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Supply Chain Risk: Changes in Supplier Composition and Vertical Integration

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Nuri Ersahin
Southern Methodist University
Mariassunta Giannetti
Stockholm School of Economics, CEPR, Swedish House of Finance and ECGI
Ruidi Huang
Southern Methodist University

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Abstract

Using textual analysis of earnings conference calls, we quantify firms' supply chain risk and explore how firms react when supply chain risk increases. We show that firms with supply chains that span across continents, multinationals, and firms with fewer suppliers of an input face higher supply chain risk. In addition, firms exhibit high supply chain risk when their suppliers also do so. Firms manage supply chain risk by establishing relationships with closer and domestic suppliers and with suppliers that are industry leaders and by vertically integrating, but they continue to work with suppliers in other continents.

Keywords: Supply chains; nearshoring; fragmentation; textual analysis; topic modeling; vertical integration; M&As

JEL Classifications: G31, G34, F15

Nuri Ersahin*
Assistant Professor of Finance
Southern Methodist University
6212 Bishop Blvd
Dallas, TX 75275, USA
phone:
e-mail: ersahin@smu.edu

Mariassunta Giannetti
Katarina Martinson Professor of Finance
Stockholm School of Economics
Sveavagen 65
113 83 Stockholm, Sweden
phone: +46 873 696 07
e-mail: mariassunta.giannetti@hhs.se

Ruidi Huang
Assistant Professor
Southern Methodist University
P. O. Box 750333
Dallas, TX 75275, USA
phone: (214) 768-1132
e-mail: ruidih@smu.edu

*Corresponding Author

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Nuri Ersahin, Mariassunta Giannetti, and Ruidi Huang*

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*Ersahin (ersahin@smu.edu) is with the Cox School of Business at Southern Methodist University; Giannetti (mariassunta.giannetti@hhs.se) is with the Stockholm School of Economics, CEPR, and ECGI; Huang (ruidih@smu.edu) is with the Cox School of Business at Southern Methodist University. We thank an anonymous referee, Laurent Bach, Jon Garfinkel, Michael Hertzel, Ron Masulis, Katie Moon, Veronica Rappoport, Shang-Jin Wei, and seminar participants at ESSEC, Southern Methodist University, the University of Iowa, the University of Mannheim, the University of New South Wales, the NBER and Central Bank of Chile International Fragmentation, Supply Chains, and Financial Frictions Conference, the Midwestern Finance Association annual meeting, the Inaugural Edition of the ESADE Spring Workshop, the Amsterdam Corporate Finance Day, the SFS Cavalcade, the Financial Intermediation Research Society annual meeting, the ECGI Global Corporate Governance Colloquium, and the University of Southern Denmark Finance Workshop for comments. Giannetti acknowledges financial support from the Jan Wallander and Tom Hedelius Foundation. A significant part of this project was completed when Ersahin was with the Michigan State University. Ersahin acknowledges financial support from Michigan State University-Center for International Business Research (CIBER).

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1. Introduction

Production relies on global and complex supply chains, which have often been optimized to reduce costs. Major events, such as the Sino-American trade war, the Covid-19 pandemic, the Suez Canal accident, and the 2011 Japanese earthquake, disrupt supply chains and production. Existing literature has widely documented that even small negative shocks, such as bankruptcies or natural disasters, are transmitted to firms upstream and downstream (Hertzel, Li, Officer, and Rogers, 2008; Acemoglu, Carvalho, Ozdaglar, and Tahbaz-Salehi, 2012; Barrot and Sauvagnat, 2016; Carvalho, Nirei, Saito, and Tahbaz-Salehi, 2021). However, we know little about which firms are more exposed or even whether firms systematically update their investors about the ex-ante probability that such shocks may occur and any perceived changes in this source of risk. We are also unable to quantify the effects of supply chain risk on corporate policies. Concerns have been raised that firms are unaware of the supply chain risks their suppliers are subject to (Choi, Rogers, and Vakil, 2020) and may not be able to manage this source of risk.

Quantification of the supply chain risk faced by different firms would be important but is challenging because supply chain risk comes from many sources and multiple channels. For instance, firms may be indirectly exposed if their suppliers, or the suppliers of their suppliers, face bottlenecks. Similarly, firms may be exposed through their customers if downstream firms are unable to source complementary inputs and are forced to limit production. Furthermore, commercial data sources mainly focus on big customers and suppliers, providing limited coverage on the potential source of shocks over the supply network. While these data sources are useful for quantifying the effects of shock propagation, they do not allow us to gauge how firms perceive supply chain risk and adapt their strategies to mitigate supply assurance concerns.

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Our objective in this paper is to develop a proxy for supply chain risk using textual analysis, and to study which firms are most affected by supply chain risk and the extent to which supply chain risk affects firms' policies and industrial structure. We perform textual analysis of earnings conference calls to construct a measure of supply chain risk faced by U.S. listed companies. Following Hassan, Hollander, Van Lent, and Tahoun (2019), we measure supply chain risk using the discussion of supply chain issues related to words capturing risk and uncertainty. We also use topic modeling analysis to ascertain the sources of supply chain risk and construct a measure of the sentiment of supply chain discussions to capture negative realizations of supply chain shocks. Supply chain sentiment can also help us capture news about the conditional mean of supply chain shocks (see Hassan, Hollander, Van Lent, and Tahoun (2019, 2020a, b) for a similar interpretation of political sentiment).

We find that between 2002 and 2020 most U.S. companies discuss topics related to supply chains in connection to risk and uncertainty. This indicates that supply chain risk is important and so far neglected in the economics and finance literature. Importantly, supply chain risk is positively correlated with stock price volatility, while supply chain sentiment is associated with positive returns. Consistent with studies that highlight that measured uncertainty in aggregate data tends to increase when the economy is affected by adverse shocks (Berger, Dew-Becker, and Giglio, 2020), supply chain sentiment turns negative and supply chain risk increases on average in conjunction with events that are known to have disrupted supply chains, such as the 2011 Japanese earthquake and the Thai floods (Carvalho et al., 2021). The increase in supply chain risk and the drop in supply chain sentiment appear unprecedented during the Covid-19 pandemic. However, while supply chain risk and supply chain sentiment are negatively correlated, the actual correlation across firms over time is only -1%, suggesting that we can independently measure negative realizations of

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supply chain shocks and supply chain uncertainty. Furthermore, supply chain risk appears to be higher for firms in industries that use differentiated products as inputs, consistent with the intuition that these goods are hard to substitute.

Even though macroeconomic and industry level uncertainty matters, the way firms discuss supply chain risk appears to be highly idiosyncratic. Most of the variation in supply chain risk is explained by firm-specific shocks rather than time- or industry-specific shocks. We provide a battery of tests showing that this idiosyncratic variation is unlikely to be noise and that it largely depends on firm characteristics affecting exposure to supply chain risk. Supply chain risk is higher for firms that have suppliers in different continents and are small relative to their suppliers, suggesting that they have limited bargaining power. Firms that have many suppliers in a given industry are less exposed to supply chain risk, suggesting that hold-up problems and lack of diversification in input sources magnify supply chain uncertainty. Large firms and multinationals, possibly having more complex supply chains, are more exposed to supply chain risk.

We also investigate the actions firms take to manage supply chain risk. First, firms appear to actively manage supply chain risk by increasing the number of their suppliers. In addition, firms that communicate more uncertainty about their supply chain subsequently establish relationships with suppliers that can be considered industry leaders and with nearby suppliers, suggesting that these firms attempt to increase the reliability of their supplier network. However, we find no evidence that firms sever their relationships with suppliers in other continents, suggesting that supply chain diversification and nearshoring do not necessarily imply more fragmentation.

In addition, we find that supply chain risk affects the boundaries of the firm and industrial structure. The benefits of common ownership of different stages of the production process are expected to increase when there is uncertainty about the availability of inputs (Williamson, 1971).

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Accordingly, firms that report high supply chain risk are involved in more vertical mergers and acquisitions (M&As). This indicates that firms tend to acquire customers and suppliers when supply chain risk increases. Financial constraints limit firms' ability to perform M&As, potentially hampering their long-term competitive advantage.

Interestingly, changes in corporate policies are driven by supply chain risk and not by supply chain sentiment. Supply chain sentiment, which is presumably more closely related to the negative shocks affecting a firm's suppliers, has different or no effects on supplier composition and vertical M&As. This is consistent with Ersahin, Giannetti, and Huang (2023), who find that supply chains are overall stable following negative shocks and suggest that financially flexible firms react when uncertainty increases, not when negative shocks occur.

Our results are robust to a battery of tests and alternative specifications. First, we address the concern that firms may discuss supply chain risk to justify vertical M&As and changes in their supplier composition, not because they are experiencing actual uncertainty in sourcing inputs. To do so, we instrument for our textual measure of supply chain risk using the supply chain risk experienced by a firm's suppliers, which can be considered exogenous to a firm's plans. Consistent with our main findings, we document increases in vertical M&As as well as in the number of suppliers that are geographically closer or industry leaders, when we use exogenous variation in a firm's supply chain risk arising from its suppliers.

Second, the results are robust if we control for firm-level measures of political risk and climate risk, which are constructed with similar techniques and have been shown in previous literature to affect firms' policies (Hassan et al., 2019, 2020a, b; Sautner, Van Lent, Vilkov, and Zhang, 2023). These findings indicate that our measure of supply chain risk captures a different source of shocks and uncertainty. More importantly, while firms appear to decrease investment

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when they face political risk and other sources of macroeconomic uncertainty (Baker, Bloom, and Terry, 2023), they increase investment by acquiring customers and suppliers when uncertainty arises from the availability of inputs, suggesting that supply chain risk deserves independent investigation.

Last, we show that our results are invariant whether we control for supply chain sentiment or not and when we control for the overall sentiment of the conference call, alleviating any concerns that supply chain risk may be correlated with negative shocks or with changes in the conditional mean of supply chain shocks.

Our work is related to several strands of the literature. First, we contribute to the literature on the boundaries of the firm. Production is believed to be coordinated within a firm, rather than through the market when transaction costs and hold-up problems are severe (Coase, 1937; Klein, Crawford and Alchian, 1978; Grossman and Hart, 1986). A more recent strand of this literature focuses on global supply chains and explores the effects of demand and technological characteristics on the decision to integrate different stages of production (e.g., Antràs and Chor, 2013; Alfaro, Antràs, Chor, and Conconi, 2019), but neglects the effects of risk. While it is well recognized that mergers facilitate collaboration especially in innovative industries (Bena and Li, 2014; Hsu, Li, Liu, and Wu, 2022), there are few empirical studies exploring vertical mergers. Existing work focuses on the role of industry shocks (Ahern and Harford, 2014), cash-flow uncertainty (Garfinkel and Hankins, 2011), and R&D incentives (Fan and Goyal, 2006; Fresard, Hoberg, and Phillips, 2020).

The role of supply chain risk in vertical integration decisions, first highlighted by Williamson (1971), has been largely neglected in subsequent investigations of vertical M&As, even though theoretically, supply assurance concerns are known to affect the decision to integrate

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vertically (Bolton and Winston, 1993). To the best of our knowledge, we are the first to show empirically that supply chain risk is a driver of vertical integration.

Second, from a methodological point of view, we contribute to a nascent literature that uses textual analysis to measure risk and uncertainty. The most prominent contributions relate to measures of political risk (Baker, Bloom, and Davis, 2016; Hassan et al., 2019). Textual analysis has also been widely used in measuring geopolitical risk (Caldara and Iacoviello, 2022), climate risk and climate risk disclosure (Sautner et al., 2023; Li, Shan, Tang, and Yao, 2023), and cyber risk (Florackis, Louca, Michaely, and Weber, 2023). We construct a measure of supply chain risk based on textual analysis and show that this source of risk warrants independent investigation not only because it is not subsumed by earlier proxies of uncertainty, but also because it has different effects on corporate policies.

Finally, the literature on networks highlights the importance of complementarities between different phases of the production process (Kremer, 1993).[1] While empirical work typically studies the consequences of negative realizations of supply chain risk, recent theories acknowledge that companies' decisions to diversify the source of inputs reflect disruption risk in a way that may lead to a decline in output and is not necessarily socially optimal (Bimpikis, Fearing, and Tahbaz-Salehi, 2018; Kopytov, Mishra, Nimark, and Taschereau-Dumouchel, 2022). To the best of our knowledge, we are the first to explore how firms manage their supply chains in response to this source of risk. This contrasts with previous literature that typically takes the supply chain as given and explores how shocks are transmitted given current customer-supplier links focusing on natural disasters (e.g., Barrot and Sauvagnat, 2016; Carvalho et al., 2021), credit shocks (Alfaro, Garcia-Santana, and Moral-Benito, 2021; Costello, 2020), data breaches (Crosignani, Macchiavelli, and Silva,

[1] Cen and Dasgupta (2021) provide a review of supply chain linkages.

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2023), or pandemic closures (Bonadio, Huo, Levchenko, and Pandalai-Nayar, 2021; Aral, Giambona, Lopez Aliouchkin, and Phillips, 2021). Using our newly developed proxy for supply chain risk, we capture firm-level perceived supply chain uncertainty potentially arising from any of the above shocks, while controlling for supply chain negative shock realizations using supply chain sentiment and other proxies.

2. Data Sources

We combine a variety of data sources. First, we collect about 200,000 transcripts of conference calls held in conjunction with an earnings release (hereafter, earnings calls) by 8,000 public firms listed in the United States from 2002 to 2020 through Refinitiv Eikon database and Capital IQ. Firms generally hold quarterly earnings conference calls to inform investors and analysts about the firm's performance. Presentation by the management is followed by a question-and-answer session. Conference calls have been widely used to construct proxies for corporate culture (Li, Mai, Shen, and Yan, 2021) as well as to quantify firms' exposure to political risk (Hassan et al., 2019), Covid-19 (Hassan et al., 2020a), Brexit (Hassan et al., 2020b), cyber risk (Florackis et al., 2023), and climate risk (Sautner et al., 2023; Li et al., 2023). We construct our proxies for supply chain risk and sentiment using the entire conference call including both the presentation and the question-and-answer session, following the approach introduced by Hassan et al. (2019).

Second, we obtain information on supply chains from Factset Revere, including specific supplier-customer pairs and their locations. Factset Revere collects relationship information from primary public sources, such as SEC 10-K annual filings, investor presentations, and press releases,

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and classifies the relationship types. Factset Revere spans the period 2002 – 2020 and limits our sample period. On average, for the sample firms, we observe 8 suppliers and 10 customers.

Third, we use the Securities Data Company (SDC) Mergers and Acquisitions database for M&As. To identify whether the target and the acquirer are in vertically related industries, we use the Bureau of Economic Analysis's (BEA) Input-Output tables, which provide the dollar flow of goods and services between producing and purchasing industries.[2]

Finally, we use Compustat and CRSP for firm-level variables. Table 1 summarizes the main variables that we introduce as we progress with the analysis. All variables are defined in Appendix A.

3. Measuring Supply Chain Sentiment and Risk

We view supply chain risk to arise from any shocks to a firm's production network. Hence, supply chain risk may arise because uncertainty about future input and commodity prices, tariffs, changes in transportation costs, uncertainty about offshore activities and bottlenecks affect the timely delivery of high-quality inputs or the probability of securing inputs at a price consistent with current profit margins. In addition, geopolitical risk may disrupt direct and indirect customer or supplier relationships, affecting firms' sales or ability to produce.

Overall, supply chain risk may arise from a variety of sources that are hard to quantify using financial data: Not only firms have thousands of customers and suppliers that are typically hard to observe, but even if we observed all the shocks affecting a firm's production network, we would be unable to quantify a firm's exposure because suppliers may choose to prioritize different

[2] We use all the links between industries, regardless of the size of the flows between industries. We show that our results are robust when we only consider vertically integrated industries with significant flows.

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customers and markets. For these reasons, we conduct textual analysis to quantify the supply chain risk to which a firm is exposed using managerial statements in conference calls.

3.1 Textual Analysis

We build on recent work that uses the proportion of the conversations during a conference call that is centered on a particular topic as a source for identifying various risks and opportunities (Hassan et al., 2019, 2020a, b). To construct our dictionary, we adopt methods developed in computational linguistics and natural language processing to capture word combinations that are indicative of discourse about a given topic (Song and Wu, 2008; Manning, Raghavan, and Schutze, 2008). Specifically, we follow Hassan et al. (2019), who study firm-level political risk and determine signal bigrams by comparing training libraries of a political textbook to bigrams appearing in nonpolitical texts, specifically an accounting textbook.[3]

We thus construct a training library of bigrams related to supply chains using the textbook, *Supply Chain Management: Strategy, Planning, and Operation* (6th edition; Chopra and Meindl, 2016). The textbook, born from a course on supply chain management taught at Northwestern University's Kellogg School of Management, focuses on the economics and management of supply chains, rather than on the mathematics of inventory optimization, and ranks among the top books in supply chain management in a variety of reviews.[4] We also construct another training library of non-supply-chain topics using the financial accounting textbook, *Financial Accounting* (10th edition; Libby, Libby, and Hodge, 2020), which allows us to capture words used in the

[3] We consider bigrams, as opposed to single words, because previous research suggests that text-classification results generally improve by applying n-grams (usually bigrams) of words as opposed to single words (unigrams) (Tan, Wang, and Lee 2002; Bekkerman and Allan 2004).
[4] See for instance https://insights.btoes.com/top-10-supply-chain-books, and https://www.linkedin.com/pulse/top-4-supply-chain-books-every-student-should-read-mohammed-boualam/

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discussion of general finance and accounting issues. We define the training library archetypical of the discussion of supply chain issues, *S*, and the other training library of general corporate financial issues, *N*. Each training library is the set of all adjacent two-word combinations (bigrams) contained in the respective supply chain and financial accounting texts.

We consider as related to supply chain issues all bigrams that appear in the supply chain textbook but not in the financial accounting textbook; in addition, since there is some overlap between supply chain and financial accounting topics, and the bigram "supply chain" naturally appears in the financial accounting textbook, we include in our supply chain training library any bigrams that are at least 30 times more frequent in the supply chain textbook than in the financial accounting textbook.

Using this methodology, we identify a total of 70,820 bigrams associated with supply chain discussions, of which only 59 also appear in the financial accounting textbook, but are at least 30 times more frequent in the supply chain book. The dictionary we obtain in this way includes words that are not easily relatable to supply chain discussions, such as "in table", "in period", etc. For this reason, we manually clean the resulting dictionary and remain with 4,631 bigrams.[5] Table IA.1 lists the top 100 supply chain bigrams in the training library. "Demand Uncertainty," "Production Cost," and "Transportation Cost(s)" figure among the top 100 bigrams

Interestingly, almost all firms discuss supply chain topics, indicating that this is an important issue, so far largely neglected in the literature. Having identified the relevant bigrams, we decompose all the conference calls of firm *i* in year *t* into a list of bigrams contained in the

[5] The following perturbations of the textual analysis do not appear to affect the thrust of of our findings: 1) excluding bigrams that are 30 times more frequent in the supply chain textbook; 2) the manual cleaning of bigrams not easily relatable to supply chain discussions.

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filings, $b = 1, \ldots, B_{it}$, and assign a score to each quarterly earnings call transcript based on the recurrence of bigrams in our dictionary.

We construct our scores at a yearly frequency because firms are likely to face switching and search costs when changing suppliers or deciding whether to vertically integrate. Since any reactions are likely to take more than a quarter, measuring supply chain risk at a higher frequency may just increase noise. To define supply chain risk, we count the number of occurrences of bigrams indicating discussion of supply chains within the set of 10 words surrounding a synonym for "risk" or "uncertainty" on either side in the earnings calls performed during year *t*, and divide by the total number of bigrams in the transcript:

$$SCRisk_{i,t} = \frac{\sum_{b}^{B_{i,t}} I[b \in S \backslash N] \times I(|b - r| < 10) \times \frac{f_{b,S}}{B_S}}{B_{i,t}},$$

where I[•] is the indicator function, r is the position of the nearest synonym of risk or uncertainty, $f_{b,S}$ is the frequency of the term b in the supply chain training library, and B_S is the total number of terms in the supply chain training library. The numerator thus simply counts the number of bigrams associated with discussion of supply chains that occur within ten words to a synonym for risk or uncertainty. Terms are given a larger weight if they recur in the training library more often. The denominator, $B_{i,t}$, is the total number of bigrams in the transcript of firm *i* in year *t*. Table IA.2 reports the list of synonyms of risk words derived from the Oxford Dictionary following Hassan et al. (2019).

A challenge for any measure of risk and uncertainty is that news about the variance of shocks may be correlated with negative shocks or shocks to their conditional mean (e.g., Bloom, 2014). For this reason, following a procedure similar to that for the construction of *SCRisk*, we construct a proxy for the sentiment of the supply chain discussions. Specifically, we condition on

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the proximity to positive and negative words, identified from Loughran and McDonald's (2011) dictionary of words related to sentiment in financial texts. Supply chain sentiment is thus defined as:

$$SCSentiment_{i,t} = \frac{\sum_{b}^{B_{i,t}} \{ I[b \in S \backslash N] \times \sum_{c=b-10}^{b+10} S(c) \times \frac{f_{b,S}}{B_S} \}}{B_{i,t}},$$

where *S(c)* is a function that assigns a value of +1 if bigram c is associated with positive sentiment and a value of -1 if bigram c is associated with negative sentiment; *S(c)* takes value zero otherwise. $\sum_{c=b-10}^{b+10} S(c)$ calculates the net sentiment among the ten words surrounding bigram b. Also, in this case, we weigh words based on their frequency in the training library.

Based on existing literature (Hassan et al., 2019, 2020a, b), we view SCSentiment and SCRisk as proxies for the first and the second moment of a firm's supply chain shocks during a year, respectively. However, the interpretation of our findings is unchanged if we, more informally, consider SCRisk as uncertainty and fear of future supply chain shocks, and SCSentiment as capturing the realization of shocks related to the supply chain during a year; in this case, to the extent that supply chain shocks are correlated over time for the same firm, SCSentiment could also capture the conditional mean of supply chain shocks.[6]

Naturally, given that measures of uncertainty typically increase when adverse shocks occur (Berger, Dew-Becker, and Giglio, 2020; Bloom, 2014), SCRisk and SCSentiment are negatively

[6] Our interpretation is confirmed by the excerpts of earning conference calls that score highest for SCRisk and SCSentiment in Panels A and B, respectively, of Table IA.3. To further evaluate our interpretation of the textual analysis proxies, we also use the dictionary of Bozanic, Roulstone, Van Buskirk (2018) to capture future statements. Even though this dictionary is adapted to disclosures rather than earnings conference calls (and therefore we may not identify all future statements), we find that 75% of the snippets that we identify as discussing supply chain risk include future statements, which is overall supportive of our interpretation of SCRisk, as uncertainty can only be related to future events. Only 50% of the snippets discussing supply chains with positive or negative sentiment contain forward-looking statements, which is consistent with the fact that SCSentiment can be backward-looking (if shocks that already occurred are being discussed) or forward-looking (if firms express negative expectations about future realizations of supply chain shocks).

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correlated. When a firm receives news that the provision of some inputs is disrupted, it simultaneously faces higher uncertainty on the future stability of its supply chain. However, the correlation between SCSentiment and SCRisk is low at around -1%, indicating that these two proxies have independent sources of variation.

3.2 What Is Supply Chain Risk About?

To provide an overview of the determinants of supply chain risk, we use topic modeling analysis, a widely used machine learning algorithm (see, e.g., Li, Liu, Mai, and Zhang, 2021; Dasgupta, Harford, Ma, Wang, and Xie, 2020), on snippets containing words in the risk and supply chain dictionaries. Applying this algorithm, we obtain several lists of words that tend to occur jointly and can therefore be considered related to different topics. From these lists, which Figure 1 presents as word clouds, we can infer the topics associated with discussions of supply chain risk. We assign meaningful labels to the topics by inspecting the list of words.

Supply chain risk appears to be linked to uncertainty about commodity price and more generally input costs, technology and cyberattacks, the environment, climate risk, and the pandemics. Firms also discuss supply chain risk in conjunction with investment and acquisitions, suggesting that firms manage this source of risk by updating their lines of production to accommodate new suppliers and even consider vertical integration. Finally, firms discuss supply chain risk in conjunction with liquidity, difficult access to loans, and other financial issues. Financial vulnerability could increase uncertainty about customers and suppliers, but also

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constrain a firm's ability to invest and vertically integrate, thus leaving firms more exposed to supply chain disruptions.[7]

3.3 Validation

The Internet Appendix shows that our proxy for SCRisk exhibits cross-industry and time series variation that aligns with reasonable priors. For instance, manufacturing (nontradable) industries have higher (lower) SCRisk (Table IA.5). Specifically, textiles, machinery, hi-tech, electronic goods (semiconductors), and mineral products are among the top industries for SCRisk as is consistent with industry reports from Boston Consulting Group or Euromonitor. Furthermore, in Table IA.6, firms that purchase more differentiated inputs, which are presumably hard to substitute, tend to have higher supply chain risk (but not lower supply chain sentiment). By converse, firms that are less dependent on their suppliers because they are in upstream industries (produce crude products) have lower SCRisk on average. This finding suggests that uncertainty originating from suppliers is more relevant for a firm than that from customers.

Figure IA.1 describes how the means of SCRisk and SCSentiment vary over time. Supply chain risk appears to be heightened and, to a somewhat lower extent, supply chain sentiment becomes more negative in connection to events that are widely known to have disrupted global supply chains, such as the 2011 great East Japan earthquake and the Thailand floods, the Sino-American trade war, and more recently the Covid-19 outbreak.[8] Supply chain sentiment oscillates between negative and positive.[9]

[7] From the algorithm, we obtain also the topic prevalence, that is, the probability that a snippet is related to a given topic. Table IA.4 relates SCRisk and SCSentiment of a firm over a year to the probabilities of each of the seven topics in its supply chain discussions, to give an idea of the relevance of each topic.
[8] Figure IA.2 relates the yearly mean of SCRisk with a measure of supply chain strains based on transportation costs, developed by Benigno, di Giovanni, Groen, and Noble (2022), and confirms that the two measures evolve similarly.
[9] For instance, offshoring can decrease costs and improve performance (Hoberg and Moon, 2019), thus leading to positive supply chain sentiment.

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While the variation of SCRisk across time and industries is meaningful, only a limited proportion of supply chain risk is explained by time or industry specific shocks. In Table IA.7, economy-wide shocks, as captured by time fixed effects, industry fixed effects (considered at different levels of granularity) and, more relevantly, interactions of industry and time fixed effects and even firm fixed effects explain at most about 50 percent of SCRisk (and SCSentiment), suggesting that firm-specific shocks are important. Importantly, Panel A of Table IA.8 shows that firms with higher SCRisk tend to have higher realized volatility. Furthermore, supply chain sentiment is positively associated with returns (Panel B), indicating that we capture actual idiosyncratic firm-level performance volatility.

4. Firms' Exposure to Supply Chain Risk

Table 2 relates SCRisk and SCSentiment to contemporaneous firm characteristics to understand which firms are relatively more exposed. Throughout the analysis, we control for interactions of industry and year fixed effects. The estimates indicate that supply chain risk is higher for firms that report a higher fraction of suppliers in other continents and large firms that tend to have more complex supply chains. A one-standard-deviation increase in the fraction of suppliers located in other continents is associated with a 5.0% increase in our measure of supply chain risk relative to the sample median. Similarly, a one-standard-deviation increase in firm size is associated with a 6.6% increase in supply chain risk. Multinationals also tend to have higher supply chain risk. These findings suggest that distance and supply chain complexity increase supply chain risk.

Supply chain risk also appears to be related to a company's bargaining power with its suppliers. First, companies that are large relative to their suppliers exhibit less supply chain risk,

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suggesting that they may benefit from being the most valued customers of their suppliers. Second, firms that have multiple providers of the same input should be better able to substitute suppliers. We thus consider firms with a higher average number of suppliers by input industry. These firms have lower SCRisk: On average, one more supplier by input industry decreases a firm's supply chain risk by 8.9% relative to the sample median, suggesting that diversification decreases supply chain risk.

While in principle supply chain risk may also arise from uncertainty about customers, we do not observe that customer dependence, which should presumably increase a firm's vulnerability, is positively associated with supply chain risk. Financial constraints also do not appear to affect supply chain risk, while firms with higher growth opportunities, which possibly rely more on knowledge and services than physical inputs for their production, face less supply chain risk. Finally, it does not appear that institutional owners push firms to discuss supply chain issues and risk, as institutional ownership is negatively related to our proxy for supply chain risk.

Interestingly, supply chain sentiment, but not supply chain risk, is more negative for small firms and firms that face a more competitive environment as proxied by a low market share, suggesting that these firms have more unstable supply chains. The estimated coefficient is not only statistically significant but also economically significant: a 10% decrease in market share is associated with a 4.1% decrease in supply chain sentiment.

5. How Firms Manage Supply Chain Risk

Since the early 1980s, production has been relying on complex global value chains (Antràs and Chor, 2022). Geopolitical tensions between the U.S. and China, the war in Ukraine, and the Covid-19 pandemic are increasingly mentioned in the press as leading to more fragmentation and

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reshoring of global supply chains.[10] Systematic evidence is however missing. In principle, firms could achieve more resilience by diversifying their suppliers, rather than relying on closer suppliers. Using our proxy for firm level supply chain risk, we can provide the first systematic evidence about how firms organize their supply chains and their production processes in response to an increase in supply chain risk.

5.1 Supplier Composition

We investigate how characteristics of the supply chain vary when firms face heightened supply chain risk. Specifically, we relate characteristics of a firm's supply chain to the one-year lag of the proxy for supply chain risk, while including firm fixed effects. In this way, we study how changes in supply chain risk affect how firms decide to source their inputs. We also absorb industry shocks by including interactions of industries and year fixed effects.

Panel A of Table 3 shows that firms attempt to reduce the probability of a supply chain disruption by changing their supplier pool. Bimpikis, Fearing, and Tahbaz-Salehi (2018) and Elliott, Golub, and Leduc (2022) predict that firms may react to heightened supply chain risk by increasing the number of suppliers and multisourcing key inputs to reduce their dependence on specific suppliers. In column 1, firms indeed appear to increase the number of suppliers in response to supply chain risk: going from the median to the 95th percentile of SCRisk leads to a 3.6% increase in the number of suppliers.

Firms address supply chain risk not only through the quantity but also through the quality of their suppliers. Elliott, Golub, and Leduc (2022) argue that firms can minimize the probability of production disruption through the reliability of the supplier network or by forming stronger

[10] See "The structure of the world's supply chains is changing" The Economist, June 16, 2022.

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relationships with their suppliers. One way to do this is through geographical proximity. First, uncertainty about transportation costs or travel damages increases as the physical distance between a firm and its supplier increases (Schmitt and Van Biesebroeck, 2013; Bray, Colak, and Serpa, 2019). Second, firms can better monitor physically closer plants, which can help them maintain consistent product quality (Giroud, 2013). Finally, better monitoring coupled with more face-to-face communication can help firms build trust with their suppliers (Schmitt and Van Biesebroeck, 2013). Therefore, we would expect that firms establish relationships with geographically closer suppliers when supply chain risk increases.

We test this conjecture in columns 2 and 3. We look at the number of suppliers in the same continent and in the U.S., respectively. The estimated coefficients on SCRisk are positive and statistically significant at the 1% confidence level and imply that following an increase in supply chain risk, U.S. public firms start working with an increasing number of suppliers located in the same continent, mainly in the U.S. In column 4, we see no change in the number of suppliers in different continents, indicating that nearshoring increases the diversification of a firm's supply chains but does not necessarily lead to more fragmentation of the supply chains.

Another way to increase the reliability of the supplier network is to work with suppliers that are leaders in their industries. Industry leaders are expected to have a reputation of delivering on their commitments, which should be particularly important when firms have concerns about the ability to source their inputs.[11] We test this conjecture in column 5. We define firms as industry leaders if their sales are above the median within their 3-digit industry. The positive coefficient of interest shows that firms establish relationships with suppliers that are leaders in their industries when supply chain risk increases.

[11] At the earnings call for the third fiscal quarter of 2020, Mark Aslett, the President and CEO of Mercury Systems, Inc., describes this firm behavior as "flight to quality suppliers."

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Taken together, these findings show that firms strategically choose their suppliers to minimize the risk of costly production disruption (Elliott, Golub, and Leduc, 2022). Supply chain diversification and nearshoring (reliance on close suppliers) thus appear complementary mechanisms to address supply chain risk.

A possible concern with the interpretation of these results is that we capture the effect of negative shocks that propagate over the supply chain. The fact that we absorb industry shocks through interaction of industry and time fixed effects and control for a firm's cash flow at *t-1* should mitigate these concerns. Yet, in columns 6 to 10 of Panel A we control for supply chain sentiment. Unsurprisingly, given the very small correlation between our SCRisk and SCSentiment, our estimates remain qualitatively invariant. Interestingly, decreases in SCSentiment are not associated with greater supply chain diversification, suggesting that if anything, shocks to the conditional mean have different effects from supply chain uncertainty. Firms appear to expand the number of close suppliers when they experience positive supply chain shocks, possibly to increase production when facing favorable conditions.

Panel B addresses the concern that discussions of supply chain risk could be endogenous. In particular, companies that are experiencing difficulties and have to switch suppliers, possibly resulting in higher costs, could strategically discuss supply chain uncertainty even if their problems do not derive from the supply chain. We conjecture that strategic discussions of supply chain risk are less likely if a firm's suppliers are also discussing supply chain risk. We thus use as an instrument for a firm's SCRisk the maximum SCRisk of all its suppliers (whether domestic or international) that we observe from Factset Revere and for which we can obtain earnings conference calls from Eikon and Capital IQ. By considering the maximum SCRisk of a firm's

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suppliers, we take into account that inputs are complements, and a firm's production is likely to be disrupted even if only one of the suppliers experiences problems.

Panel B reports the instrumental variable estimates. The effect of the instrument on a firm's SCRisk in the first stage is positive and significant, as we expect.[12] Furthermore, the F-statistic of the excluded instrument indicates that our instrument is not weak. The second stage estimates continue to support our earlier findings that following increases in supply chain risk, firms increase their number of suppliers, relying especially on suppliers that are in the same continent or domestic and are industry leaders. Importantly, it appears that firms also add suppliers in other continents, even though to a lower extent, confirming that supply chain uncertainty does not lead to more supply chain fragmentation. Also, in this case, controlling for supply chain sentiment leaves our estimates unaffected.[13]

Importantly, the coefficient on SCRisk is much larger in Panel B. For instance, in column 1, going from the median to the 90th percentile of SCRisk leads to a 67% increase in the number of suppliers. The larger parameter estimate in the instrumental variable regressions is likely to depend on two factors. First, SCRisk contains measurement error. To the extent that the measurement error is uncorrelated with firms' supply chain characteristics and just depends on idiosyncrasies of the conference calls languages, it may drive down the coefficient estimates in the ordinary least squares regressions. Second, and more importantly, when we use the SCRisk of the suppliers as an instrument, we are likely to capture disproportionately large increases in SCRisk,

[12] Table IA.9 reports the full first-stage estimates.

[13] In Table IA.10, our results are robust if we instrument for both SCRisk and SCSentiment using the SCRisk and SCSentiment of the firms' suppliers. However, the instruments are weak as the F-statistic of the excluded instruments is always around 2. For this reason, we present these estimates in the Internet Appendix. The consistency of the parameter estimates between ordinary least squares and alternative instrumentation strategies assuages concerns that biases may drive our estimates.

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which warrant discussions by several firms in the supply chain. Thus, the local average treatment effect that we capture in the instrumental variable estimate is necessarily larger.

5.2 Vertical Integration

Supply chain risk can affect not only the composition of suppliers but also the firms' boundaries. Theories of the boundaries of the firm suggest that supply assurance concerns may lead firms to integrate vertically (Williamson, 1971; Bolton and Whinston, 1993). When supply chain uncertainty increases and bottlenecks become more likely, the intensity of hold up problems between a firm and its suppliers intensifies, making vertical integration more desirable (Grossman and Hart, 1986). For these reasons, we expect firms experiencing heightened supply chain risk to have a higher probability of acquiring firms in an upstream industry to better control the access to inputs. We expect the probability of the acquisition of firms in downstream industries to increase as well because the identity of the acquirer and the target depends on technological reasons affecting their relative size, their liquid holdings, and access to external finance. For a firm to integrate with a supplier, it may just be optimal to become a target because, theoretically, what matters is the common ownership of different stages of the production process.

Table 4 explores whether firms engage in more vertical M&As when supply chain risk increases. Throughout the analysis, we include interactions of two-digit SIC industry and year fixed effects to control for industry shocks, which are known to lead to merger waves (e.g., Ahern and Harford, 2014). We also include firm fixed effects thus capturing how changes in supply chain risk change a firm's propensity to vertically integrate. We report ordinary least squares and instrumental variable specifications, in which we use the maximum SCRisk of a firm's suppliers as the instrument.

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In Panel A, column 1 evaluates the probability that a firm is involved in an M&A with a firm in an upstream industry, while column 2 considers M&As with firms in downstream industries. In both cases, we find that an increase in SCRisk leads to a higher probability of M&As. In particular, a one-standard-deviation increase in SCRisk increases the probability of an M&A with a supplier or a customer by 5.9% and 8.1% relative to the baseline merger probability of 10.0% and 7.2%, respectively. In column 3, we find that firms engage in M&As in industries that are not vertically related to a lower extent when supply chain risk increases, indicating that we are not just capturing firms' general propensity to make acquisitions. Also, in columns 4 to 6, the estimates are qualitatively invariant when we control for SCSentiment, which appears unrelated to firms' propensity to vertically integrate.

In Panel B, we address the concern that firms discuss supply chain risk because they wish to integrate vertically even if they are not experiencing supply chain uncertainty.[14] The estimated effects of SCRisk on firms' propensity to vertically integrate are significantly larger in the instrumental variable estimates, suggesting that episodes of large increases in supply chain risk, as those that we capture when we exploit variation due to the SCRisk of the suppliers, are followed by a much higher propensity of firms to vertically integrate. In particular, a one-standard-deviation increase in SCRisk increases the probability of an M&A with a supplier or a customer by 25.6% and 31.6%, respectively.

So far, we have defined upstream and downstream industries considering input-output tables. Specifically, any industry that exhibits a bilateral flow is considered vertically related. In this way, we capture that limited availability of any input can cause bottlenecks in the presence of production complementarities. One may think however that inputs that are larger proportions of

[14] Also in this case, estimates are qualitatively similar in Table IA.10 if we instrument for both SCRisk and SCSentiment with the suppliers' SCRisk and SCSentiment, even though the instruments are weak.

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an industry's costs of production matter most. In Table IA.11, we repeat our tests considering as vertically related only upstream (downstream) industries that account for at least one percent of purchases (sales) as Garfinkel and Hankins (2011) do to define vertical M&As. Our results are qualitatively invariant.

Table 5 tests another implication of the vertical integration theories. Vertical integration is expected to generate a larger surplus when supply assurance concerns are severe. Therefore, we expect the announcement of a vertical M&A to generate higher abnormal returns when firms are experiencing high supply chain risk. This is precisely what we find when we regress a firm's cumulative abnormal returns (CAR), obtained by estimating the market model over a [-255, -31] day estimation window and cumulating abnormal returns over a [-1,+1] window around merger announcement, on the interaction of SCRisk and an indicator for vertical mergers. In column 1, for example, the coefficient on the interaction term is positive and significant. The effect is also economically large. When SCRisk increases from the 50th percentile to the 90th percentile, the vertical merger CAR increases by 0.23 percentage point, representing a 23% increase in CAR compared to the mean of 1%. In columns 2 and 3, we saturate the model with firm level controls and industry and year fixed effects that could have an independent effect on the value created by a merger. Our results are qualitatively invariant.

To further corroborate our interpretation of the empirical evidence that supply chain risk leads to more vertical integration, we also exploit that financial constraints prevent companies from engaging in vertical M&As. If SCRisk captures an actual increase in supply chain uncertainty, we should observe that its effect on the probability to vertically integrate is reduced for financially constrained firms. Put differently, financially constrained firms should be affected as much as other firms by supply chain risk but should be less able to react to it.

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In Table 6, we use two measures of financial constraints to test this conjecture: The index based on size and age introduced by Hadlock and Pierce (2010) in Panel A and the Whited-Wu index proposed by Whited and Wu (2006) in Panel B. We classify firms as financially constrained (unconstrained) if their index value is above (below) the median. In columns 1 and 2 of Panels A and B, the estimated coefficients on the interaction terms are negative and statistically significant, which shows that financially constrained firms are significantly less likely to be involved in vertical M&As when supply chain risk increases.

5.3 Robustness

Table IA.12 shows that the results in Table 3 and Table 4 are robust to the inclusion of the political and climate risk proxies developed by Hassan et al. (2019) and Sautner et al. (2023), respectively. Furthermore, contrary to supply chain risk, political and climate risks have a negative or no effect on vertical integration and supplier composition. Not only does this confirm that SCRisk captures a different source of risk, but also that it has considerably different effects on corporate policies and industrial structure.

In Table IA.13, we address the concern that when a firm performs poorly, managers blame supply chain issues. If this were true, the supply chain risk could capture general negative conditions. However, our results are invariant when we control for the overall sentiment of a firm's earnings call.

Another potential concern is that SCRisk is measured with noise from the earnings call transcripts. While using the SCRisk of a firm's suppliers helps to address this concern, we also exploit that our topics analysis identifies discussions of supply chain risks in the context of general financial and analyst-related and liquidity issues that are typical of earnings conference calls.

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These snippets might reflect noise. We consider supply chain risk to be measured with noise for a firm if during a year more than 75% of the snippets that incorporate supply chain risk discussions are associated with a probability of discussing general financial and analyst and liquidity issues in the top quartile. We either substitute SCRisk that we identify as potential noise with the two-digit SIC industry median SCRisk during the same year or drop the observations. Our results in Table IA.14 and IA.15 are unaffected.

6. Conclusions

Supply chains and input availability are crucial determinants of comparative advantage. We develop a novel proxy for supply chain uncertainty based on textual analysis and explore how supply chain uncertainty affects corporate policies. We show that firms facing more supply chain uncertainty diversify their suppliers by establishing new relationships. Firms also establish relationships with suppliers in the same continent and suppliers that are industry leaders but do not decrease their reliance on suppliers in other continents. More importantly, firms that face more supply chain risk are more likely to become vertically integrated by entering into M&As with their customers and suppliers.

These results suggest that higher supply chain uncertainty could be associated with changes in the geography and organization of economic activity with protracted long-term effects on the performance of different geographical areas. Exploring these issues is an exciting area for future research.

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Figure 1. Supply chain risk topics

We apply topic modelling analysis to snippets that are within 50 words from one of our supply chain bigrams if the latter have been mentioned in association with at least one synonymous of risk and uncertainty. The figure presents the clouds of the words with the highest frequencies in each of the resulting topics.

Costs and commodity price risk

Technology and Cyberattack Risk

Climate Risk and Pandemics

Market Uncertainty and Regions

Liquidity

Analysts and Financial Issues

Investment and Acquisitions

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Table 1. Summary statistics

This table presents summary statistics for the main variables used in our analysis. All variables are defined in Appendix A.

Variables	(1) N	(2) Mean	(3) SD	(4) P25	(5) P50	(6) P75
SCRisk	36,134	4.4782	8.3637	1.2223	2.1667	4.0098
SCSentiment	36,134	40.9988	95.5976	3.8604	16.8212	42.4933
Different continents	36,134	0.1383	0.2415	0	0	0.2000
Relative size	36,134	0.7752	8.1713	0.0069	0.0391	0.3424
Average number of suppliers in an input industry	36,134	1.4874	0.8856	1.0000	1.1538	1.5600
Multinational	36,134	0.6502	0.4769	0	1	1
Customer dependence	36,134	0.1907	0.3928	0	0	0
Market share	36,134	0.1606	0.2662	0.0035	0.0302	0.1813
Financial constraint	36,134	0.3417	0.4743	0	0	1
Institutional ownership	36,134	0.5625	0.3651	0.2185	0.6752	0.8708
Size	36,134	6.7552	1.8589	5.4282	6.6804	7.9717
Tobin's Q	36,134	2.1986	1.5636	1.2287	1.6796	2.5610
Cash holdings	36,134	0.2256	0.2359	0.0448	0.1349	0.3324
Cash flow	36,134	-0.0182	0.2063	-0.0251	0.0365	0.0775
Number of suppliers	36,134	7.9352	11.5148	1	3	9
Number of suppliers in the same continent	36,134	3.7795	6.1158	0	1	4
Number of U.S. suppliers	36,134	3.6500	5.8404	0	1	4
Number of suppliers in different continents	36,134	1.3657	2.6310	0	0	1
Number of industry leader suppliers	36,134	3.6166	5.3439	0	1	5
M&A with supplier	36,134	0.0991	0.2988	0	0	0
M&A with customer	36,134	0.0720	0.2585	0	0	0
Unrelated M&As	36,134	0.0379	0.1911	0	0	0

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Table 2. Firm characteristics, supply chain risk, and supply chain sentiment

This table relates SCRisk and SCSentiment in Panel A and Panel B, respectively, to contemporaneous firm characteristics in an annual panel. The main independent variable in column (1) is *Different continents*, which is the fraction of a firm's suppliers who are located in a different continent over the total number of suppliers. The additional independent variable in column (2) is *Relative Size*, defined as a firm's total assets divided by the average total assets of its suppliers. The additional independent variable in column (3) is *Size*, defined as the natural logarithm of the firm's total assets. The additional independent variable in column (4) is *Average number of suppliers by industry*, defined as the average of a firm's number of suppliers within each of the three-digit SIC industries for which we observe suppliers from Factset Revere. The additional independent variable in column (5) is *Multinational*, defined as an indicator variable that equals one if the firm has geographical segments in other countries based on Compustat segment data. The additional independent variable in column (6) is *Customer dependence*, defined as an indicator variable that equals one if the firm reports major customers that purchase at least 10% of its sales in Compustat segment data. The additional independent variable in column (7) is *Market Share*, defined as a firm's sales divided by the total sales in the firm's industry. The additional independent variable in column (8) is *Financial constraint*, which is an indicator variable that equals one if the Whited-Wu (2006) proxy for firm-level financial constraints is above the median of our sample. The additional independent variable in column (9) is *Institutional ownership*, which is the fraction of the firm's shares owned by financial institutions, which we obtain from 13F filings. The additional independent variable in column (10) is *Tobin's Q*, defined as assets minus cash and cash equivalent securities plus book value on equity scaled by assets. We scale up the dependent variable in Panel A, SCRisk, by a factor of 1,000 for readability. The unit of observation is a firm-year. Industries are classified at the two-digit SIC code level. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
					Panel A: SCRisk					
Different continents	0.6834**	0.6834**	0.5184**	0.5281**	0.4780*	0.4782*	0.4787*	0.4668*	0.4390*	0.4454*
	(0.2687)	(0.2687)	(0.2637)	(0.2635)	(0.2635)	(0.2634)	(0.2633)	(0.2637)	(0.2647)	(0.2639)
Relative size		-0.0032*	-0.0061***	-0.0052***	-0.0050***	-0.0051***	-0.0055***	-0.0055***	-0.0056***	-0.0056***
		(0.0018)	(0.0019)	(0.0017)	(0.0016)	(0.0016)	(0.0017)	(0.0017)	(0.0018)	(0.0017)
Size			0.1326***	0.1791***	0.1443***	0.1440***	0.1225***	0.1600***	0.1840***	0.1588***
			(0.0373)	(0.0415)	(0.0424)	(0.0424)	(0.0431)	(0.0461)	(0.0477)	(0.0480)
Average number of suppliers industry				-0.2169***	-0.2002***	-0.1998***	-0.1995***	-0.2049***	-0.2191***	-0.1923***
				(0.0652)	(0.0654)	(0.0652)	(0.0653)	(0.0654)	(0.0657)	(0.0658)
Multinational					0.4393***	0.4395***	0.4332***	0.4152***	0.4158***	0.3983***
					(0.1279)	(0.1279)	(0.1281)	(0.1280)	(0.1281)	(0.1277)
Customer dependence						-0.0324	-0.0164	-0.0334	-0.0151	-0.0246
						(0.1357)	(0.1364)	(0.1373)	(0.1377)	(0.1371)
Market share							0.3853	0.3874	0.3619	0.3497
							(0.2866)	(0.2864)	(0.2849)	(0.2841)
Financial constraint								0.3579***	0.3255**	0.3053**
								(0.1321)	(0.1319)	(0.1318)
Institutional ownership									-0.4100**	-0.3169*
									(0.1653)	(0.1670)
Tobin's Q										-0.1717***
										(0.0365)
Ind x year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	36,043	36,043	36,043	36,043	36,043	36,043	36,043	36,043	36,043	36,043
Adj. R-squared	0.1070	0.1070	0.1077	0.1080	0.1084	0.1084	0.1085	0.1086	0.1088	0.1097

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
					Panel B: SCSentiment					
Different continents	0.4154	0.4155	-4.1668	-4.1853	-5.2573*	-5.2549*	-5.2437*	-5.3207*	-5.0245	-5.0708*
	(3.0913)	(3.0913)	(3.0795)	(3.0760)	(3.0610)	(3.0609)	(3.0632)	(3.0663)	(3.0594)	(3.0567)
Relative size		0.0216	-0.0580**	-0.0597**	-0.0568**	-0.0573**	-0.0658**	-0.0661**	-0.0649**	-0.0650**
		(0.0467)	(0.0282)	(0.0281)	(0.0276)	(0.0276)	(0.0298)	(0.0297)	(0.0294)	(0.0297)
Size			3.6822***	3.5939***	2.8492***	2.8459***	2.3682***	2.6087***	2.3520***	2.5353***
			(0.5519)	(0.5907)	(0.6099)	(0.6116)	(0.6125)	(0.6292)	(0.6516)	(0.6493)
Average number of suppliers industry				0.4114	0.7682	0.7737	0.7794	0.7445	0.8957	0.7004
				(1.2412)	(1.2290)	(1.2297)	(1.2266)	(1.2246)	(1.2238)	(1.2179)
Multinational					9.3985***	9.4008***	9.2623***	9.1467***	9.1398***	9.2678***
					(2.2779)	(2.2788)	(2.2801)	(2.2809)	(2.2810)	(2.2870)
Customer dependence						-0.3828	-0.0302	-0.1391	-0.3346	-0.2658
						(2.1377)	(2.1391)	(2.1420)	(2.1645)	(2.1621)
Market share							8.5360*	8.5494*	8.8225*	8.9114*
							(5.0801)	(5.0805)	(5.0659)	(5.0700)
Financial constraint								2.2968	2.6432	2.7902
								(1.9971)	(2.0080)	(2.0213)
Institutional ownership									4.3826	3.7033
									(2.9790)	(2.8988)
Tobin's Q										1.2518*
										(0.6662)
Ind x year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	36,043	36,043	36,043	36,043	36,043	36,043	36,043	36,043	36,043	36,043
Adj. R-squared	0.0819	0.0819	0.0861	0.0861	0.0876	0.0876	0.0879	0.0880	0.0881	0.0885

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Table 3. Supply chain risk and the composition of supply chains

This table reports estimates of the effects of a firm's SCRisk and SCSentiment at *t-1* on its number of suppliers at *t*. The dependent variables in columns (1) and (6), (2) and (7), (3) and (8), (4) and (9), and (5) and (10) are the number of suppliers, the number of suppliers in the same continent as the firm, the number of U.S. suppliers, the number of suppliers in different continents, and the number of suppliers that are industry leaders, respectively. Industry leaders are defined as suppliers with sales above the median of their 3-digit SIC industry. Firm controls include size, Tobin's Q, cash holdings, and cash flow. The unit of observation is a firm-year. Industries are classified at the two-digit SIC code level. Panel A reports OLS regression results. Panel B uses the supply chain risk of its suppliers as an instrument. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Number of suppliers	Number of suppliers in the same continent	Number of U.S. suppliers	Number of suppliers in different continents	Number of industry leader suppliers	Number of suppliers	Number of suppliers in the same continent	Number of U.S. suppliers	Number of suppliers in different continents	Number of industry leader suppliers
					Panel A: OLS regressions					
SCRisk	0.0193***	0.0121***	0.0099***	0.0035	0.0055*	0.0190***	0.0119***	0.0098***	0.0035	0.0053*
	(0.0067)	(0.0040)	(0.0035)	(0.0022)	(0.0029)	(0.0068)	(0.0041)	(0.0035)	(0.0022)	(0.0029)
SCSentiment						0.0010	0.0006	0.0006	0.0001	0.0005
						(0.0008)	(0.0004)	(0.0004)	(0.0002)	(0.0003)
Size	2.3159***	1.2175***	1.1648***	0.4397***	1.1591***	2.3134***	1.2159***	1.1632***	0.4395***	1.1577***
	(0.2404)	(0.1192)	(0.1116)	(0.0593)	(0.1063)	(0.2403)	(0.1191)	(0.1114)	(0.0592)	(0.1062)
Tobin's Q	0.0624	-0.0235	0.0159	0.0070	0.0355	0.0619	-0.0239	0.0155	0.0070	0.0352
	(0.0676)	(0.0334)	(0.0303)	(0.0181)	(0.0287)	(0.0676)	(0.0335)	(0.0303)	(0.0181)	(0.0287)
Cash holdings	0.2401	-0.6553*	-0.6243*	0.0695	-0.5947**	0.2383	-0.6564*	-0.6254*	0.0694	-0.5957**
	(0.6253)	(0.3546)	(0.3345)	(0.1742)	(0.2964)	(0.6254)	(0.3545)	(0.3342)	(0.1743)	(0.2964)
Cash flow	-1.9705***	-1.1747***	-1.1679***	-0.4914***	-1.0022***	-1.9754***	-1.1778***	-1.1711***	-0.4918***	-1.0049***
	(0.3657)	(0.2191)	(0.2034)	(0.1122)	(0.1714)	(0.3655)	(0.2190)	(0.2033)	(0.1122)	(0.1714)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ind x year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	24,139	24,139	24,139	24,139	24,139	24,139	24,139	24,139	24,139	24,139
Adj. R-squared	0.8268	0.7533	0.7624	0.6594	0.8317	0.8268	0.7533	0.7625	0.6594	0.8317

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Number of suppliers	Number of suppliers in the same continent	Number of U.S. suppliers	Number of suppliers in different continents	Number of industry leader suppliers	Number of suppliers	Number of suppliers in the same continent	Number of U.S. suppliers	Number of suppliers in different continents	Number of industry leader suppliers
					Panel B: IV regressions					
SCRisk	2.8039***	1.0988**	0.8981**	0.5907**	1.1505***	2.8462***	1.1130**	0.9085**	0.6007**	1.1666**
	(1.0466)	(0.4575)	(0.3813)	(0.2356)	(0.4402)	(1.0807)	(0.4700)	(0.3913)	(0.2431)	(0.4539)
SCSentiment						-0.0047	-0.0016	-0.0012	-0.0011	-0.0018
						(0.0041)	(0.0017)	(0.0014)	(0.0009)	(0.0017)
Size	2.2187***	1.1796***	1.1338***	0.4192***	1.1191***	2.2296***	1.1832***	1.1365***	0.4218***	1.1232***
	(0.4801)	(0.1975)	(0.1679)	(0.1081)	(0.1953)	(0.4846)	(0.1989)	(0.1689)	(0.1092)	(0.1969)
Tobin's Q	0.3902*	0.1044	0.1205*	0.0762*	0.1703**	0.3977*	0.1069	0.1223*	0.0780*	0.1732**
	(0.2027)	(0.0854)	(0.0711)	(0.0441)	(0.0837)	(0.2072)	(0.0871)	(0.0724)	(0.0451)	(0.0855)
Cash holdings	-4.2908*	-2.4235**	-2.0694**	-0.8859	-2.4579**	-4.3493*	-2.4431**	-2.0838**	-0.8998	-2.4801**
	(2.5828)	(1.0855)	(0.8971)	(0.5671)	(1.0755)	(2.6376)	(1.1043)	(0.9115)	(0.5794)	(1.0968)
Cash flow	-1.3579	-0.9356*	-0.9725**	-0.3622	-0.7503	-1.3252	-0.9247*	-0.9644**	-0.3544	-0.7378
	(1.2107)	(0.4926)	(0.4133)	(0.2709)	(0.4906)	(1.2305)	(0.4991)	(0.4182)	(0.2754)	(0.4983)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ind x year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	24,139	24,139	24,139	24,139	24,139	24,139	24,139	24,139	24,139	24,139
First-stage coeff	0.0102***	0.0102***	0.0102***	0.0102***	0.0102***	0.0100***	0.0100***	0.0100***	0.0100***	0.0100***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)
First-stage F-stat	13.384	13.384	13.384	13.384	13.384	12.916	12.916	12.916	12.916	12.916

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Table 4. Supply chain risk and vertical M&As

This table reports estimates of the effects of SCRisk at *t-1* on the probability that a firm is involved in M&As at *t*. The dependent variables in columns (1) and (4) and (2) and (5) are *M&A with supplier* and *M&A with customer*, which are indicator variables that equal one if the firm conducts an M&A with a firm in an upstream or downstream industry, respectively. The dependent variable in columns (3) and (6) is *Unrelated M&A*, which is an indicator variable that equals one if the firm conducts an M&A with a firm that is not in an upstream or downstream industry. The unit of observation in each regression is a firm-year. Firm controls include size, Tobin's Q, cash holdings, and cash flow. Industries are classified at the two-digit SIC code level. Panel A reports OLS regression results. Panel B uses the supply chain risk of its suppliers as an instrument. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1) M&A with supplier	(2) M&A with customer	(3) Unrelated M&As	(4) M&A with supplier	(5) M&A with customer	(6) Unrelated M&As
			Panel A: OLS regressions			
SCRisk	0.0007**	0.0007**	-0.0002*	0.0007**	0.0007**	-0.0002*
	(0.0003)	(0.0003)	(0.0001)	(0.0003)	(0.0003)	(0.0001)
SCSentiment				0.0000	0.0000	0.0000
				(0.0000)	(0.0000)	(0.0000)
Size	-0.0204***	-0.0159***	-0.0012	-0.0204***	-0.0159***	-0.0012
	(0.0062)	(0.0050)	(0.0043)	(0.0062)	(0.0050)	(0.0044)
Tobin's Q	0.0039*	0.0052***	0.0008	0.0039*	0.0052***	0.0008
	(0.0022)	(0.0018)	(0.0015)	(0.0022)	(0.0018)	(0.0015)
Cash holdings	0.1005***	0.0712***	0.0508***	0.1005***	0.0712***	0.0508***
	(0.0237)	(0.0199)	(0.0186)	(0.0237)	(0.0199)	(0.0186)
Cash flow	0.1127***	0.0769***	0.0462***	0.1127***	0.0768***	0.0462***
	(0.0141)	(0.0116)	(0.0094)	(0.0141)	(0.0116)	(0.0094)
Firm FE	Y	Y	Y	Y	Y	Y
Industry x year FE	Y	Y	Y	Y	Y	Y
Observations	24,139	24,139	24,139	24,139	24,139	24,139
Adjusted R-squared	0.1378	0.1176	0.1172	0.1378	0.1176	0.1172

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	(1) M&A with supplier	(2) M&A with customer	(3) Unrelated M&As	(4) M&A with supplier	(5) M&A with customer	(6) Unrelated M&As
			Panel B: IV regressions			
SCRisk	0.0603**	0.0541**	-0.0170*	0.0613**	0.0550**	-0.0173*
	(0.0260)	(0.0235)	(0.0102)	(0.0268)	(0.0242)	(0.0105)
SCSentiment				-0.0001	-0.0001	0.0000
				(0.0001)	(0.0001)	(0.0000)
Size	-0.0225**	-0.0177*	-0.0006	-0.0222**	-0.0175*	-0.0007
	(0.0110)	(0.0094)	(0.0049)	(0.0111)	(0.0095)	(0.0049)
Tobin's Q	0.0109**	0.0115***	-0.0012	0.0111**	0.0117***	-0.0012
	(0.0048)	(0.0043)	(0.0021)	(0.0049)	(0.0044)	(0.0021)
Cash holdings	0.0035	-0.0157	0.0781***	0.0021	-0.0170	0.0785***
	(0.0636)	(0.0564)	(0.0284)	(0.0649)	(0.0575)	(0.0287)
Cash flow	0.1258***	0.0886***	0.0425***	0.1266***	0.0893***	0.0422***
	(0.0293)	(0.0259)	(0.0119)	(0.0297)	(0.0263)	(0.0120)
Firm FE	Y	Y	Y	Y	Y	Y
Industry x year FE	Y	Y	Y	Y	Y	Y
Observations	24,139	24,139	24,139	24,139	24,139	24,139
First-stage coeff	0.0102***	0.0102***	0.0102***	0.0100***	0.0100***	0.0100***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)
First-stage F-stat	13.384	13.384	13.384	12.916	12.916	12.916

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Table 5. Stock market reaction to vertical M&A announcements

This table reports OLS regression results for firms' cumulative abnormal returns (CAR) around M&A announcements. The dependent variable is the CAR over a three-day event window [-1, +1] around an M&A announcement, obtained by estimating the market model over a [-255, -31] day estimation window. Vertical merger is a dummy variable that equals one if the firm conducts an M&A with a firm from an upstream or a downstream industry and zero if the firm conducts an M&A with a firm from neither an upstream nor a downstream industry. The unit of observation in each regression is at the deal level. Firm controls include size, Tobin's Q, cash holdings, and cash flow. All variables are defined in Appendix A. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
		CAR [-1, +1]	
SCRisk	-0.0004***	-0.0003**	-0.0004**
	(0.0001)	(0.0001)	(0.0002)
Vertical merger	0.0004	-0.0013	-0.0019
	(0.0024)	(0.0025)	(0.0029)
SCRisk * Vertical merger	0.0004**	0.0004**	0.0004**
	(0.0002)	(0.0002)	(0.0002)
Size		-0.0042***	-0.0046***
		(0.0006)	(0.0006)
Tobin's Q		-0.0018**	-0.0013
		(0.0008)	(0.0009)
Cash holdings		-0.0271***	-0.0224***
		(0.0078)	(0.0072)
Cash flow		-0.0267*	-0.0260*
		(0.0145)	(0.0148)
Year FE	N	N	Y
Industry FE	N	N	Y
Observations	7,859	7,859	7,859
Adjusted R-squared	-0.0001	0.0093	0.0138

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Table 6. Supply chain risk, financial constraints, and vertical integration

This table reports OLS estimates of the effects of SCRisk at *t-1* on firms' M&As at *t* using different measures of firms' financial constraints. Panel A and B use the Hadlock and Pierce (2010) and Whited-Wu (2006) measures, respectively, to define financial constraints. The dependent variables in columns (1) and (2) are *M&A with supplier* and *M&A with customer*, which are indicator variables that equal one if the firm conducts an M&A with a firm from an upstream or downstream industry, respectively. The dependent variable in column (3) is *Unrelated M&A*, which is an indicator variable that equals one if the firm conducts an M&A with a firm from neither an upstream nor a downstream industry. The unit of observation in each regression is a firm-year. Firm controls include supply chain sentiment, size, Tobin's Q, cash holdings, and cash flow. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1) M&A with supplier	(2) M&A with customer	(3) Unrelated M&As
Panel A: Hadlock-Pierce financial constraint measure			
SCRisk	0.0010***	0.0010***	-0.0003*
	(0.0004)	(0.0004)	(0.0002)
HP FC dummy	0.0029	-0.0050	-0.0127
	(0.0105)	(0.0083)	(0.0076)
SCRisk x HP FC dummy	-0.0017**	-0.0014**	0.0003
	(0.0007)	(0.0007)	(0.0003)
Firm controls	Y	Y	Y
Firm FE	Y	Y	Y
Industry x year FE	Y	Y	Y
Observations	24,139	24,139	24,139
Adjusted R-squared	0.1380	0.1178	0.1173
Panel B: Whited-Wu financial constraint measure			
SCRisk	0.0010***	0.0010***	-0.0002
	(0.0004)	(0.0004)	(0.0002)
WW FC dummy	-0.0049	-0.0072	-0.0056
	(0.0072)	(0.0063)	(0.0052)
SCRisk x WW FC dummy	-0.0016**	-0.0013*	-0.0001
	(0.0008)	(0.0007)	(0.0004)
Firm controls	Y	Y	Y
Firm FE	Y	Y	Y
Industry x year FE	Y	Y	Y
Observations	24,139	24,139	24,139
Adjusted R-squared	0.1380	0.1179	0.1172

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Appendix A. Variable definitions

Variables	Definition
SCRisk	Firm-level supply chain risk measure constructed from earnings calls
SCSentiment	Firm-level supply chain sentiment measure constructed from earnings calls
Suppliers' SCRisk	The maximum SCRisk of a firm's suppliers
Different continents	Fraction of a firm's suppliers located in a continent different from that of the firm over the total number of suppliers
Relative size	Focal firm's total assets scaled by its suppliers' average total assets
Average number of suppliers by industry	The average of a firm's number of suppliers by input industry
Multinational	An indicator variable that equals one if the firm has geographical segments in other countries based on Compustat segment data.
Customer dependence	An indicator variable that equals one if the firm reports major customers that purchase at least 10% of its sales in Compustat segment data
Market share	Firm's sales scaled by the 3-digit SIC industry's total sales
Financial constraint	A dummy variable that equals one if the firm's Whited-Wu (2006) measure for financial constraints is above the sample median
Institutional ownership	Fraction of shares owned by financial institutions
Size	Natural logarithm of total assets
Tobin's Q	Assets minus cash and cash equivalent securities plus book value on equity scaled by assets
Cash holdings	Cash and cash equivalent securities scaled by total assets
Cash flow	Operating cash flow scaled by total assets
Number of suppliers	A firm's total number of suppliers
Number of suppliers in the same continent	The total number of suppliers in the same continent as the firm
Number of U.S. suppliers	A firm's total number of suppliers in the U.S.
Number of suppliers in different continents	The total number of suppliers in different continents as the firm
Number of industry leader suppliers	A firm's total number of suppliers with sales above the median of their 3-digit SIC industry
M&A with supplier	A dummy variable that equals one if the firm conducts an M&A with a firm from an upstream industry according to the Bureau of Economic Analysis's (BEA) Input-Output tables.
M&A with customer	A dummy variable that equals one if the firm conducts an M&A with a firm from a downstream industry according to the Bureau of Economic Analysis's (BEA) Input-Output tables.
Unrelated M&As	A dummy variable that equals one if the firm conducts an M&A with a firm from neither an upstream nor a downstream industry

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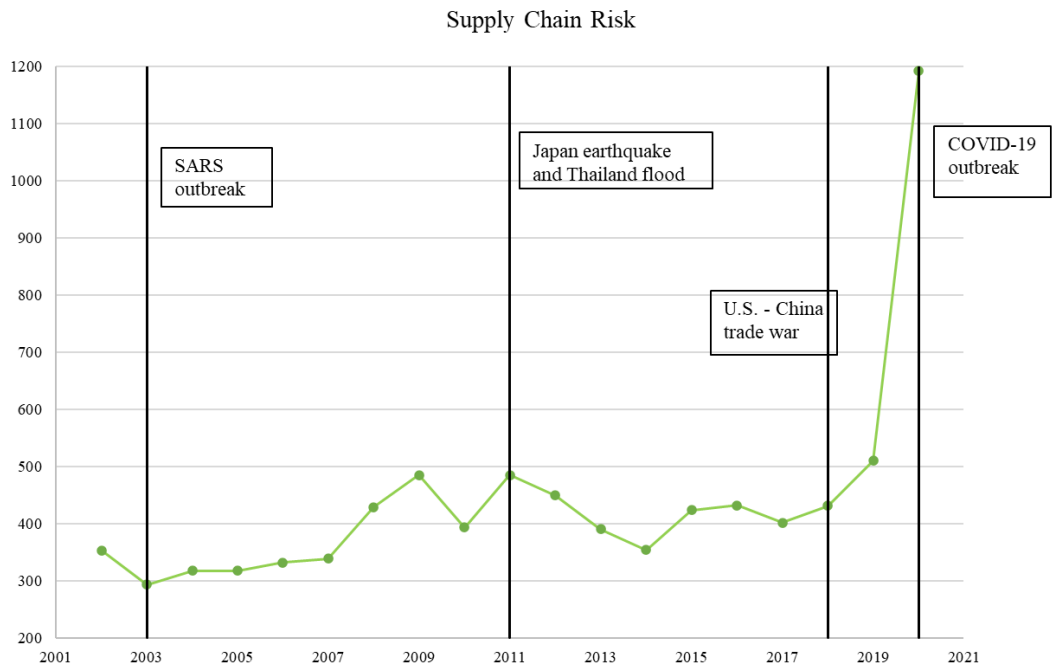
Internet Appendix

Figure IA.1. Supply chain risk and sentiment over time

This figure shows the mean of SCRisk and SCSentiment along with indicators for key events related to supply chain shocks. SCRisk and SCSentiment are scaled up by a factor of 1,000.

Panel A. SCRisk



Panel B. SCSentiment

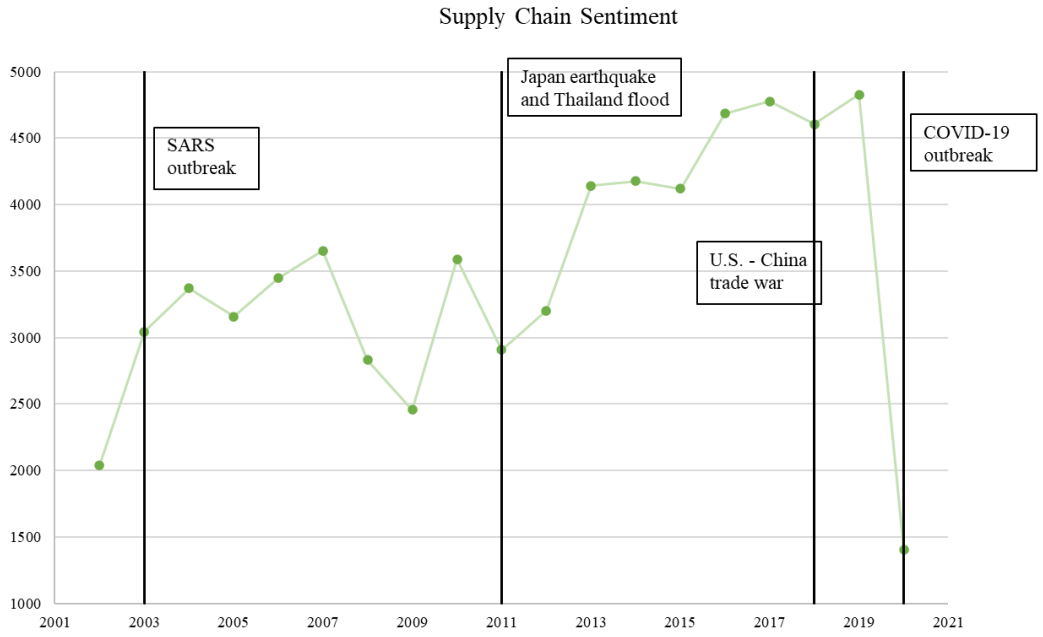


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Figure IA.2. Supply chain risk and transportation costs

This figure shows the mean of SCRisk and the global transportation costs index (TCI) developed by Benigno et al. (2022), both measures are standardized by subtracting the sample mean and dividing by the sample standard deviation.

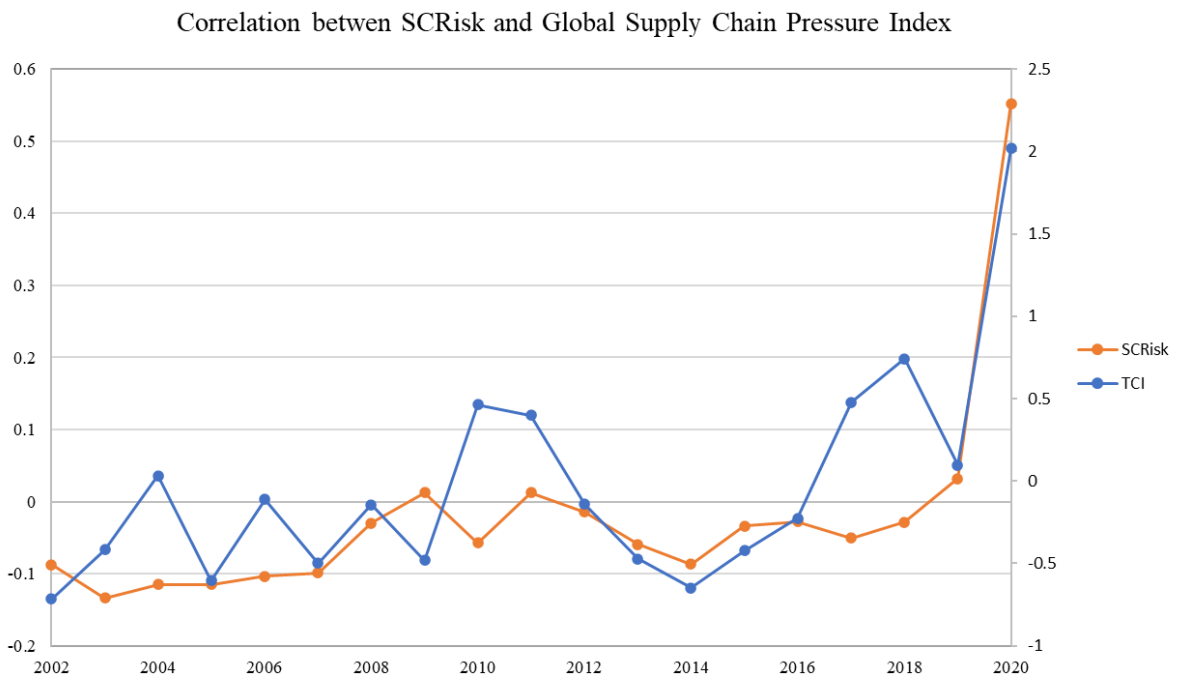

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Table IA.1. Top 100 bigrams and their weights

This table reports the 100 bigrams with the highest frequency in the training library used for the construction of SCRisk. The weight column reports the weight of the bigram in the training library.

Bigram	Weight	Bigram	Weight	Bigram	Weight
supply_chain	761.63	strategic_fit	32.64	of_capacity	18.28
the_supply	281.15	of_safety	32.21	chain_and	18.28
a_supply	146.23	chain_to	31.77	demand_the	18.28
the_retailer	133.18	to_order	31.34	production_cost	18.28
of_demand	104.89	of_scale	31.34	the_peak	17.41
the_manufacturer	104.89	supply_and	30.03	variable_cost	16.97
lead_time	98.79	if_demand	30.03	the_cycle	16.54
demand_is	93.14	the_aggregate	29.59	the_safety	16.54
of_product	79.21	the_lot	29.16	to_supply	16.54
the_demand	74.42	chain_is	28.72	demand_to	16.54
the_supplier	71.81	customer_order	27.42	chain_the	16.54
transportation_cost	64.41	spot_market	26.98	fixed_costs	15.23
of_supply	56.58	time_is	26.55	from_supplier	15.23
transportation_costs	56.58	demand_from	24.81	the_network	14.80
an_order	55.71	the_lead	23.94	million_units	14.80
expected_profit	53.53	lead_times	23.94	a_forecast	14.36
demand_and	52.66	stages_of	23.07	demand_per	14.36
third_party	52.66	the_plant	23.07	uncertainty_and	13.93
supply_chains	52.66	and_supply	23.07	of_orders	13.93
fixed_cost	46.57	the_spot	23.07	a_demand	13.93
the_season	45.26	distribution_network	22.63	the_capacity	13.49
the_quantity	44.83	demand_at	22.63	lower_price	13.49
demand_in	40.91	demand_forecast	22.63	demand_across	13.49
and_demand	39.60	when_demand	22.63	chain_for	13.49
of_transportation	38.73	in_supply	20.46	capacity_to	13.06
revenue_management	38.73	capacity_is	20.46	product_to	13.06
chain_management	38.30	demand_of	20.46	production_capacity	13.06
response_time	37.43	and_transportation	20.02	revenue_sharing	13.06
demand_uncertainty	36.99	supplier_to	20.02	future_demand	12.62
service_level	36.56	customer_orders	19.15	in_transportation	12.62
the_forecast	36.12	global_supply	18.71	product_in	12.19
customer_demand	33.95	high_demand	18.71	square_feet	12.19
economies_of	33.51	to_forecast	18.28	level_is	12.19
order_is	33.08				

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Table IA.2. Synonyms of risk words

This table reports all synonyms of "risk," "risky," "uncertain," and "uncertainty" used to construct SCRisk. Oxford Dictionary is used to identify the synonyms following Hassan et al. (2019).

Synonyms of risk words			
ambivalence	fear	niggle	treacherous
ambivalent	fickleness	oscillating	tricky
apprehension	fitful	parlous	uncertain
bet	fitfulness	pending	uncertainties
chance	fluctuant	peril	uncertainty
chanciness	fluctuating	perilous	unclear
chancy	gamble	perilousness	unconfident
changeability	gnarly	possibility	undecided
changeable	hairy	precarious	undependable
changeableness	halting	precariousness	undetermined
changeful	hazard	probability	unforeseeable
chariness	hazardous	prospect	unknown
danger	hazy	qualm	unpredictability
dangerous	hesitancy	quandary	unpredictable
debatable	hesitant	queries	unreliability
defenseless	hesitating	query	unreliable
dicey	iffy	reservation	unresolved
diffidence	imperil	risk	unsafe
diffident	incalculable	risked	unsettled
dilemma	incertitude	riskier	unstable
disquiet	inconstancy	riskiest	unsure
disquietude	indecision	riskiness	unsureness
dodgy	indecisive	risking	untrustworthy
doubt	insecure	risks	vacillating
doubtful	insecurity	risky	vacillation
doubtfulness	instability	scruple	vague
dubiety	irregular	skepticism	vagueness
dubious	irresolute	speculative	variability
endanger	irresolution	sticky	variable
equivocating	jeopardize	suspicion	varying
equivocation	jeopardy	tentative	venture
erratic	likelihood	tentativeness	wager
exposed	menace	threat	wariness
faltering	misgiving	torn	wavering

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Table IA.3. Excerpts from earnings calls

This table reports firm name, earnings call date, and excerpts from earnings calls with high SCRisk and SCSentiment (both positive and negative) in Panels A and B, respectively.

Firm Name	Date of Report	Text
		Panel A: Excerpts based on SCRisk
Mercury Systems, Inc.	April 28, 2020	The key supply chain issues that we're facing are twofold. The first is that suppliers may be financially vulnerable. This applies more so to those suppliers that are heavily exposed to the commercial aerospace sector. As you know, commercial aerospace has been significantly more impacted by COVID than defense. The other **major supply chain risk** is the potential for COVID-related manufacturing **disruptions**, that is temporary site **shutdowns** that could affect the supply of U.S. sourced components to Mercury. We're also facing other **operational risks**, the first being the potential for COVID-related disruptions within Mercury's own manufacturing facilities…That said, the **risk** does remain elevated.
Select Interior Concepts, Inc.	November 05, 2020	As we look at international supply chain, it's fairly fragmented. And you have **considerable risk** with respect to tariffs, **supply chain**, work stoppages at ports, those kinds of things.
NeoPhotonics Corp	April 30, 2020	While we believe there is immediate demand to increase network bandwidth capacity to handle the increased traffic, we continue to see **supply chain risks**. We have included approximately $10 million of impacts to Q2 revenue in our outlook due to **concerns about supplier shutdowns** as they comply with their local public health orders. We expect the **supply chain risks to continue** into the second half of the year.
SBE, Inc.	May 2006, 2005	Our customers don't provide much **forecast visibility** resulting in **hesitancy** throughout the **supply chain**.
Science Applications International Corp	December 08, 2016	The biggest **variability** this quarter, and in our portfolio as a whole, is in the **supply chain** and materials business.
Insteel Industries, Inc.	July 19, 2018	… **uncertainty** surrounding the availability of our **primary raw material**, hot-rolled steel wire rod, resulted in speculative

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		purchasing throughout the **supply chain** and sharp price increases reflecting the 25% tariff that was eventually applied to practically all imports of carbon steel products.
Entegris, Inc	April 26, 2016	As I was mentioning in my prepared remarks, we are seeing **increased level of complexity, increased risk** of contamination of critical materials in the **supply chain** at the leading-edge.
IEC Electronics Corp	May 09, 2018	This brings me to another topic: the ongoing **global supply chain component constraints**. As you know, in fiscal 2018 Q1, we mentioned that one of our challenges, which is affecting the entire industry, was associated with difficult in producing -- in **procuring** certain electronic components and in some cases, facing long lead times or allocation restrictions due to **limited global supplies**. These **shortages** can impact our ability to fulfill our customers' orders and lengthen production times as well as add some amount of **unpredictability** as we wait for a specific component to complete a job.

Panel B: Excerpts based on SCSentiment

		Positive sentiment
LightInTheBox Holding Co., Ltd.	April 21, 2016	**Stronger** than expected holiday sales were primarily a result of our **improved supply chain** management and the **stronger** support of our suppliers with discounts and sourcing prices for the holiday season.
Coty Inc.	November 9, 2020	Third, our focus and enhancements over the last year to our **supply chain** continue **to support our growth** while allowing us to **successfully** navigate the COVID-19 pandemic. We added another co-packer to our network during the third quarter, providing further capacity, flexibility and the ability to service our customers.
Vitria Technology, Inc.	October 24, 2006	Second, one of our customers, MasterBrands won "Network World's" 2006 Enterprise All-Star Award for its **innovative supply chain** management application. Powered primarily by Vitria's BusinessWare products, MasterBrands was able to dramatically speed order fulfillment, provide **exceptional** handling and enable visibility across the **supply chain**, earning the company an Enterprise All-Star Award
Tuniu Corporation	August 28, 2019	In the travel industry, the **supply chain** is the vital component that connects the supply and demand. We made **strong progress** during the last few years in further **strengthening** our **supply chain**. We continue to **consolidate procurement** across the company in order to **maximize our bargaining**

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		power with **suppliers** and minimize risk, while better sharing inventory across our various business units.
HanesBrands, Inc.	July 23, 2014	Q2 was another **great** quarter for Hanesbrands. We **expanded** operating margins by 210 basis points and **grew** our earnings 44% to $1.71 per share, providing further evidence that when you combine our Innovate-to-Elevate strategy, **our self-owned supply chain**, and strategic acquisitions, we have a **great** formula for **creating shareholder value**.
		Negative sentiment
Newell Brands Inc.	May 1, 2020	In the month of April, the **supply chain disruptions**, the **retail closures** and the consumer purchase pattern shifts contributed to an estimated **sales decline** in the 25% sales range, which has informed our call out for a challenging second quarter.
Reed's, Inc.	November 7, 2018	First quarter revenues **declined** 7.7% on a like-for-like basis, as we encountered temporary **supply chain headwinds**. Alongside the previously flagged **supply chain issues** affecting Consumer Beauty and Professional Beauty, our Luxury division was also impacted in Q1 by a **disruption** in European warehouse, by the U.S. hurricane and by **component shortages at certain external suppliers**.
Micrel Semiconductor, Inc.	April 21, 2011	Consistent with our pre-announcement of preliminary first quarter results on April 11, our top line was impacted by an unanticipated **reduction in sales** to a Korean wireless handset and consumer electronic device manufacturer which moderated product deliveries during the quarter to control inventory levels. The Company also experienced a **reduction in overall demand** toward the end of the quarter related to **disruptions** in the worldwide electronics **supply chain** as a result of the **earthquake** and **tsunami** in Japan in March.
Corning, Inc.	January 27, 2009	The **supply chain** actually reacted faster and **more severely** than we anticipated in quarter four. We had thought the supply chain would reduce 75 million square feet in Q4 with the risk of the additional 50. **The reality turned out to be far bigger**. **Supply chain reduced** 230 million square feet of glass in quarter for. When you combine the retail weakness and **supply chain contraction**, you will understand why our glass volumes were **down** so much in Q4. And by the way, these numbers I'm discussing here were for the entire industry. **So it was a difficult and disappointing quarter**.
Ocean freight, Inc.	May 27, 2011	Let's shift gears now and look at the recent developments in the **dry bulk market**. The market for the first quarter of 2011 resulted in a **very low** freight rate environment, in many cases, even **below breakeven levels**. Let's see why… Second reason is events in Japan have **disrupted the supply chain** on both raw and finished materials.

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Table IA.4. Components of supply chain risk and sentiment

This table reports the components that contribute to SCRisk and SCSentiment using topic analysis. We calculate the probability of each topic and regress SCRisk and SCSentiment on the topics' probabilities in columns (1) and (2), respectively. The topic probabilities are standardized by subtracting from each topic probability the mean and dividing by the standard deviation for ease of comparison. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Topics	(1) SCRisk	(2) SCSentiment
Costs and commodity price risk	0.6848***	-0.3608
	(0.0550)	(0.6276)
Technology and cyberattack risk	0.4951***	1.7887***
	(0.0640)	(0.6423)
Climate risk and pandemics	0.9179***	-1.0465
	(0.0714)	(0.7168)
Market uncertainty and regions	0.2035***	-0.6449
	(0.0775)	(0.9152)
Liquidity	0.3843***	-1.0770
	(0.0610)	(0.7366)
Analysts and financial issues	-0.0421	-0.6539
	(0.0447)	(0.6154)
Acquisitions	0.2419***	0.2764
	(0.0600)	(0.6579)
Firm FE	Y	Y
Industry x year FE	Y	Y
Observations	36,430	36,430
Adjusted R-squared	0.2166	0.3669

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Table IA.5. Industry level supply chain exposure

This table reports the top and bottom 10 industries in terms of our measure of overall supply chain risk, SCRisk. Industry-year average of firms' SCRisk is used to rank the industries.

SIC2	Top 10 Industries	SIC2	Bottom 10 Industries
22	Textile Mill Products	21	Tobacco Products
25	Furniture & Fixtures	27	Printing & Publishing
33	Primary Metal Industries	41	Local & Interurban Passenger Transit
34	Fabricated Metal Products	48	Communications
35	Industrial Machinery & Equipment	54	Food Stores
36	Electronic & Other Electric Equipment	58	Eating & Drinking Places
37	Transportation Equipment	72	Personal Services
42	Trucking & Warehousing	78	Motion Pictures
50	Wholesale Trade – Durable Goods	79	Amusement & Recreation Services
75	Auto Repair, Services, & Parking	82	Educational Services

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Table IA.6. Input specificity and stage of production

This table relate a firm's SCRisk to its input specificity and stage of production in Panels A and B, respectively. In Panel A, the main independent variable is *Input specificity*, which is constructed based on input-output tables and Rauch (1999) classification of differentiated products, and varies across industries and years. In Panel B, the main independent variable is *Crude dummy*, which is an indicator that equals one if the firm is producing raw commodities based on its three-digit SIC code, following the Stage of Production by the U.S. Bureau of Labor Statistics. Firm controls include size, Tobin's Q, cash holdings, and cash flow. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Input Specificity			
	Dependent var: SCRisk			Dependent var: SCSentiment		
Input specificity	0.0906***	0.0849***	0.1813***	1.0751***	0.9810***	-0.5727
	(0.0149)	(0.0149)	(0.0352)	(0.2414)	(0.2345)	(0.5100)
Size		0.1508***	0.0774*		3.1836***	3.3766***
		(0.0442)	(0.0434)		(0.6899)	(0.6534)
Tobin's Q		-0.0965**	-0.1024***		1.6880**	1.0282
		(0.0387)	(0.0378)		(0.6870)	(0.6523)
Cash holdings		-0.4989*	-0.8364***		-27.3071***	-12.8597***
		(0.2837)	(0.3169)		(4.2297)	(4.5775)
Cash flow		-0.0425	1.1318***		0.3712	-8.2426*
		(0.2589)	(0.2707)		(4.3723)	(4.4595)
Year FE			Y			Y
Industry FE			Y			Y
Observations	32,591	32,591	32,591	32,591	32,591	32,591
Adj. R-squared	0.0044	0.0067	0.0884	0.0046	0.0148	0.0803
			Panel B: Stage of Production			
	Dependent var: SCRisk			Dependent var: SCSentiment		
Crude dummy	-1.5646***	-1.9767***	-1.8757***	-33.4761***	-41.7152***	-42.2735***
	(0.1842)	(0.1971)	(0.2017)	(1.7554)	(2.0832)	(2.0791)
Size		0.1647***	0.0602		3.6366***	3.2562***
		(0.0459)	(0.0467)		(0.6965)	(0.7235)
Tobin's Q		-0.1253***	-0.2147***		1.3403*	1.1454
		(0.0401)	(0.0404)		(0.6868)	(0.7059)
Cash holdings		-0.8478***	-0.5889**		-32.1853***	-32.6849***
		(0.2982)	(0.2968)		(4.2742)	(4.2958)
Cash flow		-0.1232	1.1335***		-2.9841	-1.5845
		(0.2655)	(0.2847)		(4.3708)	(4.5351)
Year FE			Y			Y
Observations	30,686	30,686	30,686	32,591	32,591	32,591
Adj. R-squared	0.0012	0.0048	0.0648	0.0042	0.0174	0.0263

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Table IA.7. Variance decomposition of SCRisk and SCSentiment

This table reports adjusted R-squared and R-squared from the projection of SCRisk and SCSentiment on various sets of fixed effects, as indicated in the table. Industries are classified at the two-digit SIC code level in Panels A and B, three-digit SIC code level in Panels C and D, and four-digit SIC code level in Panels E and F.

	(1)	(2)	(3)	(4)
		Panel A: SCRisk – 2-digit SIC		
Year FE	Y			
Industry FE		Y		
Industry x year FE			Y	Y
Firm FE				Y
Adjusted R-squared	0.0540	0.0261	0.1031	0.1924
R-squared	0.0545	0.0276	0.1292	0.3089
		Panel B: SCSentiment – 2-digit SIC		
Year FE	Y			
Industry FE		Y		
Industry x year FE			Y	Y
Firm FE				Y
Adjusted R-squared	0.0091	0.0668	0.0836	0.3651
R-squared	0.0096	0.0683	0.1102	0.4567
		Panel C: SCRisk – 3-digit SIC		
Year FE	Y			
Industry FE		Y		
Industry x year FE			Y	Y
Firm FE				Y
Adjusted R-squared	0.0540	0.0357	0.1188	0.2020
R-squared	0.0545	0.0414	0.1956	0.3648
		Panel D: SCSentiment – 3-digit SIC		
Year FE	Y			
Industry FE		Y		
Industry x year FE			Y	Y
Firm FE				Y
Adjusted R-squared	0.0091	0.1061	0.1264	0.3839
R-squared	0.0096	0.1114	0.2026	0.5096
		Panel E: SCRisk – 4-digit SIC		
Year FE	Y			
Industry FE		Y		
Industry x year FE			Y	Y
Firm FE				Y

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Adjusted R-squared	0.0540	0.0421	0.1387	0.2167
R-squared	0.0545	0.0508	0.2469	0.4080

Panel F: SCSentiment – 4-digit SIC

Year FE	Y			
Industry FE		Y		
Industry x year FE			Y	Y
Firm FE				Y
Adjusted R-squared	0.0091	0.1195	0.1440	0.3959
R-squared	0.0096	0.1276	0.2516	0.5434

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Table IA.8. Supply chain risk, firm volatility, and returns

This table reports estimates of Fama-MacBeth regressions of firms' yearly realized volatility and 30-day average abnormal return on SCRisk and SCSentiment during the year in Panels A and B, respectively. The dependent variable in Panel A is *Realized Volatility*, computed as a firm's standard deviation of daily returns in that year. In Panel B, since earnings conference calls focus on the determinants of earnings and are therefore backward looking, we test how sentiment is associated with past stock returns. It is also plausible that the conversation is focused on the latest shocks. For this reason, in Panel B, the dependent variable is *30-day average abnormal return*, computed as the average market model abnormal stock returns for the 30 days prior to the earnings call date, which we average over the year. In panel B only, we multiply the dependent variable by a factor of 1,000 for presentation. Firm-level abnormal returns are obtained by estimating the market model over the [-255, -31] day interval. The Political risk measure is from Hassan et al. (2019). The Climate risk measure is from Sautner et al. (2023). All variables are defined in Appendix A. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
Panel A: Dependent variable – realized volatility			
SCRisk	0.0029*	0.0038**	0.0030*
	(0.0016)	(0.0016)	(0.0015)
SCSentiment		-0.0008***	-0.0008***
		(0.0001)	(0.0001)
Political Risk			0.0483***
			(0.0145)
Climate Risk			0.0204
			(0.0213)
Number of Firms	2,626	2,626	2,626
Number of Years	18	18	18
Panel B: Dependent variable – 30-day average abnormal return			
SCSentiment	0.0006***	0.0006***	0.0006***
	(0.0002)	(0.0002)	(0.0002)
SCRisk		-0.0034	-0.0037*
		(0.0023)	(0.0020)
Political Risk			0.0121
			(0.0333)
Climate Risk			0.0544
			(0.0474)
Number of Firms	2,626	2,626	2,626
Number of Years	18	18	18

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Table IA.9. First-stage regressions

This table reports estimates of the first-stage regressions. We regress the firm's SCRisk on its suppliers' SCRisk, which is our instrumental variable. The unit of observation in each regression is a firm-year. Firm controls include size, Tobin's Q, cash holdings, and cash flow. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1) SCRisk	(2) SCRisk
Suppliers' SCRisk	0.0102***	0.0100***
	(0.0037)	(0.0037)
SCSentiment		0.0020
		(0.0012)
Size	0.0220	0.0171
	(0.1490)	(0.1485)
Tobin's Q	-0.1180**	-0.1190**
	(0.0523)	(0.0522)
Cash holdings	1.6313**	1.6269**
	(0.6413)	(0.6413)
Cash flow	-0.2030	-0.2131
	(0.4108)	(0.4105)
Firm FE	Y	Y
Industry x year FE	Y	Y
Observations	24,139	24,139
Adjusted R-squared	0.1222	0.1226
First-stage F-stat	13.384	12.916

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Table IA.10. Instrumenting for both SCRisk and SCSentiment

This table reports instrumental variable estimates of the effects of SCRisk at *t-1* on firms' M&As and number of suppliers at *t* in Panel A and Panel B, respectively. The dependent variables in columns (1) and (2) of Panel A are *M&A with supplier* and *M&A with customer*, which are indicator variables that equal one if the firm conducts an M&A with a firm from an upstream or downstream industry, respectively. The dependent variable in column (3) of Panel A is *Unrelated M&A*, which is an indicator variable that equals one if the firm conducts an M&A with a firm that is neither in an upstream nor a downstream industry. The dependent variables in columns (1) to (5) of Panel B are number of suppliers, number of suppliers in the same continent as the firm, number of U.S. suppliers, number of suppliers in different continents, and number of industry leader suppliers, respectively. The unit of observation in each regression is a firm-year. Firm controls include size, Tobin's Q, cash holdings, and cash flow. We instrument for firm's supply chain risk with the supply chain risk of its suppliers and firm's supply chain sentiment with the supply chain sentiment of its suppliers. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A: Firms' M&As			
	(1) M&A with supplier	(2) M&A with customer	(3) Unrelated M&As
SCRisk	0.0819**	0.0953**	-0.0070
	(0.0366)	(0.0430)	(0.0129)
SCSentiment	-0.0024	-0.0046	-0.0011
	(0.0039)	(0.0047)	(0.0014)
Size	-0.0169	-0.0071	0.0019
	(0.0173)	(0.0203)	(0.0060)
Tobin's Q	0.0148*	0.0189**	0.0006
	(0.0077)	(0.0090)	(0.0027)
Cash holdings	-0.0264	-0.0727	0.0643**
	(0.0821)	(0.0966)	(0.0289)
Cash flow	0.1426***	0.1204**	0.0502***
	(0.0438)	(0.0528)	(0.0145)
Firm FE	Y	Y	Y
Industry x year FE	Y	Y	Y
Observations	24,139	24,139	24,139
First-stage F-stat	2.628	2.628	2.628

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Panel B: Supply chain composition					
	(1)	(2)	(3)	(4)	(5)
	Number of suppliers	Number of suppliers in the same continent	Number of U.S. suppliers	Number of suppliers in different continents	Number of industry leader suppliers
SCRisk	4.2452**	2.0202**	1.8566**	1.0215**	1.6626**
	(1.8066)	(0.9127)	(0.8728)	(0.4626)	(0.7073)
SCSentiment	-0.1618	-0.1034	-0.1076	-0.0484	-0.0575
	(0.1918)	(0.0974)	(0.0930)	(0.0493)	(0.0747)
Size	2.5912***	1.4177***	1.3815***	0.5305**	1.2514***
	(0.8612)	(0.4385)	(0.4233)	(0.2198)	(0.3363)
Tobin's Q	0.6480*	0.2692	0.2919	0.1532	0.2619*
	(0.3815)	(0.1902)	(0.1819)	(0.0962)	(0.1474)
Cash holdings	-6.2853	-3.6985*	-3.3957*	-1.4821	-3.1664**
	(4.0552)	(2.0396)	(1.9310)	(1.0177)	(1.5849)
Cash flow	-0.2442	-0.2236	-0.2319	-0.0293	-0.3546
	(2.2133)	(1.1158)	(1.0573)	(0.5663)	(0.8523)
Firm FE	Y	Y	Y	Y	Y
Industry x year FE	Y	Y	Y	Y	Y
Observations	24,139	24,139	24,139	24,139	24,139
First-stage F-stat	2.628	2.628	2.628	2.628	2.628

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Table IA.11. SCRisk and vertical M&As – alternative definitions of upstream and downstream industries

This table reports estimates of the effects of SCRisk on the probability that a firm is involved in an M&A. The dependent variables in columns (1) and (2) are *M&A with supplier* and *M&A with customer*, which are indicator variables that equal one if the firm conducts an M&A with a firm from an upstream or downstream industry, respectively. A target firm is considered to be a supplier (customer) if the acquirer's industry purchases (sells) at least one percent of its inputs (outputs) from (to) the target's industry. The dependent variable in column (3) is *Unrelated M&A*, which is an indicator variable that equals one if the firm conducts an M&A with a firm that is not in an upstream or downstream industry. The unit of observation in each regression is a firm-year. Firm controls include size, Tobin's Q, cash holdings, and cash flow. We instrument for firm's supply chain risk with the supply chain risk of its suppliers. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1) M&A with supplier	(2) M&A with customer	(3) Unrelated M&As
SCRisk	0.0570**	0.0590**	-0.0173*
	(0.0250)	(0.0251)	(0.0105)
SCSentiment	-0.0001	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0000)
Size	-0.0224**	-0.0127	-0.0007
	(0.0104)	(0.0098)	(0.0049)
Tobin's Q	0.0113**	0.0123***	-0.0012
	(0.0046)	(0.0045)	(0.0021)
Cash holdings	-0.0095	-0.0453	0.0785***
	(0.0603)	(0.0597)	(0.0287)
Cash flow	0.0992***	0.0598**	0.0422***
	(0.0274)	(0.0271)	(0.0120)
Firm FE	Y	Y	Y
Industry x year FE	Y	Y	Y
Observations	24,139	24,139	24,139
First-stage coeff	0.0100***	0.0100***	0.0100***
	(0.0037)	(0.0037)	(0.0037)
First-stage F-stat	12.916	12.916	12.916

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Table IA.12. Supply chain risk vs political risk and climate risk

This table reports estimates of the effects of SCRisk at *t-1* on firms' M&As and number of suppliers at *t* in Panel A and Panel B, respectively, controlling for two other sources of risk, political risk and climate risk. The Political risk measure is from Hassan et al. (2019). The Climate risk measure is from Sautner et al. (2023). The dependent variables in columns (1) and (2) of Panel A are *M&A with supplier* and *M&A with customer*, which are indicator variables that equal one if the firm conducts an M&A with a firm from an upstream or downstream industry, respectively. The dependent variable in column (3) of Panel A is *Unrelated M&A*, which is an indicator variable that equals one if the firm conducts an M&A with a firm that is neither in an upstream nor a downstream industry. The dependent variables in columns (1) to (5) of Panel B are number of suppliers, number of suppliers in the same continent as the firm, number of U.S. suppliers, number of suppliers in different continents, and number of industry leader suppliers, respectively. The unit of observation in each regression is a firm-year. Firm controls include size, Tobin's Q, cash holdings, and cash flow. We instrument for firm's supply chain risk with the supply chain risk of its suppliers. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A: Firms' M&As			
	(1) M&A with supplier	(2) M&A with customer	(3) Unrelated M&As
SCRisk	0.0613**	0.0549**	-0.0173*
	(0.0268)	(0.0242)	(0.0105)
SCSentiment	-0.0001	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0000)
Size	-0.0220**	-0.0173*	-0.0007
	(0.0111)	(0.0095)	(0.0049)
Tobin's Q	0.0111**	0.0117***	-0.0012
	(0.0049)	(0.0044)	(0.0021)
Cash holdings	0.0024	-0.0165	0.0785***
	(0.0646)	(0.0572)	(0.0286)
Cash flow	0.1259***	0.0886***	0.0423***
	(0.0295)	(0.0261)	(0.0120)
Political risk	-0.0033	-0.0025	-0.0001
	(0.0084)	(0.0072)	(0.0025)
Climate risk	-0.0102	-0.0102	0.0011
	(0.0085)	(0.0076)	(0.0034)
Firm FE	Y	Y	Y
Industry x year FE	Y	Y	Y
Observations	24,139	24,139	24,139
First-stage coeff	0.0100***	0.0100***	0.0100***
	(0.0037)	(0.0037)	(0.0037)
First-stage F-stat	12.916	12.916	12.916

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Panel B: Supply chain composition					
	(1)	(2)	(3)	(4)	(5)
	Number of suppliers	Number of suppliers in the same continent	Number of U.S. suppliers	Number of suppliers in different continents	Number of industry leader suppliers
SCRisk	2.8415***	1.1142**	0.9102**	0.6002**	1.1650**
	(1.0773)	(0.4699)	(0.3914)	(0.2427)	(0.4527)
SCSentiment	-0.0048	-0.0016	-0.0012	-0.0011	-0.0018
	(0.0041)	(0.0017)	(0.0014)	(0.0009)	(0.0017)
Size	2.2420***	1.1885***	1.1409***	0.4241***	1.1285***
	(0.4827)	(0.1986)	(0.1686)	(0.1089)	(0.1961)
Tobin's Q	0.3958*	0.1073	0.1228*	0.0777*	0.1725**
	(0.2060)	(0.0868)	(0.0723)	(0.0449)	(0.0851)
Cash holdings	-4.3186*	-2.4397**	-2.0830**	-0.8949	-2.4680**
	(2.6233)	(1.1010)	(0.9091)	(0.5771)	(1.0910)
Cash flow	-1.3682	-0.9461*	-0.9828**	-0.3628	-0.7565
	(1.2222)	(0.4973)	(0.4168)	(0.2742)	(0.4950)
Political risk	-0.0906	-0.1587	-0.1552	-0.0283	-0.0513
	(0.3363)	(0.1180)	(0.0959)	(0.0652)	(0.1423)
Climate risk	-0.6371*	-0.2327	-0.1846	-0.1163	-0.2682*
	(0.3475)	(0.1471)	(0.1223)	(0.0766)	(0.1451)
Firm FE	Y	Y	Y	Y	Y
Industry x year FE	Y	Y	Y	Y	Y
Observations	24,139	24,139	24,139	24,139	24,139
First-stage coeff	0.0100***	0.0100***	0.0100***	0.0100***	0.0100***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)
First-stage F-stat	12.916	12.916	12.916	12.916	12.916

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Table IA.13. Supply chain risk vs overall sentiment

This table reports instrumental variable estimates of the effects of SCRisk at *t-1* on firms' M&As and number of suppliers at *t* in Panel A and Panel B, respectively, controlling for the overall sentiment of a firm's earnings calls during year *t-1*. Overall sentiment is constructed by calculating the net sentiment in the whole earnings call transcript. The dependent variables in columns (1) and (2) of Panel A are *M&A with supplier* and *M&A with customer*, which are indicator variables that equal one if the firm conducts an M&A with a firm from an upstream or downstream industry, respectively. The dependent variable in column (3) of Panel A is *Unrelated M&A*, which is an indicator variable that equals one if the firm conducts an M&A with a firm that is neither in an upstream nor a downstream industry. The dependent variables in columns (1) to (5) of Panel B are number of suppliers, number of suppliers in the same continent as the firm, number of U.S. suppliers, number of suppliers in different continents, and number of industry leader suppliers, respectively. The unit of observation in each regression is a firm-year. Firm controls include size, Tobin's Q, cash holdings, and cash flow. We instrument for firm's supply chain risk with the supply chain risk of its suppliers. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A: Firms' M&As			
	(1) M&A with supplier	(2) M&A with customer	(3) Unrelated M&As
SCRisk	0.0611**	0.0548**	-0.0173*
	(0.0267)	(0.0241)	(0.0104)
SCSentiment	-0.0001	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0000)
Size	-0.0182	-0.0146	-0.0008
	(0.0111)	(0.0095)	(0.0050)
Tobin's Q	0.0122**	0.0125***	-0.0012
	(0.0051)	(0.0045)	(0.0022)
Cash holdings	0.0064	-0.0138	0.0784***
	(0.0640)	(0.0567)	(0.0285)
Cash flow	0.1251***	0.0882***	0.0423***
	(0.0295)	(0.0262)	(0.0120)
Overall sentiment	0.2099***	0.1553**	-0.0051
	(0.0718)	(0.0650)	(0.0292)
Firm FE	Y	Y	Y
Industry x year FE	Y	Y	Y
Observations	24,139	24,139	24,139
First-stage coeff	0.0100***	0.0100***	0.0100***
	(0.0037)	(0.0037)	(0.0037)
First-stage F-stat	12.916	12.916	12.916

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Panel B: Supply chain composition					
	(1)	(2)	(3)	(4)	(5)
	Number of suppliers	Number of suppliers in the same continent	Number of U.S. suppliers	Number of suppliers in different continents	Number of industry leader suppliers
SCRisk	2.8408***	1.1112**	0.9073**	0.6003**	1.1646**
	(1.0762)	(0.4683)	(0.3901)	(0.2425)	(0.4522)
SCSentiment	-0.0050	-0.0017	-0.0012	-0.0011	-0.0019
	(0.0042)	(0.0017)	(0.0014)	(0.0009)	(0.0017)
Size	2.3108***	1.2106***	1.1549***	0.4285***	1.1537***
	(0.4865)	(0.1995)	(0.1690)	(0.1098)	(0.1972)
Tobin's Q	0.4206**	0.1146	0.1275*	0.0798*	0.1818**
	(0.2137)	(0.0899)	(0.0749)	(0.0466)	(0.0883)
Cash holdings	-4.2613	-2.4134**	-2.0639**	-0.8926	-2.4471**
	(2.6054)	(1.0907)	(0.9006)	(0.5730)	(1.0837)
Cash flow	-1.3561	-0.9351*	-0.9714**	-0.3570	-0.7494
	(1.2263)	(0.4979)	(0.4172)	(0.2748)	(0.4969)
Overall sentiment	4.2728	1.4420	0.9675	0.3513	1.6053
	(3.0231)	(1.2638)	(1.0626)	(0.6752)	(1.2644)
Firm FE	Y	Y	Y	Y	Y
Industry x year FE	Y	Y	Y	Y	Y
Observations	24,139	24,139	24,139	24,139	24,139
First-stage coeff	0.0100***	0.0100***	0.0100***	0.0100***	0.0100***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)
First-stage F-stat	12.916	12.916	12.916	12.916	12.916

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Table IA.14. Supply chain risk – replacing potential noise with industry median

This table reports estimates of the effects of SCRisk at *t-1* on firms' M&As and number of suppliers at *t* in Panel A and Panel B, respectively. We replace firm-year observations of SCRisk in which more than 75% of the snippets that incorporate supply chain risk discussions are associated with probability of general financial or analyst and liquidity issues in the top quartile with the 2-digit SIC industry median of SCRisk. The dependent variables in columns (1) and (2) of Panel A are *M&A with supplier* and *M&A with customer*, which are indicator variables that equal one if the firm conducts an M&A with a firm from an upstream or downstream industry, respectively. The dependent variable in column (3) of Panel A is *Unrelated M&A*, which is an indicator variable that equals one if the firm conducts an M&A with a firm that is neither in an upstream nor a downstream industry. The dependent variables in columns (1) to (5) of Panel B are number of suppliers, number of suppliers in the same continent as the firm, number of U.S. suppliers, number of suppliers in different continents, and number of industry leader suppliers, respectively. The unit of observation in each regression is a firm-year. Firm controls include size, Tobin's Q, cash holdings, and cash flow. We instrument for firm's supply chain risk with the supply chain risk of its suppliers. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A: Firms' M&As			
	(1) M&A with supplier	(2) M&A with customer	(3) Unrelated M&As
SCRisk	0.0643**	0.0577**	-0.0182
	(0.0290)	(0.0262)	(0.0112)
SCSentiment	-0.0001	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0000)
Size	-0.0236**	-0.0188*	-0.0003
	(0.0115)	(0.0099)	(0.0050)
Tobin's Q	0.0110**	0.0116***	-0.0012
	(0.0051)	(0.0045)	(0.0022)
Cash holdings	-0.0030	-0.0215	0.0800***
	(0.0684)	(0.0607)	(0.0297)
Cash flow	0.1288***	0.0912***	0.0416***
	(0.0309)	(0.0274)	(0.0123)
Firm FE	Y	Y	Y
Industry x year FE	Y	Y	Y
Observations	24,139	24,139	24,139
First-stage coeff	0.0095***	0.0095***	0.0095***
	(0.0037)	(0.0037)	(0.0037)
First-stage F-stat	11.804	11.804	11.804

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Panel B: Supply chain composition					
	(1)	(2)	(3)	(4)	(5)
	Number of suppliers	Number of suppliers in the same continent	Number of U.S. suppliers	Number of suppliers in different continents	Number of industry leader suppliers
SCRisk	2.9856**	1.1675**	0.9530**	0.6302**	1.2238**
	(1.1849)	(0.5108)	(0.4247)	(0.2649)	(0.4969)
SCSentiment	-0.0050	-0.0017	-0.0013	-0.0012	-0.0019
	(0.0043)	(0.0018)	(0.0015)	(0.0010)	(0.0018)
Size	2.1627***	1.1571***	1.1152***	0.4077***	1.0958***
	(0.5041)	(0.2060)	(0.1748)	(0.1132)	(0.2049)
Tobin's Q	0.3937*	0.1053	0.1210	0.0771*	0.1715*
	(0.2144)	(0.0896)	(0.0745)	(0.0465)	(0.0885)
Cash holdings	-4.5854	-2.5354**	-2.1592**	-0.9496	-2.5769**
	(2.8100)	(1.1718)	(0.9656)	(0.6153)	(1.1674)
Cash flow	-1.2257	-0.8857*	-0.9326**	-0.3334	-0.6970
	(1.2904)	(0.5212)	(0.4362)	(0.2871)	(0.5224)
Firm FE	Y	Y	Y	Y	Y
Industry x year FE	Y	Y	Y	Y	Y
Observations	24,139	24,139	24,139	24,139	24,139
First-stage coeff	0.0095***	0.0095***	0.0095***	0.0095***	0.0095***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0037)
First-stage F-stat	11.804	11.804	11.804	11.804	11.804

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Table IA.15. Supply chain risk – omitting potential noise

This table reports estimates of the effects of SCRisk at *t-1* on firms' M&As and number of suppliers at *t* in Panel A and Panel B, respectively. We omit firm-year observations in which more than 75% of the snippets that incorporate supply chain risk discussions are associated with probability of general financial or analyst and liquidity issues in the top quartile. The dependent variables in columns (1) and (2) of Panel A are *M&A with supplier* and *M&A with customer*, which are indicator variables that equal one if the firm conducts an M&A with a firm from an upstream or downstream industry, respectively. The dependent variable in column (3) of Panel A is *Unrelated M&A*, which is an indicator variable that equals one if the firm conducts an M&A with a firm that is neither in an upstream nor a downstream industry. The dependent variables in columns (1) to (5) of Panel B are number of suppliers, number of suppliers in the same continent as the firm, number of U.S. suppliers, number of suppliers in different continents, and number of industry leader suppliers, respectively. The unit of observation in each regression is a firm-year. Firm controls include size, Tobin's Q, cash holdings, and cash flow. We instrument for firm's supply chain risk with the supply chain risk of its suppliers. All variables are defined in Appendix A. Robust standard errors clustered by firm are in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A: Firms' M&As			
	(1) M&A with supplier	(2) M&A with customer	(3) Unrelated M&As
SCRisk	0.0657**	0.0595**	-0.0177
	(0.0310)	(0.0281)	(0.0116)
SCSentiment	-0.0001	-0.0001	0.0000
	(0.0001)	(0.0001)	(0.0000)
Size	-0.0232*	-0.0176*	-0.0005
	(0.0119)	(0.0103)	(0.0051)
Tobin's Q	0.0118**	0.0124**	-0.0012
	(0.0055)	(0.0049)	(0.0023)
Cash holdings	-0.0077	-0.0278	0.0772**
	(0.0734)	(0.0656)	(0.0309)
Cash flow	0.1304***	0.0918***	0.0424***
	(0.0324)	(0.0290)	(0.0126)
Firm FE	Y	Y	Y
Industry x year FE	Y	Y	Y
Observations	23,519	23,519	23,519
First-stage coeff	0.0093**	0.0093**	0.0093**
	(0.0038)	(0.0038)	(0.0038)
First-stage F-stat	10.684	10.684	10.684

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Panel B: Supply chain composition					
	(1)	(2)	(3)	(4)	(5)
	Number of suppliers	Number of suppliers in the same continent	Number of U.S. suppliers	Number of suppliers in different continents	Number of industry leader suppliers
SCRisk	2.9100**	1.1121**	0.8988**	0.6323**	1.1599**
	(1.2023)	(0.5133)	(0.4239)	(0.2772)	(0.4914)
SCSentiment	-0.0051	-0.0017	-0.0012	-0.0013	-0.0019
	(0.0044)	(0.0018)	(0.0015)	(0.0010)	(0.0018)
Size	2.1933***	1.1742***	1.1288***	0.4145***	1.1155***
	(0.5043)	(0.2027)	(0.1710)	(0.1156)	(0.2001)
Tobin's Q	0.4058*	0.1093	0.1224	0.0823*	0.1727*
	(0.2225)	(0.0917)	(0.0757)	(0.0495)	(0.0897)
Cash holdings	-4.5736	-2.5843**	-2.1978**	-1.0188	-2.5259**
	(2.8796)	(1.1845)	(0.9692)	(0.6475)	(1.1669)
Cash flow	-1.1998	-0.8765*	-0.9244**	-0.3360	-0.6849
	(1.3059)	(0.5169)	(0.4301)	(0.2977)	(0.5157)
Firm FE	Y	Y	Y	Y	Y
Industry x year FE	Y	Y	Y	Y	Y
Observations	23,519	23,519	23,519	23,519	23,519
First-stage coeff	0.0093**	0.0093**	0.0093**	0.0093**	0.0093**
	(0.0038)	(0.0038)	(0.0038)	(0.0038)	(0.0038)
First-stage F-stat	10.684	10.684	10.684	10.684	10.684

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