# Influence of the OECD Due Diligence Guidance in the Minerals Supply Chains

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## Disclaimer

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# Table of Contents

# Acronyms

| | |
|---|---|
| 3TG | Tin, tungsten, tantalum and gold |
| ASM | Artisanal and Small-Scale Mining |
| CAHRAs | Conflict-Affected and High-Risk Areas |
| CCCMC | China Chamber of Commerce of Metals Minerals & Chemicals Importers & Exporters |
| CMD | Conflict Mineral Disclosure |
| CTSCA | California Transparency in Supply Chains Act of 2010 |
| DF Section 1502 | Dodd-Frank Wall Street Reform and Customer Protection Act, Section 1502 |
| DRC | Democratic Republic of the Congo |
| EU | European Union |
| EO 13126 | Executive Order 13126 |
| FCPA | Foreign Corrupt Practices Act of 1977 |
| NGOs | Nongovernmental Organizations |
| OECD | Organization for Economic Cooperation and Development |
| OECD DDG | OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas |
| RMI | Responsible Minerals Initiative |
| ROE | Return on Equity |
| SIC | Standard Industrial Classification |
| SEC | Securities and Exchange Commission |
| TVPA | Trafficking Victims Protection Act of 2000 |
| TVPRA | Trafficking Victims Protection Reauthorization Act of 2008 |
| UN | United Nations |

## Abstract

This study investigates the awareness and compliance of downstream companies with respect to conflict minerals and the OECD Due Diligence Guidance. Conflict minerals, often associated with human rights abuses and environmental degradation, pose ethical and regulatory challenges to companies operating in mineral supply chains. To assess corporate behavior, I employ a scoring system and regression analysis, drawing data from companies headquartered in the eight representatives of the G20 member countries. The results reveal that a majority of companies exhibit limited awareness of conflict minerals, with only a small subset explicitly mentioning their efforts to avoid their use. Moreover, a notable proportion of these companies align with the OECD Guidance, emphasizing the framework's relevance in addressing conflict mineral challenges. Geographic distribution shows the United States as a prominent contributor, followed by the European Union. A structured framework assesses companies' compliance with the OECD Guidance, revealing significant variation in adherence levels. Factors include the presence of conflict mineral policies, risk assessment, risk mitigation strategies, third-party audits, and public reporting. The European Union emerges as the dominant contributor to high compliance scores, while a substantial subset of companies demonstrates limited adherence. However, this study faces limitations related to sample size and composition, data quality, scoring system subjectivity, and limited financial analysis. Future research should consider expanding the sample, conducting industry-specific analyses, and exploring the impact of global harmonization efforts and emerging technologies on responsible mineral sourcing.

**Keywords**: Conflict Minerals, Supply Chain Due Diligence, OECD DDG, Human Rights, G20, Ordinary Least Square, Bootstrapped Quantile Regression

# Chapter 1

## Introduction

In a recent research done by the Business & Human Rights Resource Centre in London, they identified 102 cases of alleged environmental and human rights abuses by Chinese-invested companies in the transition minerals sector. More than half of the recorded allegations exerted adverse effects on the environment, and over one-third of the incidents suggested health and safety risks for workers in the workplace (SupplyChainBrain, 2023). The report also implied significant due diligence gap among companies, with less than 18% publishing human rights policies and practices. Due to mounting pressure from consumers, investors, and nongovernmental organizations (NGOs), intergovernmental organizations and companies have increased their efforts to prioritize responsible sourcing and regulate the mineral supply chains (Brigham, 2023). There already exist legislations such as Section 1502 of the Dodd-Frank Wall Street Reform and Customer Protection Act (DF Section 1502) to mandate disclosure of human rights-related risks, the California Transparency in Supply Chain Act to eradicate human trafficking and slavery, and the Organization for Economic Cooperation and Development Due Diligence Guidance (OECD DDG).

The 3rd edition of the "OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas" was published in April 2016 (OECD, 2016). It is considered a leading international standard that provides detailed recommendations, aiming to assist companies to protect human rights and avoid any contributions to conflict in the process of their mineral purchasing decisions and practices (OECD DDG). It translates the United Nations (UN) Guiding Principles of Business and Human Rights into a practical five-step risk-based framework for all companies involved in the minerals supply chains to carry out risk-based supply chain due diligence of tin, tantalum, tungsten, and gold:

***Step 1****: Establish strong company management systems*

***Step 2****: Identify and assess risk in the supply chain*

***Step 3****: Design and implement a strategy to respond to identified risks*

***Step 4****: Carry out independent third-party audit of supply chain due diligence at identified points in the supply chain*

***Step 5****: Report on supply chain due diligence*

It consists of two sections, the first one dealing with tin, tantalum and tungsten and the other with gold. Companies involved in all mineral supply chains apply this Guidance as their due diligence standard, especially ones that source from conflict-affected and high-risk areas (CAHRAs). It provides more details than the UN Guiding Principles' four-step approach (Sarfaty and Deberdt, 2023). It is essential for them to not inadvertently contribute to any extreme negative impacts such as violating human rights and financing conflicts. According to several studies, the competition for valuable minerals in Africa is the direct cause of wars (Gold et al., 2015) and the revenues resulting from mining in some regions are used to fund military operations (Silva and Shaltegger, 2019).

According to the OECD's Standards, CAHRAs are defined as the presence of armed conflict, widespread violence, or other risks of harm to people (OECD, 2016). Nord-Kivu in the Democratic Republic of the Congo (DRC) is a representative example. Human rights abuses, violations of laws and violations amounting to crimes are particularly common in such areas. Conflict minerals refer to raw minerals or minerals that are mined in CAHRAs. As defined by the US legislation, they include the metals tin, tungsten, tantalum and gold, which are extracted from the minerals cassiterite, wolframite and columbite-tantalite respectively. Downstream companies usually refer to these derivatives of the minerals as 3TG (Responsible Minerals Initiative, 2023). Industries such as electronics, vehicles, or medical equipment rely heavily on the components manufactured from refined 3TG. The process through which raw minerals are mined and eventually sold in the consumer market is identified as one element of the mineral supply chain. This system involves all organizations, resources, and services. Upstream companies are firms that extract, trade,

process, smelt, refine, and alloy raw materials. As identified by the European Union (EU) regulation, they can be mining companies, raw material traders, smelters and refiners. Likewise, downstream companies comprises all stages from metal processing to finished products.

Due diligence has its origin in the U.S. Security Act of 1993. As defined in the OECD Guidance (OECD, 2016), due diligence in the mineral supply chain is a proactive and reactive process "enterprises should carry out to identify, prevent, mitigate and account for how they address these actual and potential adverse impacts in their own operations, their supply chain and other business relationships". In the context of the conflict mineral supply chain, due diligence aims to provide a chain of custody tracking from mine to export at the national level, regional tracking of mineral flows through the establishment during a database on their purchases, independent audits on all supply chain participants, and oversight of the entire mineral chain by mineral chain auditors (Bleischwitz et al., 2012). Companies should ensure that they align with domestic laws, respect human rights and construct a conflict-free environment, which is a continuing obligation throughout the time of development.

This Dissertation will gauge the extent of the influence of the OECD DDG in the minerals space through the identification and scrutiny of relevant public representations on websites as well as social media communication of companies headquartered in the G20. This analysis of the recognition of the OECD DDG in the downstream 3TG supply chain is motivated by a evaluation of conflict minerals fillings done by Development International e.V. and an empirical study of the Dodd-Frank Act, Section 1502 by Dr. Galit A. Sarfaty (Sarfaty, 2015). The filing evaluation examines the compliance with DF2015 from both micro and macro levels, while Dr. Sarfaty's research analyzes the effectiveness of the DF1502 to regulate global supply chains by reviewing Conflict Mineral Disclosure (CMD) submitted to the U.S. Securities and Exchange Commission (SEC). Under OECD DDG, companies are encouraged to carry out reports or paper notes on the implementation of the five steps. A similar methodology will be utilized to evaluate the extent to which industry programs adhere to the detailed recommendations of the OECD Guidance.

This Dissertation's findings are based on Conflict Minerals Disclosure (CMD) in Form SD (Specialized Disclosure Report) as well as the public information posted on companies' websites. Two methodologies are employed to quantify the influence of the OECD Due Diligence Guidance on downstream companies: (I) a scoring system that measures the awareness and compliance level and (II) a series of regression analyses incorporating financial indicators to explore potential correlations. Within the sample of 1,178 downstream companies in the mineral supply chain, a majority of them (82.77%) do not mention the phrase "conflict mineral" anywhere on their official websites or fillings. Among those who do, a notable subset of 37 companies overtly engaged with the OECD Guidance, whereas the rest entities opted to demonstrate their commitment to responsible sourcing and ethical business practices by adhering to the Dodd-Frank Act Section 1502. Among Ordinary Least Squares (OLS), Bootstrapped OLS (BOLS), Quantile Regression (QR) and Bootstrapped Quantile Regression (BQR), the BOLS method is relatively more appropriate when there are no outliers but anyone of the OLS assumptions are violated. The findings from BOLS regression suggest that the countries' division classification had a statistically significant relationship with their degree of compliance towards the OECD DDG.

This Dissertation proceeds as follows. Chapter 2 provides a background on responsible sourcing in the supply chains, discussing various laws and regulations, how they combat human rights violence including forced labor, child labor and human trafficking. Chapter 3 presents empirical evidence based on this Dissertation's study of OECD DDG. It analyzes data on industry and due diligence levels. Chapter 4 summaries the outcomes, discusses the limitations of the existing methodology and provides alternative methods for future study.

# Chapter 2

## Literature Review

In this chapter, I embark on a comprehensive exploration of the critical issues surrounding responsible sourcing and minerals supply chain regulations. Human rights violations, environmental degradation, and health hazards associated with mineral extraction are prevalent issues. Challenges, including child labor, slavery, and toxic substance exposure, underscore the urgency of responsible sourcing efforts. I then discuss the emergence of supply chain-related laws and guidance in the United States, which have laid the foundation for global efforts in this arena. International initiatives, the OECD DDG, have followed suit. However, as supply chains are complex and multi-tiered, compliance with these regulations presents formidable challenges.

### 2.1 The Urgent Need for Responsible Sourcing

The globalization of supply chains brings benefits, but also poses threats in terms of social and environmental sustainability. Such concern rises especially when raw materials or minerals originated from countries with questionable regulatory practices (Chen 2022). Facing pressure from governments, consumers, NGOs, and other stakeholders, more companies start to trace the provenance of their supply chains and disclose more information in their annual reporting (Bateman & Bonanni, 2021). This approach aims to assuring responsible sourcing in the mineral supply chains. The term responsible sourcing, defined by James Upstill-Goddard et al. (2015), is "the management of sustainability issues associated with materials in the construction supply chain, often from an ethical perspective". It covers all steps of the mineral supply chains from upstream (i.e. exploration and mining) to midstream (i.e. processing, refining and transporting) and downstream (i.e. manufacturing and brand companies) actors (Deberdt and Le Billion, 2021). With the increasing recognition of the importance of responsible sourcing, companies put more focus on environmental, social and governance (ESG) issues (Bovis et al., 2023).

Even though the raw materials themselves receive most of the attention when it comes to the responsible sourcing of minerals, there are other aspects of the supply chains that are of concern. As a result, a variety of sustainability initiatives target the abuse of human rights and environmental harm in areas and facets of the mineral supply chain beyond mining (Brink et al., 2019). Social problems and human right violations are urgent but complex challenges. In 2012, the technology giant Apple admitted it has human rights problem, best illustrated by the 13 suicides or attempted suicides at the Foxconn factory that assemble devices for Apple (Foley, 2012).

Human rights, an integral aspect of ESG, mirrors a company's scrutiny and accountability throughout its supply chains. Yet, human rights violations in mineral supply chains continue to be a persistent and complicated issue (Bovis et al., 2023). When excavating the minerals, toxic substances such as mercury are heavily used. They are exposed to workers without any proper protective equipment. Such phenomenon is mostly founded in artisanal and small-scale mining (ASM) companies that locate in remote areas with poor infrastructure and little access to healthcare (TCO Development). In some industries, child labor and slavery are also serious problems. It was estimated that 40 million people were victims of modern slavery, including 25 million people in forced labor in 2016; 71% of them are women and girls, while children account for 25% (Gammarano, 2022); some workers are required to work 24 hours straight (Ye, 2017). Besides the problems of human rights violations, NGO reports also highlighted serious environmental degradation associated with mineral mining (SOMO, 2016). For instance, the mining of conflict diamonds (also known as "blood diamonds") in Angola is the direct result of soil erosion, as well as land and water pollution, which further leads to resource depletion and public health problems (Ye, 2017).

There is a critical need to promote responsible sourcing and transparent mineral supply chains, particularly concerning enterprises' human rights and environmental protections. Yet, due to a lack of independent monitoring and enforcement mechanisms, the current voluntary laws (UN Guiding Principles on Business and Human Rights) and standards (OECD Guidelines for

Multinational Enterprises, ILO's Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy, and UN Global Compact) have been ineffective in influencing corporate behavior (Sarfaty, 2015).

## 2.2 The Emergence of Supply Chain-Related Laws and Guidance

This section outlines several U.S. laws on such issues as anti-corruption, human trafficking, workers safety, and conflict minerals with regard to carrying out compliance obligations and promoting responsible and transparent supply chains. They serve as a foundation for future supply chain guidance and regulations (i.e. OECD DDG) that can be passed at the global level.

The tradition of disclosing the inputs of goods started with the Tariff Act of 1789, which required products from specific markets to be taxed at one rate, and items with different qualities and from other locations—requiring documentation and subject to inspection—to be tariffed at different rates in the United States. Ever since then, importers and producers had to know the contents and country of origin of their goods (Whitney, 2015). Under the Tariff Act of 1930 (commonly known as Smoot–Hawley Tariff Act), it prohibited merchandise mined, produced, or manufactured by forced labor to be imported into the U.S. (Deloitte, 2016) besides higher import duties.

The Foreign Corrupt Practices Act of 1977 (FCPA) is considered one of the most important corporate anti-bribery statutes in the world. It consists of antibribery prohibitions and accounting requirements with the intention of forbidding businesses from paying off foreign authorities in exchange for business and demanding publicly traded companies to keep books and records that accurately reflect financial activities (Kelly, 2020). The anti-bribery provision of the FCPA has been applied to all U.S. citizens and foreign firms that finance any corrupt payments within the territory of the United States since 1998 (The U.S. Department of Justice, 2017). Companies are obligated to exercise due diligence in examining both internal behaviors and the actions of third parties in the supply chain to ensure FCPA compliance. Failing to comply with the Act will result in substantial financial penalties and reputational damage (Miller, 2020). Given the potential

penalties and costs attached to violations under the FCPA, this law has pushed companies to develop compliance policies, and document rationales for using the third party, initial due diligence and ongoing monitoring of third-party relationships (NAVEX, 2023).

Additionally, the issues of child labor, forced labor, and human trafficking in the global supply chains have been the subjects of significant attention. As early as 1836, Massachusetts passed the first U.S. child labor law, setting the minimum age of employment as fifteen years of age. Since then, nineteen states had laws regulating the employment of children (Samet, 1999). To uphold the executive branch's commitment to combating child labor abuses, former President Clinton further expanded the laws through Executive Order 13126 in 1999 in order to extend the scope of related regulations. It aimed at prohibiting U.S. federal agencies from purchasing products made by indentured or forced child labor (ILAB). Especially, contractors who supply products to the U.S. government are required to certify they have made a reasonable effort to ascertain that those products were not produced by forced or indentured child labor (Deloitte, 2016).

Then, the United States passed the first comprehensive anti-slavery bill to help combat the growing epidemic into and within the United States of America. The Trafficking Victims Protect Act of 2000 (TVPA), which took effect October 28, 2000, laid the groundwork for the federal response to human trafficking and forced labor in all their forms. Comparing to other existing laws, the TVPA and its four subsequent reauthorizations, namely the Trafficking Victims Protection Reauthorization Act (TVPRA), criminalize a wider variety of trafficking-related activities (Ezell, 2016). Under the 2003 amendment, it is against the law for U.S. government contractors, subcontractors, and their employees to engage in severe forms of human trafficking in person or use forced labor when performing U.S. government contracts or subcontracts. In addition, the 2008 amended version imposes liability on those who ‘knew or should have known’ about forced labor or human trafficking in their corporate ventures, including their supply chains (Green, 2021). In those cases, companies’ responsibility encompasses an obligation to actively maintain a compliance policy and affirmatively monitor the corporate supply chain for indications or engagements of trafficked and forced labor (Ezell, 2016).

California Transparency in Supply Chains Act (CTSCA), effective January 1, 2012, is another landmark legislation that eradicates slavery and human trafficking in supply chains of retailing and manufacturing companies. Unlike the above laws that forbid the sales of products produced through forced labor and pursue the protection of human rights, the goal is to obligate companies to disclose their labor practices to customers so that they are able to differentiate businesses based on their efforts to supply goods free from slavery and human trafficking. Companies must report information on their websites with regard to supply chain verifications, objective audits, supplier certifications, internal accountability systems, and employee training (Koekkoek et al., 2017). Such Requirements will allow buyers to make informed purchasing decisions from companies responsibly managing their supply chains as well as encourage businesses to pay closer attention to their supply chains (Prokopets, 2014). All retailers and manufacturers doing business in the State of California with annual gross sales of at least $100 million are subject to this law (Ma et al., 2015).

Implemented by the SEC, Section 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act (DF Section 1502) is the first regulation to create binding rules on human rights-related due diligence with regard to a company's supply chain (Sarfaty, 2015). It deals with specific minerals designated as conflict minerals – i.e. 3TGs. This law requires U.S.-regulated manufacturers using conflict minerals originating in Central Africa, especially the DRC and adjoining countries, to report on whether their sourcing funds armed groups in the form of CMDs. In case they do, a complete list of the products manufactured containing those minerals will be required (Whitney, 2015). The reports follow the form of CMDs. Due diligence measures such as facilities used to produce the conflict minerals, country of origin, and chain of custody of said minerals should be described clearly in the reports (IEA, 2022).

International actions have also been sparked by U.S. efforts. In 2015, the China Chamber of Commerce of Metals Minerals & Chemicals Importers & Exporters (CCCMC) established voluntary Due Diligence Guidelines. Furthermore, the EU introduced a legislation in 2017, which required

businesses importing 3TG into the EU to conduct supply chain inspections. Similar rules have been passed for all businesses engaged in their 3TG sectors in the Congo and Rwanda as well. All of these international laws and standards are based on the international OECD standards for responsible mineral supply chains (Global Witness, 2017). As compared to the legislations discussed above, the "OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas" (OECD DDG) addresses these issues on a global level by producing standards that are specific and widely accepted. It guides companies' conflict minerals compliance activities in their supply chains to ensure that they are free of human rights violations and do not indirectly fund armed conflicts (OECD, 2016). Those steps outlined in the DDG are taken with the intention of establishing and implementing anti-human trafficking initiatives as part of a comprehensive, integrated social compliance program that addresses stakeholders' concerns as well as associated regulatory, operational, and reputational risks. (Deloitte, 2016).

However, in view of the muti-tiered and fluid nature of supply chains as well as the power dynamics between buyers and suppliers (Sarfaty, 2015), the question for the OECD DDG, and in fact all existing and future supply chain-related laws and regulations, is the extent of influence in the minerals space as to how do companies effectively align with them.

## 2.3 Difficulties and Limitations During Implementation

Numerous supply chain decision-makers and practitioners viewed the development of an exceptionally efficient and responsive supply chain system as essential to future success. With a growing body of outsourcing, the need to effectively manage the supply chain based on law requirements is getting increasingly crucial (Jain and Benyoucef, 2008). Nonetheless, marid internal and external drivers of companies' successful compliance with supply chain-related laws and regulations have been identified by scholars.

Conflict mineral supply chain is typically characterized as long and dispersed, and involves numerous entities, each with their resources and objectives (Swift et al., 2019). There is no single

authority regulated over all members in a supply chain. Because of these characteristics, tracking every supply chain is difficult, expensive and time-consuming. Efficient management has to be supported by both powerful technological tools and human competencies and experience (Jain and Benyoucef, 2008), which all contribute to high upfront costs and human costs.

Companies have to trace the origin of the minerals used in their goods via several tiers of suppliers, from the initial SORs that purchase mineral ores from mines to the manufacturers who process metals into finished products (Kim and Davis, 2016). In most cases, these minerals are mixed with other minerals from different origins. However, most focal firms have no direct relationships with the lowest-tier suppliers and little control of the activities at the upstream level (Hofmann et al., 2018). Due to the interconnectedness of multistage processes, it is also necessary for real-time collaboration across organizational, functional, and task boundaries in order to operate and make decisions (Jain and Benyoucef, 2008). As a result, the available data from the US Securities and Exchange Commission show that only a minority of firms were capable of identifying the country of origin of the minerals they used (Kim and Davis, 2016).

For those reasons, many firms in the electronics, garment, automotive and medical equipment industries are struggling to comply with the regulations to report on the origins of conflict minerals (Schwartz, 2016). Putting aside the cumbersome compliance challenges, experience with conflict minerals suggests that companies' efforts have helped them improve supply chain transparency and risk identification capacities (Deloitte, 2016).

## 2.4 Proposition

The objective of this study is to fill a noticeable gap within the existing body of literature. While a substantial number of studies have been conducted on the Dodd-Frank Act Section 1502, there is a significant dearth of research focusing on the OECD Guidance. To bridge this gap in the academic and policy discourse, this study adopts a methodological approach to the topic, which includes the collection and analysis of data and two appropriate research methods – a scoring system and regression analysis.

# Chapter 3

## Methodology

In the section, I delve into the techniques and methodologies essential for comprehending this study. This exploration leads through the realm of web scraping. Additionally, I introduce the process of sample selection and shed light on the implementation of two distinct analytical methodologies and their roles in achieving the research objectives. In order to gain in-depth insight into the recognition of the OECD DDG, I followed the methodology of Sarfaty (2015) but employed it on a much wider scale. The study focuses on the companies in the downstream 3TG supply chain headquartered in eight strong representatives of the G20 member countries.

### 3.1 Web Scraping

Before digging into data manipulation section, a key technique utilized in this study should be explained first. Web scraping, an automatic process, refers to the extraction of large amounts of data from websites. It retrieves information and exports them into a format that is more computable for users. Web scraping comprises two essential components: the crawler and the scraper. The crawler explores the internet by navigating through links to locate specific data. Conversely, the scraper is a specific tool developed to extract desired information from websites. Web Scrapers can be divided on the basis of many different criteria, including Self-built or Pre-built Web Scrapers, Browser extension or Software Web Scrapers, and Cloud or Local Web Scrapers (Harkiran78, 2023). Brower extensions and Python are the two principle methods of web scraping employed in this study. Brower extensions are easy to run as they are integrated with the browser. However, they are unable to use any sophisticated features that are beyond the capabilities of your browser. Python, on the other hand, is a more comprehensive tool as it can handle most of the processes easily via various libraries. Beautiful soup is a Python package that sits atop an HTML or XML parser, providing Pythonic idioms for iterating, searching, and modifying the parse tree (PyPI, 2023). Parse tree is an ordered rooted tree that denotes the syntactic

structure of the HTML document (Chaudhary et al., 2016). In this study where detecting keywords are required, it can help retrieve information from each link of all websites in the sample as well as search for keywords in the process. Nevertheless, users may encounter certain challenges when it comes to reading contents in a photo or translating a non-English PDF. Most importantly, although it is legal to perform the action of web scraping for public consumption, certain rules must be followed. For instance, private data that requires a username and passcodes and data that is copyrighted cannot be scraped (Barrett, 2022).

## 3.2 Data Preparation

This subsection serves to provide a clear account of the source of the database, outlining any necessary adjustments made to it, and elucidating the specific methodologies employed in the study.

### 3.2.1 Data Collection

Plenty of literature have assessed the impact of the Dodd-Frank Act on businesses with a major focus on U.S. companies. As multinational legislations and regulations continue to thrive, guidance such as the OECD DDG are global in scope and apply to all minerals supply chains. In this study, the companies within the dataset are headquartered in the G20 members, with the strongest representation from China, the United States of America, the European Union, Japan, Russia, Brazil, the United Kingdom and Germany.

Primary data was collected on Orbis, a growing database of companies covering over 200 countries (Bureau Van Dijk, 2023). The search strategy is largely based on a list of standard industrial classification (SIC) codes. They are extracted using a web scraping extension, named Web Scraper. This four digit-number identifies a very specific short descriptor of the type of business a company is engaged in. SIC codes of companies that filed Form SD between June 1$^{st}$ 2022 and May 31$^{st}$ 2023 (Filing Year 2022) are of interest. Form SD is a specialized disclosure report implemented under the DF Section 1502 relating to conflict minerals contained in a product, and must be filed with the SEC through the EDGAR System (Deloitte, 2014). By expanding

the target areas from solely U.S. to the G20 members, a database storing 436,286 active companies in the minerals supply chain with their corresponding SIC codes and financial indicators is obtained.

### 3.2.2 Data Cleaning

Upstream companies like raw-material extracting firms and SORs are not in the scope of this study, thus multiple steps were undertaken to distinguish them in the dataset. Since the original dataset is large in size and contains both small and medium-sized enterprises (SMEs) and large-sized companies, it is challenging to retrieve a dataset purely consisting of downstream companies. Thus, the goal is to maximumly exclude them. The table below summarizes the difference between the upstream and downstream supply chains and served as a guide to locate upstream companies (Khan, 2023).

| | **Upstream Supply Chain** | **Downstream Supply Chain** |
|---|---|---|
| **Definition** | The initial stages in the supply chain process, from locating raw materials to producing and manufacturing products | The remaining phases of the supply chain process, concentrated on the distribution, retail, and sales of finished goods to end consumers |
| **Activity** | • source raw materials, procurement and supplier management<br>• manufacture and production processes | • distribution logistics<br>• warehousing<br>• retail and sales operations<br>• customer service and support |
| **Focus** | • ensure a reliable and cost-effective supply of raw materials<br>• manage relationships with suppliers and vendors | • retail store distribution networks<br>• eCommerce order fulfillment<br>• delivery processes |

Firstly, companies with SIC Codes between 1000 and 1800 were removed as they fell under the Mining and Construction division. The Mining industry involves the extraction of raw minerals via surface or underground mining, while the Construction industry accounts for drilling and solid mineral exploration. Moreover, SIC Codes starting with 40 are defined as the Transportation, Communications, Electric, Gas, And Sanitary Services, thus are deleted as well. I further filtered out companies whose name contains sensitive keywords like mining, metals or resources, and companies with no website. The latter part is based on the assumption that companies without an official website would have no other sources to publish articles including conflict mineral reports. Besides, websites are a necessity for subsequent web scraping. Lastly, I cross-checked the dataset with a list of companies scraped from Resource Project that make payments to governments for extracting oil, gas and mineral resources around the globe (NRGI, 2023), and a list of SORs by comparing company names. Due to the reason that the names of the same company in various databases have some discrepancies, I combined them into one excel sheet and checked them manually. Eventually, the database size is now roughly 110,000.

### 3.2.3 Sample Selection

When it comes to large population sizes and drawing statistical insights, sampling data is beneficial in terms of efficiency and time consumption. Simple sampling, systematic sampling, stratified sampling, and cluster sampling — there are numerous methods for selecting a sample to represent the population. Each varies in accuracy, reliability, and efficiency.

Researchers commonly employ stratified random sampling when they aim to assess data across various subgroups or distinct strata. This method enables them to efficiently secure a sample that optimally mirrors the characteristics of the entire population under investigation (Qualtrics, 2023). It ensures fairness for participants through random selection within each stratum, minimizing bias. Moreover, it eliminates variation and overlap among strata due to exhaustive and mutually exclusive participant grouping. However, prior knowledge of shared characteristics might introduce selection bias when defining strata. The resulting sample might not fully represent the population, necessitating a review for proportionality (Qualtrics, 2023).

In this Dissertation, a representative sample is chosen by adopting proportional stratified sampling. In this approach, the strata can be formed based on either the origin of the country or the industry sector. Each stratum size is directly proportional to the country distribution or industry sector size of the entire population of strata. The former allows me to compare and analyze the influence of the OECD Due Diligence Guidance across different countries, which helps understand how companies in different countries are impacted and how this Guidance is implemented or adhered to in various regulatory and cultural contexts. However, this approach might not guarantee the representation of different industry sectors equally. If certain industry sectors are predominant in specific countries, it is possible to end up with an imbalanced distribution of sectors in the sample. Similarly, the latter ensures representation from various industry sectors, regardless of the countries they are headquartered in. Yet, this approach might not give equal representation to all chosen countries. Since the research question is more focused on understanding country-level differences, stratification by country ensures that I have representation from each member nation in the sample, which is considered more appropriate.

Ultimately, a sample size of 1,178 is obtained. The great majority of companies – 53.9% – were located in China and the United States of America; there were also 164 in the European Union, 142 in Japan, 67 in Russia, 66 in Brazil, 60 in the United Kingdom and 44 in Germany (see Figure 1).

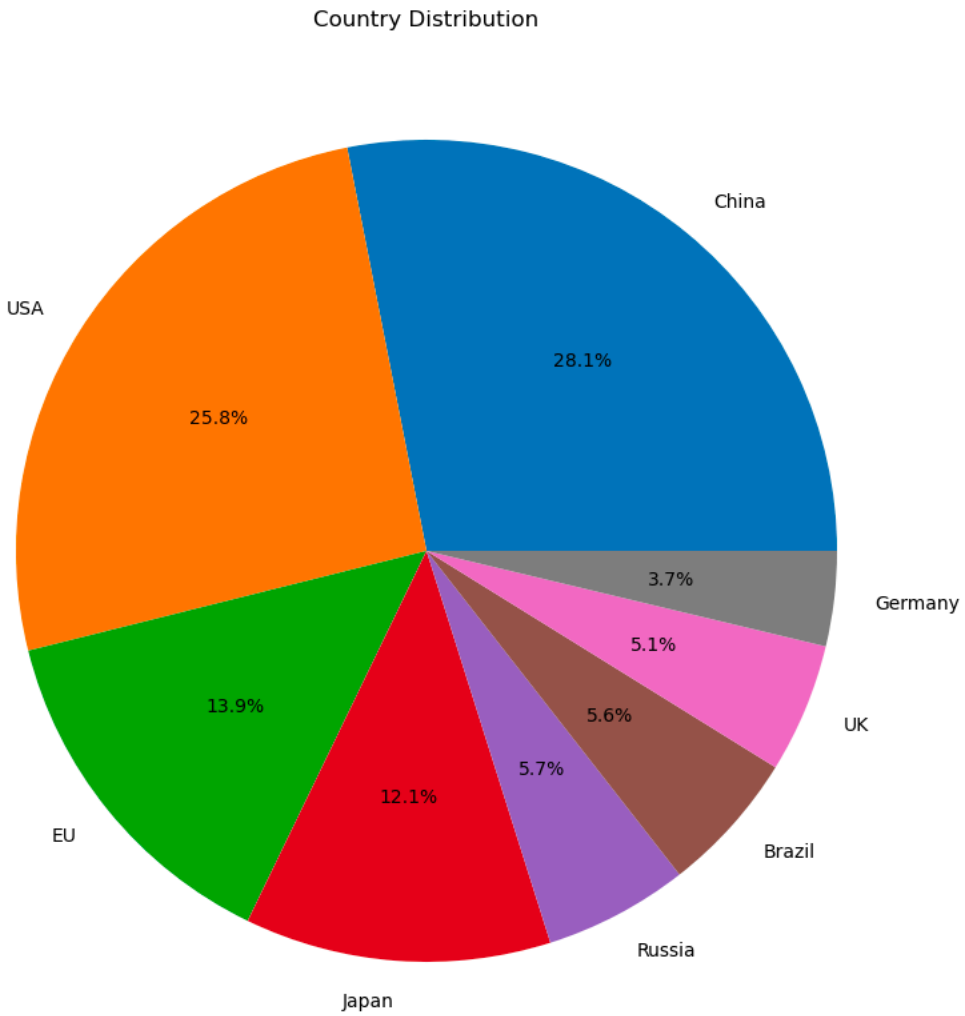


Figure 1: Company Distribution in the Eight Representatives of the G20 Member Countries

Nearly half (47.2%) of the 1,178 companies are manufacturers based on SIC codes reported, with service sectors ranked second (see Table 1).

Table 1: SIC Divisions Count

| | | Count |
|---|---|---|
| **Division Code** | **SIC Division** | |
| D | Manufacturing | 556 |
| I | Services | 404 |
| F | Wholesale Trade | 130 |
| G | Retail Trade | 88 |

The Plastic Products cohort is the largest among the manufacturers, which, however, only made up 4.75% (56 / 1,178) of the total, as presented in Table 2.

Table 2: Top Five Manufacturing Industries in Manufacturing Division

| | | Count |
|---|---|---|
| **US SIC** | **Manufacturing Industry** | |
| 3089 | Plastic Products, Not Elsewhere Classified | 56 |
| 3679 | Electronic Components, NEC | 53 |
| 3559 | Special Industry Mechinery, NEC | 44 |
| 3711 | Motor Vehicles & Passenger Car Bodies | 42 |
| 3714 | Motor Vehicle Parts & Accessories | 30 |
| ... | ... | ... |

## 3.3 Implementation

In this subsection, I outline two distinct methodologies employed to quantify the influence of the OECD Due Diligence Guidance on downstream companies: a scoring system designed to measure companies' awareness of conflict mineral due diligence and compliance with the Guidance, and a regression analysis incorporating financial indicators to explore potential correlations.

### 3.3.1 Scoring System

The first methodology involves the development of a scoring system to gauge companies' awareness and compliance level towards conflict minerals. A total of three scores are created in this system.

The first score, *Awareness_1*, measures a company's awareness level of conflict minerals in their minerals supply chain, ranging from 0 to 2. 0 means that the company does not mention conflict minerals on the website or anywhere in public, while 1 suggests that the phrase "conflict mineral" is available somewhere on its website, in a report or in a company profile. In some cases, a company can publicly state that it takes the necessary measures with due diligence to avoid using conflict minerals in the manufacture of its products such as HP and Intel, in which case it was given a score of 2. In a special case where companies have an invalid websites, they were denoted as 999.

Among companies that yielded a score of 1 in the *Awareness_1*, whether it specifically took steps to conduct due diligence levels based on the OECD Guidance was examined by *Awareness_OECD*. Section 1502 of the Dodd-Frank Act was enacted in 2010 to improve the accountability and transparency of companies and contained Form SD provisions for responsible sourcing of minerals. Companies have a clear mandate to disclose whether any conflict minerals "necessary to the functionality or production of a product" originated in the DRC or an adjoining country (IEA, 2022). However, the OECD DDG is voluntary and intended to serve as a tool to cultivate transparent mineral supply chains and sustainable corporate engagement in the minerals sector (OECD, 2013). Companies with an awareness of conflict minerals may not precisely comply with the OECD DDG. For those who specifically mentioned the OECD Guidance, it was given a score of 1. Otherwise, 0 was given to that company.

The score, *Compliance_OECD,* comprises multiple factors aimed at evaluating companies' adherence to the OECD Guidance, ranging from 0 to 5. All factors are selected from the OECD Guidance and represent all five steps of the OECD's five-step framework. The definition of each

factor and the reason why they were chosen will be concretely explained in the next section. This methodological approach aims to facilitate a granular assessment of a company's alignment with the OECD DDG, offering a quantifiable measure of companies' commitment to responsible mineral sourcing practices and ethical supply chain engagement.

### 3.3.2 Regression

The second methodology utilizes regression analysis, a statistical technique, to examine potential associations between a company's financial performance and its degree of compliance with the OECD Guidance. Among companies that explicitly report due diligence practices in public, it further takes into account their key financial indicators, including liquidity (current ratio) and profitability (return on asset (ROA)), to ascertain whether there exists a significant relationship between financial metrics and the Guidance's impact. However, the small sample size presents certain limitations, including limited generalizability, reduced statistical power of the regression analysis and higher variability. It could hinder the identification of the relationships between variables and might lead to inconclusive or non-significant results. In light of this limitation, alternative methods, such as bootstrapping or robust regression techniques, were explored to mitigate the potential shortcomings arising from the small sample size in the subsection.

# Chapter 4

## Results and Discussions

### 4.1 Scoring System

In this section of the study, I assess corporate awareness and compliance regarding conflict minerals and the OECD Due Diligence Guidance. I begin by examining how companies acknowledge the presence of conflict minerals within their product portfolios, utilizing web scraping techniques to identify relevant keywords on corporate websites and social media channels. Challenges in this process, such as language barriers and website accessibility, are also discussed. Subsequently, I explore the awareness of the OECD Guidance among companies that engage with the issue of conflict minerals. Finally, I introduce a structured framework to assess compliance with the OECD Guidance, focusing on critical factors that indicate the extent to which companies align with its principles and recommendations.

#### 4.1.1 Awareness of the Conflict Minerals (*Awareness_1*)

The exploration of pertinent information conveyed through corporate websites and social media channels offers a valuable avenue for assessing the extent of awareness exhibited by companies concerning the presence of conflict minerals within their product portfolios. This undertaking allows for an in-depth scrutiny of how businesses choose to engage with and communicate their stance on conflict minerals to their stakeholders. The result is summarized in the table below.

Table 3: Frequency Table of *Awareness_1*

| | Frequency | Percentage (%) |
|---|---|---|
| **Awareness_1** | | |
| 0 | 975 | 82.767402 |
| 999 | 112 | 9.507640 |
| 1 | 77 | 6.536503 |
| 2 | 14 | 1.188455 |

Although the technique of web scraping helps identify keywords on the website and eliminate those that do not mention the phrase “conflict mineral” at all, there are some challenges encountered in the process. It takes the form of scraping words in a picture, translating contexts in a non-English language and etc. The accessibility of numerous Chinese websites is often limited to Chinese search engines like Baidu. Consequently, it is reasonable to posit that a similar situation could arise for other websites of non-English companies, where their availability might be restricted to specific search engines relevant to their respective regions. As a result, extensive manual checks are required to ensure high data quality. Eventually, 112 out of 1,178 websites are invalid. The reasons can be that it required login; it was under temporary maintenance; or the domain was on sale. Those are denoted as 999 in the dataset. Nearly half of these are Chinese websites. It can be the case that the domain names and spaces have not been renewed or not resolved properly. A minority of companies (1.19%) explicitly stated that they avoid using conflict minerals in their supply chain (see Table 3).

### 4.1.2 Awareness of the OECD Due Diligence Guidance (*Awareness_OECD*)

In the examination of the dataset encompassing 77 distinct corporate entities that discern the issue of "conflict minerals" across their respective online platforms, a notable subset of 37 companies overtly engaged with the OECD Due Diligence Guidance within the context of their discourse on conflict minerals. This underscores the significance of the OECD framework as a preferred avenue for a portion of companies to address the multifaceted challenges associated with conflict mineral sourcing. It is noteworthy that the remaining entities within the dataset

opted to demonstrate their commitment to responsible sourcing and ethical business practices by adhering to the Dodd-Frank Act Section 1502, or alternatively, abiding by other relevant local legislations. The inclination towards compliance with the Dodd-Frank Act can be attributed to its legal nature, standing in contrast to the non-binding nature of the OECD Guidance. This juxtaposition sheds light on the strategic predilections of companies, wherein the mandatory and enforceable character of Dodd-Frank appears to wield a greater influence, potentially driving more businesses to adopt its provisions in addressing the complexities of conflict mineral sourcing and due diligence.

Figure 2 represents the geographical distribution within the subset of companies compliant with the OECD Guidance. It only includes companies with an *Awareness_1* score of 1. Notably, among the companies demonstrating compliance with the OECD guidelines, the United States emerges as the dominant contributor, occupying the largest portion of the pie chart. Following closely behind, the European Union commands a substantial share. While China may have a notable representation in terms of the number of companies at first, this does not necessarily mean a positive correlation with the level of compliance. Germany and Russia exhibit the least representation among the compliant companies, reflecting a relatively lower level of engagement with the OECD Guidance in comparison to their counterparts.

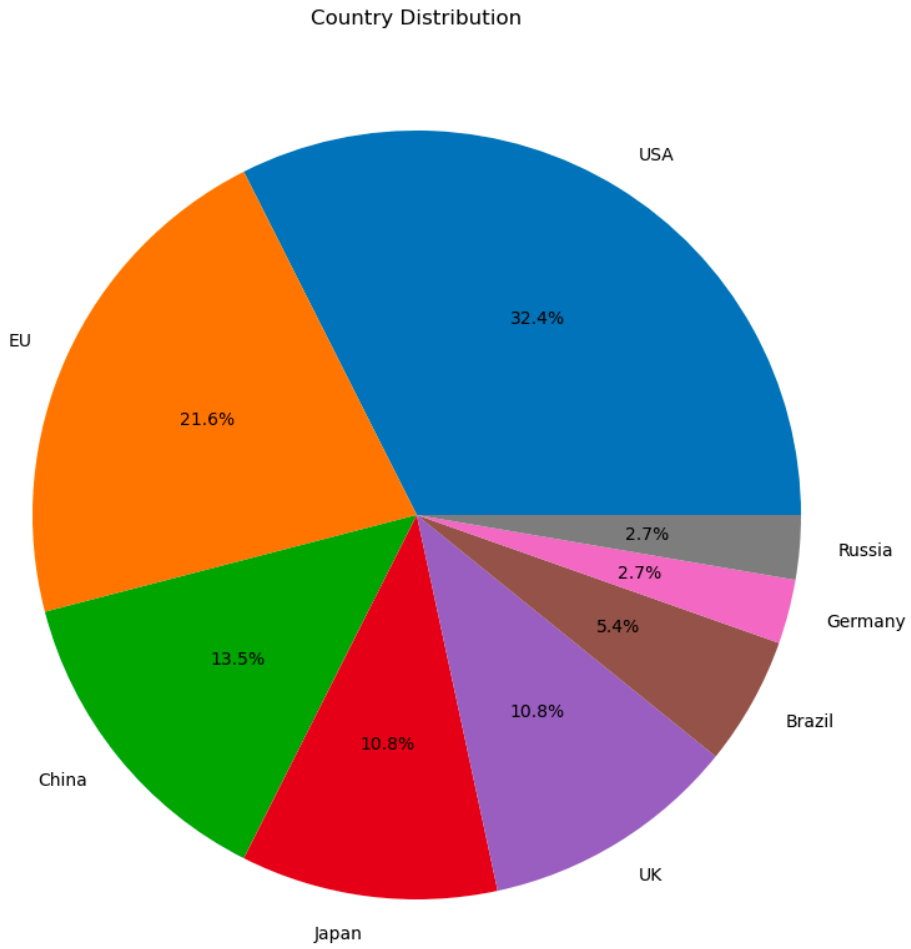


Figure 2: Geographical Distribution within the Subset of Companies Comply with the OECD Guidance

### 4.1.3 OECD Guidance Compliance Level (*Compliance_OECD*)

Within the framework of the OECD Guidance, this approach consists of a series of distinct factors that collectively evaluate a company's adherence to the principles and recommendations set forth by the OECD. At each juncture of this five-step framework, a discernible factor was determined, acting as critical indicators to gauge the degree to which a company aligns with the stipulated requirements outlined in that step. In instances where a company exhibits certain extent of compliance with the Guidance and undertakes the endeavor to align with it, a score is determined based on the specific criterion described below.

1. *Company adopts a Conflict Minerals Policy or establishes a control and transparency system.*

This factor is a component of Step 1 of the OECD Due Diligence Guidance. It entails adopting a comprehensive supply chain policy for minerals sourced from CAHRAs that encompasses a commitment to standardized principles and a well-defined risk management plan aligned with provided guidelines. For all downstream companies, it specifically recommends establishing transparency systems over the supply chain to gather information on the origin of minerals, transport, and transit for each SOR (OECD, 2016).

2. *Company identifies products containing 3TG and surveys all of its suppliers of conflict minerals.*

This factor is a component of Step 2 of the OECD Due Diligence Guidance. Downstream companies should identify products containing conflict minerals. Moreover, they should assess the practices of their SORs to identify supply chain risks using the provided Guidance. If identifying upstream actors is challenging due to size or other reasons, they can collaborate with industry peers or downstream partners to identify SORs, evaluate their due diligence practices, and ensure compliance with the Guidance (OECD, 2016).

3. *Company has a strategy for responding to identified risks in the supply base and continues to implement and track the risk mitigation plan.*

This factor is a component of Step 3 of the OECD Due Diligence Guidance. Companies must establish a supply chain risk management plan to address identified risks. They can manage risks by continuing trade with ongoing mitigation, temporarily suspending trade for mitigation efforts, or discontinuing trade if mitigation is not feasible. In this process, they should refer to the supplied supply chain policy or their own policy, and then use measurable risk mitigation strategies for

risks that don't require supplier termination, aiming for gradual performance improvement within reasonable timeframes (OECD, 2016).

4. *Company performs direct audits of SORs within its supply chain, leverages third-party due diligence consultants, or supports the Responsible Minerals Assurance Process's (RMAP) efforts to audit due diligence practices.*

This factor is a component of Step 4 of the OECD Due Diligence Guidance. Companies should arrange an external third-party audit of SORs' responsible supply chain due diligence for minerals from CAHRAs. The audit should cover scope, criteria, principles, and activities. All downstream companies are advised to engage via industry groups to select auditors and establish audit terms following the Guidance's standards. Small and medium enterprises are encouraged to collaborate with such industry bodies (OECD, 2016).

5. *Company describes all due diligence efforts annually and makes reports publicly available, with Form SD and/or on websites.*

This factor is a component of Step 5 of the OECD Due Diligence Guidance. It mandates companies to yearly disclose, or when possible, incorporate into their annual sustainability or corporate responsibility reports, additional details about their responsible supply chain due diligence for minerals sourced from conflict-affected and high-risk regions (OECD, 2016).

In this evaluation, a binary classification is employed, with a value of 1 assigned when a given factor is observed to be present, signifying compliance with the corresponding requirement. Conversely, a value of 0 is attributed when the factor is absent. As shown in Figure 3, it is evident that a noteworthy proportion, specifically 20 out of the 37 companies (54.1%), have achieved a relatively high or full compliance score with the OECD Guidance. Remarkably, within this subset of companies, companies headquartered in the European Union stand out as the prevailing contributor, showcasing the highest presence among those that have achieved high degree of

compliance. Conversely, the result also highlights a contrasting scenario, where 13 companies (35.1%) stand conspicuously as non- or low-compliant entities, demonstrating little adherence to the stipulated Guidance.

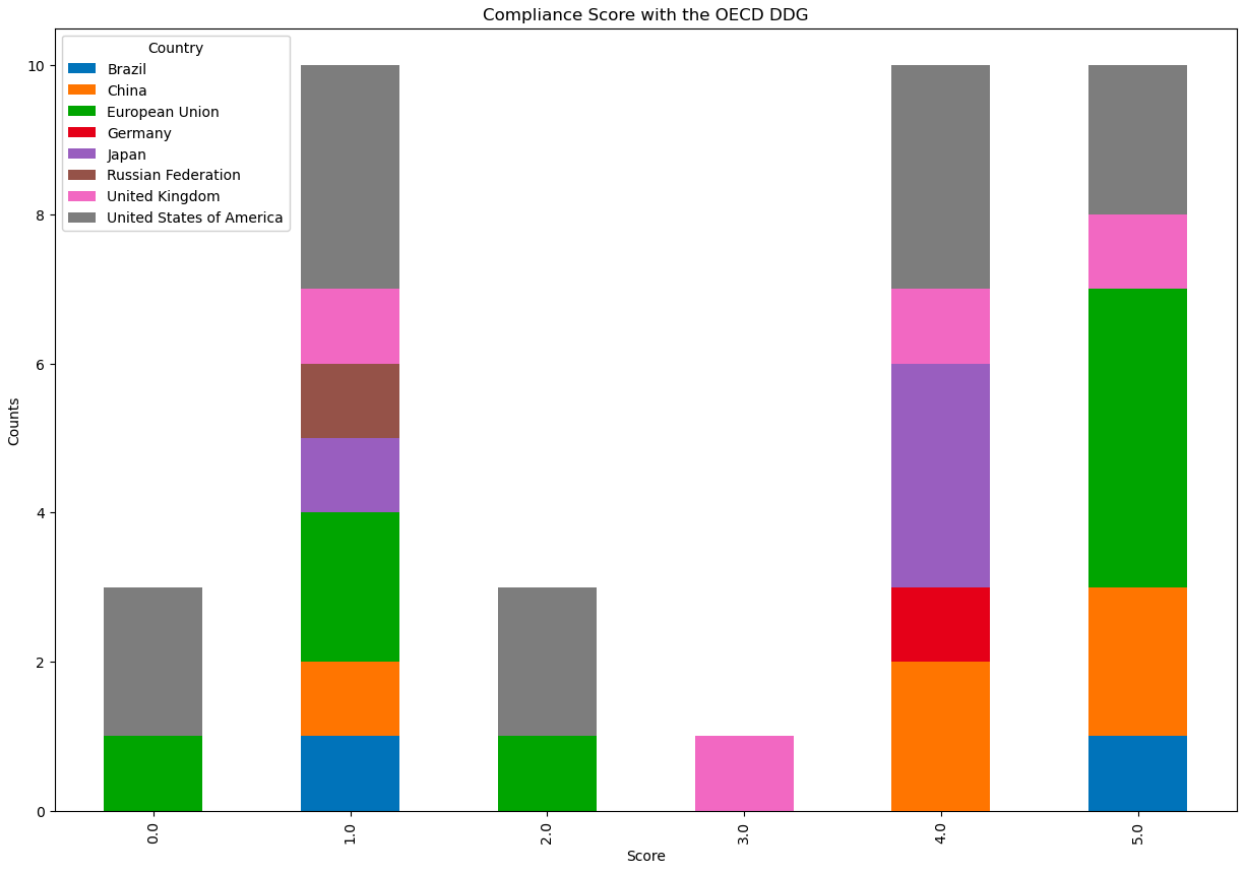


Figure 3: Stacked Bar Plot of the Compliance Score with the OECD DDG across Countries

## 4.2 Regression Analysis

In order to gain a deeper understanding in which attributes of companies linked to enhanced due diligence practices, I proceed with an Ordinary Least Squares (OLS) regression, wherein I analyze the relationship between the compliance score and a range of explanatory variables. The chosen independent variables encompass a spectrum of financial indicators that measure efficiency (log of operating revenue), liquidity (current ratio), profitability (return on equity (ROE)), as well as categorical indicators like country and division code. They are selected to capture multifaceted aspects of each company's operations, financial condition, and contextual background.

### 4.2.1 Outcomes and Limitations

OLS regression is a statistical method used for analyzing and modeling the relationship between a dependent variable and one or more independent variables. In this case, the relationship is expressed through a linear equation, written as:

$$Y = \beta_0 + \beta_i X_i + \varepsilon$$

Where:

- Y: Dependent variable which is *Compliance_Score*
- $X_1$, $X_2$, ..., $X_i$: Independent variables which include log of operating revenue, current ratio, ROE and dummies for country and division code
- β0: Intercept (the value of Y when all X variables are 0)
- $\beta_1$, $\beta_2$, ..., $\beta_i$: Coefficients (the change in Y for a one-unit change in the corresponding X variable)
- ε: Error term

*Log(operating revenue)* serves as a fundamental indicator of a company's financial performance and scale. Its inclusion allows for an assessment of how the size and financial stability of a company relate to its compliance score. Since this variable is in thousands, I took the log of it to compress its scale and improve the fit. *Current ratio* measures a company's ability to pay short-term obligations or those due within one year. It aids in determining whether companies with better liquidity management are more inclined to adhere to the OECD Guidance. *ROE* is a profitability metric that indicates a company's ability to generate profits from shareholder investments. The dummies for country and division code takes country-specific and industry-specific variations into consideration. They allow me to control for the potential influence of these factors on a company's compliance score. By incorporating them, I can discern if compliance efforts differ significantly across countries or divisions.

Among the subset of 37 companies, the primary source of data is derived from Orbis. Despite Orbis provided most of the dataset, a few financial indicators for 6 companies are lacking. To

address this gap, I manually reviewed their respective financial statements and annual reports to acquire the indicators I needed. In specific instances, supplementary data is sourced from investment analysis platforms such as Morningstar or financial portals like Investing. It is worth noting that Micromeritics Instrument Corporation does not have any financial data available on financial statements or public databases, except for its revenue. Therefore, I excluded it in the regression analysis.

Table 4: Findings from OLS Regression

| | | | |
|---|---|---|---|
| Dep. Variable: | Compliance Score | R-squared: | 0.258 |
| Model: | OLS | Adj. R-squared: | -0.181 |
| Method: | Least Squares | F-statistic: | 0.5873 |
| Date: | Thu, 17 Aug 2023 | Prob (F-statistic): | 0.839 |
| Time: | 14:05:41 | Log-Likelihood: | -65.983 |
| No. Observations: | 36 | AIC: | 160.0 |
| Df Residuals: | 22 | BIC: | 182.1 |
| Df Model: | 13 | | |
| Covariance Type: | nonrobust | | |

| | coef | std err | t | P>\|t\| | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| const | 2.3487 | 1.372 | 1.712 | 0.101 | -0.497 | 5.194 |
| log(operating revenue) | 0.0619 | 0.150 | 0.414 | 0.683 | -0.248 | 0.372 |
| Current ratio | 0.0010 | 0.002 | 0.475 | 0.640 | -0.003 | 0.005 |
| ROE | -0.0056 | 0.008 | -0.724 | 0.476 | -0.022 | 0.010 |
| Division Code_D | -0.5855 | 0.772 | -0.759 | 0.456 | -2.186 | 1.015 |
| Division Code_F | 2.0100 | 1.120 | 1.795 | 0.086 | -0.312 | 4.332 |
| Division Code_G | 0.7155 | 1.831 | 0.391 | 0.700 | -3.082 | 4.514 |
| Division Code_I | 0.2086 | 0.950 | 0.220 | 0.828 | -1.761 | 2.178 |
| Country_Brazil | 0.7485 | 1.299 | 0.576 | 0.570 | -1.945 | 3.442 |
| Country_China | 0.8468 | 0.948 | 0.893 | 0.381 | -1.119 | 2.813 |
| Country_EU | -0.1617 | 0.789 | -0.205 | 0.839 | -1.797 | 1.474 |
| Country_Germany | 1.6193 | 1.768 | 0.916 | 0.370 | -2.047 | 5.285 |
| Country_Japan | 0.6841 | 1.034 | 0.661 | 0.515 | -1.461 | 2.829 |
| Country_Russia | -1.4109 | 1.761 | -0.801 | 0.431 | -5.062 | 2.241 |
| Country_UK | 0.1205 | 1.126 | 0.107 | 0.916 | -2.214 | 2.455 |
| Country_USA | -0.0980 | 0.715 | -0.137 | 0.892 | -1.580 | 1.384 |

| | | | |
|---|---|---|---|
| Omnibus: | 3.111 | Durbin-Watson: | 2.138 |
| Prob(Omnibus): | 0.211 | Jarque-Bera (JB): | 1.555 |
| Skew: | 0.145 | Prob(JB): | 0.460 |
| Kurtosis: | 2.024 | Cond. No. | 4.39e+18 |

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 7.14e-32. This might indicate that there are strong multicollinearity problems or that the design matrix is singular.

The model summary in Table 4 contains the coefficients that represent the weights of the respective terms. None of these variables have demonstrated statistical significance. The results do not establish a statistically robust relationship between the selected independent variables and the dependent variable. All p-values are above the 5% significance level. An R-square ($R^2$) is the coefficient of determination that reveals information about the goodness of fit of a model. The closer the $R^2$ gets to 1 better the regression. In this case, a $R^2$ of 0.258 suggests a low level of explanatory power. The lack of statistical significance results in failure to conclude causation between the selected explanatory variables and independent variables.

In some instances, small sample size studies are easy and quick to conduct. This strategy prevents excessive resource allocation, including human resources, time, and financial investment, towards exploring a relationship. In the event that an association is indeed identified, it means that a larger confirmatory study is needed (Hawshaw, 2008).

Nonetheless, there are several limitations associated with a small sample size as it can directly affect the reliability of the research and result in false interpretation of the outcomes, in particular confidence intervals and p-values (Hackshaw, 2008). Firstly, a small sample size might not be representative of the broader population of downstream companies subject to the OECD DDG. The findings and relationships observed within this limited sample cannot accurately reflect the behavior of all companies, potentially leading to skewed or biased conclusions. The statistical power of the analysis is diminished (Deziel, 2018). This means that it becomes more challenging to detect true relationships or differences between variables. This could result in missing out on meaningful insights or drawing false conclusions due to insufficient evidence.

### 4.2.2 Alternative Methods (Bootstrap OLS, Quantile and Bootstrapped Quantile Regression)

A study by Nikitina, Paidi, and Furuoka (2019) explores the utilization of Bootstrapped Quantile Regression (BQR) analysis as a methodological approach for small sample research within the field of applied linguistics. It focuses on addressing the challenges posed by limited sample sizes and presents a methodological consideration for researchers aiming to derive meaningful insights

from such contexts. They also employed Ordinary Least Squares (OLS), Bootstrapped OLS (BOLS) and Quantile Regression (QR) as comparative methods to compare the outcomes. Enlightened by their study, I conducted each regression on this dataset of 37 companies. Categorical variables *Country* and *Division_Code* are converted to numeric variables to enhance performance and help reduce sparsity (Shukla, 2023). Log of the operating revenue was the only financial indicator. The R programming codes provided by Nikitina et al. (2019) are modified accordingly and utilized in the following analysis. Confidence interval, a range of likely values for the population parameter (Sullivan, n.d.), will be the main indicator when examining a variable's statistical significance. With smaller samples, the Central Limit Theorem does not apply, and the t distribution was used (Sullivan, n.d.). Confidence intervals were generated using the t values, and they would be larger for smaller samples, producing larger margins of error (Sullivan, n.d.). If zero is included in the confidence interval for a variable, it means that the variable could have a positive or negative effect on the outcome of interest.

As can be seen in the Table 5, zero was outside of the confidence intervals (CIs) at first two levels of significance for the variable *Division_Code* in the OLS regression. Therefore, the null hypothesis was rejected at the five percent level of significance for this variable. For all other variables, zero was included for all three levels of significance, meaning that the null hypothesis of no statistically significant relationship between these and the dependent variable *Compliance_Score* could not be rejected.

Table 5: Findings from OLS Regression

| **Variables** | **Coefficient** | **Standard Error** | **Confidence Intervals (CIs)** |
|---|---|---|---|
| Intercept | 1.5791903 | 1.8751361 | 90% [-0.8239, 3.9823]<br>95% [-1.5051, 4.6635]<br>99% [-2.7830, 5.9414] |
| Country | 0.0320415 | 0.1600671 | 90% [-0.1731, 0.2372]<br>95% [-0.2312, 0.2953]<br>99% [-0.3403, 0.4044] |

| | | | |
|---|---|---|---|
| US_SIC | -0.0001028 | 0.0002212 | 90% [-0.0004, 0.0002]<br>95% [-0.0005, 0.0003]<br>99% [-0.0006, 0.0004] |
| Division_Code | 0.9292819** | 0.4924715 | 90% [0.2982, 1.5604]<br>95% [0.1192, 1.7393]<br>99% [-0.2164, 2.0749] |
| log_rev | 0.0969655 | 0.2705383 | 90% [-0.2497, 0.4437]<br>95% [-0.3480, 0.5420]<br>99% [-0.5324, 0.7263] |
| Residual standard error: 1.775 on 31 degrees of freedom<br>Multiple R-squared: 0.1202, Adjusted R-squared: 0.006679<br>F-statistic: 1.059 on 4 and 31 DF, p-value: 0.3933<br>** indicates significance at the five percent level | | | |

Quantile regression estimates the conditional median of the target, and is used as is an extension of OLS when the conditions of OLS are not met (i.e., linearity, homoscedasticity, independence, or normality) (Dye, 2020). Mathematically, it is denoted as:

$$Q_q(y|x) = \beta_{0_q} + \beta_{i_q} X_i + \varepsilon$$

Where:

- q: Quantile (between 0 and 1)
- $Q_q(Y|X)$: The q-th quantile of the dependent variable *Compliance_Score*
- $X_1$, $X_2$, ..., $X_i$: Independent variables which include *Country, US_SIC, Divison_Code and log_rev*
- $B_0$, $\beta_{1q}$, $\beta_{2q}$, ..., $\beta_{iq}$: Coefficients specific to the q-th quantile (SOC910 Advanced Statistics, n.d.)

In Table 6, the QR analysis rejected the null hypothesis of no statistical significance for the variables *Country*. At the same time, it could not reject the null hypothesis for *US_SIC*, *Division_Code* and *log_rev*.

Table 6: Findings from Quantile Regression

| Variables | Coefficient | Standard Error | CIs |
|---|---|---|---|
| Intercept | -0.51082 | 2.82646 | 90% [-4.1331, 3.1114]<br>95% [-5.1599, 4.1383]<br>99% [-7.0862, 6.0645] |
| Country | 0.31860* | 0.24128 | 90% [0.0002, 0.6278]<br>95% [-0.0783, 0.7155]<br>99% [-0.2427, 0.8799] |
| US_SIC | 0.00024 | 0.00033 | 90% [-0.0002, 0.0007]<br>95% [-0.0003, 0.0008]<br>99% [-0.0005, 0.0010] |
| Division_Code | 0.94815 | 0.74232 | 90% [-0.0032, 1.8995]<br>95% [-0.2729, 2.1692]<br>99% [-0.7787, 2.6750] |
| log_rev | 0.08853 | 0.40779 | 90% [-0.4341, 0.6111]<br>95% [-0.5822, 0.7593]<br>99% [-0.8601, 1.0372] |
| * indicates significance at the ten percent level | | | |

In the following step, the BOLS and BQR analysis were performed. Bootstrapping is a robust statistical procedure which could be employed for a small sample analysis without relying on the error terms normality assumption (Nikitina et al., 2019). It involves repeatedly drawing multiple simulated samples from the existing data. The findings from BOLS confirmed the results of the OLS method. It rejected the null hypothesis of no statistically significant relationship between the variables *Division_Code* and *Compliance_Score* at the five percent level of significance. Hence, the relationship between these variables could be considered as statistically significant. These results suggest that the countries' division classification had a statistically significant relationship with their degree of compliance towards the OECD DDG.

Table 7: Findings from Bootstrap OLS, and Bootstrap Quantile Regression

| Variables | BOLS CIs | BQR CIs |
|---|---|---|
| Intercept | 90% [-2.757, 4.289]<br>95% [-3.476, 4.872]<br>99% [-5.101, 5.960] | 90% [-5.3034, 6.3340]<br>95% [-6.6970, 7.1105]<br>99% [-8.4251, 8.9956] |
| Country | 90% [-0.2184, 0.3726]<br>95% [-0.2660, 0.4439]<br>99% [-0.3655, 0.5777] | 90% [-0.5586, 0.7146]<br>95% [-0.5901, 0.7900]<br>99% [-0.6245, 0.9989] |
| US_SIC | 90% [-0.0004, 0.0004]<br>95% [-0.0005, 0.0006]<br>99% [-0.0006, 0.0008] | 90% [-0.0006, 0.0007]<br>95% [-0.0008, 0.0008]<br>99% [-0.0010, 0.0011] |
| Division_Code | 90% [0.2253, 1.7815]<br>95% [0.1058, 1.9332]**<br>99% [-0.5189, 2.7126] | 90% [-0.4299, 2.0040]<br>95% [-0.5963, 2.3502]<br>99% [-1.0587, 4.1577] |
| log_rev | 90% [-0.2676, 0.6192]<br>95% [-0.3317, 0.7439]<br>99% [-0.4971, 0.9995] | 90% [-0.4444, 0.9625]<br>95% [-0.6731, 1.1504]<br>99% [-1.1510, 1.4090] |

As demonstrated by Nikitina et al. (2019), if there are no outliers but any one of the OLS assumptions are violated, then the bootstrapped OLS method could be considered. In this case, there exists multi-collinearity in the dataset, BOLS would be an appropriate method of analysis. It should be noted that *Division_Code* is not the most important among all variables, as I aim to gauge the influence of the OECD DDG across the chosen eight countries. Yet, employing various set of measures and implementing appropriate statistical procedures could enable me to gain further insights into the nature of this elusive concept. Ultimately, it is advisable to consider increasing the size of the dataset, as this approach would likely yield more accurate and reliable results.

# Chapter 5

## Conclusion

This study gauges the recognition of the Organization for Economic Cooperation and Development Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High- Risk Areas in the downstream minerals supply chains. Its empirical analysis of the OECD Guidance focuses on the top eight representatives of the G20 members and is based on the conflict minerals disclosure and relevant public representations on websites. The result reveals a due diligence gap among companies that locate in the downstream 3TG supply chains. It identifies the awareness level and degree of compliance with the OECD Guidance. A notable subset of companies demonstrated a commitment to addressing the issue of conflict minerals on their websites. However, it constitutes a relatively small proportion, with just 1.19% of companies explicitly stating their avoidance of conflict minerals. This highlights the need for continued efforts to raise awareness among downstream companies regarding the ethical and environmental implications associated with conflict minerals. With companies that exhibit compliance, a majority of them demonstrated strong adherence to the OECD Guidance. Furthermore, the geographical distribution of companies compliant with the OECD Guidance underscores the dominance of the United States and the European Union in terms of engagement with the framework. The contrast in engagement levels among countries highlights the varying degrees of importance attributed to the OECD framework in different regulatory and cultural contexts.

In conclusion, the concentration on the OECD Guidelines illuminates these companies' commitment to aligning their practices with internationally recognized standards for responsible mineral sourcing and supply chain transparency. This study contributes to a more nuanced understanding of the strategies corporations employ to navigate the complexities of conflict minerals, highlighting the prominence of the OECD Due Diligence Guidance within this landscape. While this study contributes to the understanding of corporate responses to conflict minerals and the OECD Guidance, there remains a need for ongoing research and advocacy to address the

complex challenges associated with responsible mineral sourcing. Expanding sample sizes, enhancing data quality, and exploring diverse research methodologies will contribute to a more comprehensive and accurate assessment of this critical issue.

As the global community continues to grapple with the challenges posed by conflict minerals, it is imperative for stakeholders, including governments, industry associations, and civil society organizations, to collaborate in fostering greater awareness and encouraging responsible sourcing practices. Additionally, efforts should be directed toward harmonizing international regulations and standards to create a more cohesive and effective framework for addressing the complex issue of conflict minerals.

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