Did U.S. tariffs on Chinese EV battery components redirect U.S. investments in major cobalt-producing countries ? The case of the Democratic Republic of the Congo

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Abstract

Did U.S. tariffs on Chinese EV battery components redirect U.S. investments in major cobalt-producing countries ? The case of the Democratic Republic of the Congo

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The purpose of this thesis is to examine whether US tariffs on Chinese electric vehicle (EV) battery components redirected US foreign direct investment (FDI) toward major cobalt-producing countries, in particular the Democratic Republic of the Congo's (DRC) mining sector. The analysis focuses on the escalation period between the United States and China in 2018, with the implementation of Section 301 tariffs.

Using a country-year panel from 2010 to 2022, the analysis implements a difference-in-differences (DID) methodology with fixed effects for both the country and year. The baseline specification results suggest a decrease in U.S. FDI flows in countries with high cobalt exposure after 2018. Nonetheless, after conducting an event study, the results reveal significant pre-treatment effects. The inclusion of country-specific linear trends reverses the effect to an increase, which indicates a positive but sensitive relationship.

The findings suggest that the estimated effects are not robust to other alternative specifications; therefore, the results should be interpreted with caution as they do not support strict causal inference. Overall, the findings are consistent with broader investment reallocation dynamics during increased trade tensions and strategic emphasis on critical minerals.

Contents

List of Tables

List of Figures

1 Introduction

The purpose of this thesis is to analyze whether US tariffs on Chinese electric vehicle (EV) battery components redirected US foreign direct investment (FDI) towards major cobalt-producing countries, and mainly towards the Democratic Republic of the Congo's (DRC) mining sector. The results show that U.S. FDI in countries with high cobalt exposure experienced a relative increase compared to that in countries with lower exposure after 2018. We will see, and discuss, that the direction of the trajectory is sensitive to specification. Nonetheless, the results align with broader reallocation trends during a period of heightened trade tensions and a focus on strategic mineral policy. A lot of the early research on the trade war looked at how it affected trade flows, prices, and the well-being of consumers.

However, the larger effects on the global production network, capital allocation, the economic and geopolitical policy dynamics, especially for low to medium income economies, have yet to be studied. The trade war happened in a period of greater emphasis on the strategic importance of the critical minerals used in electric vehicle (EV) batteries and energy storage technologies. Cobalt has been a big part of talks about how to make the supply chain more resilient. The Democratic Republic of Congo is a major player and the main supplier in the EV value chain, because the country produces more than 70 percent of the world's total cobalt. The United States industrial policy adjustments such as the Inflation Reduction Act, which classifies certain minerals as vital for the country's strategic positioning in the trade-war competition, increased the necessity for diversification.

This type of reallocation is not only for cobalt. Let's look at the case of Indonesia's nickel industry for example. Nickel is another vital critical mineral for the production of lithium-ion batteries. Just as cobalt, nickel is important for electric vehicle cathodes. Wijaya and Jones (2025) show that, due to trade and economic policy shocks, Indonesia saw an increase in FDI and in its nickel processing capacity. The analysis shows that during periods of trade policy changes and geopolitical tensions, many corporations in the industry dealt increasingly with Indonesia rather than China. This allowed the country to move from simply exporting raw minerals to becoming a more significant player in the EV battery supply chain. Indonesia expanded its battery production networks, increased its refining capacity, and strengthened its international role in the sector's supply chain.

All this raises a question worth studying : Did U.S. tariffs on Chinese EV battery components in 2018 translate to a redirection of U.S. investments towards countries with a high exposure to cobalt such as the DRC ? This thesis investigates that question using a country-year panel from 2010 to 2022. The empirical methodology uses a difference-in-differences (DID) framework to analyze countries with high and medium cobalt exposure before and after 2018. The dependent variable is the stock of U.S. inward FDI, which is measured in logarithmic form. The primary explanatory variable integrates country-specific cobalt exposure with a post-2018 indicator.

The baseline fixed effects model indicates that the volume of the U.S. FDI stock in highly exposed countries will decline post-2018. On the other hand, the event-study analysis reveals a statistically significant pre-treatment discrepancy between the DRC and the comparison countries. This indicates that the assumption of parallel trends to imply a causal interpretation is challenged. Adding linear temporal trends for each country makes the predicted treatment effect positive and strong enough to be significant. This means that countries with high exposure experienced more investment flows than they would have expected based on their past performance.

Although the findings are not conclusive causal evidence that tariffs drove investment reallocation, they do indicate that U.S. FDI trends in highly cobalt-exposed countries differed during the tariff period from those in lower-exposure countries. As a result, this thesis uses an empirical interpretation that is consistent with a policy-driven mechanism, in which tariffs affecting downstream EV and battery production contributed to a reorganization of global supply chains. It examines whether changes in investment during the tariff period align with broader shifts in mining policy and the supply chain. The relevance of this study is motivated by recent policy shifts. In 2025, the Democratic Republic of Congo and the United States signed a Strategic Partnership Agreement that formally recognized the DRC as a U.S. strategic partner, where both countries decided to cooperate on critical minerals such as cobalt, security, the development of infrastructure, and the strengthening of governance. This agreement is designed to facilitate greater investment by U.S. companies, diversify the DRC's mining sector, and ensure reliable flows of cobalt, copper, and other battery metals to U.S. manufacturers while improving labour standards and reducing illicit trade. The U.S. creation of a Strategic Asset Reserve identifies important minerals for joint oversight, emphasizes Washington's will to secure supply chains at the source instead of depending on Chinese processing. This evolving geopolitical context strengthens the motivation for examining how U.S. trade measures, such as Section 301 tariffs on Chinese battery inputs, may interact with new strategic alliances to redirect investment flows toward mineral-rich countries like the DRC.

2 Literature Review

2.1 Trade Policy Shocks and Global Reallocation

In 2018, protectionism resurged in the global trade environment with the United States tariff imposition on Chinese imports under Section 301 Trade Act. In reciprocity, China responded with retaliatory tariffs creating a trade war that marked a significant shift in global trade and a reversal of long-term standing efforts towards the liberalization of trade (Fajgelbaum et al. 2020). Empirical research shows us that there are well-documented substantial effects of these tariffs on trade flows, prices, and firm behavior. Fajgelbaum et al. (2020) demonstrate that these U.S. tariffs were predominantly transmitted to domestic import prices. This resulted in an important decrease of trade volumes within the sectors impacted. Amiti, Redding, and Weinstein (2019) also show that U.S. firms and consumers were those who mainly carried the burden of these tariffs instead of foreign exporters. These studies mainly focus on the trade of goods, but they also establish the broader economic impact of the tariff shock.

Apart from the immediate effects of these tariffs, many researchers continue to study and analyze the supply chain reorganization in response to this matter. This provides a growing literature in supply chain dynamics. Freund et al. (2023) demonstrate well-documented evidence of trade diversion where we see production shifts from China to alternative suppliers such as Southeast Asia and Mexico. A concept called "friend-shoring" emerged. This is essentially a strategy that countries use to redesign or adapt supply chains in order to rely on political and economic ally countries, with the goal of reducing their dependence on geopolitical competitors. The emphasis on resilience and strategic diversification was at the heart of policymakers' discussions.

That being said, a big part of the literature remains more focused, or rather is more developed, for trade flows than that for capital flows. Investment decisions involve greater adjustment costs and require longer time frames, especially for extractive industries. It is still unclear, or rather still an open empirical question, whether trade disruptions due tariffs induction trade translate into measurable foreign direct investment (FDI) reallocations, specifically in low to upper-middle economies.

This thesis addresses that gap by analyzing whether such a major trade policy shock corresponded to differential investment dynamics in strategically vital mineral-producing countries.

2.2 Foreign Direct Investment and Policy Uncertainty

FDI theory insists on the role of market access, cost structures, institutional quality, and political stability in order to better determine multinational investment decisions (Markusen 2002). Trade policy changes can influence the overall attractiveness of host countries by changing production costs and the accessibility of markets. Handley and Limão (2017) show that decreases in trade policy uncertainty can encourage firm entry and growth in exports. On the contrary, increases in uncertainty may delay or redirect investment. The U.S.-China trade war created uncertainty not only about tariffs but also in the long-term configuration of the supply chain.

Recent empirical work suggests that geopolitical tensions influence investment patterns. Alfaro and Chen (2018) argue that multinational firms reallocate production networks in response to policy risk and trade frictions. However, such reallocations are not immediate and do depend on the specific characteristics of each sector. With regards to critical minerals sectors, investment decisions are mainly shaped by strategically taking long-term effects in consideration. Mining projects require a great amount of fixed capital, government regulation, and infrastructure development. That being said, shifts in FDI patterns reflect expectations about future demand and policy regimes, whereas short-run responses to tariffs are more directly captured by changes in investment flows. This implies that while FDI stocks capture long-term structural positioning, annual FDI flows are more appropriate for identifying short-run adjustments to trade policy shocks.

2.3 Strategic Minerals, Energy Transition, and Geopolitics

Cobalt plays a major role in the lithium-ion technology that is used in the production of electric vehicles (EVs) and for other energy storage systems (U.S. Geological Survey, 2023). Over the past decade, the global demand for EV batteries has exponentially increased as the International Energy Agency (IEA) reports its sales increase from about 17,000 units in 2010 to more than 10 million in 2022. This is mainly due to climate change policy commitments and advocacies for energy transition technologies.

At the same time, critical minerals were increasingly presented as matters of national security by many policymakers around the world, and as a result, intensified the already-rapid race to critical mineral acquisition. The U.S. Department of the Interior designated cobalt as a critical mineral in 2018. This resulted in various policy initiatives, which includes the Inflation Reduction Act of 2022. This is a broad legislative package that covers climate, energy, and industrial policy, as well as additional incentives to strengthen domestic supply chains for critical minerals and related technologies. The IRA also includes restrictions that limit eligibility for EV tax credits if battery components are sourced from "foreign entities of concern" which is a clear target at the domination of China in the manufacturing of batteries. These policies show an increased strategic framework in order to secure critical minerals.

However, the geography of cobalt production complicates this strategy. The Democratic Republic of Congo accounts for approximately 70 percent of global cobalt output (U.S. Geological Survey 2023). At the same time, Chinese firms have acquired significant ownership stakes in DRC mining operations over the past decades (Financial Times). Therefore, although U.S. policymakers do emphasize diversification to reduce dependency on China, the upstream mineral supply remains significantly concentrated in the Democratic Republic of Congo, subject to political, economic and institutional instability, with a major Chinese investment and ownership presence.

This conflicting duality of understanding the strategic importance of critical minerals, combined with Chinese ownership concentration in the world's principal cobalt producer, creates ambiguity regarding how U.S. capital might respond to tariff escalation in this matter.

2.4 The Democratic Republic of the Congo: Institutional and Policy Context

The DRC's mining sector has experienced significant policy changes from 2010 to 2022. In 2018 with the 2018 DRC Mining code, a revised version of its 2002 code, the country revised its mining code by increasing royalties, stricter compliance standards and introducing a "strategic mineral" designation that allowed for higher taxation rates (Mbazi Beda, Mbasoni, and Iragi Ntwali 2025). The reform was controversial and raised a lot of opposition by several multinational mining firms.

This mining code revision coincided with the U.S.–China tariff escalation. In this context, although domestic regulatory changes may affect investment outcomes in specific countries such as the DRC, the empirical strategy relies on cross-country variation in cobalt exposure to identify differential FDI responses after 2018 associated with international trade dynamics.

Also, the DRC faces structural challenges in governance, inadequate infrastructure, and is usually subject to political and institutional unstability. As mentioned briefly earlier, investment decisions in extractive sectors are sensitive and depend on long-term assurances. Empirical studies on developing economies rich in critical minerals emphasize that policy and institutional stability, as well as contract enforcement, significantly affect FDI inflows (Asiedu 2006).

That being said, we understand that the DRC presents a complex case in which global strategic demand for cobalt intersects with domestic institutional instability and uncertainty.

2.5 Social and Political Dimensions of Mineral Supply Chains

In addition to economic dynamics, the cobalt sector around the world has been shaped by social and geopolitical pressures that continually influence trends in the industry. Many reports on the conditions of labor, the practice of artisanal mining, ethical and environmental concerns, and geopolitical competition have continually drawn international attention to major players in the sector such as the DRC (U.S. Department of Labor, 2017 World Bank, 2019). Media investigations, civil society advocates, and many others have highlighted governance issues in cobalt supply chains.

These concerns do influence multinational firms' sourcing decisions and do have an impact on policy decisions. Companies who seek to comply with environmental, social, and governance (ESG) standards face important reputational considerations when they decide to invest in high-risk jurisdictions.

At the same time, the intensification of geopolitical competition between the United States and China continues to increase and does extend beyond tariffs. The strategic competition increasingly includes technology restrictions, control of exports, and industrial policy. Fajgelbaum et al. (2020) show how the trade war can therefore be understood as part of a broader reorientation of global economic relations. It is in this context that investment in critical minerals and engaging with their major producers may reflect important strategic positioning decisions rather than just market-driven cost considerations.

2.6 Contribution and Positioning of This Thesis

After analyzing the existing literature, we can observe three relevant findings. The 2018 tariff escalation is linked to changes in trade flows, as well as uncertainty in trade policy affects firm behavior and decisions taken at the supply chain level. Also, we see that the critical mineral sector has become increasingly central for countries' strategic positioning in industrial policy and geopolitical competition.

That being said, we observe a relatively limited empirical work that studies whether major trade shocks do actually translate into measurable reallocation of foreign direct investment toward upstream resource sectors, especially in low to middle income economies with high cobalt exposure. The purpose of this thesis is to address this gap by evaluating whether countries with high exposure to cobalt and other critical minerals used in EV battery production face important changes in U.S. FDI stock during the tariff period.

The empirical methodology used for this evaluation does acknowledge that the identification shows some limitations due to exposure concentration, pre-existing divergence, and policy changes in the DRC. Therefore, the contribution is not to claim strict and definitive causal effect, but rather to provide well-structured empirical evidence on how investment patterns do change during a period of such important trade conflict and the intensification of prioritizing strategic minerals among competitive actors.

That being said, the analysis contextualizes the empirical results within broader economic, political, and institutional trends by integrating international trade theory, literature on FDIs, and the geopolitical context of the period of study.

3 Data

3.1 Data Sources

This section presents the empirical specification and describes the variables that are used to estimate it. The dependent variable is the U.S. outward FDI stock that is expressed in current U.S. dollars. The main treatment variable is an interaction between cobalt exposure that does not change over time and the post-2018 indicator. In this panel setting, the year fixed effects actually absorb the common nominal shocks over time. The coefficient of interest is therefore identified from the differential movements across countries within a year.

For the empirical analysis, we use a country-year panel from 2010 to 2022. The Democratic Republic of the Congo (DRC), the world leader in cobalt production with 70 percent of global production, is one of the eight major cobalt-exposed countries in the sample Democratic Republic of Congo, Russia, Philippines, Madagascar, Morocco, Brazil, Zambia, and Indonesia. The countries used for the comparison are chosen based on their weight or importance in the global critical mineral market as well as the level of cobalt exposure that they are subject to.

The empirical analysis relies on a panel dataset that combines multiple sources.

- **U.S. FDI Stock**: Data on U.S. outward FDI stock by country is obtained from the U.S. Bureau of Economic Analysis (BEA).

  The variable is measured in current U.S. dollars (nominal terms). It is expressed in millions and is transformed using the natural logarithm. Since the regression includes the fixed year effect, identification is based on cross-country differences within each year. This cancels the influence of global inflation, as well as other time-specific shocks that are common to all countries.

- **Cobalt Exposure**: The exposure variable is constructed using country-level cobalt production data (2013–2017 average), based on U.S. Geological Survey (USGS) mineral statistics.

- **GDP Growth**: Annual GDP growth rates (in %) are sourced from the World Bank World Development Indicators (WDI). The indicator is NY.GDP.MKTP.KD.ZG. This variable is measured in real terms, as it captures GDP growth at constant prices.

- **Exchange Rate**: Official exchange rates (local currency units per USD) are obtained from the World Bank database.

  This is a nominal macroeconomic control included to account for cross-country differences in currency valuations and macroeconomic conditions overtime.

The final dataset covers 8 countries over the period 2010–2022, resulting in 104 country-year observations.

The dependent variable is the stock of U.S. foreign direct investment (FDI), which is quantified in current U.S. dollars and is presented in logarithmic form. The FDI stock shows how much U.S. investment has built up over time and not how much it flows in and out every year. This is an important distinction, because the structural capital reallocation, especially in response to trade policy shocks, can occur gradually instead of immediate changes in flow (Fajgelbaum et al. 2020).

The model also includes macroeconomic controls : yearly GDP growth and the nominal exchange rate. GDP growth accounts for the domestic economic performance and demand. While the changes in currency rates affect production costs and the distribution of wealth incentives. repatriation incentives. Having these variables does reduce the likelihood that the treatment effects we estimate reflects macroeconomic cycles instead of changes related to trade.

Exposure is time-invariant and it captures a country's structural importance in production of cobalt. In this fixed-effects framework, it is used only through its interaction with the post-2018 indicator.

The final dataset contains 104 observations (after we remove a few missing values) and covers 8 countries from 2010 to 2022. The data set is relatively small and this limitation is important for statistical inference and is addressed later through robustness checks and wild cluster bootstrap procedures.

3.2 Variables

The empirical specification is a difference-in-differences (DID) model with heterogeneous treatment3 intensity. While the post-2018 tariff is common to all countries, the treatment intensity changes according to each country's cobalt exposure. Since this exposure does not change overtime, it is absorbed by country fixed effects included independently. Therefore, identification is based on the interaction between cobalt exposure and the post-2018 indicator.

The regression uses the following variables:

- $\ln(FDI_{ct})$: Log of U.S. FDI stock (million USD) in country c at year t
- $Exposure_c$: Time-invariant measure of cobalt exposure (2013–2017 average)

  Since the the variable is time-invariant, it is not separately identified in a specification with country fixed effects. It's role is to define the intensity of the treatment through its interaction with the post-2018 indicator.

- $Post2018_t$: Dummy variable equal to 1 for years $t \geq 2018$

- $DID_{ct} = Exposure_c \times Post2018_t$: interaction term that captures heterogeneous post-2018 treatment intensity. This is the main explanatory variable of interest.

- $GDP\ growth_{ct}$: Annual GDP growth rate (%)

- $Exchange\ rate_{ct}$: Official exchange rate (LCU per USD)

The main explanatory variable has a difference-in-differences (DID) structure with heterogeneous treatment intensity. The post-2018 indicator is one that starts in 2018 ; which is the year that the United States increased tariffs on Chinese EV battery-related inputs with the imposition of Section 301 tariffs. Since all countries are exposed to the same global post-2018 period, the identification comes from the variations in cobalt exposure across countries. The coefficient $DID_{ct} = Exposure_c \times Post2018_t$ measures whether countries that have higher cobalt exposure experienced different changes in U.S. FDI stock after 2018 in comparison to those countries with less exposure.

3.3 Exposure

The distribution of the cobalt exposure is the main characteristic of this dataset. The DRC's exposure value is set to one to show the leading role it has in the world in terms of cobalt supply. The other countries have much less exposure estimates that go from 0.02 to 0.09.

Even though the exposure is constant, most of the changes are happening in the DRC. In other words, the identification mainly shows how the DRC is different from the other countries with much less exposure. Therefore, the empirical design reflects a scenario where there is one highly exposed country to cobalt and other comparative countries with intermediate exposure.

This highlights how the results are understood. The estimated treatment effects reflect the unique investment dynamics that are linked to extreme cobalt exposure, instead of a broader reallocation among the other similarly treated economies. That being said, the results must be a reflection of investment responses among strategically dominant mineral producers and not as universal effects across all cobalt-exporting countries.

3.4 Summary Statistics and Coorelation Matrix

Summary statistics are reported in Table 1.

The average log FDI stock is approximately 9.09, with substantial variation across countries. Exposure is highly skewed, with most countries exhibiting low exposure and the Democratic Republic of Congo reaching a value of 1.

3.5 Correlation Matrix

Table 2 reports pairwise correlations.

The correlations are generally low, suggesting limited multicollinearity concerns.

The descriptive statistics demonstrate important variations across countries and years. We see that the average log U.S. FDI stock is about 9.09, with variations that represent the economic size and sectoral composition. GDP growth has an average of about 3.6 percent across observations, and we can see the presence of volatility in each country. Looking at exchange rates, there are important fluctuations from one country to another. This shows that there are important currency differences and not just short-run fluctuations.

Also, it is important to note that exposure and FDI levels are not necessarily associated with each other in the raw data. High exposure does not always result in high FDI stock, but instead, it does appear that this association changes over time. We can mainly see this during and after the tariff period. This comforts the use of a time-interaction model rather than a static cross-sectional comparison.

About 38 percent of observations take place after 2018. This adds volatility after the treatment, but the small number of countries makes the statistics less reliable and makes them more sensitive to how they are set up. The overall evidence indicates that investment patterns are dynamic and are shaped by both structural and temporal factors. This demands us to adopt a formal difference-in-differences methodology.

In addition to FDI dynamics, macroeconomic conditions vary across countries and over time. GDP growth rates exhibit significant volatility, particularly during global shocks such as the 2020 pandemic. These fluctuations highlight the importance of controlling for macroeconomic conditions in the empirical analysis.

Overall, the descriptive evidence suggests that FDI patterns vary both across countries and over time, and that these variations are correlated with differences in cobalt exposure. The observed divergence in trends between exposure groups further motivates the use of a difference-in-differences framework to formally estimate the impact of the 2018 trade shock on U.S. FDI allocation.

4 Mehodology and Empirical Results

4.1 Baseline Difference-in-Differences Specification

In order to determine whether or not US tariffs on Chinese EV battery components resulted in changes in investment patterns toward cobalt-exposed countries, the empirical technique we use is difference-in-differences (DID) method.

The baseline specification is:

$$Y_{it} = \beta\,(Exposure_i \times Post2018_t) + \alpha_i + \delta_t + \varepsilon_{it} \qquad (1)$$

where:

- Y_{it} is the logarithm of U.S. FDI stock in country i at time t,
- $Exposure_i$ is a time-invariant measure of cobalt intensity,
- $Post2018_t$ equals one for years 2018 and after,
- α_i represents country fixed effects,
- δ_t represents year fixed effects,
- ε_{it} is the error term.

The coefficient β shows us whether countries with greater exposure to cobalt experience changes in U.S. FDI stock post-2018 compared to countries with less exposure. Adding country fixed effects gets rid of differences that do not change over time, such as the country's geography, the quality of institutions, or long-term mineral endowments. Year fixed effects take into account global shocks that hit all countries at the same time. This includes changes in commodity prices, as well as changes in the global economy.

Since the dependent variable is in logarithmic form, the coefficient β can be read as a percentage change using $\exp(\beta) - 1$.

Table 3 shows the baseline DID results.

The model estimates how the relationship between cobalt exposure and the tariff period after 2018 affects the logarithm of U.S. FDI stock. The treatment variable's estimated coefficient is 0.7403, and its clustered standard error is 0.2660. The coefficient is statistically significant at standard levels.

The transformation $\exp(\beta) - 1$ shows us how big the effect is since the dependent variable is in logarithmic form. This then gives us: exp(0.7403) 1 = 0.523, which means that there is approximately 52 percent less U.S. FDI stock in high cobalt-exposure countries after 2018 compared to that of lower exposure. This takes into account fixed effects for each country and year.

Under the baseline definition, the results show us that countries subject to a high exposure to cobalt, mainly the DRC, saw a relative reduction in US investment over the tariff period. When looking at it at first glance, this observation does not support the idea that tariffs shifted US investment into major cobalt-producing countries.

4.2 Event-Study Specification

To check the validity of the parallel trends assumption, we estimate an event-study specification.

The model is:

$$Y_{it} = \sum_{k \neq -1} \beta_k \left(Exposure_i \times \mathbf{1}[EventTime = k] \right) + \alpha_i + \delta_t + \varepsilon_{it} \tag{2}$$

This specification allows us to estimate a separate coefficient for each year relative to 2018, so that we can trace the dynamic relationship between cobalt exposure and U.S. FDI stock overtime.

EventTime = $t - 2018$, and k counts the years since 2018. The year before treatment (2017, or EventTime = -1) is not included as the reference category. See Figure 5.

This specification helps us to analyze whther countries with high cobalt exposure followed similar trends before and after 2018. The pre-treatment coefficients (k < 0) directly measure whether countries with high exposure and those with low exposure were already moving in different directions before the tariff period. If the assumption of parallel trends holds, the coefficients before the treatment should not differ statistically from zero.

The main finding appears in the pre-treatment period. The coefficients for event times -6, -5, -4, and -3 are all positive and statistically significant: 1.748, 1.228, 0.7015, and 0.4945, respectively. This means that, even before 2018, the high-exposure countries were already following a different FDI trajectory from the lower-exposure comparison countries.

This result weakens the causal interpretation of the baseline DID specification. If high-exposure countries were already diverging before 2018, then the post-2018 baseline estimate may partly reflect the continuation of pre-existing differences rather than the effect of the tariff shock alone. The post-treatment coefficients show some variation, but the most important implication of the event-study is that the standard parallel-trends assumption is not well supported in this sample.

4.3 Extended Specification with Country-Specific Trends

Since there is evidence of pre-treatment divergence, as seen in the event-study analysis, we estimate an alternative model that incorporates linear trends for each country. To this end, we developed a model that incorporates the linear temporal trends for each country. As mentioned earlier, this allows each country to have its own linear trend over time by efficiently isolating deviations from the post-2018 period.:

$$Y_{it} = \beta\,(Exposure_i \times Post2018_t) + \gamma X_{it} + \alpha_i + \delta_t + \lambda_i t + \varepsilon_{it} \tag{3}$$

λ_{it} reflects country-specific linear temporal trends and X_{it} contains GDP growth and exchange rate constraints. Including $\lambda_i t$ allows each country to have its own linear trajectory over time, and this parameter determines whether post-2018 changes are deviations from pre-existing linear trends or the continuation of the earlier divergence observed

Table 4 shows that controlling for country-specific linear trends significantly changes the magnitude and the sign of the estimated treatment effect. The coefficient on the interaction term becomes positive and statistically significant, rising to 0.6258, while the standard error goes down to 0.1565. Using the log transformation: exp(0.6258) - 1 = 0.869, this coefficient gives an implied effect of approximately $+86.98\%$ rise in US FDI stock in high-exposure nations compared to their predicted linear trajectory following 2018.

4.4 Robustness Checks

In this subsection, we will evaluate whether or not the main findings are sensitive to specific years, the underlying pre-treatment trends, and the choice of inference method. There are three additional exercises conducted. The first one will consist of re-estimating the models by excluding the last year of the sample, 2022. For the second, we will detrend the dependent variable by using country-specific trends estimated only from the pre-2018 period. Lastly, since the sample only has 8 country clusters, we will complete the inference by using wild cluster bootstrap methods.

4.4.1 Excluding 2022

In Figure 3, showing the average U.S. FDI stock by exposure group, we see a sharp drop in FDI stock for high exposure countries in 2022. In order to determine whether the results are driven by 2022, we re-estimate the baseline models excluding 2022. Table 5 reports the results.

We see that the estimated coefficients remain qualitatively similar to the baseline results. In the specification without controls, the coefficient on the interaction term changes from -0.7591 to -0.8070. This is a change from approximately -53.2% to -55.4%. Adding controls, the coefficient changes from -0.8368 to -0.8974, corresponding to a change from approximately -56.7% to -59.2%. In the model with country-specific linear trends, the coefficient is still positive and only changes a little bit from 0.2914 to 0.2811, which corresponds to about 33.8% and 32.5%, respectively.

These results show us that the main findings are actually not driven by the inclusion of 2022. The sign flip pattern still remains, as the baseline specifications are negative, while the trend-adjusted specification is positive.

4.4.2 Pre-2018 Detrending

To further address potential violations of the parallel trends assumption, the dependent variable is detrended using country-specific linear trends estimated only from the pre-2018 period. This means that, for each country, a linear trend is estimated using observations before 2018, and the fitted trend is subtracted from log FDI over the full sample. The baseline DID model is then re-estimated using the detrended outcome. Table 6 and Table 7 report the results.

The detrended estimates are positive and statistically significant under conventional clustered standard errors. Without controls, the DID coefficient is 0.7473, which implies an effect of approximately 111.1% increase in U.S FDI stock in high-exposure countries after the tariffs of 2018. When we add controls, the coefficient is 0.7389, implying about a 109.4% increase. We note that the sign does not change. When we add the exclusion of 2022, the coefficient remains positive at 0.6705, corresponding to approximately 95.5%.

What we observe in these results is the consistency with the trend-adjusted specification. This may suggest that the negative baseline estimate is sensitive to pre-existing differences in country trajectories. This means that once pre-2018 country trends are removed from the outcome, the estimated post-2018 relationship between the U.S. FDI stock and countries with high cobalt exposure becomes positive rather than negative.

4.4.3 Wild Cluster Bootstrap Inference

As mentioned earlier, the number of country clusters in the sample is small, and therefore, conventional clustered standard errors may be unreliable. To address this issue, we will complement the inference by using wild cluster bootstrap procedures, clustering at the country level. Table 8 reports the bootstrap p-values for the main controlled model, the controlled model excluding 2022, and the detrended controlled model.

The bootstrap results differ significantly from the traditional clustered-standard-error results. The bootstrap p-value for the controlled baseline mode is 0.4453. For the controlled specification excluding 2022, the bootstrap p-value is 0.3906, and for the detrended controlled model, the bootstrap p-value is 0.5469. In all three cases, the null hypothesis that the DID coefficient is equal to zero cannot be rejected at conventional significance levels.

This means that the estimated effects are not statistically significant once small-sample inference is properly accounted for. That being said, although the signs and magnitudes of the coefficients remain informative and may give us insight about the direction and the sensitivity of the estimates, the statistical evidence should be interpreted with caution.

4.5 Diagnostics and Indentification Discussion

The sign flip indicates that the main baseline fixed-effects model likely combined pre-existing divergence with post-treatment effects. Economically, what is being observed here is the interaction of two opposing forces. Firstly, the U.S. tariffs on Chinese EV supply chains may have decreased demand for critical minerals such as cobalt and exerted downward pressure on investment in countries with high exposure. Secondly, the structural challenges the DRC faces, such as the revision of the mining code, likely contributed to an upward trend in FDI. Goodman-Bacon (2021) stresses that DID estimators can blend various underlying comparisons, which may combine pre-existing trends with treatment effects when the assumptions are not satisfied.

The change in sign across the different specifications underscores the importance of the parallel trend assumption. In the baseline model, ignoring the systematic divergence before 2018 leads to an estimated negative effect of about 52 percent less U.S. FDI stock towards high-exposure countries. When linear trends for each country are added, the coefficient after 2018 becomes positive and substantial in economic terms, with a U.S. FDI stock almost 87 percent higher. The event-study with trends, on the other hand, reveals statistically significant differences in the pre-treatment coefficients. This indicates that divergence may not be totally linear and that structural differences exist in addition to simple trend patterns. Thus, while the trend-adjusted specification supports increasing post-2018 investment in high-exposure countries, this interpretation is based on the idea that linear trends properly represent pre-existing divergence.

We should be careful when intrepeting the results.

First, most of the exposure is found in the DRC. Although, the treatment variable is continuous, the identification is mostly reliant on one main observation. This restricts the degree to which findings can be generalized beyond that specific case. Second, there are only eight countries in the clusters. Although standard errors are correctly clustered at the country level, inference in small-cluster contexts may present less stability. Bertrand, Duflo, and Mullainathan (2004) show that in a DID model with few clusters, standard errors can be biased due to serial correlation, by potentially overstating statistical significance.

Nonetheless, the data indicate that investment trends in countries subject to high cobalt exposure did change post-2018. The direction and size of the tariff-shock effects, on the other hand, do depend on how pre-treatment trends are modeled. The baseline DID estimate indicates a relative decrease in FDI stock after the tariff period. When country linear trends are added, we observe a positive effect, indicating higher investment relative to pre-2018 patterns.

Since pre-treatment differences exist and exposure is concentrated in a single country, these findings are not conclusive evidence that tariffs drove investment reallocation, but they do indicate that US FDI trends in highly cobalt-exposed countries differed during the tariff period from those in lower-exposure countries.

Within the policy-oriented framework established in this thesis, the empirical results are analyzed in relation to reallocation dynamics during a period of increased strategic emphasis on essential minerals, while acknowledging the limitations in identification strength.

Altogether, the results highlight that strict causal interpretation is not supported. The presence of pre-trends, the sensitivity of estimates when including country-specific trends, as well as the lack of statistical significance under wild bootstrap inference suggest that the relationship that we estimated should be interpreted with caution.

5 Discussion: Policy-Oriented Interpretation

The trends we observe give us an important backdrop for interpreting the thesis' empirical results, as we have already mentioned, show a shift (whether up or down) in U.S. investment patterns after 2018 even if causality cannot be firmly established due to pre-trend issues. These changes align with broader geopolitical and policy developments from the U.S. tariffs on Chinese EV battery components, the new U.S. focus on critical-mineral security, and Africa's integration agenda.

5.1 Implications for the U.S

The thesis findings, when adjusted for trends, suggest that U.S. investment in countries with a high exposure to cobalt, such as the DRC, increased relatively more compared that in less-exposed countries after 2018. Some would "justify" the Section 301 tariffs on Chinese EV battery components and the Inflation Reduction Act's restrictions on "foreign entities of concern". However, these measures alone do not create additional supply, they simply make it more expensive to buy things from China. A few pieces of data show this.

First, a report from 2024 based on USGS data says that the US relied on imports for almost 100 percent of 12 important minerals and more than 50 percent of 28 other important minerals. China was the biggest producer of 30 of the 50 minerals that the U.S. had identified as critical, and because most of the local deposits are still untapped (because of regulatory issues), tariffs are actually a burden on materials that U.S. businesses have to buy from other countries (Pouy, 2025).

Second, the Chinese dominance in the extraction and processing of critical minerals around the world is not to be neglected. The Atlantic Council and Piasecki (2025) report that, based on statistics from the International Energy Agency, China controls around 90 percent of the world's graphite production, including mining, processing, and exports. China also processes around 65 percent of the world's lithium, and Chile provides most of the rest. This shows that taxes on Chinese imports raise costs but can't immediately change supply. The Democratic Republic of Congo, although producing more than 70 percent of the world's cobalt, has Chinese businesses control around 80 percent of that production. Chinese refineries process 60 to 90 percent of the world's cobalt. Last but not least, there are long lead times for mining in the US. It takes an average of almost 29 years to build a new mine in the United States, which is the second-longest time frame in the world (Scheyder, 2024). The U.S. National Association of Manufacturers (2025) says that the U.S. imports a lot of important minerals, including lithium, cobalt, and copper. It also suggests that tariffs would produce shortages right away and that the U.S. needs permitting reforms and incentives instead. Also, if the proposed taxes on Canadian, Chinese, and copper imports were combined, the cost of minerals for each electric vehicle would increase, thus tariffs alone cannot boost new supply quickly enough to fulfill demand when the time frames are so long.

To increase supply, it goes beyond just imposing tariffs. The list is endless, but pertaining to our thesis, to ensure reliable supply chains, U.S. policymakers need to include trade measures with targeted development finance and risk guarantees. This will encourage private investments in mineral-rich countries like the DRC. We see the application of this approach with the United States leading support for the Lobito Corridor. The Lobito Corridor This is a major infrastructure project that has the goal to reconstruct and expand the old Benguela railway in order to connect the port of Lobito in Angola with critical mineral-rich areas of the Democratic Republic of Congo in the Haut-Katanga province and Zambia. The project includes the development of nearly 350 miles of new track and the improvement of existing roads and railroads. This will make it faster and easier to get important minerals like copper and cobalt to global markets. The corridor, backed by the US, the EU, and regional allies with DRC as the main actor, intends to improve local economies, cut down on travel time, and provide another alternative to China's Belt and Road Initiative. Also, the minerals marketing partnership with GECAMINES (one of the major Congolese mining organizations in the Haut-Katanga province) is another example of this approach.

5.2 Implications for the DRC

For the baseline estimation, before the adjustment of trends, the finding shows a reduction in U.S. FDI towards the country. The country can consider a few suggestions with regards to these tariff policy-shock developments and political events. The nation must first work on making its mining laws more reliable. The revision of the country's mining code in 2018 nearly tripled the royalty fee from 3.5% to 10 percent. The problem is not the revision itself, as the country must firstly act in the interest of its people. The problem is the weak capacity the country faces to enforce its laws, which allows many companies in the sector to break the law and play unfair, without necessarily much consequences for them. This does not encourage other international companies to invest in the country's mining sector.

A state investigation found out that many mining companies did not register nearly US$16.8 billion in profits between 2018 and 2023. costing community development funds US$50.4 million. About 70% of companies didn't pay the 0.3 percent mining tax. The Court of Auditors recommended suspending rulebreakers and tightening oversight. The government halted shipments in February 2025 after cobalt prices plummeted. Later, they adopted quotas (Adombila and Rolley, 2025). Regulations (ARECOMS) restricted late 2025 to 18,125 tons and 2026 to 2027 to 96,600 tons in order to boost the local efficiency in terms of processing.All these sudden policy changes create confusion and underscores the need for clear and predictable regulations to allow foreign investments to flow in the country. For example, DRC's Mining Registry (Cadastre Minier : CAMI) made an encouraging move . Instead of accepting mining applications in December 2025, it cleaned up the register. It restored 594 titles encompassing 31,648 square kilometers and reinstated 210 rights lost due to force majeure (CAMI , 2026). Openness and enforcement may reassure investors, as shown by this cleaning and cadastre digitalization. The DRC must capitalize on these advances by tightening tax audits, stabilizing the fiscal system, and not banning exports to attract more varied investments. The sector will become more trustworthy to foreign investors.

Second, the government must continue to focus on building new trade relationships with other partners. We see that with Washington and Kinshasa signing a strategic minerals deal in December 2025. Gécamines and other state-owned companies will sell some of its copper and cobalt output to the U.S., giving American corporations first dibs. The partnership charter recommends reviewing beneficial ownership structures and making state mining firms more transparent. It could export 250,000 tons of copper and 12,000 tons of cobalt to the U.S. annually if done well (U.S Department of State, 2025). In addition to the Lobito Corridor mentioned earlier, the DRC may reduce its dependence on one consumer, increase its negotiating power, and acquire technology and funds from several partners. Finally, the DRC must further address social and environmental issues. In December 2025, the government banned artisanal copper and cobalt processing and created a mineral origins council to tackle unlawful mining and corruption. However, (Reuters, 2025) reports that there are still between 1.5 to 2 million artisanal miners who are subject to important human rights violations and environmental deterioration. This really demands a strict and more rigorous enforcement of laws and regulations. If the country improves labor standards and its level of compliance with ESG, more foreign investors will better consider investing in the country's mining sector. So by making sure to work on reforms, promote openness, and to prioritize human rights and environmental protection, the DRC can turn its mining wealth into a sustainable and diverse development.

6 Conclusion

This thesis looks at whether US tariffs on Chinese electric vehicle battery parts affected US foreign direct investment in countries with a lot of cobalt, especially the Democratic Republic of Congo (DRC). The study centers on the 2018 increase in tariffs between the US and China, which happened as concerns about mineral supply chains grew. Since the DRC produces about 70 percent of the world's cobalt, it is a good case to see if trade policy changes lead to shifts in upstream investment. The main findings show a change in US FDI patterns. Countries with a lot of cobalt saw a drop in US investment after 2018 in the basic DID model. However, when examining country-specific trends, this effect became positive and economically significant. This means that while the first analysis showed a decrease, more detailed modeling suggests investment in these countries actually increased compared to what past trends would predict. This highlights how sensitive the results are to the way the analysis is done.

While the findings do not prove that tariffs caused investment to shift, they do show that US FDI trends in countries with a lot of cobalt were different during the tariff period compared to countries with less cobalt. The analysis looks at whether changes in investment during this time match up with bigger changes in mining policy and the supply chain.

The evidence shows that investment patterns matched up with strategic policy changes during trade tensions. Even though the data do not clearly connect tariffs to changes in investment, US foreign direct investment trends in countries with a lot of cobalt changed during the tariff period compared to those with less cobalt.

This thesis adds to the research by looking at how the US–China trade war affected where money is invested in resource-heavy industries, not just trade flows. It also highlights the need to consider trade policy, geopolitical strategy, and industry-specific factors when studying how investments react to economic shocks.

Future research could improve the analysis by using synthetic control methods to better study the DRC as the main case. Using mining FDI data specific to each sector would make measurements more accurate. Expanding the sample to include more countries would add variety and make the results stronger. Also, directly considering changes in commodity prices would help separate global market effects.

7 Use of Generative AI and AI-assisted tools

During the preparation of my thesis, I used Chat GPT and Grammarly for assistance with corrections in my R code and Latex/Overleaf code, as well as to polish and rewrite some of my texts, as my native language is French and not English. After using this tool/service, I reviewed and edited the content as needed and take full responsibility for the content of my thesis.

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8 Appendix

8.1 Tables

Table 1: Summary Statistics

Variable	N	Mean	Median	Std. Dev.	Min	Max
$\ln(FDI)$	102	9.0859	8.6105	1.6976	6.6399	13.0961
Exposure	104	0.1655	0.0439	0.3177	0.0209	1.0000
Post2018	104	0.3846	0.0000	0.4889	0.0000	1.0000
GDP growth	104	3.5726	4.0784	3.5226	-9.5183	10.2982
Exchange rate	104	2108.78	49.44	4132.55	1.6728	14849.85

Table 2: Correlation Matrix

	$\ln(FDI)$	Exposure	Post2018	GDP growth	Exchange rate
$\ln(FDI)$	1.000	-0.340	0.141	-0.262	0.010
Exposure	-0.340	1.000	0.000	0.229	-0.101
Post2018	0.141	0.000	1.000	-0.225	0.078
GDP growth	-0.262	0.229	-0.225	1.000	0.093
Exchange rate	0.010	-0.101	0.078	0.093	1.000

Table 3: Baseline Difference-in-Differences Results

	(1) No controls	(2) With controls
Exposure × Post2018	-0.7591*	-0.7403*
	(0.2627)	(0.2660)
GDP growth		0.0137
		(0.0216)
Exchange rate		-0.0002.
		(0.0001)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	102	102
R^2	0.9304	0.9387
Within R^2	0.0651	0.1766

Clustered standard errors at the country level in parentheses.
Signif. codes: *** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.10.

Table 4: Baseline and Trend-Adjusted DID Results

	(1) Baseline with controls	(2) Country-specific trends
Exposure × Post2018	-0.7403*	0.6258**
	(0.2660)	(0.1565)
GDP growth	0.0137	0.0198
	(0.0216)	(0.0160)
Exchange rate	-0.0002.	-0.0003*
	(0.0001)	(8.44e-5)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Country-specific trends	No	Yes
Observations	102	102
R^2	0.9387	0.9828
Within R^2	0.1766	0.1336

Clustered standard errors at the country level in parentheses.
Signif. codes: *** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.10.

Table 5: Robustness Check: Excluding 2022

	(1) Baseline	(2) Controls	(3) Country Trends
Exposure × Post2018	-0.8070*	-0.8974*	0.2811
	(0.2645)	(0.3788)	(0.2443)
GDP growth		0.0077	0.0118
		(0.0227)	(0.0212)
$\ln$(Exchange rate)		0.5120	0.5172
		(0.9176)	(0.5238)
Country fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Country-specific trends	No	No	Yes
Observations	96	96	96
R^2	0.9312	0.9334	0.9818
Within R^2	0.0669	0.0970	0.0615

Clustered standard errors at the country level in parentheses. This table reports robustness checks excluding the year 2022.
Signif. codes: *** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.10.

Table 6: Robustness Check: Pre-2018 Detrended Outcome

	(1) Detrended Baseline	(2) Detrended Controls	(3) Detrended Controls, no 2022
Exposure × Post2018	0.7473*	0.7389*	0.6705*
	(0.2564)	(0.2491)	(0.2398)
GDP growth		0.0068	0.0056
		(0.0252)	(0.0255)
ln(Exchange rate)		0.0509	-0.0044
		(0.3379)	(0.3105)
Country fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	102	102	96
R^2	0.3750	0.3764	0.3355
Within R^2	0.1210	0.1230	0.1023

Clustered standard errors at the country level in parentheses.

Signif. codes: *** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.10.

Table 7: Robustness Check: Detrended Outcome (Excluding 2022)

	(1) Detrended Controls (No 2022)
Exposure × Post2018	0.6705*
	(0.2398)
GDP growth	0.0056
	(0.0255)
ln(Exchange rate)	-0.0044
	(0.3105)
Country fixed effects	Yes
Year fixed effects	Yes
Observations	96
R^2	0.3355
Within R^2	0.1023

Clustered standard errors at the country level in parentheses. This table reports robustness results using a detrended dependent variable and excluding the year 2022. Country-specific linear trends are estimated using only pre-2018 observations and removed from the outcome variable prior to estimation. Standard errors are clustered at the country level and reported in parentheses.

Signif. codes: *** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.10.

Table 8: Wild Cluster Bootstrap Inference

Model	DID coefficient	Percent effect	Bootstrap p-value
Controls	-0.8368	-56.69%	0.4453
Controls, no 2022	-0.8974	-59.24%	0.3906
Detrended controls	0.7389	109.36%	0.5469

Notes: Wild cluster bootstrap inference is conducted at the country level using `fwildclusterboot`. Because the sample contains only 8 country clusters, conventional clustered standard errors may understate uncertainty. None of the reported bootstrap p-values indicate statistical significance at conventional levels.

8.2 Figures

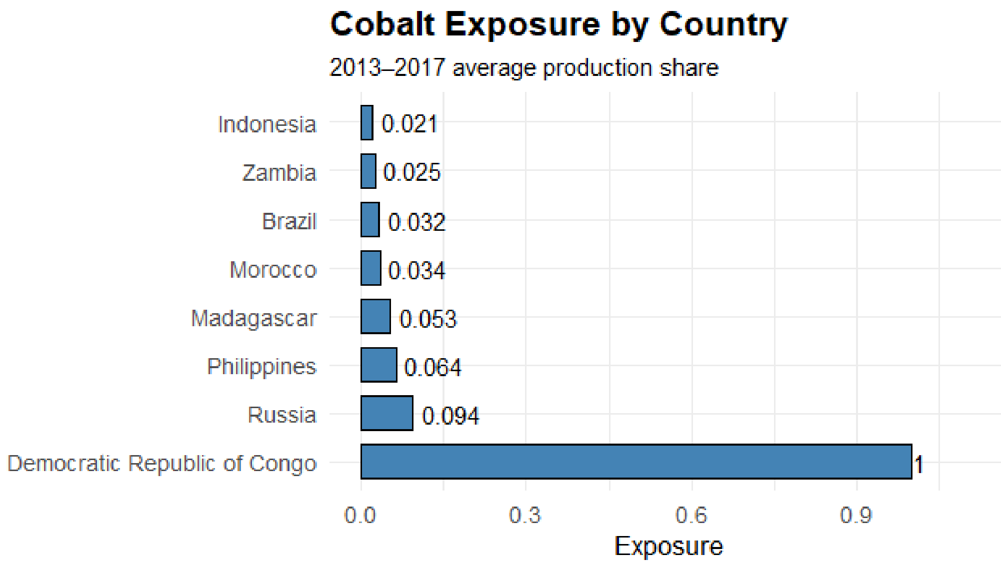

Figure 1: Cobalt exposure by country, measured as the average share of global cobalt production over the period 2013–2017. The Democratic Republic of Congo exhibits substantially higher exposure relative to other countries. Production data are compiled from the U.S. Geological Survey (USGS) Mineral Commodity Summaries.

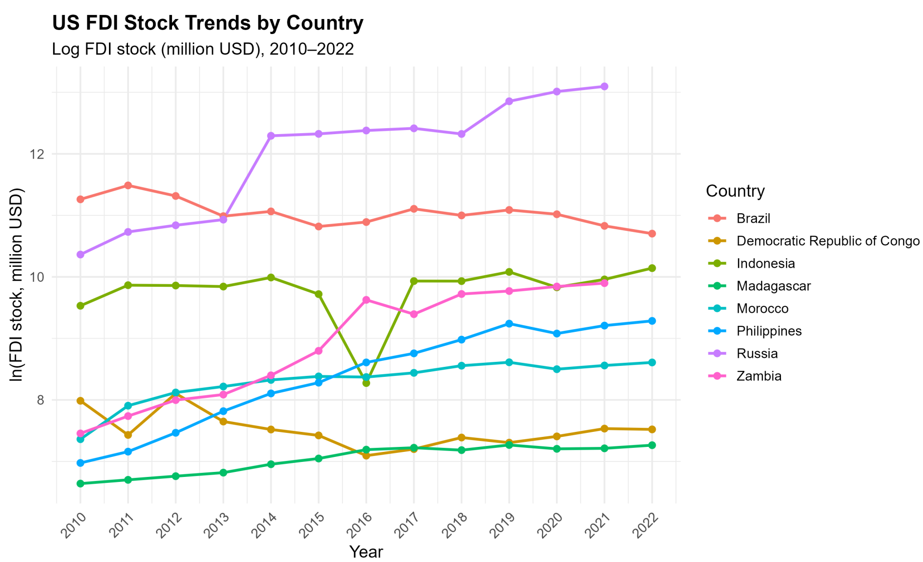

Figure 2: Log U.S. FDI stock (in million USD) by country, 2010–2022. The figure illustrates cross-country heterogeneity in the level and evolution of U.S. foreign direct investment across the sample. FDI stock data are obtained from UNCTAD bilateral FDI statistics.

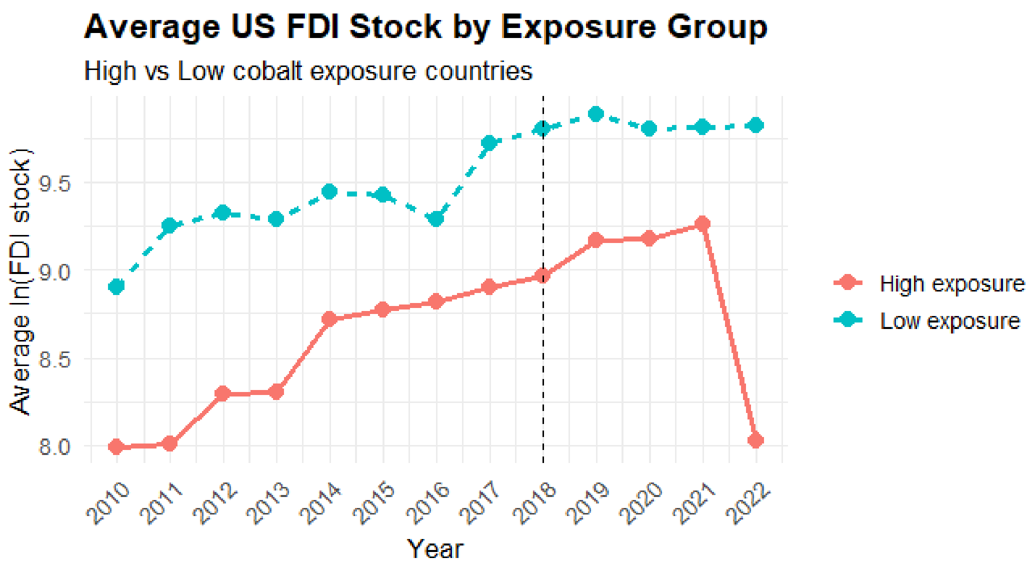

Figure 3: Average log U.S. FDI stock for high-exposure and low-exposure countries, 2010–2022. The vertical dashed line indicates the 2018 U.S.–China trade shock. The figure shows differential trends in FDI between exposure groups before and after the policy shock. FDI data are from UNCTAD, and exposure classification is based on pre-2018 cobalt production shares from USGS.

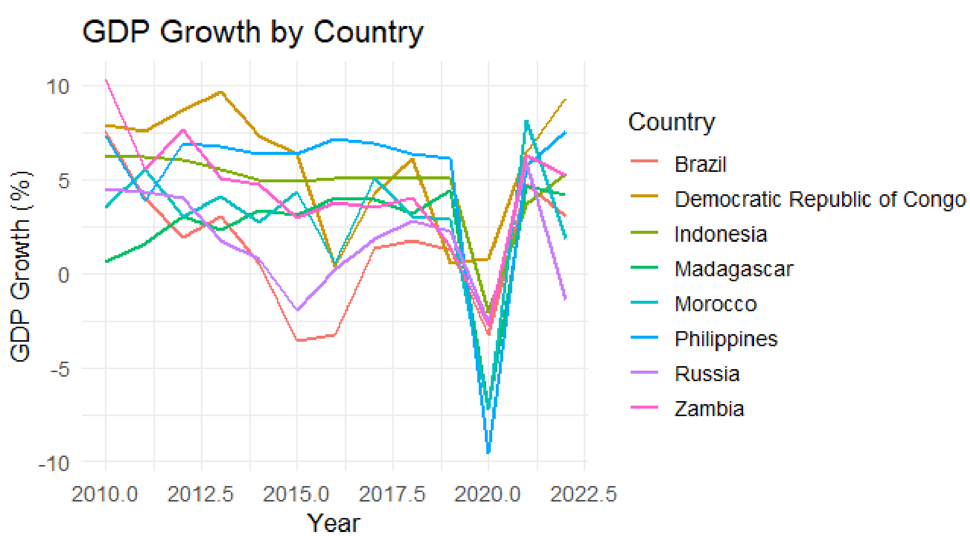

Figure 4: Annual GDP growth rates (in percent) by country, 2010–2022. The figure highlights macroeconomic volatility across countries, including the global contraction observed in 2020. GDP growth data are obtained from the World Bank World Development Indicators (indicator: NY.GDP.MKTP.KD.ZG).

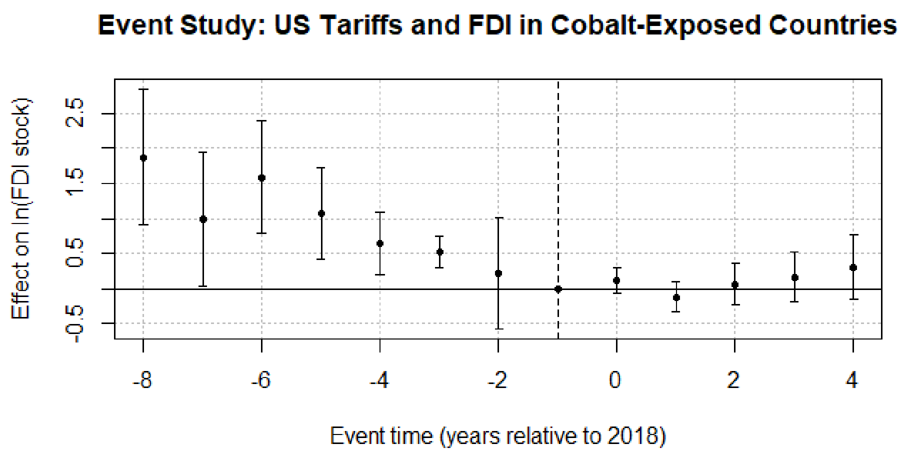

Figure 5: Event-study estimates of the effect of cobalt exposure on log U.S. FDI stock relative to 2018. Each point represents an estimated coefficient, and the vertical bars indicate 95% confidence intervals.