

CHALLENGES FOR GLOBAL SUPPLY CHAIN SUSTAINABILITY: EVIDENCE FROM CONFLICT MINERALS REPORTS

YONG H. KIM
GERALD F. DAVIS
University of Michigan

The vertically integrated corporation of the 20th century has been replaced by disaggregated global supply chains across many industries. Dis-integration can reduce costs, but also limits the ability to monitor and control critical processes, including labor practices and the sourcing of supplies. This article asks: What organizational factors distinguish corporations that are able to vouch for their supply chains from those that are not? Section 1502 of the Dodd–Frank Act of 2010 gave companies over three years to determine and report on whether their products contained “conflict minerals” from the Democratic Republic of Congo area. Our analysis of every conflict minerals report submitted to the Securities and Exchange Commission by over 1,300 corporations found that almost 80% admitted they were unable to determine the country of origin of such materials, and only 1% could certify themselves conflict-free with certainty beyond reasonable doubt. Internationally diversified firms and those with large and more dispersed supply chains were less likely to declare their products conflict-free: complexity reduces the visibility of a firm’s supply chain. Our results suggest that widespread outsourcing may have reduced the corporate sector’s capacity to account for the practices that yield its products.

For most of the 20th century, vertically integrated corporations were dominant actors in the global economy. As companies grew, they often acquired their suppliers and distribution channels, bringing control over the value chain within the organization’s boundary. Some, such as Ford Motor Company, went to extremes, manufacturing the glass and steel that went into their cars and sometimes owning the sources of their raw materials. Expectations about corporate responsibility in this context hinged on the idea that companies could be held accountable for the labor and other practices that went into their products. Over the past generation, information and communication technologies and low-cost shipping have enabled firms to outsource to suppliers around the world

based on cost and capability. Yet even as production becomes increasingly disaggregated, corporations are called on to be more accountable for the practices of their suppliers and even the actions of the states in which they operate. This reflects a “responsibility paradox:” demands for corporate social responsibility (CSR) increase even as companies’ ability to deliver shrinks (Davis, Whitman, & Zald, 2013).

This article asks: What organizational factors distinguish corporations that are able to vouch for their supply chains from those that are not? Section 1502 of the Dodd–Frank Act of 2010 gave companies listed on U.S. stock markets over three years to determine and report on whether their products contained “conflict minerals” originating from the Democratic Republic of Congo (DRC) and its nine adjoining countries.¹ Conflict minerals (tungsten, tantalum, tin, and gold, or 3TG) are found in thousands of products, including almost all electronics. This Act sought to reduce human rights abuses by armed groups in the DRC who use revenues from the sale of 3TG to fund

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¹ Angola, Burundi, Central African Republic, Congo Republic, Rwanda, Sudan, Tanzania, Uganda, and Zambia.

their activities. Firms were not forbidden from using these minerals; rather, by mandating transparency about their sources of 3TG, firms would learn about their own supply chains and (ideally) seek to avoid those sources funding conflict. Yet our analysis of every conflict minerals report submitted to the Securities and Exchange Commission (SEC) in 2014 and 2015 by over 1,300 corporations revealed that nearly 80% admitted that they were unable to determine with certainty the country of origin of such materials. Only 1% were able to declare beyond a reasonable doubt that their products were free of DRC conflict minerals. What distinguished those firms that were able to vouch for their supply chains from those that were not? Our investigation finds that several organizational factors—in particular, a firm’s internal complexity (as indicated by international diversification) and supply chain complexity (as measured by the size and concentration of the supplier base)—created the biggest hurdles to supply chain visibility. We also find that European Union (EU) -domiciled firms were more effective than their United States counterparts in vetting their supply chains.

This paper makes several contributions. First, the dispersion of supply chains makes corporate accountability beyond the boundaries of the firm one of the defining grand challenges of our era. Yet there has been surprisingly little organizational research on accountability in supply chains, in spite of its theoretical and practical importance (Davis, 2015). Second, much of what we know about supply chains stems from case studies (e.g., Locke’s [2003] exemplary research on Nike) or anecdotes in the wake of disasters and scandals. The new conflict minerals disclosure requirement applies to all domestic and foreign corporations listed on U.S. stock markets. It therefore provides a unique opportunity to examine supply chain visibility in a systematic way across a large population of firms. Third, this research can inform both managerial practice and public policy. As our study reveals, there is a gap between the intentions of public policy and what corporations are willing and able to deliver. Examining the organizational sources of that gap can contribute to more effective policy.

SUPPLY CHAINS AND ACCOUNTABILITY

Since Coase’s seminal 1937 article, economists and other scholars have highlighted the question of

where the boundaries of a firm should be placed. Transactions within a firm’s boundaries can be monitored and controlled by management, but at a cost; the decision of whether to make or buy a component turns on the hazards of leaving it to the market compared to the expense of creating a governance structure (Williamson, 1981). Over the past generation, information and communication technologies, low-cost shipping, and trade liberalization have tilted the cost balance from “make” to “buy” in a broad variety of sectors, from clothing to pharmaceuticals to electronics. Nike shoes, Apple phones, and Hewlett-Packard laptops are all manufactured by far-flung contractors, not by the company whose logo is engraved on the product. The availability of off-the-shelf production and distribution networks can allow new entrants to scale up rapidly: Irvine-based Vizio became the best-selling U.S. television brand in 2010 with only 200 employees.

Dispersed supply chains can make identifying exactly who made what extremely difficult. When the Rana Plaza building in Bangladesh collapsed in 2013 and killed over 1,100 garment workers, authorities in Dhaka could not even determine the number of factories that fell under their jurisdiction. According to a recent study conducted by BBMG (2014), 91% of consumers could not state where their favorite brands’ clothing was manufactured. “Producers” may be in much the same situation as consumers: in the wake of the Rana Plaza disaster, some global brands claimed that their goods were being produced by unauthorized subcontractors. While there is a general consensus among researchers and practitioners that the conditions at first-tier suppliers are improving, even automakers that are heavily dependent on their supply chains have difficulty identifying their fourth- or fifth-tier suppliers.

Dispersed supply chains also make it difficult to implement sustainability policies. Over 50% of an average corporation’s carbon emissions come from its supply chain rather than within its own boundaries (AT Kearney, 2011). Assessing overall climate risks requires engagement with suppliers several steps back, yet this is often well beyond a firm’s visibility. Thus, in 2009 only six firms out of the Fortune 500 were able to disclose complete information on greenhouse gas emissions across their full value chain (Jackson, 2011).

Given the magnitude of the issue, it is not surprising that there have been voluntary efforts to address supply chain accountability and sustainability. Corporate participation in programs such as the Carbon Disclosure Project and Global Reporting

Initiative has been heralded as important avenues to change corporate action and promote CSR. Both programs have also begun to focus on supply chain sustainability. However, voluntary social reporting without regulatory oversight and enforcement can become a ritualistic practice that often fails to meaningfully change firm behavior (Park, 2014). In response, a growing body of research has taken advantage of regulatory interventions to see what factors are truly associated with achieving sustainability and accountability (e.g., Kim & Lyon, 2011, 2015). Legal mandates should, in principle, provide a surer path to supply chain accountability.

Section 1502 of the Dodd–Frank Wall Street Reform and Consumer Protection Act gives us a unique opportunity to examine how organizational factors, including corporate structure and prior efforts at accountability, shape a company’s ability to vet its supply chain. The Act mandates SEC filing companies that use 3TG in their products to investigate the origins of those materials and whether they may be helping to finance armed groups in the DRC area. In this study, we provide a systematic analysis of all conflict minerals reports submitted to the SEC from the first two rounds of submissions in 2014 and 2015 to determine the prevalence of different outcomes across firms and industries. We then combine these with firm-level data from other SEC filings, Compustat, Bloomberg, Fortune, LexisNexis, news reports, third-party ratings of corporate social and environmental performance, and other sources to analyze the organizational factors associated with supply chain visibility. We also spoke with a dozen supply chain managers charged with overseeing their firms’ response to Section 1502; lawyers; and activists focused on this specific issue, with the goal of informing our theory and statistical analyses. We conducted confidential face-to-face interviews with experts we met at industry events (e.g., supply chain conferences) and others we were referred to by personal contacts. Follow-up interviews were conducted either over the phone or via email.

CONFLICT MINERALS AND THE DODD–FRANK ACT

On December 15, 2010, the SEC proposed a number of amendments to implement Section 1502 of the Dodd–Frank Wall Street Reform and Consumer Protection Act (for details, see <http://www.sec.gov/rules/final/2012/34-67716.pdf>). This rule relates to new disclosure and reporting obligations by companies concerning “conflict minerals” that originated

in the Democratic Republic of the Congo and its adjoining countries. Under the Dodd–Frank Act, conflict minerals include tantalum, tin, tungsten, and gold. This rule was enacted because of concerns that the use of conflict minerals may help finance armed groups in the DRC region. Every SEC filing company—both domestic and foreign issuers—that deem such minerals as (1) necessary to the functionality or production of a product manufactured or (2) contracted to be manufactured by the company, must conduct a reasonable investigation (also called “Reasonable Country of Origin Inquiry” [RCOI]) to determine whether the company’s products are clear from the use of minerals subsidizing conflict. Under the Dodd–Frank Act, if the company (1) knows that the minerals did not originate in the covered countries or are from scrap or recycled sources, or (2) has no reason to believe the opposite, then it must disclose this information on Form Specialized Disclosure (SD). Otherwise, it must undertake due diligence on the source and chain of custody of its conflict minerals and describe the results as an exhibit to Form SD. Companies were given an option to declare their lack of determinative knowledge for a temporary two-year period (or four-year period for smaller reporting companies) in case they were unable to determine whether the minerals in their products originated in the covered countries, or financed or benefited armed groups in those countries.

Section 1502 is a prominent example of what Park (2014) labeled “targeted social transparency” efforts, which aim to achieve human rights policy goals through securities laws. Corporate law in the United States is made at the state level, rather than the federal level; most major corporations are incorporated in Delaware. Thus, when Congress wants to regulate corporate responsibility, it often does so through securities law, which is made at the federal level (e.g., the Foreign Corrupt Practices Act of 1977). The Dodd–Frank Act does not ban or penalize the use of conflict minerals, nor does it mandate companies to stop purchasing products that directly or indirectly support conflict in the DRC. SEC penalties only apply for failure to report or for false disclosures. At this moment, there is no indication that the use of conflict minerals will be illegal, at least in the United States. Therefore, companies should have enough incentive to proactively investigate and fully disclose where their products are coming from.

Eligible companies had more than three years to investigate their supply chains. The first Specialized Disclosure Reports were due June 2, 2014, and over

1,300 companies submitted their first reports on time. A similar number of companies submitted their reports in the second round, which was due June 1, 2015. Since the Dodd–Frank Act requires companies to investigate their complete supply chain, not just their direct suppliers, many companies had to spend millions of dollars and countless hours to monitor their suppliers, ask their suppliers to survey their suppliers, and so forth. For companies whose products originated from multiple sources across multiple tiers of suppliers, the number of smelters and suppliers they had to review could be vast. For example, Caterpillar Inc. and ABB Ltd. had to review over 30,000 suppliers, while the average company screened 743 suppliers (Chasan & Murphy, 2014).

The remainder of this study examines the factors that distinguish those companies that were able to declare their products “clean” from those that could not over the first two years that Section 1502 was in effect. Because this is a new domain of study, and there is little prior theory on supply chains and accountability, we approach this in the spirit of problem-driven research (Davis & Marquis, 2005). Our primary aim is to answer this critical question accurately, and secondarily to contribute to theory.

ORGANIZATIONAL FACTORS BEHIND SUPPLY CHAIN VISIBILITY

At an abstract level, gaining visibility into a firm’s supply chain is a problem of epistemology: when can a firm say with reasonable certainty that there are no conflict minerals from the DRC in its products? But at a more concrete level, it is a problem of research, and specifically survey research: how can a firm get surveys into the hands of the right people at all of its relevant suppliers and ensure that they respond honestly and promptly? And how does a firm get its suppliers to vouch for their suppliers, and their suppliers? What is a sufficient response rate to be sure beyond a reasonable doubt?

Put in these terms, supply chain visibility is a question of an organization’s ability and motivation. Organizations vary in their internal complexity, the complexity of their supply chain, and their power to influence their suppliers to comply. They also vary in their prior experience in vetting their supply chain. All of these organizational factors speak to the firm’s ability to effectively survey their supply chain. Organizations also vary in their visibility to the public and in their reputation, which make them more or less susceptible to consequences from consumers on the basis of their use of conflict

minerals. Both of these speak to the firm’s motivation to effectively survey their supply chain. Below, we draw on prior literature to derive hypotheses for each of these factors.

Organizational Complexity

One of the central tenets of organization theory is that diversification is associated with greater organizational complexity. Chandler’s (1962) classic study of the rise of the multidivisional form (M-form) found that firms such as DuPont and General Motors encountered increasing demands for monitoring and decision making as the firms’ activities spread across product lines and geography. Increasing diversification created increasing demands for information processing, which were ultimately addressed through the use of the M-form. Relatively autonomous divisions were overseen by a corporate headquarters with final authority. However, the corporate headquarters was not expected to be intimately familiar with day-to-day operations, such as the management of suppliers: these decisions were distributed at the divisional level. Thus, we would expect more diversified firms with greater structural differentiation to have less capacity to gain visibility into their supply chains, compared to more focused firms.

The diversification literature has typically focused on three types of diversification: related, unrelated, and international. For example, Kang (2013) found that the levels of unrelated and international diversification increase the company’s corporate social performance, but related diversification does not. Similarly, different types of diversification may not have the same impact on a company’s ability to investigate and monitor its supply chain. Companies that engage in related diversification already have some relevant experience and knowledge about the industry, which in turn facilitate these companies’ ability to learn and monitor their supply base (Zahavi & Lavie, 2013). On the other hand, companies’ learning from unrelated or international diversification experiences should be less relevant for monitoring their supply base. Without the opportunity to gain from synergies through previous related diversification, we argue that companies engaging in unrelated or international diversification face more diverse and unfamiliar environments, making them less likely to be able to declare their products free of conflict minerals.

Hypothesis 1a. More industrially diversified companies are less effective in determining

whether their products are free of conflict minerals.

Hypothesis 1b. More internationally diversified companies are less effective in determining whether their products are free of conflict minerals.

Supply Chain Complexity

Companies with more complex supply bases have a greater amount of operational load in terms of monitoring and managing their supply chain networks. Supply chain complexity, represented as the number of suppliers, differentiation among those suppliers, and the level of interrelationship between them, affects the level of effort necessary to visualize a focal (or buyer) company's supply base (Choi & Krause, 2006). The first two factors bring up significant challenges for Section 1502 of the Dodd–Frank Act, which requires companies to know their complete supply chains.

Having a large number of suppliers increases monitoring costs and hampers a company's ability to investigate its complete supply chain. Unless a company makes everything it sells from scratch on its own, vetting its supply chain requires gaining compliance all the way back to the smelter that refines the minerals. The electronics industry estimated that the DRC area may, at most, supply 20% of the world's supply of conflict minerals, but this 20% could be distributed among 100% of the companies. From the focal company's perspective, the number of its indirect suppliers skyrockets when it has more direct suppliers and as it gets further away from the actual mining and production sites. Having a non-concentrated supply base only increases upstream search, monitoring, and enforcement costs (Steven, Dong, & Corsi, 2014).

Complex supply chains also tend to have more "opaque" buyer–supplier relationships where potentially sensitive information is not transmitted from the supplier to the buyer (Lamming, Caldwell, & Harrison, 2004). Individuals have some knowledge and influence over their friends' friends, but significantly less so when they seek to go one step further. Companies are no different in this aspect. If a focal company's second-tier supplier switched its supplier, there is a good chance that the focal firm will never know that it now has a new third-tier supplier. In addition, companies closer to the actual mining and production sites typically have fewer qualified personnel and resources that can be spent on

investigating the supply chain. One informant noted that big companies have dedicated resources and lawyers to respond to disclosure requirements like Section 1502, but first-tier suppliers might have only one staff member for compliance issues, and suppliers one or two tiers back might be a "mom-and-pop shop" overseas. Finally, as supply chains become more complex, there is a higher chance that information could be lost, omitted, or corrupted, and all of this leads to lower traceability (Skilton & Robinson, 2009). Therefore, we predict that companies with more complex supply chains are less likely to be able to identify each and every node in their complete supply chain network, thereby negatively affecting their ability to determine whether their products are free of conflict minerals.

Hypothesis 2. Companies that have complex supply chains are less effective in determining whether their products are free of conflict minerals.

Power over Suppliers

To map its entire supply chain, a focal company has to rely on cooperation from its first-tier suppliers, who then survey the focal company's second-tier suppliers, and so on. For a branded electronics company that relies on contract assemblers, minerals may be five or more steps back in the supply chain. Some SEC filers are themselves first-tier suppliers to other filers (e.g., Intel), making them more willing to invest resources to verify their supply chain. However, many or most suppliers are located outside the U.S.; these firms are not subject to SEC regulations, and may be disinclined to respond to surveys. Supply chain managers we spoke with voiced the challenges they face in asking their first-tier suppliers to go upstream to *their* (second-tier) suppliers. The identity of suppliers is often considered proprietary information, and some firms resist disclosing them to their own customers.

Firms that have more power over their suppliers can obtain more favorable terms (Dickinson & Sommers, 2012) and have more control over suppliers' decision making (Provan & Skinner, 1989). A firm's power over its supplier increases when the firm accounts for a major part of the supplier's revenue, or when it is less costly to switch to alternative suppliers (Banerjee, Gatchev, & Spindt, 2007; Thompson, 1967). Not only does such power prevent suppliers from engaging in opportunistic behavior, but it also gives leverage in demanding suppliers to

conform to their buyers' requests (Zhao, Huo, Flynn, & Yeung, 2008). For example, Walmart's power has enabled the company to compel its suppliers to evaluate and disclose the full environmental costs of their products, leading some scholars and environmental groups to claim that "Walmart is the only entity capable of making 'sustainable consumption' a retailing reality" (Rosenbloom, 2009).

Therefore, having power over suppliers gives companies leverage to escalate inquiries and communications with any supplier that does not provide complete and acceptable responses. Given that conflict mineral investigations require the cooperation of suppliers, we predict that firms that have more power over their suppliers will be better at investigating their supply chains.

Hypothesis 3. Companies that have greater power over their suppliers are more effective in determining whether their products are free of conflict minerals.

Visibility

Companies with high visibility—i.e., those that receive high levels of public attention—are subject to greater levels of external pressures and demands (Salancik, 1979). Visible companies get more media attention, making them more vulnerable to shareholder activism (Rehbein, Waddock, & Graves, 2004) and protests (King & McDonnell, 2015). As Orin Smith, the former Starbucks President and CEO, aptly said in 2001, the greater propensity of being a target of social movements is the "price of being so visible" (USA Today, 2001). Similarly, Nintendo was heavily criticized and protested by activists in 2012 and 2013 when the Enough Project, a human rights group, ranked Nintendo last among 24 leading consumer electronics companies based on how the companies dealt with sourcing conflict minerals (Ball, 2013).

Visible companies receive more diverse and intense stakeholder demands, and seek to accommodate diverging interests from stakeholders (Fiss & Zajac, 2006). Visibility may therefore generate a general propensity for companies to be more sensitive to social and political stakeholders (Brammer & Millington, 2006). One of our informants indicated that it is not the government that gives companies trouble for supporting warlords—it is social activists and nongovernmental organizations (NGOs). Therefore, we predict that such pressure from external audiences will force highly visible companies

to put more effort into investigating their supply chains in order to declare their products free from conflict minerals.

Hypothesis 4. Companies that are more visible to stakeholders are more effective in determining whether their products are free of conflict minerals.

Reputation

Reputation, or the public recognition and social approval of an organization as well as perceptions about its quality (Rindova, Williamson, Petkova, & Sever, 2005), may function similarly to visibility in that highly reputed companies put in more effort to meet their stakeholders' expectations. Not only are highly reputed companies broadly expected to be "good companies" to various stakeholders, but the potential backlash for violating that expectation can be harsher compared to less reputed companies (Fombrun, 1996; Wade, Porac, Pollock, & Graffin, 2006). Stakeholders respond more positively when highly reputed companies do something good, but they react more negatively when those companies do something bad (Brooks, Highhouse, Russell, & Mohr, 2003). In other words, reputation functions as an organizational liability when that organization cannot live up to stakeholders' expectations (Rhee & Haunschild, 2006).

However, another body of research has shown how reputation can buffer companies from negative outcomes. For instance, highly reputed companies experience significantly less penalty following negative earnings surprises (Pfarrer, Pollock, & Rindova, 2010), downsizing (Love & Kraatz, 2009), or boycotts (King, 2011). Stakeholders may be inclined to give a firm with a good reputation the benefit of the doubt, inferring good motives for what that firm did (Campbell, 1999). This line of research has suggested that highly reputed companies accrue a stock of social capital with their stakeholders over time, which they can use to reduce the adverse consequences of a negative event (Zavyalova, Pfarrer, Reger, & Hubbard, 2016).

In sum, reputation may be a burden (prompting firms to address potential threats more vigorously) or a benefit (providing a buffer if and when they fall short). In this context, the former motivation is likely to be dominant. Our informants suggested that companies worried more about the reputational consequences of disclosure than about potential legal repercussions. No one wants to be accused by activists of producing a "genocide phone," and firms

with stronger reputations have more to lose, and within a more immediate time horizon. Therefore, we predict that highly reputed companies are likely to investigate their supply chains more comprehensively, increasing their chance of knowing whether their products are free of conflict minerals.

Hypothesis 5. Companies that have a better reputation are more effective in determining whether their products are free of conflict minerals.

Voluntary CSR Participation

Companies voluntarily engage in CSR for a variety of reasons. They may participate in sustainability programs in order to improve their brand image or to strategically appeal to socially concerned customers. In particular, by actively engaging in CSR programs that go beyond their own four walls, companies can develop ecologically related resources and capabilities to build long-term profit potentials (Bansal & Roth, 2000; Hart, 1995). The capacity to understand their supplier base through CSR participation provides companies with knowledge they can use to make their production process more efficient and reliable (Carter, 2005). Any level of organizational learning via the experience of participating in CSR programs should give those companies a head start when it comes to surveying their suppliers.

Voluntary CSR becomes a requirement through laws like Section 1502 of the Dodd–Frank Act. Some companies, most noticeably Intel, actively expanded their preexisting CSR initiatives to incorporate and highlight the conflict minerals issue and produced costly advertisements demonstrating their commitment to conflict-free production (see <http://www.intel.com/content/www/us/en/corporate-responsibility/conflict-free-minerals.html>). Even if a company has only symbolically adopted a CSR program, often there is a lasting effect on the company that transforms how it operates and makes decisions (Kelly & Dobbin, 1998). Additionally, companies that are known for being socially responsible are in fact penalized more harshly if their positive image is tarnished (King & McDonnell, 2015), which should motivate companies that participate in CSR to be more proactive in addressing supply chain sustainability issues. Therefore, we predict the following:

Hypothesis 6. Companies that voluntarily participate in sustainability-related programs are

more effective in determining whether their products are free of conflict minerals.

DATA, MEASUREMENT, AND METHODS

Data

To test our hypotheses, we started by collecting all conflict minerals reports submitted to the SEC. The Dodd–Frank Act created a new form type named “Specialized Disclosure (SD)” for conflict mineral reports, which can be accessed and downloaded from the SEC’s EDGAR database. In addition to the SD report, most companies (78%) submitted one or two supplementary “Exhibit” documents that described what due diligence and RCOI they performed. As of June 21, 2015, there were 4,611 documents submitted by 1,382 unique companies (1,318 in 2014; 1,262 in 2015), identified by Central Index Key codes. Although 1,199 companies (87%) submitted a report in both rounds, a two-period sample does not lend itself to a strong panel design. Therefore, we employed cross-sectional analyses, using a one-year panel of data for each regression. In this study, we used the reports submitted in 2015 for the analysis.

Among 1,262 companies that submitted the SD report in 2015, we were able to find valid company-level information for 1,179 (93.4%) companies, which constituted our final sample. The 83 omitted companies either did not appear in the Compustat universe ($n = 29$) or lacked information to construct company-level independent and control variables ($n = 54$). Companies were missing for several reasons: some were wholly owned subsidiaries or foreign private issuers that did not issue annual financial statements to the SEC. Some had only issued over-the-counter securities or consummated the initial public offering (IPO) within the past 12 months. Others had gone private or had been taken over, ceasing to file financial reports. Missing data on these firms does not pose a hazard for our inferences.

Dependent Variable

The dependent variable of our study is the outcome of the conflict minerals report submitted to the SEC. In principle, the documents can have one of four outcomes. First, a company may claim its products have “not been found to be DRC conflict-free” (that is, the company can admit that its products contain conflict minerals from the DRC), but at the time of this study no company had made this

claim. Second, a company can declare its products to be “DRC conflict undeterminable” when it was unable to determine whether its products contain conflict minerals. About eight out of 10 companies fall under this category. Third, a company is eligible to forgo submitting an exhibit if after a “reasonable country of origin” inquiry, it has “no reason to believe” that the minerals may have originated from the Congo area. Finally, a company can declare itself to be “DRC conflict-free” if it is certain that the minerals originating from the Congo area did not finance or benefit armed groups.²

The latter two outcomes are similar in that the company has some knowledge of where the raw minerals in its products are coming from. However, the level of certainty associated with that knowledge differs substantially. Companies declaring themselves to be “DRC conflict-free” have to “go the extra mile:” they need hard proof beyond reasonable doubt that their products are not aiding armed groups in the Congo area. These companies have to be certain that each and every supplier is free of conflict minerals, and they have to obtain an independent private-sector audit as well. Ultimately, they must know the exact smelter from which the raw minerals contained in their products were extracted, no matter how many steps they are removed from the mining sites. On the other hand, companies that have “no reason to believe” their products contain conflict minerals only need to know whether their products contain any tantalum, tin, tungsten, or gold, and whether those minerals originated from the Congo area. In addition, the legal expression “no reason to believe” leaves companies with some margin of error. Companies’ judgments must be “more likely than not,” but not having to submit exhibits represents a low standard of evidence. Additionally, companies in this category are not subject to an independent private-sector audit.

² As a result of the decision made by the United States Court of Appeals for the District of Columbia Circuit in *National Association of Manufacturers, et al. v. SEC, et al.*, No. 13-5252 (made on April 14, 2014), as of September 11, 2016, companies must disclose information about their due diligence processes and procedures in their conflict minerals reports; however, they are not required to describe their products as “DRC conflict-free,” “having not been found to be ‘DRC conflict-free,’” or “DRC conflict undeterminable.” This specific rule is subject to change by either an introduction of new guidance by the SEC or the pending court decision from the United States District Court for the District of Columbia.

The ordered nature between these two outcomes also emerged as a theme in our discussions with informants. One informant said that he or she would only be willing to certify as conflict-free if the firm achieved a 100% response rate from suppliers, all the way back to the smelters. Another stated that a “reasonable effort” would be sufficient; that is, initial contact for the survey and two follow-ups, and a judgment call where necessary. Not surprisingly, companies in pursuit of proof beyond reasonable doubt, as well as most NGOs and activists, criticize the “reasonable effort” approach for exploiting the legal loophole. On the other hand, companies that take the “reasonable effort” approach consider the Section 1502 of the Dodd–Frank Act to be too costly and unrealistic.

Reflecting these differences among report outcomes, we created our dependent variable, *conflict-free*, as an ordinal measure.³ This variable had the value of 0 when a company was unable to determine whether its products contain conflict minerals, 1 when a company stated it had no reason to believe its products contain minerals originating from the Congo area, and 2 when a company declared its products to be free from conflict minerals originating from the Congo area with a great level certainty and evidence beyond reasonable doubt. Essentially, our analysis compares the companies that were able to visualize and clear their supply chains with different levels of certainty with those that were not able to do so.

To determine the outcome of individual reports, we first conducted semi-automated coding of SEC filings using regular expressions. At this stage, the computer program detected any instance of outcome-related keywords or phrases such as “unable to determine,” “conflict-free,” or “undeterminable,” as well as the occurrence of numbers, tables, and figures. Then, three research assistants who were blind to the hypotheses independently read each document. They were asked to evaluate the report’s outcome and also manually grab details of

³ Ideally, we would use a sliding scale of varying levels of determinability to capture whether companies are intentionally disclosing as little as possible driven by a lawyerly risk aversion in an uncertain regulatory environment. However, the majority of the reports did not contain any fine-grained information about the level of determinability (e.g., number of smelters audited; number of unverifiable suppliers). 40% of the companies provided either direct or indirect information about their supplier survey response rate.

the report, such as the supplier survey response rate and the time when a company began to investigate its suppliers. Based on a random sample of 50 documents, three research assistants showed a high level of intercoder reliability (> 0.90). The semi-automated coding results differed from the manual coding results in less than 5% of all reports. When this happened, we consulted with Responsible Sourcing Network, a nonprofit organization that specializes in human rights issues associated with raw materials in global supply chains, to discuss the proper outcome.

Independent Variables

Organizational complexity (diversification). To measure product diversification, we first calculated the entropy measure of total diversification. This variable measures the extent to which a firm operates in a number of industries using a weighted average of the proportion of a firm's sales made in each of the industry segments (Jacquemin & Berry, 1979). Firms are required to report accounting data at the level of business segments, and each segment can have up to two four-digit standard industry classification (SIC) codes. Using these data, we calculated the entropy measure of diversification as follows:

$$\text{Total diversification} = \sum P_i \ln(1/p_i) \quad (1)$$

Where π is the proportion of the firm's sales in segment i . Previous research has suggested that this approach has some methodological advantages as well as high construct validity (Hoskisson, Hitt, Johnson, & Moesel, 1993; Palepu, 1985). For companies that operate in only a single industry segment, this measure has the value of 0. *Unrelated diversification* was calculated in the same manner, except that segments are defined at the two-digit SIC level; that is, the measure is calculated after first summing sales across two-digit SIC categories. We calculated *related diversification* by subtracting unrelated diversification from total diversification (Palepu, 1985).

Recognizing that the breadth and depth of international diversification may have a separate influence on firm behavior (Allen & Pantzalis, 1996; Hitt, Hoskisson, & Kim, 1997; Strike, Gao, & Bansal, 2006), we employed separate measures for the two dimensions. To measure the depth of international diversification, we calculated *% of foreign sales* as a company's foreign sales divided by its total sales. This variable is commonly used in the diversification

literature to measure a company's multinationality (e.g., Collins, 1990; Geringer, Beamish, & daCosta, 1989). Following Tallman and Li (1996), we calculated *country scope* to measure the breadth of international diversification. This variable counts the number of countries in which a company had at least one subsidiary, and then takes the natural log of the total count to correct for its positively skewed distribution. We used Compustat segment files and LexisNexis Directory of Corporate Affiliations to calculate these diversification measures. The Directory of Corporate Affiliations lists all current corporate affiliations (e.g., subsidiary, branch, nonoperating entity) of nearly 2 million companies. Assuming the number of foreign countries in which a company has a subsidiary remains stable within the past 12-month window, we used the corporate affiliations data as of June 30, 2016 to calculate *country scope* (see Delios & Beamish, 1999 for a similar approach).

Supply chain complexity. Since companies consider the identity of their suppliers to be proprietary information, collecting supply chain information across multiple companies introduces a significant barrier for researchers. For example, the High Performance Manufacturing project is an ongoing global research network to collect detailed plant-level information in the automobile, machinery, and electronic industries (Schroeder & Flynn, 2001). However, linking individual participants' survey responses with other databases is effectively impossible. Another commonly used source of buyer-supplier relationship data is the Compustat Segment file (e.g., Cohen & Frazzini, 2008). Regulation SFAS No. 131 requires suppliers to disclose any major customer that represents more than 10% of its total reported sales. The Compustat segment data capture this information, but entail two noticeable limitations. The first is sampling bias; since only major customers contributing more than 10% of sales are reported, data are missing for small customers, thus making it difficult to comprehensively capture buyer-supplier relationships. The second limitation is the omission of major international (non-U.S.-based) suppliers.

Therefore, in this study, we used a newly available data source, the Bloomberg Supply Chain Function. Bloomberg now maps about 35,000 companies with their suppliers and buyers by showing the most recent snapshot of money flows between companies on both a buyer (revenue) and supplier (cost) basis. Bloomberg collects supply chain information from various sources, including public filings (which makes Compustat segment data a subset of

Bloomberg data), announcements from manufacturers and their suppliers, and other proprietary data Bloomberg purchases. Deriving information from a variety of data sources allows Bloomberg to capture more comprehensive supply chain data. For S&P 500 high-tech firms, for example, the total number of suppliers identified by Bloomberg was on average seven times larger than that identified by Compustat (Wang, Li, & Anupindi, 2015). Not surprisingly, Bloomberg's supply chain data are starting to get some attention in operations research (e.g., Steven et al., 2014; Wang et al., 2015; Wu & Birge, 2014), but remain a relatively untapped data source in management research.⁴

"Supply chain complexity" is a new construct in management research, and we therefore created two measures to get at this construct. First, we measured *number of suppliers* by counting the total number of current suppliers with which a focal company has enduring business relations, and taking the natural log of the total count to adjust for its positively skewed distribution. Second, we measured *supplier concentration* by calculating the percentage of a focal company's cost of goods sold that is spent on its five main suppliers. Currently, Bloomberg only provides a cross-sectional dataset with the latest annual relationships. Our measures of supply chain complexity used the data as of December 31, 2015. We assume that broad features of the supply chain network that we measure (the number and concentration of suppliers) remain stable within the past 12-month window (see Wu & Birge, 2014 for a similar approach).

Power over suppliers. We used *inventory turnover* (cost of goods sold divided by the average inventory) as a proxy of a firm's power over its direct suppliers. Previous research has suggested that firms that have power over their suppliers will be able to demand favorable credit terms and delivery arrangements, and hence improve their operational efficiency (McHugh, Humphreys, & McIvor, 2003; Summers & Wilson, 2003; Wilson & Summers, 2002). For example, if the buyer can shift some of its inventory task to the supplier since it is more powerful

than the supplier, higher inventory turnover will be observed within the buying firm. In short, a company's power over its suppliers is expected to be captured, at least partially, in its inventory turnover (Dickinson & Sommers, 2012). We used Compustat data to calculate inventory turnover.

Visibility. We measured a company's visibility by capturing the level of media attention granted to a company (see Bushee & Miller, 2012; King, 2008 for a similar approach). We first gathered news articles mentioning a given company for a 12-month period leading up to the SEC filing due date. In line with prior research (e.g., Fang & Peress, 2009), articles were collected from four influential daily newspapers with nationwide circulation: *New York Times*, *USA Today*, *Wall Street Journal*, and *Washington Post*. Media volume tends to be skewed toward high-reputation actors (Graffin, Bundy, Porac, Wade, & Quinn, 2013). Therefore, we measured *media attention* by calculating the natural log of the number of articles mentioning each company during the past 12 months.

Reputation. We used the company's presence on Fortune's Most Admired Companies list as an indication of reputation. This annual list is based on a large-scale survey sent out to executives, outside directors, and securities analysts to identify and rate the 10 largest companies in their operating (or covering, for analysts) industry based on eight criteria. While this list is known to be significantly correlated with a firm's financial performance in the previous year (Brown & Perry, 1994), Fortune's Most Admired Companies list has been widely used to measure firm reputation (e.g., Fombrun, 2007; Love & Kraatz, 2009; Pfarrer et al., 2010; Roberts & Dowling, 2002). Since not all of the firms in our sample appeared on Fortune's Most Admired Companies, we created a binary variable, *most admired companies*, that took the value 1 if a firm appeared on the top 50 list in 2014 and 0 otherwise.

Voluntary CSR participation. We measured a company's previous CSR participation by looking at their involvement in Carbon Disclosure Project (CDP). CDP is a United Kingdom-based nonprofit organization that collects firm-level data on greenhouse gas emissions and climate change strategies. In particular, CDP asks reporting companies to disclose their Scope 3 emissions, which encompass all indirect emissions occurring along their supply chain, both upstream and downstream. On behalf of 767 institutional investors, CDP sends out a detailed survey to companies that can either elect to disclose their environmental information or decline to

⁴ Given the comprehensive coverage of Bloomberg's supply chain data, it might be useful to calculate international diversification measures using this database. However, in addition to the absence of past sales figures from Bloomberg, we chose to use the established criteria to measure those variables to facilitate comparison between our results and those in the literature, as well as those in future research.

participate in the survey. Using this information, we created a binary variable, *participated in CDP*, that had the value of 1 if a company participated in CDP's survey in 2014 and 0 otherwise. We also tried to capture the degree to which companies followed the guidelines, using CDP's disclosure evaluation score (ranges from 0 to 100).⁵ This version of the measurement did not affect the overall regression results.

Control Variables

Since large, old, and profitable companies may have greater visibility, power over suppliers, and prior CSR participation, we controlled for company size, age, and performance. We used *total revenue* (logged due to its positively skewed distribution) as a proxy for size. *Age* was calculated as the difference between 2015 and a company's founding year. We treated the earlier year that contains the IPO date or the date the company first appeared on Compustat as a company's founding year. Compustat annual data go back to 1950. For the companies that already existed in that year, we searched their company website to find the accurate founding year. We logged this variable to adjust for its skewed distribution. We added *return on assets* as an accounting measure of profitability and *total shareholder return* as a market measure of firm performance.

Nationality of a company is determined based on the location of its headquarters. About 15% of the companies in our sample were headquartered outside of the United States. These companies have to abide by a different set of regulations compared to U.S.-headquartered companies. The EU's environmental and product safety standards tend to be the strictest, and the EU's regulations have been developed to encompass not only the goods and services that are produced and traded, but also the process by which they are produced and sold (Davis et al., 2013). For example, in 2006 the EU managed to ban toxic materials such as lead, cadmium, and mercury from all electronics products. European companies that already had to eradicate those heavy metals from their supply chains may thus be better at eradicating conflict minerals from their products. Therefore, two binary variables were added, one for companies located in the EU member country (*HQ: EU member*), and another for

companies located outside of the United States and the EU (*HQ: non-U.S. & non-EU*). We used U.S.-headquartered companies as the reference category.

Finally, we controlled for three industry-level variables to capture the distribution of conflict-free status of the focal company's industry peers. Specifically, we calculated the percentage of industry peers, defined by four-digit SIC codes, by each possible outcome. To avoid endogenous calibration of these three variables (*% peers: undeterminable*, *% peers: reasonable to believe*, and *% peers: beyond reasonable doubt*), we removed the focal company's information when calculating the industry average. We counted the number of listed companies in each industry using data obtained from Orbis, and used the percentage of industry peers that did not submit a Form SD in 2015 as the reference category.

Estimation

We used an ordered logit model to estimate the probability of a company declaring itself conflict-free. An ordered logit model is a qualitative choice model that is appropriate when the dependent variable has ordinal properties but is not ratio-scaled (Amemiya, 1981). The dependent variable of this study has three response levels (i.e., unable to determine; clean, reasonable to believe; clean, beyond reasonable doubt). A multinomial logit model does not capture the information inherent in the ordering of the dependent variable, while an ordered logit model makes use of the ordered nature of the response levels without being influenced by the numerical values used for the dependent variable (see Obstfeld, 2005 for a similar approach). Since industries vary significantly in their use of 3TG in their products, we computed robust standard errors adjusted for clustering at the four-digit SIC codes. All independent and control variables were lagged by one year unless explicitly noted.

RESULTS

Among 1,262 companies that submitted a conflict minerals report in 2015, eight out of 10 (79% in 2015; 77% in 2014) admitted they were unable to determine where the raw minerals contained in their products originated. In their reports, most companies cited "the complexity and size of our supply chain" as the primary reason why they were unable to identify where their products originated from. Numerous companies argued that they were "multiple tiers removed from the origin of materials in the products supplied to us" and many of their vendors were often "not required to

⁵ These scores do not mean performance, as they simply indicate the extent to which the guidelines have been applied. For example, a company that emits tons of greenhouse gas can still score a "100" from CDP as long as it fully discloses its emission data and environmental strategy.

comply with the Conflict Minerals Rule.” The majority of the remaining companies reported that they reasonably believed that the raw minerals contained in their products did not come from the Congo area. Only 1% of companies declared their products to be free of any conflict minerals with great certainty.

In Figure 1, we show the composition of conflict-free status and the proportion of Form SD filers of the 10 major industry groups (defined as the two-digit SIC codes) in terms of the number of Form SD filers. Altogether, companies in these 10 industries account for 77% of the entire filers. Only one industry group—“primary metal industries”—had fewer than half of the companies as unable to determine whether their products contained conflict minerals. Arguably, this is the very industry where a company usually has direct access and complete control over its smelters and refineries, owning them overseas.

Table 1 provides descriptive statistics and zero-order correlations for all variables. Most correlations shown in Table 1 are low in magnitude, but there is a high level of correlation among total revenue, country scope, number of suppliers, and media coverage. Although these levels of correlation do not necessarily bias our results, we checked for multicollinearity by computing the variance inflation factors (VIFs) and condition numbers for each model. VIFs in all models were below the threshold of 5, and the largest condition number computed from the correlation matrix without a constant was 5.04. These results suggest that multicollinearity was not likely to be a significant issue in our models.

Table 2 shows the results of the ordered logit regression on the company’s conflict-free status. For each model, we report unstandardized coefficients and standard errors. Throughout all models, the difference between the two cut-points is statistically significant ($p < 0.01$). Model 1 presents the results of our baseline model. Larger and older companies tend to find investigating their entire supplier bases more challenging, although these variables are not statistically significant in the fully specified model (Model 12). We consistently found significant differences between U.S.-based companies and non-U.S. based companies. For example, compared to U.S.-based companies, EU-based companies, as well as those based outside of Europe and the United States, were about 22% less likely to admit they were unable to verify the origins of their products.⁶ The stark

difference stemming from a company’s regulatory environment is consistent with the prediction by Davis et al. (2013) that European companies that already had to remove toxic minerals (lead, cadmium, and mercury) from their electronics products would be better at eradicating conflict minerals (3TG) from their products.

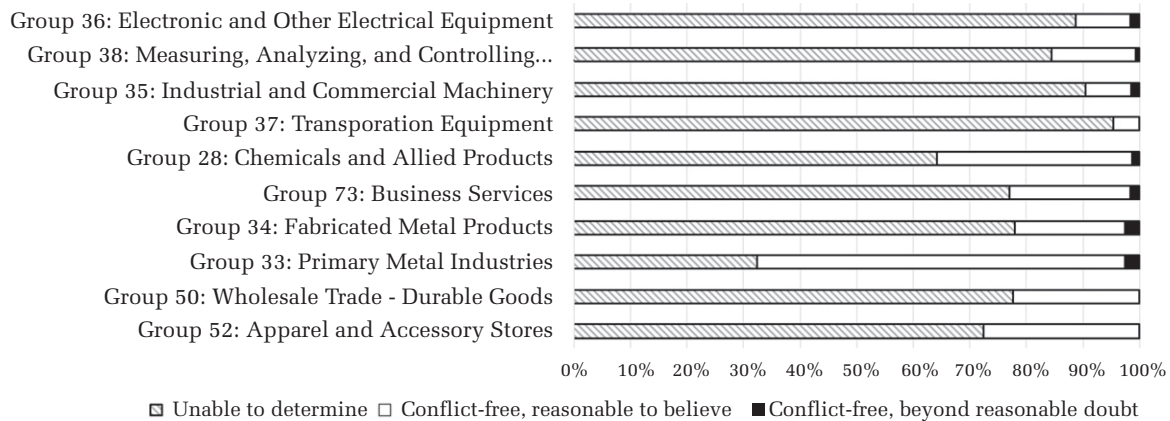
In Models 2–5, we added diversification measures as proxies for organizational complexity. We did not find any significant impact of related and unrelated diversification. We checked whether the effect of unrelated diversification follows a curvilinear pattern (Zahavi & Lavie, 2013), but its second-order term was not statistically significant. On the other hand, international diversification exacerbated a company’s inability to verify the origin of its products, providing support for Hypothesis 1b. Companies that had foreign subsidiaries across many countries (+1 *SD*; about 18 countries) were 29% less likely to have reason to believe their products were conflict-free, compared to companies with average country scope (about five countries). We found a similar pattern for the percentage of foreign sales, although the variable was not statistically significant in the fully specified model. International diversification is often seen as a strategy to spread the risk across multiple markets (Heston & Rouwenhorst, 1994). Our results suggest that doing so inevitably exposes a company to more markets, making it more difficult to monitor its entire production process.

In Models 6–7, we added the two measures of supply chain complexity. We found strong empirical support for the influence of number of suppliers, providing partial support for Hypothesis 2. Compared to companies with an average number of suppliers (about 10 suppliers), companies with a high (+1 *SD*; about 49 suppliers) number of suppliers were about 19% less likely to declare that they had reason to believe their products to be conflict-free. The effect of supplier concentration was marginally significant in Model 7, but not in our fully specified model. Our results indicate that investigating complete supply chains was particularly challenging for companies with larger supply chains. One of our informants likened gaining full knowledge on his company’s supply chain to the Holy Grail, voicing the difficulty of simply trying to contact hundreds of suppliers that they had never heard of. In most cases, those suppliers have no obligation to conform to the SEC’s rules. Supply chain complexity renders a company’s production process less visible.

We did not find support for Hypothesis 3, where we predicted that power over suppliers helps

⁶ Among the 118 companies that had headquarters located outside of Europe and the United States, 28 (24%) were based in Israel and 24 (21%) in Canada.

FIGURE 1
Composition of Conflict-Free Status by Major Industry Group



Notes: Sorted (from top to bottom) by the number of Form SD filers within the major industry group. Major industry group is defined by two-digit SIC codes. The 10 industries shown above account for 77% (971 out of 1,262) of all companies that submitted Form SD in 2015. The names of four industries have been shortened in the figure above. The actual names of the four industries are: (1) electronic and other electrical equipment and components, except computer equipment (group 36); (2) measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks (group 38); (3) industrial and commercial machinery and computer equipment (group 35); and (4) fabricated metal products, except machinery and transportation equipment (group 34).

companies investigate their entire supply chain (Model 8). One possible explanation for the lack of support for this hypothesis pertains to where the biggest challenge of visualizing the entire supply chain lies: not with first-tier suppliers, but with indirect suppliers. In a supplemental brief for a recent lawsuit against the SEC, the National Association of Manufacturers underlined that there are often “ten, twelve, or even more layers of intermediaries between the mines and the final manufacturer who must make the statement” (National Association of Manufacturers et al. v. Securities and Exchange Commission, 2014: 14). When most companies are multiple tiers removed from the origin of materials in the products supplied to them, having more power over their direct suppliers may have little to do with the ability to figure out what is happening to small, foreign suppliers that are multiple tiers away.

Neither visibility (Model 9) nor reputation (Model 10) had a statistically significant impact on a company’s conflict-free status. However, the effect of reputation became positive and significant in the fully specified model. Through additional analyses, we found that reputation became a statistically significant predictor once the main effect of supply chain complexity (especially the number of suppliers) was accounted for. Previous research has suggested that high visibility and reputation would influence a company’s motivation, either positively or negatively, to react to social and political

stakeholders. Our results suggest that reputation is more likely to function as a burden rather than a buffer in that it forces highly reputed companies to actively look into their supply chains. However, the effectiveness of reputation is perhaps contingent on whether a highly reputed company has the ability to solve the challenges along its supply chain.

The results in Model 11 indicate no significant difference between the companies that voluntarily participated in CDP and those that did not. By design, CDP is rather technical and focused on environmental issues, which should give its participants a head start in terms of understanding their supply chains (Bansal, Gao, & Qureshi, 2014). However, some of our informants, including sustainability managers, cautioned that a firm’s commitment to environmental issues does not necessarily lead to greater certainty in the knowledge about its supply chain. As committed companies dig deeper into their supply chains, they may realize just how little they know about where and how their products are being made. Indeed, in 2015, the Responsible Sourcing Network, a project of the nonprofit organization As You Sow, ranked a sample of 51 companies’ first-round reports and announced that three companies—Intel, Qualcomm, and Apple—had the best practices in terms of engaging with the conflict minerals issue. All three of them participated in CDP for many years, yet all declared their products as “DRC conflict undeterminable.”

TABLE 1
Descriptive Statistics and Correlations

| | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|------|------|------|
| 1. Conflict-free ^a | 0.21 | 0.44 | | | | | | | | | | | | | | | | | | | |
| 2. Total revenue | 7.00 | 2.20 | -0.04 | | | | | | | | | | | | | | | | | | |
| 3. Age | 3.28 | 0.70 | -0.08 | 0.34 | | | | | | | | | | | | | | | | | |
| 4. Return on assets | -0.01 | 0.34 | 0.00 | 0.35 | 0.17 | | | | | | | | | | | | | | | | |
| 5. Total shareholder return | 2.85 | 36.00 | -0.03 | 0.13 | 0.08 | 0.21 | | | | | | | | | | | | | | | |
| 6. HQ: EU member | 0.05 | 0.22 | 0.08 | 0.22 | -0.05 | 0.03 | -0.04 | | | | | | | | | | | | | | |
| 7. HQ: non-U.S. & non-EU | 0.10 | 0.30 | 0.10 | 0.02 | -0.16 | -0.02 | -0.02 | -0.08 | | | | | | | | | | | | | |
| 8. % peers: undeterminable | 47.71 | 27.09 | -0.24 | -0.17 | -0.04 | -0.01 | 0.06 | -0.12 | 0.05 | | | | | | | | | | | | |
| 9. % peers: reasonable to believe | 9.66 | 13.53 | 0.21 | 0.08 | 0.09 | 0.02 | -0.04 | 0.02 | -0.03 | -0.29 | | | | | | | | | | | |
| 10. % peers: beyond reasonable doubt | 0.60 | 2.59 | 0.02 | -0.02 | -0.02 | 0.01 | -0.02 | -0.04 | 0.04 | -0.04 | 0.04 | | | | | | | | | | |
| 11. Related diversification | 0.08 | 0.21 | -0.02 | 0.22 | 0.19 | 0.06 | 0.02 | 0.03 | -0.02 | -0.08 | 0.05 | 0.06 | | | | | | | | | |
| 12. Unrelated diversification | 0.21 | 0.34 | -0.03 | 0.26 | 0.25 | 0.07 | -0.02 | 0.00 | -0.04 | -0.07 | 0.03 | -0.04 | 0.06 | | | | | | | | |
| 13. % foreign sales | 0.41 | 0.32 | -0.06 | 0.13 | -0.02 | 0.06 | 0.03 | 0.23 | 0.34 | 0.15 | -0.04 | 0.04 | 0.02 | -0.06 | | | | | | | |
| 14. Country scope | 1.70 | 1.21 | -0.15 | 0.61 | 0.33 | 0.19 | 0.10 | 0.23 | -0.01 | 0.01 | 0.00 | 0.01 | 0.22 | 0.20 | 0.45 | | | | | | |
| 15. Number of suppliers | 2.35 | 1.54 | -0.07 | 0.76 | 0.25 | 0.15 | 0.12 | 0.20 | 0.12 | -0.08 | 0.01 | 0.01 | 0.17 | 0.12 | 0.18 | 0.48 | | | | | |
| 16. Supplier concentration | 7.35 | 13.04 | -0.05 | 0.31 | -0.01 | 0.06 | 0.11 | 0.07 | 0.14 | 0.04 | 0.00 | -0.01 | -0.01 | -0.07 | 0.23 | 0.15 | 0.52 | | | | |
| 17. Inventory turnover | 7.58 | 15.27 | 0.05 | 0.14 | -0.03 | 0.03 | 0.00 | 0.08 | 0.02 | -0.20 | -0.06 | -0.05 | 0.00 | 0.06 | -0.08 | 0.00 | 0.11 | 0.06 | | | |
| 18. Media attention | 2.08 | 2.04 | -0.05 | 0.63 | 0.21 | 0.15 | 0.09 | 0.14 | 0.00 | -0.15 | 0.01 | 0.02 | 0.12 | 0.14 | 0.08 | 0.38 | 0.60 | 0.28 | 0.11 | | |
| 19. Most admired companies | 0.02 | 0.15 | 0.03 | 0.30 | 0.18 | 0.04 | 0.04 | -0.01 | -0.03 | -0.07 | 0.01 | 0.01 | 0.06 | 0.09 | 0.01 | 0.16 | 0.34 | 0.12 | 0.09 | 0.31 | |
| 20. Participated in CDP | 0.19 | 0.40 | -0.04 | 0.49 | 0.26 | 0.10 | 0.10 | 0.07 | 0.09 | -0.04 | -0.02 | 0.00 | 0.10 | 0.10 | 0.16 | 0.39 | 0.53 | 0.31 | 0.07 | 0.44 | 0.22 |

Notes: $n = 1,179$. Correlations above $|.06|$ are significant at the .05 level (two-tailed).

^a Conflict-free is an ordinal measure. The mean represents an average response across three categories. A value of 0 marked “unable to determine” (80%), 1 was used for “conflict-free, reasonable to believe” (19%), and 2 for “conflict-free, beyond reasonable doubt” (1%).

TABLE 2
Ordered Logit Regression on Declaring Conflict-free

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 | Model 10 | Model 11 | Model 12 |
|----------------------------------|-------------------|------------------------------|------------------------------|------------------------------|-------------------|------------------------------|-------------------|-------------------|-------------------|------------------------------|-------------------|-------------------|
| Related diversification | -0.36 (0.33) | | | | | | | | | | | -0.22 (0.33) |
| Unrelated diversification | | | -0.16 (0.24) | | | | | | | | | -0.20 (0.25) |
| % foreign sales | | | | -0.78** (0.24) | | | | | | | | -0.30 (0.29) |
| Country scope | | | | | -0.34** (0.07) | | | | | | | -0.29** (0.09) |
| Number of suppliers | | | | | | -0.16* (0.07) | | | | | | -0.16* (0.08) |
| Supplier concentration | | | | | | | -0.01* (0.00) | | | | | -0.01 (0.01) |
| Inventory turnover | | | | | | | | 0.00 (0.00) | | | | 0.00 (0.00) |
| Media attention | | | | | | | | | -0.05 (0.05) | | | -0.05 (0.06) |
| Most admired companies | | | | | | | | | | 0.88 ⁺ (0.49) | | 1.13* (0.53) |
| Participated in CDP | | | | | | | | | | | 0.05 (0.21) | 0.27 (0.24) |
| Total revenue | -0.14** (0.05) | -0.13** (0.05) | -0.13* (0.05) | -0.13** (0.05) | -0.04 (0.05) | -0.05 (0.06) | -0.12* (0.05) | -0.14** (0.05) | -0.11* (0.06) | -0.15** (0.05) | -0.14** (0.05) | 0.04 (0.07) |
| Age | -0.22* (0.11) | -0.21 ⁺ (0.11) | -0.21 ⁺ (0.11) | -0.22 ⁺ (0.11) | -0.12 (0.12) | -0.21 ⁺ (0.11) | -0.24* (0.11) | -0.22* (0.11) | -0.22* (0.11) | -0.24* (0.11) | -0.23* (0.11) | -0.16 (0.12) |
| Return on assets | 0.29 (0.31) | 0.29 (0.31) | 0.29 (0.31) | 0.35 (0.31) | 0.23 (0.29) | 0.18 (0.27) | 0.27 (0.30) | 0.29 (0.31) | 0.27 (0.31) | 0.33 (0.32) | 0.30 (0.31) | 0.17 (0.25) |
| Total shareholder return | 0.00 (0.00) | 0.00 (0.00) | -0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | -0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) |
| HQ: EU member | 0.90** (0.31) | 0.90** (0.32) | 0.88** (0.32) | 1.23** (0.33) | 1.20** (0.33) | 0.97** (0.32) | 0.91** (0.31) | 0.89** (0.32) | 0.91** (0.32) | 0.94** (0.30) | 0.90** (0.31) | 1.40** (0.34) |
| HQ: non-U.S. & non-EU | 0.88** (0.22) | 0.88** (0.22) | 0.88** (0.22) | 1.18** (0.25) | 0.89** (0.22) | 0.96** (0.24) | 0.93** (0.23) | 0.87** (0.22) | 0.87** (0.22) | 0.90** (0.23) | 0.87** (0.23) | 1.13** (0.25) |
| % peers: undeterminable | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) | -0.02** (0.00) |
| % peers: reasonable to believe | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) | 0.03** (0.01) |
| % peers: beyond reasonable doubt | 0.01 (0.03) | 0.01 (0.03) | 0.00 (0.03) | 0.01 (0.03) | 0.01 (0.03) | 0.01 (0.03) | 0.00 (0.03) | 0.01 (0.03) | 0.01 (0.03) | 0.00 (0.03) | 0.01 (0.03) | 0.01 (0.03) |
| Cut-point 1 | -0.77 (0.48) | -0.73 (0.49) | -0.73 (0.50) | -0.89 ⁺ (0.49) | -0.22 (0.52) | -0.50 (0.51) | -0.73 (0.48) | -0.72 (0.49) | -0.69 (0.49) | -0.91 ⁺ (0.48) | -0.80 (0.49) | -0.24 (0.58) |
| Cut-point 2 | 2.50** (0.57) | 2.54** (0.58) | 2.53** (0.59) | 2.39** (0.58) | 3.08** (0.62) | 2.77** (0.59) | 2.53** (0.57) | 2.54** (0.58) | 2.58** (0.58) | 2.35** (0.58) | 2.47** (0.57) | 3.08** (0.66) |
| Log-likelihood | -578.70 | -578.30 | -578.50 | -574.60 | -570.30 | -576.80 | -577.80 | -578.50 | -578.20 | -577.40 | -578.70 | -564.60 |
| Model χ^2 | 96.27 | 97.78 | 105.90 | 115.60 | 113.20 | 106.50 | 117.60 | 99.13 | 96.41 | 99.91 | 96.38 | 160.50 |
| Mean VIF | 1.14 | 1.15 | 1.15 | 1.18 | 1.26 | 1.45 | 1.56 | 1.14 | 1.27 | 1.15 | 1.20 | 1.63 |
| Max VIF | 1.39 | 1.43 | 1.46 | 1.40 | 1.93 | 3.02 | 1.56 | 1.41 | 2.10 | 1.50 | 1.71 | 4.15 |
| Condition number | 1.92 | 1.98 | 2.00 | 1.97 | 2.54 | 3.36 | 2.08 | 1.94 | 2.62 | 2.04 | 2.24 | 5.04 |

Notes: $n = 1,179$. Robust standard errors in parentheses, clustered by four-digit SIC codes.

⁺ $p < 0.1$ (two-tailed)

* $p < 0.05$

** $p < 0.01$

We conducted several supplementary analyses to ensure the robustness of our results. First, we repeated the analyses using the reports submitted in 2014. In the fully specified model (akin to Model 12 in Table 2), we found country scope (unstandardized $b = -0.33$; $p < 0.01$) and number of suppliers (unstandardized $b = -0.19$; $p < 0.05$) to be statistically significant predictors of the conflict-free status of reports submitted in 2014, as they were in 2015. Second, we checked whether our findings were sensitive to the inclusion or exclusion of companies with few suppliers and foreign subsidiaries. For both years, the number of suppliers and country scope were statistically significant predictors at the 0.05 level after removing companies with few suppliers and a narrow country scope (e.g., fewer than five) from the analyses. Additionally, some companies did not observe the due date for the conflict minerals report submission, resulting in a “late submission.” We did not find, however, any systematic differences in terms of length, format, and outcome between the reports that were submitted before the deadline and the late submissions. Clustering the standard errors at the two-digit (as opposed to four-digit) SIC codes hardly changed the results.

Second, we ran a series of binary logit models predicting individual levels of the outcome variable. The result of the ordered logit regression was very similar to the result of a binary logit regression that combined “conflict-free, reasonable to believe” and “conflict-free, beyond reasonable doubt” into a single category. For example, the exact seven variables that were significant at the 0.05 level in Model 12 in Table 2 were statistically significant in the expected direction in this binary logit regression model.

Third, we constructed alternative measures for our independent variables. We created an alternative indicator of visibility—the logged number of analysts following a company—using data from the I/B/E/S database. This variable is highly correlated with our measure of visibility that captures the degree of media attention given to a company ($r = 0.52$, $p < 0.01$). When using analyst coverage information to measure visibility, we found that visibility was now statistically significant (unstandardized $b = -0.19$; $p < 0.05$), but the sign and significance level for other variables were not significantly affected. As an alternative measure of previous CSR participation, we used Bloomberg ESG data, which measure whether a company has implemented any initiatives to reduce social risks in its supply chain (e.g., poor working conditions; the use of child or forced labor; lack of a living, fair or minimum wage). However, we

did not find any evidence that participation in these programs made a statistically significant difference compared to nonparticipation ($p > 0.50$). Supplementary analysis results are available upon request.

DISCUSSION: CHALLENGES FOR ACHIEVING GLOBAL SUPPLY CHAIN SUSTAINABILITY

The dis-integration of supply chains over the past generation means that the 21st-century economy is organized very differently compared to the 20th-century corporate economy. Companies are often removed from the assembly and distribution of their products, and even further removed from the materials that go into them. In the apparel industry, Western companies often do not know which contractors are producing the goods bearing their label, much less where the materials that went into them originated. Pet food brands have been surprised to learn that the overseas fishing fleets that supply the materials for their cat chow sometimes rely on slave labor (Urbina, 2015). Corporate social responsibility increasingly extends well beyond the boundaries of the corporation or the nation where it is nominally located.

Section 1502 of the Dodd–Frank Wall Street Reform and Consumer Protection Act gives us an opportunity to answer the question of how well firms know their own supply chains. In some sense, the most important findings of our study are the descriptive statistics. Nearly eight out of 10 companies admitted that they were unable to determine the country of origin of 3TG minerals in both 2014 and 2015, citing that they are several levels removed from the mining and smelting of these essential raw materials. Even if they had reason to believe the minerals may have originated from the Congo area, companies were unable to determine whether the conflict minerals financed or benefited armed groups. The majority of the remaining companies stated that they had no reason to believe their products included non-scrap or non-recycled minerals originating from the Congo area. Only 1% of the total number of submitters declared their products to be conflict-free with certainty beyond reasonable doubt.⁷

⁷ This paper was accepted for publication before the filing deadline for the third round of Form SD. As of September 11, 2016, a total of 1,220 companies had submitted conflict mineral reports for 2016. Our initial screenings of these reports suggest that about 76% of them were unable to determine where the raw minerals contained in their products originated, and about 1% were able to certify themselves conflict-free with certainty beyond reasonable doubt.

The findings presented in this study illuminate the organizational factors that make it difficult to achieve global supply chain sustainability. Companies that have a complex structure, both internally and externally, often do not have the ability to investigate and verify where the raw materials used in their products are coming from. Our paper finds that even large and visible companies, as well as those that voluntarily participate in CSR programs, were no better at figuring out whether their suppliers relied on conflict minerals. Evidently, deep pockets and motivation to be sustainable were not sufficient to achieve accountability.

The hypotheses featured in the present study can be categorized into two groups. The first set of predictions relate to a company's *ability* to verify its products' conflict-free status. International diversification may be useful in spreading a firm's risk across multiple markets, but it also decreases the ability of a firm to monitor its supply chain. Number of suppliers functions as the most immediate basis of supply chain complexity (Choi & Krause, 2006), impeding the capacity of the corporate sector to account for the practices that yield its products. On the other hand, power over direct suppliers did not have the predicted effect, perhaps because the most questionable practices happen among distant suppliers multiple tiers away. We found little support for the second set of hypotheses, which concern a company's *motivation* to fully vet its supply chain. In broad strokes, organizational and supply chain complexity are the dominant factors hindering supply chain accountability and sustainability.

One unexpected, interesting finding from our regression result is that it was the breadth aspect of complexity (e.g., country scope and number of suppliers) that was associated with greater challenges in investigating a company's entire supply chain. On the other hand, the depth of complexity or the leverage a company has over its suppliers had limited or insignificant impact compared to the sheer amount of geographies and suppliers with which a company has to deal. Taken together, our results suggest that the most imminent challenges regarding the conflict minerals issue is the lack of ability to gather the information (e.g., track and trace point of origin of the original minerals), even before enforcing or negotiating the necessary changes in their global supply chains.

It is ironic that at a time when one quarter of the world's population holds smartphones with built-in GPS receivers, most companies—including those that make smartphones—are unable to determine the

origins of crucial raw materials that go into their products. Why is it that even giant multinationals with vast budgets and a sector of client-hungry auditors cannot figure out where their tantalum comes from? We conclude from our findings that businesses are not dissembling about their inability to determine the source of their minerals. They simply cannot obtain a reasonable degree of certainty about processes from which they are three or more steps removed.

What would it take for firms to have greater accountability in their supply chains? While we cannot offer a silver bullet for this grand challenge, we offer three suggestions that may help solve this problem moving forward. First and foremost is enforcement of regulations. For environmental violations, deterrence tends to occur through regulatory and legal penalties rather than reputational concerns (Karpoff, Lott, & Wehrly, 2005). Voluntary social reporting without regulatory oversight and enforcement often becomes a ritualistic practice that fails to meaningfully change firm behavior (Park, 2014). The Dodd-Frank Act does not mandate companies to stop purchasing products that directly or indirectly support conflict in the DRC. In the absence of legal sanctions for failing to make supply chains free of conflict minerals, let alone the sanctions for using them, firms may be unwilling to invest heavily in compliance.

Second, more collective efforts to reduce the cost of investigating supply chains are needed. Complete supply chain visibility requires an enormous amount of resources and commitment to verify each and every direct and indirect supplier. Companies collectively spent a total of \$709 million (an average of half a million dollars per company) and six million staff hours to prepare their conflict minerals reports (Bayer, 2014). This can be prohibitively costly for smaller firms. Indeed, the SEC initially predicted that 6,000 issuers would file a Form SD, but only a quarter actually did. In supplementary analyses, we found that the filers were significantly larger (in terms of total revenue, employee count, total assets, market capitalization, and sales) and more diversified than their industry peers that did not submit the report (results available upon request). Fortunately, there are already some initiatives underway that can reduce these costs, such as industry-certified sources. Verifying smelters rather than mines allows firms to guide their suppliers to approved sources. Intel decided to "open source" its methods for verifying whether its products contain minerals from armed groups involved in the DRC

area, which could save other companies significant amounts of money.

Finally, we would like to urge more public interest in the conflict minerals issue. Upon the introduction of Section 1502 of the Dodd–Frank Act, many investors voiced that “conflict minerals disclosures are material to investors and will inform and improve an investor’s ability to assess social (i.e., human rights) and reputational risks in an issuer’s supply chain” (SIF & ICCR, 2011). In unreported event study analyses, we found that in 2014, markets generally responded negatively upon the date of filing for all categories of filers. In 2015, in contrast, markets responded positively to filings (results available upon request). We interpret this first finding to indicate that the 2014 filings conveyed negative information; that is, that the company was subject to conflict minerals disclosure and its attendant costs. In contrast, the 2015 filings conveyed positive information—reporting that companies were not reporting any evidence that their products were not “conflict free.” As more companies move away from the “unable to determine” category, we expect more material benefits of achieving conflict-free status.

Relatedly, one peculiar finding of this paper is that reputation itself did not have a significant main effect, but became a strong, positive predictor after a company’s supply chain complexity was accounted for. For companies with the same level of supply chain complexity, highly reputed companies are more likely to be able to verify the origins of their products. We are tentative about making this statement because the result is sensitive to the inclusion of two of the most admired companies that declared their products to be free of any conflict minerals with great certainty: DuPont and Costco. DuPont is a chemical company; Costco does not manufacture any nonfood products. Although our study cannot conclusively identify whether reputation leads to a higher level of supply chain sustainability, it raises the possibility that recognition and concomitant pressure from stakeholders are more likely to be a burden rather than a buffer for companies.

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Yong H. Kim (yonghyun@umich.edu) is a doctoral candidate in the management and organizations area at the Ross School of Business, University of Michigan. His research interests include social networks, sustainability, social movements, and “big data” applications to organizational research.

Gerald F. Davis (gfdavis@umich.edu) is the Wilbur K. Pierpont Collegiate Professor of Management at the University of Michigan's Ross School of Business and a professor of sociology. His research examines the changing organization of the economy and alternatives to the public corporation.



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