

Light in Dark Places: The Hidden World of Supply Chain Fraud

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Abstract—Interorganizational fraud, or fraud that occurs between organizations, is a critical component of supply chain fraud and supply chain relational risk, yet empirical evidence on the scale of interorganizational fraud and its antecedents remains scant. Despite its hidden nature, interorganizational fraud can have major implications for supply chain performance. Based on the theories of transaction cost economics, agency theory, and the fraud triangle, widely used in accounting and auditing research, five potential antecedents of supply chain fraud are considered and compared with reported losses due to interorganizational fraud. The data collected via a survey questionnaire with a sample of 151 supply chain employees in manufacturing demonstrate that informants estimated median losses due to interorganizational fraud to be 9% of their firm's total revenue. The most common types of fraud reported include product quality fraud, pricing/invoicing fraud, and corruption. Using a two-step generalized method of moments technique for estimation, the results found that transactional complexity, competitive pressures facing the supply chain, and weak firm ties were significantly related to interorganizational fraud, and that supply chain monitoring and ethical sourcing were not significantly related to interorganizational fraud. These findings contribute to the research on relational risk, supply chain risk management, and opportunism.

Index Terms—Behavioral operations, ethics, fraud triangle, opportunism, risk management, supply chain (SC) fraud, supply chain relational risk, supply chain uncertainty.

I. INTRODUCTION

EARLY in 2013, a scandal in Europe emerged when products being sold as beef were found to contain horsemeat, with some cases containing 100% horsemeat [1]. The obvious distinction between a cow and a horse suggests that the adulteration of the food in the supply chain (SC) was deliberate, rather than through accidental substitution. Fraud that occurs within the SC has seen little research attention, despite being identified

as the “single most exposed area” of fraud [2], [3]. In order to understand SC fraud, we introduce the concept of interorganizational fraud, which is defined as any intentional deceptions or neglectful misrepresentations of product information or quality or any deliberate deception to gain unfair or unlawful advantage that occurs between organizations.

Although little research has been done to determine the nature and extent of interorganizational fraud, several real-world incidents exemplify the risk and effect, which can include a mix of social, environmental, and economic impacts. Oceana released a study that found 33% of the 1215 fish samples collected at restaurants, sushi vendors, and grocery stores were mislabeled. Of those, 59% of fish being sold as tuna was actually escolar, an oily fish that can cause keriorrhea, a problem similar to diarrhea [4]. In 2007, a supplier for Mattel intentionally used cheaper lead-based paint from an unapproved supplier, despite strict quality controls and Mattel having built and paid for a testing laboratory at the supplier's factory [5]. Mattel had made efforts to control its SC from accidental quality issues, but remained exposed to interorganizational fraud perpetrated by the supplier deliberately circumventing the safeguards in place [5], [6]. Aston Martin recalled over 17 000 cars (affecting approximately 75% of the cars produced from 2007 to 2012) due to a subsupplier using counterfeit plastic material in the accelerator arms [7]. Combined, these examples highlight the potential impact and spread of SC fraud.

This research addresses the following two research questions.

- 1) What is the extent of interorganizational fraud observed by SC managers?
- 2) What are the factors that increase a firm's exposure to interorganizational fraud?

One of the main challenges of exploring interorganizational fraud is that both perpetrators and victims of fraud tend to hide it. Perpetrators desire to hide their behavior, and victims are not interested in disclosing fraud that affects their product quality and company image. Despite the nature of interorganizational fraud as a hidden event, it can have significant financial impact on firm performance. Research on interorganizational fraud has received limited attention, but understanding disruptions that occur due to intentional behavior has been identified as an important area of risk management [8], [9]. Furthermore, endogenous risks that occur within an SC have been suggested as more important than exogenous risks, motivating additional research into risks which can occur between parties in an SC such as interorganizational fraud [9], [10]. Recently, emphasis has been placed on the need to better understand effectively managing opportunistic behavior

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through relational management [11], [12]. To date, no diagnostic tool/model for interorganizational fraud is available to help motivate further research and understanding of this phenomenon in detail. To account for the challenge of observing the largely hidden phenomenon, we rely on theoretically motivated constructs as possible antecedents to SC fraud and test the relationships those constructs have with estimated losses from interorganizational fraud. We do this using three theoretical perspectives that explore opportunistic behavior from multiple perspectives. Motivated by these theoretical lenses, we explore the relationship between interorganizational fraud and the SC constructs of SC monitoring, strong firm ties, competitive pressures facing the SC, ethical sourcing, and transactional complexity.

This article makes three key contributions. First, we obtain empirical evidence of the existence of interorganizational fraud and an estimated degree of financial losses incurred due to interorganizational fraud within SCs. These findings suggest that interorganizational fraud is an important issue meriting additional research. Second, we combine several theoretical perspectives to explain interorganizational fraud, including transaction cost economics, agency theory, and the fraud triangle. This provides a theoretical foundation for the antecedents of interorganizational fraud and practical tools to identify SC fraud risk. Third, we provide an econometric analysis of the relationship between the five constructs explored in this manuscript and interorganizational fraud, finding statistical support that weak firm ties, SC competitive pressures, and transactional complexity can lead to interorganizational fraud, and that SC monitoring and ethical sourcing are not significantly related to interorganizational fraud.

II. LITERATURE REVIEW

This article combines three literature streams for understanding interorganizational fraud: SC risk management, opportunism, and accounting fraud. These are discussed in following sections.

A. Relational Risk and Opportunism

The concept of SC relational risk (SCRR) has grown in importance in recent years [13]–[16]. SCRR can include both sub-optimal collaboration and behavior associated with opportunism [16]. The risk of opportunistic behavior can inhibit successful collaboration within SCs [17]. Both SCRR and SC opportunism are tightly connected to interorganizational fraud. Although significant literature exists to explore SC risk [18]–[21], much of the emphasis is on the sources and mitigation of performance risks [16], [21]–[23], and limited attention has been paid to managing SCRR [14], [16], [24], [25]. SCRR has emerged as a stream of risk literature which explores the risk associated with the behavior of the parties within the SC and has been defined as “the risk to the SC of either party in a buyer-supplier relationship not fully committing to joint efforts due to either problems associated with cooperation or problems associated with opportunistic behavior” [16]. Following this approach, we identify SC fraud as including deceptive practices due to both neglectful and opportunistic behavior. Risk is an increasingly

important area of research [26]–[28], and additional empirical research on SC risks that occur due to intentional behavior in the SC is necessary [9].

Because interorganizational fraud is based on intentional behavior, the strategies for detecting and managing risk associated with it differ substantively from those explored in traditional risk management literature [9]. For example, inventory management, which can protect against disruptions [18], [29], can exacerbate risks when the inventory is of fraudulent quality. Because the nature of the risk changes when the intent is considered, research on fraud should consider the motivational and behavioral factors that lead to fraud.

Both transaction cost economics (TCE) and agency theory provide rich theoretical perspectives for understanding opportunism in relationships. TCE is a primary theoretical lens for examining governance in buyer-supplier relationships [30], [31]. TCE identifies one of the main choices for supplier governance is to establish effective supplier governance to safeguard against opportunism [32]. Agency theory [33], [34] explains how opportunistic behavior emerges in a relationship between two entities when desires and information levels differ between entities [35]. When information asymmetry exists, opportunistic behavior is more likely to occur unless proper monitoring or incentives are in place to engender positive behaviors [36].

B. SC Fraud and Interorganizational Fraud

Fraud has received significant emphasis in accounting/auditing literature [37], and has recently been expanded to include the influence that fraud can have on SCs [38]. Several industry-facing publications have explored the impact of SC fraud [38]–[41], but relatively little academic research has explored the phenomenon of SC fraud despite evidence that this fraud is increasing [42]. Although little research on SC fraud exists, SC ethics has been identified as an important area to explore [43], [44].

The survey conducted in this research and discussed in the methods section identified several specific examples of SC fraud. Of the specific instances of interorganizational fraud reported by managers, the three most common categories of fraud were product quality fraud, pricing/invoicing fraud, and corruption. These types of fraud can have a major impact. For example, two NASA satellites costing \$700 million and years of work failed to deploy because a key supplier of aluminum had been falsifying certifications and test data on aluminum strength and reliability for 19 years [45]. Prior research suggests that invoicing fraud is both a major challenge and one that is increasing over time [46].

SC fraud has been identified as an issue in prior work [47], [48], and early SC research has identified the value of connecting accounting audits with the purchasing role to help eliminate fraud [49], [50], though the research on SC fraud, particularly empirical work from the SC perspective, is very limited. To distinguish that the emphasis of this research is on fraud that occurs between organizations in the SC as opposed to fraud perpetrated by individuals within the SC or by organizations defrauding investors, we focus on interorganizational fraud. It is important to distinguish between interorganizational fraud that

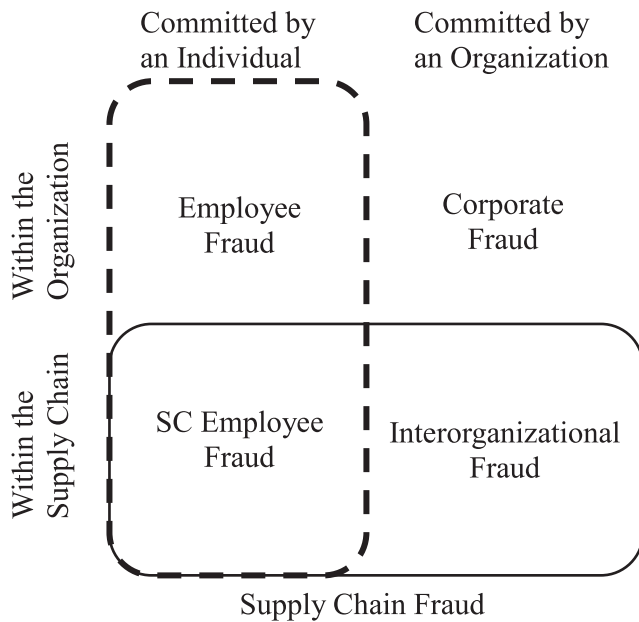


Fig. 1. Types of fraud.

occurs within the SC and the broader definition of SC fraud, which has previously referred to an individual fraudster engaging in unilateral behavior [39]. Fig. 1 presents these distinctions.

C. Behavioral Motivations of Fraud: The Fraud Triangle

The fraud triangle was first introduced to identify motivations of criminal fraudulent behavior and describes the behavioral motivations which lead to fraud [51]. The fraud triangle consists of three dimensions that must be present in order for fraud to occur: opportunity, pressure, and rationalization [52]. Opportunity describes an environment in which one perceives the ability to perpetrate and conceal fraud [37]. Opportunity has been shown to be related to fraudulent behavior in terms of weaker corporate governance [53], reduced oversight quality [54], and a lack of detection and oversight [55]. Pressure describes the perceived need to engage in fraudulent behavior, and it can include things such as pressures to meet financial targets, compensation packages, business failures, or market saturation [56]. Rationalization describes the ability of potential perpetrators of fraud to justify engaging in fraudulent behavior [53], [57].

While the fraud triangle is well established in the auditing literature, it has seen limited exposure in the SC literature, with two notable exceptions. Arnold *et al.* [58] used the fraud triangle to explain corruption in Germany, and Katz [70] discusses it in his book on SC fraud.

III. HYPOTHESES

A. Antecedents of Interorganizational Fraud

1) *Supply Chain Monitoring*: One of the most discussed antecedents to both fraud and opportunism is the role of monitoring to limit the opportunity of malicious actors engaging in fraud. We define SC monitoring as *the amount of oversight a firm utilizes to verify product quality and integrity from their supply chain*. The

ability of a firm to monitor partners is a prevention mechanism of opportunistic behavior [59]. Auditing literature exploring the opportunity dimension of the fraud triangle finds that weaker corporate governance [53], reduced oversight quality [54], and a lack of detection and oversight [55] are positively related to interorganizational fraud. Appropriate checks and balances limit the opportunity to engage in fraud and increase the monitoring of independent parties, which can help reduce opportunity for fraud [60]–[64]. These antecedents for accounting fraud are strong corollaries with SC monitoring. Supporting this connection is that stronger compliance with the Sarbanes-Oxley Act of 2002, designed to increase transparency and oversight, can improve SC performance in variety of ways [65], [66].

Both TCE and agency theory similarly support the role of monitoring for preventing opportunistic behavior [67]. TCE theorizes that monitoring is a key tool for reducing the transaction costs of opportunism, reducing the exploitation of informational asymmetries [68]. If suppliers perceive that there is an opportunity to perpetrate and conceal fraud from a buyer, they might be more likely to engage in fraudulent behavior. Research on opportunism has identified that monitoring supplier qualification can help protect against opportunistic behavior [69]. To further substantiate this, Katz [70] argues that the more electronically integrated the systems are in a supplier chain, the less opportunity there will be for fraud in an SC. Overall, the evidence suggests that SC monitoring can help prevent opportunistic behavior in general, and we extend this to the focus on interorganizational fraud with the following hypothesis:

H1: *Higher levels of supply chain monitoring will be negatively associated with interorganizational fraud.*

2) *Transactional Complexity*: The specific nature of the transaction as well as the norms associated with it has been identified as risk factors for opportunistic behavior [71]. We define transactional complexity as *the degree of complexity and variance associated with a firm's transactions with their supply base*. Previous research has suggested that complexity at a transactional level, such as ambiguity and volatility in transactions, is related to governance challenges and opportunism [72]. As such, complexity is a critical component of how firms structure buyer–supplier relationships to limit opportunistic behavior [73]. Complexity can increase the challenges of governance [74] and hide anomalies in event transactions, leading to higher levels of SC fraud [75]. Transaction complexity has been identified as an indicator of fraud behavior [56], [76] and one of the causes of the subprime mortgage crisis in 2007–2008 [77]. Both organizational and functional complexities have been shown to increase corruption levels [58]. Thus, we focus on transactional complexity to consider which SC conditions might lead to fraud.

The complexity of transactions in a relationship exacerbates the problems associated with TCE as transactional complexity increases the bounded rationality of the firm. Volatility and ambiguity in the contractual relationship, which can be seen as highly related to the construct of complex transactions, have been shown to be highly correlated with opportunistic behavior in interorganizational relationships [72]. Since the transactions are not standard and have additional degrees of complexity, it makes it more difficult to engage in effective monitoring

and preventing fraudulent behaviors by suppliers. Similarly, highly complex transactions that are nonstandardized create challenges of governance associated with managing those relationships, suggesting that, in those situations, traditional efforts to limit opportunistic behavior based on TCE will be less effective in preventing interorganizational fraud. Accordingly, we hypothesize

H2: *Transactional complexity will be positively associated with interorganizational fraud.*

3) *SC Competitive Pressures:* Competitive pressures facing suppliers can lead to the perceived need or motivation to engage in fraudulent behaviors in order to remain competitive or profitable. We define SC competitive pressures as *the degree of difficulty facing a firm's supply base to remain competitive over time*. Competitive pressures can emerge within an SC when suppliers are in highly competitive markets or have high levels of environmental pressures. Excessive bidding, which decreases the long-term gains, can provoke opportunism from the winning bidder [78]. Favorable conditions, such as premiums for potential cheaters, can reduce the likelihood of cheating behavior in contracts [79]. Pressure to engage in fraudulent behaviors can include things such as pressures to meet financial targets, compensation packages, business failures, or market saturation [56]. The influence of pressure on accounting fraud has seen significant research, which suggests that pressure incentives can lead to higher levels of fraudulent behaviors [37].

Conditions with high levels of pressure can create the perception of need or the financial motivation to engage in fraudulent behavior for the suppliers to remain profitable, increase profits, or even to avoid bankruptcy. Firms that are facing high levels of competitive pressures might resort to less ethical options to manage the immediate pressures. We propose that high levels of SC pressure will lead to higher interorganizational fraud. Accordingly, we hypothesize

H3: *Supply chain competitive pressure will be positively associated with interorganizational fraud.*

4) *Strong Firm Ties:* The nature of the relationship between firms can change the motivation to engage in fraudulent behaviors. We define strong firm ties as *the longevity and degree of collaboration a firm has with its suppliers*. Research on the relationship of firm ties and opportunism proposes that as firms become increasingly embedded and interdependent, opportunism is likely to decrease [80]. Long-term relationships can protect against opportunistic behaviors [81]. Relational controls such as trust have served as a second form of governance to replace or support contractual controls. Kim and Choi [82] found that a long-range view, relational stability, and relational posture (composed of commitment, trust, information sharing, relational norms, and conflict resolution) were negatively correlated with supplier opportunism, supporting the linkage between relational controls as limits on opportunism.

Integration and cooperation with suppliers can reduce the hazard of opportunistic behavior [83]. Aligning the goals of organizations together can limit the incentives for opportunism, as the principal agent problem is alleviated when incentives are closer. Weak firm ties, on the other hand, can lead to more

negative relational outcomes when firms have less long-term strategic interest. High turnover increases financial statement fraud [84]. Long-term relationships can reduce unethical SC behavior [44], while fast turnover rates in an SC could lead to short-term motivations that suppliers might use to justify fraudulent behaviors. Based on the research on governance, fraud, and opportunism, we posit the following hypothesis:

H4: *Strong firm ties will be negatively associated with interorganizational fraud.*

5) *Ethical Sourcing:* Firms that emphasize ethical sourcing might be less exposed to unethical behavior such as fraud from their suppliers. We define ethical sourcing as *the use of sourcing strategies to procure from firms that value ethical behaviors*. Firms that communicate ethical standards to partners are less likely to engage in unethical behavior [44]. Buyers in the for-profit sector are more likely to behave opportunistically when compared to the not-for-profit sectors [85]. When firms emphasize ethical sourcing strategies, it is possible that this emphasis can limit certain unethical tendencies from the SC if firms are effectively aligning their interests and motivations with their supply base. Establishing such norms of behavior can communicate expected norms of behavior in the relationship, leading to less unethical behavior such as interorganizational fraud. This is supported by the notion that because market relationships are "socially embedded, and, consequently, the norms of social relationships (e.g., reciprocity, fairness) provide a countervailing force to constrain this inherent opportunism (Casson 1997)" [86]. Combined, the evidence suggests ethical sourcing can help limit unethical and opportunistic behavior at the interorganizational level, leading to the following hypothesis:

H5: *Ethical sourcing will be negatively associated with interorganizational fraud.*

These hypothesized relationships are summarized in Fig. 2.

IV. METHODOLOGY

A. Target Population and Sample

Based on the recommendations of Weele and Raaij [87], we identify the target population and sample selection process below. We selected the target population as SCs for firms in the manufacturing industry. The selection of manufacturing SCs was done because evidence of interorganizational fraud would be most observable in a manufacturing setting and because the manufacturing setting provides discrete opportunities to engage in fraud as it relates to specific products and transactions between firms.

Data were collected via an e-mail distribution to a panel of individuals working for Australian firms. The panel consisted of paid employees within the manufacturing/services sector. Prior to answering the survey, informants were asked to identify their primary industry and were asked to continue the survey only if they selected manufacturing.

Target informants were individuals familiar with their firm's supply base. Self-reported job titles included owner, CEO, director of operations, purchasing manager, accountant, purchasing

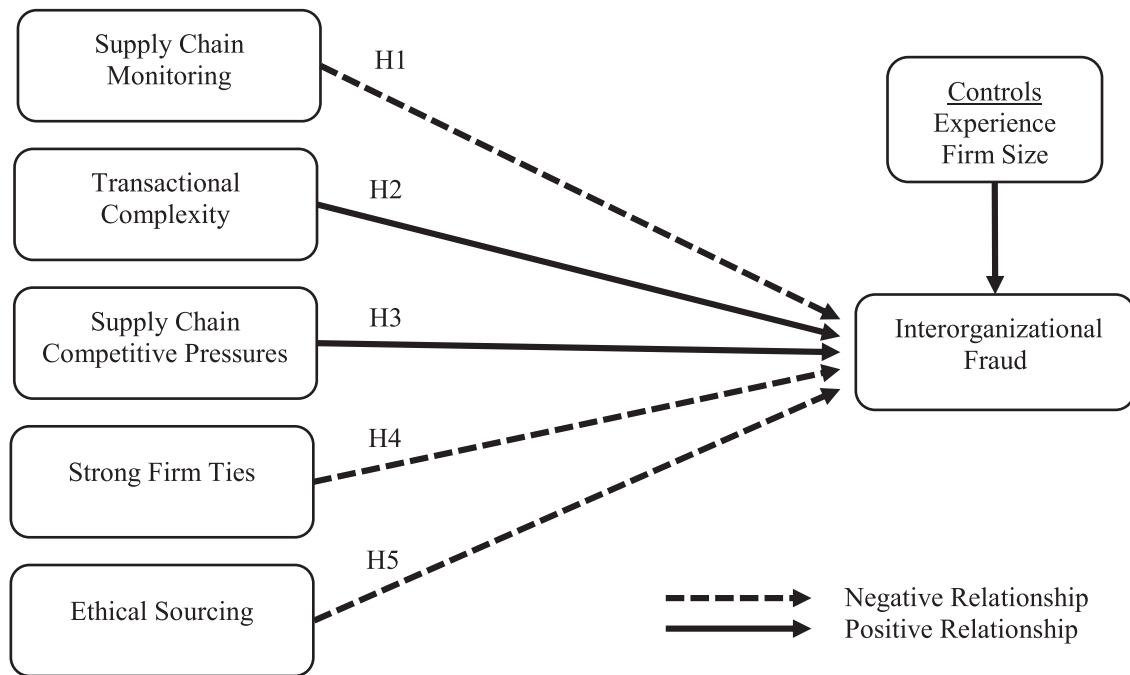


Fig. 2. Research model and hypotheses.

assistant, SC manager, purchasing officer, production manager, chief operating officer, etc. Informants also had a high level of experience, with over 60% of them having five or more years of experience in their current or a similar position at their firms. In order to ascertain the informants' abilities to respond to the questionnaire, informants' years of experience and job titles were collected. A search was implemented on the data to determine whether the job title indicated words associated with a specific level of responsibility to ascertain the informant's ability to answer regarding the SC context. This data is reported in Table I as "Informant Job Titles by Keyword" with the keywords for each job title included as a count variable. Since our method relied on searching for key words within the job titles, not every job title showed up in the table (for example, "Buyer" or "Product Engineer" would not show up). Job titles without the keywords used in the search were included in the category of "Other." Based on the sample collected, we believe that the informants form a representative sample and have the requisite experience and responsibility to answer the survey questionnaire. Informant information is included in Table I.

In total, 3695 invitations to participate in the survey were distributed. A total of 412 responses were received, representing a response rate of 11.1%. Informants were first asked to identify their firm's industry, and only those who identified manufacturing were asked to continue the survey. After listwise deletion for missing data, the resulting sample size was 151 informants.

B. Measurement Development and Validation

The survey measures were generated through a review of prior literature on fraud and potential drivers of opportunistic behavior

TABLE I
INFORMANT CHARACTERISTICS

How many years have you been employed in your current position or a similar job?	
< 2 years	20
2-4 years	36
5-7 years	28
8-9 years	16
10 years or more	51
Informant Job Titles Including Key Words	
Owner/Proprietor	7
Executive Officer (CEO, COO, CFO, or 'Officer')	8
Director	5
Manager	30
Supervisor	4
Operator	8
No Job Title Reported	5
Other*	84

*This category includes informants who identified a job title, but that job title didn't include one of the above keywords as not all job titles indicated a specific level of responsibility.

in an SC context. Prior to distributing the survey, its content validity was evaluated by four academics familiar with SC and accounting literature using the Q-sort method [88], which consists of randomizing the list of measures and then asking each expert to sort the measures into each of the constructs. Item placement ratios were computed by calculating the percentage

TABLE II
CONSTRUCT DEFINITIONS, MEASURES, AND RELIABILITY

Construct. Definition.	Measures	Cronbach's Alpha
Supply Chain Monitoring. <i>The amount of oversight a firm utilizes to verify product quality and integrity from their supply chain.</i>	Our company actively monitors the behavior of its suppliers Our company often holds planned and unplanned audits of its suppliers Our company qualifies suppliers before sourcing from them Our firm independently checks the quality and integrity of our suppliers' products Our firm has checks in place to verify product integrity from its suppliers Our firm relies on suppliers' confirmations of product quality for products our firm purchases (-) It is hard to easily verify the quality of products our firm purchases from our suppliers (-)	0.84
Transactional Complexity. <i>The degree of complexity and variance associated with a firm's transactions with their supply base.</i>	The products that our firm purchases from our suppliers change often Transactions with our firm's supply base are complex Our firm's suppliers could substitute inferior products or materials in their products without our firm being aware There are many inferior alternative products available for the products we purchase from our suppliers	0.74
Supply Chain Competitive Pressure. <i>The degree of difficulty facing a firm's supply base to remain competitive over time.</i>	Our firm's supply base faces a high degree of competition Our firm's supply base is a saturated market (there is an excess of suppliers) Our firm's supply base faces small profit margins Our firm's supply base is facing decreasing demand Our firm's supply base faces high pressure to meet institutional standards Our firm's supply base is financially stable (-) Companies in our firm's supply base tend to be in business for a long time (-)	0.76
Strong Firm Ties. <i>The longevity and degree of collaboration a firm has with its suppliers.</i>	Our firm has long term relationships with its suppliers Our firm works closely with its suppliers to achieve mutual goals Our company is electronically integrated with its suppliers	0.75
Ethical Sourcing. <i>The use of sourcing strategies to procure from firms that value ethical behaviors.</i>	Our firm sources from countries that are known for deceptive or fraudulent practices (-) Our firm only sources from companies that are not known for deceptive or fraudulent practices Our firm sources from countries that are known for valuing morality and ethical behavior in business relationships Our firm only hires suppliers that are known for valuing morality and ethical behavior in business relationships Our firm seeks to source from companies with high levels of corporate social responsibility behaviors	0.71

of correctly placed measures into each theoretically determined construct following similar approaches in the previous literature [89]. The Q-sort identified several constructs with significant overlap such as quality monitoring and SC monitoring, which were combined to a single-measure. In addition, specific measures were removed from the survey when these were shown to be connected to multiple constructs based on the responses. The average item placement ratio for each construct was above 7 prior to distributing the survey, suggesting reasonable agreement among experts regarding construct validity [90]. After collecting the data, the reliability scores of the constructs were calculated using Cronbach's alpha. Table II presents the constructs, definitions, measures, and reliability scores for measures used in the analysis. The reliability scores of the independent variables were all above the accepted threshold of .7 [91].

Several approaches were used to control for and assess common method variance. Appropriate survey design, complex model specification, and statistical tests were applied based on the recommendations of Podsakoff *et al.* [92]. Survey design to reduce common method bias included guaranteeing anonymity by not collecting identifiable individual or company information and creating proximal distance between the predictor and criterion variables via different pages and text information to break up the flow of the survey. To the extent possible, use of measures

not directly connected to the dependent variable measuring interorganizational fraud were used to introduce psychological separation of the independent variables to create psychological separation [92]. Dependent and independent variables also differed in terms of the types of questions being asked (Likert scale versus a percentage response). Lastly, common method variance was evaluated statistically using single-common-method-factor recommended when the cause of the bias is indeterminate [92]. No single factor emerged that included over 50% of the variance. Although we are reliant on single informants for the analysis, we have sought to minimize the issues associated with common method bias in this article.

As much as possible, previously established measures and concepts from prior literature were used to develop a set of measurements based on the previous literature on opportunism and by adapting the fraud triangle literature to the SC. To the best of our knowledge, these measures have never been empirically tested as relating to interorganizational or SC fraud. The constructs and measurements items are included in Table II, and correlations among these are presented in Table III.

1) *Supply Chain Monitoring*: We define SC monitoring as the amount of oversight a firm utilizes to verify product quality and integrity from their SC. Ineffective monitoring is one of the most common causes of fraud [60]–[64], [69], [70]. SC

TABLE III
PAIRWISE CORRELATION MATRIX

Variable	1	2	3	4	5	6	7	8
1 Interorganizational Fraud	-							
2 SC Monitoring	-.07	-						
3 Transactional Complexity	.47*	.06	-					
4 SC Competitive Pressure	.40*	-.05	.59*	-				
5 Strong Firm Ties	-.06	.63*	.28*	.09	-			
6 Ethical Sourcing	-.19*	.49*	-.12	-.22*	.50*	-		
7 Experience	-.07	.10	-.09	.04	.12	.05	-	
8 Firm Size	.16*	.24*	.05	.02	.12	.06	.10	-

*Indicates significant at the .05 level (two-tailed); Uses pairwise correlations with listwise deletions. $n = 151$.

monitoring is measured by the average of seven measures adapted from previous work on supplier opportunism and motivated by research on the fraud triangle and consists of measures such as “our company often holds planned and unplanned audits of its suppliers,” “our firm independently checks the quality and integrity of our suppliers’ products,” and “our firm relies on suppliers’ confirmations of product quality for products our firm purchases” (reverse coded). The measure had Cronbach’s alpha of .84.

2) *Transactional Complexity*: We define transactional complexity as the degree of complexity and variance associated with a firm’s transactions with their supply base. Transactional complexity is calculated by the average of four measures, consisting of how complex and difficult it is to monitor the supplier’s behavior, and include four items: “the products that our firm purchases from our suppliers change often,” “transactions with our firm’s supply base are complex,” “our firm’s suppliers could substitute inferior products or materials in their products without our firm being aware,” and “there are many inferior alternative products available for the products we purchase from our suppliers.” The measure had a Cronbach’s alpha of .74.

3) *SC Competitive Pressure*: We define SC competitive pressure as the degree of difficulty facing a firm’s supply base to remain competitive over time. SC competitive pressure is computed by the average of seven measures, e.g., “our firm’s supply base faces a high degree of competition,” “our firm’s supply base faces small profit margins,” and “companies in our firm’s supply base tend to be in business for a long time” (reverse coded). These measures were adapted to the SC context from previous work on fraud [64] and are designed to measure the degree of competitive pressures that a supply base is facing. Similar to previous literature on managerial fraud focusing on pressures, we base these measures on the competitive nature of an industry and a decline in customer demand in the industry or marketplace [56], [76]. The measure had a Cronbach’s alpha of .76.

4) *Strong Firm Ties*: We define strong firm ties as the longevity and degree of collaboration a firm has with its suppliers. Strong firm ties are determined by the average of three measures consisting of “our firm has long-term relationships with its suppliers,” “our firm works closely with its suppliers

to achieve mutual goals,” and “our company is electronically integrated with its suppliers.” The measure had a Cronbach’s alpha of .75.

5) *Ethical Sourcing*: We define ethical sourcing as the use of sourcing strategies to source from firms that value ethical behaviors. Ethical sourcing is calculated by the average of five measures capturing whether sourcing strategies emphasize ethical characteristics including deception/fraud, CSR, and morality. Measures include, for example, “our firm sources from countries that are known for deceptive or fraudulent practices” (reverse coded), “our firm only hires suppliers that are known for valuing morality and ethical behavior in business relationships,” and “our firm seeks to source from companies with high levels of corporate social responsibility behaviors.” The measure had a Cronbach’s alpha of .71.

6) *Interorganizational Fraud*: Interorganizational fraud was measured by asking informants to provide an estimate of what percentage of their company’s annual revenues are lost due to interorganizational fraud. This measure was used for all statistical analyses. The measure was selected, as opposed to using a Likert scale, to help mitigate issues with single-method bias by using different response formats. Informants were provided with a formal definition of interorganizational fraud prior to responding to the question. At the end of the survey, informants were asked if they could recall a specific instance of fraud and were asked additional details about the event, including the financial impact and scale if they selected “Yes.” The approaches for measuring fraud by asking informants to identify a percentage of revenue lost due to fraud and identifying median losses from specific fraudulent events are common approaches used by prior surveys and research on fraud [3], [42], [93]–[96].

In order to check the criterion validity of our measure of interorganizational fraud, we followed previous research that measured the correlation of the measure with other measures that are expected to be related [97], [98]. We used three alternative measures of fraud for this process: two measures were focused on fraud impacting the informant’s firm directly, while the third measured the informant’s general perception of fraud in business. These measures are discussed briefly here. The informants were asked to rate the level of confidence of the

TABLE IV
INFORMANT RESPONSES REGARDING A SPECIFIC INTERORGANIZATIONAL FRAUD INSTANCE ($N = 17$)

Nature of Interorganizational Fraud	
Product Quality Fraud	6
Pricing/Invoicing Fraud	5
Corruption	2
Quantity Delivered	1
Other*	3
Reported Impact of Interorganizational Fraud	
Median Reported Economic Loss	\$250,000
Range of Economic Loss Reported	[\$1,000, \$230 Million]
Median/Average Duration of Fraud Before Detection	8 Months/17.5 Months
Reported Example of Reported Fraud	
"Inflated invoices, internal collusion"	
"the raw material used was not as per specifications of quality"	
"Misbranding of finished products to avoid taxes and penalties that others pay."	
"Manipulated price of materials"	
"Inferior product"	
"Less quantity than what was paid for"	
Reported Mechanisms for Detecting Specific Interorganizational Fraud	
Audit (Internal/External/Plant Check)	4
Customer Complaint	3
Whistleblower/Insider in SC	2
Looked Suspicious	1
Other Businesses Raised Concerns	1
Other*	6

*Includes confidential responses and/or non-responses.

following statement: "our firm is currently NOT experiencing economic losses resulting from interorganizational fraud" using a Likert scale. This was significantly correlated with interorganizational fraud in the direction expected (pairwise correlation of $-.24$, $p < .01$). Second, informants were asked if they could recall a specific incidence of interorganizational fraud and were then asked for more additional specific information regarding the event. This was significantly correlated with the measure of interorganizational fraud (pairwise correlation of $.23$, $p < .01$). Lastly, informants were asked to respond to a general perception of fraud unrelated to their firm. Informants were asked to agree/disagree with the following statement: "fraud between organizations is a problem in business today." It was not significantly correlated to interorganizational fraud (pairwise correlation of $.1165$, $p > .10$). Interorganizational fraud was significantly correlated with other measures of fraud at a firm level (including both a subjective measure of fraud and a dichotomous variable of recalling specific fraud events), but was not significantly correlated to informants' general perceptions of fraud, suggesting that it is reasonably robust to informants' general perceptions of fraud. Combined, these results suggest that the measure of interorganizational fraud is capturing the amount of fraud experienced by the informant's firm rather than a general perception of the fraud levels.

7) *Controls*: Two additional controls were included: firm size and employee experience. Firm size was captured with a categorical response indicating the total revenue of a firm in USD and providing the current currency exchange rate.

The categories included less than \$10 million, \$10–99 million, \$100–\$499 million, \$500 million–\$1 billion, and \$1 billion or more. Informant experience was captured similarly, with the categories including the years of experience in their current position or a similar position by their firm. Categories included less than two years, two–four years, five–seven years, eight–nine years, or ten years or more. The control variables were treated as continuous in the analysis.

C. Evidence of Interorganizational Fraud

The results from the survey indicated that interorganizational fraud was a major challenge faced by firms. The median value reported for the percentage of revenue lost due to interorganizational fraud was 9%. This level was higher than anticipated but is similar to other estimates of fraud for both the percentages reported, as well as informants' estimates of the financial impact on specific cases of fraud. In considering internal fraud, a survey of certified fraud examiners found a median estimate for the losses of a typical organization in a given year as a result of fraud was 5% [93]. It is estimated that health care fraud and abuse account for 10% of the total spending on health care [99]. Data collected on examples of individual fraud events from our informants had a median level of loss of \$250 000. These reported levels of fraud were also highly comparable to those reported in the 2016 Global Fraud Study that reported a median loss \$194 000 due to fraud from 192 cases in manufacturing [93] and a median loss of \$245 000 for all 221 fraud cases observed in

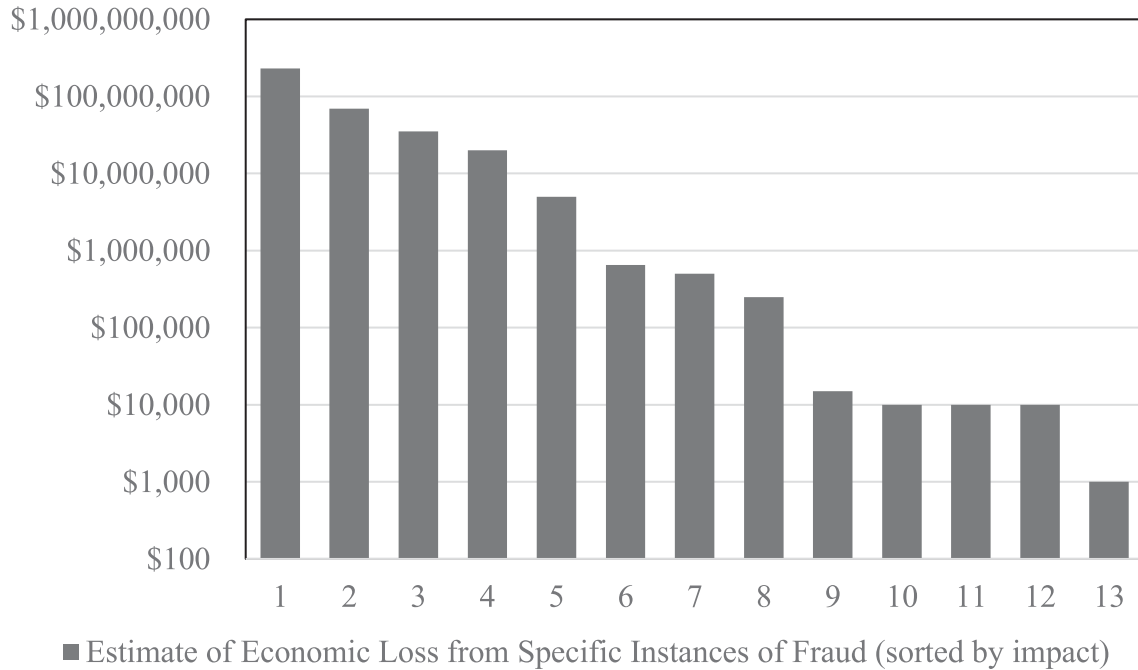


Fig. 3. Reported estimates of economic loss from specific instances of fraud in USD (logarithmic scale).

the Asia-Pacific region. This provides significant evidence that our results are within the similar ranges of other data, reports, and estimates on the financial impact of fraud from a variety of different sources.

At the end of the survey, informants were asked if they recalled a specific instance of fraud and, if they responded yes, were asked an additional set of questions regarding the specific event. Summary information from these responses is included in Table IV, and the values of these specific responses are included in Fig. 3. The results further confirm the large financial impact that interorganizational fraud can have. The specific examples present future directions of research to focus on the primary causes of interorganizational fraud reported in the survey. Descriptions of fraud reported were coded to categories and summed in Table IV.

D. Model Estimation Results

In hypotheses H1–H5, we presented five possible antecedents of interorganizational fraud. These relationships were tested using a two-step generalized method of moments (GMM) estimation.

$$\begin{aligned} \text{Interorganizational Fraud} = & \beta_0 + \beta_1 (\text{Experience}) \\ & + \beta_2 (\text{Firm Size}) + \beta_3 (\text{SC Monitoring}) \\ & + \beta_4 (\text{Transaction Complexity}) + \beta_5 (\text{SC Pressure}) \\ & + \beta_6 (\text{Ethical Sourcing}) + \varepsilon. \end{aligned}$$

The results of this estimation are reported in the first column of Table V.

The relationship between SC monitoring and interorganizational fraud was found to be non-significant ($B = .43, p > .10$), providing no support for H1. Interestingly, the direct correlation of SC monitoring and interorganizational fraud was significant,

yet when considering monitoring in the full model, this relationship did not remain significant. We discuss several possible explanations for this. First, it is notable that in previous examples of fraud, monitoring failed to prevent interorganizational fraud. For example, Mattel had several aspects of monitoring in place, including a testing laboratory at their supplier and an approved supplier list. Both process-based controls were intentionally circumvented to commit the fraud. It is possible that SC monitoring is less effective against fraud than it is against more traditional forms of opportunism. Second, a higher level of monitoring might be in place by firms experiencing higher levels of fraud—higher levels of monitoring might be necessary when fraud is higher, causing the opposite relationship to cancel out any positive gains from monitoring. Additional data, longitudinal or experimental, would be necessary to parse these causal relationships out.

Transactional complexity was found to be significantly related to interorganizational fraud ($B = 9.14, p < .01$), supporting H2. Given that interorganizational fraud is inherently a boundary-spanning behavior because it consists of fraud between organizations, it follows that complexity within the transactions that compose that relationship can increase the losses from interorganizational fraud. While the unit of analysis differs between accounting fraud and interorganizational fraud, this confirms that the roles of transactional complexity in either enabling or covering up fraud persist.

SC competitive pressure was found to be significantly related to interorganizational fraud ($B = 6.10, p < .05$), supporting H3. As SC competitive pressures increase, suppliers are more likely to pursue aggressive strategies, which might include opportunistic behavior such as interorganizational fraud. Recognizing the pressures of an industry and working closely with suppliers to ensure mutual profitability has helped build successful

TABLE V
GMM ESTIMATION INTERORGANIZATIONAL FRAUD AND ROBUSTNESS CHECKS

Model Number	Model 1	Model 2	Model 3	Model 4	Model 5
Sample	Full Sample	Experience 5+ Years	Experience 8+ Years	Full Sample	Full Sample
Estimation Method	GMM	GMM	GMM	OLS	OLS with Huber-White standard errors
Main Effects					
SC Monitoring	.43 (2.08)	.33 (2.64)	.81 (2.68)	.43 (2.95)	.43 (2.14)
Transactional Complexity	9.14** (2.02)	10.73** (2.52)	12.40** (2.70)	9.14** (1.99)	9.14** (2.07)
SC Competitive Pressure	6.10* (2.67)	7.27* (3.26)	7.78* (3.22)	6.10† (3.32)	6.10* (2.74)
Strong Firm Ties	-4.79* (1.98)	-5.11* (2.40)	-4.08 (2.51)	-4.79* (2.28)	-4.79* (2.03)
Ethical Sourcing	-.16 (1.83)	1.03 (2.44)	1.93 (2.95)	-.16 (2.20)	-.16 (1.88)
Controls					
Experience	-.40 (1.18)	-.79 (2.25)	9.95† (5.61)	-.40 (1.19)	-.40 (1.21)
Firm Size	3.35* (1.60)	3.10† (1.64)	2.77 (1.84)	3.35* (1.48)	3.35* (1.64)
Intercept	-23.39 (17.91)	-35.75 (23.65)	-107.85** (38.17)	-23.39 (16.54)	-23.39 (18.40)
n	151	95	67	151	151
χ^2 (df) ¹	62.36** (6)	45.75** (6)	38.12** (6)	-	-
R ²	-	-	-	0.31	0.31
RMSE	-	-	-	20.81	20.81
F Test	-	-	-	9.04**	8.57**

Reported coefficients are non-standardized. Standard errors are reported in parentheses; ¹Wald test of joint significance, asymptotically distributed as χ^2 with H0 indicating no relationship. ** $p < .01$, * $p < .05$, † $p < .10$.

relationships for Toyota and its suppliers, and this could in part be responsible for fewer recalls than their counterparts [100].

The relationship between strong firm ties and interorganizational fraud was found to be significant ($B = -4.79$, $p < .05$), supporting H4. Integration with suppliers and aligning incentives with buyers and suppliers can reduce the risk of the principal-agent problem as the motivation to engage in fraudulent behavior is reduced. Simultaneously, strong firm ties can provide additional SC visibility without compromising the levels of trust in the relationship that could be associated with higher levels of SC monitoring.

Ethical Sourcing was not found to be significantly related to interorganizational fraud ($B = -.16$, $p > .10$), providing no support for H5. Traditional relational controls that have been shown to limit opportunistic behavior might not be as effective for interorganizational fraud given that the intention behind the behavior is to deliberately circumvent such controls. As with monitoring, there exists anecdotal evidence of fraud occurring despite specific procedural efforts to ensure ethical sourcing. For example, Chipotle suspended sales of carnitas once it was determined that their supplier had been deceptive regarding meeting animal welfare standards and was using antibiotics [101]. Given the nature of interorganizational fraud as intentionally deceiving partners and circumventing processes, ethical sourcing strategies might not prevent unethical behaviors.

E. Robustness Checks

Because of the exploratory nature of the issue and the challenge in acquiring data that explores the issue of fraud at an

SC level, several robustness checks were used in order to help ensure validity of the data and sample. Four additional models were considered: two of them to test the robustness of the results to different levels of experience to ensure that the informants could answer the questions in the survey, and two models to test the robustness of the estimation procedures. All robustness test models and results are included in Table V.

Given the emphasis in the manuscript on familiarity with both SC conditions and interorganizational fraud levels, we implemented two robustness checks to verify that the relationships explored in this manuscript hold at different levels of experience at their firm. First, the estimation procedure was repeated after dropping responses with less than five years of experience in their current position or a similar position at their firm. This led to a reduced sample size of 94 observations. Despite the smaller size, these informants would be better positioned to understand both the general SC conditions and interorganizational fraud levels facing their company when compared to the general size. All hypotheses remained supported at the same significance levels in this reduced sample. A further test was done to include only those informants who had eight years or more of experience at their firm. While this further reduced the sample size to only 67 informants, the relationships were similar in size and direction for all hypotheses, with only one relationship (strong firm ties) no longer remaining significant, though it was in the same direction and the p-value was close to the .10 cutoff ($p = .104$). Overall, the results are robust to the informant's experience in their firm.

Testing was done to verify the results using ordinary least squares (OLS) regression, OLS regression with Huber-White

standard errors. The findings of the different OLS regressions for the final model specification matched the results of the GMM estimation procedure with only minor changes in the significance of individual relationships. Variance inflation factors (VIF) were calculated for the OLS regressions. The VIF for the model estimation procedures were less than 3, which is well below the often suggested value of 10 [102].

Overall, the different robustness tests highlighted that the main relationships held across different sampling strategies and estimations with minor variations in statistical significance.

V. DISCUSSION AND CONCLUSION

This research extended the research on relational risk and SC risk management to explore the risks of interorganizational fraud using the theories of TCE, agency theory, and the fraud triangle. The results showed that interorganizational fraud can have a major financial impact on firms, and the overall findings identified important antecedents for managing fraud risks.

The results from the analysis showed that two traditional approaches for managing opportunistic behavior (SC monitoring and ethical sourcing) were not significantly related to interorganizational fraud as hypothesized. This provides an interesting point of differentiation between interorganizational fraud and research on opportunism. While opportunism has been widely studied in SC literature, additional studies exploring SC fraud is a critical area for future research. One area of potential contribution would be in differentiating between opportunism and fraud to identify if and how risk management and traditional theoretical models are different for managing fraud versus opportunism. Previous conceptual research has identified an important difference between process-based approaches and relational-based approaches for managing disruptions when we consider the intent behind the behavior as either intentional or inadvertent, suggesting that traditional process-based approaches are ineffective [9]. These findings empirically support and extend upon this prior research, suggesting that traditional process-based approaches to limit fraud are not effective approaches, as they can be intentionally circumvented.

Fraud management approaches that limit the use of complex transactions, decrease SC pressures, and establish long-term relationships can serve as potential solutions to limit SC fraud. These additional measures serve to identify two additional mechanisms: relational-based approaches (reducing SC pressures and emphasizing stronger relationships), and transactional-based approaches (reducing transactional complexity) that could be used to limit fraud.

A. Theoretical and Practical Implications

This article demonstrated the potential impact of interorganizational fraud on firm performance and the importance of understanding the antecedents to interorganizational fraud. We identified key drivers of interorganizational fraud and also the relationship between these drivers and interorganizational fraud. This manuscript made three key contributions to research. First, we established empirical evidence that interorganizational fraud is an important and impactful concern for SC managers.

This finding motivates additional research on interorganizational fraud as an important component of SCRR. Second, this research combined several theoretical perspectives to explain interorganizational fraud and identified important antecedents of SC fraud. By establishing a theoretical foundation for SC fraud and a way to measure a firm's exposure to interorganizational fraud, we created opportunities for additional research in this domain. Third, we developed and tested a model relating important antecedents of interorganizational fraud and found evidence that weak firm ties, SC competitive pressures, and transactional complexity are positively related to interorganizational fraud.

B. Limitations and Future Research

Despite the methodological rigor taken during this study, there are several limitations of the work that should be addressed. First, the data collected were from manufacturing firms in Australia and the results might not be generalizable to the rest of the world or to other industries. Because this work primarily emphasized manufacturing, it would be valuable to explore the role of fraud for service operations, as it is uncertain how these constructs and our findings would apply to service operations. Future research should explore these findings in other contexts, including across different regions and industries. Second, additional verification of these relationships using other approaches, including objective measures, secondary data, or experimental approaches, can extend the validity of these relationships outside of the limitations of the measures in this research. The dependent variable in this research is an estimated measure based on the informant's best approximation. While several tests were done to verify that the results are robust to an informant's level of experience to account for this challenge, future research using a more objective dependent variable on interorganizational fraud is necessary. While the antecedents in this model were based on prior research on accounting fraud and opportunism, they are for the large part novel constructs, and additional testing of the measures included in this manuscript and the development of additional measures for detecting interorganizational fraud may yield additional insights. Such approaches should additionally explore EFA/CFA approaches that were not possible in this experiment, as the data collected did not meet the general recommendations for factor analysis [91], [103]. Third, the data collected were single respondents. As such, the findings in the manuscript should be corroborated with additional research that uses different methodological approaches and sources for data.

Several mechanisms have been proposed for limiting opportunism in relationships, which can be mapped to the concept of the constructs and theories explored in this manuscript, such as trust, [104], [105], formal and relational contracting [72], and justice practices [106]–[109]. Understanding the relationship that these factors have with interorganizational fraud can yield additional insight on this important topic. For example, trust can influence both the strong firm ties (by increasing one's vulnerability in the relationship) and reduce SC competitive pressures, while decreasing rationalization (by demonstrating positive goodwill in the relationship). Other related

concepts to supply chain fraud, such as opportunism or other unethical behaviors, could be explored simultaneously. Monitoring can decrease the level of opportunity but might also increase the rationalization of a firm if it perceives a lack of trust.

VI. CONCLUSION

Using survey data from 151 informants from manufacturing firms, we found that the median reported impact of interorganizational fraud was 9% of a firm's total revenue, suggesting that interorganizational fraud can have a large impact. Using several more in-depth responses from the informants, we identified several specific examples of interorganizational fraud, primarily consisting of either product quality fraud or pricing/invoicing frauds. Three antecedents of interorganizational fraud (transactional complexity, SC pressures, and weak firm ties) were found to be positively related to the reported losses from interorganizational fraud, suggesting additional areas to emphasize for managing SC fraud risks and for future research to explore.

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