BI Norwegian Business School - campus Oslo

GRA 19703

Master Thesis

Thesis Master of Science

Performance and Conflict Minerals: A study on corporate due diligence and market effects from the Dodd-Frank Act Section 1502

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Start: 15.01.2019 09.00

Finish: 01.07.2019 12.00

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Performance and Conflict Minerals:

A study on corporate due diligence and market effects from the Dodd-Frank Act Section 1502

Date of Submission:
01.07.2019

Supervisor:
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Campus:
BI Norwegian Business School, Oslo

Program:
Master of Science in Business, Major in Business Law, Tax and Accounting

Examination Code and Name:
GRA 19703 Master Thesis

This thesis is a part of the MSc program at BI Norwegian Business School. The School takes no responsibility for the methods used, results found and conclusions drawn.

Abstract

In July of 2010, the Dodd-Frank Wall Street Reform and Consumer Protection Act was signed into law. December 15th of 2010, Section 1502 was announced to be amended in the legislation. The goal behind this particular Section was to prevent funding of rebel groups in the DRC which profit from artisanal mining of conflict minerals. This thesis investigates how an amendment, such as Section 1502, affected firm value, the 3TG markets and supply chain sustainability. Through difference-in-differences estimation, we find that changes in abnormal return among firms affected by Section 1502 are not explained by firm characteristics. Our assessment is that the firm value effects were more likely due to off-balance sheet effects, such as increased information flow and other supply chain initiatives. Furthermore, the slowing effect Section 1502 might have had on the 3TG markets was more than made up for by the growing mineral demand fueled by emerging economies. Finally, we find that by 2016 most firms contract conflict free mineral processors, indicating that the amendment worked as intended in this regard.

Acknowledgement

This master thesis constitutes the final product of our MSc in Business at BI Norwegian Business School. Completing this thesis has been challenging, educational and rewarding.

We would like to express our gratitude to our supervisor, Assistant Professor Kizkitza Biguri of the Department of Accounting, Auditing and Business Analytics at BI Norwegian Business School. We would especially thank her for introducing us to the subject matter, and for the valuable input and guidance along the way.

Table of Contents

ABSTRACT ..... **II**

ACKNOWLEDGEMENT ..... **III**

1. INTRODUCTION **1**

2. BACKGROUND **2**

3. PRELIMINARY STUDY **4**

3.1 ANALYTICAL TECHNIQUE 4
3.2 RESULTS FROM THE ANNOUNCEMENT OF SECTION 1502 IN 2010. 5
3.3 RESULTS FROM THE PUBLISHED FORM SD'S IN 2014 5

4. THEORY AND HYPOTHESES DEVELOPMENT **6**

4.1 HEDGING ACTIVITIES 7
4.2 LIQUIDITY 9
4.3 LEVERAGE 10
4.4 WORKING CAPITAL MANAGEMENT 11

5. ANALYTICAL TECHNIQUES **11**

5.1 DIFFERENCE-IN-DIFFERENCES ESTIMATION OF THE ANNOUNCEMENT OF THE DODD-FRANK ACT SECTION 1502. 11
5.2 DESCRIPTIVE ANALYSES 12
5.2.1 Commodities *12*
5.2.2 Smelters Disclosed in the Published Form SD's *13*

6. DATA **13**

6.1 FIRM CHARACTERISTICS 13
6.1.1 Sample *13*
6.1.2 Treatment and Control Groups *14*
6.2 COMMODITIES 15
6.2.1 Sample *15*
6.3 SMELTERS 15
6.3.1 Sample *15*

7. DIFFERENCE-IN-DIFFERENCES ESTIMATION OF THE ANNOUNCEMENT OF SECTION 1502 OF THE DODD-FRANK ACT **16**

7.1 HEDGING ACTIVITIES 16
7.2 LIQUIDITY 18
7.3 LEVERAGE 20
7.4 WORKING CAPITAL MANAGEMENT 22

8. OTHER CONTRIBUTING FACTORS TO THE INCREASED ABNORMAL RETURN IN 2014 ..... **23**

9. DESCRIPTIVE ANALYSIS OF THE 3TG MARKETS REACTION **26**

9.1 TANTALUM 26
9.2 TUNGSTEN 29
9.3 TIN 32
9.4 GOLD 34
9.5 SUMMARY 37

10. DESCRIPTIVE ANALYSIS OF SMELTERS DISCLOSED IN THE FORM SD'S **38**

11. CONCLUSION **41**

REFERENCES **43**

APPENDICES **51**

APPENDIX 1: AVERAGE NUMBER OF CLICKS ON THE PUBLISHED FORM SD'S 51
APPENDIX 2: FULL LIST OF DEPENDENT VARIABLES AND CONTROL VARIABLES 51
APPENDIX 3: SUMMARY STATISTICS OF DEPENDENT VARIABLES 54
APPENDIX 4: AVERAGE DEBT AND TOTAL ASSETS FOR ANY CM, DERIVATIVES AND GOLD 55
APPENDIX 5: SMELTER LOCATION 55
APPENDIX 6: SMELTERS PER COMMODITY 55

List of Tables

Table 1: Treatment groups and firm-year observations 14
Table 2: Hedging 17
Table 3: Liquidity 19
Table 4: Leverage 21
Table 5: Working capital management 23

List of Figures

Figure 1: The DRC and bordering countries. 3
Figure 2: Event study 1 5
Figure 3: Event study 2 6
Figure 4: Tantalum price 28
Figure 5: Tantalum world production 28
Figure 6: Tantalum trade 29
Figure 7: Tungsten price 30
Figure 8: Tungsten world production 31
Figure 9: Tungsten production in affected countries 31
Figure 10: Tungsten trade 32
Figure 11: Tin price 33
Figure 12: Tin world production 33
Figure 13: Tin production in affected countries 34
Figure 14: Tin trade 34
Figure 15: Gold price 35
Figure 16: Gold world production 36
Figure 17: Gold production in affected countries 36
Figure 18: Gold trade 37
Figure 19: Smelters per company 39
Figure 20: Use of conflict free smelters 40

1. Introduction

The increased awareness of corporate impact on social and environmental issues was a key driver to include CSR disclosure provisions, such as Section 1502 on "conflict minerals", in the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. The growing attention towards supply chain responsibility and sustainability has therefore made companies accountable not only for their in-house operations, but their suppliers' operations as well (Kalkanci and Plambeck, 2019). This act made all companies trading on U.S. stock exchanges disclose whether any part of their supply chain uses "conflict minerals" sourced from the Democratic Republic of the Congo (DRC) or its nine bordering countries (Figure 1). Such minerals include tin, tantalum, tungsten and gold, and are often referred to as the 3TGs. The Section was included to ensure that mining of essential minerals for consumer products was not financing rebel groups in the Eastern DRC.

Several studies have tried to determine different facets of the amendment impact. Some have tried to quantify the cost of the due diligence, like Griffin, Lont and Sun (2014), while Kim and Davis (2016) investigated which organizational factors distinguished conflict free versus non-conflict free companies. Others, like Seay (2012), have focused more on the social consequences in the region where conflict minerals are extracted. In order to contribute to the existing research of Section 1502, this thesis will examine to what extent the amendment influenced the value of the affected companies, and verify the causality of the findings using a difference-in-differences estimation of firm characteristics. Furthermore, it will investigate the commodity markets' reactions and whether the amendment changed supplier policy and compliance within the mineral industry. To the best of our knowledge, this has not been done before.

This thesis proceeds as follows: Section 2 explains Section 1502 in further detail. Section 3 presents a preliminary study of the impact Section 1502 had on abnormal stock returns for the affected companies, while Section 4 reviews established economic theories on corporate policies and behaviors. The analytical techniques and data are elaborated in Section 5 and 6, and Section 7 presents key findings from the difference-in-differences estimation of firm characteristics. Section 8 discusses other confounding factors related to abnormal return. Lastly, Section 9 and 10

elaborate on how the amendment affected the 3TG markets and whether the mandated due diligence improved compliance among the affected companies' smelters.

2. Background

The Dodd-Frank Wall Street Reform and Consumer Protection Act, hereafter referred to as the Dodd-Frank Act, was signed into law by President Barack Obama on July 21st, 2010 (SEC, 2013). The legislation was a response to the financial crisis the United States of America was subject to from late 2007 to mid 2009 (Rich, 2013). The Dodd-Frank Act was, in addition to stimulate economic growth, implemented to address the fragility in the U.S. financial system. In hindsight, it is considered to be one of the most comprehensive financial reforms in history (Webel, 2017).

In addition to addressing the fragility in the U.S. financial system, the Dodd-Frank Act also included CSR disclosure provisions, such as Section 1502 on conflict minerals. The amendment was adopted by the U.S. Securities and Exchange Commission (SEC) on August 22nd, 2012 and is a product of increasing international focus on conflict minerals in consumer products (SECa, 2012). Section 1502 of the Dodd-Frank Act has a narrower definition of "conflict areas" compared to the OECD guidelines. The major difference between the two is that the OECD Due Diligence Guidelines includes all "conflict-affected and high-risk areas" whereas Section 1502 targets specific African countries (OECD, 2013 p. 12; SECb, 2012).

Figure 1: *The DRC and bordering countries.*
Illustrates countries affected by Section 1502 of the Dodd-Frank Act. From "Conflict Minerals" by Ernst and Young, 2012, p. 2, Copyright 2012 EYGM Limited

The main purpose of the Dodd-Frank Act Section 1502 was to distinguish mineral trade and conflict financing in the DRC and bordering countries. Since the American economy is characterized as being a "free market", with a low degree of restrictions or regulations on business activities, lawmakers did not want to make it strictly illegal to use conflict minerals (Lynn, 2011). It did, however, make it mandatory to disclose the 3TG country of origin to the SEC. A company is obligated to file a specialized disclosure form (Form SD) if tin, tungsten, tantalum or gold is considered necessary to the production or functionality of its product(s). They then have to "conduct in good faith a reasonable country of origin inquiry" to confirm whether the minerals originate from the DRC or bordering countries (SEC, 2019, p. 2). The results of which, are made public in an online registry. The SEC hoped public shaming would be sufficient for companies to disengage from conflict mineral trading from the DRC and bordering countries (Lynn, 2011). The first Form SDs were to be handed in May 31st, 2014, covering the calendar year of 2013. After submission, the forms would be processed, and penalties would be given by the SEC to the companies neglecting to report their findings or disclosing false information (Kim & Davis, 2016).

Section 1502 especially affected industries such as electronics and communication, aerospace, automotive, jewelry and industrial products. Small amounts of 3TG can be found in consumer products, which make it even harder to determine the origin of the minerals. The transparency solely relies on whether or not all parties involved in the manufacturing process are able to determine the origin of their minerals. It is needless to say that this process was costly for the affected companies. Estimates are ranging between $71.2 million (Bayer, 2015) and $16 billion (NAM, 2011).

3. Preliminary Study

Since estimates of the total costs of Section 1502 vary greatly, we wished to analyze its economic effects by conducting event studies on the affected firms around the date of announcement and the reporting deadline.

3.1 Analytical Technique

An event study is often used to measure the effect of an event, and how that economic event has affected the value of a firm (MacKinlay, 1997). Assuming that the market is efficient, and that Section 1502 was the only significant occurring event, one can assume that the reaction, illustrated by abnormal return, is the true effect (MacKinlay, 1997). The normal return reflects the expected return if the event would never occur. The abnormal return is therefore the difference between the actual ex post return and normal return (MacKinlay, 1997). The studies will use the constant mean return model, in other words, the X_t in the equation will be constant:

$$AR_{it} = R_{it} - E(R_{it}|X_t) \qquad (1)$$

Two event studies were conducted in relation to Section 1502. The first study was on the day of announcement in 2010, while the second was on the day the Form SD's were published in 2014. Both studies were included to ensure that all effects related to the Dodd-Frank Act Section 1502 were detected. The set up for estimation window and event window were similar, with five days prior and ten days following the event. Furthermore, the selection criteria for the firms included in both studies is the obligation to submit the Form SD.

3.2 Results From the Announcement of Section 1502 in 2010.

The Dodd-Frank Act was announced December 15th, 2010. The event window was defined as the day of the announcement and the following ten days. The result of the event study clearly indicates that the announcement of Section 1502 had an effect on the particular group of companies. The abnormal return was 2% lower than the market return in the following ten days (Figure 2).

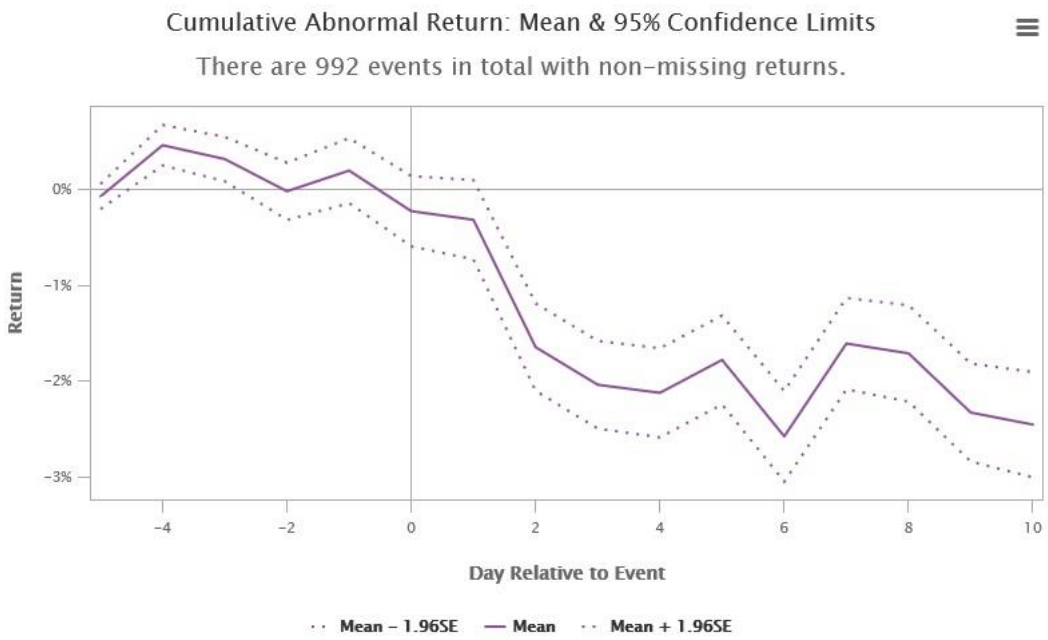

Figure 2: *Event study 1*
This figure shows the cumulative abnormal return for companies affected by Section 1502 around the announcement of the amendment.

3.3 Results From the Published Form SD's in 2014

A similar event study was conducted on May 31st, 2014, the day the Form SD's were published. The event window was defined as the publishing date and the following ten days. 2014 was the first year of mandatory filing for companies affected by Section 1502. The study showed that the companies had an increased abnormal return of 1% (Figure 3). One would assume that the market reaction was due to positive results regarding the firms' due diligence.

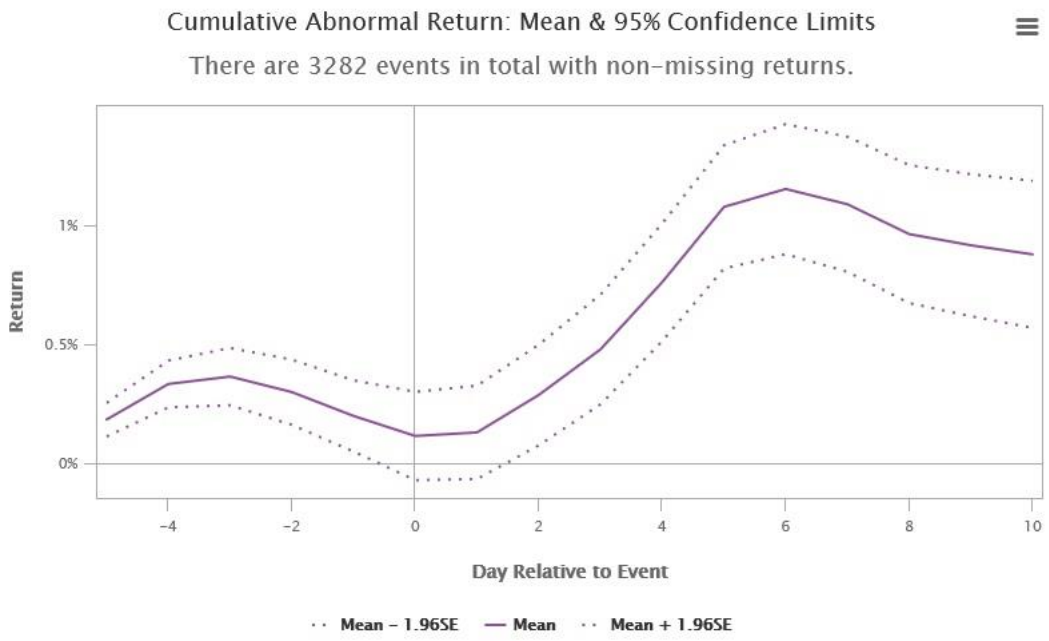

Figure 3: *Event study 2*
This figure shows the cumulative abnormal return for companies affected by Section 1502 around the date of publication of the Form SD's.

However, Appendix 1, illustrating the average number of clicks on the published Form SD's, indicates that there was a negligible interest in the contents of the disclosure forms.

4. Theory and Hypotheses Development

One of the three angles this thesis examines is whether Section 1502 had an effect on the firm value of the companies affected by the amendment. The preliminary study in the previous section showed an increased abnormal return when the Form SD's were published in 2014, despite low public interest in their contents. The thesis will therefore investigate whether the change in abnormal return could be explained by other factors, such as differences in the affected firms' financial characteristics. In this section, hypotheses are constructed for a difference-in-differences estimation of firm characteristics that may imply differences in firm value. These are defined as the firms' hedging activities, liquidity, leverage and working capital management.

4.1 Hedging Activities

Financial hedging is the practice of reducing the risk of a position by combining it with a hedging instrument. Such instruments can be options, futures, forwards and swaps (Dimitris, 2008, p. 75).

An option is a contract between two parties that gives the buyer the opportunity to exercise a certain right. The price for which this option can be exercised is called the strike price. The buyer of the option pays the writer (seller) a premium for taking on the associated risk that comes with granting the option. If the buyer/seller of a given asset is worried that the market price will change in his/her disfavor, he/she can buy the option to buy/sell the asset for a set price within a certain date, called the expiration date. An option is named as such due to the fact that the owner is not obliged to exercise the right, but has the opportunity to do so. The owner of the option will only exercise it as long as it is in their interest (Dimitris, 2008, p. 149). Because the option limits the potential downside of the transaction, it hedges the position of the owner.

Historically, hedging has played a large role in commodity markets, often through forward and futures contracts. In a commodity setting, a forward contract is a binding obligation by a seller to deliver a certain quantum of goods, at a given time, to a certain price. The deal is bilateral, meaning the details are worked out between the two parties. Unlike options contracts, the parties in a forward contract are obliged to fulfill their part of the agreement come maturity. By using a forward contract, the hedger can effectively eliminate the volatility of the asset's price.

Futures contracts are quite similar to forward contracts in how they work. The main differences are that futures are standardized contracts that are traded on an exchange. These contracts are marked to market on a daily basis and very liquid, which make them popular among speculators who wish to bet on the price movements of an underlying asset. Therefore, futures contracts are often closed before they reach maturity, meaning no actual movement of goods is taking place.

"A swap is a financial transaction in which two counterparties agree to exchange streams of payment over time" (Dimitris, 2008, p. 295). Swaps are complex and

come in many different varieties. One of the most common types are interest rate swaps. One party agrees to pay a fixed rate, that is agreed upon in advance, and receives a floating rate. The other party will pay the floating rate and receives the fixed rate. One party benefits and the other one loses, depending on which of the rates are lower as time passes (Gottesman, 2016, p. 252). A company that is worried about rising interest rates on its obligations might hedge against this risk by swapping for a fixed rate with a second party. Such swaps can also be performed with each party operating in a different currency, usually referred to as currency swaps.

Even though financial hedging is commonly practiced, literature on the causal effects of hedging is scarcer, and results vary. Through analyzing American and Canadian oil & gas companies, Gilje and Taillard found that firms who experience an exogenous drop in hedging effectiveness have significantly lower stock returns than those unaffected. This relationship is even stronger for highly levered firms (2017, p. 4083-4085). They conclude that hedging has a positive effect on return, to varying degrees of leverage.

Alayannis & Weston (2001) examined Compustat data for 720 non-financial, large U.S.-firms that faced credit risk in their operations. They discovered that firms who used foreign currency derivatives were valued 4.87% higher by shareholders than companies that did not hedge using such derivatives. They further found evidence that firms who discontinued their hedging policies had a decrease in firm value compared to those that chose to continue, and those who initiated a hedging policy increased in value compared to those that remained unhedged.

Others have found that hedging has real cash effects but question the extent to which it affects firm value. Guay & Kothari (2003) estimated how much cash a firm's derivative portfolio generates. The median payout among 234 companies was considered small compared to respective operating cash flows, even in the unlikely event that underlying risk factors moved by three standard deviations. They concluded that "non-financial firm's derivatives are not large enough to have noticeable effect on stock return volatility" (p. 427). This brings us to the first hypothesis of this thesis:

H1: Affected companies are expected to engage in significantly more hedging activities after treatment.

4.2 Liquidity

"Liquid assets are usually defined as assets that can be quickly and easily converted into cash in the market at a reasonable cost" (Soprano, 2015). A firm's liquidity is measured by its access to such assets.

There are numerous economic theories for why companies hold liquid assets. According to Gill, the most liquid asset is considered to be cash, which measures the company's ability to pay its obligations on time (2012 p. 71). Keynes (1936) states that there are three main motives for companies to hold cash: The transaction motive, the precautionary motive and the speculative motive. The transaction motive constitutes the need of cash for current transactions. By holding cash, a company may continue business as usual even if there are low cash flows and difficulties getting external financing. The precautionary motive illustrates a need for protection from future uncertainties in prices and idiosyncratic risk. A company may try to secure a given amount of a commodity or resource for a certain price. Finally, the speculative motive entails trying to speculate on fluctuations of future profit, by knowing future outlooks better than the market.

Bates, Kahle and Stulz (2009) present findings which are in line with the general economic and financial theory of why companies hold cash. They argue that the increase in cash holdings correlate with the precautionary motive and changes in firm characteristics and business environment. First, they found that an increase in cash holdings could be explained by companies experiencing an increase in cash flow volatility. Second, they found that firm characteristics were their main reason for the increase in cash holdings. The independent variables used in their model are based on research conducted by Opler, Pinkowitz, Stulz and Williamson (1999), which consisted of variables such as: market-to-book ratio, firm size, cash flow-to-assets, leverage and NWC-to-assets. Bates et al. (2009) found that the companies indeed had a precautionary motive for the increase in cash holdings, and that firm characteristics largely explain the change in demand for cash. Furthermore, Lam,

Ma, Wang and Wei (2015) found a significant positive relation between high cash holding and abnormal stock returns and correspondingly low abnormal return for low cash holding. This brings us to the second hypothesis:

H2: Affected companies are expected to have an increased liquidity after treatment.

4.3 Leverage

The most common economic theory on capital structure is Modigliani and Miller's (1985) proof of irrelevance theory. The main take-away from their theory is that the capital structure of a company in a complete and perfect capital market is irrelevant for the market value of the firm. Their theory is based on a number of assumptions which argues that the firm value is solely determined by decisions affecting the asset side of the balance sheet, hence the rate of return on assets. The assumptions proposed by Modigliani and Miller have been questioned since the publication of the research article. Barklay, Smith and Watts (1995) argue that the set assumptions for the irrelevance theory are restricted to conditions that do not hold in the real-life capital market. In addition, later research has indeed showed that there exists an optimal capital structure. Jensen and Meckling (1976) argues that ownership structure is the main determinant for the optimal capital structure. Based on the agency cost model, they showed that there is a combination between optimal equity and debt which maximizes the firm's value by minimizing the agency cost.

Ross (1977) researched whether signaling could have an effect on capital structure. He argues that changes in a company's leverage can affect the market's perception of the firm's risk. These signaling effects can therefore be a tool for managers to increase the company's value by signaling positive future outlooks to the market with higher financial leverage. This argument is also supported by Barklay et al. (1995) with announcements of transactions of a leverage-increasing manner, and vice versa. They argue that if a company adds more debt to their capital structure then this announcement serves as a signal for a future with increased cash flows. Furthermore, Bhandari (1988) proves with empirical evidence that expected return is positively related with leverage for manufacturing firms. The findings are in

conjunction with the established economic theory, and brings us to the second hypothesis:

H3: Affected companies are expected to be significantly more levered after treatment.

4.4 Working Capital Management

The cash conversion cycle (CCC) is, as a dynamic measure of liquidity, often used to indicate working capital management. While a more traditional measure, such as net working capital, is a static number measured in currency, CCC expresses the amount of days it takes to recover a cash expenditure with cash income. It is calculated by adding days in inventory with days in accounts receivables, and subtracting days in accounts payables (Jose, Lancaster & Stevens, 1996). Jose et. al studied Compustat data from 2718 U.S. firms, and found an inverse relationship between the cash conversion cycle and profitability. This means that a firm may increase profitability by lowering its CCC. This held true for several industries, including natural resources and manufacturing, but only up to a certain point. A short inventory holding period is related to higher opportunity costs, because the firm risks being out of stock and unable to deliver on customer orders. Too few days in receivables will alienate customers that prefer more credit, while too many days in accounts payables will lower flexibility and potential supplier discounts. The final hypothesis is:

H4: Affected companies are expected to have a significantly lower CCC after treatment.

5. Analytical Techniques

5.1 Difference-in-Differences Estimation of the Announcement of the Dodd-Frank Act Section 1502.

In order to test whether a change in state policy had an effect on a specific group of firms, a difference-in-differences estimation of causal effects proves sufficient (Callaway and Sant'Anna, 2018). In the context of this thesis, the test will be used to measure differences in firm characteristics, based on financial data, between the

firms affected by Section 1502 and accompanying control groups. This section will present the model for estimating the outcome on numerous dependent variables corresponding with the hypotheses presented in Section 4.

The general equation used for a diff-in-diff estimation is presented below:

$$Y_{it} = \alpha + \beta T_{it} + \gamma t_{it} + \delta\,(T_{it} * t_{it}) + \varepsilon_{it} \qquad (2)$$

$\mathbf{T_i}$ = takes the value 1 for companies affected by Section 1502

$\mathbf{t_i}$ = takes the value 1 for the time period after Section 1502 was announced

The $\boldsymbol{\delta}$ constitutes the true treatment effect of the policy change, the $\boldsymbol{\beta}$ accounts for the average difference between the treatment and control group and the $\boldsymbol{\gamma}$ constitutes the time trend for both the treatment and control groups (Albouy, 2004).

Furthermore, the model used in this thesis also includes firm and time fixed effects and controls:

$$Y_{it} = \alpha + \beta T_{it} + \gamma t_{it} + \delta\,(T_{it} * t_{it}) + \theta X_{it} + \mu_t + \sigma_i + \varepsilon_{it} \quad (3)$$

The intuition of this equation (3) is the same as (2), but now we have included a term for control variables for firm characteristics, $\boldsymbol{X_{it}}$, $\boldsymbol{\mu_t}$ for time fixed effects and $\boldsymbol{\sigma_i}$ for firm fixed effects. The control variables are intended to increase the precision of the average treatment effect (ATE). That is, we want to control for effects that are not directly related to Section 1502 and the treatment groups. The control variables for the four classifications are chosen because they are known to be determinants for each firm characteristic. See Appendix 2 for a full list of the dependent variables in each firm characteristic classification and corresponding control variables. Adding firm and time fixed effects allows us to control for observed and unobserved confounders, which makes the estimates more credible (Strumpf, Harper, Kaufman, 2006).

5.2 Descriptive Analyses

5.2.1 Commodities

The descriptive analysis of tantalum, tungsten, tin and gold, will provide insights on how the global 3TG markets reacted to the announcement of Section 1502. The focus will be on changes in price, production and trade. In regard to production and

trade, the analysis will specifically focus on changes connected to the DRC and bordering countries. The time period, 2000 - 2017, will provide insights on underlying trends prior to 2010 and the possible reactions related to Section 1502 of the Dodd-Frank Act in 2010 and later.

5.2.2 Smelters Disclosed in the Published Form SD's

A descriptive analysis of the companies' smelters will provide insights on how the affected companies responded to the outcome of the supply chain due diligence. The analysis is based on the filed Form SD's from 2014 - 2018 and mainly focus on the two most relevant dimensions for supply chain complexity, the total number of suppliers and their differentiations. Furthermore, the analysis will try to shed light on whether the supply chain due diligence increased the level of conflict free companies.

6. Data

6.1 Firm Characteristics

6.1.1 Sample

The sample is based on U.S. firms that are publicly traded on the major U.S. Stock Exchanges. The firms' financials are gathered from the Compustat annual database over the period 2005 - 2016. All firm-year observations from the transportation and public utility sector (SIC codes 4900-4999) and finance, insurance and real estate sector (SIC 6000-6999) are removed from the sample. In order to define the treatment groups for the difference-in-differences estimation, the Compustat dataset is merged with a dataset consisting of firms filing the Form SD in 2014-2018 and companies who disclosed usage of the 3TG in their 10-K's.

To construct the sample for the difference-in-differences estimations, all firm-year observations except for the years 2009-2013 were dropped. The pre-treatment period was set to the year 2009 while the post-treatment periods include one short from 2010-2011 and one long from 2010-2013. A post-period is intended to only observe the specific changes in the dependent variables related to the announcement of the Dodd-Frank Act Section 1502. The long post-period can therefore threaten the validity, as the likelihood of the period containing confounding factors increases

(Yamamoto, 2016). However, a long post-period was deemed necessary since the disclosure date in 2014 might have delayed the affected companies' reaction to the amendment.

The final sample consists of 5,075 companies and 18,864 company-year observations. Appendix 3 presents the summary statistics of the variables with statistically significant results.

6.1.2 Treatment and Control Groups

After the sample creation, we constructed the treatment and control groups for the first difference-in-differences estimation. First, we constructed dummy variables for firms exposed to any or a particular conflict mineral. Second, we constructed a dummy variable for reporting firms. In total, we ended up with six treatment groups presented in Table 1.

Any CM	4,396
Form SD	5,098
Derivatives	3720
Tantalum	259
Gold	3,354
Tungsten	417

Table 1: *Treatment groups and firm-year observations*

The first treatment group, Any CM, consists of all companies exposed to any of the 3TGs. The second consists of companies filing the Form SD, also referred to as reporting firms, in the period between 2010 and 2014. Furthermore, the 3TGs consists of two minerals, tin and gold, which are traded on a derivative market. Based on the assumption that the companies exposed to these two minerals have a similar treatment effect, we found it reasonable to include companies exposed to these minerals in one treatment group. The remaining three treatment groups consist of companies exposed to tantalum, tungsten and gold respectively. The standard set-up for a difference-in-differences estimation is that the control group consists of all the other observations which are not a part of the treatment group. There are therefore one corresponding control group for each treatment group.

6.2 Commodities

6.2.1 Sample

The descriptive analysis of the 3TG markets reactions to Section 1502 is based on historical statistics on price, production and trade for each commodity. The datasets contain yearly observations for the time period 2000-2017. The 3TG prices are gathered from Metalary.com, a database with historical metal prices. Furthermore, the production volumes are gathered from The British Geological Survey (BGS), which provides country-specific statistics on production of the 3TG per country. Finally, the reported trade from the affected countries are gathered from the UN Comtrade database with historical statistics of global trade data.

Conversely, the export statistics reported by the DRC and bordering countries did not correspond with the import statistics reported by international countries. Previous research has proven occurrences of inter-regional smuggling and lack of monitoring of the origin of the commodities (Mancheri et al., 2018, p. 57). The datasets for conflict minerals trade from the DRC and bordering countries are therefore based on reported import by other nations. The BGS and the UN Comtrade database both provide statistics on reported import from the DRC and bordering companies. There was, however, a discrepancy between the two datasets. The datasets from the UN Comtrade database appeared more reliable since there were trade-year observations missing in the BGS statistics.

6.3 Smelters

6.3.1 Sample

The sample for the descriptive analysis of the smelters is based on data from the Form SD's filed to the SEC in 2014-2018. The Form SD is, as already mentioned, the specialized disclosure reports all companies affected by Section 1502 had to file. The Form SD data was merged with corresponding data on a third-party audit. The audit-data was gathered from the Responsible Minerals Initiative (RMI), which determines and verifies which smelters and refiners are in line with the global standard of responsible mineral sourcing. The sample consists of 554 unique U.S.-listed companies and 125 unique smelters disclosed in the Form SD's.

The limitations to this analysis are the lack of comparable data prior to 2014 and smelters being the only reported part of the supply chain. The analysis will therefore not be able to see any significant changes in the companies' supply chain made in the period between the announcement date and the submission deadline. In addition, the supply chain from miners to the mineral traders is not accounted for.

7. Difference-in-Differences Estimation of the Announcement of Section 1502 of the Dodd-Frank Act

7.1 Hedging Activities

In this section we measure the impact of the Dodd-Frank Act Section 1502 on firm hedging policy. In our model, we estimate the probability of the firms using different hedging activities sorted by type (futures, forwards, swaps, options and other derivatives) and by their exposure (interest rate, foreign exchange and commodity). See Appendix 2 and 3 for the full variable list and summary statistics, and Section 6.1.2 for an explanation of the different treatment groups.

Table 2: Hedging

	Pre-period = [2009], Post-period = [2010-2011]						Pre-period = [2009], Post-period = [2010-2013]				
Dependent variables:	Hedge				Futures		Hedge			Commodity	Futures
	(1)	(2)	(3)	(4)	(5)	(6)	(5)	(6)	(7)	(8)	(9)
ATE Form SD	-0.0846***						-0.173***				
	(0.0155)						(0.0151)				
ATE Tantalum		-0.137***			-0.00288*			-0.305***		-0.00582*	-0.00353*
		(0.0514)			(0.00168)			(0.0625)		(0.00299)	(0.00154)
ATE Gold			0.0362*								
			(0.0191)								
ATE Tungsten				-0.0801**		-0.00282*			-0.168***		
				(0.0376)		(0.00156)			(0.0467)		
Lsize	0.00645	0.00525	0.00487	0.00501	-0.000862	-0.000869	0.00126	6.68e-05	-0.000167	0.000898	-0.000399
	(0.00626)	(0.00622)	(0.00621)	(0.00622)	(0.000923)	(0.000923)	(0.00357)	(0.00355)	(0.00356)	(0.00118)	(0.000705)
cashflow_at	0.00413*	0.00381	0.00416*	0.00427*	0.000123	0.000127	-0.00147	-0.00152	-0.00144	-4.83e-05	5.56e-05
	(0.00249)	(0.00248)	(0.00244)	(0.00245)	(0.000333)	(0.000332)	(0.00177)	(0.00174)	(0.00175)	(0.000430)	(0.000246)
Market-/Book value	0.000348	0.000311	0.000320	0.000319	-4.07e-06	-4.14e-06	-0.000142	-0.000169	-0.000177	2.68e-05	-6.78e-07
	(0.000229)	(0.000230)	(0.000230)	(0.000230)	(3.60e-05)	(3.60e-05)	(0.000128)	(0.000129)	(0.000129)	(5.37e-05)	(2.70e-05)
cash_inv_pct	0.00746	0.00931	0.00945	0.00910	0.00520	0.00520	-0.0336	-0.0311	-0.0306	-0.00540	0.00283
	(0.0387)	(0.0385)	(0.0384)	(0.0385)	(0.00489)	(0.00489)	(0.0248)	(0.0248)	(0.0248)	(0.00695)	(0.00492)
Tangibility	0.0218	0.0311	0.0310	0.0299	0.0114	0.0114	-0.00763	0.000931	0.00245	0.000188	0.00635
	(0.0689)	(0.0686)	(0.0686)	(0.0685)	(0.00879)	(0.00880)	(0.0381)	(0.0382)	(0.0382)	(0.0121)	(0.00502)
Observations	11.392	11.392	11.392	11,392	11,392	11,392	18,864	18,864	18,864	18,864	18,864
Clustered SE	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Firm&Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table reports difference-in-differences estimation results for the average treatment effect (ATE) from Section 1502 of the Dodd-Frank act on different hedging activities. An explanation of each variable, and how they are computed, is given in Appendix 2. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

As shown in Table 2, our tests show that firms submitting the Form SD's are significantly less likely to engage in hedging activities after treatment. This effect is even stronger among the firms that were exposed to tantalum. A coefficient of -0.137 in specification (2) indicates that these firms were 13.7% less likely to hedge in the short period. In the long period, these firms were 30.5% less likely to hedge, as seen in specification (6). While the hedging dummy is the collective term, there are also significant negative differences in the dummy variables *commodity* and *futures*. It is important to stress that, while *futures* is significant for the tantalum treatment group, these futures do not have tantalum as an underlying asset, simply because there is no futures market for tantalum. The treatment coefficient for commodity is significant in the long period only. Because the difference-in-differences test is cumulative in nature, the long period will naturally have a larger magnitude, given that the trend continues. In a longer period, there could also be more events that may occur with confounding properties, which lowers the accuracy of the findings (Yamamoto, 2016). This does not necessarily mean that results that are significant in the long period, but not in the short, should be overlooked. Actions taken in response to Section 1502 might have been delayed with a couple of years, given that the reporting firms had four years to prepare for the submission deadline. All of the aforementioned results are contradictory to Hypothesis 1, which expected hedging to increase among the affected firms. Therefore, hedging cannot explain the increase in abnormal return in 2014 and Hypothesis 1 is consequently discarded.

7.2 Liquidity

This section measures to what degree the announcement of Section 1502 impacted the firms' liquidity. The results in Table 3 shows that two out of five treatment groups had significant average treatment effects, and that the two dependent variables with statistically significant results were net cash percentage and net working capital. See Appendix 2 for all tested dependent variables related to the firms' liquidity, Appendix 3 for summary statistics and Section 6.1.2 for an explanation of the treatment groups.

Table 3: Liquidty

	Pre-period = [2009], Post-period = [2010-2011]	Pre-period = [2009], Post-period = [2010-2013]	
Dependent variables:	Cash pcnt	Cash pcnt	NWC
	(1)	(2)	(3)
ATE Form SD			0.0757*
			(0.0437)
ATE Tantalum	0.0934**	0.0290*	
	(0.0438)	(0.0174)	
lsize	0.489***	0.0329***	0.794***
	(0.0760)	(0.00332)	(0.0651)
cashflow_at	(0.00302)	-0.00142	0.649***
	(0.0534)	(0.00228)	(0.0571)
mkt_to_book	0.0071***	0.000695***	0.000746
	(0.0024)	(0.000122)	(0.00159)
book_lev	0.292***	0.0183***	-1.209***
	(0.109)	(0.00468)	(0.0986)
Observations	11,392	18,864	18,864
R-squared	0.875	0.819	0.901
Clustered SE	Firm	Firm	Firm
Firm&Year FE	Yes	Yes	Yes

This table reports difference-in-differences estimation results for the average treatment effect (ATE) from Section 1502 of the Dodd-Frank act on different liquidity measures. An explanation of each variable presented, and how they are computed, is given in Appendix 2. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

The coefficients 0.0934 and 0.0290 in specification (1) and (2) indicate that companies exposed to tantalum had on average a 9.34 and 2.90 higher net cash percentage after the treatment. The coefficient for net cash percentage decreases from the short post-period to the long post-period. Two plausible explanations for the decrease could either be that the treatment group no longer needed an extensive amount of cash or the control group increased their cash percentage. Another interesting result in the long post-period was that the dependent variable for net working capital, became statistically significant for reporting firms. This treatment group had a 7.57 percentage point increase in net working capital. One can argue that a plausible reason for why this dependent variable became significant in the long post-period was a delay in actions taken by the reporting firms.

The due diligence mandated by Section 1502 proved to have significant costs, which is more thoroughly explained in Section 8. The results might therefore be partially explained in conjunction with commodity prices (Section 9) and the cost of the required supply chain due diligence. The general presumption for Hypothesis 2 in Section 4.2 was that the affected companies would have an increase in liquidity. It is, therefore, surprising that the only treatment groups with significant results were reporting firms and companies exposed to tantalum. The results of the tests are therefore to a degree consistent with Hypothesis 2.

Furthermore, empirical studies have established a positive relationship between cash holdings and stock return. The on average higher net cash percentage can therefore be a contributing factor for the increased abnormal return in the preliminary study in Section 3.3. On the other hand, one can also argue that increased liquidity for two treatment groups alone cannot be the sole explanation for the positive abnormal return in 2014.

7.3 Leverage

This section measures to what degree the announcement of Section 1502 impacted the firms' leverage. The results, as displayed in Table 4, reveals that four out of six treatment groups had significant average treatment effects and that both dependent variables tested were statistically significant.

The average treatment effects on the book value of leverage in the short period (long period) were on average 5.52 (5.81), 7.07 (7.76) and 5.87 (6.33) lower for the treatment groups Any CM, Derivatives and Gold, respectively. See Section 6.1.2 for an explanation of the treatment groups and Appendix 2 and 3 for the list of variables and summary statistics. The decrease in book value leverage ratios for the treatment groups were mainly due to a higher increase in total assets than debt (Appendix 4). An interesting observation for the long post-period was that the market value of leverage became significant for reporting firms. These companies had on average a 1.12 lower market value leverage ratio after the treatment.

Table 4: Leverage

	Pre-period = [2009] Post-period = [2010-2011]			Pre-period = [2009] Post-period = [2010-2013]			
Dependent variabes:	Book_lev			Book_lev			Mkt_lev
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATE All CP	-0.0552*			-0.0581*			
	(0.0321)			(0.0300)			
ATE Form SD							-0.0112*
							(0.00618)
ATE Derivatives		-0.0587*			-0.0633**		
		(0.0331)			(0.0310)		
ATE Gold			-0.0706**			-0.0776**	
			(0.0356)			(0.0331)	
lsize	0.367***	0.367***	0.367***	0.365***	0.365***	0.365***	0.0237***
	(0.0401)	(0.0401)	(0.0401)	(0.0215)	(0.0215)	(0.0215)	(0.00365)
cashflow_at	-0.208***	-0.208***	-0.208***	-0.213***	-0.213***	-0.213***	0.00583**
	(0.0312)	(0.0312)	(0.0312)	(0.0164)	(0.0164)	(0.0164)	(0.00242)
mkt_to_book	0.00665***	0.00666***	0.00666***	0.00696***	0.00696***	0.00696***	0.00261***
	(0.00110)	(0.00110)	(0.00110)	(0.000737)	(0.000737)	(0.000737)	(0.000138)
cash_inv_pct	0.557***	0.557***	0.556***	0.710***	0.710***	0.710***	-0.0674***
	(0.215)	(0.215)	(0.215)	(0.128)	(0.128)	(0.128)	(0.0211)
Dummy_hedge	-0.0333	-0.0330	-0.0324	0.0199	0.0204	0.0208	0.00962**
	(0.0217)	(0.0217)	(0.0217)	(0.0154)	(0.0154)	(0.0154)	(0.00383)
tangibility	1.945***	1.945***	1.945***	1.755***	1.755***	1.755***	0.0903***
	(0.366)	(0.366)	(0.366)	(0.202)	(0.202)	(0.202)	(0.0312)
Observations	11,392	11,392	11,392	18,864	18,864	18,864	18,864
R-squared	0.934	0.934	0.934	0.896	0.896	0.896	0.864
Clustered SE	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Firm&Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table reports difference-in-differences estimation results for the average treatment effect (ATE) from Section 1502 of the Dodd-Frank act on firm leverage. An explanation of each variable presented, and how they are computed, is given in Appendix 2. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Results from a shorter post-period is often more reliable since the result is less likely to be subjected to other confounding factors. Since the Form SD's were not due before 2014, there is reason to believe that the significant result for reporting firms in the long post-period is a lagged reaction to Section 1502.

The aforementioned results contradict Hypothesis 3 in Section 4.3, stating that the affected companies would be significantly more levered after the treatment. Established economic theory indicates that higher leverage, in other words increased risk, is linked to a higher expected firm value. Based on the theory, the

findings in this difference-in-differences estimation shows that leverage does not explain the increased abnormal return in 2014.

7.4 Working Capital Management

In this final section of the difference-in-differences estimation we measure the impact of the Dodd-Frank Act Section 1502 on working capital management. The full list of dependent and control variables used in the test are listed in Appendix 2. Of all the dependent variables regressed, there were significant differences in the number of days that goods spend in inventory (Table 5). These treatment effects are only significant in one of the two periods. In the short period, the treatment coefficient for reporting firms is -0.000146 as seen in specification (1). The interpretation is that reporting firms had their goods, on average, 0.000146 days fewer in inventory after treatment. This equivalates to 12.6 seconds. For the firms exposed to tantalum in specification (2) the coefficient translates to 16.8 seconds less. As previously discussed in Section 4.4, fewer days in inventory lowers the carrying cost of goods and an aggressive working capital improves profitability. The average treatment effects for these groups are no longer significant by the long period. Instead, the inventory days have a significant increase in the treatment groups for Gold and Derivatives. The coefficients in specification (3) and (4) indicate an increase in inventory time of 21.9 and 24.1 seconds, respectively. Such an increase is associated with an increase in the working capital management, and contradicts Hypothesis 4, which is consequently discarded.

Table 5: Working Capital Management

	Pre-period = [2009], Post-period = [2010-2011]		Pre-period = [2009], Post-period = [2010-2013]	
Dependent vatiables:	Days_inv		Days_inv	
	(1)	(2)	(3)	(4)
ATE Form SD	-0.000146*			
	(8.82e-05)			
ATE Tantalum		-0.000195*		
		(0.000101)		
ATE Derivatives			0.000253*	
			(0.000149)	
ATE Gold				0.000279*
				(0.000164)
lsize	-0.000472***	-0.000475***	-0.000542***	-0.000542***
	(0.000127)	(0.000127)	(7.54e-05)	(7.54e-05)
cashflow_at	2.91e-05	3.04e-05	7.46e-05	7.47e-05
	(7.51e-05)	(7.54e-05)	(5.15e-05)	(5.15e-05)
mkt_to_book	4.44e-06	4.44e-06	7.44e-06***	7.44e-06***
	(3.51e-06)	(3.51e-06)	(2.29e-06)	(2.29e-06)
cash_inv_pct	0.00106*	0.00107*	0.00135***	0.00135***
	(0.000646)	(0.000646)	(0.000453)	(0.000453)
tangibility	-0.000968	-0.000960	-0.00105	-0.00105
	(0.00116)	(0.00116)	(0.000679)	(0.000678)
Observations	11,392	11,392	18,864	18,864
R-squared	0.853	0.853	0.790	0.790
Clustered SE	Firm	Firm	Firm	Firm
Firm&Year FE	Yes	Yes	Yes	Yes

This table reports difference-in-differences estimation results for the average treatment effect (ATE) from Section 1502 of the Dodd-Frank act on different working capital measures. An explanation of each variable presented, and how they are computed, is given in Appendix 2. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

8. Other Contributing Factors to the Increased Abnormal Return in 2014

The findings from the difference-in-differences estimation on firm characteristics did not provide sufficient results for why the abnormal return increased in 2014 (Section 3.3). This means that there must have been other contributing factors that caused the positive market reaction. This section will discuss other factors related to the supply chain and their possible impact on positive abnormal return.

Previous research has indicated an increased attention to the benefits of managing supply chain risk. These benefits have compelled firms to be more proactive than passive in relation to actively managing risk connected to the supply chain (Tang and Musa, 2010). Giannakis and Papadopoulos (2015) also argue that the increased attention to supply chain risk management has been primarily driven by a growing consumer awareness of the impact supply chains have on social and environmental issues. The growing attention towards supply chain responsibility and sustainability has made companies accountable for their suppliers' operations in addition to their in-house operations (Kalkanci and Plambeck, 2019).

Kim, Wagner and Colicchia (2019) tried to determine the financial consequences of scandals related to supply chain risk and found that there was a negative market reaction. The cost of managing supply chain risk is perceived as off-balance sheet liabilities (Griffin, Lont and Sun, 2014). A significant amount of off-balance sheet liabilities can be essential for an investor in a decision-making process, since it is harder to determine the magnitude of the cost. On the other hand, allocating resources to supply chain sustainability activities can enhance a firm's competitiveness and increase its value, which in turn leads to more sustainable supply chains (Giannakis and Papadopoulos, 2015). Wang and Sarkis (2013) argue that investments in supply chain sustainability activities are considered long-term investments since the payoff does not occur immediately. In the case of Section 1502, the event study for 2014 showed a positive abnormal return when the Form SD's were published (Section 3.3). One could therefore argue that this increase is the related financial reward for the due diligence process in 2010 - 2014.

Kalkanci and Plambeck (2019) argue that in cases where the supply chain impact is severe, companies will take steps regardless of cost and public awareness because the cost, when known, will be higher if they refrain from taking action. In these cases, a mandatory disclosure is not needed because the companies will act regardless. On the other hand, they argue that a mandatory disclosure can force companies to take action when they usually would not allocate resources to reduce the supply chain impact.

Section 1502 forced the affected companies to increase their supply chain due diligence and were therefore subject to the high costs it entails. The National Association of Manufacturers estimated in 2011 that the total cost of the due diligence activities would be between $9-$16 billion (NAM, 2011), while Bayer and de Buhr (2011) estimated the cost to $8 billion. Furthermore, in 2010 the SEC initially estimated the cost to be $71,2 million and in 2012 re-estimated it to be closer to $4 billion (SEC, 2010, p. 78; 2012, 240). The lack of consistent estimates of the costs of the due diligence could be an explanatory factor for the investors' perception of the affected companies in 2010. Furthermore, a mandatory disclosure could be a contributing factor to the increased abnormal return in 2014. As previously mentioned in Section 3.3, the interest in the published Form SD's was negligible. The results therefore suggest that the disclosed information was not the factor which increased the abnormal return, but rather the compliance the companies showed by filing the Form SD. The disclosure increased the companies' information flow and perceivably decreased the risk of omitted information regarding supply chain risk. One could therefore argue that the increased awareness and the mandatory disclosure positively increased the investors' perception of the reporting firms.

Furthermore, Schiller (2018) highlights that global supply chains can benefit from implementing new governmental policies. Suppliers with foreign corporate customers are more likely to adopt the implemented foreign policies and, therefore, increase the overall environmental and social performance. The International Conference on the Great Lakes Region implemented the Regional Initiative against the Illegal Exploitation of Natural Resources (RINR) in December of 2010 (ICGLR, 2019). In addition, the China Chamber of Commerce of Metals, Minerals and Chemicals Importers and Exporters launched their initiative, Guidelines for Social Responsibility Outbound Mining Investment, in October 2014 (CCCMMC, 2015). The targeted countries and one of the most significant suppliers of minerals to the U.S. have taken steps in order to be more in line with the announced amendment in their corporate customer country. These initiatives benefit the affected companies in the U.S. and the overall supply chain sustainability.

There are reasons to believe that the underlying factors for the positive abnormal return in 2014 could be due to supply chain initiatives rather than changes in firm characteristics. Kalkanci and Plambeck (2019) argue that mandatory disclosures can decrease an investors valuation of a company due to high expected costs related to managing supply chain risk. The negative abnormal return in 2010 was most likely due to investors' perception of the expected cost of the mandatory due diligence. On the other hand, the mandated disclosure increased the companies' information flow and perceivably decreased the risk of omitted information regarding supply chain risk in 2014. Although the discussion indicates that companies "do well by doing good" (Falck and Heblich, 2007, p. 1) we encourage researchers to further investigate the link between due diligence and increased abnormal return to provide substantial evidence for this link.

9. Descriptive Analysis of the 3TG Markets Reaction

This descriptive analysis intends to shed light on the real effects Section 1502 had on the global 3TG markets. It is reasonable to assume that an amendment particularly targeting what is perceived to be the major producers of the specific commodities would have an effect on the 3TG trade. As mentioned in Section 5.2.1, the analysis focuses on the price, production and trade of tantalum, tungsten, tin and gold.

An underlying factor, which needs to be addressed, is the mineral commodity boom from 2003/2004 - 2014 (Mothersole, 2019). The boom in mineral trading was largely due to an increased demand for certain minerals in China and other emerging economies (Radetzki, 2012). Just like previous commodity booms, increased demand resulted in higher commodity prices (Radetzki, 2006).

9.1 Tantalum

The U.S. Geological Survey (USGS) reported in 2015 that the affected countries had from 2000 to 2014 increased their share of world production from approximately 21% to 67% and, therefore, becoming the leading producers of mined tantalum (Bleiwas, Papp & Yager, 2015). Humphries (2015) states that the U.S. is one of the leading consumers of tantalum and relies on importing this mineral in order to meet the domestic demand. The USGS also report that there has

been no significant domestic mining of tantalum since 1959 (2019 p. 164). There are therefore compelling arguments for Section 1502 to have market effects related to the price, production and trade of tantalum.

Findings

The price for tantalum peaked in 2011 with an increase of 230% from 2010 (Figure 4). The rapid increase in price can be explained by the continuous growing demand of tantalum, especially in emerging economies, as it is irreplaceable in many electronic products (Mancheri et al., 2018). Furthermore, the volumes reported by the British Geological Survey indicate that the affected countries represented a negligible percentage of world tantalum production up to 2006. In the period of 2006 to 2010 the share increased to approximately 47%. Tantalum is a rare mineral, and large deposits are found only in a few countries. Even fewer are extracting the mineral. At the time of the announcement of Section 1502, the tantalum market was highly concentrated, and the companies that wished to acquire conflict free tantalum had few options. This likely contributed to the sharp increase in tantalum prices (Moreno, 2011). There was, however, no noteworthy effect on the production volume in the affected countries. During the following two years after the announcement of the Dodd-Frank Act, the share reached 73% of world production (Figure 5). The increase was mainly fueled by the DRC and Rwanda. The production has continued to grow every year since, but no longer constitutes the majority of world production, after a major increase in world production driven by Brazil. This was probably prompted by high tantalum prices in the period that made extraction more profitable. There is no indication that the production level was affected by Section 1502 in 2010 or later.

The analysis of the country-specific import data from the affected countries shows that China was the main importer of tantalum from 2002 to 2012. China, with its growing demand for commodities, was one of the emerging economies that caused the commodity boom in 2003/4. The U.S. did not report any import from the affected countries in the years prior to Section 1502 but they did, however, import a small amount in the years after (Figure 6). This is interesting since the potential impact of Section 1502 would therefore be expected to be lower than initially anticipated. One might suspect that the trade data is either misrepresented due to

lack of monitoring prior to 2010 or intentionally mislabeled as originating from dominant suppliers like China.

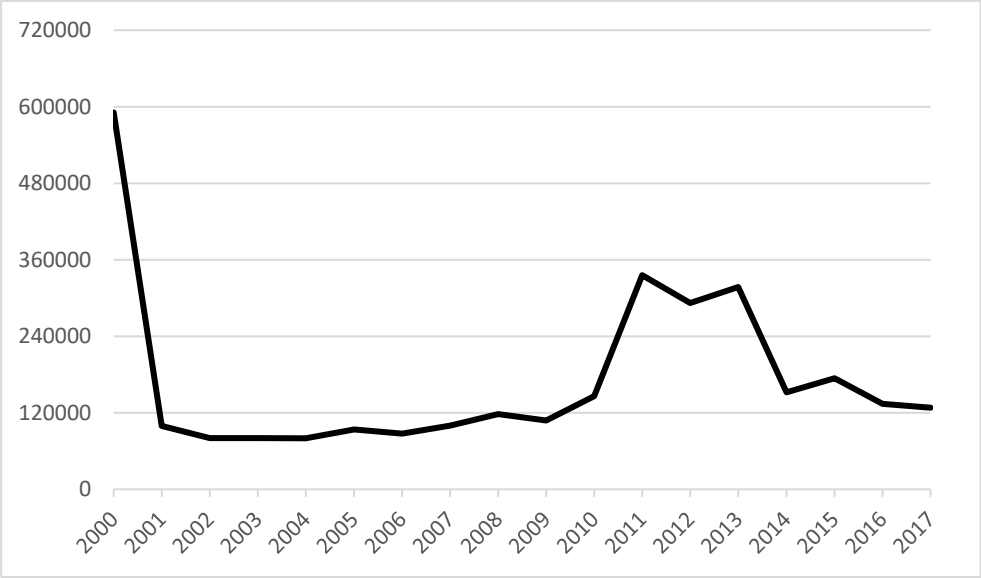

Figure 4: *Tantalum price*
Tantalum price development obtained from Metalary.com. The price is presented in U.S. Dollars per metric ton.

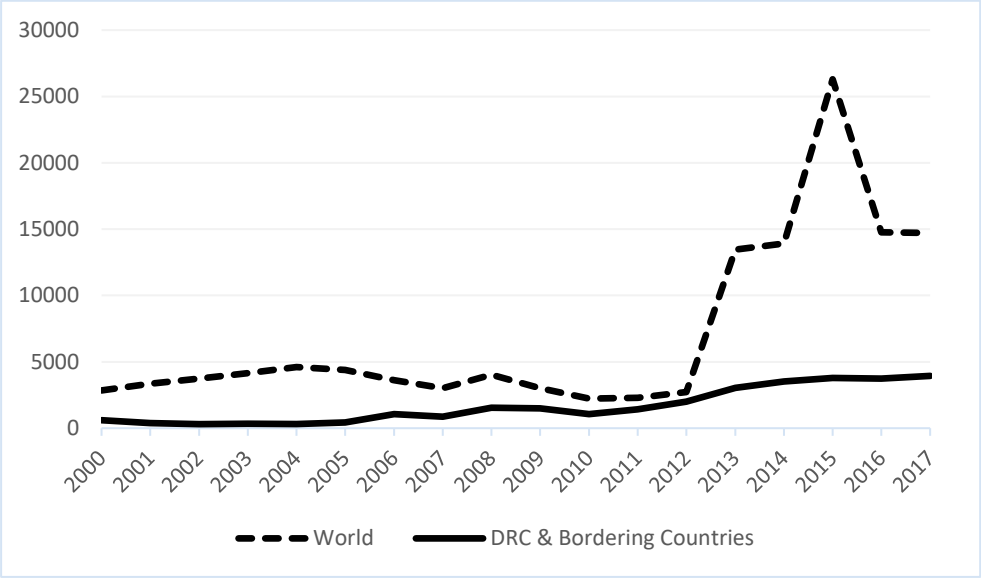

Figure 5: *Tantalum world production*
Tantalum production development obtained by the British Geological Survey. The production is presented in metric tons. The figure presents the world production (dashed line) and the production in the DRC and bordering countries (straight line).

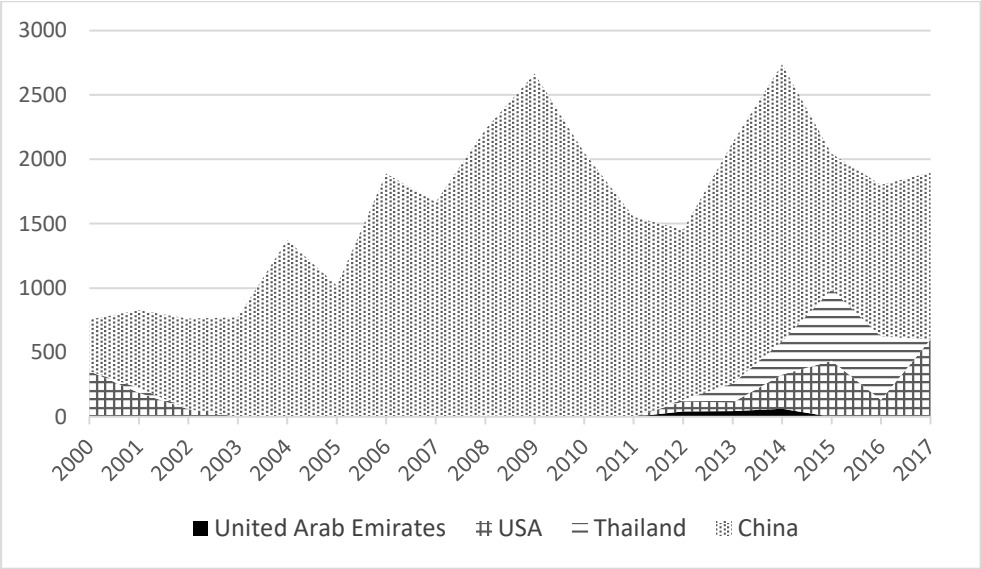

Figure 6: *Tantalum trade*
Import tonnages of tantalum from the DRC and bordering countries as reported by international countries to the UN Comtrade database.

9.2 Tungsten

The American consumption of tungsten is mainly for construction, metalworking, mining and oil and gas drilling industries (USGS, 2019 p. 178). The USGS also reported that the U.S. has not had any domestic production of tungsten since before 1994 and between 2007-2016 (2004 p. 180; 2008 p. 182; 2019 p. 178). This means that the U.S. has been, in some periods more than others, dependent on importing tungsten in order to meet the domestic demand.

<u>Findings</u>

Tungsten had a price increase of 173 % from 2010 to 2011 (Figure 7). Furthermore, the production level in the affected countries represented only on average 1.6 % of the world production in the period from 2000 – 2017 (Figure 8). China is the world's largest producer, consumer and exporter of tungsten. In 2010 they represented 86% of the global tungsten production (USGS, 2012). The same year they reduced export quotas, which caused the price to increase. Later, when the export quotas were raised again, the price decreased correspondingly (Montgomery, 2010). There is therefore reason to believe that Section 1502 had little effect on the price or world production. There was, however, a steep decrease in the production in 2009 within the affected countries, which is more likely to be due to an excessive amount of reserves or the trade collapse caused by the financial crisis rather than the announcement of Section 1502 (Figure 9).

There are some similarities between tantalum and tungsten in the analysis of the country-specific import. China was the biggest importer from 2005 to 2017 with approximately 60 % of the exports from the affected countries. In contrast to the other minerals, the U.S. reported import from the affected countries in the years prior to Section 1502 (Figure 10). The U.S.-import had a decreasing trend from 2007 to 2014, which corresponds well with the initiated domestic production in 2007. When the domestic production was closed in 2016 the import from the affected countries continued. The decrease and halt in imports by the U.S. is therefore most likely not due to Section 1502 itself but due to other factors such as U.S. domestic production.

Figure 7: *Tungsten price*
Tungsten price development obtained from Metalary.com. The price is presented in U.S. Dollars per metric ton.

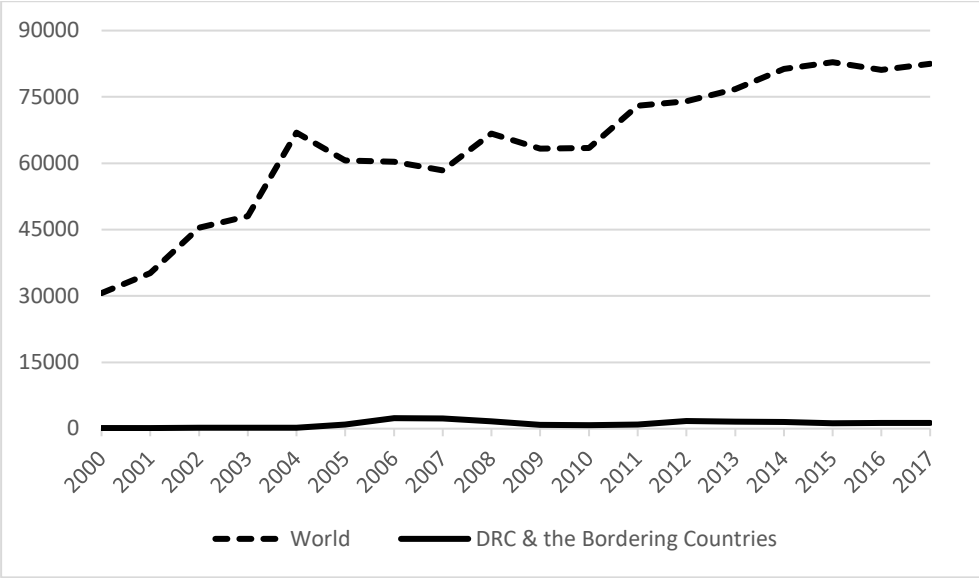

Figure 8: *Tungsten world production*
Tungsten world production development obtained by the British Geological Survey. The production is presented in metric tons. The figure presents the world production (dashed line) and the production in the DRC and bordering countries (straight line).

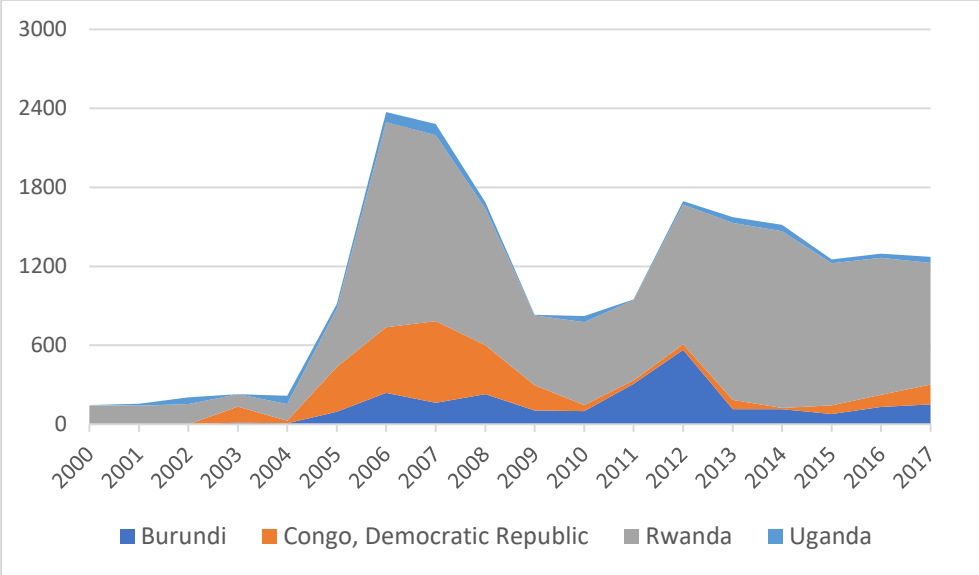

Figure 9: *Tungsten production in affected countries*
Tungsten production development within the DRC and bordering countries. The production is presented metric tons and obtained by the British Geological Survey.

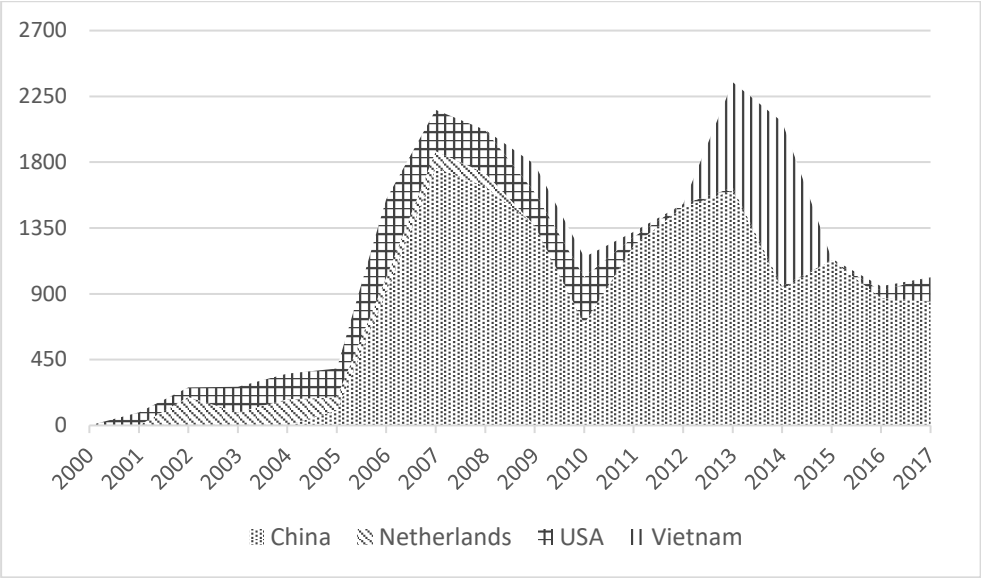

Figure 10: *Tungsten trade*
Import tonnages of tungsten from the DRC and bordering countries as reported by international countries to the UN Comtrade database.

9.3 Tin

Tin has, in addition to tantalum and tungsten, been characterized as a "critical mineral" by the U.S. government. The U.S. defines "critical minerals" as minerals that are essential to national security and economic prosperity. Critical minerals are vulnerable to disruptive supply chains and the U.S. government has therefore initiated steps in order to secure a steady supply of these minerals. (Fortier et al., 2018). Furthermore, The USGS reported that there have been no domestic mines or smelters of tin in the U.S. since 1993, which means that it is completely reliant on imports (2019 p. 172).

<u>Findings</u>

Tin had a price increase of 128% from 2010 to 2011 (Figure 11). The fluctuation of the production level in the affected countries follows the price fluctuation, just like the world production. The production in the affected countries constitutes on average merely 2.8% of world production in the period 2000-2017 (Figure 12). Similarly to tungsten, the findings indicate that Section 1502 had little effect on the total production of tin (Figure 13). The tin production in the affected countries constitutes such a small part of the global production that the potential to affect global production or price levels is miniscule. The major producers of tin in 2000-2017 were China, Indonesia and Peru with an average market share of 38%, 27% and 11% respectively.

The country-specific trade analysis shows that there was a shift in key importers from the affected countries. The largest importer prior to 2010 was Thailand, with an average of 64% of the total import. They lowered their import significantly in 2010, when Malaysia increased their import to an average of 78% of the total import from 2010 to 2017 (Figure 14). The key takeaway is that the U.S. is not listed as a direct importer from the affected countries, which means that Section 1502 would have little effect on U.S. mineral processors.

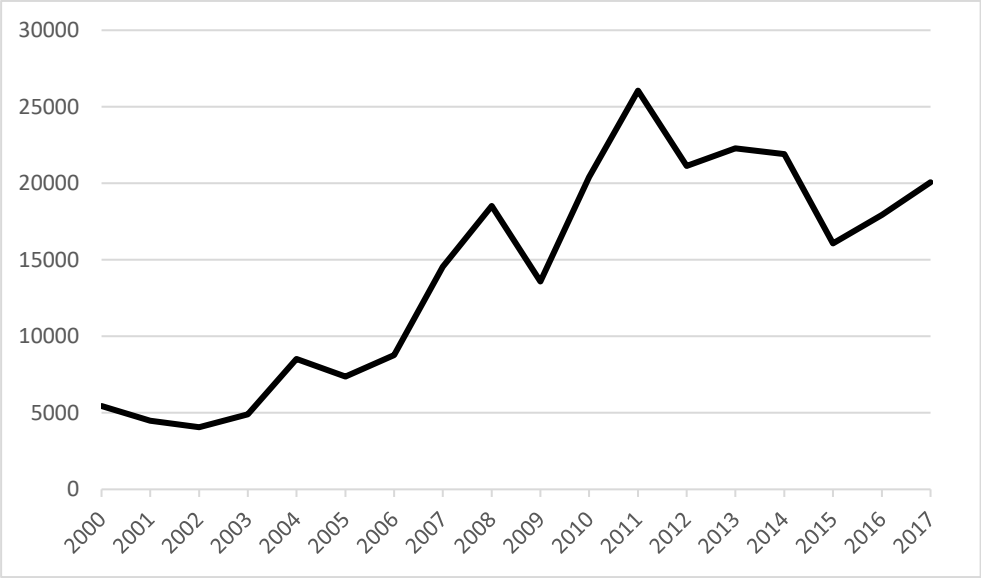

Figure 11: *Tin price*
Tin price development obtained from Metalary.com. The price is presented in U.S. Dollars per metric ton

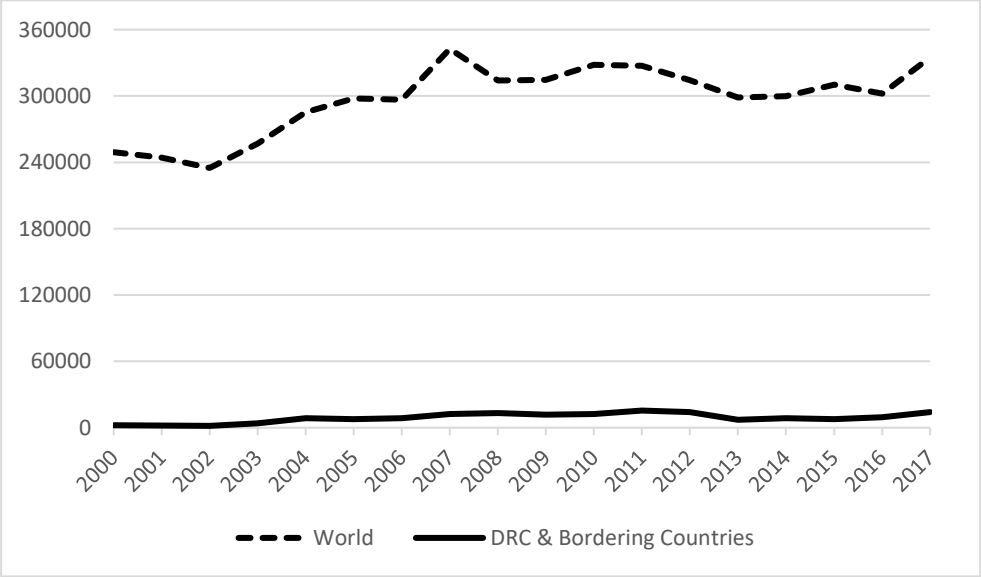

Figure 12: *Tin world production*
Tin production development obtained by the British Geological Survey. The production is presented in metric tons. The figure presents the world production (dashed line) and the production in the DRC and bordering countries (straight line).

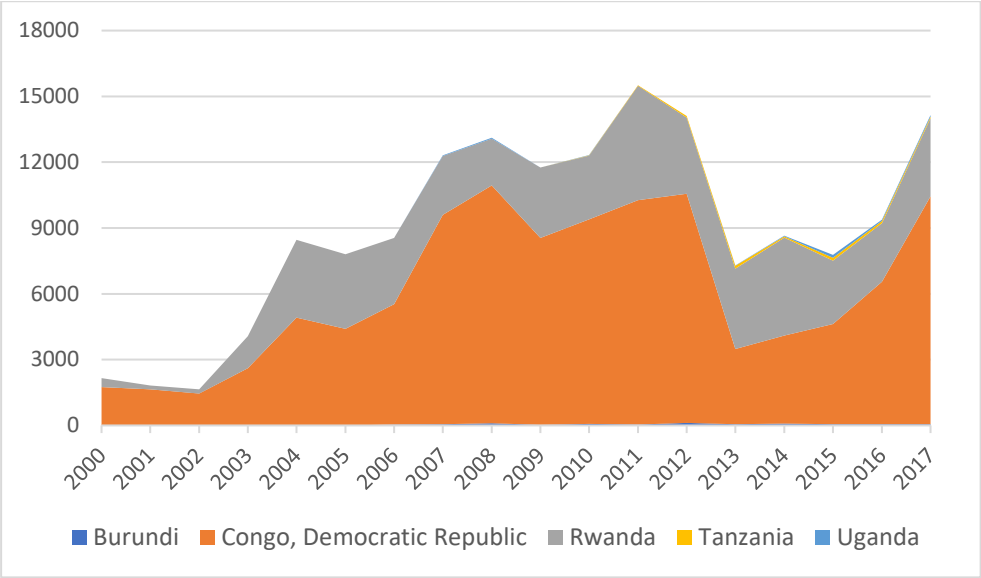

Figure 13: *Tin production in affected countries*
Tin production development within the DRC and bordering countries. The production is presented metric tons and obtained by the British Geological Survey.

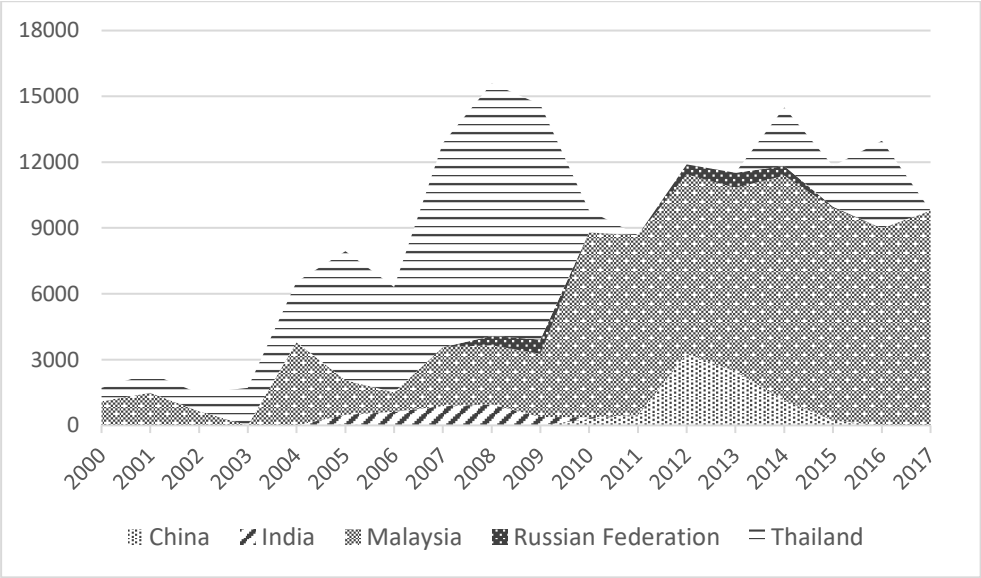

Figure 14: *Tin trade*
Import tonnages of tin from the DRC and bordering countries as reported by international countries to the UN Comtrade database

9.4 Gold

The use of gold in electronics and electronic components has increased in the last 40 years, which in turn has increased the demand for this commodity (Goodman, 2002). The U.S. has had a sufficient domestic production in the period of this analysis which would indicate that it is not as reliant on importing gold as the other commodities. According to the U.S. Geological Survey, the U.S. has been a net exporter of gold since 2004 (2004 p. 72; 2008 p. 72; 2019 p. 70).

Findings

The price of gold increased 128% from 2010 to 2011 but has had an increasing trend consistent with the commodity boom in 03/04 (Figure 15). The increased world production from 2008 was mainly due to China increasing its share and becoming the leading producer of gold (Figure 16) (Zhang, Pian, Santosh & Zhang, 2014 p. 724). The affected countries increased its market share from 2.5 % in the beginning of the 2000s to nearly 5.8% in 2017. The production within the affected countries increased from 2007-2017 with 354%, mainly due to increased production in Sudan (Figure 17). There is therefore little evidence to suggest that Section 1502 had a significant effect on gold production in the area.

Unlike the other conflict minerals, the analysis of the trade data of gold shows a very low level of reported imports from the affected countries (Figure 18). The major importers are the United Arab Emirates and India. India increased the level of imports from the affected countries significantly from 2013-2015. This was due to the Indian government lifting restrictions placed on import of gold in 2013 (ESCAP, 2015). There is therefore seemingly little evidence to suggest that Section 1502 had an impact on the trade of gold from the affected countries.

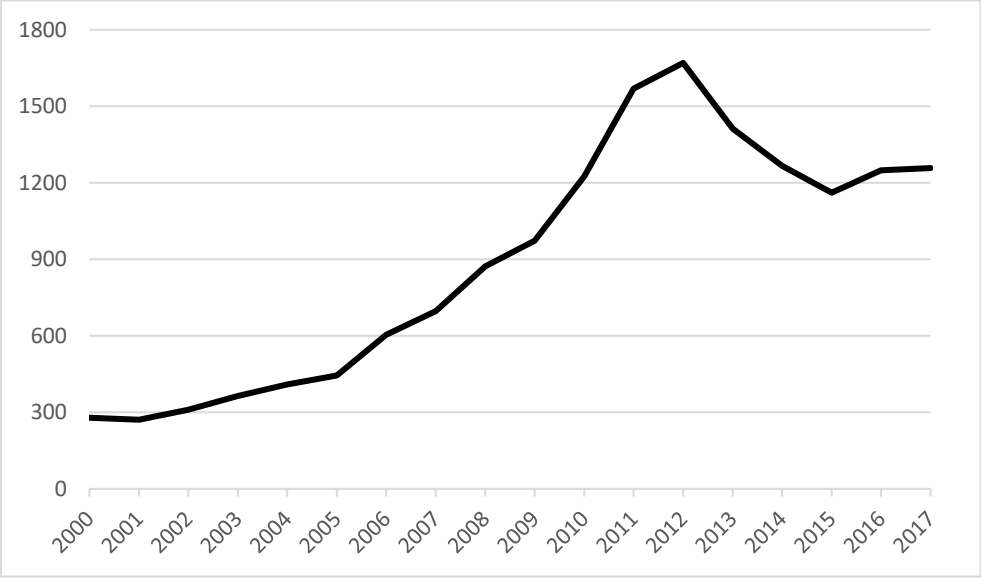

Figure 15: *Gold price*
Gold price development obtained from Metalary.com. The price is presented in US Dollars per troy ounce.

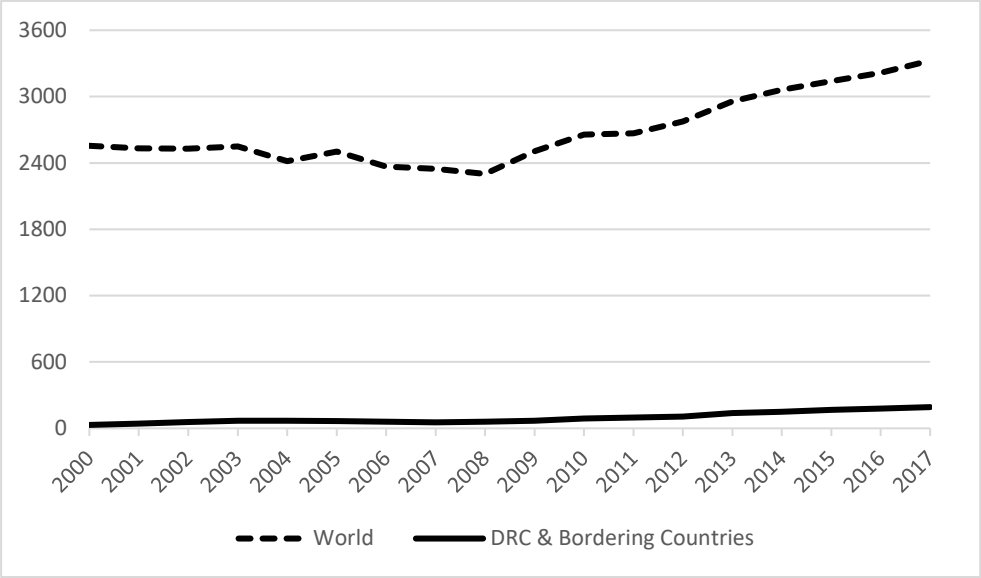

Figure 16: *Gold world production*
Gold production development obtained by the British Geological Survey. The production is presented in metric tons. The figure presents the world production (dashed line) and the production in the DRC and bordering countries (straight line).

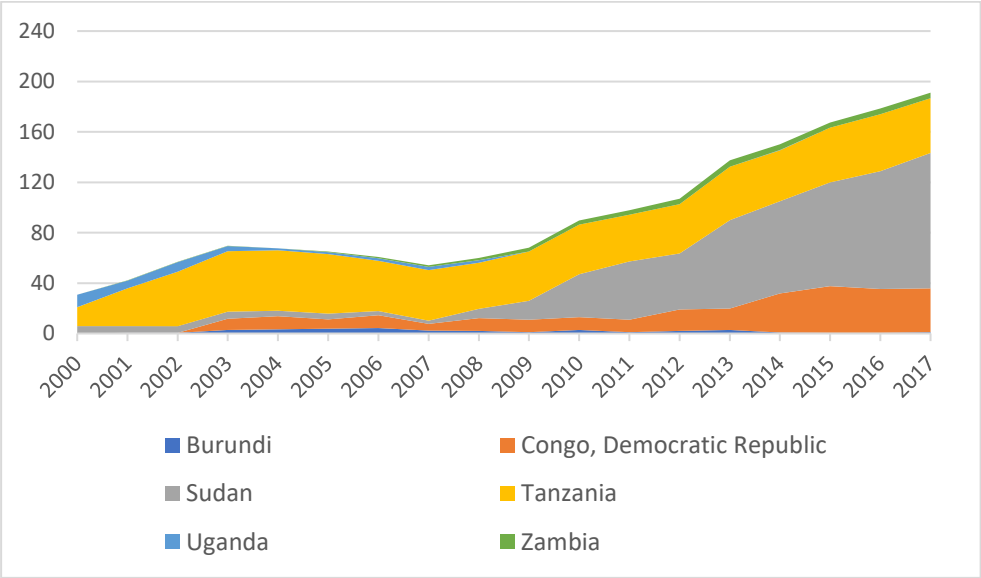

Figure 17: *Gold production in affected countries*
Gold production development within the DRC and bordering countries. The production is presented metric tons and obtained by the British Geological Survey.

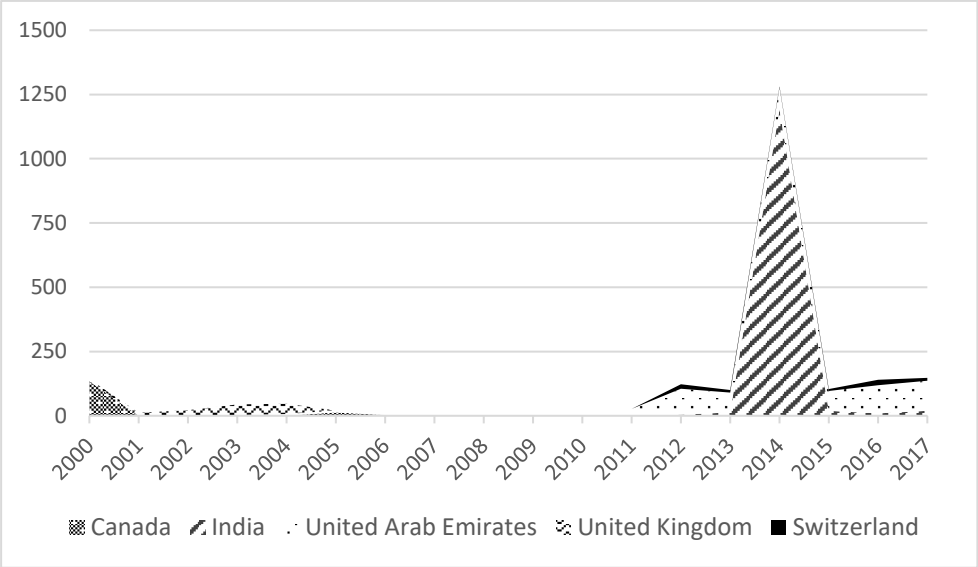

Figure 18: *Gold trade*
Import tonnages of gold from the DRC and bordering countries as reported by international countries to the UN Comtrade database.

9.5 Summary

The result of the analyses clearly indicates a significant increase in price for all commodities in the years following Section 1502. There was, however, a trend of increasing prices for all commodities from 03/04 related to the commodity boom. Tantalum is the only commodity where the affected countries are big enough producers for Section 1502 to have any clear price effects. Furthermore, the production of the commodities in the affected countries has not had any significant changes, except for tantalum which increased their market share to 73% in 2012. It appears that any slowing effect that Section 1502 might have had was more than made up for by the growing mineral demand fueled by emerging economies. The results from the trade analysis showed that the U.S. did not import conflict minerals directly from the affected countries, except for tungsten. The dominant importers, mainly Asian countries, were also the main suppliers of processed minerals to the U.S. As mentioned in Section 8, no regulations on trading conflict minerals were implemented in the most significant importer, China, until 2014. According to Parker and Vadheim (2017), after the RMI (previously known as EIIC) boycotted smelters not able to determine the origin of their minerals, Chinese smelters continued to buy conflict minerals from the affected countries at a reduced price nearly 80% below the market. This suggests that conflict minerals bought by Chinese smelters prior to the 2014-guidelines might still circulate the U.S.

suppliers. The overall interpretation of the findings is therefore that except for tantalum prices, Section 1502 did not have a significant effect on the commodity price, production or trade.

10. Descriptive Analysis of Smelters Disclosed in the Form SD's

The concern and focus on supply chain management has been growing because of more complex supply chains with a larger supply base and supply network (Blome & Schoenherr, 2011). The complexity of the supply base, which constitutes a portion of the supply network directly managed by the buying company, consists of three key dimensions (Choi & Krause, 2006). The three key dimensions are the total number of suppliers, the differentiations of the suppliers and the inter-relationships among the suppliers. For the case of the Dodd-Frank Act Section 1502, key dimension one and two are deemed most relevant. First, an increase (decrease) in the number of suppliers will increase (decrease) the complexity of the supply base. Second, the differences in characteristics and geography among the suppliers will also affect the complexity of the supply chain. In addition, Kim and Davis (2016) argues that the complexity of the supply chains contributes negatively to supply chain visibility, which is crucial for the affected companies' due diligence.

When looking at the location of the smelters reported in the Form SD's, we see that a clear majority is located in Asia. Out of the 125 unique smelters identified, 80 are registered in Asian countries (Appendix 5). Europe, with its 24 smelters, has the second most, which is still a lot more than the rest of the continents housing 10 or less. This corresponds with how Asian countries represent the clear majority of 3TG import, shown in Figures 6, 10, 14 and 18 in Section 9. In addition, despite the level of mining in Africa, only one single smelter is located there, which is in South Africa, to be precise. When close to none of the 3TG minerals are processed into refined products within Africa, and most of it is processed in Asia, the companies affected by Section 1502 that utilize Asian smelters are reliant on receiving accurate due diligence data to uphold the amendment.

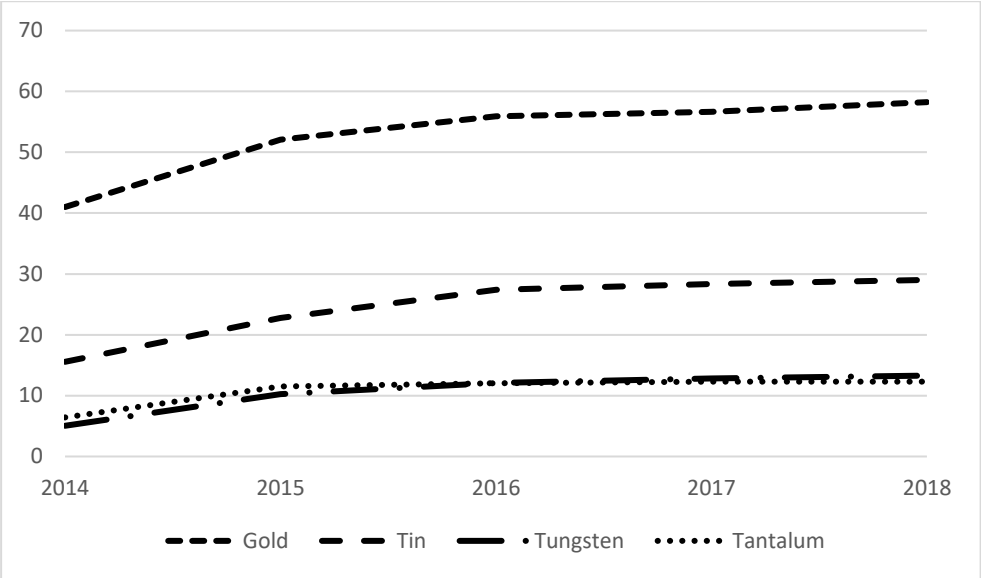

Figure 19: *Smelters per company*
This table shows the average number of unique smelters the reporting firms listed as their suppliers.

With the announcement of Section 1502 and the public focus on supply chain due diligence, it is interesting to look at the measures taken by the reporting firms with regards to their supply chain. Table 6 shows the average number of smelters that each company reported using in their disclosure forms. On average, the companies listed 68 different smelters in 2014. One might expect this number to decrease as the years pass, as this would lower the supply chain complexity of the reporting firms, making the due diligence process easier. Instead, it rises to 107 by 2016.

There are several potential explanations for this development. One is that the increase is related to the firms' operations. This could be a higher activity level or adopting suppliers through the acquisition of other reporting firms, as reported by Microsoft Corporation (2015). It could also be changes made in the supplier base to replace suppliers that refuse to comply with due diligence measures (Apple Inc., 2019). Such information is voluntarily disclosed in the individual firm's Form SD, and therefore difficult to infer for the entire sample. The other explanation is that the increase is related to the submission of the Form SD's. Reporting firms were allowed to declare "lack of determinative knowledge" regarding their mineral origin for the calendar year of 2014. Smaller reporting firms were given until 2016 (SEC, 2019, p. 5). Many firms that are encompassed by Section 1502 also failed to deliver their Form SD's within the initial deadline. The SEC estimated that 5994 firms would file a Form SD in 2014 (2012, p. 247). According to Kim and Davis,

only 1300 firms managed to submit the Form SD's on time in 2014, while almost an equal number of firms filed their reports for the first time just before the second deadline, June 1st, 2015 (2016, p. 1899). It is reasonable to assume that failure to meet a reporting deadline is correlated with supply base complexity. The number of Form SD filers continued to increase in 2016, before stabilizing in the years after. It is also likely that in an effort to reach the initial deadlines, many of the filers failed to fully disclose all of their suppliers, making the initial submissions incomplete.

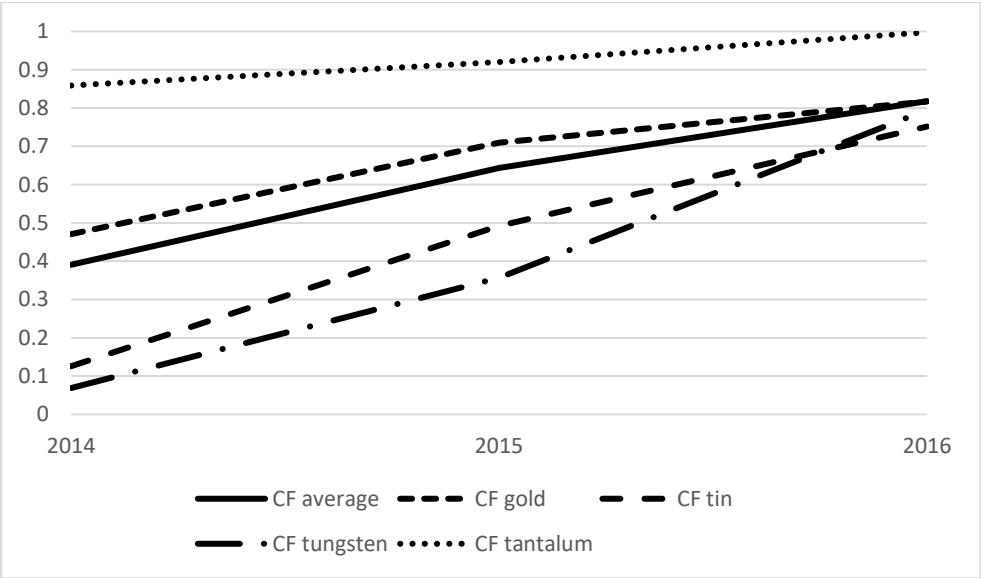

Figure 20: *Use of conflict free smelters*
This figure displays the degree of conflict free smelters listed in the Form SD's.

With Section 1502, lawmakers hoped that the awareness created through supplier due diligence, and the shaming that follows public disclosure of the results, would be enough to incentivize firms to use conflict free minerals (Lynn, 2011). Figure 20 provides a summary of the degree this was accomplished, by summarizing the auditing results from the Form SD's. At the submission deadline in 2014, 39.1% of the smelters included in the reports were conflict free. The figure also extracts the commodity specific results, which show that the usage of conflict free tungsten smelters was merely 6.9%. In the other end of the spectrum, tantalum was already at 85.9% conflict free in 2014. What both commodities have in common is that there are few unique smelters reported in both categories, as shown in Appendix 6. The difference being that tantalum mining is concentrated in Central Africa, while Tungsten mining is concentrated in China. Year by year,

there is a clear positive trend in the usage of conflict free smelters, and by 2016, 81.8% of reported smelters were conflict free. With this development in mind it can be argued that Section 1502 has worked as intended in regard to company behavior.

11. Conclusion

The purpose of this thesis was to explain how new due diligence measures, set by Section 1502 of the Dodd-Frank Act, affected the return of U.S.-firms and 3TG markets. It further investigated how the amendment changed supplier policy and compliance.

The event study of the announcement of Section 1502 showed that firms affected by the amendment experienced a drop in abnormal return. A similar study of the disclosure date of the mandated reports showed a subsequent rise in abnormal return, even though public interest in the contents of the reports was negligible. In an effort to explain the underlying reasons for this change, a difference-in-differences estimation on the firms' financial data was conducted. Hypotheses were constructed based on how significant changes in hedging activities, liquidity, leverage and working capital management, could be the cause of the increase in abnormal return. The results showed significant differences between the treatment firms and the control group within every category, but none that could infer such an increase in abnormal return. Hypothesis 1, 3 and 4 were discarded, while the results in Section 7.2 were to a degree consistent with hypothesis 2. This study reveals that the change in abnormal return was more likely due to off-balance sheet effects, such as increased information flow and other supply chain initiatives. Furthermore, the discussion in Section 8 explains that the completed due diligence and the willingness to ensure supply chain sustainability could be favorable for firm value.

The result of the descriptive analysis of the 3TG markets showed a markedly increase in market prices of each commodity. However, tantalum was the only commodity where the DRC and bordering countries produced enough for Section 1502 to have any clear price effects. Both the production and global market share of conflict minerals continued to increase despite of Section 1502, mainly fueled

by exports to Asia but for some minerals also to the United States. The study confirms that any slowing effect Section 1502 might have had was more than made up for by the growing mineral demand fueled by emerging economies. The overall interpretation of the findings was therefore that, except for tantalum prices, Section 1502 did not have a significant effect on the commodity price, production or trade.

Furthermore, the result of the analysis of the reported smelters in the specialized disclosure forms reveals that the mandatory disclosure from 2014 did work as intended, in regard to compliance. The positive trend in the usage of conflict free smelters showed that the company specific initiatives and collaborative suppliers were contributing factors to the 3TG supply chain sustainability. The analysis also illustrated that the average number of disclosed smelters per company was increasing every year after the reporting deadline. Despite of the supplier complexity, the affected firms still managed to complete the due diligence process with an overall satisfying result. This further shows that supply chain sustainability initiatives pay off, and that companies "do well by doing good" (Falck and Heblich, 2007, p. 1).

This study has contributed to the existing research by determining that firm characteristics were not the sole reason for the increased firm value. Other researchers are encouraged to further analyze the link between firm value and increased supply due diligence and decreased supply chain risk. Conclusively, Section 1502 of the Dodd-Frank Act contributed to 3TG supply chain sustainability by being the leading example for later implemented legislations and guidelines for conflict free use of 3TG.

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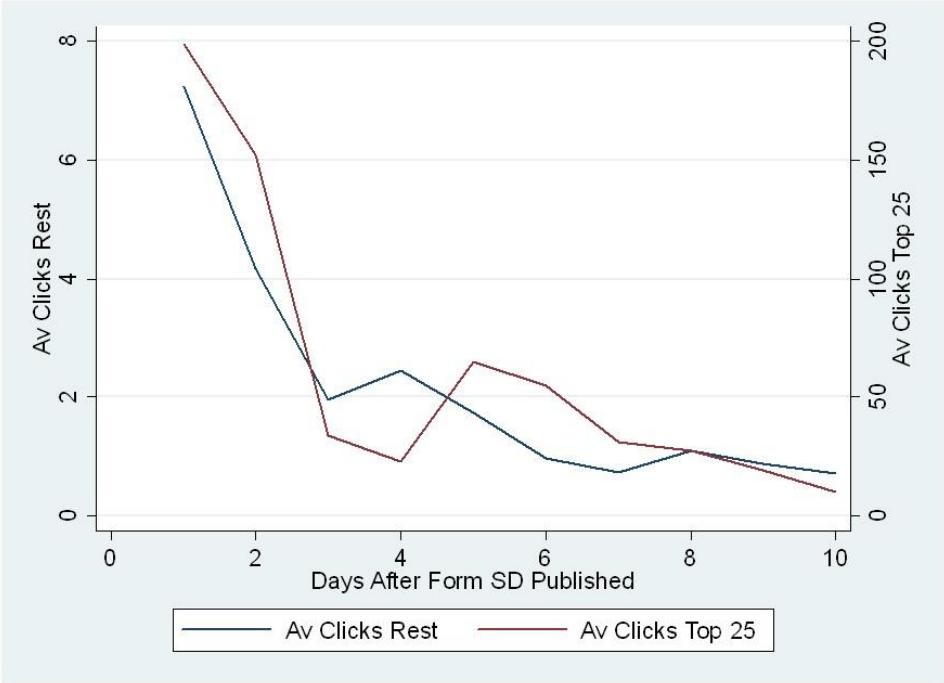
Appendices

Appendix 1: *Average number of clicks on the published Form SD's*



Appendix 2: *Full list of dependent variables and control variables*

<u>Dependent Variables for Firm Characteristics:</u>

Hedging Activities

Dummy_hedge = 1 for any hedging activities and 0 otherwise

Dummy_int = 1 for interest rate hedging and 0 otherwise

Dummy_comm = 1 for commodity hedging and 0 otherwise

Dummy_fx = 1 for foreign exchange hedging and 0 otherwise

Dummy_swap = 1 for swap hedging and 0 otherwise

Dummy_future = 1 for future hedging and 0 otherwise

Dummy_forward = 1 for forward hedging and 0 otherwise

Dummy_option = 1 for option hedging and 0 otherwise

Dummy_other = 1 for other hedging activities and 0 otherwise

Liquidity

Cash_pct = $\frac{Cash}{Total\ Assets}$

Cash_pcnt = $\frac{Cash}{(Total\ Assets - Cash)}$

Cash_inv_pct = $\frac{(Cash + Short\ term\ Investments)}{Total\ Assets}$

Cash_inv_pcnt = $\frac{(Cash + Short\ term\ Investments)}{(Total\ Assets - (Cash + Short\ term\ Investments))}$

Nwc_at = $\frac{(Working\ Capital - (Cash + Short\ term\ Investments))}{Total\ Assets}$

Leverage

Mkt_lev = $\frac{Total\ Debt}{(Total\ debt + Market\ Value\ of\ Equity)}$

Book_lev = $\frac{Total\ Debt}{Total\ Assets}$

Cash Conversion Cycle

CCC = $Days_inv + Days_rec + Days_pay$

Days_inv = $\frac{Inventory}{Cost\ of\ Goods\ Sold}/365$

Days_rec = $\frac{Accounts\ Receivables}{Sale}/365$

Days_pay = $\frac{Accounts\ Payables}{Cost\ of\ Goods\ Sold}/365$

Apc_pct = $\frac{Accounts\ Payables}{Total\ Assets}$

Invfg_pct = $\frac{Inventories\ of\ Finished\ Goods}{Total\ Assets}$

Invrm_pct = $\frac{Inventories\ of\ Raw\ Materials}{Total\ Assets}$

Control Variables for Firm Characteristics:

Hedging Activities	**Liquidity**	**Leverage**	**CCC**
Lsize Cashflow_at Mkt_to_book Cash_inv_pct Tangibility	Lsize Cashflow_at Mkt_to_book Book_lev	Lsize Cashflow_at Mkt_to_book Cash_inv_pct Dummy_hedge Tangibility	Lsize Cashflow_at Mkt_to_book Cash_inv_pct Tangibility

Lsize = $Log\ (Total\ Assets)$

Cashflow_at = $\frac{OIBDP\ - Interest\ Expence - TXT - Dividends}{Total\ Assets}$

OIBDP = Operating income before depreciation
TXT = Total Income Taxes

Mkt_to_book = $\frac{Market\ Value\ of\ Equity + Total\ Debt + PSTKL + TXDITC}{Total\ Assets}$

PSTKL = Preferred Stock Liquidation Value
TXDITC = Deferred Taxes and Investments Tax Credit

Cash_inv_pct = $\frac{(Cash + Short\ term\ Investments)}{Total\ Assets}$

Dummy_hedge = 1 for any hedging activities and 0 otherwise

Tangibility = $\frac{Total\ Property\ Plant\ \&\ Equipment}{Total\ Assests}$

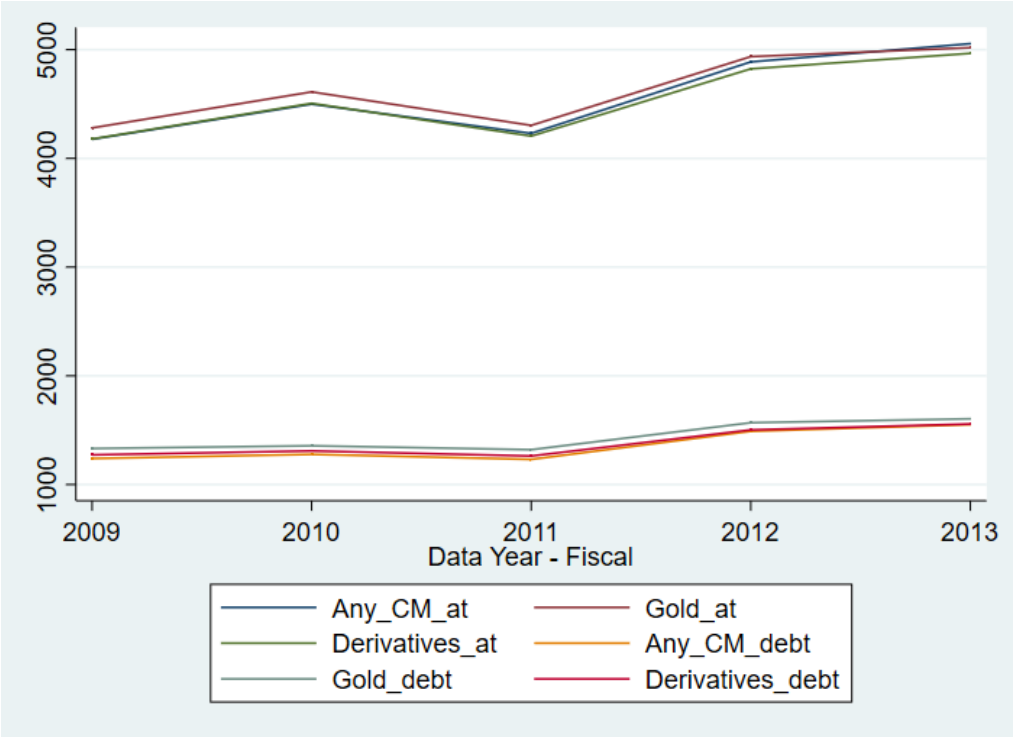
Appendix 3: *Summary statistics of dependent variables*

	Treat Any CM				Treat Form SD			
	Yes		No		Yes		No	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Dummy_hedge	0.534	0.499	0.455	0.498	0.645	0.478	0.407	0.491
Dummy_comm	0.032	0.175	0.034	0.182	0.026	0.159	0.037	0.188
Dummy_future	0.011	0.102	0.007	0.081	0.007	0.081	0.008	0.087
Cash_pcnt	0.931	2.644	1.076	2.847	0.385	1.289	1.291	3.156
Nwc_at	-0.624	3.753	-0.759	4.076	0.118	0.227	-1.046	4.654
Book_lev	0.591	1.508	0.684	1.691	0.204	0.465	0.836	1.888
Mkt_lev	0.246	0.287	0.249	0.302	0.176	0.215	0.275	0.321
Days_inv	0.002	0.005	0.002	0.005	0.001	0.001	0.002	0.005
Lsize	5.754	3.105	5.228	3.193	6.668	2.090	4.844	3.370
Cashflow_at	-0.579	2.736	-0.677	2.898	0.037	0.385	-0.913	3.310
Mkt_to_book	19.312	52.922	22.448	56.903	5.499	27.149	27.836	62.510
Cash_inv_pct	0.243	0.266	0.268	0.291	0.211	0.187	0.282	0.313
Tangibility	0.261	0.252	0.257	0.273	0.189	0.154	0.284	0.297
Number of obs.	4396	4396	14468	14468	5098	5098	13766	13766

	Treat Tantalum				Treat Derivatives			
	Yes		No		Yes		No	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Dummy_hedge	0.826	0.380	0.467	0.499	0.525	0.499	0.459	0.498
Dummy_comm	0.019	0.138	0.034	0.182	0.033	0.179	0.034	0.182
Dummy_future	0.004	0.062	0.007	0.086	0.011	0.103	0.007	0.081
Cash_pcnt	0.589	1.974	1.053	2.816	0.952	2.685	1.069	2.836
Nwc_at	0.088	0.316	-0.743	4.038	-0.659	3.838	-0.749	4.052
Book_lev	0.272	0.803	0.671	1.663	0.609	1.533	0.679	1.683
Mkt_lev	0.199	0.250	0.249	0.300	0.251	0.291	0.247	0.301
Days_inv	0.001	0.003	0.002	0.005	0.002	0.005	0.002	0.005
Lsize	6.626	2.251	5.319	3.189	5.722	3.127	5.243	3.188
Cashflow_at	-0.099	1.321	-0.664	2.881	-0.602	2.782	-0.670	2.886
Mkt_to_book	10.738	40.188	21.953	56.291	19.995	53.820	22.243	56.659
Cash_inv_pct	0.214	0.195	0.264	0.287	0.243	0.269	0.268	0.290
Tangibility	0.197	0.165	0.259	0.270	0.265	0.255	0.256	0.272
Number of obs.	259	259	18605	18605	3720	3720	15144	15144

	Treat Gold				Treat Tungsten			
	Yes		No		Yes		No	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Dummy_hedge	0.515	0.500	0.462	0.499	0.727	0.446	0.466	0.499
Dummy_comm	0.034	0.180	0.034	0.181	0.022	0.145	0.034	0.182
Dummy_future	0.010	0.100	0.007	0.082	0.010	0.098	0.007	0.085
Cash_pcnt	1.012	2.790	1.054	2.811	0.874	2.522	1.050	2.813
Nwc_at	-0.731	4.022	-0.731	4.009	-0.520	3.830	-0.736	4.015
Book_lev	0.641	1.596	0.670	1.667	0.517	1.484	0.668	1.663
Mkt_lev	0.252	0.296	0.247	0.300	0.194	0.247	0.249	0.300
Days_inv	0.002	0.005	0.002	0.005	0.002	0.004	0.002	0.005
Lsize	5.660	3.200	5.267	3.174	6.063	2.935	5.321	3.185
Cashflow_at	-0.660	2.915	-0.656	2.855	-0.456	2.602	-0.661	2.871
Mkt_to_book	21.504	55.677	21.863	56.212	14.539	45.827	21.963	56.317
Cash_inv_pct	0.247	0.273	0.266	0.289	0.248	0.245	0.263	0.287
Tangibility	0.265	0.260	0.257	0.271	0.239	0.229	0.258	0.270
Number of obs.	3354	3354	15510	15510	417	417	18447	18447

Appendix 4: *Average debt and total assets for Any CM, Derivatives and Gold*



Appendix 5: *Smelter location*

	2014	2015	2016	2017	2018
Asia	77	80	80	80	80
Europe	23	24	24	24	24
Northern Am	8	10	10	10	10
Latam	8	9	9	9	9
Oceania	1	1	1	1	1
Africa	1	1	1	1	1
Sum	118	125	125	125	125

Appendix 6: *Smelters per commodity*

	2014	2015	2016	2017	2018
Gold	63	64	64	64	67
Tin	29	31	31	31	32
Tungsten	13	14	15	15	14
Tantalum	13	16	15	15	12
Sum	118	125	125	125	125