	–9.020***	–45.292***	–14.901***	–3.752***	–10.816***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
YearFE and FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	2482	2482	2432	2432	4914	4914
No. Treatment Observations	1211	1211	1146	1146	2357	2357
No. Control Observations	1271	1271	1286	1286	2557	2557
No. Treatment Firms	127	127	111	111	231	231
No. Control Firms	127	127	111	111	231	231
F-statistics	20.468***	4.551***	6.059***	4.518***	38.122***	30.931***
Prob> F	0.000	0.000	0.000	0.000	0.000	0.000
Adj.R^2	0.188	0.178	0.159	0.152	0.182	0.154

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. The numbers in parentheses indicate robust p-values. MP is a dummy variable, where MP = 1 indicates the supply chain partner with lower market power, and MP = 0 indicates the supply chain partner with higher market power.

Table 11 shows the results of the moderating effect of the firm's market power. The results of models (1) and (2) show that the regression coefficients of interaction *SCA* × *Post* are both significantly negative (–0.595 and –0.387, respectively), while the regression coefficients of the interactions *SCA* × *Post* in models (3) and (4) are not significant (–0.430 and –0.286, respectively). The comparison of models (1) with (3), and (2) with (4) suggests that the treatment effect is only significant in firms with lower market power. This result indicates that the impact of SCAs on the performance volatility of firms is asymmetric.

To make our results robust, we re-examine the moderating effect of the market power of the firms by using difference-in-difference-in-difference regressions. The results of models (5) and (6) show that the regression coefficients of interaction *SCA* × *Post* × *MP* are significantly negative (–0.072 and –0.357, respectively), which indicates that our inferences are robust.

Therefore, the results in Table 11 show that the firm's market power has a negative moderating effect on the performance volatility of firm after participating in the SCAs. Hence, these results verify Hypothesis 3.

5.3. Market value of supply chain partner and asymmetric performance

We explore whether the treatment effects vary with the market value of supply chain partners. According to the related literature (McConnell & Nantell, 1985; Chan et al. 1997), we divide a pair of supply chain partners into two groups in terms of their market value ("MV = 1" vs. "MV = 0"). Then we repeat the same PSM and DID procedures in the primary regression. To make our results robust, based on the method of Bena and Li (2014), we re-examine the moderating effect of the market value of the firms by using difference-in-difference-in-difference regressions.

Table 12. Market value of supply chain partner and firm performance

Variables	Smaller Market Value (MV = 1)			Larger Market Value (MV = 0)					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)
	Growth	RP	NP	Growth	RP	NP	Growth	RP	NP
SCA × Post × MV							0.092*	0.516**	0.108
							(0.053)	(0.049)	(0.590)
SCA × Post	0.125***	0.729**	0.316	0.064	0.201	0.121	–0.040	0.184	0.182
	(0.002)	(0.041)	(0.554)	(0.125)	(0.332)	(0.683)	(0.201)	(0.195)	(0.299)
Post × MV							–0.022	–0.466*	–0.373**
							(0.448)	(0.056)	(0.015)
Post	–0.073**	–0.399	0.456	–0.023	–0.195	–0.351			
	(0.045)	(0.206)	(0.317)	(0.506)	(0.285)	(0.257)			
Size	0.169***	–0.626***	1.323***	0.190***	–0.420***	0.051	0.061***	–0.687*	0.022
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.682)	(0.005)	(0.088)	(0.815)
SOE	–0.041	0.300	0.825	0.009	–0.201	–0.042	0.016	–0.376	–0.018
	(0.525)	(0.524)	(0.476)	(0.857)	(0.472)	(0.879)	(0.699)	(0.172)	(0.921)
Lev	0.686***	2.742***	–2.808**	0.337	1.220**	–1.198**	0.238**	2.496*	–0.524*
	(0.000)	(0.000)	(0.018)	(0.156)	(0.023)	(0.039)	(0.049)	(0.095)	(0.059)
First	–0.156	–3.453***	–4.655	0.316	–0.954	–1.904**	0.145	–2.524**	–1.198**
	(0.446)	(0.009)	(0.117)	(0.260)	(0.193)	(0.037)	(0.364)	(0.032)	(0.016)
Indep	–0.334	–2.721	–6.485	–0.611**	–0.903	–0.625	–0.415*	–1.628	–1.303*
	(0.361)	(0.257)	(0.148)	(0.024)	(0.524)	(0.756)	(0.082)	(0.325)	(0.086)
Duality	0.035	0.284	–0.391	0.026	–0.003	0.165	0.026	0.136	0.033
	(0.329)	(0.258)	(0.358)	(0.440)	(0.984)	(0.550)	(0.313)	(0.499)	(0.831)
Age	0.052	0.110	0.065	0.108***	0.074	–0.239	0.075***	0.064	–0.184
	(0.108)	(0.694)	(0.859)	(0.002)	(0.696)	(0.573)	(0.004)	(0.478)	(0.557)
EPS	0.279***	2.187***	7.975***	0.223***	0.718***	2.510***	0.202***	1.413**	1.760***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.016)	(0.000)

End of Table 12

Variables	Smaller Market Value (MV = 1)			Larger Market Value (MV = 0)					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)
	Growth	RP	NP	Growth	RP	NP	Growth	RP	NP
Tobin's Q	–0.046***	–0.291***	0.436***	–0.015	–0.169***	–0.045	0.007	–0.264	0.001
	(0.003)	(0.000)	(0.004)	(0.273)	(0.001)	(0.395)	(0.461)	(0.146)	(0.982)
LDR	–0.000	–0.036	–0.207**	–0.025***	–0.012	–0.000	–0.007	–0.019	–0.021
	(0.971)	(0.538)	(0.016)	(0.008)	(0.795)	(0.996)	(0.352)	(0.789)	(0.226)
Constant	3.139***	12.231***	–25.661***	3.291***	8.277***	2.182	–1.840***	14.161*	2.131
	(0.000)	(0.004)	(0.004)	(0.000)	(0.003)	(0.671)	(0.000)	(0.097)	(0.648)
YearFE and FirmFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	2608	2608	2608	2611	2611	2611	5219	5219	5219
No. Treatment Observations	1306	1306	1306	1221	1221	1221	2527	2527	2527
No. Control Observations	1302	1302	1302	1390	1390	1390	2692	2692	2692
No. Treatment Firms	129	129	129	110	110	110	231	231	231
No. Control Firms	131	131	131	112	112	112	233	233	233
F-statistics	11.587***	8.811***	16.441***	15.917***	4.165***	3.971***	19.837***	12.483***	5.904***
Prob> F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adj.R^2	0.170	0.086	0.416	0.183	0.042	0.365	0.126	0.064	0.346

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. Numbers in parentheses represent robustness p-values. MV is a dummy variable, where MV = 1 represents the supply chain partner with smaller market value, and MV = 0 represents the supply chain partner with larger market value.

Table 12 shows the results of the moderating effect of the firm's market value. The results of models (1) and (2) show that the regression coefficients of interaction *SCA* × *Post* are both significantly positive (0.125 and 0.729, respectively), while the regression coefficients of the interactions *SCA* × *Post* in models (4) to (6) are not significant (0.064, 0.201 and 0.121, respectively). The comparison of models (1) with (4), and (2) with (5) suggests that the treatment effect is only significant in firms with smaller market value.

Moreover, the results of models (7) and (8) show that the regression coefficients of interaction *SCA* × *Post* × *MV* are significantly positive (0.092 and 0.516, respectively), indicating that our inferences are robust.

The results in Table 12 show that the firm's market value has a positive moderating effect on the firm's performance after participating in the SCAs. Hence, these results verify Hypothesis 3.

Table 13. Market value of supply chain partner and performance volatility

Variables	Smaller Market Value (MV = 1)		Larger Market Value (MV = 0)			
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)
SCA × Post × MV					–1.008**	–0.294*
					(0.015)	(0.051)
SCA × Post	–1.276***	–0.335**	–0.232	–0.191	0.121	–0.041
	(0.007)	(0.037)	(0.708)	(0.254)	(0.649)	(0.666)
Post × MV					0.041	–0.173*
					(0.875)	(0.065)
Post	0.627	0.204	0.058	–0.264*		
	(0.129)	(0.190)	(0.895)	(0.081)		
Size	1.617***	0.295***	1.117***	0.787***	1.473***	0.530***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SOE	–2.282***	–0.065	0.093	–0.240	–0.200	–0.244**
	(0.000)	(0.580)	(0.865)	(0.247)	(0.518)	(0.029)
Lev	–1.183	0.139	3.810***	0.575	0.855	0.389*
	(0.293)	(0.662)	(0.003)	(0.211)	(0.137)	(0.085)
First	1.413	0.648	–1.604	0.567	–0.377	0.437
	(0.403)	(0.103)	(0.345)	(0.335)	(0.658)	(0.157)
Indep	2.643	3.833	–8.096	2.065*	–1.006	2.545***
	(0.342)	(0.115)	(0.164)	(0.062)	(0.507)	(0.000)
Duality	–0.199	0.057	0.179	0.290**	0.082	0.172***
	(0.548)	(0.349)	(0.694)	(0.020)	(0.642)	(0.007)
Age	0.453	0.068	0.045	0.239	0.282	0.160*
	(0.379)	(0.106)	(0.904)	(0.224)	(0.293)	(0.093)
EPS	1.330***	-0.013	2.112***	0.213***	1.334***	0.083**
	(0.000)	(0.923)	(0.000)	(0.001)	(0.000)	(0.042)
Tobin's Q	–0.086	0.014	–0.140	0.004	–0.007	0.029
	(0.419)	(0.427)	(0.173)	(0.921)	(0.907)	(0.159)
LDR	0.007	0.031**	0.123**	0.051*	0.059	0.040***
	(0.929)	(0.033)	(0.018)	(0.068)	(0.125)	(0.006)
Constant	–38.929***	–8.592***	–22.221***	–20.484***	–33.883***	–14.205***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
YearFE and FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	2480	2480	2367	2367	4847	4847
No. Treatment Observations	1225	1225	1170	1170	2395	2395
No. Control Observations	1255	1255	1197	1197	2452	2452
No. Treatment Firms	129	129	110	110	231	231
No. Control Firms	131	131	112	112	233	233

End of Table 13

Variables	Smaller Market Value (MV = 1)		Larger Market Value (MV = 0)			
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)
F-statistics	9.897***	3.336***	6.307***	19.676***	34.661***	30.383***
Prob> F	0.000	0.000	0.000	0.000	0.000	0.000
Adj.R^2	0.101	0.133	0.184	0.187	0.171	0.152

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. Numbers in parentheses represent robustness p-values. MV is a dummy variable, where MV = 1 represents the supply chain partner with smaller market value, and MV = 0 represents the supply chain partner with larger market value.

Table 13 shows the results of the moderating effect of the firm's market power. The results of models (1) and (2) show that the regression coefficients of interaction *SCA* × *Post* are both significantly negative (–1.276 and –0.335, respectively), while the regression coefficients of the interactions *SCA* × *Post* in models (3) and (4) are not significant (–0.232 and –0.191, respectively). The comparison of models (1) with (3), and (2) with (4) suggests that the treatment effect is only significant in firms with smaller market value. This result indicates that the impact of SCAs on the performance volatility of firms is asymmetric.

To make our results robust, we re-examine the moderating effect of the market power of the firms by using difference-in-difference-in-difference regressions. The results of models (5) and (6) show that the regression coefficients of interaction *SCA* × *Post* × *MV* are significantly negative (–1.008 and –0.294, respectively), which indicates that our inferences are robust.

The results in Table 13 show that the firm's market value has a negative moderating effect on the performance volatility of the firm after participating in the SCAs. Hence, these results verify Hypothesis 3.

6. Vertical SCAs vs. horizontal SCAs

According to the related literature (Cannavale et al., 2021), we partition our treatment sample into two subsamples based on whether the alliance partners are from the same industry. One subsample represents vertical SCAs, while the other subsample represents horizontal SCAs. Then we repeat the same PSM and DID procedures in the primary regression. According to the Industry Classification Guidelines for Listed Companies issued by the China Securities Regulatory Commission, we used standard industry codes (SIC) to determine whether a pair of supply chain partners are from the same industry. After that, among the 148 pair SCAs in this study, 32 pair SCAs were classified as horizontal SCAs, and 116 pair SCAs were classified as vertical SCAs.

Table 14 presents the impact of vertical and horizontal SCAs on corporate working capital. The results of models (1) and (2) show that the regression coefficients of interaction *SCA* × *Post* are both significant (4.192 and –0.013, respectively), while the regression coefficients of the interactions *SCA* × *Post* in models (3) and (4) are not significant (0.892 and –0.013, respectively). The comparison of models (1) with (3), and (2) with (4) suggests that the treatment effect is only significant in vertical SCAs.

Table 14. The impact of SCAs on corporate working capital: Vertical SCAs vs. horizontal SCAs

Variables	Vertical SCAs		Horizontal SCAs	
	Model (1)	Model (2)	Model (3)	Model (4)
	WCT	Cashhold	WCT	Cashhold
SCA × Post	4.192**	–0.013**	0.892	–0.013
	(0.016)	(0.039)	(0.607)	(0.327)
Post	–4.029**	0.005	–0.984	0.013
	(0.016)	(0.367)	(0.533)	(0.309)
Size	–1.126	–0.005*	–0.023	0.011*
	(0.165)	(0.056)	(0.981)	(0.071)
SOE	1.401	–0.044***	0.543	0.003
	(0.445)	(0.000)	(0.670)	(0.866)
Lev	–0.511	–0.043***	–2.588	–0.139***
	(0.934)	(0.004)	(0.545)	(0.000)
First	7.679	–0.054**	–0.149	–0.023
	(0.291)	(0.021)	(0.981)	(0.587)
Indep	–11.530	–0.043	19.052	0.150
	(0.415)	(0.280)	(0.248)	(0.138)
Duality	4.829**	0.017***	0.520	0.011
	(0.035)	(0.000)	(0.649)	(0.231)
Age	0.341	0.026***	–0.489	0.013
	(0.525)	(0.000)	(0.717)	(0.132)
EPS	2.313**	0.023***	–0.123	0.039***
	(0.039)	(0.000)	(0.892)	(0.000)
Tobin's Q	0.236	–0.005***	–0.283	–0.004*
	(0.498)	(0.000)	(0.320)	(0.097)
LDR	0.051	0.030***	–0.185	0.022***
	(0.789)	(0.000)	(0.132)	(0.000)
Constant	24.432	0.068	3.404	–0.212
	(0.200)	(0.397)	(0.888)	(0.184)
YearFE and FirmFE	Yes	Yes	Yes	Yes
No. Observations	3906	3906	1100	1100
No. Treatment Observations	1892	1892	549	549
No. Control Observations	2014	2014	551	551
No. Treatment Firms	186	186	57	57
No. Control Firms	188	188	57	57
F-statistics	1.291*	93.883***	0.984*	15.016***
Prob> F	0.062	0.000	0.095	0.000
Adj.R^2	0.015	0.396	0.019	0.279

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. Numbers in parentheses represent robustness p-values.

Therefore, the results in Table 14 indicate that vertical and horizontal SCAs have different economic consequences. Vertical SCAs significantly enhance the efficiency of corporate working capital compared to horizontal SCAs. Hence, these results verify Hypothesis 4.

Table 15. The impact of SCAs on firm performance: Vertical SCAs vs. horizontal SCAs

Variables	Vertical SCAs			Horizontal SCAs		
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	Growth	RP	NP	Growth	RP	NP
SCA × Post	0.165***	1.376**	0.707	0.091	0.037	0.321
	(0.000)	(0.029)	(0.547)	(0.321)	(0.591)	(0.481)
Post	–0.069**	–1.069*	–0.847	–0.110	–0.028	–0.495
	(0.040)	(0.054)	(0.278)	(0.257)	(0.686)	(0.255)
Size	0.248***	0.231	2.289**	0.287***	–0.002	0.531**
	(0.000)	(0.386)	(0.010)	(0.000)	(0.954)	(0.028)
SOE	–0.009	–0.038	–1.955	–0.271*	–0.006	–0.060
	(0.904)	(0.965)	(0.408)	(0.058)	(0.930)	(0.836)
Lev	0.364**	–3.274**	–4.250*	0.796*	–0.208	–1.504**
	(0.025)	(0.025)	(0.084)	(0.082)	(0.223)	(0.042)
First	0.063	5.375**	–8.144	0.992	0.067	0.685
	(0.767)	(0.020)	(0.102)	(0.129)	(0.757)	(0.592)
Indep	–0.326	1.353	9.947	–0.554	–0.248	–2.655
	(0.335)	(0.734)	(0.334)	(0.356)	(0.588)	(0.245)
Duality	0.018	–0.982**	0.591	0.138**	0.067	–0.331
	(0.584)	(0.029)	(0.474)	(0.037)	(0.166)	(0.305)
Age	0.018	–0.255	1.296*	0.085	0.025	0.045
	(0.414)	(0.662)	(0.093)	(0.257)	(0.622)	(0.623)
EPS	0.261***	0.542**	13.307***	0.318***	0.143***	2.709***
	(0.000)	(0.049)	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	–0.057***	–0.334**	0.740***	–0.014	0.019	0.006
	(0.000)	(0.028)	(0.000)	(0.602)	(0.115)	(0.940)
LDR	–0.015*	–0.028	–0.155	–0.011	0.007	0.046
	(0.083)	(0.786)	(0.148)	(0.548)	(0.604)	(0.513)
Constant	5.363***	–2.745	–62.516***	5.044***	–0.119	–11.781**
	(0.000)	(0.728)	(0.002)	(0.000)	(0.888)	(0.027)
YearFE and FirmFE	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	3906	3906	3906	1100	1100	1100
No. Treatment Observations	1892	1892	1892	549	549	549
No. Control Observations	2014	2014	2014	551	551	551
No. Treatment Firms	186	186	186	57	57	57
No. Control Firms	188	188	188	57	57	57
F-statistics	9.818***	1.984***	7.689***	7.125***	2.410***	2.191***
Prob> F	0.000	0.003	0.000	0.000	0.000	0.003
Adj.R^2	0.147	0.014	0.445	0.170	0.059	0.406

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. Numbers in parentheses represent robustness p-values.

Table 15 reports the impact of vertical and horizontal SCAs on firm performance. The results of models (1) and (2) show that the regression coefficients of interaction *SCA* × *Post* are both significantly positive (0.165 and 1.376, respectively), while the regression coefficients of the interactions *SCA* × *Post* in models (4) to (6) are not significant (0.091, 0.037 and 0.321, respectively). The comparison of models (1) with (4), and (2) with (5) suggest that the treatment effect is only significant in vertical SCAs.

Therefore, the results in Table 15 indicate that vertical and horizontal SCAs have different economic consequences. Vertical SCAs significantly improve firm performance compared to horizontal SCAs. Hence, these results verify Hypothesis 4.

Table 16. The impact of SCAs on performance: Vertical SCAs vs. horizontal SCAs

Variables	Vertical SCAs		Horizontal SCAs	
	Model (1)	Model (2)	Model (3)	Model (4)
	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)
SCA × Post	–0.701*	–0.182**	–0.602	–0.097
	(0.066)	(0.036)	(0.351)	(0.563)
Post	–0.005	0.097	0.203	0.068
	(0.989)	(0.197)	(0.749)	(0.677)
Size	1.541***	0.494***	2.382***	0.475***
	(0.000)	(0.000)	(0.000)	(0.000)
SOE	–1.287**	–0.232**	–2.105***	–0.341**
	(0.013)	(0.049)	(0.001)	(0.040)
Lev	1.117	0.713***	0.623	0.135
	(0.211)	(0.000)	(0.697)	(0.745)
First	–2.990**	–0.392	6.115***	1.077**
	(0.029)	(0.208)	(0.002)	(0.034)
Indep	–0.766	1.662***	–6.286	2.187**
	(0.747)	(0.002)	(0.138)	(0.046)
Duality	0.167	0.204***	–0.883**	–0.267**
	(0.537)	(0.001)	(0.049)	(0.021)
Age	0.507	0.207**	0.010	0.084
	(0.214)	(0.026)	(0.984)	(0.514)
EPS	1.609***	0.055	2.438***	0.140**
	(0.000)	(0.158)	(0.000)	(0.036)
Tobin's Q	0.019	0.068***	0.060	0.031
	(0.841)	(0.002)	(0.603)	(0.294)
LDR	0.087	0.055***	0.070	0.038
	(0.217)	(0.001)	(0.591)	(0.263)
Constant	–36.571***	–13.492***	–50.134***	–12.130***
	(0.000)	(0.000)	(0.000)	(0.000)
YearFE and FirmFE	Yes	Yes	Yes	Yes
No. Observations	3776	3776	1036	1036

End of Table 16

Variables	Vertical SCAs		Horizontal SCAs	
	Model (1)	Model (2)	Model (3)	Model (4)
	Vol (Rev)	Vol (NCF)	Vol (Rev)	Vol (NCF)
No. Treatment Observations	1790	1790	521	521
No. Control Observations	1986	1986	515	515
No. Treatment Firms	186	186	57	57
No. Control Firms	188	188	57	57
F-statistics	20.326***	21.094***	12.854***	8.863***
Prob> F	0.000	0.000	0.000	0.000
Adj.R^2	0.130	0.135	0.261	0.196

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. Numbers in parentheses represent robustness p-values.

Table 16 reports the impact of vertical and horizontal SCAs on corporate performance volatility. The results of models (1) and (2) show that the regression coefficients of interaction *SCA* × *Post* are both significantly negative (–0.701 and –0.182, respectively), while the regression coefficients of the interactions *SCA* × *Post* in models (3) and (4) are not significant (–0.602 and –0.097, respectively). The comparison of models (1) with (3), and (2) with (4) suggests that the treatment effect is only significant in vertical SCAs.

Therefore, the results in Table 16 indicate that vertical and horizontal SCAs have different economic consequences. Vertical SCAs significantly reduce corporate performance volatility compared to horizontal SCAs. Hence, these results verify Hypothesis 4.

7. Conclusions

Taking advantage of the proliferation of SCAs among listed companies in China in recent years, we examined the impact of SCAs on the performance of customers and suppliers and their underlying mechanisms. The main findings and conclusions are summarized as follows:

First, SCAs can alleviate the friction between customers and suppliers and significantly improve the efficiency of working capital utilization for both parties. Our results show that, compared with suppliers without an SCA, suppliers that enter into an SCA experience a significant improvement in their working capital turnover, inventory turnover, and accounts receivable turnover, and their cash holdings are significantly reduced. This indicates that SCAs can increase inventory turnover and accounts receivable turnover for suppliers while reducing their cash holdings. Additionally, our results show that, compared with customers without an SCA, customers that enter into an SCA experience a significant improvement in their raw material turnover and accounts payable turnover. This means that SCAs can enhance customers' raw material turnover and reduce accounts payable turnover.

Second, the impact of SCAs on customers and suppliers is asymmetric. Suppliers benefit more from SCAs, as evidenced by significant improvements in their financial performance and reduced performance volatility. Our results show that, compared with suppliers without an SCA, suppliers that enter into an SCA experience significant improvements in their

sales growth, operating profit margin, and net profit after entering into an SCA. This means that SCAs improve the financial performance for suppliers compared to those without an SCA. Additionally, compared with suppliers without an SCA, suppliers that enter into an SCA experience a significant decrease in the volatility of their revenue and net cash flow. This indicates that SCAs reduce performance risks for suppliers compared to those without an SCA. Moreover, our results show that the treatment effect of SCAs is only significant in suppliers and not in customers.

Third, a "large customer-small supplier" alliance exists within SCAs. Specifically, customers tend to be older, have larger asset size, higher market value, and more abundant cash flow than suppliers. Additionally, suppliers exhibit lower financial leverage and higher research and development intensity than customers. Customers tend to select suppliers with lower financial risks and higher R&D investment as their alliance partners, while suppliers choose customers with ample cash flow as their alliance partners.

Fourth, the "inherent differences" in market power and value between customers and suppliers lead to asymmetric economic consequences. After allying, the lower-market-power partner in an SCA experiences better financial performance and lower performance volatility. Similarly, the partner with smaller-market-value achieves better financial performance and lower performance volatility.

Lastly, compared to horizontal SCAs, vertical SCAs significantly improve firms' financial performance and reduce performance volatility. Specifically, our results show that the treatment effect is only significant in vertical SCAs.

8. Practical suggestions and managerial implications

The conclusions of this paper hold theoretical values and offer insightful implications for both governments and companies which seek to deepen supply chain cooperation in emerging markets.

First, SCAs can enhance the working capital efficiency for both customers and suppliers. This implies that SCAs are beneficial to both parties in terms of working capital. Therefore, governments should actively guide and encourage firms to form SCAs, enhance interconnectivity, and leverage the synergies of SCAs to withstand external shocks such as geopolitical conflicts, energy interruptions, financial crises, natural disasters, and pandemics. This will ensure the security and stability of the supply chain, with particular emphasis on encouraging small and medium-sized firms to actively form SCAs to obtain support in terms of funding, raw material sourcing, and sales channels.

Second, the formation of SCAs involves mutual selection between customers and suppliers, and the economic impact of SCAs is asymmetric. Suppliers benefit more than customers within the SCA. Furthermore, the partner with lower-market-power tends to achieve better financial performance and lower performance volatility, while the partner with smaller-market-value tends to experience better financial performance and lower performance volatility. Therefore, we should recognize the "leaning on a bigger tree for shade" effect that SCAs have for small firms. Customers, suppliers, and firms with different market power and market value should take this finding into account to make more informed decisions when choosing an al-

liance partner. This necessitates that firms judiciously select the right alliance partner based on their supply and demand relationship with the partner, and particularly factors like market power and market value.

Third, horizontal and vertical SCAs have different economic consequences. SCAs formed among companies within the same industry involve more competition and conflicts of interest, while alliances formed across different industries involve more cooperation and long-term symbiosis, which leads to significant improvements in firm performance. Therefore, firms need to recognize that the industry environment, as a boundary condition, significantly affects the economic consequences of alliances. When selecting alliance partners, it is necessary to consider both the similarities and dissimilarities in the business scope of the parties involved to lay a solid foundation for mutual benefit and win-win outcomes in SCAs.

In recent years, an increasing number of local firms have entered into SCAs with foreign firms. Who benefits more from cross-border SCAs is an important issue that deserves attention. Future research could explore economic consequences of cross-border SCAs by analyzing samples based on global sourcing data.

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APPENDIX

Table A1. Probability of SCAs

Variables	(1)	(2)
	Logit (SCA = 1)	Probit (SCA = 1)
Age	–0.021	–0.007
	(0.102)	(0.137)
Size	0.573***	0.228***
	(0.000)	(0.000)
SOE	–0.514***	–0.209***
	(0.002)	(0.001)
Lev	–0.854*	–0.344*
	(0.074)	(0.056)
First	–0.943**	–0.367**
	(0.044)	(0.040)
Indep	–0.988	–0.413
	(0.358)	(0.328)
Duality	0.316**	0.136***
	(0.013)	(0.006)
EPS	0.095	0.052
	(0.289)	(0.160)
Tobin's Q	0.164***	0.067***
	(0.000)	(0.000)
LDR	–0.129**	–0.049***
	(0.014)	(0.010)
Constant	–17.375***	–7.284***
	(0.000)	(0.000)
YearFE and IndustryFE	Yes	Yes
No. Observations	27292	27292
No. Treatment Observations	310	310
No. Control Observations	26982	26982
No. Treatment Firms	268	268
No. Control Firms	4361	4361
Wald chi2	338.492***	295.340***
Prob > chi2	0.000	0.000
Pseudo R2	0.103	0.101

Note: *p ≤ 0.1; **p ≤ 0.05; ***p < 0.01. The numbers in parentheses represent robustness P-values.