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No Blood in my Mobile: Regulating Foreign Suppliers

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Abstract

Can developed countries enforce that goods consumed domestically do not contribute to human rights violations in developing countries where they are sourced? This paper studies the enforcement of new due diligence policies, which constrain firms to curb foreign sourcing linked to human rights violations through transparency and reporting. I study the US Dodd-Frank Act Conflict Mineral Rule (2010), a limiting the use of *conflict minerals* extracted in Democratic Republic of Congo (DRC) and adjoining countries in supply chains of US eletronic firms. The law increased administrative cost of complying firms, showing that subtantial regulatory constraints were created. I test how diligence obligations shaped exports of targeted countries, and whether they are circumvented through opaque territories called legal havens. Using a triple difference strategy and the structural gravity framework, I find that this policy decreased DRC and adjoining countries' exports of conflict minerals by 76%. One fourth of this decrease is due to circumvention through legal havens, which then re-export more intensively to countries hosting foreign suppliers of US-regulated firms.

JEL codes: F14, F63, F59, H73, K33, O13, O24

Keywords: trade diversion; legal haven; due diligence; minerals; supply chains.

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1 Introduction

Can developed countries enforce that goods consumed domestically do not contribute to human rights violations in developing countries where they are sourced? In 2017, around half of the world's tantalum was extracted from Africa's Great Lakes Region, where armed groups are present at up to 60% of mining sites (USGS, 2017; Weyns et al., 2015). As a result, suppliers of multinational companies, such as Apple and Bayer have been found to buy and use tantalum inputs sustaining human rights violations around extraction sites (Global Witness, 2022; United Nations, 2002). Cases of detrimental production processes in foreign sourcing are not limited to the metal and mining sector: cases have also been documented in the garment and wood industries for example.[1]

Enforcement of rules on production processes in international supply chains is not straightforward. When a destination country seeks to regulate processes taking place abroad, it must rely on extraterritorial rules, i.e. regulating actions taking place outside of its jurisdiction. In source countries, both states and firms could lack the capacity or incentive to enforce these regulations effectively. In settings with weak state capacity, exporters may be incentivized to evade regulations, especially by prohibitively high compliance costs when accessing international markets. Opportunities to circumvent regulations are provided by what is commonly referred to as *legal havens*, third-party territories that offer *"advantages to* [...] *hide illicit activity and* [*be exempted*] *from legal obligations linked to their economic activities"* (Lemaître, 2019). These territories are jurisdictions with legal systems designed to create opacity around international flows passing through them.

This paper focuses on a U.S. due diligence initiative to regulate its foreign supply chains of minerals. *Due diligence policies* have rapidly spread among developed countries.[2] Firms falling under these rules must comply with processes preventing their affiliates or suppliers from generating negative outcomes near their production sites, and must be transparent about it. I study the implementation of the U.S. Dodd-Frank Act Conflict Mineral Rule (2010), which imposes extraterritorial constraints on the metal suppliers of the largest U.S. firms and their use of conflict minerals. Conflict minerals, with their ubiquitous industrial use and growing demand, provide a relevant set-up of foreign inputs linked to adverse outcomes. The rule mandates listed U.S. firms to ensure that the metals used in their products do

[1] See the Rana Plaza Collapse https://www.nytimes.com/2013/04/25/world/asia/bangladesh-building-collapse.html, or illegal wood trade from Amazon deforestation https://us.eia.org/press-releases/20210927-us-company-pleads-guilty-to-importing-illegal-timber-from-peru/.

[2] Including the US in 2010, France in 2017, the EU in 2017 and 2024, and Germany in 2024. There are at least 15 active due diligence laws, and as many still under discussion.

not financed armed groups in the Democratic Republic of the Congo (DRC) and neighbouring countries, even if the firm is not the direct metal importer. I show that the due diligence created by Dodd-Frank creates subtantial regulatory constraints on firms and source countries, as reflected in the change in firms financials and conflict mineral exports. Yet, sizable regulation avoidance takes place through legal havens.

The extent to which states can use international exchanges as a vector to enforce rules abroad remains an open question in Economics. First, the regulation of international production processes could multiply in response to growing demands for sustainable processes in developed countries. Yet the literature on enforcement of better production standard has mainly focused on voluntary initiatives and sourcing scandals (Atkin et al., 2022). Second, the current shift to a new geopolitical order could incentivize states to mix of trade and political objectives, and the developing literature on extraterritorial economic policies has mainly focused on the use of sanctions (Mohr and Trebesch, 2025). This paper asks to what extent a large economy can use its economic linkages with the rest of the world to induce compliance of private actors with sourcing standards abroad.

The design of the Conflict Mineral Rule enables me to properly identify the response of trade flows and firms to the Dodd-Frank Act. First, on the firm side, the rule introduces new filing obligations to the Security Exchange Commission for the largest U.S. firms, for which financial information is well reported and accessible through Compustat. From the new firms filing, I am able to observe and compile metal supplier linkages across the world: I build a new data for 739 firms and 2,349 suppliers, out of which more than 90% are outside the United States. I compare the dynamic of sales and costs of firms regulated by the Dodd-Frank Act, to other non-regulated firms within the same industrial sector. I find that regulated firms face a decline in global sales by 3%. Administrative costs react when firms start complying with the law: the cost paid per dollar earned increases by 4.2%, amounting to around 30 thousands USD annually, for an average firm. Interestingly, this compliance cost is mostly borne by firms filing extensive reports, firms with larger supplier networks, and more upstream. The effect on input costs is very noisy and close to zero, but I find that the price of some metal downstream products increase at the US border.

Second, at the global level, the Dodd-Frank Act Conflict Mineral Rule targets specific metals and their ore (minerals): tin, tantalum and tungsten (hereafter 3T). 3T have a large range of industrial applications for which they cannot be substituted, or only at prohibitive costs, which limit demand substitution effects on other metals and minerals trade.[3] This

[3] Among others, those metals are used in the technology, medical services, jewellery and automotive sectors.

design naturally yields other minerals' as a relevant control group. On the other hand, only a few source countries of 3T fall under the rule, which enables me to implement a triple difference strategy. I compare targeted countries' exports to other producers in the world, which cancels for changes affecting the whole 3T market at the time of the Dodd-Frank Act. I use the structural gravity framework to estimate the policy change on mineral trade trade, which is well suited to study diversion effects (Viner, 1950; Carrère, 2006; Yotov et al., 2017).[4] By using bilateral trade data, I can observe exports at a disaggregated product level in one of the least developed regions in the world. Furthermore, the use of this publicly available data source makes it easy to replicate this analysis for any other due diligence policy targeting a region.

To study the heterogeneity in partners' response and diversion channels driven by regulation avoidance, I use a new classification of legal havens from a complementary paper (Moreau-Kastler, 2025). A legal haven is a jurisdiction with laws enabling one to evade regulations linked to economic activity in a source country. Its laws generate legal opacity, altering or hiding information on flows resulting linked to this activity. Through its extraterritorial design, the Dodd-Frank Act provides a relevant natural experiment to study regulation avoidance offered by legal havens. The law increases the costs for suppliers of U.S. firms of sourcing conflict minerals, through the risk of name and shame, trade disruption with partners, or U.S. retaliation. These costs are mitigated by legal opacity which limits the exposure of the Conflict Mineral Rule, preventing NGOs and civil society actors to act as enforcers of the law (Eilstrup-Sangiovanni and Sharman, 2022). Moreover, if the law causes a drop in foreign demand addressed to DRC and neighbouring countries, legal havens provide an alternative market to sell to for these countries.

I find that the Dodd-Frank Act introduced substantial trade costs for regulated countries. 3T exports from the DRC and adjoining countries to the rest of the world decreased by 76%. The effect of the Dodd-Frank Act is equivalent to a 25% increase in tariffs on 3T products for the Great Lakes Region. Testing for heterogeneous responses to due diligence, I find that legal havens mitigate these trade costs linked to the Dodd-Frank Act. The share of 3T exported to legal havens in total 3T exports from the region increases by 15.7 percentage points. Diversion is particularly pronounced when rules are strongly enforced, for exporters closer to the most violent region of Kivus. Making use of the structural gravity model to compute general equilibrium diversion effects, I find that 24% of the drop in export is due to diversion to legal

[4] Additionally, several papers have employed this structural gravity framework to examine trade in extractive commodities, such as Fally and Sayre (2018) and Larch et al. (2022).

havens. Finally, I find that legal havens re-export more 3T to countries hosting metal suppliers of the US-regulated firms. I use robustness tests to ensure that this diversion effect is not driven by other institutional factors, such as countries' control of corruption or tax haven status. The results show that they do not explain the heterogeneous response among trade partners. Moreover, findings are robust to testing for leads and lags, placebo products, using alternative definitions of legal havens, or using internal trade flows as an alternative control group. I also find that the Dodd-Frank Act diverts part of global demand to other producers of the same minerals: other 3T producers increase exports by 24%.

After examining the magnitude of regulation avoidance, I assess which countries benefit from trade diversion. First, diversion offered by legal havens mitigates the adverse trade shock on the Democratic Republic of the Congo and adjoining countries. Countries have to adjust downward mine-gate prices, but 3 percentage points less than if legal havens did not provide opacity. Loss in output is also of a lesser magnitude. Wether trade diversion through legal havens prevent the rule from reducing violence linked to mineral extraction depends on the local distribution of this change in income. Finally, legal havens derive a rent from regulation avoidance: they can import 3T at lower prices from the regulated countries, without having to pay new trade costs caused by due diligence. Compared to a reference country that is not a legal haven, their 3T world price index decreases by 1 per cent.

This paper relates to a growing literature on trade and enforcement of responsible production standards. Recent studies focus on the role of multinational firms as vectors of sustainable work conditions to their affiliates or suppliers abroad (Amengual and Distelhorst, 2019; Boudreau, 2024; Alfaro-Ureña et al., 2025). For these large firms, the salience of global norms also seems to matter as Harrison and Scorse (2010) show that MNCs adjust labour compensation to respond to foreign activists campaigns. However, when importers doubt the capacity of their partners to comply with these norms, their access to international markets can be reduced (Koenig and Poncet, 2022; Bai et al., 2021). I contribute by showing that due diligence policies have great compliance potential as they can have global effects even if enforced by a large enough economy. I provide the first estimates of internal compliance costs paid by firms, and show that these costs depends on the firm position in the supply chain, as well as its number of suppliers. Finally, I show that the Conflict Mineral Rule creates a substantial income shock for source countries. Whether this shock, and the possibilities of regulation avoidance undermine the objective of the law will depend on the distribution of the income change within extractive countries.

This paper also contributes to developing research on the enforcement and diversion of

extraterritorial economic policies. The effect of the Dodd-Frank Act on trade is close to a complete trade sanctions (Felbermayr et al., 2025). Trade sanction often generate strong diversion effects (Haidar, 2017; Corsetti et al., 2024). Turning to trade policies, new barriers are partly undermined by illicit trade, re-rerouting or trade diversion (Fisman and Wei, 2004; Rotunno et al., 2013; Che et al., 2025), which incentivize the design of more complex instruments to account if third country effects (Conconi et al., 2018). I show that in the case of due diligence, the rule creates an incentive to exchange through legal havens, which challenges enforcement. Trade diversion to legal havens observed in the case of the Dodd-Frank Act is large. The mechanism and incentives for regulation avoidance are crucial to take into account in future design of due diligence.

My results also add to the literature highlighting the role of havens as opacity providers to facilitate international illicit flows. Many papers show a high prevalence of illicit flows in various types of non-cooperative jurisdictions, such as tax havens or offshore financial centers (Andersen et al., 2017, 2022; Johannesen and Zucman, 2014; Marcolongo and Zambiasi, 2022; Omartian, 2017; Vuillemey, 2020). I add to this literature by providing new evidence for legal havens, non-cooperative jurisdictions defined on legal and regulatory avoidance mechanisms that they offer. I show that these legal havens challenge the enforcement of extraterritorial regulation of production processes.

A few papers evaluate the effect of the Dodd-Frank Act on violence in the Great Lake Region. Parker and Vadheim (2017), Stoop et al. (2018) and Bloem (2023) provide evidence that the law actually increased the level of violence in regulated countries. My paper is the first to evaluate how the Dodd Frank Act changed targeted source countries' ability to export 3T. I also show that it is partially undermined by the possibility of regulation avoidance. Regarding welfare consequences, legal havens still provide market access for conflict minerals and partially offset the drop in income for rebel groups that the law intended to cause. Second, legal havens blur the distinction between conflict and conflict-free minerals that the Act seeks to clarify. As such, they could sustain collective reputation effects for 3T, preventing conflict-free mines from gaining market shares.[5]

The rest of the paper is organized as follows. Section 2 discusses the institutional context of the Dodd-Frank Act and the expected effects derived from the theoretical framework. Section 3 presents data sources and preliminary pieces of evidence of the effect of the Dodd-

[5]Finally, a few papers from the law and management literature document changes implemented within firms and firms' valuations reaction to disclosure: Sarfaty (2015); Dalla Via and Perego (2018); Baik et al. (2021) have explored firms' disclosure behaviours and documented that firms with better governance system and in sectors with higher public scrutiny provide higher quality reports under Dodd-Frank Act Conflict Mineral Rule.

Frank Act. Section 4 presents results at the firm level. Section 5 details the empirical strategy built within the structural gravity framework and results on trade diversion. In Section 6, I develop a counterfactual analysis of general equilibrium changes caused by the Dodd-Frank Act and diversion opportunities. Section 7 concludes.

2 Dodd Frank Act Conflict Mineral Rule

2.1 Institutional context

Section 1502 of Dodd-Frank Act In 2010, the Dodd-Frank Act introduced its *Conflict Mineral Rule* through Section 1502.[6] This law implements new filing obligations to the Security Exchange Commission (hereafter the SEC) for U.S. firms sourcing minerals in Central Africa's Great Lakes Region. The law regulates the use of four metals and their minerals: gold, tantalum, tungsten and tin (3TG). I exclude gold from my analysis because of data constraints discussed in Section 3.

Firms required to comply with the Conflict Mineral Rule are U.S. firms filing to the SEC: typically large firms listed on US stock exchanges, but also smaller companies and some foreign issuers. These firms represent a large share of US sales and profits (Asker et al., 2015). Companies are required to verify if the products they manufacture (or contract to) contain tin, tantalum, tungsten or gold to determine if they are subject to the rule. In this case, firms reveal if a minimal inquiry allows to determine that no 3T products comes from DRC or adjoining countries (the *covered countries*). If this is not the case, there are supplementary requirements: companies should determine if the minerals used could have fueled conflicts in covered countries and present policies in place to prevent it (i.e. due diligence). They typically do so by providing information on refiners and smelters of metal in their supply chains. Conclusions are disclosed in a special report certified by an independent third-party audit.

This law is not an embargo on the Great Lake Region, and there are no sanctions introduced by the law for indirectly sourcing conflict minerals. Public disclosure of reports and labelling of products was thought of as a *name and shame* mechanism to outsource enforcement of responsible behaviours to third parties from the civil society. Firms can face sanctions for not conducting their inquiry in good faith (Sarfaty, 2015), and providing false

[6] The rest of the Dodd-Frank Wall Street Reform and Consumer Protection Act is composed mainly of financial regulations.

information under the SEC rules.[7] These sanctions can be substantial and are the same than for misreporting of financial reporting in other SEC filings. In 2014, Barack Obama implemented secondary sanctions on DRC: for direct or indirect support to armed gorups by the illicit trade of natural resources. This sanction applies to any type of natural resource, but it only interacts with increase transparency for 3T because of the Conflict Mineral Rule.

All regulated products are used in industrial production technologies and are hardly substitutable inputs. Tantalum incorporates small-size capacitors, tin in many consumer goods, like ballons or tin cans, and tungsten is used as a component of light bulbs or electrodes, or in some military devices. The most represented sector among filing firms is "Electronic and other electrical equipment" (25%) (see Figure B1). The law was designed to induce compliance of suppliers of the regulated firms, even if they are abroad.

This law was motivated by civil society initiatives in the United States, such as the Enough Project. These campaigns supported and spread the idea that the use of minerals by the tech industry was causally linked to local violence around extraction sites. The choice of those products was motivated by their strategic role for the downstream, following the narrative of "blood in the mobile". A second motivation was the feasibility of enforcement, as their ore (coltan, wolframite, cassiterite, ...) can be found in similar extraction sites in the covered countries for geological reasons.

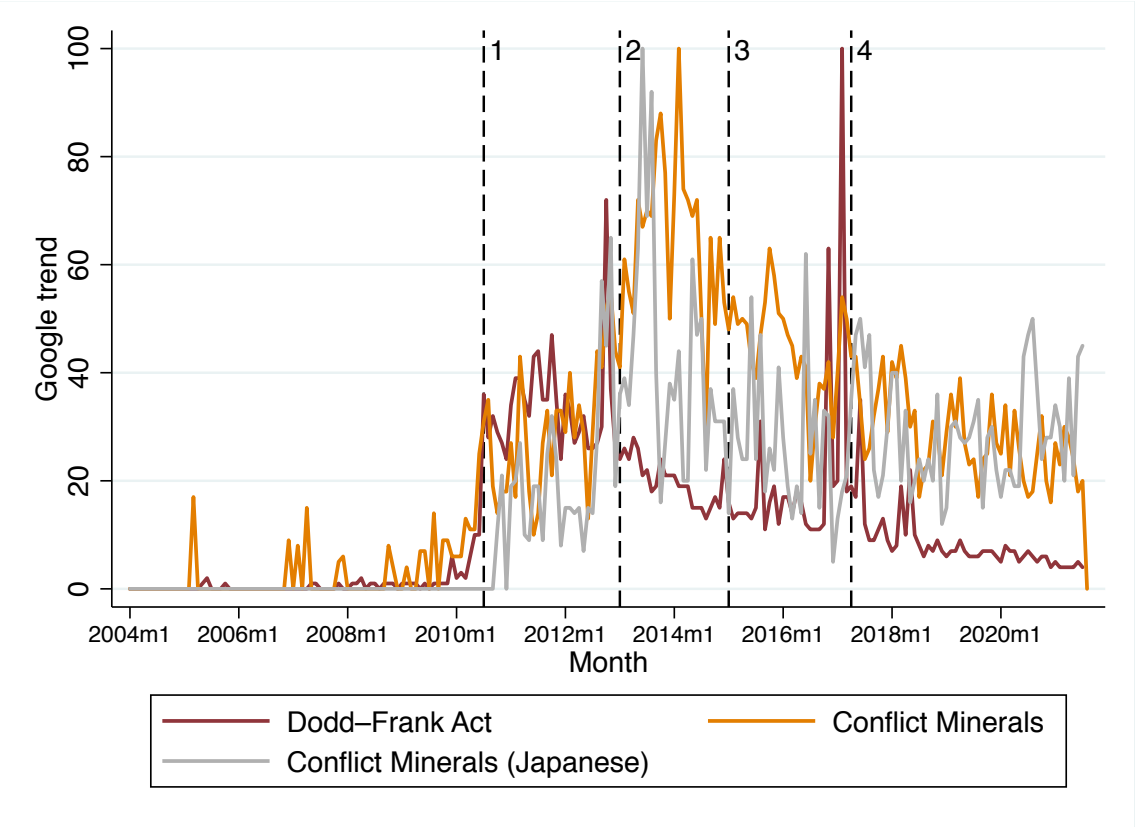
The Dodd-Frank Act was implemented in four wide periods (see Appendix for detailed timeline). It was signed in July 2010, which started a period of high uncertainty for firms and local exporters. Rules were published in late 2012, and gradually implemented from 2013 to 2015, without certification. Rules were fully implemented in 2015 until the Trump administration repealed mandatory certification and reporting requirements in 2017 (but firms could continue to do so). There is no similar regulation implemented within this time frame: the Canadian bill for a Conflict Mineral Rule in 2015 did not pass in parliament, and a similar European legislation was only signed in 2017 and implemented in 2021.[8]

The Conflict Mineral Rule generated a large salience of conflict mineral topics. Figure 1 plots monthly Google Trend worldwide indexes for terms associated with the Dodd-Frank Act. The index indicates the relative popularity of terms compared to the top popularity in the period (base 100 for top popularity in the series). The maroon curve displays the

[7] under Exchange Act Section 18(a): concerning "any material fact, shall be liable to any person (not knowing that such statement was false or misleading) who, in reliance upon such statement, shall have purchased or sold a security at a price which was affected by such statement, for damages caused by such reliance, unless the person sued shall prove that he acted in good faith and had no knowledge that such statement was false or misleading."

[8] Canadian Conflict Minerals Act, bill C-486. European directive 2017-821.

Figure 1 – Google trends in terms associated to Dodd-Frank Act



Note: 1: Uncertainty; 2: Implementation; 3: Full application; 4: Relaxed disclosure. The Google trend denoted Dodd-Frank Act stands for the full law name *"Dodd-Frank Wall Street Reform and Consumer Protection Act"*.

Google trend index for the full name of the Dodd-Frank Act, and the other two curves display indexes for the term conflict mineral both in English (orange) and in Japanese (grey). Japan host a large smelting industry of 3T.[9] Conflict minerals became a generic term to designate 3T after 2010. Series associated with three terms were close to zero before 2010, and sharply gained in popularity around the third and fourth quarter of year 2010, at the signature time of the Dodd-Frank Act. Popularity levels reach 20 to 40% of top popularity. The term conflict minerals in both languages reach their maximum level during this implementation period of the law. The two series are highly correlated with each other (0.80 correlation coefficient), reflecting that salience was transmitted to locations with a large transformation industry abroad.

Mining trade from the Great Lake Region The covered countries were chosen based on the situation of violence intertwined with extractive activity. A second motivation was the

[9] In the period between signature and final rules design (2010-2012), several Japanese industrial associations exchanged with the Security Exchange Commission underlining the cost that they would incur as suppliers of the US economy (SEC, 2012).

risk of smuggling between them, to prevent re-routing to close countries.

The Dodd-Frank Act regulates ten countries, named the *covered countries*: Democratic Republic of the Congo, Rwanda, Burundi, Angola, Congo-Brazzaville, Central African Republic, South Sudan, Tanzania, Uganda and Zambia. The region, which has the size of Western Europe is displayed in Figure 2. This is a large mining region: it produces at least 14 different minerals and the extractive sector represents between 10 and 20% of GDP (USGS, 2010).

The region is a large producer of tantalum: in the 2006 to 2009 time period, covered countries produced 34% of world ore volume.[10] Relative market shares in other products are smaller: regional production represents 3.6% of the tin world supply and 2.9% of the tungsten world supply. Tin is highly abundant and less concentrated, and major tungsten suppliers are located elsewhere. Minerals from the covered countries tend to be cheaper than those from other producing regions.

Table 1 – Share of world production volume (2006-2009)

Countries	Tantalum	Tin	Tungsten
Covered countries	0.346	0.036	0.029
ROW	0.654	0.964	0.971

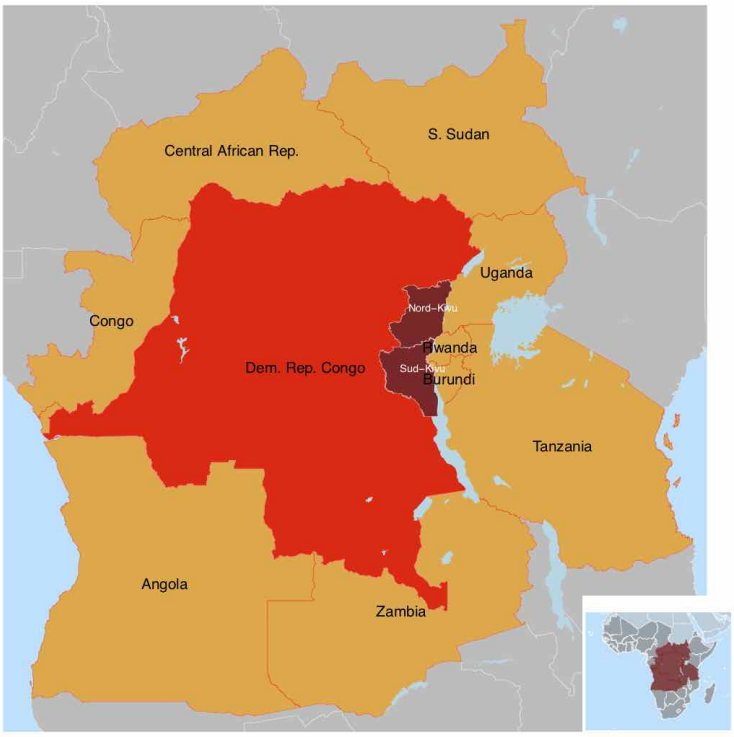
Note: Own computation based on Fally and Sayre (2018) data.

Local 3T mineral extraction is mainly artisanal, and linked to regional conflicts. In Kivus regions, between 2013 and 2015 Weyns et al. (2015) estimated that armed groups were present at 65% of mining sites. According to the UN Group of Experts on the Democratic Republic of the Congo, most minerals extracted in DRC benefit directly or indirectly to armed forces present in the area (United Nations, 2002). According to a field study from Cuvelier et al. (2014), local stakeholders did not anticipate the Dodd-Frank Act Conflict Mineral Rule before the signature.

The Dodd-Frank Act covers a large region: the reason for this design is that distinguishing the true origin of minerals between covered countries is notoriously hard because of pervasive smuggling between countries. Minerals extracted in DRC are often smuggled across the border and reported by neighbouring countries across the lakes, such as Rwanda. Bleischwitz et al. (2012) estimates that 55% of coltan exported from Rwanda to China is smuggled from DRC.

[10] Based on production series from the British Geological Survey harmonized by Fally and Sayre (2018), see Section 3.

Figure 2 – Covered countries



Note: Covered countries displayed in colour. In red: Democratic Republic of the Congo; in orange: adjoining countries; in brown: North and South Kivu.

There is almost no local transformation of minerals in metals. After extraction, mineral products are transported from the mine to local trading towns by *négociants*, sold to comptoirs, which sell them to international traders. Traders organize the export logistics, from covered countries to processors and smelters in the rest of the world, which transform minerals into metal. Large transformation industries are typically located in South and East Asia, with small refining activity in the United States and Europe (USGS, 2014a,b,c). World markets for tantalum and tungsten are rather small with no organized spot market in 2009 (Bleischwitz et al., 2012), contrary to tin.

2.2 Expected effect and theoretical framework

The Dodd-Frank Act increased the cost of importing tantalum, tin and tungsten from covered countries through several channels. To illustrate these changes in trade flows, I draw from the general equilibrium gravity framework (Anderson and Van Wincoop, 2003). Consumers in each country j maximize their utility over varieties i of mineral products produced in the world:

$$u_j = \Big(\sum_i \alpha_i^{\frac{1-\sigma}{\sigma}} c_{ij}^{\frac{\sigma-1}{\sigma}} \Big)^{\frac{\sigma}{\sigma-1}}$$

With α_i and exogenous taste parameter, and σ the elasticity of substitution among varieties. Total expenditures from country j is the sum of consumptions in value:

$$E_j = \sum_i p_{ij} c_{ij}$$

Expenditure shares, imports from partner country i, and price index in j follow from CES preferences:

$$X_{ij} = \Big(\frac{\alpha_i p_i t_{ij}}{P_j}\Big)^{1-\sigma} E_j$$
$$P_j = \Big[\sum_i (\alpha_i p_i t_{ij})^{1-\sigma}\Big]^{\frac{1}{1-\sigma}}$$

With P_j the price index faced by importer j on the world market. Imposing that the sum of expenditures in all goods for a country i must equalise the value of output Y_i up to a trade imbalance of an exogenous ϕ_i, the "mine-gate" prices in i is:

$$p_i = \Big(\frac{Y_i}{Y}\Big)^{\frac{1}{1-\sigma}} \frac{1}{\alpha_i \Pi_i} \tag{1}$$

This is the price paid to mineral producers, at the exit point of the mine, in country i. Similarly, we derive the gravity systems in 2 and 3:

$$X_{ijt} = \frac{Y_{it} E_{jt}}{Y_t} \left(\frac{t_{ijt}}{\Pi_{it} P_{jt}}\right)^{1-\sigma} \tag{2}$$

$$\begin{aligned} \Pi_{it}^{1-\sigma} &= \sum_j \left(\frac{t_{ijt}}{P_{jt}}\right)^{1-\sigma} \frac{E_{jt}}{Y} \\ P_{jt}^{1-\sigma} &= \sum_i \left(\frac{t_{ijt}}{\Pi_{it}}\right)^{1-\sigma} \frac{Y_{it}}{Y} \end{aligned} \tag{3}$$

Equation 2 is the trade gravity relationship, stating that trade X_{ijt} between from exporter i to importer j at time t, is a function of exporter output Y_{it}, importer total expenditures E_{jt}. Trade is also a function of trade frictions made of t_{ijt} bilateral trade costs, and Π_{it} and P_{it} the multilateral resistance terms of importing and exporting countries. They are defined by the relationships in Equations 3. Multilateral resistance terms (MRTs) measure how remote a country is from all other countries, to export (outward multilateral resistance $\Pi_{it}^{1-\sigma}$) and to import (inward multilateral resistance $P_{jt}^{1-\sigma}$). MRTs summarize trade costs faced by an exporter (importer) to access foreign markets. The parameter σ is the elasticity of substitution among mineral varieties and determines the trade elasticity. To complete the characterization of the economy, we consider that output in country i is determined by a fixed endowment

Q_i:

$$E_i = \phi_i Y_i = p_i Q_i \tag{4}$$

This system holds at the industry level, as it is additively separable: at the mining sector level.

The Dodd-Frank Act directly impact the trade costs $t_{DFA,j}$ between covered countries and their trade partners j not covered by the Conflict Mineral Rule. It does not only affect $t_{DFA,USA}$ but also other trade partners j to the extent that regulated firms have large linkages with the rest of the global economy. It does so through the combination of three mechanisms.

First, importers supplying to the United States have to enter a lengthy and costly due diligence administrative process if they import 3T from covered countries. It will affect suppliers to the US-regulated firms in all other regions, as Dodd-Frank Act obligations extend to all the supply chains of regulated firms. The Security Exchange Commission explicitly states that the competitiveness of US production should not be affected to the extent that the supplier's network of regulated firms is wide and will have to comply with the rule to keep supplying regulated firms. Only focusing on the United States, the SEC estimated that the upfront implementation cost of compliance with the law for the economy should be 3 to 4 billion US dollars, and the annual cost for updating information of 34 to 101 thousand US dollars per firm on average (SEC, 2012). This cost includes gathering information on supply chains, verifying information from suppliers, and payment of auditing third parties. Moreover, *conflict-free* certifications developed to comply with due diligence obligations: to cite a few, the iTSCI for tin, or the Responsible Mineral Initiatives. These initiatives implemented costly processes to ensure that minerals were not sourced from conflict-related mines, raising the cost of minerals sourced from the region.

Second, the salience of the conflict mineral issue rose following the Dodd-Frank Act's signature, inducing the risk of campaigns or consumer backlash and collective reputation effects. This salience is depicted in the Google Trends change in Figure 1. Campaigns are found to be effective at changing sourcing behaviours in the context of anti-sweatshop activism (Harrison and Scorse, 2010).[11] As conflict and conflict-free minerals are hard to distinguish in the covered countries, collective reputation is also likely to decrease foreign demand to this region (Bai et al., 2021).

Third, it exposes firms to potential sanctions by publicly disclosing information on 3T sourcing choices. Firms might, knowingly or not, source conflict minerals and engage in

[11] Name and shame is also found by the management literature to induce firm compliance (in the case of aggressive tax planning see Dyreng et al. (2016)).

commercial relationships with rebel groups involved with human rights violations. Under international or some national regulations (such as US sanctions), such transactions could be subject to legal retaliations.

These costs are passed on to all suppliers of US firms sourcing from the covered countries. A metal supplier can engage with a regulated US firm only if compliant. The term $t_{DFA,j}$ embeds the three mechanisms and increases. From equation 2, an increase in $t_{DFA,j,t\geq 2010}$ will translate into a decrease in $X_{DFA,j,t\geq 2010}$. This is a first-order effect of the change in $t_{DFA,j}$.

H1: 3T exports from covered countries will decrease following the Dodd-Frank Act.

If suppliers of the regulated firms are not willing to keep importing from covered countries and incur new trade costs, they face two choices: (i) they can switch to a non-regulated source country or (ii) to avoid the Dodd-Frank Act Conflict Mineral Rule. These are second-order effects caused by $t_{DFA,j}$ in the gravity system.

First, importers can decide to switch to another source of minerals to avoid the new trade costs. If US firms and their suppliers only import from countries non-regulated, they do not have to file a Conflict Mineral Report, audit all their supply chain and implement due diligence measures. They do not face risks of campaigns or sanctions. After 2010, some smelters as well as downstream US companies adopted an embargo strategy: they completely stopped importing from DRC, or contracted for suppliers to do so (Dalla Via and Perego, 2018). This will cause some importers to redirect demand to other producers, generating trade diversion (Viner, 1950; Carrère, 2006). Structurally, this is a second-order general equilibrium effect conveyed through multilateral resistance terms: when $t_{DFA,j}$, it affects exchanges P_j, and in turn X_{ij}.

H2: Other countries exporting 3T will increase exports after the Dodd-Frank Act Conflict Mineral Rule as they face more foreign demand.

Minerals from other producers tend to be more expensive, in lower abundance (especially for tantalum), or of a different quality, limiting substitution. A last choice for regulated firms or their suppliers is to avoid the Dodd-Frank Act Conflict Mineral Rule. The enforcement of the Dodd-Frank Act Conflict Mineral Rule operates through transparency of sourcing choices from regulated firms and their suppliers. The transparency held them accountable through *name and shame*: US authorities expect that non-complying firms will be held accountable through campaigns or public disclosure of their behavior.

Mapping the supply chain from downstream to the mine is especially challenging: Sarfaty (2015) notes that some firms took a year to trace it internally. NGOs or private actors willing

to verify firms' use of conflict minerals are more prone to do so by operating from upstream to downstream: investigating who are the direct and indirect customers of conflict mines.[12] A key point of regulation avoidance is therefore to render opaque the origin of minerals and metals in the first step of the supply chain. It is important to note that this regulation avoidance could be undertaken by indirectly regulated suppliers, and not mandated by US-regulated firms, as supply chains often involve many steps.

Legal opacity in havens provides a set of legal tools that, when combined, can conceal information on a trade flow and its origin. First, traders located in legal havens can shield themselves and their customers from either prosecutions or public backlash. They do so by preventing other jurisdictions or other third parties from gathering information on supply chains, combined with potential leniency in compliance high international standards on conflict minerals. This results in a loss of paper trail: for example, in 2013 the UN group of experts on DRC identified a Hong-Kong-based firm called King Wood buying conflict coltan but was not able to identify its beneficial owners or downstream clients (United Nations, 2013) because of the opacity and unwillingness of the jurisdiction to cooperate. The legal prevents NGOs to play the role of enforcers of international law (Eilstrup-Sangiovanni and Sharman, 2022) designed by the Dodd-Frank Act Conflict Mineral Rule.

Second, when hosting a transformation industry, legal havens can potentially "launder" conflict minerals and commodities exchanged (Public Eye, 2012; Delestrac et al., 2018; Global Witness, 2022). In 2015, Public Eye (2015) found that a large part of gold from Burkina Faso smuggled illegally to Togo was laundered through Swiss refiners. Refiners in legal havens import minerals can import metals of different origins, and once metals are melted together, it is impossible to distinguish their source. These possibilities of regulation avoidance, if exploited, will translate in trade diversion from covered countries to legal havens. Finally, if covered countries do not have access to regular trade partners but still can export to legal havens, a share of exports will mechanically be redirected to them.

Sales that were before exported to regular trade partners are redirected to legal havens. This translate also into second-order effects: a change in $t_{DFA,j \notin LH}$ causes a change in Π_{DFA}, causing an increase in $X_{DFA,LH}$, reflecting that when experiencing higher barriers with regular trade partners, covered countries redirect exports to other countries (legal havens). The second-order effects causing trade diversion are always lower than the first-order effect running through $t_{DFA,j}$ if a country pair is experiencing both.

[12] This how operates a recent report from Global Witness (2022) on DRC, linking conflict tin to Apple.

H3: 3T exports originating from covered countries will be directed relatively more to legal havens after the Dodd-Frank Act is passed.

If legal havens generate efficient loopholes they both alter real information on the origin and provide a credible alternative source to report to US downstream firms. In this case, they can declare that they do not source conflict minerals in covered countries to their knowledge, once due diligence is undertaken.

H4: If legal havens are successful at regulation avoidance of the Dodd-Frank Act, they will re-route exports to the United States and their suppliers.

Trade barriers and diversion generated by the Dodd-Frank Act generate income effects in covered countries, which are intended by US policymakers to reduce extractive revenue for rebel groups. In this structural framework, a change in $t_{DFA,j}$ causes an increase in Π_{DFA}, reflecting that covered countries face a higher outward multilateral resistance, i.e. lower access to the world market. To keep exporting, covered countries compensate for higher trade barriers by lowering their mine-gate prices: an increase in outward multilateral resistance Π_i cause a decrease in p_i. This change in prices will directly change the value of output in equation 4 and in turn trade flows in equation 2. Cuvelier et al. (2014) documents that in South Kivu in 2012, prices of artisanal tin ore had dropped down from 8$ per kg to 2.5$ per kg in most extreme cases. This change in prices in turn translates to a change in the total output Y_i. The law is successful if this drop in prices and output affects rebel groups and not civilians.

Changes in producer prices affect the price index that importers from any country face when sourcing from abroad. Structurally, the inward multilateral resistance term P_j of country j also corresponds to the price index of products from all partner countries. Legal havens facing a different $t_{DFA,j}$ thanks to regulation avoidance, their price index will be lower than the rest of the world after the Dodd-Frank Act is passed and will further motivate regulation avoidance.

Anecdotal evidence suggests that the Act changed market access of covered countries as soon as it was signed in July 2010. It was also not anticipated by local miners Cuvelier et al. (2014). The signature time was a time of high uncertainty through which collective reputation effects took place. The level of constraints and proper rules were published in 2012, clarifying the scope for regulation avoidance from 2013 onward.

There are further effects that this model does not include and that are outside the scope of this paper. There could be changes in market power along the supply chain caused by

compliance with the Dodd-Frank Act. If due diligence responses are costly, such as certification of inputs, contracting over sources, and dissociation from non-conflict-free smelters, it should be reflected in the price of minerals, and turn higher input costs. Finally, regulated firms could face changes in their market share, either at home under the pressure of consumers, or abroad if their productivity is affected.

3 Data & preliminary evidences

3.1 Data

Trade in minerals. I use two data sources to measure trade flows in minerals, at country pair-product-year level. First, I use the bilateral trade flows at the product and year level from the BACI database (Gaulier and Zignago, 2010), at the HS6 product level. Compared to UN Comtrade, BACI has the advantage of reconciling exporter and importer-reported trade flows and minimizes discrepancies in declared values. This process allows the validation or completion of the information reported by regulated countries, to avoid quality concerns associated with data reported by countries with lower state capacities.[13] I restrict the trade matrix to mineral and metal products for which some data on production to reconstruct internal trade flows is available (see below). I include only upstream forms of metal when available, at the least processed stage. The list of mineral products and HS codes is provided in Table B5. Similarly to the 3T, those minerals and metals tend to be unsubstituable inputs for specific industries. The control group includes mineral widely concentrated in the region and subject to the same conflict and informal mining issues as 3T, such as Copper and Cobalt for example. The final sample includes flows from 152 countries exporting 16 different products at two transformation stages to a total of 211 destinations over the years 2005 to 2017.

BACI provides supplementary files to recover true zero trade flows from missing values. Zeros for a given year and country pair are reported when at least one of the countries is reporting non zero trade to another partner. If information is missing from both sides, the trade flow is set to missing. In the final database, 65% of observations at the country pair-product-year level report zero trade flows.[14]

[13] I let the reader refer herself to the method of (Gaulier and Zignago, 2010) for more details on their reconciliation process. In Figure B13 in Appendix, I plot the difference in mirror flows following Fisman and Wei (2004), to make sure that there is no change in missing imports at the same time as the Dodd-Frank Act from covered countries $MissImports_{ijt} = ln(RepExports_{ijt}) - ln(RepImports_{jit})$.

[14] Out of which a large part will be dropped if it does not provide identifying variation, in particular bilateral variation.

I match the trade flow matrix with national production to build internal trade flows, i.e. total production in value minus total exports from a country. Fally and Sayre (2018) provide production data for minerals from the British Geological Survey, harmonized with the HS classification from 1970 to 2017. The final database is a complete trade matrix at the mineral product-country pair-year level from 2005 to 2017, with trade-in value (thousands of USD) and volume (tons).

I apply some restrictions. I exclude trade in gold from the analysis: first, trade in gold was highly dominated by Switzerland at the time of the Dodd-Frank Act, but until 2012, Switzerland was not reporting part of its gold trade through administrative dispositions.[15] Second, gold is harder to track in this region because it can be transformed directly at the mine, and I focus on reported trade from the regulated area.[16] I exclude trade statistics for South Sudan: the country gained its independence in 2011 around the timing of the Dodd-Frank Act and does not provide trade statistics before 2012.

Firm level data. I use two sources of firm-level data: the Compustat North America database and the Form SD Exhibit 1.01 remitted to the Security Exchange Commission by firms under the Dodd-Frank Act.

Compustat provides data from consolidated income statements and balance sheets from mandatory filings to the Security Exchange Commission. This is the set of firms subject to the Dodd-Frank Act if using 3T. Out of the 1,621 firms filing under the Conflict Mineral Rule, I am able to match 1,277 of them. The rest of the 4,686 firms in Compustat are comparable large public-listed firms subject to financial filings, not filing under the Dodd-Frank Act. I observe consolidated: total sales, total selling, general and administrative expenses and total cost of goods sold in value every year. Selling, general and administrative expenses measure the cost of sales, operating expenses and administration costs that are not directly related to the production of a good or a service. Compliance costs incurred by implementing the Dodd-Frank Act's requirement and generating new administrative expenses will be reflected in this item. Expenses in external audits from independant third party are not included and would be supplementary costs. The cost of goods sold reflects the total input cost and will reflect costs passed by suppliers. I restring the sample to firms observed at least 10 years on the time period to avoid including extreme values around the entry or exit times. Variables are winsorized at 1%. Table B2 details the size of control and treated groups by sec'"tor

[15] for gold imports under the code 7108.12, see https://www.ezv.admin.ch/ezv/en/home/topics/swiss-foreign-trade-statistics/daten/waren/gold.html

[16] See (Sanchez de la Sierra, 2020) for contextual evidence on gold vs 3T smuggling.

and Table B3 provides descriptive statistics of variables of interest. Regulated firms firms represented at least 9 000 billion USD global sales in 2010. Regulated firms tend to be larger, more downstream, and operate in a small set of sectors (see also Figure B1).

The second data source comes from Form SD Exhibit 1.01 filed to the SEC under the Dodd-Frank Act Conflict Mineral Rule. Firms filing under the rule determine if there is a reasonable doubt that targeted metal products could come from the African Great Lakes Region, in which case firms remit a special report in Exhibit 1.01. This report provides due diligence steps to ensure the legal origin of minerals. Among the 1,621 treated firms, 1,262 remit such a report and 739 provide detailed information on the name, product and location of their potential metal suppliers. Firms typically report the conflict-free certifications of their suppliers as a proof of their due diligence efforts. Figure B2 in the appendix provides an example. I collect and harmonize the name, product and location of each supplier, and build a yearly database of targeted metals supply chains for firms under the Dodd-Frank Act. Information provided starts in 2013 with the application of the law and I collect suppliers up to the year 2019. The resulting data provides supply chains US firms and their metal suppliers abroad. The supplier's linkages can be direct or indirect: a firm can import metal directly or incorporated in an intermediate good. Linkages are most of the time metal specific. I identify 2,912 unique suppliers, out of which 2,349 supply 3T. Among them, 1041 supply at least 10 of the regulated US firms, and 88% fo these substantial suppliers are located outside of the United States. The main limitation of this data is that it only provides suppliers willingly disclosed by firms, once supply chains have potentially adjusted after the implementation of the Conflict Mineral Rule.

Table 2 presents the four main data sources used to capture margins of adjustment to the Dodd-Frank Act.

Table 2 – Main data sources

Source	Unit of obs.	Years	Variables	Coverage
Compustat	Firm	2000-2020	Costs, Sales, Assets	Treated & control firms
Form SD	Firm-Supplier	2013-2019	Country, Metal sold	Treated firms
BACI	Country pair-product	1995-2021	Trade in volume & value	World mineral trade
Fally and Sayre (2018)	Country-product	2000-2017	Production in volume & value	World mineral production

US minerals end use The US Geological Survey provides statistics on the end use for 76 different commodities (Barry et al., 2015). This dataset allows me to identify final and intermediate goods imported by the United States incorporating 3T. The end-use table lists the description of industries incorporating different metals, based on US mineral use data, with their 3 to 6-digit corresponding NAICS codes, contrary to other end-use table which usually aggregate the full metal sector. I match the NAICS codes to corresponding HS product codes. Foreign export prices of 3T downstream products exported to the US are recovered from US import unit values, provided by the US Census Bureau. Import unit values correspond to the average price of products sold by foreign producers at a monthly level before tariffs are applied.

Legal Havens. I use the classification of legal havens from Moreau-Kastler (2025). Legal havens are a concept in international law from Delmas-Marty (2004): "[countries or independent territories which] adopt laws offering advantages to entities or individuals enabling them to conceal illicit activity and evade legal obligations related to their economic activities" (Lemaître, 2019). These laws create four key dimensions of opacity: (i) financial secrecy, (ii) opaque legal structures, (iii) domestic policies, and (iv) low international cooperation with other jurisdiction.

Using legal variables from over ten international comparative sources, supplemented with national legal data, legal opacity is measured by a composite index on 191 territories, covering the decades 2000–2009 and 2010–2019. Legal havens are the top 25% opaque countries. I use the average of legal disposition across the time period to build the list of legal havens. The list of legal havens is provided in Table B1. I later explore the sensitivity of my results to the construction of the list of legal havens.

Legal havens include both large economies often classified as financial secrecy jurisdictions, small island states offering offshore services, and emerging economies. The legal havens list only partially overlapping with traditional tax haven or other existing offshore financial center classifications. Moreau-Kastler and Toubal (2021) shows that legal havens are linked to illicit flows from drug trafficking.

Among trade partners of covered countries, there are several types of legal havens. There are large trading hubs such as Hong Kong, Singapour, Panama, United Arab Emirates. There are legal havens also hosting a metal transformation industry, such as Switzerland, Luxembourg, Malaysia, Thailand. Finally there are subsaharan nearby developing countries with low transparency, such as Mozambique, Kenya and Namibia. I explore these different types

in my analysis. Thailand is classified as a legal haven but also has a large industry in tin refining. Prior to Dodd-Frank, it is a large importer of tin from covered countries, as for many tin exporters in Subsaharan Africa. In following analysis, I verify that my results are robust with and without the inclusion of Thailand in the legal havens list.

Other data From the Gravity CEPII database, I use bilateral data on regional trade agreements (Head et al., 2010). I use the measure of sector's upstreamness from Antràs et al. (2012). From the World Bank Entrepreneurship database, I recover the total number of firms (Meunier et al., 2024). When data is missing for countries hosting metal suppliers of regulated firms, I complement the data with alternative sources from Table B4. Data on metal prices comes from Fally and Sayre (2018).

3.2 Preliminary evidence

Unilateral shock with global reach Eventhough the Conflict Mineral Rule is unilaterally implemented by the United States, it has a global reach through reguted firms' linkages with the rest of the world.

The United States represent a priori a small export market for the covered countries, as displayed in column (1) of Table 3: covered countries export respectively 3.6%, 0.1% and 10.2% of tantalum, tungsten and tin to the US. In column (2) of Table 3 I compute export shares from covered countries to the United States adding re-exports of 3T from third countries to the US. By approximating re-exports, I assume that each third country is allocating the origin of minerals similarly across destination countries.[17] Up to 37.7% and 33.4% of tantalum and tungsten from the covered countries could be exported to the United States. These numbers do not account for exports embeded in intermediate products.

In Figure 3, I display further micro-evidence of regulated firms' linkages abroad. The figure charts the geography metal suppliers of the regulated firms as reported in Conflict Mineral Reports between 2014 and 2017. Each bar correspond, for a metal, to the share of total metal suppliers located in the country. The share of metal suppliers located in the US is substantial but not the majority: between 9 and 12%. The largest is reported in China: 30 to 39%. Other large supplier countries are, Indonesia, Japan and Germany. There is of course a size effect explaining that more suppliers are found in larger economies. Figure B3 in Appendix plots the total number of metal suppliers in a country, scaled by the total

[17] It could be that minerals from Brazil or DRC transformed in Japan are destined to different countries.

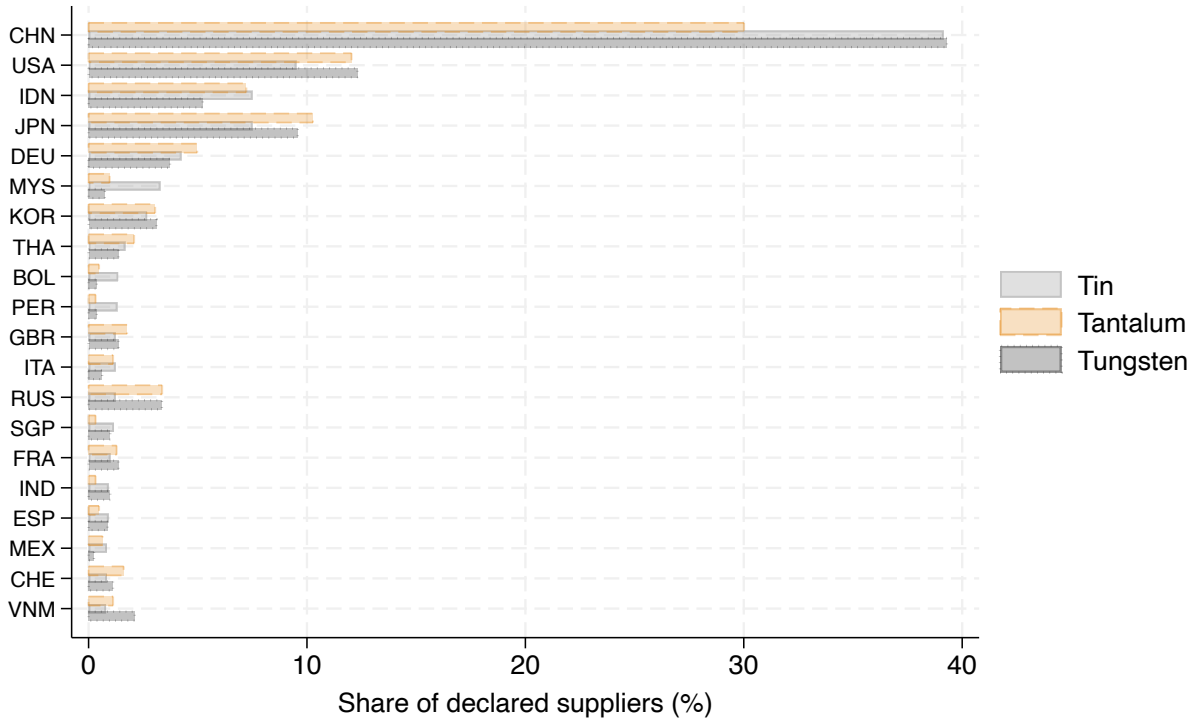
number of firms in the country. The ranking shifts slightly, but countries more specialized in supplying the US-regulated firms are still Japan, Indonesia and China.

Table 3 – Covered countries: export share to the United States

Product	Exports to US (1)	+ Re-exports (2)
Tantalum	0.036	0.377
	0.033	*0.203*
Tin	0.001	0.032
	0.001	*0.019*
Tungsten	0.102	0.334
	0.082	*0.353*

Note: 2006-2009 3T exports of covered countries, in value and *volume*. Column (2): exports direct and indirect if each country was re-exporting equally from covered countries.

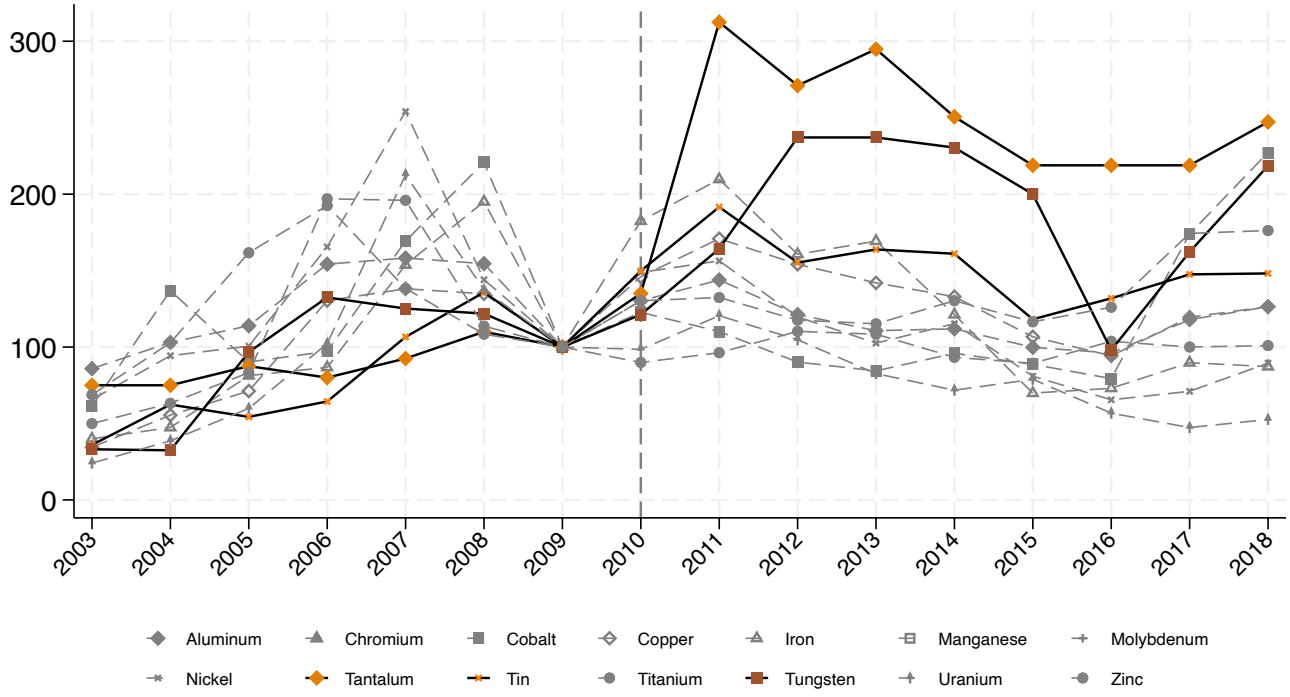
Figure 3 – Reported metal suppliers of US firms



Note: Declared suppliers by regulated firms in Conflict Mineral Reports between 2013 and 2017.

Global production and prices In Figures 4 and B5 I plot the change in metals' world market comparing 3T to other metals. Figure 4 charts the change in world prices for the main metals, using 2009 as a reference. Figure B5 does the same for production volumes. After the adoption of the Conflict Mineral Rule, prices of tantalum and tungsten increased two to three times compared to their baseline level. The price of tin, which has a large organized market, does not react more than other comparable metals. Production volumes remained flat, except for tantalum. Theoretical framework from Section 2, predicts that the relative mine gate price of minerals extracted in covered countries to decrease. Compare to the increased price on world market, this wedge created economic incentives for regulation avoidance: to escape regulation costs and keep importing relatively cheap minerals compared to high world market prices.

Figure 4 – World metal price index



Note: Base 2009 indexes of corresponding metal prices. Data sources: IMF, World Bank, USGS.

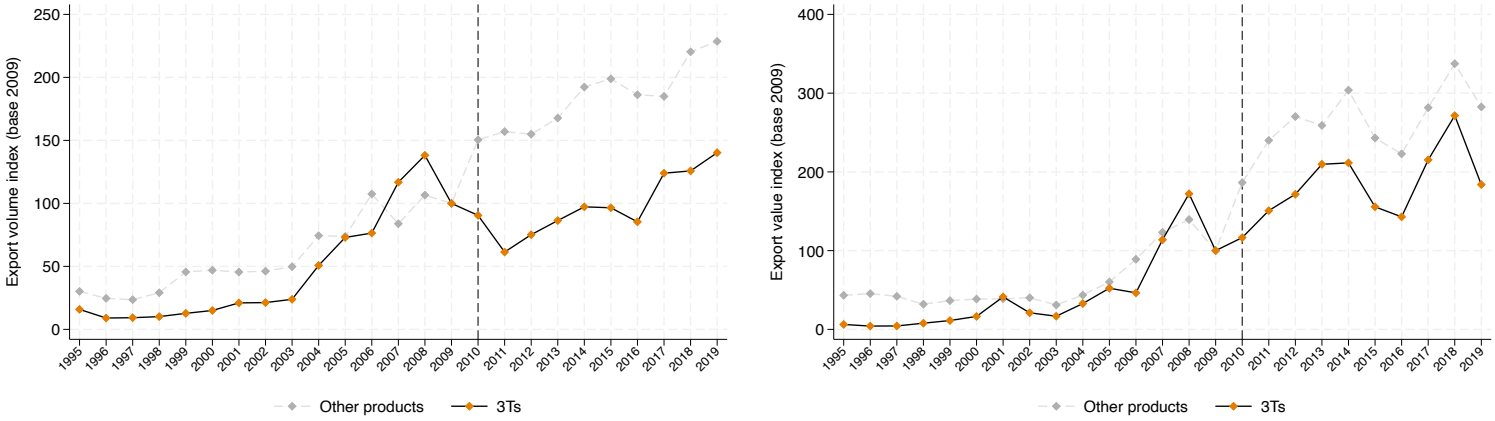
Change in covered countries exports Exports of 3T from the covered countries display an unconditional decrease after the Dodd-Frank Act is signed. Figure 5 plots the index base 2009 for exports in volume (left) and value (right), for 3T in orange and other metals and minerals in grey from covered countries. Reading the orange curve, export volume was 90% of their 2009 counterpart in 2010 and dropped to 60%-75% in 2011-2012. They only recovered their pre-signature level in 2017. In contrast, the series for non-targeted products displays a continuous increase in export volumes after 2010.

Series diverge in the year previous to the Dodd-Frank Act signature: export volumes of 3T decreased between 2008 and 2009. This drop is tied to 3T market specific events and also observed for exports from the rest of the world in Figure B6.[18] Changes in value account for world price changes displayed Figure 4. Looking at the series in value on the panel right, the two series display similar evolutions before 2010, and the post-treatment period displays a wedge between the two series despite price effects.

Aggregate changes in 3T exports mask changes in the allocation of exports across destinations. I compute and plot the export share of the regulated area to legal havens for each

[18] In 2007 China strongly restricted exports of tungsten to boost domestic industrial use (Zhu et al., 2019).

Figure 5 – Covered countries export index in volume (left) and value (right)



3T:

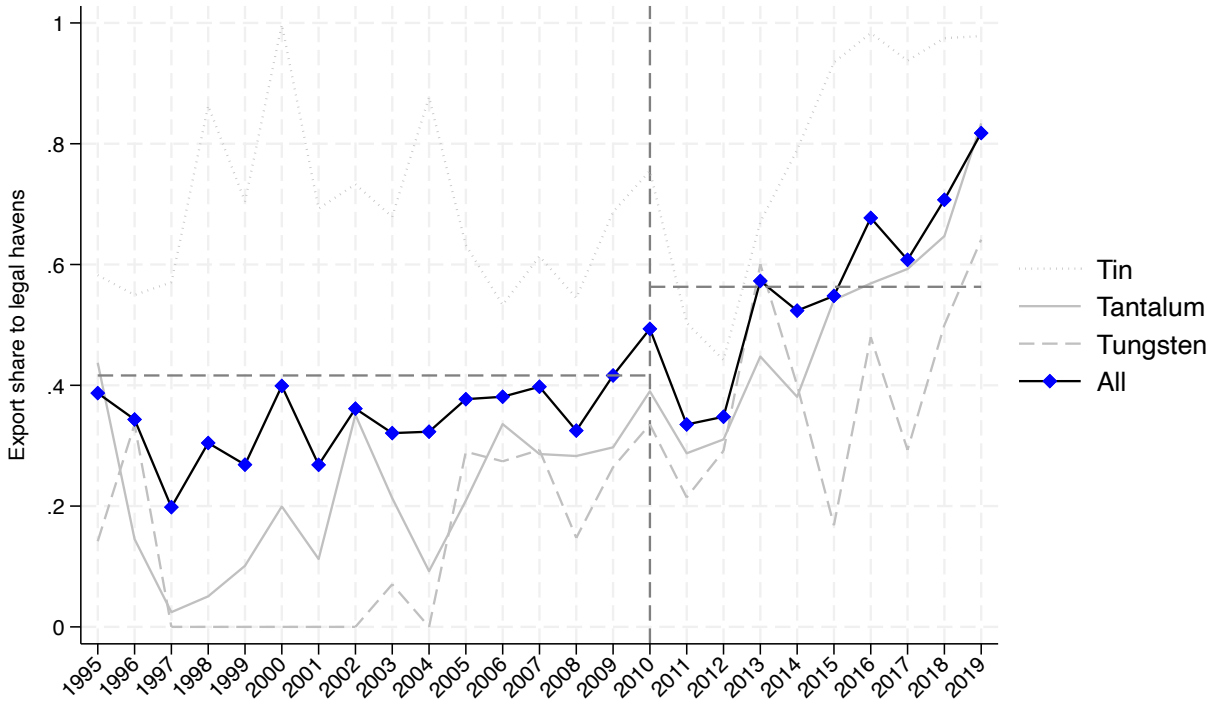
$$Y_{pt} = \frac{\sum_i \sum_j X_{i \in DFA, j \in LH, p \in 3T, t}}{\sum_i \sum_j X_{i \in DFA, j, p \in 3T, t}}$$

with i origin country, j destination country, p product and t year. Indices LH and DFA denote legal havens and covered countries. Figure 6 plots export shares for each 3T in grey lines, and the average of the export shares in blue.[19] From 2000 to 2009, the level of the export shares was stable (average at 41.6 in 2009). Following the signature of the Dodd-Frank Act, the share increased, especially around the time of implementation of the law.

Overall, these results indicate that 3T diversion channels should have taken place through legal havens. Figure B7 of unconditional export series show that covered countries' exports of 3T to legal havens catch up with export series of other products compared to non-legal havens destinations after 2013. For the more extreme case of Switzerland (figure B9), 3T imports from the covered countries surged in 2010.

[19] For readability purposes, the share in volume, which can be easily interpreted.

Figure 6 – Export share to legal havens, from covered countries, 3T



Note: Figure B11 without Thailand as LH in Appendix.

4 US firms adjustment

This Section investigates the effect of the Dodd-Frank Act Conflict Mineral Rule on regulated firms. I use other firms filing to the Security Exchange Commission, but not subject to the Conflict Mineral Rule, as a control group. Firms subject to the Conflict Mineral Rule tend to be more concentrated in some specific sectors, such as electronic equipment and measuring instruments (Table B2). Table B3 provide descriptive statistics on control and treated firms. I compare firms within the same two-digit SIC sector, ensuring that firms are subject to the same sectoral time trend and that there are non-regulated firms in the control group.

I use a differences-in-differences approach to estimate the effect of the Dodd-Frank Act on treated firms. The first identification assumption is that there is no anticipation of the regulatory change by treated firms in the treated outcome. The second identification assumption is the parallel trend, holding at the sector level: within the same sector, in the absence of the law firms would have behaved on average as the other control firms. I estimate the following specification:

$$y_{ist} = \alpha_0 + \alpha_1 Regulated_i + \alpha_2 \mathbb{1}_{\{t \geq July2010\}} + \beta Regulated_i \times \mathbb{1}_{\{t \geq July2010\}} + \nu X_{it} + \mu_i + \mu_{st} + \varepsilon_{ist} \quad (5)$$

With y_{ist} the logarithmic transformation of consolidated sales, production, or administrative costs. Subscripts i in the equation correspond to individual firms, s to sectors defined by 2-digit SIC codes, and t to years. The coefficient β captures the approximate average percent change in y_{ist} attributable to the Dodd-Frank Act. $Regulated_i$ and $\mathbb{1}_{\{t \geq July2010\}}$ respectively capture the average outcome log point difference between the two groups in the pre-treatment period, and the average outcome log point difference in the control group between the two periods. These terms will be dropped because of colinearity with fixed effects for both individual firms (μ_i) and sector-time (μ_{st}). Fixed effects μ_{st} will account for sectoral time trends, as well as for producer price changes at the sectoral level. Additionally, I include for firm-time varying controls X_{it}: the logarithm of firm assets and the logarithm of firm employees, controlling for capital and labour.

I check whether there is any change in firms' sales on the treated period. A simultaneous drop in sales and in production could affect costs negatively through production volume changes. Ideally, one would rather observe average unit cost than total cost, because the latter could also reflect changes in the volume of production. Computing unit cost $AC(Q) = \frac{C(Q)}{Q}$ requires data on production volumes, which is unavailable and would be challenging to compute for multiproduct firms. I normalize total administrative and production costs by the value of total sales, which measures $AC(Q) \times P$ and is the best available approximation of unit costs.[20] I estimate the model with OLS. Standard errors are clustered at the firm level.

Results are displayed in Table 4. Columns (1), (2) and (3) estimate the baseline model. In column (1), the model estimates that compared to firms in the same sector, treated firms' sales value decreases by 3.05% once the law is signed.[21] The effect is statistically significant at the 5% level. However, the effect is challenging to interpret as Compustat reports consolidated sales, both in the US and in the rest of the world, and markets could react differently to the new U.S. Conflict Mineral Rule. These effects are especially difficult to decompose as only 69 firms out of the 1187 treated in the sample do not sell abroad. Coefficients associated with assets and employees and positive and statistically significant, reflecting that larger firms sell more. Column (2) estimates the effect of the law on dollars spent on input cost per dollar earned in sales. The model estimates that compared to non-treated firms in the same sector, the scaled production cost does not change. Column (3) estimates the change in administrative cost compared to the treated group: scaled administrative cost increases by 4.2%.[22] Reassuringly, coefficients associated with assets and employees are negative for administra-

[20] Sectoral fixed effects will partially alleviate the producer price changes at the sectoral level.
[21] $exp(-0.031) - 1 = -0.0305$
[22] $exp(0.041) - 1 = 00418$

Table 4 – Differences-in-differences: filing firms

Dep. Variable (in log)	Sales (value)	Prod. cost (over sales)	Admin. cost (over sales)	Sales (value)	Prod. cost (over sales)	Admin. cost (over sales)
	(1)	(2)	(3)	(4)	(5)	(6)
$Regulated_i$	-0.031**	-0.012	0.041***			
$\times \mathbb{1}_{\{t \geq July2010\}}$	(0.014)	(0.010)	(0.015)			
× No CMR				-0.047**	0.000	0.026
				(0.020)	(0.013)	(0.023)
× CMR				-0.026*	-0.015	0.046***
				(0.015)	(0.010)	(0.016)
Assets (log)	0.308***	0.011	-0.037***	0.308***	0.011	-0.037***
	(0.015)	(0.008)	(0.012)	(0.015)	(0.008)	(0.012)
Employees (log)	0.573***	0.014*	-0.127***	0.573***	0.015*	-0.127***
	(0.018)	(0.008)	(0.014)	(0.018)	(0.008)	(0.014)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	57,743	57,743	57,743	57,743	57,743	57,743
R-squared	0.983	0.780	0.882	0.983	0.780	0.882
Number of firms	4182	4182	4182	4182	4182	4182

Note: Sample: Firms with at least 5 observations over the sample (2000-2018). Standard errors clustered at the firm level. OLS estimator. CMR stands for a firm filing a Conflict Mineral Report because the firm suspects some 3T could come from DRC(+9). SIC-2 digit sectors. Administrative and production costs trimmed at 1%.

tive costs, reflecting the fact that larger firms are more efficient.

Columns (4), (5) and (6) explore heterogeneity, splitting the effect between firms declaring with certainty that no 3T in their supply chain comes from the African Great Lakes Region, and firms not able to prove it and required to thoroughly implement due diligence in their supply chain. This second group of firms file a special Conflict Mineral Report (CMR) to the Security Exchange Commission. Interestingly, firms not filing a CMR seem to face a slightly bigger sales drop than firms filing: -4.6% against -2.6%, but the difference is not statistically significant (p-value=0.26). In column (6), we can reject that the change in administrative cost is zero for firms filing a Conflict Mineral Report, but not for firms not filing a CMR (although the difference in coefficients is not statistically different). The administrative cost per dollar sold increases by 4.67%. Conflict Mineral Reports are indeed more costly to implement.

I verify that the coefficients estimated in columns (2), (3), (5) and (6) do not reflect the decrease in the denominator (sales). In Table E4, I re-estimate the model without scaling costs. In column (6), the value of total administrative costs increases by 2.8% for firms filing a Conflict Mineral Report. Using the average administrative cost at baseline, it implies that firms pay around 30,120 USD more per year, corresponding to the lower bound of compliance cost estimated by the Security Exchange Commission when designing the rule.[23] In

[23] $1,075,716 \times 0.028 = 30,120$.

Figure E2 in Appendix, I plot the full-time-flexible model of columns (1), (2) and (3), testing pretrend and dynamic effects with leads and lags. Effects start appearing around the time of implementation (year 2014).

In Table 5, I further show the role of firm's supply chains in compliance cost. Columns (1) to (3) use scaled administrative costs as an outcome, and columns (4) to (6) the unscaled cost. In columns (1) and (4), I distinguish between the firms publicly disclosing in their Conflict Mineral Reports the list of metal suppliers identified in their supply chain, and the ones who do not. Firms disclosing their suppliers display a lower administrative cost increase by half (+3.6% vs +6.1%), although the difference is not statistically significant (p-value=0.23).

In columns (2) and (5), I check if the increase in compliance cost depends on the size of the firm's supply network, by interacting the coefficient with the log of the number of the firm's metal suppliers (distribution ploted on Figure B4). The baseline coefficient for a firm only one reported supplier is negative and statistically significant at the 10% level, but the coefficient associated to the log number of metal suppliers is positive and statistically significant at the 1% level. The net overall effect is positive and statistically significant for firm above the first quartile of the number of suppliers (p-value=0.093). For these firms, a 1% increase in the number of metal suppliers is associated with a 0.028% increase in the administrative cost, compared to another firm disclosing suppliers. This translates for the average firm in the sample in a 5.1% increase in administrative cost from the baseline period, and to a 70,359 USD yearly compliance cost.[24] This correspond to the yearly salary of an entry to mid-level job in administrative services. Figure E3 in Appendix explores the type of metal which drives the increase in administrative cost, for 3T metal suppliers. Although the coefficients are quise noisy, tantalum suppliers seem to be driving most of the increase.

In columns (3) and (6), I explore wether firms that are more upstream in the value chain face more increase in administrative cost. Upstream firms are the most likely to directly import metals or minerals. Moreover, Herkenhoff et al. (2024) show that contractual incompleteness could drive lower level of corporate social responsability higher in the value chain, which would make due diligence more costly at baseline for upstream firms. I use the variable from Antràs et al. (2012), which computes for each NAICS code the number of stages separating the sector from the final consumer. A few firms do not provide a NAICS code and are droped from the sample. Upstreamness is positively associated to administrative costs paid by firms at the time of the Dodd Frank Act. One more step between the final consumer and the firm increases scaled cost by 4%, and total cost by 2.6%. It is also notable that con-

[24] $1,379,606 * exp(-0.104 - 0.028 \times ln(248.6)) - 1) * 100 = 70,359.$

Table 5 – Role of supply chains

Dep. Variable (log)	Admin. cost (over sales)			Admin. cost (value)		
	(1)	(2)	(3)	(4)	(5)	(6)
$Regulated_i \times \mathbb{1}_{\{t \geq July2010\}}$						
× No CMR	0.026	0.026	-0.056	-0.005	-0.005	-0.056*
	(0.023)	(0.023)	(0.038)	(0.021)	(0.021)	(0.033)
× CMR only	0.060***	0.062***	-0.014	0.043**	0.044**	-0.005
	(0.021)	(0.021)	(0.037)	(0.018)	(0.018)	(0.032)
× Disclose suppliers	0.035**	-0.104*	-0.181***	0.019	-0.082*	-0.133***
	(0.017)	(0.057)	(0.063)	(0.015)	(0.043)	(0.050)
× Nb suppliers (log)		0.028***	0.028***		0.020**	0.020**
		(0.011)	(0.010)		(0.008)	(0.008)
× Upstreamness			0.040***			0.026**
			(0.015)			(0.013)
Assets (log)	-0.037***	-0.037***	-0.039***	0.163***	0.163***	0.162***
	(0.012)	(0.012)	(0.013)	(0.010)	(0.010)	(0.010)
Employees (log)	-0.127***	-0.127***	-0.123***	0.246***	0.246***	0.247***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Sale (log)				0.350***	0.350***	0.349***
				(0.012)	(0.012)	(0.012)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	57,743	57,743	55,878	57,743	57,743	55,878
R-squared	0.882	0.882	0.884	0.985	0.985	0.986
Number of firms	4182	4182	4031	4182	4182	4031

Note: Sample: Firms with at least 5 observations over the sample (2000-2018). Standard errors clustered at the firm level. OLS estimator. CMR stands for a firm filing a Conflict Mineral Report because the firm suspects some 3T could come from DRC(+9). SIC-2 digit sectors. Administrative and production costs trimmed at 1%.

troling for upstreamness makes the effect for CMR only firms disappear, while it does not affect the coefficient associated to the number of supplier (although decreasing the baseline coefficient for disclosing firms).

Overall results show that the Dodd Frank Act Conflict Mineral Rule created substantial compliance costs among regulated firms, and these costs are exacerbated by the size of their suppliers network and the place of the firm in the value chain. On average, these costs correspond to the cost of one mode employee in administrative services.

5 Exports from the Great Lake Region: trade change and diversion

5.1 Empirical strategy: triple difference gravity

To assess the effect of the Dodd-Frank Act on the distribution of trade flows, I draw my empirical strategy from the structural gravity framework described in Section 2.2.

The Dodd-Frank Act raised the cost of exporting from covered countries to all of their non-regulated trade partners. Identification of such non-discriminatory trade policies is challenging, because treated trade flows usually lack reliable control groups. A strategy developed by Heid et al. (2021) is to estimate changes in trade flows *relative to changes in internal trade flows*. In this case, I would rely on two control groups: internal trade flows and trade flows between covered countries. If internal and regional recorded 3T trade flows are affected by this trade policy in a non-conventional way because of regional smuggling, they do not constitute a reliable control group.[25] This issue is discussed extensively in Appendix C, I still implement and discuss this strategy in robustness analysis below.

Instead, my main empirical strategy makes use of the product disaggregation in the trade data, to use other reliable control groups available and implement a tripple difference strategy. The three control groups available are: (i) exports of non-3T products from covered countries (ii) exports of 3T products from other countries (iii) exports of non-3T products from other countries. Identification in a triple difference strategy does not require that a parallel trend holds between each of the treated and control groups. Rather, the parallel trend assumption should hold between relative terms between treated and control groups: in the absence of the Dodd-Frank Act, the relative change in 3T exports value compared to other minerals exports in covered countries should have been the same as the relative growth of 3T exports value in the rest of the world compare to other minerals (Olden and Møen, 2022). This strategy will cancel out any for product-specific shocks affecting global trade. It will also controls any local spillover effects running to other minerals in covered countries, as it identifies changes *relative* to control minerals between covered countries and the rest of the world. Figures' 5 and B6 left panels display the unconditional exports in values. They show that prior to the Dodd-Frank Act, the relative change of 3T compared to other minerals was

[25] As internal flows correspond to production minus the sum of exports, their measure will be affected by the smuggling of minerals. Moreover, if the Dodd-Frank Act affects the smuggling rate of covered countries heterogeneously across smuggling destinations, a change in trade costs will be indistinguishable from this effect.

the same in covered countries and in the rest of the world.

Using the mineral trade matrix, I the econometrics specification accounts the structural form of the gravity equation. Structural gravity is run on export in value as the theoretical relationship accounts for price adjustments. I estimate the following model:

$$\begin{aligned} Y_{ijpt} = exp[\beta_{DFA} \cdot \text{DRC+9 to ROW}_{3T,t\geq 2010} + Controls'_{ijpt}\gamma \\ + \lambda_{ijp} + \mu_{pt} + \mu_{it} + \eta_{jt} + \theta_{iipt}] \times \zeta_{ijpt} \end{aligned} \tag{6}$$

The coefficient of interest β_{DFA} is associated with an indicator variable for trade flows of regulated products from covered countries to the rest of the world after 2010: DRC+9 to ROW$_{3T,t\geq 2010} = \mathbb{1}_{\{i=DFA\}} \times \mathbb{1}_{\{j\neq DFA\}} \times \mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}}$. It captures trade flow growth differences (1) in years before and after the signature of the Dodd-Frank Act (2) in regulated and non-regulated exporting countries and (3) in regulated and non-regulated mineral products. I estimate the effect of the Dodd-Frank Act on trade flows from regulated countries starting from 2010 to encompass effects from the signature date and any anticipation effect associated. The coefficient captures a percent change in 3T exports from covered countries.

Using the mineral trade matrix identifies β_{DFA} while controlling for product-time specific μ_{pt} and exporter-time specific shocks μ_{it}: orthogonal to shocks affecting all 3T exporters or shocks affecting all covered countries' minerals exports at the time of the Dodd-Frank Act signature. Fixed effects λ_{ijp}, μ_{it} and η_{jt} control for invariant product level trade costs and directional gravity terms (including multilateral resistance terms), and are constant across products.[26] The term θ_{iipt} excludes internal flows from the comparison sample.

Controls variables include an indicator variable for 3T flows between covered countries after treatment.[27] Finally, I control for regional trade agreements between country pairs. The sample runs from 2006 to 2017 to exclude any effect of the Congo War before, and EU Conflict Mineral Rule after. The estimation sample includes zero trade flows. The model is estimated with Poisson-pseudo maximum likelihood, and standard errors are clustered on country-products-dyads.

In this setup, I further study second-order effects from hypothesis **H2** and **H3** in Section 2.2. For **H3**, the relative diversion to legal havens, I will first do so through an interaction of binary variable DRC+9 to ROW$_{3T,t\geq 2010}$ with the legal haven indicator. The coefficient should

[26] Multilateral resistance terms account for conflicts effects on the entire mineral sector. Any conflict affecting the results should be product-country-time specific. Moreover local conflicts are a collider of the Dodd-Frank Act and minerals trade according to previous studies.

[27] Which should be affected non-conventionally due to smuggling as explained in Appendix C: the expected effect (β_I) could be negative contrary to conventional trade diversion effects.

be interpreted as a deviation from the average effect on trade partners. A positive coefficient capture a reallocation of 3T exports to legal havens. I also control for the global change in legal havens 3T imports on the post-treatment period to make sure that I capture changes in trade flows with covered countries. For **H2**, the diversion of foreign demand to other producers, I introduce new indicator variables for other exports not directly targeted, constructed in the same manner as $\mathbb{1}_{\{i\}} \times \mathbb{1}_{\{j \neq DFA\}} \times \mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t \geq 2010\}}$. When introduced, these new treatment terms will change the composition of reference group relative to which β_{DFA} is estimated.

5.2 Results

5.2.1 Exports from covered countries

Baseline Table 6 displays the baseline results. Column (1) estimates of equation 6, comparing 3T exports from covered countries, to other 3T exporters and other minerals trade. The effect of the Conflict Mineral Rule on exports from covered countries is negative and large, but not statistically significant, due to large heterogeneity accross importers.

In column (2) I decompose the effect between a legal havens premium and other partner countries. The coefficient associated with DRC+9 to $\text{ROW}_{3T,t\geq 2010}$ captures the baseline change in 3T export from covered countries in 2010, and the total change for importers that are not legal havens. It is statistically significant at the 1%. It is negative, and correspond to a 76.5% decrease in 3T average export value from the targeted area after 2010.[28] This effect is equivalent to an average increase in tariffs faced by covered countries to the rest of the world of 25 percents.[29] This effect is large and comparable to the effect of trade sanctions.

The interaction of DRC+9 to $\text{ROW}_{3T,t\geq 2010}$ with the legal havens dummy captures the supplementary change for legal havens and will test for **H3**: the reallocation of exports to Legal Havens. The coefficient associated with the interaction term is positive and statistically significant. Legal havens offset the trade barriers imposed by the Dodd-Frank Act. As the change in exports is compared to exports from other 3T exporters and other mineral trade flows, which keep increasing on the time period, this is a *relative change*. If total exports from covered countries decrease after 2010, as hinted by column (1) and the reduced form estimates in Table E1, but exports are redirected to legal havens, exports to legal havens to catch up with the growth rate of the control group. This is what I find in column (2). To further compute the magnitude of exports diverted from regular trade partners to legal havens, I use

[28] $[e^{-1.451} - 1] \times 100 = -76.5$.

[29] considering a trade elasticity of $\sigma = 5$, $[e^{-1.451/5} - 1] \times 100 = 25$.

the general equilibrium set-up in the following section.

Table 6 – Baseline results

Dep. variable	Bilateral trade flow: X_{ijpt}			
	(1)	(2)	(3)	(4)
DRC+9 to ROW$_{3T,t\geq 2010}$	-0.871	-1.451***	-1.372***	-1.325**
	(0.553)	(0.501)	(0.502)	(0.540)
$\times LH_{j,top25\%}$		0.970**	0.995**	0.992**
		(0.492)	(0.491)	(0.494)
$\times 3Tproducer_{j,p,t}$				-0.0743
				(0.291)
3T producer to ROW$_{3T,t\geq 2010}$			0.199***	0.197***
			(0.0654)	(0.0654)
Bewteen DRC+9 countries$_{3T,t\geq 2010}$	-2.446***	-2.524***	-2.427***	-2.418***
	(0.717)	(0.721)	(0.722)	(0.723)
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}} \times LH_{j,top25\%}$		-0.377**	-0.394***	-0.394***
		(0.150)	(0.146)	(0.146)
RTA	0.129**	0.126**	0.126**	0.126**
	(0.0580)	(0.0581)	(0.0581)	(0.0581)
Observations	842,131	842,131	842,131	842,131
Pseudo R^2	0.967	0.967	0.967	0.967
Origin x Time FE	Yes	Yes	Yes	Yes
Destination x Time FE	Yes	Yes	Yes	Yes
Product x Time FE	Yes	Yes	Yes	Yes
Border x Product x Time FE	Yes	Yes	Yes	Yes
Dyad x Products FE	Yes	Yes	Yes	Yes

In column (3), I test for hypothesis **H2**: an increase in exports of other producers of 3T who face an increased demand from the rest of the world. Note that these exports will be identified relative to the internal flows of other producers. The coefficient is positive and precisely estimated. Exports of 3T from other producers increase on average by 22% after 2010.[30] In column (4) The coefficient on DRC+9 to ROW$_{3T,t\geq 2010}$ and its interaction, now estimated relative to trade flows of other minerals, remain close to columns (2): exports to regular trade partners decrease by 74.6 percent.

Across all specification, the change in trade flows between countries is negative and the effect is large. It is hard to interpret, as it can be due to a real drop in exports or to increased smuggling (illicit trade) between countries. Note that in columns (2) to (4), the total 3T imports of legal havens tend to decrease compare to the counterfactual groups. The effect of regional trade agreements is always positive (+13.4%).

[30] $[e^{0.199} - 1] \times 100 = 22$.

Robustness I check for alternative channels of diversion. Covered countries could export to other producers of 3T not targeted by the Dodd-Frank Act, to mix their production with minerals from other origins. In column (4), I test for the change in 3T exports from the covered countries, to other producers of 3T. The coefficient is negative, small and not statistically different from zero.

A second alternative explanation is that exports to legal havens are actually motivated by other institutional determinants of countries, such as being a tax haven or being less resilient to corruption. In Table E6, I introduce interaction coefficients with alternative measures. I interact DRC+9 to $\text{ROW}_{3T,t\geq 2010}$ with an indicator variable for the standard list of tax havens from Dharmapala and Hines (2009), and the control of corruption from the World Governance Indicators (Kaufmann et al., 2010). The coefficient for tax havens is positive, but small and not statistically significant, and fades away when I control for legal havens. The coefficient associated with good control of corruption is positive and not statistically significant. The coefficient associated with legal havens remains with all combinations of interaction coefficients. I also make sure that the definition of the Legal Havens variable is not driving the results. In Table E7, I test for different definitions. Estimated coefficients remain for legal havens defined as the top 30 and 35% countries. In column (4), I use the legal havens definition based only on sources published before the Dodd-Frank Act signature (2000-2010). In column (5), I use a different aggregation of dimensions of legal opacity, using PCA loading. Results remain.

I also check the robustness of my results to alternative specifications. In Appendix E.2, I use a reduced form specifaction to test for reallocation of exports to legal havens (**H2**). I compare covered countries' export share to legal havens in 3T, to their export share in other mineral products. The 3T export share to Legal Havens increases by 11.6 to 21 percentage points depending on specification. The result is robust to triple difference (using other countries), placebo products, and inclusion of leads and lags. In Appendix C, I estimate the structural gravity equation on trade flows of 3T only as discussed above. This enables me to construct inward and outward multilateral resistance terms for 3T products. The change in 3T exports from covered countries is now identified relative to trade flows within the regulated area: internal trade flows and exchanges between covered countries. I find that all results remain quantitatively similar. Results are displayed in Table D1 in the Appendix.

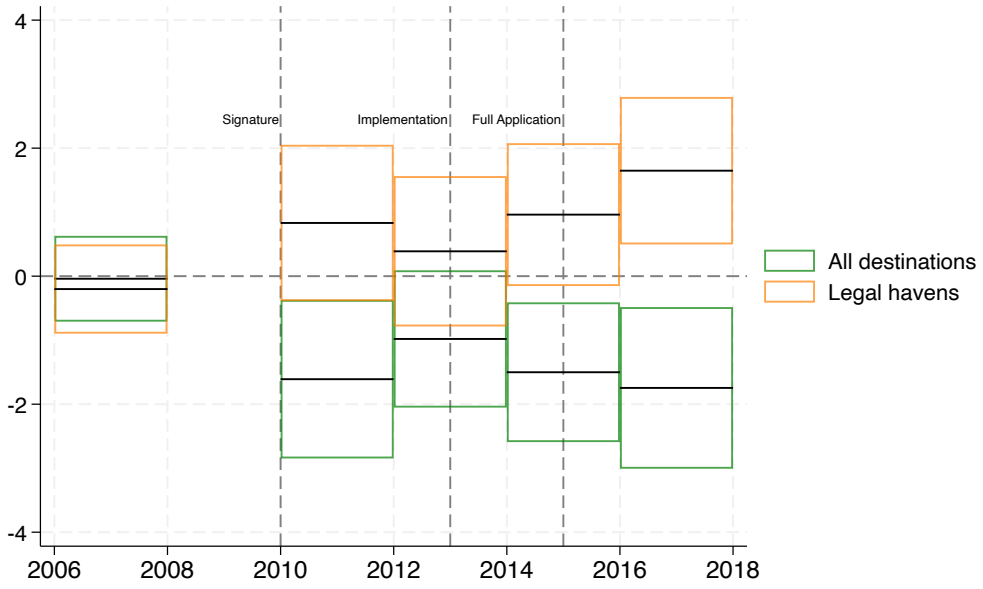
Mechanisms I investigate the different phases of the Dodd-Frank Act. I interact the term DRC+9 to $\text{ROW}_{3T,t\geq 2010}$ with 2-years indicator variables in the similar gravity triple-differences

setting, using the specification of Table 6 column (2):

$$
\begin{aligned}
Y_{ijpt} = exp\Big[& \sum_{t=2006,2007}^{2016,2017} \beta_{DFA,t} \cdot \text{DRC+9 to ROW}_{3T,t\geq 2010} \\
& + \sum_{t=2006,2007}^{2016,2017} \beta_{LH,t} \cdot \text{DRC+9 to ROW}_{3T,t\geq 2010} \times \mathbb{1}_{j\in LH} \\
& + \beta_I I_{ijp} \times \mathbb{1}_{\{t\geq 2010\}} + Controls'_{ijpt}\gamma \\
& + \lambda_{ijp} + \mu_{pt} + \mu_{it} + \eta_{jt} + \theta_{iipt} \Big] \times \zeta_{ijpt}
\end{aligned}
\tag{7}
$$

Each coefficient $\beta_{DFA,t}$ is capturing net shocks specific to 3T exported from covered countries to the rest of the world, for each 2-year time point, relative to the pre-signature period. The time dummy 2008-2009, prior signature, is dropped as a reference. Coefficients $\beta_{DFA,t}$ are displayed in Figure 7, with 95% confidence intervals.

Figure 7 – Time decomposition

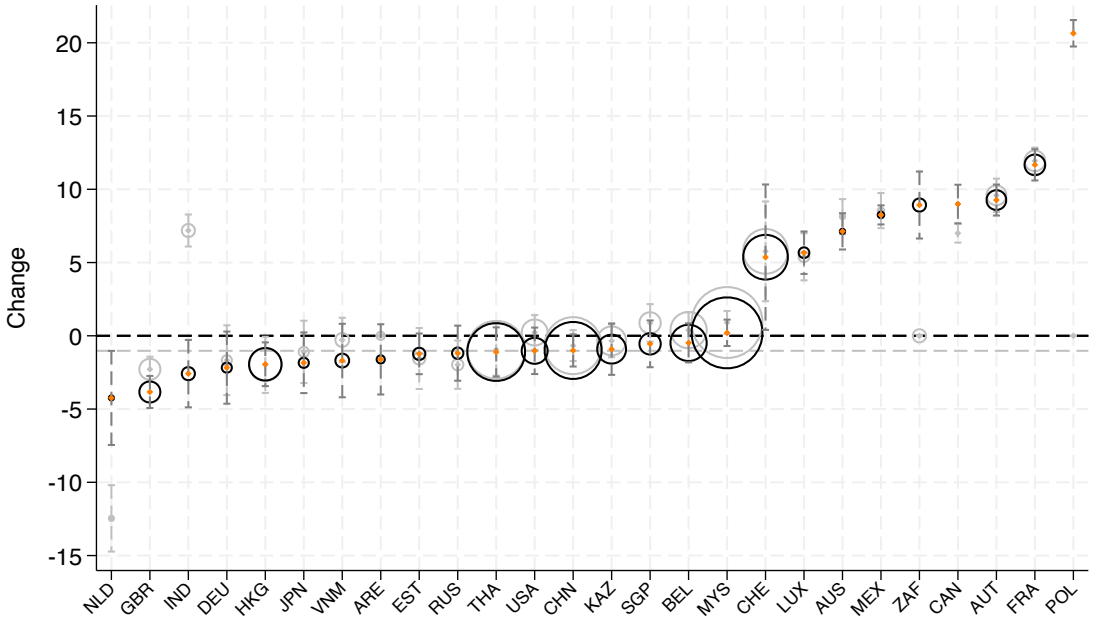


The lead coefficient estimated for the years 2006-2007 is close to zero indicating that 3T exports were similar to the reference period 2008-2009. The conflict mineral rule has a negative and statistically significant effect on 3T exports from the area from 2010 to 2017. Both the law's signature and its implementation massively decreased exports: the Dodd-Frank Act had an anticipation effect just after it was signed, on top of the regulation impact after 2013 and 2015. This anticipation effect is not surprising, given that the salience of the conflict mineral topic likely caused collective reputation effects from signature (see Section 2.2).

The full rules from the Security Exchange Commissions were only disclosed in 2012. Adaptation to these rules takes place after this time. The coefficient of the interaction term for legal havens is always positive but starts being statistically significant and larger after the Dodd-Frank Act Conflict Mineral Rule is implemented.

I recover similar results In Table E10 in Appendix, this time decomposing three time periods with different length based on signature, implementation and application periods. Estimations confirm that the Dodd-Frank Act generated new trade barriers starting at the signature date in 2010. But legal havens mitigation takes place only after the application: coefficients are statistically significant on interactions, and remain positive.

Figure 8 – Export change - Net effect - Destination heterogeneity



Note: Note: 95% confidence intervals displayed. Coefficients are estimated on the interaction term between $\mathbb{1}_{\{i \in DFA\}}$ an indicator for origin regulated countries, $\mathbb{1}_{\{p=3T\}}$ an indicator for affected product, $\mathbb{1}_{\{t \geq 2010\}}$ an indicator for post Dodd-Frank Act years, and $\mathbb{1}_{\{j \neq DFA\}}$ an indicator for each partner country. Each coefficient captures the net change in 3T flows between the regulated countries and each partner country following the Dodd-Frank Act. For readability, trade flows inferior to 500 USD are set to zero. Light grey coefficients correspond to the same estimation considering the regulated countries as one single country. Circles correspond to import value over the entire period.

In Figure 8, I explore the heterogeneity in destination countries. I decompose the main effect for each partner country, estimating one coefficient per country:

$$Y_{ijpt} = exp\Big[\sum_{j} \beta_{DFA,j} \text{DRC+9 to ROW}_{3T,t\geq 2010} \times \mathbb{1}_j + Controls'_{ijpt}\gamma + \lambda_{ijp} + \mu_{it} + \eta_{jpt}\Big] \times \zeta_{ijpt} \tag{8}$$

Each point displays a coefficient $\beta_{DFA,j}$, and the circle around it is proportional to 3T imports in value from the covered countries. The relative standard deviation of estimated coefficients

is 2.68, indicating large dispersion. The grey dashed line marks the change in covered countries 3T exports to the United States: they drop by -64% after the Dodd-Frank Act is signed. Many other importers display a similar drop in exports, among them countries ranking high in the presence of post-Dodd-Frank Act US-regulated suppliers: Japan, China and Indonesia.

The positive premium for legal havens is driven by Switzerland, Luxembourg and Liechtenstein (reported together), and Malaysia, which concentrate a large part of 3T imports. Exports from covered countries to these countries increase by 141% (p-value: 0.047, see Table E5 column (4)). These four countries host metal transformation industries: US firms declare some suppliers in these countries. Trade diversion is not driven by legal havens that are trade hubs like Hong Kong and Dubaï, which display negative changes along the lines of the United States.

In Table E5, I explore the type of legal havens driving the results. I distinguish legal havens in Subsaharan Africa through which minerals could be re-exported. I find no diversion of export to these countries. Hosting a metal transformation though makes legal havens more prone to trade diversion effects. Two potential, non-competing, mechanisms could drive this effect: (i) legal havens, through the existence of a transformation industry, provide a reliable alternative country of origin to covered countries; (ii) covered countries have reduced access to international markets because of collective reputation effects and name and shame, and divert export to legal havens less sentivite to transparency.

We can note some other unconventional responses at the time of the Dodd-Frank Act. Exports to Mexico and Canada, two countries contiguous to the United States, increased, although they are rather small. The extent to which this is due regulation avoidance could be concerning to policymakers, but import volumes are rather small. Second, Austria and France display a positive increase in 3T imports. France ranks low in the presence of revealed US suppliers, potentially pointing to alternative demand for 3T. However, the data from firms' filings reveals publicly disclosed suppliers after the Dodd-Frank Act and does not correspond to pre-act real supply chains. Without existing data on these supply chains, it is challenging to make further claims.

5.2.2 Legal havens exports: regulation avoidance

Lastly, I turn to re-exports of 3T from legal havens to test for **H4**. With the approach, I test if legal havens reallocate their exports following the Dodd-Frank Act Conflict Mineral Rule. I update the specification of Table 6 column (3) with a new interaction term LH to $\text{ROW}_{3T,t\geq 2010} =$

$LH_{i,top25\%} \times \mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}}$. The associated coefficient will capture the change in legal havens 3T exports after the Dodd-Frank Act, *relative to* exports of legal havens in other mineral products, trade flows of 3T from other exporters, and trade flows from other products and other exporters. As earlier, I investigate the heterogeneity accross importers of legal havens, while always controlling for the global change of their 3T imports on the post-treatment period. Results are presented in Table 7. The higher part of the table presents the coefficients of interest, while the lower part of the table presents the coefficients associated to global change in importers' demand (level controls).

I drop observations for which the legal haven indicator is not available on the exporter side, and re-estimate the specification of Table 6 column (3) in column (1). This excludes from three covered countries from exporters: DRC, Central African Republic and Burundi. Coefficients remain and are statistically significant. In column (2), I test for a general change in legal havens 3T exports, to all their partner countries. The coefficient associated with LH to $\text{ROW}_{3T,t\geq 2010}$ is negative and statistically significant. This effect coincides with the general decrease in Legal Havens 3T imports already noted in Table 6, and displayed in the lower panel. In column (4), I find that the drop in Legal Havens exports is driven by importer countries with a 3T metal transformation industry.

In columns (3) to (6), I check whether re-exports are redirected where there is a higher presence of US firms supply chains. In column (3), I interact variable LH to $\text{ROW}_{3T,t\geq 2010}$ with a dummy for exports to the United States. The coefficient associated is positive and statistically significant at the 5% level. It corresponds to US 3T imports from Legal Havens doubling. In Table D1 in Appendix, implementing structural gravity on 3T trade flows only, I find similar magnitude. Figure B12 plots unconditional series of legal havens imports and exports to the United States. While imports of legal havens are mainly in ore, their exports to the United States are in transformed metal.

In column (5) and (6) I test for the presence of US regulated firms metal suppliers in countries importing from legal havens. I use the variables charted in Figures 3 and B3. First, the share of disclosed suppliers per country: $Suppliers_{j,p} = \frac{\#ReportedSmelters_{j,p}}{\sum_j \#ReportedSmelters_{j,p}}$. Second, the prevalence of US metal suppliers among local firms: $Suppliers_{j,p} = \frac{\#ReportedSmelters_{j,p}}{\#Firms_j}$. With $Smelters_{j,p}$ the number of different smelters and refiners of product p in country j revealed between 2013 and 2017. The two measures vary over the dimensions product p within 3T and importer j. These measures have two advantages: (i) they scale the number of suppliers either by the size of US firms' supply network, or by the size of j (ii) they are defined for $\#ReportedSmelters_{j,p} = 0$. In column (4), exports of legal havens to countries which are

Table 7 – Regulation avoidance: legal havens exports

Dep. variable	Bilateral trade flow: X_{ijpt}					
	(1)	(2)	(3)	(4)	(5)	(6)
DRC+9 to ROW$_{3T,t\geq 2010}$	-2.089***	-2.156***	-2.160***	-2.149***	-1.934***	-2.145***
	(0.631)	(0.629)	(0.628)	(0.611)	(0.652)	(0.611)
$\times LH_{j,top25\%}$	1.319***	1.331***	1.306***	1.277**	1.084*	1.263**
	(0.477)	(0.473)	(0.472)	(0.570)	(0.574)	(0.570)
LH to ROW$_{3T,t\geq 2010}$		-0.410***	-0.512***	0.0919	0.104	0.0939
		(0.131)	(0.130)	(0.239)	(0.240)	(0.238)
$\times USA_j$			0.689**	0.756**	0.637*	0.813**
			(0.337)	(0.360)	(0.358)	(0.363)
$\times$ Metal industry$_{j,p}$				-0.665***	-0.722***	-0.725***
				(0.245)	(0.255)	(0.249)
$\times USSuppliers_{j,p}$ (Share)					1.627**	
					(0.669)	
$\times USSuppliers_{j,p}$ (Density)						0.144
						(0.215)
3T producer to ROW$_{3T,t\geq 2010}$	0.192***	0.178***	0.173***	0.178***	0.182***	0.174***
	(0.0655)	(0.0658)	(0.0660)	(0.0591)	(0.0590)	(0.0581)
Bewteen DRC+9 countries$_{3T,t\geq 2010}$	-1.617*	-1.668*	-1.689*	-1.751*	-1.672*	-1.765*
	(0.942)	(0.935)	(0.936)	(0.998)	(0.966)	(1.002)
RTA	0.124**	0.126**	0.127**	0.127**	0.126**	0.128**
	(0.0584)	(0.0583)	(0.0583)	(0.0516)	(0.0516)	(0.0516)
	Level controls					
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}} \times LH_{j,top25\%}$	-0.398***	-0.424***	-0.405***	-0.373***	-0.457***	-0.354***
	(0.146)	(0.133)	(0.129)	(0.115)	(0.119)	(0.115)
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}} \times US_j$			-0.0300	-0.0112	0.100	-0.00558
			(0.173)	(0.148)	(0.146)	(0.148)
$\mathbb{1}_{\{t\geq 2010\}} \times$ Metal industry$_{j,p}$				-0.0707	0.0515	-0.0778
				(0.185)	(0.189)	(0.184)
$\mathbb{1}_{\{t\geq 2010\}} \times USSuppliers_{j,p}$ (Share)					-2.281***	
					(0.418)	
$\mathbb{1}_{\{t\geq 2010\}} \times USSuppliers_{j,p}$ (Density)						0.00405
						(0.204)
Observations	824,749	824,749	824,749	824,749	824,749	824,749
Pseudo R^2	0.968	0.968	0.968	0.968	0.968	0.968
Origin x Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Destination x Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Product x Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Border x Product x Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Dyad FE x Product	Yes	Yes	Yes	Yes	Yes	Yes

not the United States or their reported suppliers decrease compared to other control groups. Looking at the coefficient on $Suppliers_{j,p}$ in (5) and (6), only the share of US metal suppliers is statistically significant. 3T exports from Legal Havens are concentrating in countries hosting a large share of suppliers of the US firms. Comparing two importer countries hosting a 3T metal processing industry, a one standard deviation increase in share US firms suppliers increases 3T imports from legal havens by 12.4%.[31]

Can this US suppliers demand adressed to legal havens be satisfied by minerals sourced from other origins than countries covered by the Dodd-Frank Act? This would require that legal havens host intermediates with dichotomized production lines, one for covered countries to non-US 3T demand, and one for other producers to US 3T-demand. This hypothesis imply increased production costs for intermediates implementing such production process, and does not explain why legal havens exports would concentrate where US suppliers are. Furthermore I show that for some product-legal havens dyads, this is clearly impossible to hold. Without firm-to-firm trade flow value, I use import 3T volumes to and from legal havens to test if dichotomized supply chains are possible. I compute the ratio of imports from other producers to exports from legal havens to destination countries hosting an above average number of US metal suppliers. Ratios are displayed per legal haven and metal in Figure B14: a ratio below one prevents all products exported to US supplier from being sourced outside of covered countries.

6 General equilibrium: magnitude and real income effects

Estimates of the previous section do not allow to compute the complete magnitude of trade diversion to legal havens. To do so, I use the general equilibrium system from Section 2.2. The nature of this quantitative approach is different from the previous one: general equilibrium computation determines, keeping countries' total output and expenditures constant, i.e. as they were in aggregate after treatment, what would have been the exports to regular trade partners, had the trade cost vector $t_{DFA,j}$ not been changed by the Dodd-Frank Act. Contrasting with predicted trade flows under the Dodd-Frank Act allows to compute the share of exports diverted to legal havens. To compute more general gains and losses for all countries, I also compute general equilibrium changes on producer prices, output and consumer price indexes.

[31] $0.076 \times 1.776 \times 100 = 12.4$.

6.1 Calibration and counterfactual scenarii

I define two counterfactual scenarios. First, a counterfactual economy in which no Dodd-Frank Act was ever enforced. In this counterfactual situation, no country supports the trade costs introduced by the Dodd-Frank Act. Second, a counterfactual economy in which the Dodd-Frank Act is fully enforced by all trade partners, and legal havens are regular partner countries with no legal opacity available. In this situation, every partner country of the covered countries faces the same trade cost introduced by the policy. Defining this counterfactual situation shuts down the regulation avoidance channel and adjustment that occurs through legal havens. In what follows I compare the general equilibrium effects of a Dodd-Frank Act taking place in two states of the world: (i) with existing regulation avoidance channels and (ii) with global compliance. The first scenario considers the general equilibrium effects when legal havens offer regulation avoidance. The second is when all trade partners, including legal havens, comply with the Dodd-Frank Act.

The model is used to simulate counterfactual world economies. The calibration of the model uses trade data for countries with at least one strictly positive export and one strictly positive import flow in 3T. In Section 5, I estimated the change in the vector of trade costs t_{ij} due to the Dodd-Frank Act: exports from covered countries to regular trade partners decrease by 74.6%. I estimate the rest of the trade cost vector from bilateral fixed effects and time-varying bilateral control variables. In counterfactual scenarios, trade costs are adjusted accordingly: I remove the cost of the Dodd-Frank Act in the first counterfactual scenario, and extend it to all partners in the second one. I then predict trade flows, which are redistributed between partner countries according to the new bilateral trade costs, keeping output and expenditures fixed. The full system is solved using the procedure from Yotov et al. (2017) (details are provided in Appendix E), and equilibrium values are solved for changes compared to a baseline situation. The system of multilateral resistance terms can be solved only up to a scalar: changes in MRTs, prices, output and expenditures are normalized relative to one change in inward multilateral resistance term for a reference country.[32] The only parameter left to calibrate is the σ which I set to the standard value of $\sigma = 5$ (Fally and Sayre (2018) show that this is reasonable for mineral trade given existing estimates).

[32] Here Japan.

6.2 Trade diversion: magnitude

I simulate the model to compute the full diversion effects on exports of covered countries caused by the Dodd-Frank Act with and without legal opacity. Results are displayed in Table 8. The first line is the general equilibrium response of diversion in the presence of legal havens endowed with legal opacity. The second line displays general equilibrium diversion without legal opacity in legal havens.

Each cell in the first three columns corresponds to the average change in trade flows of a certain type for covered countries. The last column corresponds to the share of 3T flows going to regular trade partners which are now diverted to legal havens. On average for covered countries, total exports to the rest of the world decrease by 13.5%.[33] This change can be decomposed by the type of partner. Exports to regular trade partners decrease by 21.27% in value. However, exports to legal havens increased by 71.48%. Holding total exports constant after 2010, the model predicts that the share of exports diverted from regular trade partners is 36.77%.

Table 8 – General equilibrium diversion in covered countries exports

State of the world		Exports (total)	Exports to LH	Exports to other importers	Share diverted
Regulation avoidance	%	-12.49	+71.48	-21.27	36.77
Global Compliance	%	-14.68	-15.20	-14.23	-0.24

Note: $\sigma = 5$ (Fally and Sayre (2018) for minerals). Country set: covered countries.

Reconciling this results with the total drop in exports from Section 5, it implies that with X^{NLH}_{NODFA}, $X^{NLH}_{DFA,DIV}$ and $X^{NLH}_{DFA,NODIV}$ respectively the exports to regular trade partners with no Dodd-Frank, with Dodd-Frank and no trade diversion, and with Dodd-Frank and diversion, we have $X^{NLH}_{DFA,DIV} = (1-0.3677)X^{NLH}_{DFA,NODIV} = (1-0.765)X^{NLH}_{NODFA}$. One can derive the contribution of trade diversion to legal havens to the decline of trade flows to regular trade partners:

$$1 - \frac{X^{NLH}_{NODFA} - X^{NLH}_{DFA,NODIV}}{X^{NLH}_{NODFA} - X^{NLH}_{DFA,DIV}} = 0.24 \tag{9}$$

Trade diversion to legal havens contributes to 21% of the drop in 3T exports from covered countries.

In the case of global compliance, diversion effects are shut down as Legal havens face

[33] This magnitude is lower than the partial equilibrium effect estimated in Section 5, as aggregate trade destruction is hold constant and the model now integrates adjustments through diversion, output and price changes.

the same due diligence cost as other countries. The total drop in 3T exports from covered countries is now 14.7%. The predicted diverted share is zero as there is no arbitrage possible across partner countries.

6.3 Real income and price effects

For targeted countries Table 9 displays the changes in mine-gate prices and output in the two states of the world for covered countries and other regular exporters. Price changes are relative to changes in the reference country. In the presence of regulation avoidance channels, mine-gate prices in covered countries decrease by 16.45%. The value of output decreases by 15.89%. In comparison mine-gate prices and output value change marginally among regular other exporters. In the case of a fully enforced Dodd-Frank Act, changes in mine-gate prices and output of covered countries are magnified. Covered countries now face an increase in bilateral trade costs with all their trade partners. Without diversion opportunities, prices have to decrease by a higher amount to compensate for new trade barriers. Mine-gate prices are decreased by -18.90% and output by 15.89%.

Table 9 – Change in producer prices and output

State of the world		DRC+9		ROW	
		Mine-gate prices	Output	Mine-gate prices	Output
Regulation avoidance	Δ%	-16.45	-14.13	0.04	0.04
Global compliance		-18.90	-15.89	-0.00	-0.00

Note: $\sigma = 5$ (Fally and Sayre (2018) for minerals). Country set: covered countries and non-legal havens exporters.

Regulation avoidance offered by legal mitigates the negative trade shock generated by the Dodd-Frank Act on covered countries. The extent to which this mitigation is working against the objective of the Dodd-Frank Act Conflict Mineral Rule to reduce conflict is difficult to state without further information. One needs to embed the heterogeneity of mines and the distribution of this shock across rebel groups and miners. Affecting mostly armed groups should lower their capacity to exert violence and decrease its general level. Affecting local populations it could lower the opportunity cost of joining an armed group and increase the general level of violence.

For legal havens I now turn to prices faced by covered countries' trade partners. As discussed above, changes in prices are all normalized relative to one country's change. If the

Dodd-Frank Act generated a general increase in 3T prices it will be canceled out. Table 10, I compute changes in inward multilateral resistance P_j. P_j corresponds to the price index of the world economy faced by importers in j. I distinguish between changes in IMR faced by regular partners (first column) and legal havens (second column). What matters is the wedge between prices in the two types of importers.

In the presence of regulation avoidance, legal havens benefit from a drop in prices of covered countries which decreases their general price index. Covered countries decrease their mine-gate price p_i due to an increase in outward multilateral resistance, and legal havens do not face an increase in bilateral trade cost with these countries. On average, IMRs of legal havens decrease by 1.04% compared to the reference. The rest of the world faces an increase in the price index due to the increase in trade costs with the covered countries. The average increase is 0.17% (relative to the reference country). On the second line, the price index change is now more homogeneous, and marginal for legal havens compared to the first line. A change in world price indexes (IMRs) could also an increase in other exporter's prices. Other countries benefit from increased demand from partners of covered countries, which decreases their outward multilateral resistance Π_i. In response, they increase mine-gate prices. However, those changes are of higher order compared to changes in covered countries' mine-gate prices.

Table 10 – Change in IMR - Consumer price indexes in ROW

State of the world		Regular partners	Legal havens
Regulation avoidance	Δ%	0.17	-1.04
Global compliance		0.06	-0.03

Note: $\sigma = 5$ (Fally and Sayre (2018) for minerals). Country set: Non-covered countries.

This last general equilibrium change rationalizes the existence of legal havens. Importers in legal havens benefit from lower mine-gate prices in covered countries, thanks to their legal opacity which limits the effects of due diligence. When they are able to do so, legal havens derive a rent from offering regulation avoidance.

For US importers I finally check for the transmission of the Dodd-Frank Act costs to downstream products incorporated 3T imported in the United States. In Appendix D, I compare products incorporating 3T to products incorporating other metals after 2010. I use unit values of imports at the border as a measure of import prices. I find that there is an increase in input prices (i) after the implementation of the law (ii) only for products incorporating

tantalum. Unit values of products incorporating tantalum increases by 9.2%. Interestingly, product heterogeneity could explain part of why the input cost of firms in Section 4 does not react to the Dodd-Frank Act. If only inputs incorporating tantalum see an increase in prices, firms could display a large heterogeneity in their input costs due to different intensities in each of the regulated minerals.

7 Conclusion

The extractive sector is a key provider of inputs for large industries sustaining global growth, development and technological change. Yet the downstream supply chains operate along many countries, potentially sourcing metals from conflict areas. Due diligence policies aim to prevent downstream industries from sustaining funding violent armed groups by imposing processes to prevent conflict minerals sourcing. The Dodd-Frank Act Conflict Mineral Rule is the first due diligence policy implemented. Under this regulation, U.S. firms are required to publish information on their suppliers and their mineral inputs in gold, tantalum, tungsten and tin (3T), even though they are sourced in foreign countries. Filing obligations require firms to disclose sourcing in DRC and adjoining countries, a region exporting conflict minerals.

In this paper, I show that there is great potential for enforcement of this new type of regulation: the Dodd-Frank Act generated a decrease in (3T) exports from the regulated area, by introducing new trade barriers equivalent to a 22% increase in bilateral tariffs. The drop in trade flows is observed between covered countries and most of their trade partners, not only with the United States, indicating a global response. However, this effect is offset in countries displaying large levels of opacity, *legal havens*. Legal havens offer diversion channels: the empirical analysis provides evidence that their trade costs relative to other partners of covered countries decreased. The legal opacity they provide enables traders to hide information on mineral origin to avoid due diligence requirements. In turn, legal havens export more to the United States and countries hosting suppliers of US firms after the Dodd-Frank Act is implemented. In a general equilibrium analysis, I show that the presence of legal havens mitigates adverse consequences of the Dodd-Frank Act for covered countries and the associated income shock. Legal havens benefit from lower mineral prices in covered countries. I show that the costs of the law might have been in part supported by US importers: unit values of products incorporating 3T imported to the United States increased in the post-Dodd-Frank Act period.

The development of extraterritorial regulations, conditioning domestic market access to sustainable production processes is on the rise. Since 2010, there have been 35 due diligence regulations signed, encompassing different sectors, countries and firms. In traditional trade instruments such as trade agreements, partner countries develop mirror clauses, demanding that products abide by constraints on production processes. This paper shows that the enforcement of this new type of regulation is challenging. The European regulation on Conflict Minerals also rests on a list of countries, generating potentially similar issues on the reliability of information on metal origin. Yet the definition of a clear target in terms of sector and production process to improve abroad should ease the compliance goal for firms and their suppliers to reach. More general regulations such as the EU Corporate Sustainability Due Diligence Directive (CSDDD) could face larger challenges.

The question of who should enforce these regulations is also important to consider. Such as the Dodd-Frank Act, and the French 2017 due diligence law, despite having clearly associated sanctions, rely on NGOs and private actors to build and submit cases. The use of opacity and the dilution of publicly available information on supply chain' actors' compliance proves itself here to be a challenge for this type of enforcement.

A remaining question is whether the presence of this diversion and regulation avoidance undermines the success of the Dodd-Frank Act Conflict Mineral Rule. Thinking about welfare consequences, legal havens still provide market access for conflict minerals and partially offset the drop in income for rebel groups that the law intended to cause. Second, legal havens blur the distinction between conflict and conflict-free minerals that the Act seeks to clarify. As such, they could sustain collective reputation effects for 3T, preventing conflict-free mines from gaining market shares. An avenue to answer this question would be to study the distribution of the local income shock generated by the Dodd-Frank Act and its effect on violence and assess whether a conflict-free sector can develop in this local context.

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Appendix

A Dodd-Frank Act Figure 1502

Political process. Arguments calling for regulation of U.S. companies sourcing conflict minerals have been motivated by civil society initiatives. Campaigns by NGOs like the Enough Project supported and spread the idea that the use of minerals by the tech industry was causally linked to local violence around extraction sites. Over the beginning of the century, this view gained further political support. The first bill was presented to Congress by Senator Sam Brownback in April 2009. The objective of the law was to limit the industrial use of minerals associated with adverse consequences in the Great Lake Region, especially with conflicts. The law failed to pass congress but was later integrated as Section 1502 of the Dodd-Frank Act.[34]

Extent. The law regulates the use of four products: gold, tantalum, tungsten and tin (3TG). The choice of those products was motivated by their importance in the local conflict political economy, as well as their strategic role for the downstream tech industry. However, Section 1502 states that the American Congress is allowed to extend the list of "conflict minerals" if necessary. The ten covered countries from Section 1502 are the Democratic Republic of the Congo, Rwanda, Burundi, Angola, Congo-Brazzaville, Central African Republic, South Sudan, Tanzania, Uganda and Zambia. They were targeted based on the situation of violence intertwined with extractive activity discussed earlier. The choice of the Democratic Republic of the Congo and all adjoining countries was also motivated by the smuggling pattern affecting the area: targeting only DRC could have generated a regulation diversion through informal trade networks in place.

Firms complying with Dodd-Frank Act's Section 1502 are U.S. public companies: typically large firms, but also smaller companies and some foreign issuers. They are firms using minerals and already filing information to the Security Exchange Commission (S.E.C.) under the Security Exchange Act of 1934. This includes firms listed on US securities exchanges, firms publicly offering in the US and firms reaching specific size thresholds.[35] The most represented sector among filing firms is the "Electronic and other electrical equipment", with

[34]The Dodd-Frank Wall Street Reform and Consumer Protection Act is composed principally of financial regulations and extends the Security Exchange Commission duties. As such, it was a convenient way to introduce regulations regarding minerals for listed firms.

[35]Size thresholds are a total asset of $10 million and equity securities held by either 2000 persons or 500 accredited investors.

25% of filers. Section B1 in Appendix details the distribution of firms sectors. Extractive firms are excluded from firms required to report mineral sources under the Dodd-Frank Act, as the S.E.C. consider that they do not process metal.

Enforcement. Section 1502 of the Dodd-Frank Act relies on a name-and-shame mechanism to ensure compliance of firms. Name and shame is the process of coercing an actor through public exposure of their actions and their consequences. Compliance is ensured by social stigma and control, and in the case of firms, through faced demand. The economic and management literature has found it a relevant instrument to make firms compliant (in the case of aggressive tax planning see Dyreng et al. (2016)). The Dodd-Frank Act ensures that firms publicly reveal the sources of their mineral inputs, and there are no federal sanctions for using conflict minerals or components integrating conflict minerals in this law. The only sanctions in the Dodd-Frank Act punish firms providing false information.[36]

Firms are required to reveal the source of minerals and fill associated SEC reports, if and only if their products contain tin, tantalum, tungsten or gold. In particular, they have to reveal if those inputs originate from the ten "covered countries". The reporting process can be summarized as follows: (i) firms determine if their products contain one of the four regulated minerals (ii) if not, they do not fall under this regulation. If so, they determine if the source country of minerals is one of the ten targeted countries and report this source country (iv) in case the origin is a targeted country, firms have to provide the name of their smelters, the source of the mineral if known, determine to what extent it could have fueled conflicts, and file a special report that should be certified (v) this audit process and the reports are publicly disclosed by the SEC and by firms on their website (vi) according to its the conclusion, firms label their products as "DRC conflict free" or "could not be found DRC conflict-free".

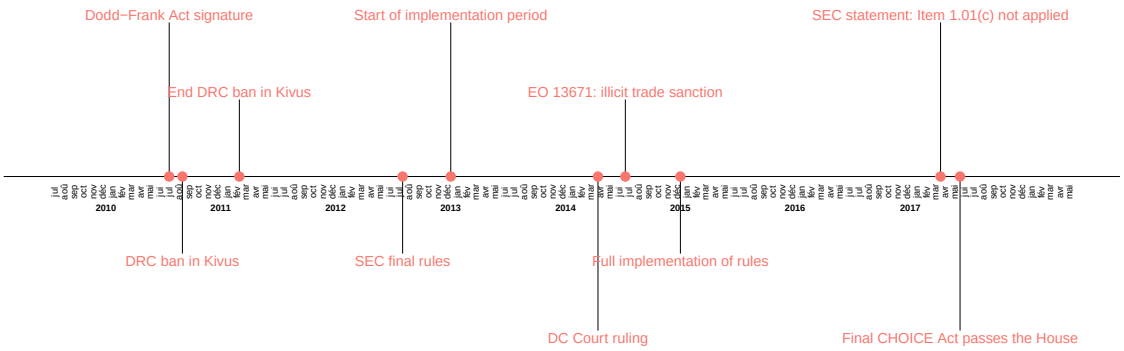
Timing. Figure A1 details events on the timeline of Dodd-Frank Act implementation. The law was signed in 2010 but only applied with a few years' delay. The SEC was chosen as the relevant institution to design and implement relevant rules. From 2010 to 2012, the latter was discussed with industrial stakeholders. In August final rules were published with a one-year delay on the provisional calendar. They were applied to economic activity taking place after January 1st 2013. The first reports were submitted in May 2014. Rules were applied for the

[36] under Exchange Act Section 18(a): "with respect to any material fact, shall be liable to any person (not knowing that such statement was false or misleading) who, in reliance upon such statement, shall have purchased or sold a security at a price which was affected by such statement, for damages caused by such reliance, unless the person sued shall prove that he acted in good faith and had no knowledge that such statement was false or misleading."

two first years gradually, not requiring that firms label their products and certify their Conflict Mineral Report. At the same time, a backlash process from industry stakeholders was at play: in 2012, a group of firms initiated a trial against the Dodd-Frank Act disclosure principle that ended in 2014. The DC appeal court ruled that the labelling product obligation was anticonstitutional, but did not challenge the rest of SEC laws. On the same year, President Obama amended previous Executive Order 13 by EO 13671. The latter extended sanctions to perpetrators of violence in the Great Lake Region to legal and physical persons giving direct or indirect support to armed groups through illicit trade.

Full implementation of SEC rules took place in 2015. They were finally challenged when the Trump administration. In January 2017, the acting SEC chairman indicated that rules would be reviewed, following the DC Court of Appeal ruling.[37] In April 2017, a second statement indicated that before further conclusions from the SEC, it would no longer enforce item 1.01(c) implementing Conflict Mineral Disclosure reports and certification.[38] Firms would be free to follow previous rules on that matter, and would not be fined for only providing a country of origin inquiry. In the same year, Republican Congressmen supported the Final CHOICE Act, which passed the House of Representatives in June 2017. This Act was designed to repeal a large part of the Dodd-Frank Act, including Section 1502. The bill however died in the House.

Figure A1 – Dodd-Frank Act's Section 1502 time line



[37] see https://www.sec.gov/news/statement/reconsideration-of-conflict-minerals-rule-implementation.html

[38] see https://www.sec.gov/news/public-statement/corpfin-updated-statement-court-decision-conflict-mine

B Data

B.1 Legal Havens

Table B1 – Legal havens

Afghanistan, Angola, Antigua and Barbuda, Aruba, Bahamas, Belize, Bolivia*, Brunei Darussalam, Chile, Comoros*, Costa Rica, Dominica, Dominican Republic*, Ecuador, Gibraltar*, Grenada, Guinea, Hong Kong*, Kenya*, Lao People's Democratic Republic, Luxembourg*, Maldives, Malaysia*, Mauritius, Mozambique*, Namibia*,	Nepal, Panama*, Paraguay, Qatar, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Seychelles*, Sierra Leone, Singapore*, Suriname, Switzerland*, São Tomé and Príncipe, Thailand*, Turks and Caicos Islands, Uganda, United Arab Emirates*, United Republic of Tanzania, Vanuatu, Viet Nam*

Note: Partners of covered countries are marked with *.

B.2 SEC filings & Compustat

Figure B1 – Filing firms sectoral distribution

Source: author's calculation based on Form SD reports.

Table B2 – Sectoral composition

	Number of firms			
	Control	Regulated		
Sector (2dg-SIC)		No CMR	CMR	Disclose suppliers
Electronic equipement	142	39	72	136
Measuring instruments	109	18	65	83
Machinery	72	17	47	84
Chemicals	286	30	23	31
Transportation	40	3	27	41
Metal products	13	8	13	15
Primary metal	22	23	4	5
Business services	444	9	25	30
Wholesale trade	64	9	10	12
Apparel retail	18	5	9	10
Other	1785	88	82	114
Total	2995	249	377	561

Note: Sectoral composition for the ten sectors (2dg-SIC) with the highest number of regulated firms. Restricted to firms included in the estimation sample. CMR stands for a firm filing a Conflict Mineral Report because the firm suspects some 3T could come from DRC(+9). Some firms disclose their list of metal suppliers (smelters or refiners) in their CMR.

Table B3 – Firm sample: descriptive statistics

	Nb firms	Mean	Median	S.d.
		Control		
Sales (SALE)	2995	3,370	284.3	14,117
Administrative cost (XSGA)	2995	602.3	54.74	2,301
Production cost (COGS)	2995	2,217	150.3	10,699
Employees (EMP)	2995	11.78	1.064	42.00
Assets (PPET)	2995	3,129	134.2	15,644
Upstreamness	2995	2.138	1.976	0.862
		Regulated, no CMR		
Sales (SALE)	249	10,043	845.3	46,992
Administrative cost (XSGA)	249	1,172	146.6	5,842
Production cost (COGS)	249	7,452	529.9	37,136
Employees (EMP)	249	22.48	3	140.9
Assets (PPET)	249	8,482	353.9	39,706
Upstreamness	249	2.211	2.295	0.862
		Regulated, CMR		
Sales (SALE)	377	3,555	564.6	11,261
Administrative cost (XSGA)	377	740.0	123.8	2,593
Production cost (COGS)	377	2,216	311.8	8,301
Employees (EMP)	377	10.90	2.353	26.35
Assets (PPET)	377	2,415	190.5	18,556
Upstreamness	377	1.930	1.762	0.684
		Regulated, Disclose suppliers		
Sales (SALE)	561	8,134	1,351	21,805
Administrative cost (XSGA)	561	1,653	280.5	4,342
Production cost (COGS)	561	5,055	723.0	15,010
Employees (EMP)	561	24.82	5.570	53.21
Assets (PPET)	561	4,594	501	16,154
Upstreamness	561	1.882	1.690	0.705
Nb suppliers	561	248.6	274	183.9

Note: Firms included in the estimation sample. CMR stands for a firm filing a Conflict Mineral Report because the firm suspects some 3T could come from DRC(+9). Name of corresponding Compustat variables in parenthesis. Variables SALE, COGS, XGSA, PPET reported in millions of USD. Variable EMP reports total employees in thousands.

B.3 Metal supplier database

Collection I first collect the list of firms filing under the Dodd-Frank Act and of reports filed over the years, using the SEC's EDGAR search engine. I then scraped the firm's name, address, sector (SIC) and links for submitted files. I construct a binary variable which takes the value one if a firm submitted a Conflict Mineral Report on top of form SD.

For firms submitting a Conflict Mineral Report, I collect the list of 3T suppliers if it is included in the report. The information collected on suppliers are supplier name, country of location, metal processes, conflict-free status and participation to a conflict-free certification initiative. The collection of reported information is undertaken by the firm Suntech.

Harmonization Raw data collected has to be harmonized since US firms might report names (for firms or certification initiatives for example) using slight variations in the spelling of those names. Harmonizing suppliers' names is crucial to generate supplying firms' unique identifiers, but it has to be done without knowing the exact final set of names, which is challenging. The harmonization process implemented is the following:

1. Correct by-hand errors in the collection process.
2. Harmonize metal and country names using Stata's `kountry` command and by hand.
3. Remove special characters, corporate extensions and useless words from suppliers' names.
4. For all combinations of supplier names within a country, compute the Jaro-Winkler distance between the names. Assign two names to the same firm if the distance is equal or above 0.9. This process is undertaken country by country to be less computationally intensive. For suppliers with missing information on the country of location, distances are computed as if they were part of another country.
5. The remaining firm name harmonization is undertaken by hand.

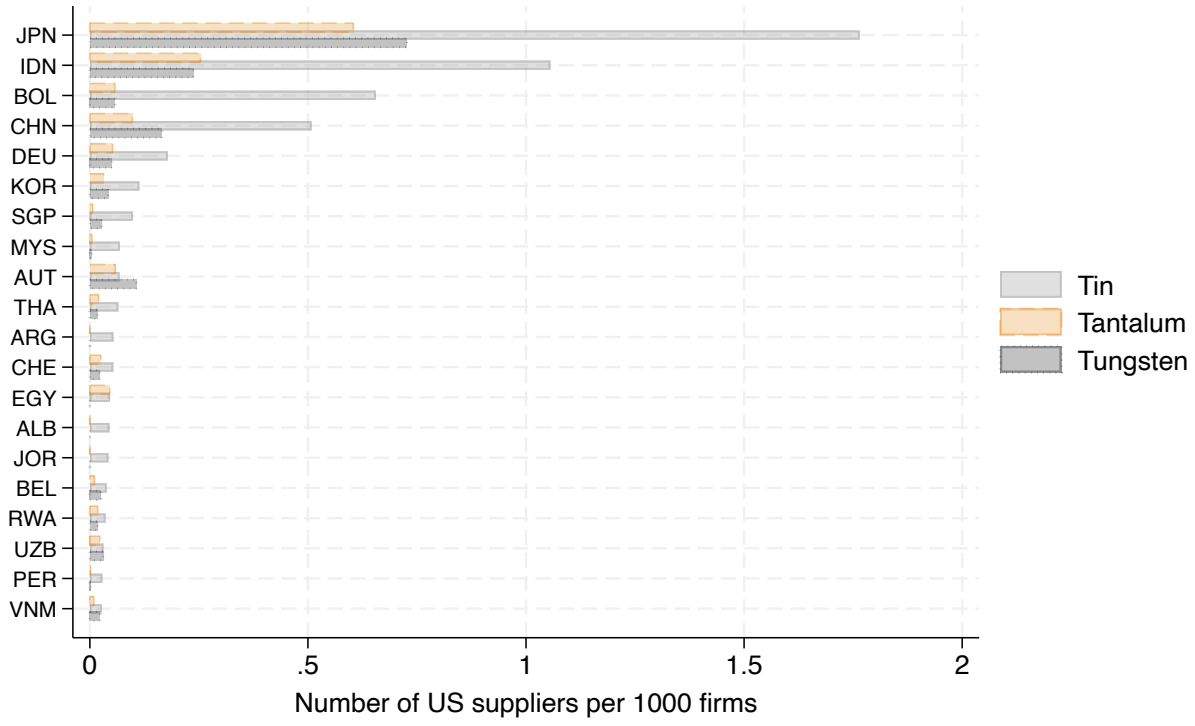
Figure B2 – Snapshot of potential metal suppliers identified by Dish Network for the filing year 2019.

Annex 1

CURRENTLY KNOWN SMELTER AND REFINERY LIST

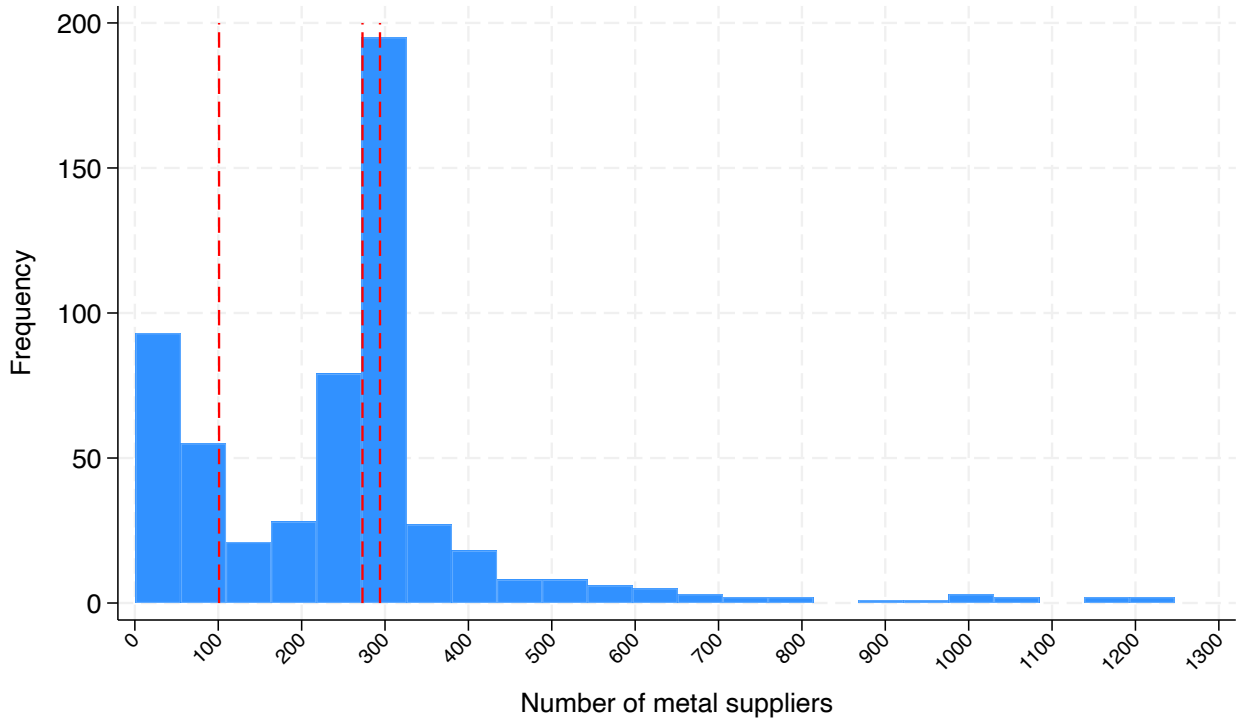
Metal	Smelter Name	Country of Smelter Facility
GOLD	8853 S.P.A.	ITALY*
GOLD	ABINGTON RELDAN METALS, LLC	UNITED STATES OF AMERICA
GOLD	ADVANCED CHEMICAL COMPANY	UNITED STATES OF AMERICA*
GOLD	AFRICAN GOLD REFINERY	UGANDA
GOLD	AIDA CHEMICAL INDUSTRIES CO., LTD.	JAPAN*
GOLD	AKTYUBINSK COPPER COMPANY TOO	KAZAKHSTAN
GOLD	AL ETIHAD GOLD REFINERY DMCC	UNITED ARAB EMIRATES
GOLD	ALLGEMEINE GOLD-UND SILBERSCHEIDEANSTALT A.G.	GERMANY*
GOLD	ALMALYK MINING AND METALLURGICAL COMPLEX (AMMC)	UZBEKISTAN*
GOLD	ANGLOGOLD ASHANTI CORREGO DO SITIO MINERACAO	BRAZIL*
GOLD	ARGOR-HERAEUS S.A.	SWITZERLAND*
GOLD	ASAHI PRETEC CORP.	JAPAN*
GOLD	ASAHI REFINING CANADA LTD.	CANADA*
GOLD	ASAHI REFINING USA INC.	UNITED STATES OF AMERICA*
GOLD	ASAKA RIKEN CO., LTD.	JAPAN*
GOLD	ATASAY KUYUMCULUK SANAYI VE TICARET A.S.	TURKEY
GOLD	AU TRADERS AND REFINERS	SOUTH AFRICA*
GOLD	AURA-II	UNITED STATES OF AMERICA
GOLD	AURUBIS AG	GERMANY*
GOLD	BAIYIN NONFERROUS METALS CORPORATION (BNMC)	CHINA
GOLD	BANGALORE REFINERY	INDIA*
GOLD	BANGKO SENTRAL NG PILIPINAS (CENTRAL BANK OF THE PHILIPPINES)	PHILIPPINES*
GOLD	BAUER WALSER AG	GERMANY
GOLD	BOLIDEN AB	SWEDEN*
GOLD	C. HAFNER GMBH + CO. KG	GERMANY*
GOLD	C.I METALES PROCESADOS INDUSTRIALES SAS	COLOMBIA
GOLD	CARIDAD	MEXICO
GOLD	CCR REFINERY - GLENCORE CANADA CORPORATION	CANADA*
GOLD	CENDRES + METAUX S.A.	SWITZERLAND*
GOLD	CGR METALLOYS PVT LTD.	INDIA
GOLD	CHANGSANJIAO ELC. LTD	CHINA
GOLD	CHIMET S.P.A.	ITALY*
GOLD	CHINA GOLD INTERNATIONAL RESOURCES CORP. LTD.	CHINA
GOLD	CHINA NATIONAL GOLD GROUP CORPORATION	CHINA
GOLD	CHUGAI MINING	JAPAN*
GOLD	CODELCO	CHILE
GOLD	COLT REFINING	UNITED STATES OF AMERICA
GOLD	DAEJIN INDUS CO., LTD.	KOREA, REPUBLIC OF*
GOLD	DAERYONGENC	KOREA, REPUBLIC OF
GOLD	DAYE NON-FERROUS METALS MINING LTD.	CHINA
GOLD	DEGUSSA SONNE / MOND GOLDHANDEL GMBH	GERMANY
GOLD	DIJLLAH GOLD REFINERY FZC	UNITED ARAB EMIRATES
GOLD	DODUCO CONTACTS AND REFINING GMBH	GERMANY*
GOLD	DONGGUAN CAMEROONCHEMICAL MATERIALS CO., LTD	CHINA

Figure B3 – Reported metal suppliers of US firms



Note: Declared suppliers by regulated firms in Conflict Mineral Reports between 2013 and 2017.

Figure B4 – Reported metal suppliers of US firms



Note: Maximum declared metal suppliers by firm on the period. Red lines indicate quartiles. $Q1 = 101, Q2 = 274, Q3 = 294$.

Table B4 – Complementary sources for the total number of firms

Country (ISO)	Source	Link
ASM	US County Business Patterns	https://www.census.gov/programs-surveys/cbp.html
BFA	Imputation from new business density rate	https://www.worldbank.org/en/programs/entrepreneurship
BLZ	Open Corporates	https://opencorporates.com/
IDN	Imputation from new business density rate	https://www.worldbank.org/en/programs/entrepreneurship
MOZ	UNU Wider	https://www.brookings.edu/wp-content/uploads/2016/07/L2C_WP21_Schou-and-Cardoso-1.pdf
USA	US County Business Patterns	https://www.census.gov/programs-surveys/cbp.html
VNM	Open Corporates	https://opencorporates.com/
ZAF	Open Corporates	https://opencorporates.com/

B.4 Trade in minerals

Table B5 – List of minerals products

Product	HS code	Characteristics
Tantalum	261590, 810310, 810390	Rare, High unit value, unsubstituable industrial input, bulky, strategic
Tin	2609, 8001, 8003, 8004, 8005, 8006	Rare, Wide range of industrial applications, alloy, bulky
Tunsgten	2611, 8101	Common, industrial input, bulky, strategic
Aluminium	2606, 281820	Wide range of industrial applications, bulky, alloy, strategic
Chromium	2610, 8112	Alloy, strategic
Cobalt	2605, 8105	Unsubstituable indistrial input, bulky, strategic
Copper	2603, 7401, 7402, 7403, 7405, 7406, 7407, 7408, 7409, 7410, 7411, 7412	Wide range of industrial applications, bulky
Diamonds	710210, 710221, 710231	Rare, High unit value, concealable
Iron	260111, 260112	Common, Wide range of industrial applications
Manganese	2602, 8111	Common, alloy
Molybdenum	2613, 8102	Unsubstituable industrial input, strategic
Nickel	2604, 7501, 7502, 7503, 7504, 7505, 7506, 7507	Common, alloy
Titanium	2614, 8108	Common, alloy, strategic
Uranium	261210, 281210	High unit value, strategic
Zinc	2608, 7901, 790390, 7904, 7905, 7906	Common, a wide range of industrial applications, alloy

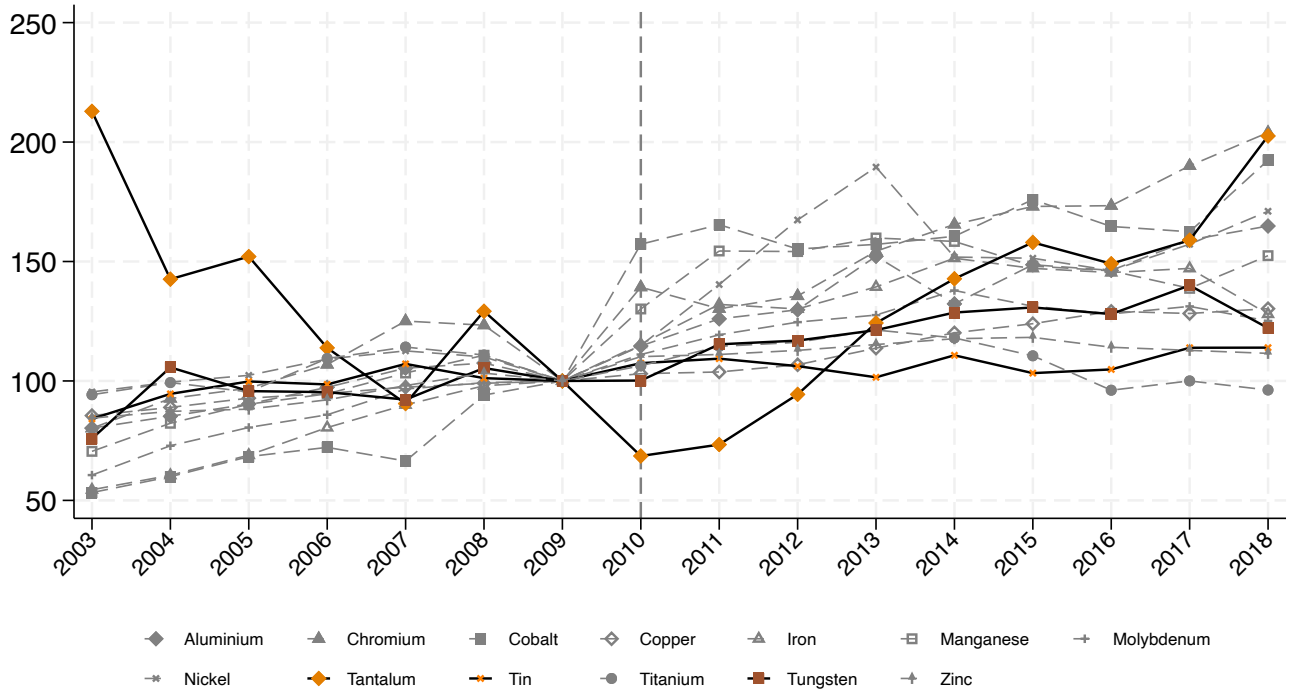
Silver is not included for two reasons. First, its mineral/ore stage is under the same heading as gold, and gold is excluded. Second, the metal stage is not included in the Fally and Sayre (2018) classification so I cannot build internal trade flows.

Share of affected exports Using aggregate trade flow, I compute the export shares of covered countries to the United States accounting for metal re-exports during the pre-treatment period (2006-2009):

- $Y_{DFA,US} = \frac{\sum_i \sum_j X_{i \in DFA,US}}{\sum_i \sum_j X_{i \in DFA,j}}$ is the share of 3T exported by covered countries directly to the USA.
- $\sum_j Y_{DFA,j} \times Y_{j,US}$ is the sum of each export share to another destination, times the export share of this destination to the USA. This term approximates the export share accounting for re-exports. It assumes that intermediate third countries source minerals

homogeneously across their exportation markets: the share of minerals sourced in DRC is the same for products exported to Germany or to the USA.

Figure B5 – World ore production index



Note: Base 2009 index of corresponding ore production (right). Data sources: Fally and Sayre (2018).

Figure B6 – Control group export index in volume (left) and value (right)

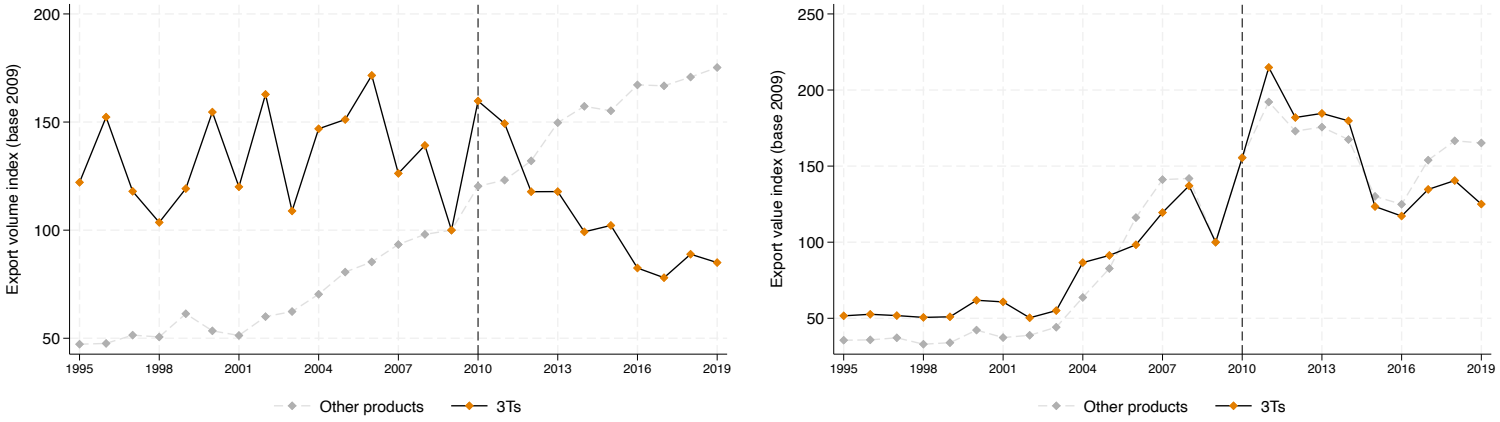


Figure B7 – covered countries export index in volume (left) and value (right)

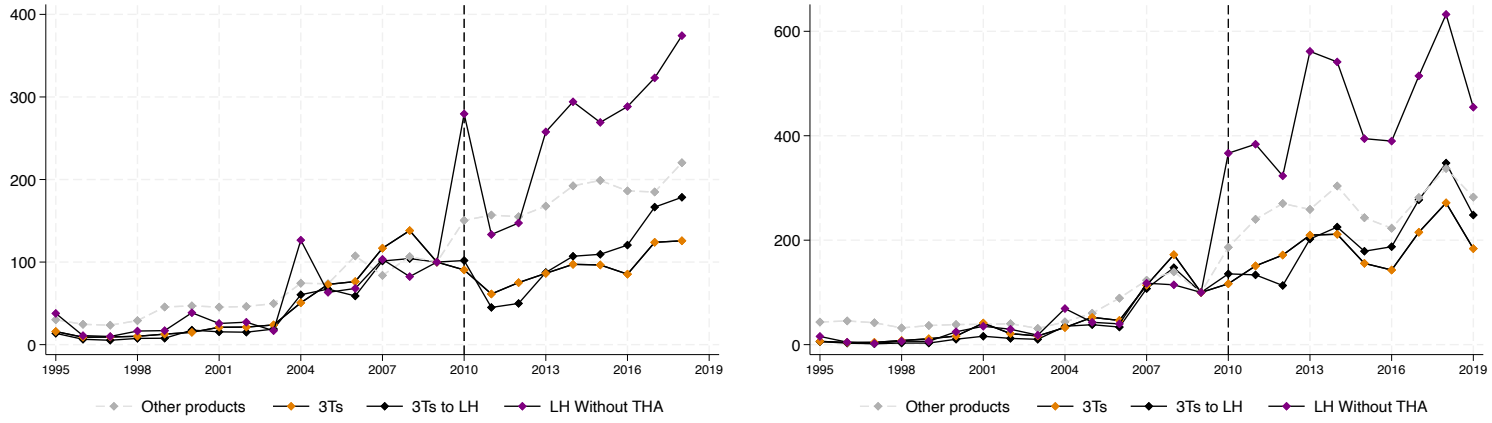


Figure B8 – Control group export index in volume (left) and value (right)

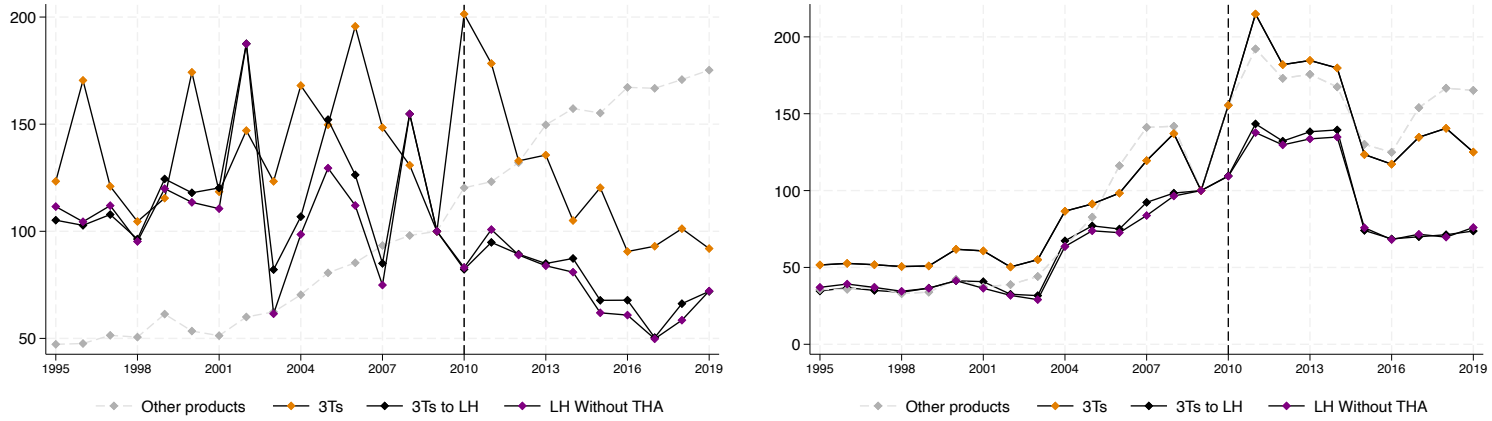


Figure B9 – Exports from covered countries to Switzerland- Index in volume (left) and value (right)

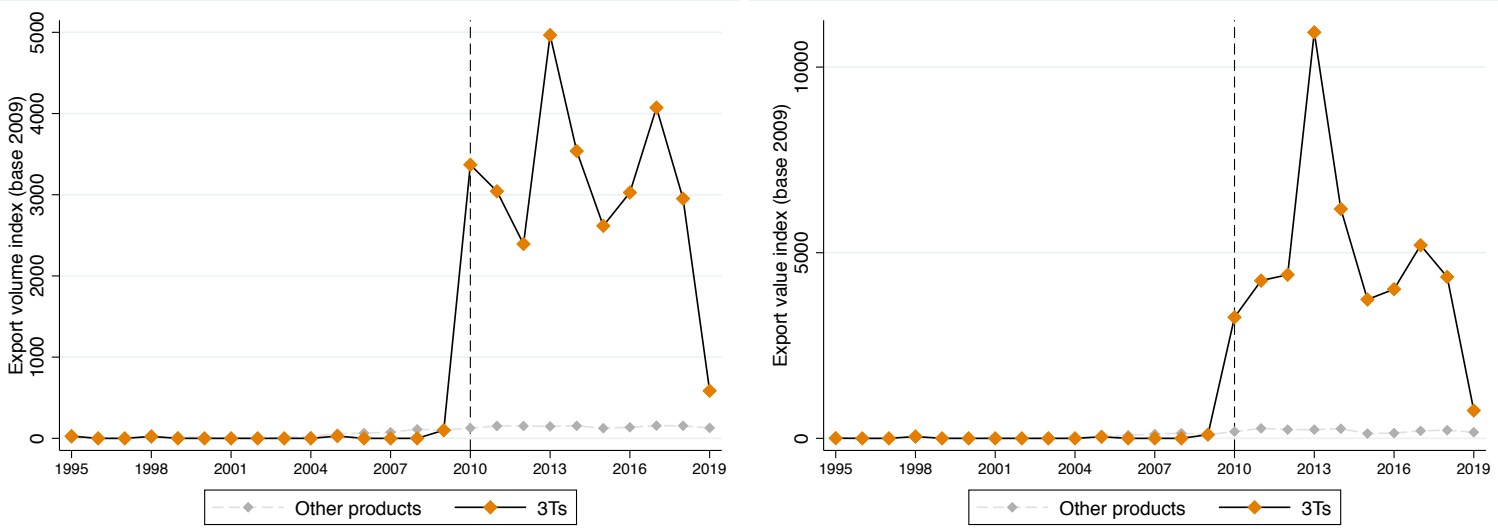


Figure B10 – Exports from Switzerland- Index in volume (left) and value (right)

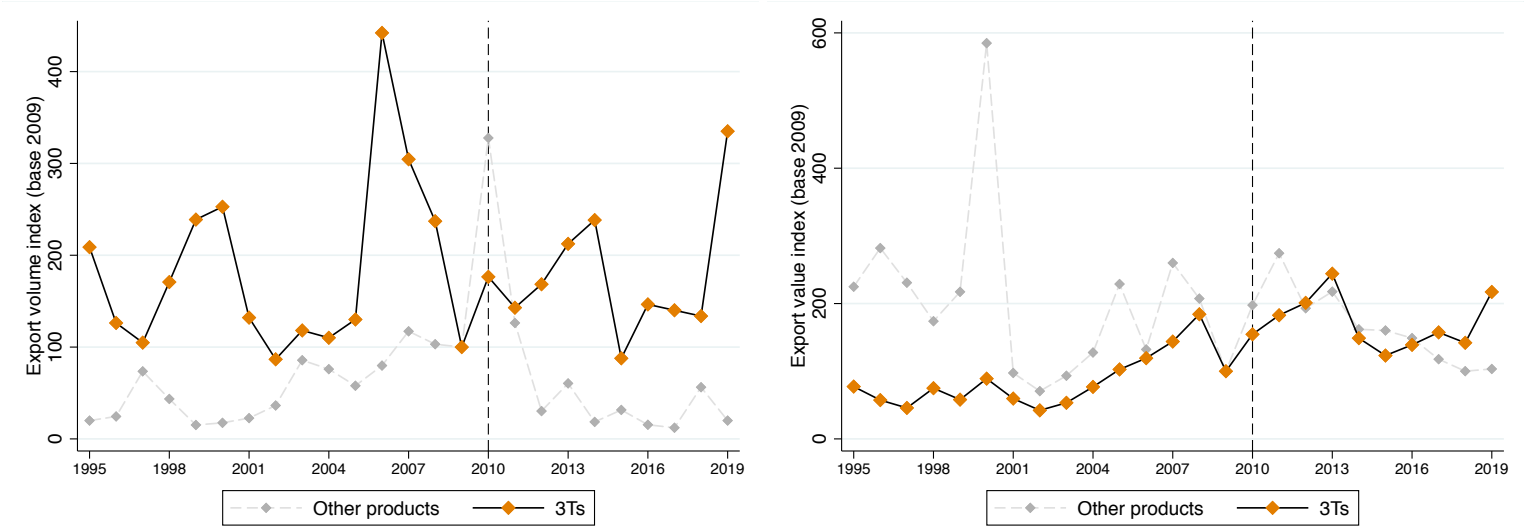


Figure B11 – Export share to legal havens, from covered countries, 3T

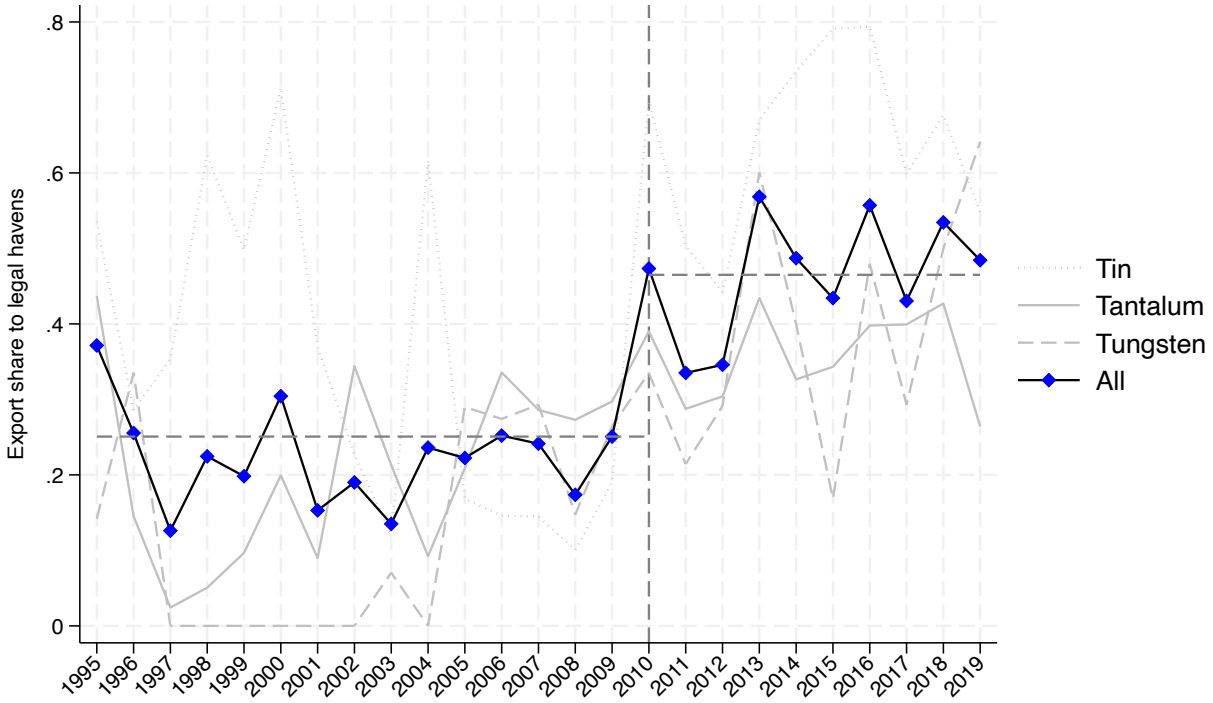
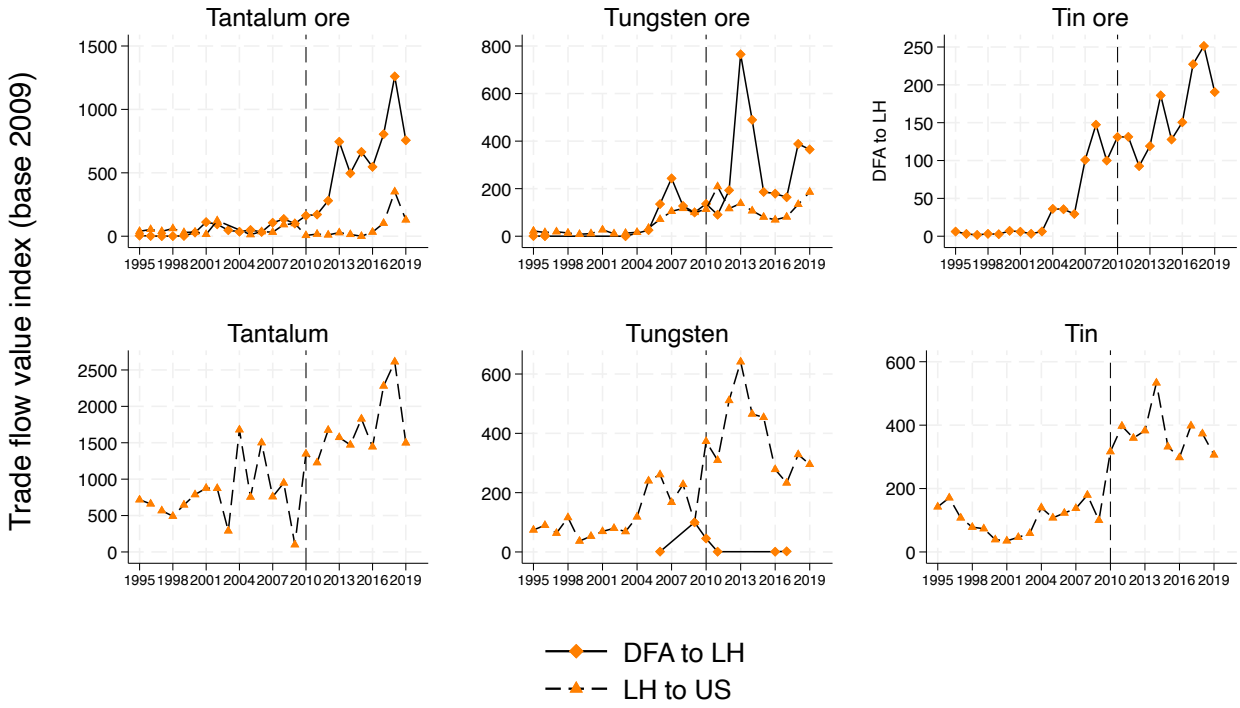
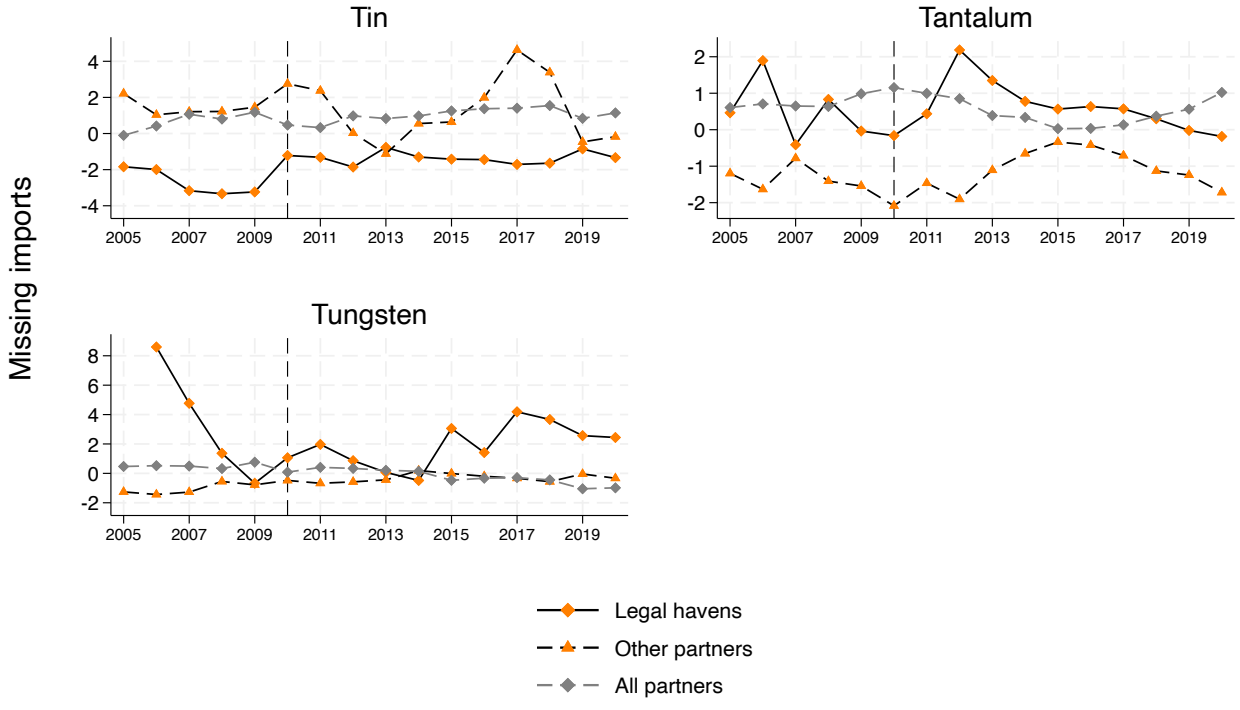


Figure B12 – Exports to and from legal havens - By product



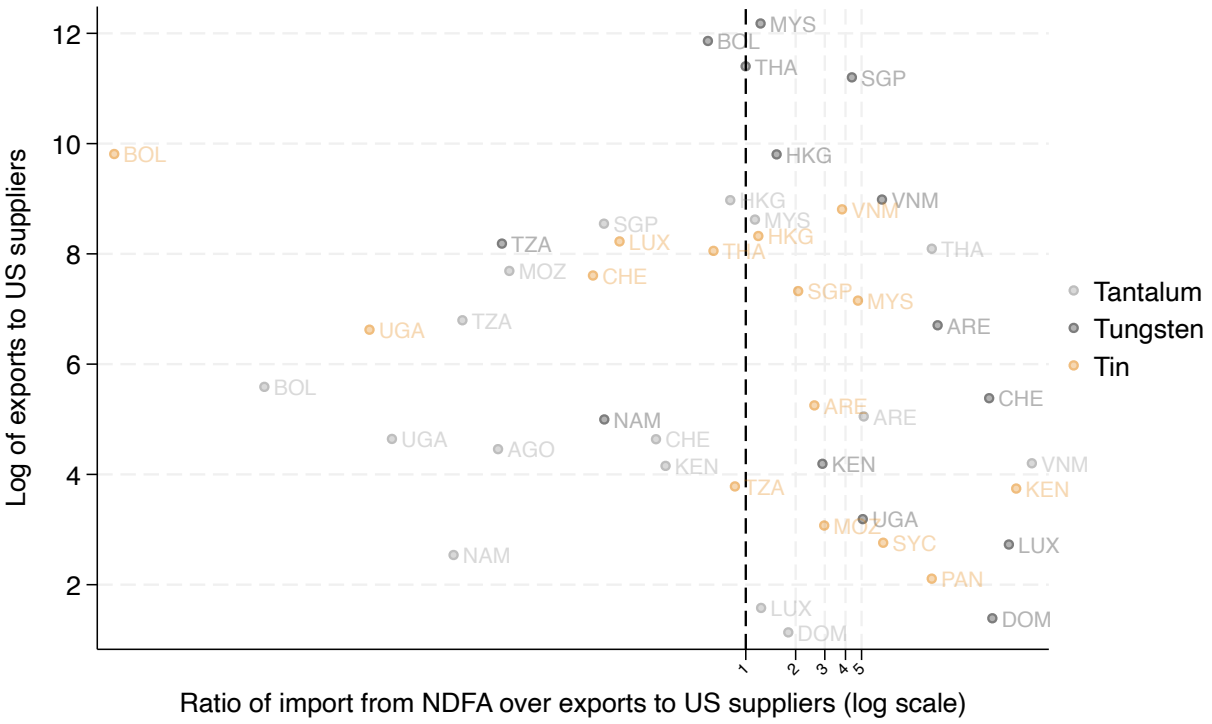
Note: Index base 100 in 2009 of trade flow value. With diamond exports from covered countries to legal havens. With triangles exports from legal havens to the United States.

Figure B13 – Mirror flows



Note: Data from UN Comtrade.

Figure B14 – LH entering and exiting flows



Note: Ratio of imports volumes from other origins over exports to US supplying countries for Legal Havens. Volumes of imports are adjusted for average metal import content of mineral concentrates: Tantalum: 32%; Tungsten: 65%; Tin: 50%.

C Product-level gravity and smuggling

The structural gravity equation can be derived at the mineral product level, if one considers it to be a more appropriate industry level:

$$X_{ijpt} = \frac{Y_{ipt}E_{jpt}}{Y_{pt}} \left(\frac{t_{ijpt}}{\Pi_{ipt}P_{jpt}} \right)^{1-\sigma}$$

With X_{ijpt} the trade flows from exporter i to importer j of product p at time t, Y_{it} and E_{jpt} total production and expenditures of exporter and importer, t_{ijpt} bilateral trade costs, and Π_{ipt} and P_{ipt} the multilateral resistance terms of importing and exporting countries, defined by the relationships $\Pi_{ipt}^{1-\sigma} = \sum_j \left(\frac{t_{ijpt}}{P_{jpt}}\right)^{1-\sigma} \frac{E_{jpt}}{Y}$ and $P_{jpt}^{1-\sigma} = \sum_i \left(\frac{t_{ijpt}}{\Pi_{ipt}}\right)^{1-\sigma} \frac{Y_{ipt}}{Y}$. Multilateral resistance terms (MRTs) measure how remote a country is from all other countries, in terms of exports (outward multilateral resistance $\Pi_{ipt}^{1-\sigma}$) and imports (inward multilateral resistance $P_{jpt}^{1-\sigma}$).

Smuggling. The smuggling of minerals is especially prevalent between covered countries. Using trade data from BACI, I can only observe recorded trade flows, which in the covered countries are likely to differ from actual trade flows taking place. Actual trade flows face an evaporation rate θ_{it} when recorded: a smuggling rate which is assumed to be country-specific:

$$\widetilde{X_{ijpt}} = (1-\theta_{it})X_{ijpt}$$

$$\widetilde{X_{ijpt}} = (1-\theta_{it}) \times \frac{Y_{ipt}E_{jpt}}{Y_{pt}} \times \left(\frac{t_{ijpt}}{\Pi_{ipt}P_{jpt}}\right)^{1-\sigma} \tag{10}$$

Concerning international flows, the evaporation rate is just a country-specific scaling parameter of gravity determinants. For countries with reliable recording processes, θ_{it} will be close to zero, while for covered countries it will be larger.

The Dodd-Frank Act effect is equivalent to an increase in trade costs t_{ijpt} from covered countries to all other unregulated destinations, as discussed in Section 2. This is a non-discriminatory trade policy from the regulated area on all other destinations. The identification of a non-discriminatory trade policy effect on trade flows is usually challenging, as it is unilateral. The effect of such a policy usually varies along the same dimension as the outward multilateral resistance term, and cannot be identified separately.

Identification. Following Heid et al. (2021), one can use two sets of trade flows originating in i that are unaffected by the regulation: trade flows between covered countries and covered countries' internal trade flows. First, flows between covered countries will not be affected by

increased bilateral trade costs, as there exists no regulation arbitrage between covered countries for reported flows, ensured by the design of the rule (cf. Section 2). Second, internal trade flow, i.e. production for domestic consumption, will not be affected as there is no international trade cost. These flows provide control groups to identify the policy effect separately from OMR.

The following specification implements this identification strategy, with the dependent variable Y_{ijpt} is trade flows of product p from i to j:

$$\begin{aligned} Y_{ijpt} =& exp(\beta_{DFA} \times \mathbb{1}_{\{i=DFA\}} \times \mathbb{1}_{\{j\neq DFA\}} \times \mathbb{1}_{\{t\geq 2010\}} \\ &+ \lambda_{ijp} + \mu_{ipt} + \eta_{jpt}) \times \zeta_{ijpt} \end{aligned} \tag{11}$$

The fixed effects λ_{ijp}, μ_{ipt} and η_{jpt} respectively control for time-invariant bilateral trade costs, exporter and importer-specific terms at the product level. Directional fixed effects are required to correctly account for multilateral resistance terms. The importer-specific fixed effect will also control the smuggling evaporation rate. The term β_{DFA}, associated with the interaction term, captures variation in bilateral trade flows from covered countries to all unregulated destinations after 2010. Using the two control groups, β_{DFA} estimates the Dodd-Frank Act effects on recorded exports from covered countries to the rest of the world, relative to reported regional and internal trade flows. I estimate the model with PPML and clustered standard errors on country-product-pairs.

I take a simple two-country set-up (DFA, $NDFA$) with one good to illustrate this strategy. The Dodd-Frank Act will affect flows from DFA (the targeted country) to $NDFA$ (non-covered countries). The parameters η and μ are respectively the exporter and importer fixed effects controlling for multilateral resistance terms. The matrix of covariates is the following:

$$\begin{array}{ccccc} & i & j & & \\ 1 & DFA & NDFA & & \\ 2 & DFA & DFA & = & \\ 3 & NDFA & NDFA & & \\ 4 & NDFA & DFA & & \end{array} \begin{pmatrix} DOFA & \eta_{DFA} & \eta_{NDFA} & \mu_{DFA} & \mu_{NDFA} \\ 1 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 \end{pmatrix} \tag{12}$$

$DOFA$ denotes the indicator variable capturing the Dodd-Frank Act's effects on trade flows. In the presence of exporter-specific fixed effects, it is identified thanks to observation 2, trade flows within DFA. The coefficient associated with the vector $DOFA$ captures the variation in exports from the targeted country to the non-targeted country relative to exchanges within

the targeted country.

Using now a three-country set-up, there are now two covered countries DFA_1, DFA_2 and one non-targeted country $NDFA$. The matrix of covariates becomes:

$$
\begin{array}{ccc} & i & j \\ 1 & DFA_1 & NDFA \\ 2 & DFA_1 & DFA_1 \\ 3 & DFA_1 & DFA_2 \\ 4 & DFA_2 & NDFA \\ 5 & DFA_2 & DFA_2 \\ 6 & DFA_2 & DFA_1 \\ 7 & NDFA & DFA_1 \\ 8 & NDFA & DFA_2 \\ 9 & NDFA & NDFA \end{array} = \begin{pmatrix} DOFA & \eta_{DFA_1} & \eta_{DFA_2} & \eta_{NDFA} & \mu_{DFA_1} & \mu_{DFA_2} & \mu_{NDFA} \\ 1 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \end{pmatrix} \tag{13}
$$

The control group is, as in the previous example, composed of flows within the regulated area. It consists now in two subgroups: flows between regulated countries DFA_1 and DFA_2 (observations 3 and 6) and internal flows in regulated countries (observations 2 and 5). Keeping the two subgroups within the estimation sample is not required for identification. The parameter β_{DFA} can be estimated with only exchanges between covered countries as a control group. However, changing the composition of this control group will change the interpretation of β_{DFA}.

Threats. Two issues can arise in this setting. First, we assumed that the smuggling rate is the same for all partner countries. However, it is plausible that the smuggling rate differs if a targeted country exports to another country of the regulated area or a country outside the regulated zone. Linearizing equation 10, I get the following equation:

$$\ln \widetilde{X_{ijpt}} = \ln(1-\theta_{it}) + \ln E_{jpt} + \ln Y_{ipt} - \ln Y_{pt} + (1-\sigma)\ln t_{ijpt} - (1-\sigma)\ln P_{jpt} - (1-\sigma)\ln \Pi_{ipt} + \varepsilon_{ijt}$$

If differences in smuggling rates between regulated and non-regulated trade partners are constant in time, this will be captured by bilateral fixed effects. If differentials in smuggling rates to covered and to non-covered countries change with the Dodd-Frank Act, then this effect will be also captured by the coefficient β_{DFA}, as it will affect reported trade differently.

Rewriting the linearized structural gravity, we have that:

$$ln\widetilde{X_{ijpt}} = \ln\Big(1-\theta_{iDFA(j)t}\Big)+\ln E_{jpt}+\ln Y_{ipt}-lnY_{pt}+(1-\sigma)\ln t_{ijpt}-(1-\sigma)\ln P_{jpt}-(1-\sigma)\ln\Pi_{ipt}+\varepsilon_{ijt}$$

Estimated β_{DFA} will capture any change in t_{ijpt}. but also in $\theta_{DFA,NDFA,t}$

Second, recorded internal flows are not impacted by smuggling evaporation in the same way. Recorded internal flows consist of production minus the sum of recorded exports:

$$\widetilde{X_{iipt}} = Q_{ipt} - \sum_{j,i\neq j} \widetilde{X_{ijpt}}$$

In the case of constant evaporation rate:

$$\widetilde{X_{iipt}} = Q_{ipt} - (1-\theta_{it}) \sum_{j,i\neq j} X_{ijpt}$$

An increase (decrease) in internal flows can come from, everything else being equal: (i) an increase (decrease) in national production (ii) a decrease (increase) in real exports (iii) an increase (decrease) in the smuggling rate. Parameter θ_{it} affects now intranational flows in a way that cannot be controlled with exporter fixed-effects, even if it is homogeneous for all destinations.

Smuggling in 3T impacts both control groups in opposite ways and is likely to be affected by the Dodd-Frank Act as well, as local smuggling adjusts to the act. The interpretation of β_{DFA} will not be straightforward as it is relative to both smuggling and reported trade flows.

Results Table D1 displays the results. In columns (1) and (2), the control group all flows internal to the region of covered countries. Exports to legal havens display a positive premium while there is no statistically significant effect for other destinations. In columns (3), (4), (5), the control group is only composed of internal trade, with $T_{I,external}$ controlling for the change in trade between covered countries. The coefficient on exports to legal havens remains, while there is a large negative statistically significant effect on exports to other destinations. covered countries' exports to regular trade partners decrease *relative to* internal trade, but not to trade between covered countries.

Table D1 – Gravity on 3T sample

Dep. variable	Bilateral trade flow: X_{ijt}						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DRC+9 to ROW$_{3T,t\geq 2010}$	-0.818	-1.825**	-1.882**	-1.723*	-1.717*	-	-
	(0.690)	(0.811)	(0.806)	(0.903)	(0.907)		
$\times LH_{j,top25\%}$	1.343***	1.357***	1.367***	1.306***	1.305***	1.148**	1.202**
	(0.468)	(0.467)	(0.463)	(0.479)	(0.482)	(0.479)	(0.477)
$\times 3T producer_j$				-0.192	-0.187	-0.211	-0.222
				(0.461)	(0.462)	(0.453)	(0.455)
3T producer to ROW$_{3T,t\geq 2010}$			0.283***	0.289***	0.286***	-	-
			(0.0790)	(0.0808)	(0.0892)		
LH to USA$_{3T,t\geq 2010}$				0.616**	0.629**	0.560**	0.639**
				(0.309)	(0.307)	(0.284)	(0.303)
LH to Metal industry$_{p,j,t\geq 2010}$					-0.0980	-0.516**	-0.469**
					(0.201)	(0.236)	(0.229)
LH to US Suppliers$_{p,j,t\geq 2010}$ (Share)					0.567	1.348**	
					(0.669)	(0.632)	
LH to US Suppliers$_{p,j,t\geq 2010}$ (Density)							0.0827
							(0.0755)
Bewteen DRC+9 countries$_{3T,t\geq 2010}$		-5.195***	-5.167***	-5.177***	-5.181***	-1.742**	-1.712**
		(1.015)	(1.015)	(1.017)	(1.027)	(0.795)	(0.792)
RTA	0.263*	0.264*	0.239*	0.273**	0.282**	0.184	0.185
	(0.138)	(0.138)	(0.135)	(0.131)	(0.131)	(0.131)	(0.131)
Pseudo R^2	0.981	0.981	0.981	0.981	0.981	0.952	0.952
Observations	70,855	70,855	70,855	70,855	70,855	70,450	70,450
Origin x Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destination x Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dyad FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Border x Time FR						Yes	Yes

Note: Sample: matrix of 3T trade flows in value.

D Downstream US import prices

I check whether the Dodd-Frank Act Conflict Mineral Rule translated into higher prices for downstream products incorporating 3T imported to the United States. Following Amiti et al. (2019), I compare unit values at the border of products incorporating some 3T compared to other products incorporating only other metals. The identifying assumptions are that there is no anticipation of the policy causing a price change before July 2010 and that in the absence of treatment, the price of downstream products would have evolved on average such as the one of other products incorporating metals. I estimate the following model to estimate the percentage change in unit values:

$$\ln uv_{pt} = \alpha + \beta_1 Dowstream_p + \beta_2 \mathbb{1}_{\{t \geq July2010\}} + \beta_3 Dowstream_p \times \mathbb{1}_{\{t \geq July2010\}} + \mu_p + \mu_t + \varepsilon_{pt} \quad (14)$$

The variable $Downstream_{pt}$ is an indicator variable taking the value one if the product incorporates 3T. Indicator variable $\mathbb{1}_{\{t \geq July2010\}}$ takes the value one for the period after the signature of the law. Coefficient β_1 captures baseline divergence in percentage between the two product groups, β_1 shared proportional time evolution between the two time periods. The terms μ_p and μ_t are product and time-fixed effects and their inclusion will drop terms $\mathbb{1}_{\{t \geq July2010\}}$ and $Dowstream_p$ because of collinearity.

Coefficient β_3 captures the change of interest: the change in unit value of downstream 3T products caused by the Dodd-Frank Act. This change is a likely first-order effect: I estimate the effect of the new law on products directly incorporating 3T. Second-order effects increase the prices of products further down the value chain, in which case my estimate would underestimate the law's total effect. I break down the average effect on unit prices along two dimensions: type of 3T metal incorporated and timing of rule implementation. I estimate equation 14 on HS10 product series observed from the full period from January 2005 to December 2018, with OLS.

Results are presented in Table D1. From column (1), we observe no statistically significant effect on 3T downstream products, even though estimates are positive. The coefficient indicates an average 2.1% increase in downstream prices. Distinguishing by metal in column (2), the positive effect on unit values seems to be driven only by-products incorporating tantalum. Unit values of these products increase by 9.6% per cent on average. From column (3), when rules are fully implemented, column (4) indicates that the effect starts as soon as they are implemented for tantalum.

Where does product heterogeneity comes from? A first candidate explanation could be

Table D1 – Difference-in-differences: U.S. downstream import prices

Dep. variable	Log imports unit value: $\ln uv_{pt}$			
	(1)	(2)	(3)	(4)
$Dowstream_p \times \mathbb{1}_{\{t \geq July2010\}}$	0.0208			
	(0.0201)			
× Tantalum input		0.0922***		
		(0.0325)		
× Tunsgten input		-0.0182		
		(0.0253)		
× Tin input		-0.0625		
		(0.0937)		
× Signature			-0.00574	0.0448
			(0.0195)	(0.0301)
× Implementation			0.0159	0.0719*
			(0.0235)	(0.0413)
× Full application			0.0559**	0.154***
			(0.0256)	(0.0429)
Product FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Treated products	3T	3T	3T	Tantalum
Observations	907,043	907,043	907,043	866,747
R-squared	0.965	0.965	0.965	0.961
Number of products	6214	6214	6214	5938

Note: Standard errors clustered by product. Monthly time frequency (2005-2017). Log-OLS estimator.

that tin and tungsten are far less concentrated than the other 3T. The great lake region represents only around 3 percent of their world production, which makes easy for downstream producers to find subsitutes without increasing commodity prices too much. A second candidate explanation would be the differences in metal certification mechanisms: sectoral initiatives were introduced for tantalum and tin, potentially changing market power by concentrating certified traders, but lagged behind for tungsten.

E Other results

E.1 Reduced form: change in total exports

Table E1 – Robustness: total export change

Dep. var.	X_{ijpt}					
	DiD (1-4)				Triple Diff. (5-6)	
Unit	Volume		Value			
	(1)	(2)	(3)	(4)	(5)	(6)
$Dodd - FrankAct_{pt}$	-1.014*		-0.715		-0.981*	
	(0.575)		(0.575)		(0.580)	
Signature		-0.601		-0.634		-1.084**
		(0.390)		(0.435)		(0.442)
Implementation		-1.250**		-0.871		-1.108*
		(0.624)		(0.620)		(0.599)
Full application		-1.118*		-0.656		-0.816
		(0.669)		(0.642)		(0.691)
Observations	1,906	1,932	1,906	1,932	39,387	39,387
Pseudo R^2	0.960	0.979	0.960	0.979	0.991	0.991
Coutry x Product FE	Yes	Yes	Yes	Yes	Yes	Yes
Product x Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Coutry x Time FE					Yes	Yes

Note: Estimator: PPML. Control group: (1)-(4): other products; (5)-(6): other products and other countries. Clusters: (1)-(4): products; (5)-(6): country-products.

E.2 Reduced form: diversion to legal havens

I compare export shares to legal havens in 3T to export shares in other mineral products extracted by covered countries, not listed by the Dodd-Frank Act. Using a differences-in-differences strategy, I test in reduced form if the Dodd-Frank Act increased 3T export shares to legal haven:

$$Y_{i\in DFA,p,t} = \frac{\sum_{j\in LH} X_{i\in DFA,j,p,t}}{\sum_{j} X_{i\in DFA,j,p,t}} = \alpha + \beta Dodd - FrankAct_{ipt} + \mu_p + \mu_t + \varepsilon_{i,p,t} \tag{15}$$

The outcome $Y_{i\in DFA,p,t}$ is the export share to legal havens for country i, of product p at time t. Coefficients μ_p and μ_t are product and time-fixed effects. $Dodd - FrankAct_{ipt} = \mathbb{1}_{\{3T\}} \times \mathbb{1}_{\{i\in DFA\}} \times \mathbb{1}_{\{t\geq 2010\}}$ is a binary variable, taking the value one for 3T from covered countries after 2010. It captures the change in export share to legal havens following the

Dodd-Frank Act. $\varepsilon_{i,p,t}$ is the error term. The model is estimated via OLS and standard errors are clustered at the product level. Results are displayed in Table E2.

In column (1), I estimate that the Dodd-Frank Act increased the 3T export share to legal havens by 11.3 percentage points. This coefficient is precisely estimated. In column (3), I decompose the three timings: there is no effect between the signature of the law and its implementation, but a large effect in the two following implementation periods. In column (5), I decompose from countries contiguous and non-contiguous to Kivus, the region most prone to conflict and 3T extraction. The positive effect on export share to legal havens is more precisely estimated for countries contiguous in the region extracting most conflict minerals.

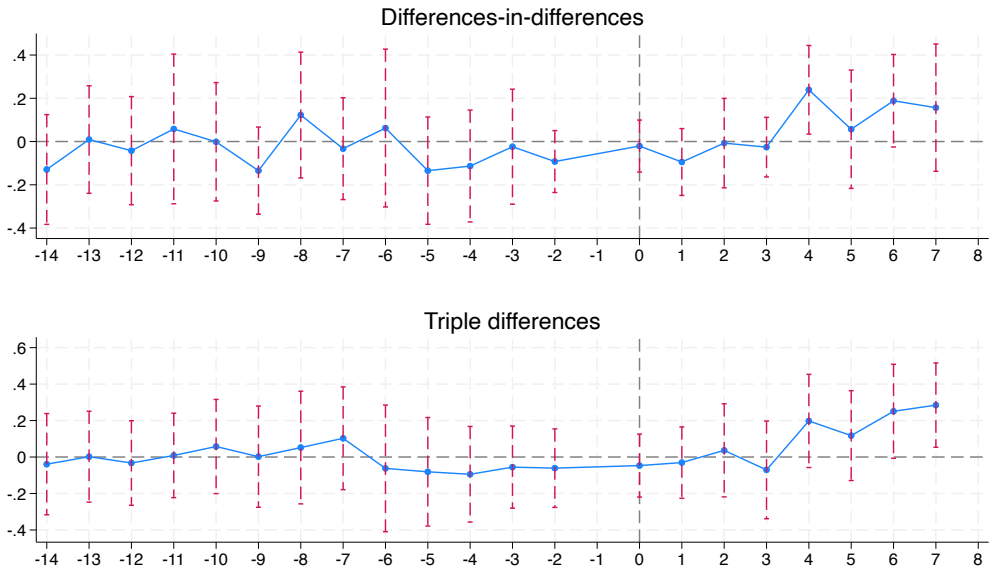
A drawback is that if there are some disclosure spillovers to other minerals extracted in the region, through increased media coverage, for example, this estimation strategy will underestimate the effect. In Table E2 columns (2), (4), (6), I estimate a triple difference model, using other countries for all mineral products as a control group. It controls for spillovers to other non-3T products. I estimate a 14 percentage point increase in the legal havens' export share. In Table E3, I estimate the DiD model using copper and cobalt as placebo products. There is a zero effects on export shares to legal havens. I test for parallel trends using leads and lags. Coefficients are plotted in Figure E1: there is no statistically significant pre-trend.

Table E2 – Robustness: triple difference

Dep. var.	Export share to legal havens					
	DiD	Triple Diff.	DiD	Triple Diff.	DiD	Triple Diff.
	(1)	(2)	(3)	(4)	(5)	(6)
$Dodd - FrankAct_{pt}$	0.116**	0.157*				
	(0.0410)	(0.0813)				
Signature			0.0227	0.0462		
			(0.0828)	(0.0912)		
Implementation			0.149***	0.113		
			(0.0434)	(0.105)		
Full application			0.181**	0.293***		
			(0.0754)	(0.0931)		
Kivus contiguous countries					0.107***	0.215***
					(0.0302)	(0.0717)
Rest of targeted area					0.143	0.0224
					(0.0886)	(0.201)
Observations	1,057	22,996	1,057	22,996	1,057	22,996
R-squared	0.169	0.520	0.174	0.520	0.170	0.520
Product FE	Yes		Yes		Yes	
Time FE	Yes		Yes		Yes	
Product x Time FE		Yes		Yes		Yes
Country x Time FE		Yes		Yes		Yes
Country x Product FE		Yes		Yes		Yes

Note: Bootstraped standard errors clustered at the product level.

Figure E1 – Leads and lags



Note: Bootstraped standard errors clustered at the product level.

Table E3 – Robustness: placebo products

Dep. var.	Export share to legal havens			
	DiD	Triple Diff.	DiD	Triple Diff.
	(1)	(2)	(3)	(4)
$\mathbb{1}_{\{Copper\}} \times \mathbb{1}_{\{i \in DFA\}} \times \mathbb{1}_{\{t \geq 2010\}}$	-0.0225	-0.0388		
	(0.0245)	(0.0583)		
$\mathbb{1}_{\{Cobalt\}} \times \mathbb{1}_{\{i \in DFA\}} \times \mathbb{1}_{\{t \geq 2010\}}$			-0.0442	-0.0281
			(0.0266)	(0.0484)
Observations	1,057	22,996	1,057	22,996
R-squared	0.165	0.519	0.166	0.519
Product FE	Yes		Yes	
Time FE	Yes		Yes	
Product x Time FE		Yes		Yes
Coutry x Time FE		Yes		Yes
Coutry x Product FE		Yes		Yes

Note: Bootstraped standard errors clustered at the product level.

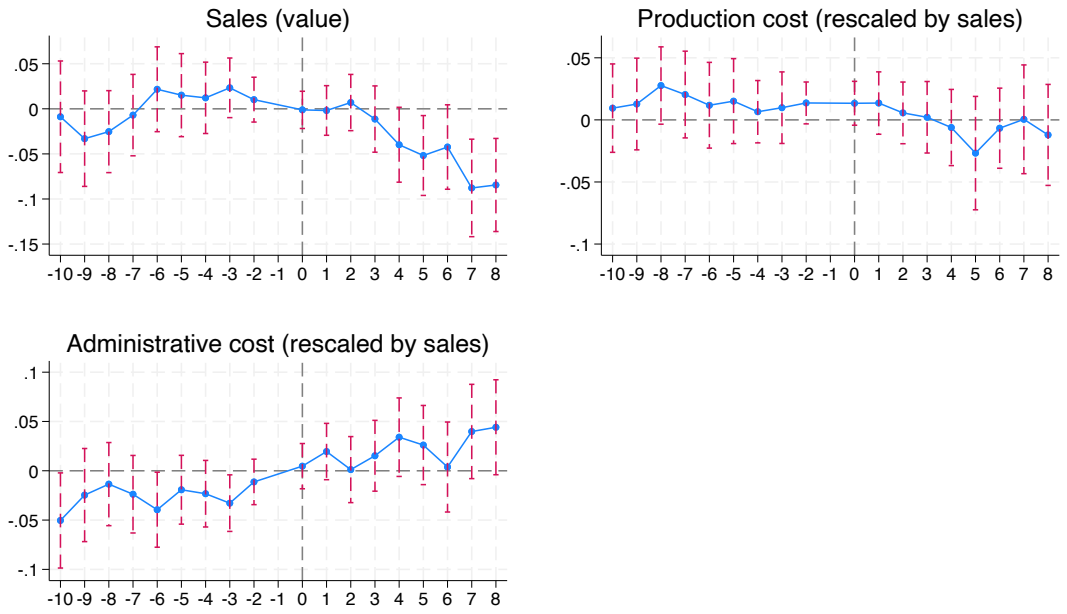
E.3 US firms

Table E4 – Differences-in-differences: filing firms

Dep. Variable (in log)	Sales (value)	Prod. cost (value)	Admin. cost (value)	Sales (value)	Prod. cost (value)	Admin. cost (value)
	(1)	(2)	(3)	(4)	(5)	(6)
$Regulated_i$	-0.031**	-0.015	0.021			
$\times \mathbb{1}_{\{t \geq July2010\}}$	(0.014)	(0.009)	(0.013)			
× No CMR				-0.047**	-0.005	0.005
				(0.020)	(0.012)	(0.021)
× CMR				-0.026*	-0.018*	0.029**
				(0.015)	(0.010)	(0.014)
Assets (log)	0.308***	0.046***	0.163***	0.308***	0.046***	0.163***
	(0.015)	(0.008)	(0.010)	(0.015)	(0.008)	(0.010)
Employees (log)	0.573***	0.081***	0.246***	0.573***	0.081***	0.246***
	(0.018)	(0.011)	(0.014)	(0.018)	(0.011)	(0.014)
Sales (log)		0.885***	0.350***		0.885***	0.350***
		(0.012)	(0.012)		(0.012)	(0.012)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	57,743	57,743	57,743	57,743	57,743	57,743
R-squared	0.983	0.991	0.985	0.983	0.991	0.985
Number of firms	4182	4182	4182	4182	4182	4182

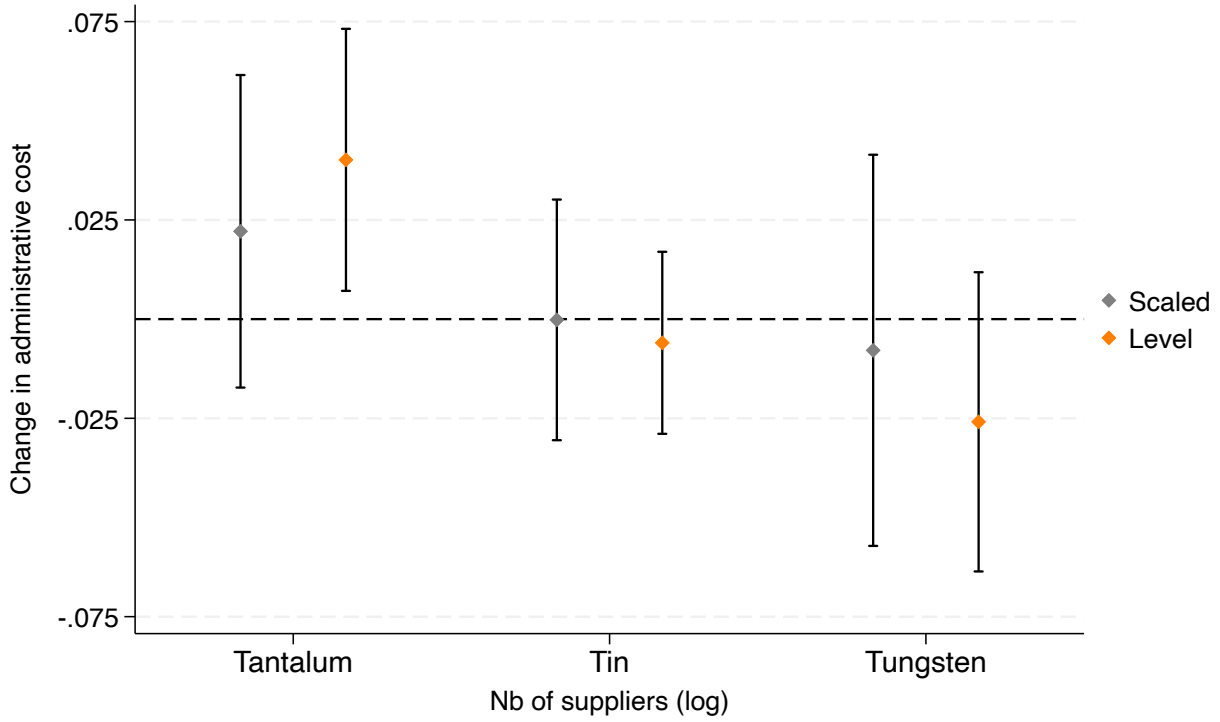
Note: Sample: Firms with at least 5 observations over the sample (2000-2018). Standard errors clustered at the firm level. OLS estimator. CMR stands for a firm filing a Conflict Mineral Report because the firm suspects some 3T could come from DRC(+9). SIC-2 digit sectors.

Figure E2 – Treated firms - event study



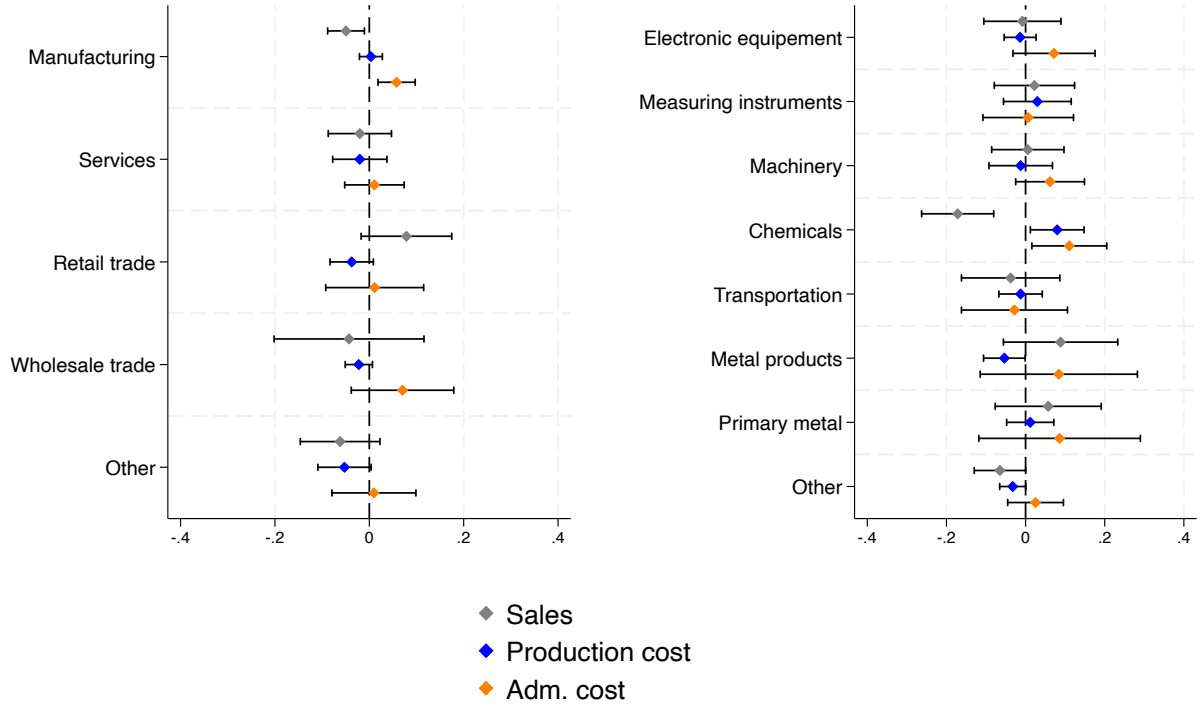
Note: Sample: Firms with at least 5 observations over the sample (2000-2018). Standard errors clustered at the firm level. OLS estimator. 95% confidence intervals.

Figure E3 – Treated firms - Supplier's metal heterogeneity



Note: Sample: Firms with at least 5 observations over the sample (2000-2018). Standard errors clustered at the firm level. OLS estimator. Administrative and production costs trimmed at 1%. 95% confidence intervals. Grey: outcome if log of administrative cost scaled by total sales. Orange: outcome is log of total administrative cost.

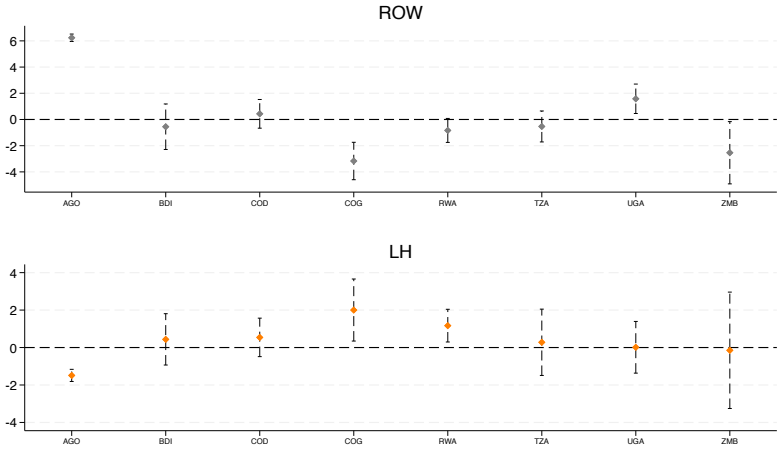
Figure E4 – Treated firms - Sector heterogeneity



Note: Sample: Firms with at least 5 observations over the sample (2000-2018). Standard errors clustered at the firm level. OLS estimator. Administrative and production costs trimmed at 1%. 95% confidence intervals.

E.4 Gravity

Figure E5 – Export change - Origin heterogeneity



Note: Note: 95% confidence intervals displayed. Coefficients are estimated on the interaction term between $\mathbb{1}_{\{j \neq DFA\}}$ an indicator for partner countries, $\mathbb{1}_{\{p=3T\}}$ an indicator for affected product, $\mathbb{1}_{\{t \geq 2010\}}$ an indicator for post Dodd-Frank Ac t years, and $\mathbb{1}_{\{i \in DFA\}}$ an indicator for each origin targeted country, for ROW and LH premium.

Table E5 – Legal haven heterogeneity

Dep. variable	Bilateral trade flow				
	(1)	(2)	(3)	(4)	(5)
LH Definition	$LH_{j,top25\%}$	LH_{NoTHA}	LH_{SSA}	LH_{Metal}	$LH_{CHE,LUX,MYS}$
DRC+9 to ROW$_{3T,t\geq 2010}$	-1.451***	-1.484***	-0.871	-1.443***	-1.547***
	(0.501)	(0.514)	(0.553)	(0.501)	(0.489)
$\times LH_j$	0.970**	1.816***	-0.257	0.957*	2.428***
	(0.492)	(0.428)	(2.103)	(0.493)	(0.451)
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}} \times LH_j$	-0.377**	-0.357**	-0.816	-0.371**	-0.330*
	(0.150)	(0.166)	(0.838)	(0.152)	(0.200)
Bewteen DRC+9 countries$_{3T,t\geq 2010}$	-2.524***	-2.454***	-2.447***	-2.679***	-2.681***
	(0.721)	(0.714)	(0.717)	(0.717)	(0.708)
RTA	0.126**	0.127**	0.129**	0.126**	0.129**
	(0.0581)	(0.0581)	(0.0580)	(0.0581)	(0.0580)
Observations	842,131	842,131	842,131	842,131	842,131
Pseudo R^2	0.967	0.967	0.967	0.967	0.967
Origin x Time FE	Yes	Yes	Yes	Yes	Yes
Destination x Time FE	Yes	Yes	Yes	Yes	Yes
Product x Time FE	Yes	Yes	Yes	Yes	Yes
Dyad x Product FE	Yes	Yes	Yes	Yes	Yes
Border x Product x Time FE	Yes	Yes	Yes	Yes	Yes

Table E6 – Interaction robustness

Dep. variable	Bilateral trade flow				
	(1)	(2)	(3)	(4)	(5)
DRC+9 to ROW$_{3T,t\geq 2010}$	-1.451***	-0.887	-1.450***	-0.791	-1.296***
	(0.501)	(0.553)	(0.495)	(0.526)	(0.482)
$\times LH_{j,top25\%}$	0.970**		0.969*		0.874*
	(0.492)		(0.523)		(0.505)
$\times TH_j$		0.503	0.0210		
		(0.579)	(0.563)		
$\times$ Control of Corruption				0.233	0.160
				(0.215)	(0.223)
Bewteen DRC+9 countries$_{3T,t\geq 2010}$	-2.524***	-2.419***	-2.517***	-2.209***	-2.288***
	(0.721)	(0.718)	(0.721)	(0.719)	(0.730)
RTA	0.126**	0.127**	0.126**	0.130**	0.127**
	(0.0581)	(0.0581)	(0.0581)	(0.0580)	(0.0581)
			Levels		
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}} \times LH_{j,top25\%}$	-0.377**		-0.386**		-0.412***
	(0.150)		(0.156)		(0.142)
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}} \times TH_j$		-0.282	0.0151		
		(0.180)	(0.205)		
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}} \times$ CC				0.131**	0.149***
				(0.0524)	(0.0540)
Observations	839,322	839,322	839,322	839,322	839,322
Pseudo R^2	0.967	0.967	0.967	0.967	0.967
Origin x Time FE	Yes	Yes	Yes	Yes	Yes
Destination x Time FE	Yes	Yes	Yes	Yes	Yes
Product x Time FE	Yes	Yes	Yes	Yes	Yes
Dyad x Product FE	Yes	Yes	Yes	Yes	Yes
Border x Product x Time FE	Yes	Yes	Yes	Yes	Yes

Table E7 – Legal haven definition robustness

Dep. variable	Bilateral trade flow				
	(1)	(2)	(3)	(4)	(5)
LH Definition	$LH_{top25\%}$	$LH_{top30\%}$	$LH_{top35\%}$	LH_{2000}	LH_{PCA}
DRC+9 to ROW$_{3T,t\geq2010}$	-1.451***	-1.418***	-1.420***	-1.451***	-1.452***
	(0.501)	(0.502)	(0.502)	(0.501)	(0.501)
$\times LH_j$	0.970**	0.879*	0.881*	0.970**	0.973**
	(0.492)	(0.484)	(0.484)	(0.492)	(0.492)
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq2010\}} \times LH_j$	-0.377**	-0.272**	-0.274**	-0.377**	-0.380**
	(0.150)	(0.123)	(0.121)	(0.150)	(0.149)
Bewteen DRC+9 countries$_{3T,t\geq2010}$	-2.524***	-2.530***	-2.531***	-2.524***	-2.524***
	(0.721)	(0.717)	(0.717)	(0.721)	(0.721)
RTA	0.126**	0.127**	0.127**	0.126**	0.125**
	(0.0581)	(0.0581)	(0.0581)	(0.0581)	(0.0582)
Observations	842,131	842,131	842,131	842,131	842,131
Pseudo R^2	0.967	0.967	0.967	0.967	0.967
Origin x Time FE	Yes	Yes	Yes	Yes	Yes
Destination x Time FE	Yes	Yes	Yes	Yes	Yes
Product x Time FE	Yes	Yes	Yes	Yes	Yes
Dyad x Product FE	Yes	Yes	Yes	Yes	Yes
Border x Product x Time FE	Yes	Yes	Yes	Yes	Yes

Table E8 – Clusters

Dep. variable	Bilateral trade flow: X_{ijpt}		
	(1)	(2)	(3)
Cluster	(i,j,p)	(i,j)	(i,p)
DRC+9 to ROW$_{3T,t\geq2010}$	-1.451***	-1.451***	-1.451**
	(0.501)	(0.487)	(0.615)
$\times LH_j$	0.970**	0.970*	0.970**
	(0.492)	(0.578)	(0.427)
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq2010\}} \times LH_j$	-0.377**	-0.377***	-0.377***
	(0.150)	(0.143)	(0.135)
Bewteen DRC+9 countries$_{3T,t\geq2010}$	-2.524***	-2.524***	-2.524***
	(0.721)	(0.760)	(0.628)
RTA	0.126**	0.126**	0.126*
	(0.0581)	(0.0514)	(0.0691)
Observations	842,131	842,131	842,131
Pseudo R^2	0.967	0.967	0.967
Origin x Time FE	Yes	Yes	Yes
Destination x Time FE	Yes	Yes	Yes
Product x Time FE	Yes	Yes	Yes
Dyad x Product FE	Yes	Yes	Yes
Border x Product x Time FE	Yes	Yes	Yes

Table E9 – Trade barriers robustness

Dep. variable	Bilateral trade flow: X_{ijpt}			
	(1)	(2)	(3)	(4)
Trade barrier def.	Tariffs	AVEs	Tariffs	AVEs
DRC+9 to ROW$_{3T,t\geq 2010}$	-2.095***	-2.102***	-1.452***	-1.454***
	(0.634)	(0.635)	(0.502)	(0.502)
$\times LH_j$	1.135**	1.144**	0.970**	0.972**
	(0.497)	(0.497)	(0.492)	(0.492)
$\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}} \times LH_j$	-0.332**	-0.330**	-0.377**	-0.375**
	(0.158)	(0.158)	(0.150)	(0.150)
Bewteen DRC+9 countries$_{3T,t\geq 2010}$	-2.583***	-2.590***	-2.509***	-2.500***
	(0.981)	(0.975)	(0.723)	(0.719)
RTA	0.159***	0.156***	0.125**	0.123**
	(0.0569)	(0.0567)	(0.0574)	(0.0574)
Trade barrier$_{ijpt}$	-0.995	-1.719	-0.347	-0.958
	(2.397)	(2.052)	(1.952)	(1.721)
Observations	715,791	715,791	842,131	842,131
Pseudo R^2	0.969	0.969	0.967	0.967
Origin x Time FE	Yes	Yes	Yes	Yes
Destination x Time FE	Yes	Yes	Yes	Yes
Product x Time FE	Yes	Yes	Yes	Yes
Dyad x Product FE	Yes	Yes	Yes	Yes
Border x Product x Time FE	Yes	Yes	Yes	Yes

Note: Columns (3) and (4): trade barriers are set to zero if missing.

Table E10 – Gravity: timeline

Dep. variable	Bilateral trade flow: X_{ijpt}	
	(1)	(2)
DRC+9 to ROW$_{3T,t\geq 2010}$	-1.451***	
	(0.501)	
× Signature		-1.316**
		(0.574)
× Implementation		-1.444**
		(0.579)
× Full application		-1.697***
		(0.595)
$\times LH_{j,top25\%}$	0.970**	
	(0.492)	
× Signature		0.550
		(0.610)
× Implementation		0.778
		(0.569)
× Full application		1.616***
		(0.545)
Observations	842,131	842,131
Pseudo R^2	0.967	0.967
Origin x Time FE	Yes	Yes
Destination x Time FE	Yes	Yes
Product x Time FE	Yes	Yes
Dyad x Products FE	Yes	Yes
Border x Product x Time FE	Yes	Yes
Controls	Yes	Yes

Note: Control variables correspond to specification in column (4) of Table 6. It includes RTA, Non-producers, $T_{I,external}$, $T_{I,internal}$ and $\mathbb{1}_{\{p=3T\}} \times \mathbb{1}_{\{t\geq 2010\}} \times LH_{j,top25\%}$ (interacted with law timing in column (2)).

F Counterfactual analysis

This Section studies the general equilibrium effects in the 3T sector, using Yotov et al. (2017) methodology. Based on the demand-side driven gravity model of Anderson and Van Wincoop (2003). The following system describes the economy:

$$
\begin{aligned}
X_{ij} &= \frac{Y_i E_j}{Y}\Big(\frac{t_{ij}}{\Pi_i P_j}\Big)^{1-\sigma} \\
\Pi_i^{1-\sigma} &= \sum_j \Big(\frac{t_{ij}}{P_j}\Big)^{1-\sigma}\frac{E_j}{Y} \\
P_j^{1-\sigma} &= \sum_i \Big(\frac{t_{ij}}{\Pi_i}\Big)^{1-\sigma}\frac{Y_i}{Y} \\
p_i &= \Big(\frac{Y_i}{Y}\Big)^{\frac{1}{1-\sigma}}\frac{1}{\alpha_i \Pi_i} \\
E_i &= \phi_i Y_i = \phi_i p_i Q_i
\end{aligned}
\tag{16}
$$

Counterfactual scenarii and decomposition of GE effects

Realized Dodd-Frank Act compared to no Dodd-Frank Act

Diversion effects: holding output and expenditures constant Direct effects of the Dodd-Frank are captured by the effect of the induced change in trade costs $t_{i\in DFA, j\notin DFA, LH}$ on associated trade flows. However, a change in trade cost $t_{i,j}$ will also cause a change in inward multilateral resistance $\Pi_i^{1-\sigma}$ and outward multilateral resistance $P_j^{1-\sigma}$ by construction. In this case, an increase in $t_{i\in DFA, j\notin DFA, LH}$ will translate into a decrease in $\Pi_{DFA}^{1-\sigma}$ and $P_{NDFA,NLH}^{1-\sigma}$.

These changes in structural terms represent trade diversion effects arising from a trade policy: facing increased trade costs with some trade partners, an adjustment mechanism for countries is the reallocation of imports and exports to non-affected trade partners. One can conceptualize a hypothetical situation in which expenditures and output stay constant, to assess these diversion effects. Importers not endowed with an opacity technology face supplementary trade costs from covered countries and reallocate part of their expenditures to other exporters. covered countries exporters reallocate part of their exports to destination not affected by the change in bilateral trade cost, which becomes relatively less remote. These effects can be observed in the structural terms changes:

- An increase in $t_{i\in DFA, j\notin DFA, LH}$ will cause a decrease in $P_{NDFA,NLH}^{1-\sigma}$ and an increase in $X_{i,j\notin DFA,LH}$ for all i. Directly affected destinations redirect their expenditures. If $P_{NDFA,NLH}^{1-\sigma}$ decreases ($P_{NDFA,NLH}$ increases), their market becomes less competitive.
- An increase in $t_{i\in DFA, j\notin DFA, LH}$ will cause a decrease in $\Pi_{DFA}^{1-\sigma}$ and an increase in $X_{DFA,j}$

for all j. Directly affected origins redirect their production.

- These effects are dominated by direct partial equilibrium effects.

These changes in OMR and IMR caused by changes in trade costs will then translate into changes in other countries' multilateral resistance terms. These effects are second-order effects and will be of a smaller magnitude than first-order effects described previously.

- An decrease in $P_{NDFA,NLH}^{1-\sigma}$ will cause an increase in $\Pi_i^{1-\sigma}$ for all i and a decrease in $X_{i,j}$ to all j. As non-affected new source countries become more integrated with directly affected destinations, this crowds out exports to other destinations.

- An decrease in $\Pi_{DFA}^{1-\sigma}$ will cause an increase in $P_j^{1-\sigma}$ for all j and a decrease in $X_{i,j}$ from all i. As non-affected new destinations become more integrated with directly affected origin countries, this crowds out expenditures on all other source countries.

Adjustment of prices, output and expenditures Changes in OMR will trigger changes in factory-gate prices and output:

- In covered countries, an increase in Π_{DFA} will cause a decrease in factory-gate prices p_{DFA} as displayed by equation (4). Producers experience higher outward multilateral resistances and are forced to decrease their factory-gate prices. In turn, Y_{DFA} increases.

- For other non targeted importers, an decrease in Π_i will cause an increase in factory-gate prices p_i. Outward multilateral resistance decreases due to an increase in $P_{NDFA,NLH}$, and producers are able to increase their prices. In turn, Y_i increases.

These effects will translate into changes in expenditures.

Effects on trade:

- A decrease in output and expenditures in covered countries will lower their imports and exports with the rest of the world. As they become poorer, their exchanges with the rest of the world decrease.

- An increase in output and expenditures in other countries will increase their imports and exports with the rest of the world.

Realized Dodd-Frank Act compared to full Dodd-Frank Act (no legal havens)

Diversion effects: holding output and expenditures constant Conceptualizing a situation where the cost induced by the Dodd-Frank Act holds for all destinations, comparing these two situations induces a trade cost change only from covered countries to legal havens. The realized Dodd-Frank Act induces a decrease in $t_{i\in DFA,j\in LH}$ compared to the counterfactual situation.

- An decrease in $t_{i\in DFA,j\in LH}$ will cause an increase in $P_{LH}^{1-\sigma}$ and a decrease in $X_{i,j\in DFA,LH}$ for all i. Legal havens import less from all other origins. If $P_{LH}^{1-\sigma}$ increases (P_{LH} decreases), their market becomes more competitive.

- An decrease in $t_{i\in DFA,j\in LH}$ will cause an increase in $\Pi_{DFA}^{1-\sigma}$ and an decrease in $X_{DFA,j}$ for all j. As legal havens and covered countries are relatively more integrated than in the counterfactual situation, covered countries export less to all other destinations.

- These effects are dominated by direct partial equilibrium effects.

These changes in OMR and IMR caused by changes in trade costs will then translate into changes in other countries' multilateral resistance terms. These effects are second-order effects and will be of a smaller magnitude than first-order effects described previously.

- An increase in $P_{LH}^{1-\sigma}$ will cause an decrease in $\Pi_{i}^{1-\sigma}$ for all i and a increase in $X_{i,j}$ to all j. Legal havens are relatively less integrated with all other source countries which re-direct their exports.

- An increase in $\Pi_{DFA}^{1-\sigma}$ will cause an decrease in $P_{j}^{1-\sigma}$ for all j and a increase in $X_{i,j}$ from all i. covered countries are relatively less integrated with destinations affected by the Dodd-Frank Act in both situations, countries which re-direct their imports.

Adjustment of prices, output and expenditures Changes in OMR will trigger changes in factory-gate prices and output:

- In covered countries, an decrease in Π_{DFA} will cause an increase in factory-gate prices p_{DFA} as displayed by equation (4). Producers experience lower outward multilateral resistances and can increase their factory-gate prices. In turn, Y_{DFA} increases.

- For other non targeted importers, an increase in Π_i will cause a decrease in factory-gate prices p_i. Outward multilateral resistance increases due to an increase in P_{LH}, and producers have to slightly decrease their prices. In turn, Y_i decreases.

These effects will translate into changes in expenditures.

Effects on trade:

- A decrease in output and expenditures in always affected countries will lower their imports and exports with the rest of the world. As they become poorer, their exchanges with the rest of the world decrease.
- An increase in output and expenditures in covered countries will increase their imports and exports with the rest of the world.

Computational methodology

Conditional General Equilibrium Correspond to effect driven through OMR and IMR while holding total output and expenditures constants.

The conditional counterfactual exercise consists of three steps:

1. I first compute baseline MRT: inward and outward resistance under the Dodd-Frank Act, accounting for changes in trade costs caused by this policy. I recover estimates of IMR and OMR using the fact that there is an exact correspondence between fixed effects and MRTs in the Poisson model (**?**):

$$[\widehat{\Pi}_{it}^{1-\sigma}]^{BLN} = \frac{Y_{it}}{exp(\widehat{\pi_{it}})} \times E_{Rt} \tag{17}$$

$$[\widehat{P}_{jt}^{1-\sigma}]^{BLN} = \frac{E_{jt}}{exp(\widehat{\chi_{jt}})} \times \frac{1}{E_{Rt}} \tag{18}$$

   With $\widehat{\pi_{it}}$ and $\widehat{\chi_{jt}}$ the estimated fixed effect. As the system of OMR and IMR can be solved up to a scalar, it requires a normalization. Here, it is normalized relative to a reference country's total expenditures.
2. I define the counterfactual scenario as no signature and implementation of the Dodd-Frank Act in the post-2010 period. Direct trade cost changes induced by the policy between covered countries and non-legal haven destinations are set to zero.
3. I compute counterfactual Multilateral Resistance Terms under this counterfactual trade costs vector, using PPML and estimated fixed effects:

$$[\widehat{\Pi}_{it}^{1-\sigma}]_{CDL}^{CFL} = \frac{Y_{it}}{exp(\widehat{\pi_{it}}^{CFL})} \times E_{Rt} \tag{19}$$

$$[\widehat{P}_{jt}^{1-\sigma}]_{CDL}^{CFL} = \frac{E_{jt}}{exp(\widehat{\chi_{jt}}^{CFL})} \times \frac{1}{E_{Rt}} \tag{20}$$

4. I compute the baseline and counterfactual trade matrix, predicted by the structural gravity model.

This part of the counterfactual exercises recovers the following outcome indexes, under no change in output and expenditures: changes in exports, imports, IMR and OMR.

Full Endowment General Equilibrium In this part of the analysis I allow for endogeneous adjustments of prices, output and expenditures, under fixed endowment Q_i. The full system is non-linear and therefore solved by an iterative procedure.

1. Allow for first-order adjustment of prices (through adjustment of OMR, assuming no change in output).
$$\Delta p_{it}^{CFL} = \frac{p_{it}^{CFL}}{p_{it}} = \Big(\frac{\widehat{\pi_{it}}^{CFL}/E_{Rt}^{CFL}}{\widehat{\pi_{it}}/E_{Rt}}\Big)^{\frac{1}{1-\sigma}} \tag{21}$$

2. Change in output and expenditures:
$$Y_{it}^{CFL} = (p_{it}^{CFL}/p_{it})Y_{it} \tag{22}$$
$$E_{jt}^{CFL} = (p_{jt}^{CFL}/p_{jt})E_{jt} = (p_{jt}^{CFL}/p_{jt})\phi_j Y_{jt} \tag{23}$$

3. Update trade value:
$$X_{ijt}^{CFL} = \frac{[\widehat{t}_{ijt}^{1-\sigma}]^{CFL}}{[\widehat{t}_{ijt}^{1-\sigma}]} \times \frac{Y_{it}^{CFL}E_{jt}^{CFL}}{Y_{it}E_{jt}} \times \frac{[\widehat{\Pi}_{it}^{1-\sigma}]}{[\widehat{\Pi}_{it}^{1-\sigma}]^{CFL}} \times \frac{[\widehat{P}_{jt}^{1-\sigma}]}{[\widehat{P}_{jt}^{1-\sigma}]^{CFL}} \times X_{ijt} \tag{24}$$

4. Re-estimate the fixed effect from this new value of trade, and steps 1 to 3 until the change in prices is close to zero.