SCHOOL OF ECONOMICS AND MANAGEMENT

Bachelors Programme in Economy & Society

# Tariff Exemptions and Trade Diversion: Evidence from U.S. Section 232 Aluminum Tariffs in 2018 and 2025

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# Abstract

Section 232 of the Trade Expansion Act authorizes the President of the United States to impose tariffs on certain goods if they are considered to impose threats to national security. In March 2018, Section 232 was enacted for the first time in over 30 years when President Donald Trump imposed tariffs on certain aluminum products. The initial tariffs implemented in 2018 escalated into a near-universal policy shock in 2025, with doubling tariff rates affecting nearly all sourcing countries. Existing research has extensively examined the price-, employment- and welfare-effects following this, leaving the effects on country-level composition of U.S. aluminum sources largely unexamined. This study therefore examines to what extent the Section 232 tariff revisions of 2018 and 2025 separately affected the country-level sourcing patterns of U.S. aluminum imports.

# Acknowledgements

Before beginning I would like to express gratitude towards my supervisor William Skoglund for insightful guidance and a helping hand throughout this project. His engagement in this project has been invaluable in shaping this bachelor thesis.

## AI Declaration Statement:

This thesis has made limited use of artificial intelligence (AI) tools as supportive instruments during the research and writing process. I acknowledge the use of Claude (Claude.ai) for technical support when handling the code for the data analysis. Examples of usage were, to revise and debug syntax errors and understanding functions in Stata. Codes that revealed syntax errors were run through Claude for technical assistance to debug the syntax errors. Although used as assistance to debug syntax errors and understand functions in Stata, each code was manually entered, logged and saved in separate do-files for transparency and replicability of this study. Do-files are available upon request, as they were too large to insert as separate appendixes. The AI tool Grammarly was used for language-related assistance, including grammar correction and providing synonyms to improve language fluency.

Whenever these AI tools were used, I thoroughly reviewed, edited and cross-checked the content as needed. The AI tools were only used as assistance in improving and debugging and no AI tools have been used to generate results, conclusions or interpretations. The final content, all claims, interpretations and references are independent work and I take full responsibility for any errors or omissions in this bachelor thesis.

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# 1. Introduction

Over the past 50 years, the United States has gone from being one of the world's largest aluminum producers to being heavily import dependent, as rising energy costs eroded domestic competitiveness and moved sourcing toward low-cost foreign suppliers. This structural vulnerability laid the foundation for the national security concerns that motivated Section 232 of aluminum tariffs. What began as targeted tariffs towards selected countries in 2018, has since escalated into a near universal policy shock, with tariff rates doubled and nearly all exemptions removed in 2025 (Office of the President, 2018a, 2025a).

## 1.1 Research Problem

The United States cannot fully meet its domestic demand for high-purity aluminum though, making import sourcing decisions particularly sensitive to tariff policy. When tariffs are imposed on long-standing suppliers such as Canada, Mexico and the EU, importers face incentives to seek alternative cheaper sources, resulting in sourcing reallocation. While existing research examines price effects, employment outcomes and downstream cost burdens, country-level sourcing patterns remain largely unexamined. The early dynamics following the 2025 revision are just becoming visible, offering a unique opportunity to study how sourcing responds to tariffs not as a one-time intervention but as a repeated and escalating policy strategy from 2018. Motivating the central research questions of this study:

*To what extent did the Section 232 tariff revisions of 2018 and 2025 alter the country-level sourcing patterns of U.S. aluminum imports?*

*To what extent do the early sourcing shifts observable following the 2025 tariff revision vary in magnitude from those recorded in the equivalent period after the 2018 episode?*

## 1.2 Aim and Scope

This study aims to examine the extent to which Section 232 aluminum tariff revisions altered country-level sourcing patterns of U.S aluminum imports across two distinct tariff episodes, the 2018 implementation and the 2025 universal elimination of exemptions. Further, whether the 2025 revision produced larger sourcing shifts than the equivalent period after 2018. This is assessed through descriptive analysis of monthly import shares across the full sample period, followed by difference-in-differences designs exploiting variation in exemption status. Extended to cohort-specific and country-specific specifications to examine heterogeneity in treatment effects.

The study is restricted to aluminum tariff exclusively, and the product scope covers HTS Chapter 76 only, leaving aluminum derivatives explicitly excluded. The sample period runs from 2015 to 2026 covering both tariff episodes with sufficient pre- and post-treatment data. The analysis is restricted to country-level import share dynamics and does not extend to price effects, domestic production responses, welfare or employment outcomes, as these fall outside the research aim and have been addressed in existing literature (Durante, 2024; Cigna et al., 2020).

## 1.3 Outline of the Thesis

Section 2 introduces the policy background behind Section 232 aluminum tariffs. Section 3 presents the theoretical framework and previous research and Section 4 describes data sources, sample construction and limitations. Section 5 presents the empirical methodology while Section 6 and 7 presents and discusses the findings in relation to theory. Section 8 concludes the thesis with practical implications and a summary of directions for future research.

# 2. Policy Background

## 2.1 Section 232 of the Trade Expansion Act of 1962

Section 232 of the Trade Expansion Act of 1962 authorises the President of the United States to impose trade restrictions if imports of a given good are determined by the Department of Commerce, to threaten national security (Kitamura, 2026). In March 2018, President Trump invoked Section 232 for the first time in over 30 years when imposing duties on U.S. imports of certain steel and aluminum products (Weaver, 2019; Office of the President, 2018a). Based on concerns raised by the Secretary of Commerce regarding national security threat, domestic industry viability and the risk of total import dependence on crucial inputs (Office of the President, 2018a).

The Secretary's concerns were based on a structural decline of U.S. production. Once among the world's largest producers in 1980, the U.S. lost ground to global competitors following rising energy costs after the financial crisis which left only one active smelter capable of producing high-purity aluminum (Watson, 2022). This is particularly significant given that aluminum used in U.S. defence applications must comply with strict purity standards of 99.9% or above, meaning the entire U.S. military's domestic aluminum supply had become dependent on a single commercial smelter facility (Watson, 2022; Department of Commerce, 2021). Combined with a structural import dependence of approximately five metric tons annually, the Secretary concluded that the scale and circumstances of aluminum imports posed a genuine threat to national security. Motivated by the military's reliance on a critical input that was sourced predominantly from foreign suppliers which created structural vulnerabilities in the U.S. defence industrial base. To address this a global tariff was therefore necessary to restore domestic production capacity explaining the Section 232 aluminum tariff rationale (Office of the President, 2018a).

The broad and expansive legal definition of "national security" encompassing both domestic industry capacity, economic welfare, defence needs and critical infrastructure (Trade Expansion Act of 1962, 19 U.S.C. §1862(d)). Enabled flexibility for the President to determine which countries posed a threat and which did not. This flexibility was precisely what produced the fragmented and frequently shifting exemption landscape that this study examines. Following the initial 10% tariff implementation in March 2018, key allies including Canada, Mexico, the EU, Australia, Brazil, South Korea and the UK were granted temporary tariff relief arrangements ranging from full exemptions to tariff-rate quotas (Office of the President, 2018a). Within the first year alone, several countries switched from temporary exemption status to TRQ arrangements or to non-exempt status based on the degree of national threat the President determined that they posed (Office of the President, 2018a, 2018b, 2018c). In March 2025, all previously granted arrangements were eliminated simultaneously and the tariff rate increased from 10% to 25%, later doubled to 50% in June 2025 (Office of the President, 2025a, 2025b). This universal elimination of exemptions after almost seven years of fragmented tariff relief created the structurally clean policy shock that motivates the comparative design of this study. The full timeline is documented in Appendix 1.

# 3. Theory

## 3.1 Theoretical Foundation

The classical case against tariffs is rooted in comparative advantage where Smith (1776) established that free trade increases national wealth through specialization. Ricardo (1817) formalized this by showing that countries benefit from specializing in goods they produce most efficiently and trading for the rest. The Hecksher-Ohlin model extended this further, demonstrating that trade patterns reflect differences in factor endowments and that free trade maximizes welfare by enabling each economy to allocate its land, capital, labor and natural resources efficiently (Ohlin, 1933). Together these frameworks establish free trade as the welfare-maximizing baseline under perfect competition, arguing that tariffs distort this structure by artificially raising prices and breaking the efficiency logic behind free trade.

### 3.1.1 Tariffs in Partial Equilibrium

The partial equilibrium framework can be used to explain how tariffs work through the standard supply and demand diagram logic (Krugman & Obstfeld, 2012). When implemented, an import tariff will raise the domestic price above the market price leading to an increase in domestic production, resulting in a fall in consumption and the gap gets filled by imports. The tariff raises the price of a good in the importing country and lowers it in the exporting country resulting in that consumers lose in the importing country, while gaining in the exporting country which is known as producer gains and consumer losses (Krugman & Obstfeld, 2012). Additionally the government imposing the tariff gains government revenue. Therefore a tariff generates four effects: producer gains, consumer losses, government revenue and a deadweight loss arising from production and consumption distortions, reflecting welfare that is lost due to the tariff (Krugman & Obstfeld, 2012). Generally economists agree that the effects of such asymmetrical trade policies often result in producer benefits and consumer damages resulting in welfare losses (Krugman & Obstfeld, 2012).

### 3.1.2 Strategic Trade Theory and Market Structure

The free trade conclusion arguing against tariffs, depends critically on market structure and country size (Kaldor, 1940; Brander & Spencer, 1984). Because when the importing country is large enough to influence world prices, a tariff will reduce import demand sufficiently to force foreign exporters to lower their prices in order to maintain market access (Kaldor, 1940). The resulting fall in world prices shifts part of the tariff burden onto foreign producers instead of the earlier mentioned distortions, generating a term of trade gain for the implementing country (Kaldor, 1940). When this gain exceeds the deadweight loss the result is the optimal tariff, allowing a large country to raise national welfare despite the distortions (Kaldor, 1940).

Under imperfect competition the justification for tariffs and strategic intervention extends further. Krugman (1979) showed that economies of scale create self-reinforcing cost advantages, providing a rationale for shielding domestic industries in order to reach sufficient scale to become internationally competitive. Brander and Spencer (1984) further demonstrate that in oligopolistic industries, governments can use policy instruments to shift rents from foreign to domestic firms, resulting in improved welfare although at the cost of inefficiencies (Brander & Spencer, 1984). Beyond economic motives, economists argue that tariffs can be used to explore geopolitical leverage (Hirschman, 1945). Where the threat and the actual tariffs create asymmetrical trade relationships that create dependencies, that are used to weaponize trade to force concessions on non-economic issues like national security concerns (Hirschman, 1945). This interpretation is consistent with the mercantilist logic that trade policy serves national power accumulation. Also with strategic trade policy arguing that large economies can exploit market access asymmetry to extract bilateral concessions using tariffs (Brander & Spencer, 1984). However Krugman (1987) cautioned that practical gains from tariffs are limited and uncertain, as governments rarely have the information needed to identify genuinely strategic sectors and retaliation risks which reduces welfare gains quickly.

### 3.1.3 Viner's Trade Diversion Mechanism

Viner (1950) showed that eliminating discriminatory trade policies in a customs union generates two possible outcomes. Trade creation, when high-cost domestic production is replaced by lower-cost imports from a non-tariffed country, improving welfare through more efficient resource allocation. Trade diversion occurs when imports shift away from a lower-cost supplier toward a higher-cost one solely because tariff structures make the former artificially expensive. Here, trade is redirected for policy reasons rather than economic efficiency resulting in a welfare loss due to the customs union and tariff structure (Viner, 1950). Although originally developed for customs unions, the mechanism applies whenever trade partners face asymmetric tariff treatment, where some face full tariff burden and others are exempted, confirmed in modern empirical work (Mattoo et al., 2019; Nicita, 2019., Cigna et al., 2020).

## 3.2 Previous Research: Empirical Results of Tariffs

The repeated granting, revoking and renegotiating of exemptions throughout the Section 232 period, raises the question whether aluminum tariffs actually operate as strategic national security barriers or as actual geopolitical leverage. Falkner (2026) explored this angle of U.S. tariffs especially under the second Trump administration, arguing that the dramatic escalation of tariffs were not only due to protectionism, but an actual shift towards the use of tariffs as a tool of geopolitical strategy Falkner (2026). Building on this, Carvalho (2025) explored how the repeated granting and revoking of exemptions made tariffs function partly as credible punishment mechanisms in a repeated bargaining game. Where granted exemption status reflected diplomatic outcomes rather than genuine national security assessments (Carvalho, 2025).

Following the announcements of Section 232 aluminum tariffs in early 2018, a wave of simulation-based studies predicted that tariffs would raise industry costs, reduce GDP, welfare and employment, generating concentrated gains for domestic producers at the expense of broader economic consequences (Ciuriak & Xiao, 2018; Francois & Baughman, 2018; Hufbauer & Jung, 2018). Subsequent empirical research largely confirmed these predictions. Durante (2024) found that Section 232 tariffs increased production costs for U.S. manufacturers, reduced employment and hurt exports, concluding that revoking them would boost long-run GDP. Johanson et al. (2024) similarly found that higher import prices translated directly into increased input costs for downstream industries.Yilmazkuday (2025) adds an important dimension, finding that repeated tariff revisions created an unpredictable environment with chilling effects on business investments.

To understand how these welfare effects arise in practice, it is necessary to examine how tariffs affect prices and import quantities at the micro level. Amiti et al. (2019) addresses this directly, finding a near-complete pass-through of U.S. tariffs to domestic importers as foreign exporter prices showed essentially no response. This implies that U.S. consumers and importers bore virtually the entire cost of the tariffs. Combining price and quantity estimates, they calculated a cumulative deadweight welfare loss of $8.2 billion over 2018, empirically confirming the partial-equilibrium mechanism outlined by Krugman & Obstfeld (2012). They further estimated that approximately $165 billion of trade per year would be redirected to avoid the tariffs if sustained (Amiti et al., 2019), providing direct empirical support for the trade diversion mechanism central to this thesis. However their analysis operates at the HTS10-product-country-month level exploiting variation across tariffed and non-tariffed products to identify price and quantity effects, leaving a gap for country-level analysis exploiting variation in exemption status to directly measure sourcing reallocation.

Nicita (2019) and Cigna et al. (2020) begin to fill this gap by confirming that Viner's trade diversion mechanism holds empirically in similar settings as this study. Nicita (2019) found that U.S. tariffs on China produced a strong decline in imports from China partly replaced by a surge from third countries, validating that country-level trade diversion is detectable using U.S. customs data in similar settings. Cigna et al., (2020) further found that while the trade-destroying effect of tariffs is immediate, while the trade-creating diversion effect takes longer to materialize. However neither examines Section 232 aluminum tariff specifically nor exploits variation in exemption status as the identification strategy, leaving country-level sourcing reallocation following Section 232 largely unexplored.

Beyond these country-level diversion effects, recent research highlights that tariff impacts often materialize even before implementation. Klomp (2025) shows that Section 232 tariffs announcements, implementation dates and retaliation threats all triggered declines in U.S. defence stock prices up to three percent. His finding reinforced that tariffs created investor uncertainty and triggered effects already at the announcement stage, indicating that such tariff threats could have functioned as a form of political leverage. Complementing this recent evidence documented significant frontloading behaviour ahead of 2025 Section 232 tariff announcements (Lu & Milkov, 2026). Followed by, Soyers et al. (2025) who showed that U.S. imports surged sharply in the first quarter of 2025 as firms accelerated shipments ahead of the 2025 new tariff schedule. Lu and Milkov (2026) further demonstrate that the 2025 frontloading episode was substantially more sophisticated than in 2018, indicating that firms had learned from the earlier tariff cycle. Taken together, these findings are relevant to this study interpretation of results, as they highlight that a temporary increase in aluminum imports ahead of tariff implementations might reflect on frontloading behaviour rather than genuine demand shifts.

## 3.3 Theoretical Predictions

Existing studies examine the economic, employment and structural effects of general U.S. tariffs, where they collectively treat trade diversion as a background assumption rather than a measurable outcome. Nicita (2019) and Cigna et al. (2020) provided evidence that country-level trade diversion is empirically detectable in the U.S.-China trade war, a context similar to the one of this study motivating the empirical strategy employed. However they left Section 232 aluminum tariffs and variations in exemption status as an identification strategy largely unexamined. Furthermore, existing research often treats 2018 and 2025 separately, where this study aims to directly compare long-run adjustments patterns after 2018 with early sourcing shifts following the more extensive 2025 episode. Offering a new comparative angle to discussion that existing literature has yet to address.

By directly applying Viner's mechanism to the context of Section 232 aluminum tariffs specifically, the intention is that results from this bachelor thesis will not only add to empirical knowledge, but also offer new useful insights. In the context of Section 232 aluminum tariffs, Viner's mechanism operates through two channels that are directly relevant to this study. When a country loses exemption status, the tariff raises its export price relative to exempt suppliers. If this price increase exceeds the country's underlying efficiency advantage, its competitiveness declines, leading to a supply-side contraction as its export volumes fall. As the U.S. domestic production cannot meet total demand, this lost supply must be replaced generating a demand-side reallocation toward countries that remain exempt from face lower effective costs. The Section 232 exemption structure therefore created precisely the discriminatory conditions under which

Vinerian trade diversion is expected to occur, making the mechanism directly applicable to the sourcing shifts analyzed in this thesis.

Under perfect competition this shift is expected to appear immediately as importers redirect toward the cheapest supplier (Ricardo, 1817). While under imperfect competition, large integrated producers can partially absorb tariff costs to defend market access, which would yield more gradual adjustments (Brander & Spencer, 1984). If the Section 232 tariff revisions significantly shifted country-level sourcing of U.S. aluminum imports and whether this resulted in a persistent reallocation remains an empirical question that this study aims to address. While the treatment variable is conceptually identical across both episodes, the magnitude of competitive shock differs. Treated countries in 2018 faced the Section 232 tariff for the first time at 10% since they were exempted from implementation date. Compared to treated countries in 2025 who went from tariff relief to tariff rate at 25% following seven years of protection. This substantial difference motivates the sub-hypothesis that sourcing shifts are expected to be larger in magnitude following the 2025 episode. Examined in the following sections of this study.

The main hypothesis: Section 232 tariff revisions are expected to significantly alter the country-level composition of U.S. aluminum imports, resulting in persistent trade diversion following the 2018 episode and measurable early similar sourcing shifts following the 2025 revision.

The sub-hypothesis: The sourcing shifts following the 2025 tariff revision are expected to be larger in magnitude than those recorded in the equivalent period after the 2018 episode, driven by the universal removal of exemptions on long-standing trading partners that had previously protected them from the full tariff burden.

# 4. Data

## 4.1 Data Sources

### 4.1.1 United States International Trade Commission (USITC) DataWeb

The empirical analysis of this quantitative study, draws on trade data retrieved from the United States International Trade Commission (USITC) DataWeb. It is a free publicly accessible database consisting of comprehensive U.S. import and export statistics sourced directly from the U.S Customs and Border Protection (CBP) and the U.S. Census Bureau (USITC, 2026). The DataWeb provides detailed bilateral trade flows at the Harmonized Tariff Schedule (HTS) 10-digit level, including import quantities, countries of origin, tariff classifications, monthly and annual reporting frequencies. Making it the sole U.S. database allowing for precise filtering with a comprehensive coverage of all U.S. trading partners. This level of precision enables precise identification of aluminum products subject to Section 232 tariffs and a thorough analysis of country-level sourcing patterns, critical for this study.

### 4.1.2 Presidential Proclamations

Presidential proclamations under Section 232 function as the official and legally binding records of each tariff reaction, published in the Federal Register and carrying the force of law (Office of the President, 2018). The presidential proclamations issued under Section 232 of the Trade Expansion Act of 1962 serve as the second data source of this study. Each proclamation is consulted manually to identify which HTS 10-digit codes were subject to Section 232 aluminum tariffs at what tariff rate and during which time periods. The proclamations also hold information regarding country-specific exemptions and quota arrangements, crucial for defining treatment and control groups in the DiD specifications. The foundational presidential proclamation was signed March 8, 2018 announcing the initial aluminum tariff of 10% and the country-specific exemptions at that time (Office of the President, 2018). Throughout the study period several proclamations were published in the Federal Register, including modifications on country-exemptions, quota agreements and tariff rates. For detailed information about presidential proclamations see Appendix 1.

## 4.2 Data Quality

The USITC DataWeb is a regularly updated site that reflects official trade records rather than estimations ensuring temporal consistency across the study period. Additionally it is widely used and referred to across academic trade research. The reliability is further supported by its transparency as the DataWeb offers extensive documentation on data revisions, HTS code changes and includes suppression warnings when data is temporarily withheld for confidentiality (USITC, 2026). The presidential proclamations are immutable primary legal documents, meaning that once published in the Federal Register they cannot be altered making them stable and consistent sources (Office of the President, 2018). Each proclamation is marked with unique numbers and effective dates eliminating ambiguity. Taken together both these data sources represent high reliability and are considered suitable data sources for this study.

The USITC DataWeb constitutes secondary administrative data derived from mandatory customs declarations, legally required under U.S. law covering all aluminum import transactions (USITC, 2026). This ensures full population coverage over all trading partners, eliminating sampling bias and concerns about external validity. The USITC DataWeb offers the availability of all HTS 10-digit codes relevant to Section 232 aluminum products, making it highly representative for analyzing country-level sourcing shifts. The presidential proclamations cover the full legal scope of the tariff action across the entire study period, ensuring the treatment definition to be complete. Having the treatment definition based on the authoritative legal text rather than secondary interpretations strengthens the validity of the HTS code selection and ensures that the exemption mapping accurately reflects the evolving scope of the tariff action.

The USITC DataWeb contains the exact variables required, directly aligned with the research question on sourcing shifts, meaning that no proxy variables are needed (USITC, 2026). The data directly aligns with the conceptual focus on trade diversion and country-level sourcing shifts following the Section 232 tariffs, supporting strong construct validity. Since the proclamations function as the legal instrument creating the tariffs, they are the most conceptually valid source for defining treatment. Using proclamations directly, rather than secondary summaries eliminates interpretative distortion.

## 4.3 Sample of Data

The data used in this study was collected from the USITC DataWeb (2026), including monthly import data of aluminum products subject to Section 232 tariffs, from January 2015 to January 2026. This 11 year long sample period provides sufficient pre- and post-treatment periods for both the 2018 and 2025 tariff episodes. The unit of measurement is physical quantities in kilograms, rather than trade volumes since the USITC standardizes all HTS Chapter 76 codes to kilograms in order to ensure consistency. The data is collected at HTS-10 level in a single unified dataset. The data scope is restricted to solely aluminum imported products classified under Chapter 76 “Aluminium and articles thereof” of the Harmonized Tariff Schedule that were explicitly stated in the presidential proclamations subject to Section 232 tariffs.

### 4.3.1 HTS Code Scope

U.S. aluminum imports span multiple chapters of the Harmonized Tariff Schedule, ranging from primary aluminum and aluminum alloys to downstream derivatives and products containing aluminum as a component. Since Section 232 aluminum tariffs exclusively target certain aluminum products, including all U.S. aluminum imports across all chapters would introduce noise from products unaffected by the tariffs. This study is therefore restricted to aluminum products that fall under HTS Chapter 76, which covers primary aluminum, alloys, plates, sheets and structural components. All of which account for approximately 90% of total U.S. aluminum imports by volume, ensuring that all are subject to the Section 232 tariffs (USITC, 2010; Office of the President, 2018a).

Chapter 76 in the Harmonized Tariff Schedule of the United States consists of 16 full headings, in which seven of them are fully subject to Section 232 tariffs at HTS-6 and HTS-10 level. Restricting the dataset to the exact relevant HTS headings within Chapter 76, listed in the proclamations for each tariff episode ensures that the analysis captures only tariff-affected products and thereby improves validity and reduces measurement error. The seven HTS-6 headings included in Chapter 76 that are subject to the tariffs are stated in Table 1, sourced directly from the initial proclamation 9704 (Office of the President, 2018a). Aluminum derivative products introduced in later proclamations in 2020 and 2025 are deliberately excluded from the data sample, as they fall outside Chapter 76. Additionally aluminium derivatives vary widely in aluminum content, and are classified across 15 HTS chapters including them would introduce heterogeneity and measurement error resulting in weakening the validity of the treatment definitions and the data sample.

Data was collected at HTS-10 level and “Imports for Consumption” was selected to ensure only goods that cleared customs and paid the Section 232 tariff were included, excluding goods in transit or bonded warehouses (USITC DataWeb, 2026). As USITC DataWeb provides no filtering option for Section 232 aluminum tariffs specifically, the seven Chapter 76 headings at HTS-6 level: 7601, 7604, 7605, 7606, 7607, 7608 and 7609, were manually identified and each underlying HTS-10 sub-heading was individually manually selected to avoid including products never subject to the tariff (USITC DataWeb, 2026; Office of the President, 2018a). Selected HTS-6 and HTS-10 headings are presented in Table 1.

Table 1: HTS Chapter 76 Headings included.

| **HTS Chapter 76 Headings:**<br>HTS-6 & HTS-10 | **Definitions**: |
|---|---|
| 7601 | Unwrought aluminum |
| 7604 | Bars, Rods and Profiles |
| 7605 | Wire |
| 7606 | Plates, Sheets and Strip |
| 7607 | Foil |
| 7608 | Tubes, Pipes |
| 7609 | Tube or Pipe fittings |
| 7616.99.51 | Castings and forgings of aluminum |
| 7616.99.51.30 | Sub-heading subject to Section 232: Ladders |
| 7616.99.51.40 | Sub-heading subject to Section 232: Venetian blinds and parts thereof |

| | |
|---|---|
| 7616.99.51.60 | Sub-heading subject to Section 232: Castings |
| 7616.99.51.70 | Sub-heading subject to Section 232: Forgings |
| 7616.99.51.90 | Sub-heading subject to Section 232: Other |

Table 1: Chapter 76 Headings at HTS-6 included in the data sample.
Source: USITC, (2026).

### 4.3.3 Data Construction

After the manual selection process, data was downloaded from the USITC DataWeb into Excel where all variables were checked for consistency across units of measurement. Sub-heading 7616.99.51.40 was removed from the sample as it was reported in numbers rather than kilograms, making it incompatible with volume-based analysis. This removal is not considered to interfere with the results as the sub-heading covers "Venetian blinds and parts thereof" constituting a negligible share of total U.S. aluminum imports, but is acknowledged for transparency (USITC DataWeb, 2026). After sorting the raw data in Excel, it was imported to Stata with 104,663 initial observations. Summary statistics for import volumes were generated prior to any transformations and the sample-period specific means in Table 2 are used to validate results from import share specifications by cross-checking against their implied absolute volumes equivalents. The data was then collapsed to country-month level and a time variable was constructed for monthly import shares of total U.S aluminum imports. Consistency was validated against the raw Excel file throughout to ensure no observations were lost or altered during the process. All coding steps were logged in do-files ensuring full replicability of the analysis.

Table 2: Average Monthly U.S. Aluminum Imports

| **Sample Period** | **Mean** (million kg) | **Min** (million kg) | **Max** (million kg) |
|---|---|---|---|
| Full sample 2015-2025 | 482 | 314 | 770 |
| 2018 Episode: sample 2015-2019 | 503 | 375 | 770 |
| 2025 Episode: sample 2022-2025 | 473 | 314 | 665 |

Table 2: Average Monthly U.S. Aluminum Imports by Sample Period.

Source: Authors' calculations based on USITC DataWeb (2026).
Note: Import volumes reflect total U.S. aluminum imports within the seven Chapter 76 HTS headings included in this study and do not represent total U.S. aluminum imports across all product categories.

## 4.4 Data Limitations

Several data limitations must be acknowledged. By deliberately excluding aluminum derivatives and downstream products the scope of this study is limited meaning that tariff effects transmitted through downstream supply chains fall outside the analysis. Additionally restricting to tariff-affected products removes the possibility of a within-sample comparison between tariffed and non-tariffed goods, which would have strengthened causal identification, however the current pre- and post-periods allow for temporal comparison of the same products. The absence of a single consolidated reference document covering all Section 232 aluminum tariff modifications introduces a risk of misclassification when mapping exemption status across the full study period. This limitation is addressed through systematic mapping of all relevant presidential proclamations in Appendix 1, cross-checked against existing academic documentation of Section 232 modifications (Weaver, 2019).

Since the data is collected from the USITC DataWeb which is based on mandatory customs declarations for aluminum imports, it automatically excludes informal or undeclared imports of aluminum. Since customs records are declared based on the origin of the export, transhipment cannot be detected and is therefore not accounted for in the data. Meaning that aluminum products that have been produced in one country and then rerouted through a third country in order to avoid the tariff before entering the U.S. customs are not correctly captured. This leaves shifts in country-level import shares to perhaps reflect routing changes rather than genuine sourcing changes which should be considered when interpreting the results. This study is intentionally limited to country-level import share dynamics and does not extend to price effects, domestic production response, welfare or employment outcomes, as these have been addressed in existing literature or fall outside the scope.

# 5. Methodology

## 5.1 Difference-in-Differences Framework

Drawing on theoretical insights from previous literature, this study employs Difference-in-Difference (DiD) frameworks to assess the causal effect of the variations in exemption status on U.S. country-level sourcing. DiD is a quasi-experimental design that uses longitudinal data from treatment and control groups to construct comparisons which enable estimation of causal effects (Angrist & Pischke, 2008). Using DiD rather than only comparing visual import trends before and after the tariff episodes allows the average treatment effect to be isolated from confounding factors that may influence sourcing patterns independently of the tariff. By comparing the changes in outcomes over time between a group that received the treatment and a group that did not, the DiD design controls for any time-invariant differences between countries as well as common shocks affecting all countries simultaneously (Angrist & Pischke, 2008). The treatment effect is identified by separating variations between groups and over time, and subtracting the treated group's change from the control group's change leaving only the net impact to the loss of exemption status.

The mathematical DiD effect is estimated as follows:

1) $$DiD_{Effect} = (Y_{Treatment,\ Post} - Y_{Treatment,\ pre}) - (Y_{Control,\ Post} - Y_{Control,\ pre})$$

Where Y represents the outcome variable for the treatment or control group in pre- or post- event period. The $DiD_{Effect}$ is the average treatment effect which is the difference in the change in the outcome variable between treatment and control groups following a tariff episode.

### 5.1.1 Outcome Variables

The outcome variable $Y_{it}$ is measured using two dependent variables. The primary dependent variable is country-level import shares since trade diversion is considered a compositional phenomenon rather than a purely volume change. Import shares are therefore the most direct measure of sourcing reallocation as it captures shifts access of total market share, closest aligned with the research question. However, import shares introduces a compositional constraint, since shares sum to one across all source countries a rise in one country's share mechanically implies a loss elsewhere by construction (Aitchison, 1994). Introducing mechanical interdependence between all units in the sample (Aitchison, 1994, pp. 73-74). In a DiD context this is particularly problematic as it introduces mechanical interference between treated and control groups, potentially contaminating the counterfactual and violating the no-inference requirement of SUTVA. This is visually apparent as perfect mirroring in Figure 3.

Absolute import volumes in kilograms are therefore included as a complementary Y as a decline in one country's export does not mechanically affect another's. Although avoiding the compositional constraint absolute volumes introduce demand-side noise since aggregate U.S. aluminum demand fluctuates with macroeconomic conditions independently of tariff policy. Using complementary Y therefore allows for a cleaner assessment of whether observed share movements reflect genuine trade volume changes or compositional artefacts.

## 5.2 Main DiD Specifications

The two tariff episodes are estimated in separate DiD specifications, as each reflects a distinct treatment environment with slightly different underlying economic mechanisms. The 2018 episode involves staggered treatment timing, where countries lost exemption status at different points in time, requiring a modified extension of the standard DiD estimator. The 2025 episode involves simultaneous universal treatment, making the standard two-way fixed effects specification appropriate. This separation was made to ensure that the two episodes remain methodologically comparable despite their structural differences.

Following Angrist and Pischke (2008, p.177) the regression equation for the standard DiD framework the Two-Way Fixed Effects baseline specification is estimated as:

2) $$Y_{it} = \alpha_i + \lambda_t + \beta_2(Treated_i \text{ x } Post_t) + \varepsilon_{it}$$

Where $\alpha_i$ denotes country fixed effects absorbing time-invariant country characteristics, $\lambda_t$ denotes time fixed effects absorbing common shocks affecting all countries simultaneously. $Treated_i$ is a binary variable equal to one for treated countries and zero for the control group. $Post_t$ is a binary variable equal to one from the respective treatment date and onwards. $\beta_2$ is the coefficient of interest capturing the differential change in import share for treated countries relative to control countries following the tariff shock and $\varepsilon_{it}$ is the error term. The outcome variable $Y_{it}$ is either import shares or absolute volumes in kilograms, central to how trade diversion is measured in this study and is discussed in the following section. The treatment variable, ($Treated_i$ x $Post_t$) is the loss of exemption status which is a binary indicator equal to one when a country transitions from holding tariff relief, to facing the full aluminum tariff burden, and equal to zero otherwise. Exemption status is determined by the presidential proclamations and varies across countries over time.

The methodological limitation with the standard DiD regression equation, is that it represents a single pooled average treatment effect for all countries within the treatment-group (Angrist & Pischke, 2008). Therefore under staggered treatment timing, where countries within the same country-group get treated at different times the $\beta_2$ will mask heterogeneous responses across individual countries (Roth et al., 2023). As it treats already-treated units as controls for later-treated units, producing biased estimates with potentially negative weights, known as the forbidden comparison problem (Goodman-Bacon, 2021). Therefore the Callaway and Sant'Anna (2021) estimator is employed as the main DiD specification for the 2018 episode.

Following Callaway and Sant'Anna (2021, p. 203), the average treatment effect is estimated as:

$$ATT(g, t) = E[Y_t(g) - Y_t(0) | G_g = 1] \tag{3}$$

The CS estimator is built around group-time average treatment effects written as ATT(g,t) representing the DiD effect, where *g* denotes the period when a group first received treatment and *t* denotes the time period being evaluated (Callaway & Sant'Anna, 2021, p. 204). The CS estimator estimates the group-time average treatment effect ATT (g,t), constructed as a weighted average across all treatment cohorts with weights proportional to cohort size, meaning that cohorts with more observations contribute more to the overall estimate (Callaway and

Sant'Anna, 2021). By estimating ATT (g,t) separately for each group sharing the same treatment date and using not-yet-treated units as clean dynamic controls the CS estimator avoids the negative weighting and the forbidden comparison problem inherent in the standard TWFE under staggered treatment timing (Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021).

Both DiD specifications are estimated with cluster-robust standard errors at the country-level, since treatment was assigned at the country-level meaning all observations from the same country share the same treatment assignment (Abadie et al., 2017; Angrist & Pischke, 2008). Clustering at the country-level allows for arbitrary correlation of error terms within countries across time while assuming independence across countries, producing reliable standard errors that reflect the true number of independent units rather than the number of observations (Cameron & Miller, 2015). Both specifications meet the minimum threshold as they each have 50-62 clusters ensuring that the reported p-values and confidence intervals can be interpreted with confidence (Cameron & Miller, 2015).

## 5.3 Assumptions

In order to ensure causal DiD estimates, several underlying assumptions must be met, summarized in Table 3.

Table 3: Summarized Assumptions for causal effects with DiD

| **Assumption** | **Definition** | **Source** |
|---|---|---|
| 1. Exchangeability | Treated and untreated groups would have had the same outcomes if they received the same treatment. | Hernán & Robins (2025) |
| 2. Positivity | Every unit has a non-zero probability of receiving either treatment or control status. | Hernán & Robins (2025) |
| 3. Intervention unrelated to outcome at baseline | Treatment assignment was not determined by prior outcome levels. | Hernán & Robins (2025); Angrist & Pischke (2008) |

| | | |
|---|---|---|
| 4. Stable Group Composition | Treatment and control groups remain constant across the sample period. | Angrist & Pischke (2008) |
| Absorbing State Assumption *(CS estimator)* | Once a unit receives treatment it remains treated in all subsequent periods. Ruling out units that switch between treatment groups. | Callaway and Sant'Anna (2021) |
| 5. Parallel Trends Assumption | In the absence of treatment, treated and control groups would have followed the same outcome trend over time. | Angrist & Pischke (2008); Roth et al. (2023) |
| 6. SUTVA: Stable Unit Treatment Value Assumption | A unit's potential outcome is only affected by its own treatment status and not the treatment status of others. Underlying requirements must be met:<br>a) no-interference<br>b) no hidden variations of treatment<br>c) no spillover effects | Rubin (1980); Hernán & Robins (2025) |

Table 3: Summarized assumptions for causal effects with DiD.
Sources: Exchangability, Positivity and SUTVA (Hernán & Robins, 2025)., SUTVA origin (Rubin, 1980)., Intervention unrelated to baseline and parallel trends (Angrist & Pischke, 2008).

As both Section 232 tariff episodes created sharp externally imposed policy shocks on clear dates, with exemption status determined by U.S. foreign policy considerations rather than countries' own trade performance. It created a plausibly exogenous natural experiment, perfectly aligned with the first three foundational assumptions for a causal DiD design in Table 3.

Stable group composition requires treatment and control groups remain constant throughout the sample period. The frequently shifting Section 232 exemption architecture, meant that countries switched treatment status from exempted to non-exempted throughout the 2018 sample period, violating this assumption. Addressed through the use of cohort-specific results estimated with the CS-estimator. The 2025 episode instead had universal treatment but two countries were subject to additional economic treatment beyond Section 232 tariffs which were excluded from the sample to address this assumption (see Section 5.4). The no-interference requirement of SUTVA (Rubin, 1980), is inherently challenged in the import share setting due to the compositional constraint, addressed by including absolute volumes for both episodes. The no hidden variations component is satisfied as a uniform tariff rate was applied across all non-exempt countries, ensuring an identical shock.

The parallel trends assumption is the core identifying assumption and is examined formally in the following section. It states that in the absence of Section 232 tariffs, the import shares of treated and control countries would have followed the same trend over time (Roth et al., 2023; Angrist & Pischke, 2008). However, the parallel trends assumption can never be proven, but it can be supported or rejected by visual evidence of mean outcomes for both groups pre-treatment (Roth et al., 2023). Results from the parallel trends tests for both episodes can be found in Section 6. While rejection of the parallel trends assumption means estimates cannot be interpreted as causal effects, the significance of pre-trend violations remains debated in econometric literature, for a comprehensive discussion see Roth et al. (2023).

## 5.4 Treatment Definition

In both episodes treatment assignment is determined by presidential proclamations rather than countries' own trade performance, addressing the DiD assumptions. Further a minimum of 10 observations per country annually is applied to ensure data consistency across both episodes.

### 5.4.1 The 2018 Episode

The sample period runs from January 2015 to April 2019. With a pre-treatment window from January 2015 to February 2018, and a post-treatment window from April 2018 to April 2019. Importantly, March 2018 is a partial treatment month as tariff announcements were published in the beginning but first effective at the end of the month (Office of the President, 2018a), including it would risk violating the no-anticipation assumption since behavior might change already after the initial announcement. Therefore observations are excluded, but the treatment is still used in the estimations handled automatically by the CS estimator (Callaway and Sant'Anna, 2021). April 2019 ends the post-treatment period to avoid Canada and Mexico switching treatment groups violating the absorbing state assumption, as they were re-exempted in May

2019. Treatment cohorts and control group classifications are defined in Table 4, based on proclamation effective dates.

Table 4: Treatment Classification Used in the DiD for the 2018 Episode.

| **Group** | **Countries** | **Rationale** |
|---|---|---|
| Treated: *Countries never received "treatment" in terms of exemptions as tariff reliefs.* | All countries never receiving exemption status (of minimum 10 observations) | Countries never appeared in any presidential proclamations or Department of Commerce announcements, indicating no tariff relief. |
| Never-treated controls: *Countries maintained tariff relief, either by fully exempted or quota arrangement.* | Australia, Argentina | Argentina and Australia maintained a quota arrangement, stated in Proclamation 9739, (Office of the President, 2018b) |
| Treatment cohorts: | (1) May 2018 Cohort: *South Korea* | (1) South Korea lost exemption status in May 2018, stated in Proclamation 9739, (Office of the President 2018b). |
| | (2) June 2018 Cohort: *Canada, Mexico, EU and Brazil* | (2) Canada, Mexico, EU and Brazil lost tariff relief in June 2018, stated in Proclamation 9758 (Office of the President 2018b) |

Table 4: Treatment Definition 2018 Episode.
Source: Office of the President; Presidential Proclamations (2018a, 2018b, 2018c, 2019, 2020, 2021, 2023, 2025a, 2025b), and announcements from the Department of Commerce DoC, (2021, 2022).
Note: The CS estimator allows for including March 2018 as the treatment date without observations and automatically accounts for this (Callaway and Sant'Anna, 2021).

### 5.4.2 The 2025 Episode

The main specification for the 2025 episode estimates trade diversion following the universal elimination of all remaining exemptions in March 2025. The sample period runs from January 2022 to December 2025. With a post-treatment period from March 2025 to December 2025, leaving nine months of post-tariff implementation. Treatment and control group classifications are defined in Table 5 based on proclamation effective dates.

Table 5: Treatment Classifications Used in DiD for the 2025 Episode

| Group | Countries | Rationale |
|---|---|---|
| Treated | Canada, Mexico, EU, Argentina, Australia | Countries that lost tariff relief (exemption status or quota arrangement) following the unified removal of exemptions stated in Proclamation 10895 (Office of the President, 2025a). |
| Control *(Never-treated)* | Countries that never were subject to any form of tariff relief during DiD 2 sample period. | Countries that already were fully tariffed, at the time of the exemption losses (Office of the President, 2025a). |
| Excluded | Russia, UK | Excluding countries that were subject to additional economic mechanisms during the sample period. Russia with 200% economic sanctions and UK with a bilateral trade agreement (Office of the President; 2023, 2025b) |

Table 5: Treatment Definition 2025 Episode.
Source: Office of the President; Presidential Proclamations (2018a, 2018b, 2018c, 2019, 2020, 2021, 2023, 2025a, 2025b), and announcements from the Department of Commerce DoC, (2021, 2022).

### 5.4.3 Comparability of Treatment Effects Across Episodes

As shown in Table 4 and 5, the control groups differ across the two episodes, which limits direct comparability of the estimated coefficients. In the 2018 episode, treated countries are measured relative to countries that maintained exemption status throughout the sample period, providing a clean counterfactual that shares the same pre-treatment tariff status as the treated cohorts. In the 2025 episode, the universal removal of exemptions left no country retaining tariff relief, meaning treated countries are instead measured relative to countries that were never exempt. These never-exempt countries serve as the only available control group in 2025, whereas in 2018 they form a treatment cohort as their immediate tariff exposure from March 2018 makes them a less sustainable counterfactual than countries that were initially exempt.

Because the two episodes are estimated against fundamentally different counterfactuals, the coefficients are not directly comparable in magnitude and any cross-episode magnitude comparison would require methodological extensions beyond the scope of this study, discussed further in Section 7. Nevertheless, both coefficients capture sourcing shifts away from countries losing exemption status, making them comparable in direction and allowing for a meaningful qualitative assessment of how sourcing patterns responded across the two episodes.

## 5.5 Robustness Checks

Robustness checks are conducted across both episodes to ensure that assumptions are met and that the results are reliable. Firstly, by re-estimating both specifications using absolute volumes as the dependent variable, holding the sample period and treatment structure constant, we can confirm that findings are not driven by the compositional constraint. For the 2018 episode the post-treatment window is extended six years by excluding re-exempted countries to examine whether the short-run effects reflect temporary disruption or lasting structural reallocation.

For the 2025 episode the treatment group is restricted to fully exempt countries only, testing whether the effects are more homogeneous. Furthermore, the main pooled specification for the 2025 episode is replaced with country-specific interaction terms producing separate treatment effect estimates for each formerly exempt country, to examine whether the pooled average treatment effect masks heterogeneous country-level responses.

# 6. Empirical Analysis

## 6.1 Descriptive Analysis

This section presents the descriptive statistics for the U.S. aluminum imports of products included in HTS Chapter 76, subject to the Section 232 aluminum tariffs. The sample period of the descriptive statistics ranges from January 2015 to January 2026 providing sufficient pre- and post-data for displaying broad sourcing trends related to the tariff episodes.

### 6.1.1 Total U.S. Aluminum Imports Over Time

Figure 1: Total U.S. HTS Chapter 76 Aluminum Imports Over Time

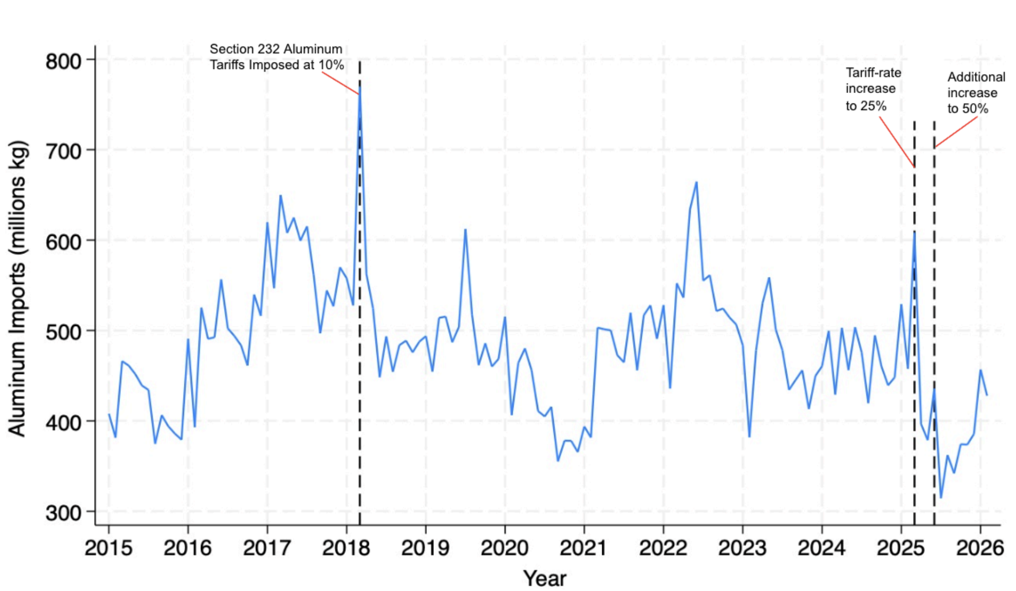



Figure 1: Total U.S. Aluminum Imports Over Time (2015-2026).
Source: Authors calculations based on USITC DataWeb, (2026).

Figure 1, displays total U.S. aluminum imports within HTS Chapter 76 in absolute volume, over 2015 to early 2026. There are three vertical dashed lines indicating the tariff rate increases starting in March 2018, with tariff implementation at 10% and March 2025, increasing to 25% and  June 2025, increasing to 50%. Including tariff rate increase events displays interesting market behaviour related to the tariff rate increases.

Key trends observed from the general trade pattern is a notable surge in import volumes observed in early 2018, consistent with proactive behaviour earlier described as front-loading (Lu & Milkov, 2026), ahead of the Section 232 tariff implementation in March 2018, followed by a sustained decline in subsequent months. There is a further dip notable around 2020, possibly indicating Covid-19 pandemic disrupting global supply chains and reducing import volumes. Furthermore, a similar front-loading pattern as observed in early 2018, is visible ahead of March and June 2025 tariff-rate increases, followed by a sharp decline in import volumes in subsequent months, with the all-time low marked at around 320 million kg in mid 2025. The overall trade pattern observed, started at pre-tariff levels, around 400 million kg in 2015, followed by several spikes, reaching up to 780 million kg, and an increase in general import volume up until the last two tariff-increases. Ending the general trade pattern at pre-tariff levels, suggesting the U.S. continued importing aluminum at similar quantities but potentially from different countries.

### 6.1.2 Country-Level Sourcing Patterns

Figure 2: Total Import Shares by 10 Largest U.S. Aluminum Sourcing Countries

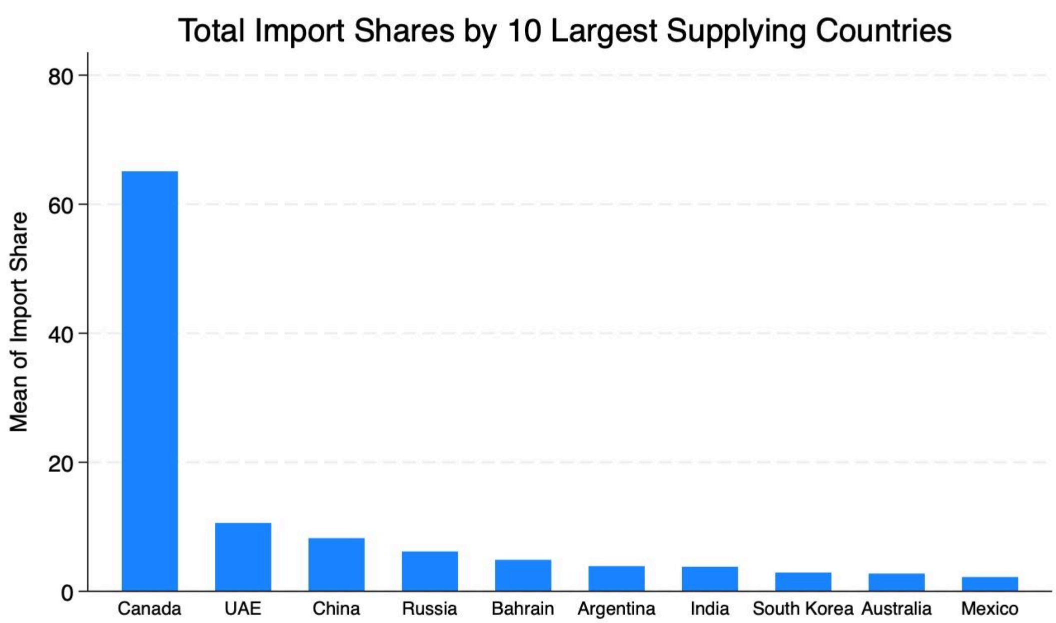



Figure 2: Total Import Shares by 10 Largest U.S. Aluminum Sourcing Countries, throughout the sample period.
Source: Authors calculations based on USITC DataWeb, (2026).

Figure 2, displays the mean import shares of the ten largest U.S. aluminum sourcing countries of aluminum products within HTS Chapter 76, across the full descriptive sample period ranked in descending order. Canada is by far the dominant supplier, averaging approximately 65% of total U.S. aluminum imports, roughly six times larger than the second-largest supplier, the UAE. The remaining nine countries each individually account for less than 10%. This unequal distribution across countries is what later justifies the negative weighting problematics in the cohort- and country specific DiD models.

### 6.1.3 Exempted vs. Non-Exempted Countries

Figure 3: U.S. Aluminum Import Shares: Exempted vs. Non-Exempted countries, 2015-2026.

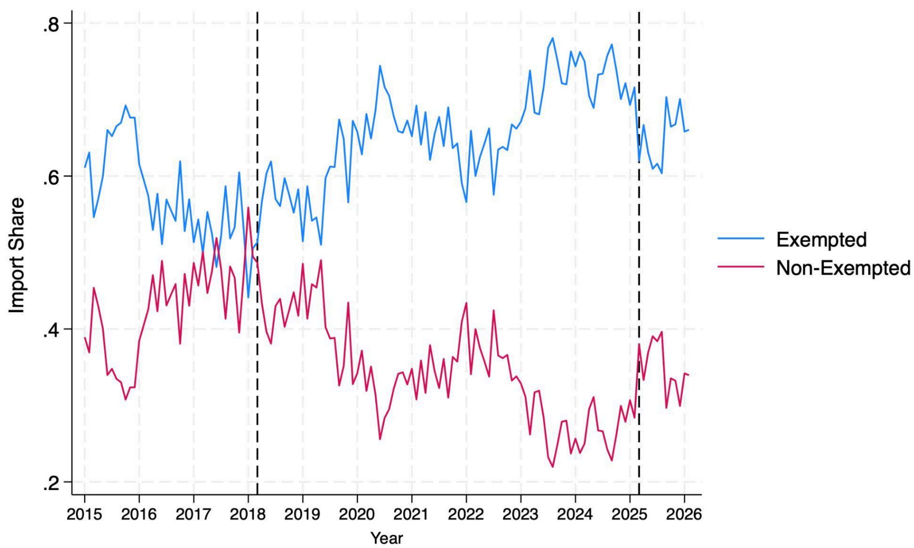



Figure 3: U.S. Aluminum Import Shares: Exempted vs. Non-Exempted Countries, 2015-2026.
Source: Authors calculations based on USITC DataWeb, (2026).
Note: Treatment group definitions can be found in Appendix as Table 7.

Figure 4: U.S. Aluminum Import Volumes: Exempted vs. Non-Exempted countries, 2015-2026.

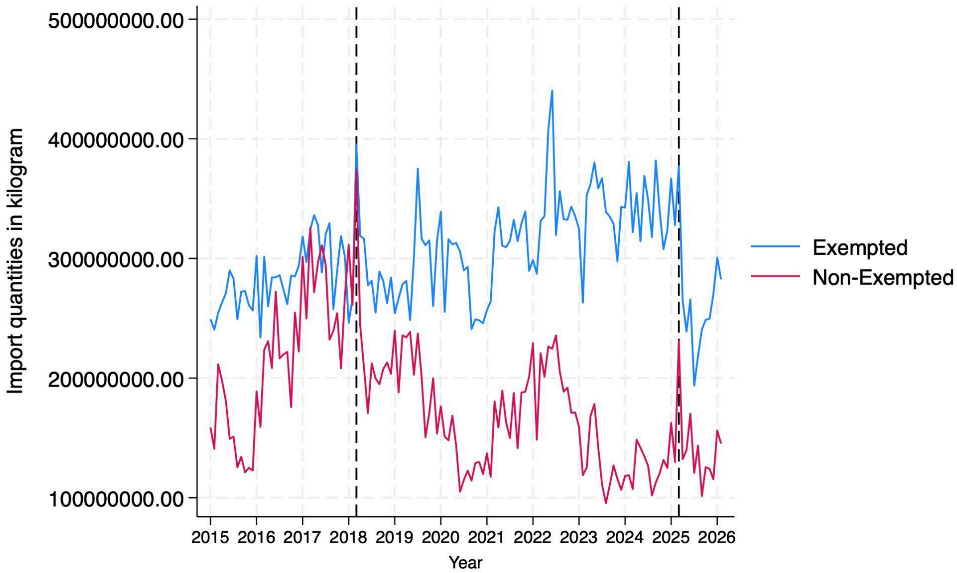



Figure 4: Total aluminum imports in absolute volume (kg): Exempt vs Non-Exempt countries, 2015-2026.
Source: Authors calculations based on USITC DataWeb, (2026).
Note: Treatment group definitions can be found in Appendix as Table 7.

Figure 3 and 4 display exempt and non-exempt country import shares and absolute volumes respectively across the full sample period. Where Figure 3, visually illustrates the compositional constraint with import shares by the perfectly inverse pattern between the two series throughout. Meaning that Figure 3 cannot be interpreted as independent evidence of sourcing shifts, but as visual support for the compositional constraint (Aitchison, 1994). Figure 4, addresses this by plotting absolute volumes removing the mechanical constraint showing genuine overall demand fluctuations rather than pure compositional constraints. Crucially, the gap between the two series widens visibly after both tariff episodes, with exempt volumes remaining elevated while non-exempt volumes trend downward. Which provides clean descriptive evidence that the sourcing shifts toward exempt countries reflect a genuine behavioural response, rather than a compositional artefact, motivating the formal DiD analysis that follows.

## 6.2 Empirical Results: Difference-in-Difference

This section presents the empirical findings from the DiD analysis. First by visually validating the parallel trends assumption separately for both episodes as well as across both choices of dependent variables. Followed by estimating the causal impact of the Section 232 aluminum tariff exemption removals on country-level import sourcing for both tariff episodes. Complemented with robustness checks using alternative specifications.

Results for both DiD estimators are estimated with an identification strategy focusing on variation in exemption status rather than variation in tariff rate, where the logic is that if Section 232 tariffs caused trade diversion, countries losing exemption status should experience a relative decline in the outcome variable compared to the control group. A negative DiD coefficient indicates a loss of import share or absolute volumes following the loss of exemption status, relative to the control group, which is defined separately for each episode.

## 6.2.1 Validating the Parallel Trends Assumption

The null hypothesis is that no systematic pre-treatment differences exist between treated and control groups in any of the parallel trends tests displayed below. Pre-treatment coefficients clustered around zero with no systematic trend support the assumption, while statistically significant or visually diverging pre-treatment patterns reject it (Baker et al., 2022). The validation of parallel trends assumption is presented in event study plots for the 2018 episode, consistent with the CS estimator (Callaway & Sant'Anna, 2021) while the 2025 episode shows average means plotted consistent with the standard DiD without staggered treatment timing (Roth et al., 2023)

Figure 5: Event study plot as pre-trends test for both dependent variable specifications, 2018 episode.

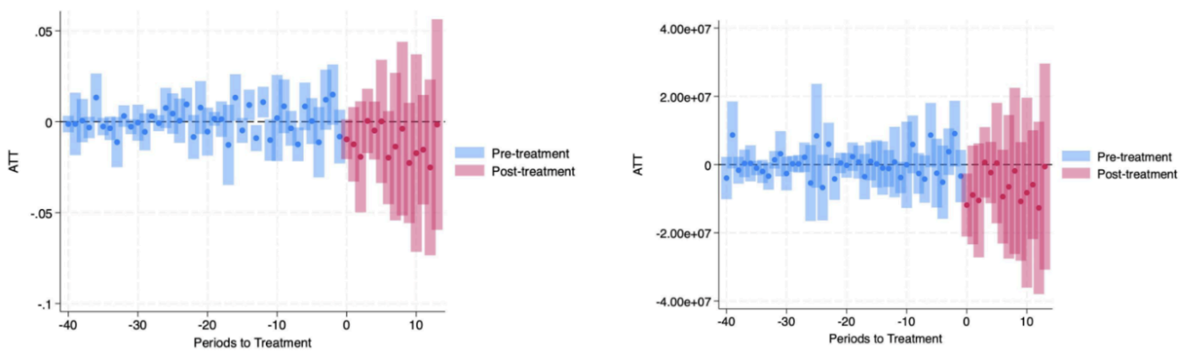



Figure 5: Event study plot as pre-trends test for both dependent variable specifications, 2018 episode.
Source: Authors' calculations based on USITC (2026) and Callaway & Sant'Anna (2021).
Note: Both figures are displayed in order to display the differences between the import share specification, to the left and the volume specification to the right.

Figure 5 displays event study plots for the 2018 episodes across both dependent variable specifications. The majority of the pre-treatment coefficients are scattered closely around zero across the 40 pre-treatment months, providing visual support for the parallel trends assumption regardless of dependent variable choice. However the periods immediately preceding treatment show more upward movement, with coefficients departing from zero in the final months before March 2018. Results from the 2018 episode should therefore be interpreted with some caution.

Figure 6: Pre-trends test for the both dependent variable specifications, 2025 episode.

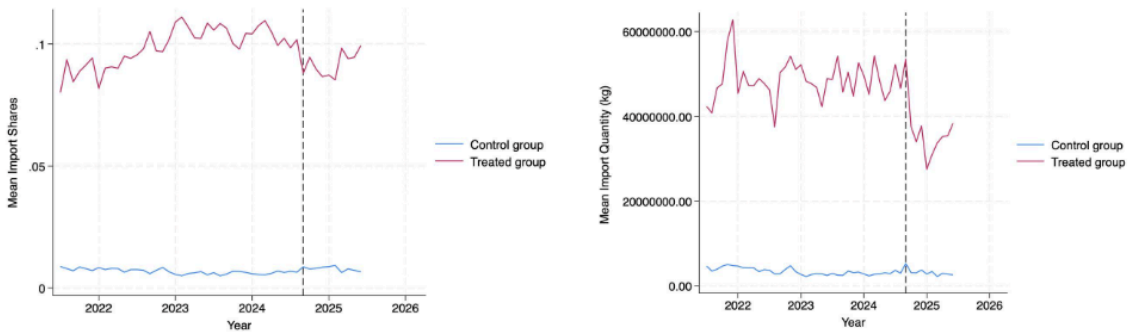



Figure 6: Pre-trends test for the both dependent variable specifications, 2025 episode.
Source: Authors' calculations based on USITC, (2026)
Note: The pre-trends test for the 2025 episode was made by plotting mean import shares for treated and control groups over the given sample period.

Figure 6 displays pre-trend plots for the 2025 episode. Pre-treatment trends from January 2022 to February 2025 diverge visibly, with the treated group fluctuating while the control group remains largely stable, failing to support the parallel trends assumption. Results from the 2025 episode should therefore be interpreted with caution, although rejection of parallel trends does not automatically invalidate the estimates (Roth et al., 2023).

### 6.2.2 Results From the 2018 Episode

Results from the 2018 episode illustrate the effect of losing exemption status relative to the always-exempted control group, consisting of Argentina and Australia.

Result-Table 1: Main Specification for the 2018 episode using import shares.

| VARIABLES | (1)<br>Main Specification |
|---|---|
| Overall ATT | -0.0119 |
| | (0.0163) |
| Never-Exempt | -0.0088 |
| | (0.0169) |
| May 2018 cohort | -0.0199*** |
| | (0.0073) |
| June 2018 cohort | 0.0443** |
| | (0.0205) |
| Observations | 2318 |
| Groups | 55 |
| Country FE | Yes |
| Time FE | Yes |

Source: Source: Authors' calculations based on USITC DataWeb (2026). Callaway and Sant'Anna (2021) estimator with not-yet-treated comparison group.
Note: Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.10. Control group: Argentina and Australia. Callaway and Sant'Anna (2021) estimator with not-yet-treated comparison group.

Result-Table 1, presents the results from the main specification for the 2018 episode. The overall group-time ATT yielded a negative coefficient without statistical significance, suggesting that on average across all treatment cohorts and post-treatment periods, treated countries experienced a 1.19 percentage point (p-value=0.464) decline in import share relative to the always-exempted control group following the March 2018 tariff episode. Similarly the never-exempt cohort showed a negative coefficient suggesting a 0.8 percentage point (p-value=0.601) reduction in import shares compared to the control group but also not statistically significant. The May 2018 cohort includes countries that lost exemption status in May 2018, including South Korea, who lost approximately 2 percentage points (p-value=0.006) in import share relative to the control group following their loss of exemption, significant at the 1% level. The June 2018 cohort shows a statistically significant increase of 4.43 percentage points in import shares relative to the control group. Representing countries that lost tariff relief in June 2018 including: Canada, Mexico, aggregated EU and Brazil, this positive effect could be driven heavily by Canada's large weight in the cohort.

The wider confidence interval relative to the May-cohort, reflects greater within-cohort heterogeneity, as Canada, Mexico, the EU and Brazil differ substantially in size and trade relationship depth compared to the single-country May-cohort. The weighted cohort-average should be interpreted with caution as it is heavily influenced by Canada's structural dominance at approximately 65% of total U.S. aluminum imports, Figure 2. Meaning the cohort-average decline likely reflects Canada's individual decline rather than a uniform effect across all four countries. To address the compositional constraint concern with import shares, robustness check 1 for episode 2018 re-estimates the main specification using absolute volumes. Results are presented in Result-Table 2, directly compared to the share-specification.

Result-Table 2: Comparison of Main Specification and Robustness Check 1 for 2018 Episode.

| | (1) | (2) |
|---|---|---|
| VARIABLES | Main Specification | Volume Specification |
| Overall ATT | -0.0119 | -5964687 |
| | (0.0163) | (8612409) |
| Never-Exempt | -0.0088 | -4015017 |
| | (0.0169) | (8852348) |
| May 2018 cohort | -0.0199*** | -9420806** |
| | (0.0073) | (3911922) |
| June 2018 cohort | 0.0443** | 27,000,000** |
| | (0.0205) | (1,380,000) |
| Observations | 2318 | 2318 |
| Groups | 55 | 55 |
| Country FE | Yes | Yes |
| Time FE | Yes | Yes |

Source: Authors' calculations based on USITC DataWeb (2026. Callaway and Sant'Anna (2021) estimator with not-yet-treated comparison group.
Note: The main specification dependent variable is import share. Robustness Check 1 dependent variable is absolute import volumes in kilograms. Robustness Check 1 coefficient expressed in kilograms. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.10. Control group: Argentina and Australia. Callaway and Sant'Anna (2021) estimator with not-yet-treated comparison group.

Result-table 2, compares the results from the main specification including the corresponding cohorts with the volume specification. The overall ATT remains insignificant for RC1, while May 2018 and the June 2018 cohorts show statistically significant volume declines consistent with the import share result from the main specification.

Results show that the May-cohort lost approximately 9.4 million kg of import volume relative to the control group, consistent with the share decline. The June-cohort lost approximately 27 million kg relative to controls, suggesting a relatively larger decline than implied by the 4.4

percentage decline in the main specification representing 22 million kg. The gap between the implied 22 million kg and the observed 27 million kg likely reflects Canada's structural dominance, where modest percentage point declines in Canada's share translate into disproportionately large absolute volume reductions relative to what cohort average share decline would imply. The consistency of significant effects across both dependent variable specifications confirms the cohort results reflect genuine trade volume changes rather than artefacts of the compositional constraint. The May-cohort significance weakens slightly from 1% to 5% when switching to absolute volumes, likely reflecting the additional demand-noise, while the June-cohort remains significant at the 5% level, consistent with the main specification.

Having confirmed that the significance observed was not reflecting the compositional constraint but genuine trade volume changes, robustness check 2 extends the post-treatment window to approximately six years, to test if short-run cohort-specific effects identified in the main specification persist over a longer horizon, displayed below:

Result-Table 3: Robustness Check 2 for 2018 Episode; *Extending the post-treatment window*

| | (1) |
|---|---|
| VARIABLES | Robustness Check 3 |
| | |
| Overall ATT | -0.0021 |
| | (0.015) |
| Never-Exempt | -0.002 |
| | (0.015) |
| May 2018 cohort | -0,005 |
| | (0.004) |
| | |
| Observations | 5373 |
| Groups | 62 |
| Country FE | Yes |
| Time FE | Yes |

Source: Authors' calculations based on USITC DataWeb (2026. Callaway and Sant'Anna (2021) estimator with not-yet-treated comparison group.
Note: Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.10. Control group: Argentina and Australia. Callaway and Sant'Anna (2021) estimator with not-yet-treated comparison group.

The overall ATT coefficient of -0.0021 remains insignificant. The cohort-specific results show no significant effects for either the never-exempt cohort (p-value of 0.894) or South Korea (p-value of 0.202). The null result therefore persists over a six-year horizon, suggesting that the absence of detectable trade diversion in the main specification does not reflect the brevity of the post-treatment window but rather a genuine absence of detectable persistent sourcing shifts following the 2018 tariff episode. Indicating that sourcing shifts were temporary rather than long-term in the 2018 episode.

### 6.2.3 Results From the 2025 Episode

Having established that the 2018 tariff episode produced no persistent sourcing shift over a six-year horizon, the analysis now turns to the 2025 episode. The following section examines whether the universal removal of all remaining exemptions in March 2025, produced different results. The results indicate the effect of losing exemption status compared to countries always tariffed, the never-exempted control group. Using the standard TWFE, the ATT is displayed below:

Result-table 4: Main specification for 2025 episode.

| | (1) |
|---|---|
| VARIABLES | Main Specification |
| DiD | -0.00853 |
| | (0.0125) |
| Observations | 2,436 |
| Clusters | 62 |
| Country FE | Yes |
| Time FE | Yes |
| Within R2 | 0.00996 |

Source: Authors’ calculations based on USITC DataWeb (2026).
Note: Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.10. Control group: Countries that never received exemption status throughout the sample period. Clusters above threshold, suggesting coefficient can be interpreted with confidence.

Results from the main specification suggests that formerly exempt countries experienced an average decline in 0.85 percentage points (p-value=0.498) in import share relative to never-exempt countries following March 2025. However, this result is not statistically significant at any conventional level and the null hypothesis of no aggregate trade diversion cannot be rejected. The within R-squared of 0.00996 indicates that the regressors explain only 1% of within-country variation after accounting for fixed effects, consistent with the null results.

Result-table 5: Main specification compared to Volume specification (RC1) for 2025 episode.

| VARIABLES | (1)<br>Main Specification<br>(Import Shares) | (2)<br>Robustness Check 1<br>(Absolute Volumes) |
|---|---|---|
| DiD | -0.00853 | -12,030,000 |
| | (0.0125) | (10,660,000) |
| Observations | 2,436 | 2,436 |
| Clusters | 62 | 62 |
| Country FE | Yes | Yes |
| Time FE | Yes | Yes |
| Within R2 | 0.00996 | 0.0611 |

Source: Authors’ calculations based on USITC DataWeb (2026).
Note: Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.10. Control group: Countries that never received exemption status throughout the sample period. Clusters above threshold, suggesting coefficient can be interpreted with confidence.

Result-table 5, compares the main specification with one using absolute volumes as the dependent variable. Suggesting a -12.03 million kg (p-value = 0.263) average decline in imports relative to never-exempt countries. The R-squared value of 0.0611 is larger than in the main specification, indicating that absolute volumes capture slightly more within-country variation but still fails to reach conventional significance thresholds. These results suggest that factors beyond the March 2025 tariff shock drove import share and volume fluctuations.

The null result is consistent across both dependent variable specifications, confirming it is not an artefact of the compositional constraint. Both specifications point in the same direction suggesting a modest decline for treated countries, but neither precisely estimated enough to reject the null hypothesis. However, as established in Section 6.1 the parallel trends assumption cannot be fully confirmed for the 2025 episode, meaning the null result may reflect weak identification rather than a genuine absence of trade diversion. Results should therefore be interpreted with caution, and are discussed further in Section 7.

The treated group included fully exempt and TRQ countries, meaning the tariff shock was not fully uniform across treated units. Robustness check 2 for the 2025 episode restricts the treated group to fully exempt countries only, testing whether the null persists when treatment is more homogeneous, displayed below.

Result-table 6: Restricting to only fully exempt countries (RC 2a &2b), for the 2025 episode.

| | (1) | (2) |
|---|---|---|
| VARIABLES | RC2a (Import Shares) | RC2b (Absolute Volumes) |
| DiD | -0.0261 | -23,250,000 |
| | (0.0162) | (16,400,000) |
| Observations | 2,292 | 2,292 |
| Clusters | 59 | 59 |
| Country FE | Yes | Yes |
| Time FE | Yes | Yes |
| Within R2 | 0.0645 | 0.136 |

Source: Authors' calculations based on USITC DataWeb (2026).

Note: Robustness check 2a uses import shares as dependent variable, and RC2b uses import quantity in kilograms as the dependent variable to address the compositional constraint for the new treatment groups.

Results suggest that when restricting the treatment group to fully exempt countries, it yields a negative coefficient across both dependent variables. Illustrated by the reduced 2.6 percentage points (p-values=0.113) of import share relative to never-exempt countries and the -23.25 million kg (p-value=0.162) relative to never-exempt countries. This is larger than the main specification coefficient of -0.0085, consistent with the expectation that restricting the sample to fully exempt countries produces a larger and cleaner shock. Both specifications in robustness check 2 remain statistically insignificant, failing to reject the null hypothesis. Although the coefficient is larger when restricting to fully exempt countries, it also reduces the number of treated units and widening the standard error relative to the main specification.

The within R-squared values of 0.0645 and 0.136 respectively, are substantially higher than the main specifications of 0.00996, confirming that restricting to fully exempt countries produces a better fitting and more homogeneous model. Despite this improvement, both specifications remain statistically insignificant, confirming that the null result persists even when restricting to the most homogeneous treated group. The consistency of null results across both specifications confirms that it is not driven by the compositional constraint of import shares. The progressive increase within R-squared from 0.0100 in the main specification to 0.136 (RC2b) confirms that treatment heterogeneity suppressed explanatory power in the pooled main specification, yet even the cleanest treated group fails to reach conventional significance thresholds. The insignificance may be partly rooted in the thin control group and larger SE, short post-treatment window or the earlier discussed weak parallel trends all of which will be further discussed in Section 7.

Robustness check 3 extends this further by applying country-specific interaction terms, by replacing the single pooled interaction term with separate interaction terms for each formerly exempt country.

Result-table 7: Country-specific interaction terms for treated countries, 2025 episode (RC3).

| | (1) |
|---|---|
| VARIABLES | Country-Specific Interaction Model |
| DiD: Canada | -0.0812*** |
| | (0.00111) |
| DiD: Mexico | -0.00882*** |
| | (0.00111) |
| DiD: Australia | -0.0182*** |
| | (0.00111) |
| DiD: EU | 0.0129*** |
| | (0.00111) |
| DiD: Argentina | -0.000411 |
| | (0.00111) |
| Observations | 2,436 |
| Clusters | 62 |
| R-squared | 0.158 |
| Country FE | Yes |
| Time FE | Yes |
| Within R2 | 0.158 |

Source: Authors' calculations based on USITC DataWeb (2026).

Note: Coefficients represent country-specific DiD estimates relative to a never-exempt control group. Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.10. The identical standard errors reflect the symmetric binary structure of each interaction term, where each dummy variable has identical within-cluster variances across the 62 clusters. Control group: Countries that never received exemption status throughout the sample period. Clusters above threshold, suggesting coefficient can be interpreted with confidence.

Result-table 7, illustrates that Canada experienced the largest and most significant decline of import shares of approximately 8 percentage points, significant at the 1% level. This large and significant decline is consistent with its dominant supplier position being severely disrupted by the loss of full exemption status in March 2025. Mexico and Australia also show significant negative coefficients indicating a loss of 0.8 and 1.7 percentage points of import shares respectively, following the loss of full exemption status. In contrast the EU showed a statistically significant positive coefficient, indicating an increase in import shares of 1.4 percentage points, relative to the never-exempted control group. A statistically significant, but unexpected finding further discussed in Section 7.3. Argentina shows no statistically significant effect consistent with the quota arrangement already constraining exports below the ceiling before March 2025.

The within R-squared reveals that the country-specific model explains 15.8% of within-country variation compared to the pooled main specification's 1%. Confirming that the treatment effects are highly heterogeneous across countries.

# 7. Analysis and Discussion

Overall results for both episodes revealed that the pooled main specifications for the episode revealed no statistically detectable trade diversion. However each robustness check progressively improved the specification and moved closer to significance. Switching to absolute volumes reduced the compositional constraint and lowered the p-value, restricting the treated group to fully exempt countries produced larger coefficients and substantially higher within R-squared values of up to 0.136. Disaggregating to the country-level revealed statistically significant effects for individual countries at the 1% level and the largely consistent direction of negative coefficients across specifications for formerly exempt countries, suggests that a genuine trade effect exists but that the aggregated pooled specifications lack the precision to detect it. Likely due to the short post-treatment windows, treatment heterogeneity and weak parallel trends identification for both episodes, implying that the aggregate null findings reflect structural limitations of average weighting in staggered DiD designs rather than true absence of effects (Goodman-Bacon, 2021). The evidence therefore points toward an effect that is real but not statistically confirmable at the aggregate level with the data currently available.

The null results for the pooled main specifications suggest that there is no statistically detectable aggregate trade diversion for either 2018 or 2025 sampling periods, while at the disaggregated level there is a genuine trade effect for both episodes separately. Rather than indicating an absence of trade diversion, this pattern suggests that aggregate sourcing reallocation takes time to materialise, while individual countries may experience significant changes earlier. This interpretation aligns with Cigna et al. (2020), who found that the trade-creating diversion effects materialize more slowly than the immediate trade-destroying effect in the U.S.-China trade war. The short post-treatment windows, with ten and nine months of post-treatment data respectively, therefore provide a plausible explanation for the absence of aggregate effects. A further explanation for the null results lies in imperfect competition. Large integrated suppliers such as Canada may partially absorb tariff costs to defend their market access, dampening the immediate sourcing shifts and generating more gradual adjustment dynamics (Brander & Spencer, 1984). This suggests that the aggregated null results may reflect the inability of the pooled specifications to detect early, gradual sourcing adjustment within the post-treatment windows, rather than a genuine absence of tariff effects.

Both episodes separately revealed statistical significance at the disaggregated level, when running cohort- and country-specific specifications. Although estimated using two different versions of the DiD design, the significance reflects the same weighting problem in the pooled specifications suggesting lack of precision in detecting heterogeneity within the groups (Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021). Both results suggest that when a country goes from tariff relieved status to fully tariffed, it generally leads to a decline in imports compared to the control group. For the 2018 episode results show that South Korea lost approximately 2 percentage points in import shares after losing exemption status in May 2018 compared to the always exempted group. Supported by countries losing exemption status in June 2018 who experienced a weighted average of 4.4 percentage point reduction in imports (Result-table 1). The country-specific interaction terms for the 2025 episode revealed substantially different effects across countries. Canada experienced approximately 8 percentage points reduction in import shares compared to the always tariffed control group and Mexico and Australia saw significant reductions in import shares of 0.8 and 1.2 percentage points respectively (Result-table 7).

The country-specific interaction model for the 2025 episode revealed that the EU experienced a significant increase in import share following the 2025 exemption removals, compared to the never-exempt control group. A finding initially counterintuitive given that the EU simultaneously lost its preferential treatment, but the absolute volume graph (Figure 8 in Appendix) strengthens this result, confirming that the EU's gain reflects a genuine increase in import volumes despite losing its preferential treatment after March 2025. As Canada and other major suppliers lost full exemption status in March 2025, U.S. importers sought alternative sources. The visible increase despite losing tariff relief could suggest that the EU benefited and potentially captured some of the diverted demand after the universal exemption removal. However, what appeared as an increase in EU production might also reflect the transshipment as it potentially also could reflect aluminum tariffed products rerouted through EU member states, rather than genuine increase in EU production.

This general trend of decline in exports can be explained through the foundational theory of comparative advantage (Ricardo, 1817). Suggesting that when a country loses exemption status its exports becomes more expensive, when these costs exceed the country's efficiency gains it results in a loss in competitiveness (Ricardo, 1817). This ultimately forces these countries to give up market share to competitors, allowing countries with similar or lower costs to gain market share (Ricardo, 1817). The direction is consistent with trade diversion theory as losing tariff protection reduces your competitive position and import shares from that country declines (Viner, 1950).

However, taking together the results from each DiD specification alone does not provide empirical findings strong enough to support the full trade diversion mechanism. The significant results in this study only imply that import shares decline following exemption removal, but do not prove that import shares increase when granted exemption status. However when combining the significant results from both episodes one could find some empirical evidence that supports the supply disruption and reallocation associated with trade diversion theory. Applying Viner's trade diversion mechanism to the findings of this study, the significant declines in import shares in the cohort- and country specific results for each episode respectively, confirms the supply disruption side as countries losing exemption status largely experienced significant declines in import shares to the U.S., consistent with the trade shifting away from newly tariffed suppliers. The reallocation side is partially confirmed through the unexpected EU finding, suggesting that trade was redirected toward alternative suppliers following the universal exemption removal in March 2025.

## 7.1 Limitations & Future Research

One central limitation of this study is the inability to compare the episodes in magnitude due to different counterfactuals and DiD estimators required for the episodes. Results from the June-cohort in the 2018 episode revealed a weighted average of 4.4 percentage points decline in exports following loss of exemption compared to countries always exempted. While the results from the country-specific interaction terms in 2025 showed that Canada alone experienced a 8 percentage point reduction following the loss of exemption status compared to always-tariffed countries. As the counterfactuals differ between the episodes the results are not directly comparable since the 2018 results show the effect of losing exemption status compared to being exempted, while 2025 show the effect of losing exemption status compared to always being tariffed. Although not directly comparable, the substantial difference in the effect between the June-cohort used in 2018 and the results alone for Canada in 2025 could suggest that the cohorts masked substantial within-cohort heterogeneity. Reflecting a limitation with the CS estimator, which accounts for staggered treatment timing across cohorts, but does not automatically decompose effects within cohorts treated simultaneously (Callaway & Sant'Anna, 2021).

A natural extension of this study is therefore to distinguish between units within the cohort's for the 2018 episode. To address this, one would need to compute country-specific interaction terms with the CS estimator by running the CS estimator separately for each treated country while maintaining staggered timing structure. This methodological extension of this study would address two main limitations with this study, making the episodes directly comparable in magnitude as well as accounting for within-cohort heterogeneity.

A further limitation with this study is the short post-treatment data windows. The 2025 episode only captures nine months of post-treatment data, insufficient for distinguishing temporary disruption from lasting structural reallocation. With three to five years of post-treatment data it would allow parallel trends assumptions to be re-examined and alternative control group constructions to be explored. Furthermore future research should address the structural limitation with the thin never-treated control group in the 2018 episode, consisting of only two countries. By systematically mapping each country's exact exemption status at each point in time directly it would allow countries that switched exemption status to be included without contaminating treatment and control group classifications. If managed, this would extend the control group and enable richer estimation, beyond the absorbing state constraint of the current CS estimator design that limited this study(Callaway & Sant'Anna, 2021).

A further natural extension of this study would be to include a comparable metal not subject to Section 232 tariffs as a counterfactual, allowing for a cleaner identification of sourcing shifts against a stable benchmark. However, the high correlation between metal commodity indexes makes isolating such a counterfactual empirically difficult. The compositional constraint inherent in import shares is a central limitation to this study although addressed by including absolutes as comparisons future research should consider using alternative outcome variables to eliminate the interference.

Beyond the methodological extensions, the scope of this thesis itself could be broadened. This study deliberately excludes aluminum derivative products classified outside HTS Chapter 76, which risks understating the full effect of Section 232 tariffs on U.S. aluminum sourcing. By extending the analysis to derivative products across all relevant HTS chapters, future research would capture a more complete picture of tariff induced sourcing shifts, perhaps reaching more statistical significance. Additionally, collecting data that captures aluminum imports across all HTS chapters would result in a more comprehensive analysis of how Section 232 aluminum tariffs affected the overall U.S. aluminum sourcing patterns. However as of this study, it remains outside the scope leaving it for future research to explore. Extending the scope to examining price and inflation effects followed by the aluminum tariffs would complement the quantity-based sourcing analysis conducted in this thesis, since price mechanism is the theoretical channel through which tariffs drive trade diversion but remains unexamined in this study. Firm-level customs data would further allow disaggregation below the country-level to identify which U.S. industries and buyers drove the sourcing patterns observed in the analysis.

# 8. Conclusion

Relating back to the research aim and objectives of this study, the purpose was to examine whether Section 232 aluminum tariffs reallocated country-level U.S. aluminum import sourcing, across the two tariff episodes. By examining visual descriptive trends and looking at variations in exemption status this study's main research question was answered by the significant cohort- and country-specific decline in import shares related to losing exemption status for both tariff episodes. However this study failed to detect statistically significant aggregate import share shifts and failed to compare the country-level magnitude of effects between the episodes due to the structural differences between the episodes.

## 8.1 Practical Implications

A practical contribution of this study is the systematic mapping of all relevant Section 232 aluminum proclamations into a single consolidated reference document. As no such unified source existed prior to this study, Appendix 1 serves as a replicable foundation for future research. By allowing subsequent studies to build directly on the exemption mapping established here rather than reconstructing it from individual proclamations. This study extends existing literature by incorporating the 2025 tariff episode, providing empirical evidence on how U.S. aluminum import sourcing adjustments across two separate and structurally different policy shocks rather than treating tariff implementation as a one-time intervention. This study also provides empirical evidence of heterogeneous trade diversion effects at the cohort-specific levels following the 2018 episode and country-specific levels following the 2025 episode and demonstrate that the pooled specifications conceal meaningful variation in how individual countries and cohorts respond to changes in exemption status. By focusing exclusively on aluminum rather than treating steel and aluminum as unified, this study provides precise evidence on aluminum-specific sourcing dynamics that existing Section 232 literature obscures through aggregation. As most prior research examined steel and aluminum jointly, this study fills a specific gap by isolating the aluminum market where sourcing patterns, exemption structures and supply dependencies differ meaningfully from steel.

## 8.2 Chapter Summary

This study finds that Section 232 aluminum tariffs did not produce statistically detectable aggregate trade diversion in either the 2018 or 2025 episodes, but disaggregated results reveal significant sourcing shifts correlated with changes in exemption status. The frequently revised and diplomatically negotiated exemption structure suggests that tariffs operated partly as instruments of bilateral leverage rather than purely trade barriers, which itself may explain why sourcing shifts were concentrated, asymmetric and short-term rather than producing the systematic reallocation standard trade diversion theory predicts. While magnitude comparisons between episodes require methodological extensions beyond this study, the available evidence points in the direction that losing exemption status largely results in loss in country-specific exports. Taken together the findings suggest that Section 232 tariffs disrupted established trade relationships when long-term suppliers became tariffed, without producing systematic sourcing reallocation. Future research should extend the methodology in order to estimate causal findings using the mapped framework produced in this study, Appendix 1.

# References

*References are structured in alphabetical order according to the LUSEM standard reference guide. The accessed dates show the date that the sources were accessed latest and links are provided accordingly.*

Abadie, A., Athey, S., Imbens. W. G., Wooldridge, J. (2017). When Should You Adjust Standard Errors for Clustering? NBER Working paper. No. 24003, DOI: https://doi.org/10.3386/w24003

Aitchison, J. (1994). Principles of Compositional Data Analysis. *Lecture Notes-Monograph Series. Vol. 24. pp. 73-81.* DOI: https://www.jstor.org/stable/4355794?seq=1

Angrist, J.D., & Pischke, J.S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton: Princeton University Press.

Amiti, M., Redding. J. S., Weinstein, E. D. (2019). The Impact of the 2018 Tariffs on Prices and Welfare. *Journal of Economic Perspectives. Vol. 33. NO. 4. pp. 187-210.* DOI: https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.33.4.187

Brander, J., & Spencer, B. (1984). Export subsidies and international market share rivalry. *Journal of international economics. Vol. 18, Issue 1-2, pp 83-100.* DOI: https://doi.org/10.1016/0022-1996(85)90006-6

Baker, A.C., Larcker, D. F., & Wang, C. C. Y., (2022). How Much Should We Trust Staggered Difference-in-Difference Estimates? *Journal of Financial Economics. Vol. 144., Issue 2.* DOI: https://doi.org/10.1016/j.jfineco.2022.01.004

Callaway, B., Sant'Anna, H.C. P., (2021). Difference-in-Differences with multiple time periods. *Journal of Econometrics. Vol. 225. Issue 2. pp. 200-230.* DOI: https://doi.org/10.1016/j.jeconom.2020.12.001

Cameron, A. C., & Miller, D. L. (2015). A Practitioner's Guide to Cluster-Robust Inference. *Journal of Human Resources. Vol. 50. Issue 2. pp. 317-372.* DOI: https://doi.org/10.3368/jhr.50.2.317

Carvalho, C. (2025). *Trump and Game Theory -Tariffs as a Geopolitical Strategy*. Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5180046 [Latest Accessed May 5, 2026].

Cigna, S., Meinen, P., Schulte, P. & Steinhoff, N. (2020). *The impact of US tariffs against China on US imports: evidence for trade diversion*? ECB Working paper No. 2503 [pdf], Frankfurt am Main: European Central Bank. Available at: https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2503~ca71d98a53.en.pdf [Latest Accessed April 30, 2026]

Ciuriak, D., & Xiao, J. (2018). Quantifying the Impacts of the US Section 232 Steel and Aluminum Tariffs, SSRN Working Paper No. 3190699. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3190699 [Latest Accessed April 30, 2026]

Durante, A. (2024). *How the Section 232 Tariffs on Steel and Aluminum Harmed the Economy.* Tax Foundation. https://taxfoundation.org/wp-content/uploads/2024/05/How-the-Section-232-Tariffs-on-Steel-and-Aluminum-Harmed-the-Economy-2024.pdf [Latest Accessed April 20, 2026]

Falkner, R. (2026). Geopolitics and Tariffs: An International Relations Perspective. *LSE Public Policy Review. Vol. 4. Issue 2. pp. 1-9*. DOI: https://doi.org/10.31389/lseppr.157

Francois, J., & Baughman, L. (2018). *The Potential Employment Impact of the U.S. Section 232 Steel and Aluminum Tariffs* [pdf]. Trade Partnership Worldwide, Policy Brief. https://tradepartnership.com/wp-content/uploads/2018/03/232EmploymentPolicyBrief.pdf [Latest Accessed April 30, 2026]

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics. Vol. 225., NO. 2. pp. 257-277.* DOI: https://doi.org/10.1016/j.jeconom.2021.03.014

Hernán, M. A., & Robins, J. M. (2025). *Causal inference: What if.* Chapman & Hall/CRC.

Hirschman, O. A. (1945). National Power and the Structure of Foreign Trade, Berkeley: University of California Press.

Hufbauer, G., & Jung, E. (2018). *Steel Profits Gain, but Steel Users Pay, under Trump's Protectionism*. Peterson Institute for International Economics. https://www.piie.com/blogs/trade-and-investment-policy-watch/steel-profits-gain-steel-users-pay-under-trumps [Latest Accessed April 30, 2026]

Johanson, D. S., Schmidtlein, R. K., Kearns, J. E., & Karpel, A. A. (2024). *Economic Impact of Section 232 and 301 Tariffs on U.S. Industries.* United States International Trade Commission, USITC Publications. No. 5405. https://www.usitc.gov/publications/332/pub5405.pdf [Latest Accessed April 30, 2026]

Kaldor, N. (1940). A Note on Tariffs and the Terms of Trade. *The Review of Economic Studies.* Vol. 7., NO. 1., pp 47-60. DOI: https://doi.org/10.2307/2550231

Kitamura, K. H. (2026). *Section 232 of the Trade Expansion Act of 1962, Congressional Research Service*, Available Online: https://www.congress.gov/crs-product/IF13006 [Latest Accessed May 1, 2026]

Krugman, P. (1979). Increasing returns, monopolistic competition and international trade. *Journal of International Economics. Vol. 9., NO. 4, pp. 469-479.* DOI: https://doi.org/10.1016/0022-1996(79)90017-5

Krugman, P. R. (1987). Is Free Trade Passé?, *Journal of Economic Perspectives. Vol. 1, No. 2. pp. 131-144.* DOI: https://www.jstor.org/stable/1942985?seq=1

Krugman, P.R, Obstfeld, M. & Melitz, M.J. (2012). *International Economics: Theory and Policy.* 9th Edition. Boston: Pearson.

Lu, J., Milkov, D. (2026). *Understanding China's 2024–25 Frontloading from the Lens of Product-Level Export Baskets.* IMF Working Paper No. 2026/013, Available at SSRN: https://ssrn.com/abstract=6144719 [Latest Accessed May 3, 2026].

Mattoo, A., Mulabdic, A. & Ruta, M. (2019). *Trade Creation and Trade Diversion* [pdf]. World Bank. Available at: https://thedocs.worldbank.org/en/doc/328491559591517896-0050022019/original/TradeCreationanfTradeDiversion.pdf [Latest Accessed April 30, 2026]

Nicita, A. (2019). Trade and trade diversion effects of United States tariffs on China. *UNCTAD.* Research Paper No. 1 [pdf],. Geneva: United Nations Conference on Trade and Development. Available at: https://unctad.org/system/files/official-document/ser-rp-2019d9_en.pdf [Accessed 15 April, 2026]

Office of the President. (2018a, March 8). Proclamation 9704: Adjusting imports of aluminum into the United States. *Federal Register. Vol. 83, No. 51, pp 11619-11625*. https://www.govinfo.gov/content/pkg/FR-2018-03-15/pdf/2018-05477.pdf

Office of the President. (2018b). Proclamation 9739 and 9758: Adjusting Imports of Aluminum Into the United States. *Federal Register. Vol. 83., NO. 108, pp 25849-25855.* https://www.govinfo.gov/content/pkg/FR-2018-06-05/pdf/2018-12137.pdf

Office of the President. (2019). Proclamation 9893: Adjusting Imports of Aluminum Into the United States. *Federal Register. Vol. 85., NO. 158, pp 49921-49926.* https://www.govinfo.gov/content/pkg/FR-2018-06-05/pdf/2018-12137.pdf

Office of the President. (2020). Proclamation 10006 and 10106: Adjusting Imports of Aluminum Into the United States. *Federal Register. Vol 83., NO. 158, pp 49921-49926.* https://www.govinfo.gov/content/pkg/DCPD-202000806/pdf/DCPD-202000806.pdf

Office of the President. (2023). Proclamation 10522: Adjusting Imports of Aluminum Into the United States. *Federal Register. Vol. 88., NO. 41, pp 13267-13276.* https://www.govinfo.gov/content/pkg/FR-2023-03-02/pdf/2023-04470.pdf

Office of the President. (2025a). Proclamation 10895: Adjusting imports of aluminum and steel into the United States. *Federal Register. Vol. 90, No. 31, pp 9807-9816.* https://www.govinfo.gov/content/pkg/FR-2025-02-18/pdf/2025-02832.pdf

Office of the President. (2025b). Proclamation 10947: Adjusting imports of aluminum and steel into the United States. *Federal Register. Vol. 90, No. 109, pp 24199-24216.* https://www.govinfo.gov/content/pkg/FR-2025-06-09/pdf/2025-10524.pdf

Ohlin, B. (1933). *Interregional and International Trade.* Cambridge, MA: Harvard University Press.

Ricardo, D. (1817). *On the Principles of Political Economy and Taxation.* https://www.marxists.org/reference/subject/economics/ricardo/tax/ch07.htm [Latest Accessed April 20, 2026]

Roth, J., Sant'Anna, H.C. P., Bilinski, A., Poe, J. (2023). What's trending in difference-in-differences? A synthesis of the recent econometrics literature. *Journal of Econometrics. Vol. 235, Issue 2.* DOI: https://doi.org/10.1016/j.jeconom.2023.03.008

Rubin, D. B. (1980). Randomization analysis of experimental data: The Fisher randomization test comment. *Journal of the American Statistical Association. Vol. 75, NO. 371. pp 591-593.* DOI: https://www.jstor.org/stable/2287653

Smith, A. (1776). *The Wealth of Nations (1776): On Free-Market Economics.* Bloomsbury.

Soyers, F., Goernemann, N., & Machol, C. (2025). *Racing against tariffs: Global impacts of frontloading.* FEDS Notes. Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/econres/notes/feds-notes/racing-against-tariffs-global-impacts-of-frontloading-20250801.html [Latest Accessed May 24, 2026]

Trade Expansion Act of 1962. 19 U.S.C. §1862(d), Available online: https://www.govinfo.gov/content/pkg/USCODE-2024-title19/pdf/USCODE-2024-title19-chap7-subchapII-partIV-sec1862.pdf [Latest Accessed April 30, 2026]

U.S. Department of Commerce and Office of the United States Trade Representative (2021). *Announcement of Actions on EU Imports Under Section 232*. Washington, DC: U.S. Department of Commerce (DoC). Available at: https://www.commerce.gov/sites/default/files/2021-10/US%20232%20EU%20Statement.pdf [Latest Accessed May 5, 2026]

U.S. Department of Commerce and Office of the United States Trade Representative (2022). *Announcement of Actions on UK Imports Under Section 232.* Washington, DC: U.S. Department of Commerce (DoC). Available at: https://www.commerce.gov/sites/default/files/2022-03/UK232-US-Statement.pdf [Latest Accessed May 5, 2026]

USITC. (2026). U.S. International Trade Commission (USITC) Trade DataWeb: https://dataweb.usitc.gov/trade/search/Import/HTS [Latest Accessed May 1, 2026]

Viner, J. (1950). *The Customs Union Issue*. New York: Carnegie Endowment for International Peace.

Watson, C. D. (2022). U.S. Aluminum Manufacturing: Industry Trends and Sustainability, Congressional Research Service, CRS Report R47294, Available Online: https://www.congress.gov/crs-product/R47294 [Latest Accessed April 30, 2026].

Weaver, M. (2019). Section 232 and 301 Trade Actions in 2018, United States International Trade Commission, *USITC*, Available Online: https://www.usitc.gov/research_and_analysis/tradeshifts/2018/section_232_and_301_trade_actions_in_2018.pdf [Latest Accessed April 30, 2026]

Yilmazkuday, H. (2025). *Accounting for Trump Tariffs.* SSRN Working Paper. https://dx.doi.org/10.2139/ssrn.5576113

# Appendix:

## Appendix Tables:

Table 6: (Referred to as Appendix 1): *Table summarizing the systematical mapping of information regarding exemption status and tariff rates, extracted manually from each relevant presidential proclamation.*

| **Proclamation** | **Date** | **Tariff Rate** | **Countries Gaining Exemption** | **Countries Losing Exemption** | **Countries Under Quota/TRQ** |
|---|---|---|---|---|---|
| 9704<br><br>(Office of the President, 2018a) | Mar, 2018 | 10% | Canada, Mexico, EU, Australia, Brazil, South Korea | - | - |
| 9740<br><br>(Office of the President, 2018b) | May, 2018 | 10% | - | South Korea | - |
| 9758,<br><br>(Office of the President 2018b) | Jun, 2018 | 10% | Australia (Exempt conditions), | Canada, Mexico, EU, Brazil | Argentina (annual quotas) |
| 9893<br><br>(Office of the President, 2019) | May, 2019 | 10% | Canada, Mexico | - | - |
| 10006<br><br>(Office of the President, 2020) | Aug, 2020 | 10% | - | Canada (HTS 7601.10 explicitly) | - |
| 10106<br><br>(Office of the President, 2020) | Sep, 2020 | 10% | Canada (Fully Restored), | - | - |

| | | | | | |
|---|---|---|---|---|---|
| Department of Commerce<br><br>(Doc, 2021) | Jan, 2022 | 10% / 25% | - | - | EU (TRQ) |
| Department of Commerce<br><br>(Doc, 2022) | Jun, 2022 | 10% / 25% | - | - | UK (TRQ) |
| 10522<br><br>(Office of the President, 2023) | Feb, 2023 | 200% | - | Russia (200% Economic Sanction) | - |
| 10895<br><br>(Office of the President, 2025a) | Mar, 2025 | 25% | - | All countries | - |
| 10947<br><br>(Office of the President, 2025b) | Jun, 2025 | 50% | - | - | UK (TRQ, stays at 25%) |

Note: All presidential proclamations are published in the Federal Register, direct links to respective proclamations can be found in the reference list. EU and UK TRQ arrangements were established through executive agency announcements by the U.S. Department of Commerce and the Office of the U.S. Trade Representative. These are referred to as DoC, in the Appendix. Full
citations for all sources are provided in the reference list, accordingly.

Table 7: Treatment Classification Used in the Descriptive Analysis. *The exempt group includes all countries that had exemption status granted at least once during the full sample period 2015-2026. The non-exempt group was all countries that never were granted any exemption. The countries that are displayed in the table are the largest suppliers plus a note representing "All other countries".*

| **Exempt Group** | **Non-Exempt Group** |
|---|---|
| Canada | China |
| Australia | Russia |
| Argentina | Bahrain |

| | |
|---|---|
| Mexico | India |
| South Korea | *All other countries* |
| EU Countries | |
| UK | |
| Brazil | |

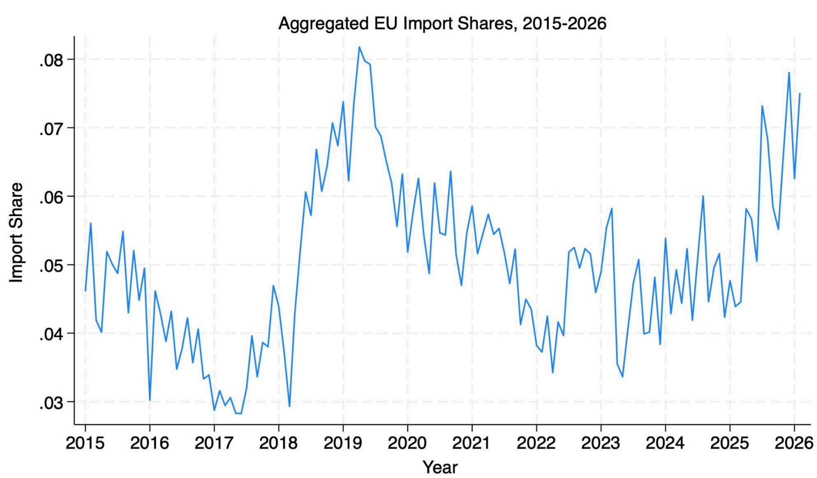
Table 7: Treatment classification of exempted and non-exempt groups.
Source: Office of the President; Presidential Proclamations (2018a, 2018b, 2018c, 2019, 2020, 2021, 2023, 2025a, 2025b), and announcements from the Department of Commerce DoC, (2021, 2022).

## Appendix Figures:

Figures listed below support the thesis findings and are considered supplementary findings.

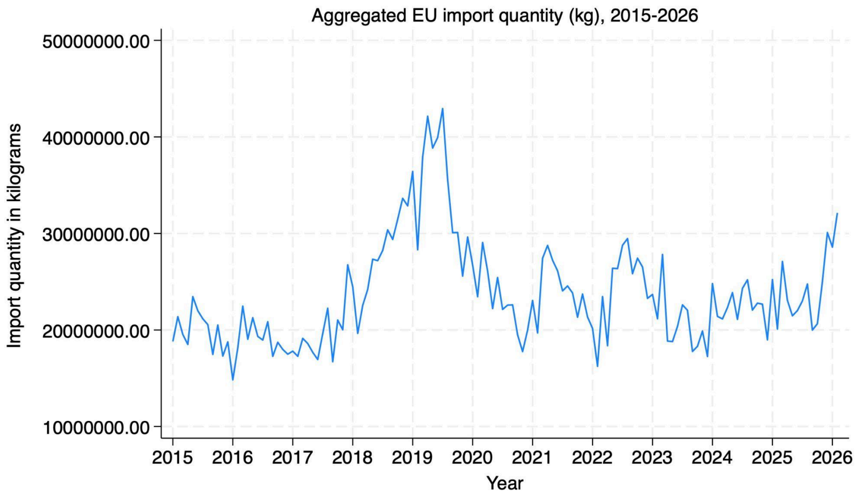
Figure 7 & 8: *Are supplementary figures that support the unexpected results from the country-specific interaction terms, especially displaying aggregated EU aluminum import patterns across the full sample period 2015-2026.*

Figure 7: Total import shares for aggregated EU, 2015-2026.




Source: Authors' calculations based on USITC DataWeb (2026).

Figure 8: Total import quantity in kilograms for aggregated EU, 2015-2026.




Source: Authors' calculations based on USITC DataWeb (2026).