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TÁC ĐỘNG CỦA MỨC THUẾ QUAN 25% DƯỚI THỜI TRUMP (2018) ĐỐI VỚI XUẤT KHẨU THÉP CỦA VIỆT NAM SANG HOA KỲ: PHÂN TÍCH THỰC NGHIỆM TRONG GIAI ĐOẠN 2013 – 2024

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Tóm tắt

Nghiên cứu này nhằm phân tích mức độ ảnh hưởng của mức thuế quan 25% do Hoa Kỳ áp dụng theo Mục 232 của Đạo luật Mở rộng Thương mại năm 1962 lên giá trị xuất khẩu thép sang Hoa

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Kỳ của Việt Nam. Mặc dù chính sách thuế quan của chính quyền Trump đã được nghiên cứu nhiều đối với các quốc gia xuất khẩu thép lớn và ngành công nghiệp nội địa Hoa Kỳ, nghiên cứu về tác động của nó đối với các nước xuất khẩu mới nổi như Việt Nam còn hạn chế, đặc biệt khi 13% doanh thu xuất khẩu thép của Việt Nam đến từ thị trường Hoa Kỳ. Dựa trên phương pháp định lượng, các kết quả thực nghiệm cho thấy rằng, mặc dù xuất khẩu thép của Việt Nam đã tăng trưởng đáng kể qua các năm, việc áp thuế đã gây ra tác động tiêu cực rõ rệt đến giá trị xuất khẩu. Nghiên cứu cũng chỉ ra rằng, GDP và tỷ giá hối đoái là những yếu tố quan trọng ảnh hưởng đến thương mại. Trong bối cảnh các chính sách bảo hộ ngày càng gia tăng, nghiên cứu này hỗ trợ các bên liên quan và nhà hoạch định chính sách ứng phó với các cú sốc bên ngoài và xây dựng chiến lược linh hoạt để duy trì khả năng chống chịu thương mại.

Từ khoá: thuế quan dưới thời Trump, xuất khẩu thép Việt Nam

THE IMPACT OF THE 25% TRUMP'S TARIFF (2018) ON VIETNAM'S STEEL EXPORTS TO THE U.S: AN EMPIRICAL ANALYSIS ON THE 2013 - 2024 PERIOD

Abstract

This study examines how Vietnam's steel export performance has been affected by the 25% steel tariff levied by the U.S. under Section 232 of the Trade Expansion Act of 1962. While the Trump administration's tariff policy has been extensively studied in the context of major steel-exporting nations and domestic industries in the United States, limited research has been conducted on how it affects emerging exporters like Vietnam, given that 13% of Vietnam's steel export revenue comes from the U.S. market. Based on the empirical findings, which were obtained using a quantitative approach, Vietnam's steel export performance has increased significantly over the years, but the tariff's implementation had a distinguishable negative impact on export value. The results also show that GDP, and exchange rates are important factors that influence trade. Corresponding to the growing protectionist policies, the research helps stakeholders and policymakers navigate external shocks and develop strategies to preserve trade resilience.

Keywords: Trump's tariff, Vietnamese steel exports

1. Introduction

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Vietnam's steel industry forms a critical pillar of the national economy, making a significant contribution to both export revenue and industrial growth. As a significant participant in the global steel market, Vietnam has established a vigorous export presence in the United States, a primary destination for its steel products. Following the election of President Donald Trump in 2016, the U.S. administration imposed a 25% tariff on steel imports in 2018, which posed a challenging obstacle to Vietnam's steel exports by increasing costs and potentially undermining market competitiveness. The reintroduction of a 25% tariff in February 2025, accompanied by a proposed 46% reciprocal tariff scheduled for July 2025, highlights the continued necessity of examining historical trade barriers to address present challenges.

This study therefore focuses on Vietnam's steel exports (classified under HS code 72) to the U.S. market from 2013 to 2024, with particular emphasis on the impact of the 25% tariff implemented in 2018. The research objectives are threefold: Firstly, to undertake a comprehensive analysis of the 2018 tariff's effects on the volume, value, market share, and competitiveness of Vietnam's steel exports. Secondly, to highlight the opportunities and challenges that Vietnam's steel sector faced as a result of the 2018 Trump tariffs. Thirdly, to formulate evidence-based recommendations for the Vietnamese government and steel exporters to capitalize on opportunities and mitigate challenges in the context of the 2025 tariff regime.

Geographically, the study focuses on trade between Vietnam and the United States. Chronologically, the analysis covers the period from 2013 to 2024 to capture both the pre- and post-tariff conditions. Thematically, the research is limited to the examination of Vietnam's steel export performance in the context of the 2018 U.S. tariff policy, while drawing forward-looking implications for the upcoming 2025 tariff regime.

The present research is guided by the following research questions: To what degree did Trump's 25% tariff (imposed in 2018) affect the export value of Vietnam's steel (HS code 72) to the U.S. market? What other factors, apart from Trump's 2018 tariff, influenced the export value of Vietnam's steel to the U.S.? What can the Trump's 2018 tariff regimes inform recommendations for Vietnam's steel export strategies in the context of the 2025 46% counter-tariff?

The study is well-structured into six sections: Section 2 provides Literature review. Section 3 explains the Theoretical framework that will be followed throughout this research. Section 4

outlines the research methodology and data sources. Section 5 presents the estimation results and diagnostic tests. And finally, the last section includes our limitations and the recommendations of our approach.

2. Literature review

2.1. Overview of steel exports and trade barriers

2.1.1. General overview of Vietnam's steel export industry (HS code 72)

Since the first batch of cast iron at TISCO on November 29, 1963, Vietnam has become a major steel producer in the world especially in crude steel production. Data from the UN Comtrade database indicates that between 2017 and 2021, Vietnam exported steel and iron to 123 countries and imported steel products from 84 countries. During these five years, Vietnam exported 8 million tonnes of steel products, valued at 7.3 billion USD annually.

Table 1. Vietnam's export and import of CBAM-targeted steel and iron products.

| Indicators	Export	Import
Number of trading partners	123	84
The value of trade (million USD)	7277	11,053
The quantity of trade (million tonnes)	8	13

Source: UN Comtrade database,

Numbers are the 5-year annual average from 2017 to 2021.

From 5.1 million metric tons in 2022 to 6.5 million metric tons in 2023, the Vietnamese steel trade deficit increased by 26.9 percent. Between 2015 and 2023, exports increased by 417.4% while imports declined by 12.5% over the same period. (1276, n.d.)

Figure 1. Vietnam's annual trade in steel mill products from 2015 to 2023 (metric tons).

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Vietnam* Trade in Steel Mill Products, Annual, Metric Tons
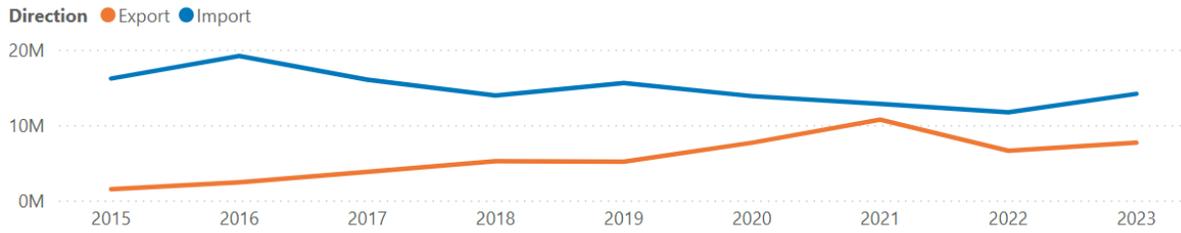
Vietnamese steel exports hit a record 10.7 million metric tons in 2021. From 2015 to 2023, export volume rose by 417.4%, and export value increased by 440%. Strong growth was seen in 2016 (62.4%), 2017 (57.7%), 2018 (37.1%), 2020 (49.0%), 2021 (40.0%), and 2023 (16.4%). However, exports fell by 1.3% in 2019 and sharply dropped by 38.5% in 2022. In 2023, Vietnam exported 7.7 million metric tons of steel, but export value fell by 11.7%, from $7.4 billion in 2022 to $6.5 billion.

In 2023, flat products accounted for the largest share of Vietnamese steel exports at 66.2 percent, or 5.1 million metric tons (mmt). Furthermore, semi-finished products accounted for 15.3 percent, or 1.2 million metric tons, followed by long products at 10.6 percent (0.8 million metric tons), stainless products at 4.2 percent (0.3 million metric tons), and pipe and tube at 3.7 percent (0.3 million metric tons).

**Figure 2.** Vietnam's annual export volume of steel mil products from 2015 to 2023 (metric tons).

Vietnam* Exports of Steel Mill Products, Metric Tons
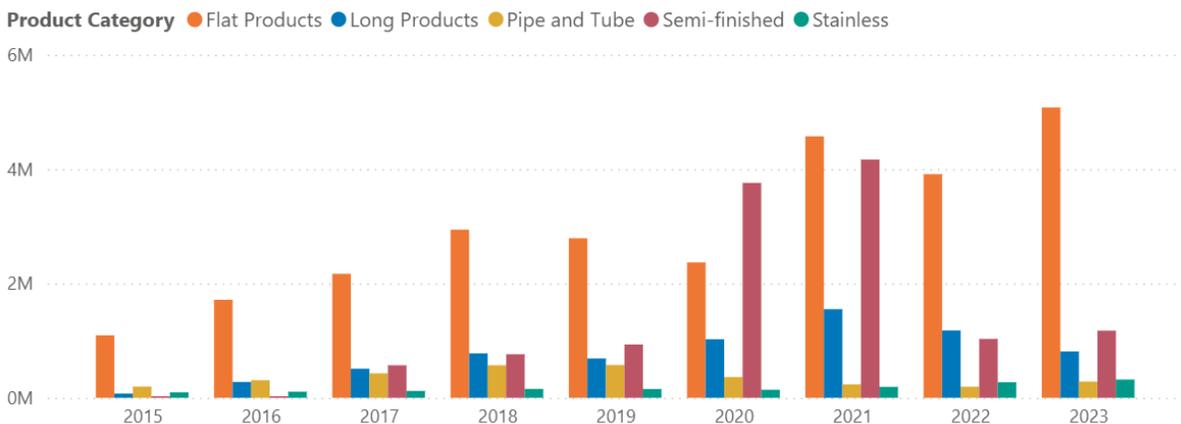
Figure 3. Vietnam's annual export value of steel mil products from 2015 to 2023 (U.S. dollars)

Vietnam* Exports of Steel Mill Products, U.S. Dollars

Product Category ● Flat Products ● Long Products ● Pipe and Tube ● Semi-finished ● Stainless
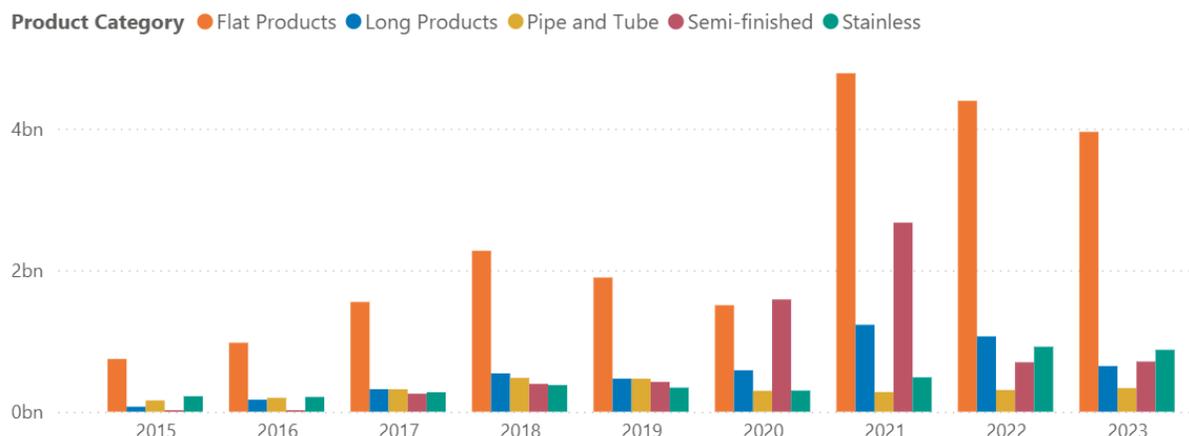
Vietnam's steel mill product exports were concentrated in a few key markets, with Italy (17.22%), India (13.1%), and Malaysia (10.72%) emerging as the most favourable destinations in 2023. Vietnam's strategic integration into international supply chains is reflected in this distribution, especially in the manufacturing and construction industries, where there is a steady need for steel. The competitiveness of Vietnam's steel sector in both developed and emerging economies is further demonstrated by the presence of regional partners like Indonesia and Thailand, in addition to developed markets like the United States and Belgium.

Figure 4. Vietnam's 10 partner countries of steel mill products exports.

Vietnam* Exports of Steel Mill Products - 2023, Top 10 Sources, Metric Tons

Top Partner Countries
● Rest of the World
● Italy
● India
● Malaysia
● Indonesia
● United States (Consumption/Dom...
● Belgium
● Taiwan
● South Korea
● Spain
● Thailand
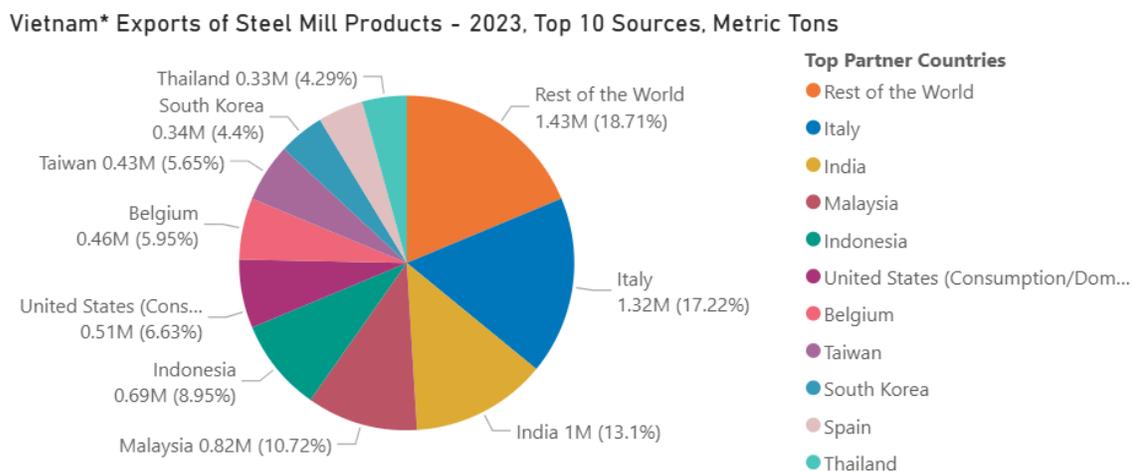
2.1.2. The role of tariffs as trade barriers and their effects on international trade

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Although most economists and schools of thought argue for free trade, there are others who support protection, inward-looking strategies, and import substitution (Mishra, 2014). International trade has historically been significantly hampered by tariffs and trade barriers, especially during periods of economic distress. According to (Roorbach, 1933), national governments sought to stem the tide by the familiar method of increasing tariff duties, already high, in order to shut out cheap imports that appeared to threaten established industries. Tariffs not only protect domestic industries but also generate trade revenue, help address trade deficits, and attract investment to protected sectors. (Hayakawa et al., 2020) proved a direct positive relationship between import tariff and export expansionsis. Consequently, application of tariffs as trade barriers might lead to a vicious cycle where each succeeding measure of attempted relief further curtailed the flow of trade (Roorbach, 1933).

2.2. *Previous research on tariffs and their impact on exports*

On 1 March 2018, the President of the United States (US), Donald Trump announced a 25 % tariff on steel and a 10 % tariff on aluminium imports with some major trade partners exempted. The declared aim of this trade policy is to preserve employment and safeguard national security while also bolstering the U.S. metal sector; however, a move that threatens to drive up prices on a broad range of consumer and industrial goods for Americans ("Trump imposes sweeping 25% steel and aluminum tariffs. Canada and Europe swiftly retaliate | CNN Business," n.d.).

The most significant economic effect of Trump's tariffs on steel and aluminium involves the basic metals trade to the U.S., whose volume would decrease (European Commission. Joint Research Centre., 2019). Empirical estimates indicate that the tariff resulted in the decrease of imports of steel, declining 17.2% from 2017 to 2021 and simultaneously boosted domestic steel production by 1.9%, which is equivalent to an annual increase of approximately USD 1.5 billion during the 2018 - 2021 period ("Economic Impact of Section 232 and 301 Tariffs on U.S. Industries.pdf," n.d.).

As reported by the International Trade Commission in 2023 ("Economic Impact of Section 232 and 301 Tariffs on U.S. Industries.pdf," n.d.), although Trump's 2018 metals tariffs expanded U.S. production modestly, it sent costs rising for cars, tools and machines and shrank those industries' output by more than $3 billion in 2021. The average price of steel in the U.S. was anticipated to rise by 2.4%, respectively, as a result of the tariffs according to the United States International

Trade Commission. Moreover, prices of domestically manufactured steel had climbed by an average of 0.7%, while imports of steel products subject to duties had increased by an average of 22.7%.

Although the effects vary by industry, downstream industries were generally negatively impacted. As mentioned by the United States International Trade Commission ("Economic Impact of Section 232 and 301 Tariffs on U.S. Industries.pdf," n.d.), the average annual decrease in production values for these industries was $3.4 billion during 2018–21 which caused the most negative impact in several downstream sectors including machinery and automotive. Therefore, a significant number of downstream sectors switched some of their sourcing from foreign to domestic producers as a result of the increase in the cost of imported steel and goods.

Figure 5. Estimated effects of Section 232 steel and aluminum tariffs on U.S. steel and aluminum production, prices, and imports.

Variable	Impact in 2018	Impact in 2019	Impact in 2020	Impact in 2021	Average effect
Quantity of covered steel imports	−23.8	−23.6	−24.7	−24.0	−24.0
Quantity of covered aluminum imports	−30.3	−29.8	−32.2	−32.0	−31.1
Delivered price of covered steel imports	22.8	22.8	22.7	22.7	22.7
Delivered price of covered aluminum imports	8.0	8.1	7.9	7.9	8.0
Price of domestically produced steel	0.81	0.87	0.52	0.75	0.74
Price of domestically produced aluminum	1.02	1.10	0.67	0.71	0.87
Average steel price in U.S.	2.7	2.8	1.6	2.5	2.4
Average aluminum price in U.S.	1.8	1.9	1.2	1.3	1.6
Quantity of domestic steel production	2.0	2.2	1.3	1.9	1.9
Quantity of domestic aluminum production	4.2	4.5	2.7	2.9	3.6

Source: USITC

2.3. *Impact of tariffs on Vietnam's steel exports*

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Based on the WTO Center ("TTWTO VCCI - How does the US's 25% tax on imported steel and aluminum affect businesses?," n.d.), the three largest exporters of steel and aluminum to the U.S. are Canada, Brazil, and Mexico, followed by South Korea and Vietnam. Although the U.S. market represents 13% of total steel export turnover ("TTWTO VCCI - Steel industry faces pressure from increased U.S. import tariffs," n.d.), it holds strategic significance for Vietnamese steel and sheet metal manufacturers. The U.S. steel demand relies 12% to 15% on imports, equating to about 20-25 million tonnes annually, presenting a potential market for Vietnam if trade barriers can be navigated.

According to the Vietnam Steel Association (VSA), in 2024, Vietnam exported over 12.62 million tons of steel in 2024, up 13.47% from 2023. The value of its exports was 9.08 billion USD, up 8.78%. After ASEAN (26%) and the EU (23%), the U.S. became Vietnam's third-largest export market, with a 13% share. Furthermore, major steel exporting nations including Canada, Mexico, Brazil, and the Republic of Korea were compelled to search for alternate markets to dump their excess production due to a "domino effect" driven by market constraints in the global steel industry. Therefore, domestic enterprises had to quickly develop effective competitive strategies to deal with the greater disadvantage.

2.4. Inheritance value and research gap

While much work has been done to examine the global impact of Trump's Section 232 steel tariffs, the majority of prior studies have focused on domestic outcomes in the U.S. or on significant steel exporters such as Canada, Mexico, and South Korea. These investigations have generated insights into how protectionist measures affect production capacity, pricing structures, and downstream industries in developed economies. However, relatively few studies have explored the ripple effects of these tariffs on emerging exporters, particularly those in Southeast Asia with growing industrial capacity and increasing integration into global supply chains.

Given a 440% increase in export value and a 417.4% increase in export volume, Vietnam's steel exports have grown substantially between 2013 and 2024. However, little has been discovered regarding the extent to which external trade policies, such as Trump's tariffs, have influenced this trajectory. Furthermore, there are not many empirical studies looking at how export volume and value have changed in response to tariffs. Besides, much of the existing work has relied on broad macro-level trends without employing quantitative models to isolate the causal

impacts of the tariff on trade performance. As medium-sized exporters like Vietnam face particular opportunities and challenges when conquering global trade disruptions, this methodological limitation prevents a more nuanced understanding of the tariff's effects on them.

The current study hence endorses a focused empirical investigation into the impact of Trump's 25% steel tariff on Vietnam's exports in order to address this gap. In particular, it looks at how Vietnam's steel exports to the U.S. market changed in terms of both volume and value in the years before and after the tariff came into effect. Hence, this study intends to advance a more thorough understanding of how developing economies absorb and adjust to external policy shocks in the global trade market by situating Vietnam within the larger conversation on trade protectionism.

3. Theoretical framework

3.1. Conceptual framework

Figure 6. Conceptual framework
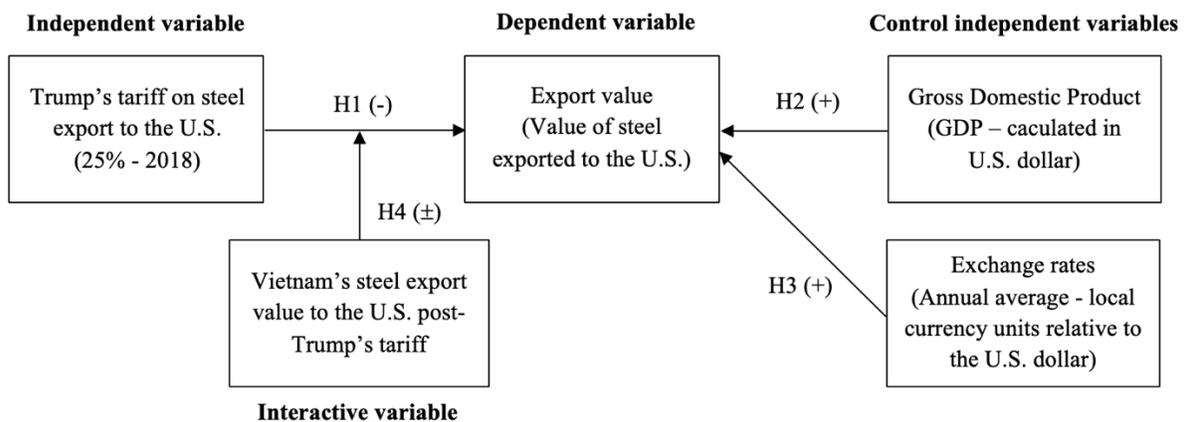
Source: Compiled by the authors (2025)

In this study, Trump's 25% tariff on steel exports to the U.S. (2018) is used as the target independent variable. Meanwhile, exchange rates and GDP are considered as control independent variables. Finally, the export value of steel to the U.S., which reflects the performance of Vietnam's steel exports, acts as the dependent variable. Additionally, the interaction variable (Vietnam's steel export value to the U.S. post-Trunp's tariff) is included to capture the specific impact of the tariff policy on Vietnam compared to other steel-exporting countries.

3.2. Research hypothesis

Based on the aforementioned literature review and foundational theories, the hypotheses are proposed as follows:

- Hypothesis 1 (H_1): The 25% Trump's tariff on steel imposed in 2018 has a negative impact on the export value of steel to the U.S.

- Hypothesis 2 (H_2): A depreciation of the exporting country's currency (higher exchange rate) has a positive effect on the export value due to increased price competitiveness.

- Hypothesis 3 (H_3): A higher GDP of the exporting country (in USD terms) reflects stronger production and export capacity, thereby increasing the steel export value to the U.S.

- Hypothesis 4 (H_4): The interaction effect between Vietnam and the post-tariff period significantly affects Vietnam's steel export value to the U.S., with the direction of impact being context-dependent (either positive due to trade diversion or negative due to tariff pressure).

3.3. Underpinning theories

In the context of international trade between the United States and Vietnam, a variety of market-related, policy-related, and economic factors are believed to affect the export value of Vietnamese steel. In line with previous empirical studies and economic theory, this research is underpinned by three primary theoretical frameworks: Price Elasticity of Demand Theory (Krugman and Obstfeld, 2003), New Trade Theory (Krugman, 1983), and Trade Diversion Theory (Viner, 1950).

3.3.1. The Price Elasticity of Demand Theory

According to Krugman and Obstfeld (2003), the degree to which demand is sensitive to price changes is a crucial component of global trade. One of the key elements influencing prices in global marketplaces is the exchange rate. By making its products relatively less expensive in

foreign markets, a decline in the value of the exporting country's currency raises demand for its exports and reverse. This theory underpins Hypothesis 2 (H_2), which suggests that exchange rates have a positive influence on export value. In particular, it is anticipated that a higher exchange rate - or a decline in the value of the home currency in relation to the U.S. dollar - will make steel exports more competitive and increase the overall value of exports (Chit and Judge, 2011).

3.3.2. New Trade Theory

Originally introduced by Krugman (1983), the New Trade Theory indicates that the export performance of a country is positively related to its economies of scale and industrial capacity (often measured in GDP), especially for sector-specific exports which are characterized by increasing returns to scale, including heavy industries. In the larger scheme of this research, the GDP of the exporting country is used as a proxy for its production capacity and international competitiveness. Higher GDP nations frequently obtain more developed industrial infrastructure, greater capital accumulation, and technological capability, all of which contribute to their ability to produce and export goods at scale. Accordingly, Hypothesis 3 (H_3) indicates that the greater GDPs countries possess, the more likely they are to export steel in larger quantities and at higher prices to the United States.

3.3.3. Trade Diversion Theory

Trade Diversion Theory, initially articulated by Viner (1950) in his analysis of customs unions and preferential trading arrangements, serves as the third theoretical framework utilized in this study. The phenomenon known as "trade diversion" occurs when trade flows from more efficient producers to less efficient ones as a result of trade barriers such as tariffs. When a major importer like the U.S. imposes sector-specific tariffs on selected countries (e.g., China or Russia), it may consequently reduce imports from these targeted nations and shift demand toward alternative suppliers not subject to the same level of protection, such as Vietnam (Dang et al., 2024).

This research adopts Trade Diversion Theory to interpret the impact of Trump's 2018 steel tariff on Vietnam's export performance. The policy shock is captured using a dummy variable indicating the post-tariff period and an interaction term between Vietnam and the tariff period. This variable is essential to Hypothesis 4 (H_4), which examines whether Vietnam experienced a significant change in export value after the tariff imposition - either positively, due to diverted

demand, or negatively, if Vietnam itself became subject to indirect trade frictions or capacity limitations. Implementing this interaction effect is consistent with empirical methods for assessing the impact of policies, especially when treatment varies among nations (Feenstra, 2004).

4. Methodology, data, and model specification

4.1. Research model

This study will use a panel data regression model to analyze the impact of Trump's 25% tariff on Vietnam's steel exports to the U.S. using data from 2013 to 2024.

The export value of Vietnamese steel goods to the United States (EV), given in current U.S. dollars, is the dependent variable. The independent control variables including the exchange rate between the Vietnamese dong and the U.S. dollar (EX), and Vietnam's GDP (GDP) are all expressed in logarithmic form to reflect elasticity. We also utilize 2 dummy variables, one is a dummy variable for Trump's tariff, which takes the value of 1 for the years 2018 and onward, and 0 otherwise, the other represents Vietnam (VN), which is introduced to isolate country-specific effects. The interaction term (VNpt) is introduced to capture the change in Vietnam's steel export performance after the tariff imposition, relative to other exporters.

We specify the study model as below:

$$EV_{it} = \beta 0 + \beta 1 \cdot \ln EX_{it} + \beta 2 \cdot \ln GDP_{it} + \beta 3 \cdot \ln tariff_{it} + \beta 4 \cdot VNpt_{it} + \hat{u}_{it}$$

In which:

- EV_{it} : Export value of steel product i to the U.S. in year t (USD)
- $\ln EX_{it}$: Natural log of annual average exchange rate (VND/USD)
- $\ln GDP_{it}$: Natural log of Vietnam's gross domestic product (in current USD)
- $\ln tariff_{it}$: Dummy variable for 25% Trump's tariff (1 if year ≥ 2018, 0 otherwise)
- $VNpt_{it}$: Interaction term for Vietnam's post-tariff export performance
- $\hat{u}_{it}$: Error term

4.2. Data collection

The study uses panel data from 09 large steel-exporting countries to the United States during the 12 years from 2013 to 2024. The duration is sufficiently long to examine both the pre- and post-tariff periods, thereby enabling an assessment of the impact of U.S. trade policy changes

under the Trump administration. The selected countries are Brazil, Canada, Germany, Japan, Italy, Mexico, South Korea, Russia, Vietnam, and Turkey, which represent the top steel exporters to the U.S. market during the study period. Initially, Taiwan was also considered due to its significant export volume but it was excluded from the final dataset due to the unavailability of complete data. The relationships between steel export performance and key explanatory variables will be investigated in detail to uncover additional implications of trade protectionism. Details of variable construction and data sources are presented in Table 2.

Table 2. Summary of variables and data sources

Variable name	Type	Symbol	Unit of measurement	Expected impact	Source
Export value	Dependent	EV	USD		UN Comtrade
Exchange rate	Control	EX	VND/USD	+	World Bank
GDP	Control	GDP	USD	+	World Bank
Trump's tariff	Dummy	tariff	tariff = 1 if year ≥ 2018, 0 otherwise	–	
Vietnam	Dummy	VN	VN = 1 if the exporter is Vietnam		
VN post-tariff	Interaction	VNpt	Vietnam's steel export value after Trump's tariff compares to others	±	

Source: Compiled by the authors (2025)

4.3.   Statistical description and correlation analysis

4.3.1.   Statistical description

Figure 7. The statistical description of variables

Variable	Obs	Mean	Std. dev.	Min	Max
EV	104	2.26e+09	2.13e+09	2.62e+07	9.97e+09

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lnEX	107	3.340334	3.354044	-0.2840511	10.09266
lnGDP	99	28.18804	0.7528586	26.08788	29.28205
tariff	108	0.5833333	0.4953051	0	1
VN	108	0.1111111	0.3157348	0	1
VNpt	108	0.0648148	0.2473466	0	1

- **Export value (EV)**

The average value of exports in the sample is approximately 2.26e+09 with a very large standard deviation of 2.13e+09, ranging from the lowest value of 2.62e+07 in Vietnam in 2023 to the highest of 9.97e+09 in Canada in the year 2022. The large range indicates great variations in export values among the sample countries.

- **Log of Exchange rate (lnEX)**

The log exchange rate variable (lnEX) has a mean of 3.34 and a standard deviation of 3.35, reflecting substantial differences in exchange rate levels across countries. Some values are barely negative, which may correspond to strong currencies or low exchange rates.

- **Log of GDP (lnGDP)**

The variable GDP in natural logarithm form has a mean of 28.19 and a standard deviation of relatively small size (0.75). The minimum is 26.09 and the highest value is 29.28, indicating that the sample includes economies of moderately large size with limited variation.

- **Trump's tariff (tariff)**

The tariff variable is a dummy indicator and has a mean of 0.58 and a standard deviation of 0.49. This implies that approximately 58.33% of the observed flows of trade are under tariffs and the remaining 41.67% are not.

- **Vietnam dummy (VN)**

The VN dummy variable, which equals 1 when Vietnam is the exporter, has a mean of 0.1111 and a standard deviation of 0.3157. This shows that Vietnam is the exporting country in about 11.11% of the cases.

- **Vietnam's steel export value post Trump's tariff (VNpt)**

The VNpt dummy variable equals 1 when Vietnam is the exporting country and the year is within the post-tariff period. Its mean value of 0.0648 and standard deviation of 0.2473 indicate that Vietnam's post-tariff export data accounts for around 6.48% of the total observations.

4.3.2. Correlation analysis

Figure 8. Correlation of variables.

	EV	lnGDP	lnEX	tariff	VN	VNpt
EV	1.0000					
lnGDP	0.1071	1.0000				
lnEX	-0.3523	-0.6373	1.0000			
tariff	0.1603	0.0576	0.0196	1.0000		
VN	-0.2901	-0.8256	0.7146	0.0067	1.0000	
VNpt	-0.1814	-0.5310	0.5155	0.2389	0.7180	1.0000

Source: Compiled by the authors (2025)

Correlations between the dependent and independent variables were examined before regression analysis. The exchange rate (lnEX) displays a moderate negative correlation with EV (–0.3523). It suggests that higher exchange rate values may be associated with lower steel export values, possibly as a result of macroeconomic volatility or pricing effects. Both lnGDP (0.1071) and the tariff dummy (0.1603) show weak positive correlations with EV, implying that there is a lack of direct association. It is also worth noticing that Vietnam has lower export values than other nations, especially in the post-tariff period, as indicated by the moderately and negatively correlated Vietnam dummy (VN) (-0.2901) and the interaction term VN post-tariff (VNpt) (-0.1814). The multicollinearity issues, hence, can be concluded as minimal because most correlations are negative or low.

5. Diagnostic tests and estimation results

5.1. Diagnosing model specification issues

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To ensure the most important econometric assumptions are not violated in the estimated fixed-effects regression model, a range of diagnostic tests have been used for multicollinearity, heteroskedasticity, autocorrelation, and cross-sectional dependence.

Figure 9. Multicollinearity test result.

Test	Results	Interpretation
Multicollinearity (VIF)	Mean VIF = 2.88	No significant multicollinearity
Heteroskedasticity	Chi-squared = 591.16, p-value = 0.0000	Heteroskedasticity exists; residual variance differs across panels
Autocorrelation	F-statistic = 87.65, p-value = 0.0000	First-order autocorrelation exists; errors are correlated across panels
Cross-sectional dependence	Test statistic = 4.68, p-value = 0.0002	Cross-sectional dependence detected; residuals are correlated across panels

Source: Compiled by the authors (2025)

Variance Inflation Factor (VIF) is employed in this study to gauge the presence of multicollinearity. It becomes apparent that all the independent variables have VIF values less than 10, with the highest one reaching 5.53 and the average one being 2.88. In short, the fact that the variables are not perfectly related means we can proceed with reasonable estimates in this model.

In addition, the Modified Wald test for groupwise heteroskedasticity is performed to investigate whether the panels' residuals have the same level of variance. The results revealed that the chi-squared statistic was 591.16, accompanied by a p-value of 0.0000, proving the model suffers from heteroskedasticity.

The Wooldridge test for serial correlation in panel data was done to explore autocorrelation. The results are an F-statistic of 87.65 and a p-value of 0.0000, thus suggesting that the error terms show first-order autocorrelation. This means that the residuals in panels tend to show a pattern over time that goes against the rule of independence.

Finally, Pesaran's test for cross-sectional dependence was conducted to determine whether residuals across entities (product codes) were correlated. The test produced a statistic of 4.68 with a p-value of 0.0002, confirming significant cross-sectional dependence.

According to the results, the model deals with heteroskedasticity, autocorrelation and cross-sectional dependence, which could affect the standard error estimates and the reliability of the hypothesis tests.

5.2. Fixing specification issues

To address these issues, the model was estimated again using the Fixed Effects regression and Driscoll–Kraay standard errors that are unaffected by problems caused by heteroskedasticity, autocorrelation and cross-sectional dependence. Standard errors are fixed using this method, which leaves the main points of the analysis unaffected.

Below are the regression results after the data was corrected.

5.3. Estimated model

5.3.1. Regression result

Sample regression model:

$$EV_{it} = -1,96\text{e}11 + 4,45\text{e}9 \cdot \ln EX_{it} + 6,50\text{e}9 \cdot \ln GDP_{it} - 4,07\text{e}8 \cdot \ln tariff_{it} - 1,96\text{e}9 \cdot VNpt_{it} + \hat{u}_{it}$$

- R-squared (within): 0.4042
- F-statistic: 7.96 (p = 0.0029)

The meaning of the coefficient of determination: R-squared = 0,4042 means that 40,42% of the variation in the dependent variable is explained by the independent variable included in the model.

Interpretation of coefficient (holding other factors constant):

- $\beta 0 = -1,96\text{e}11$: The expected export value when all other independent variables are zero.

- $\beta 1 = 4,45\text{e}9$: A 1% increase in the exchange rate (local currency units relative to the U.S. dollar) is associated with an increase of approximately 4,45e9 units in the export value.

- $\beta 2 = 6,50\text{e}9$: A 1% increase in the exporter's GDP is associated with an increase of approximately 6,50e9 units in the export value.

- $\beta3 = -4{,}07e8$: The post-tariff period is associated with an estimated decrease in steel export value to the U.S. by approximately 4,07e8 units, relative to their pre-tariff level.

- $\beta4 = -1{,}96e9$: In the post-tariff period, Vietnam's steel export value to the U.S. is estimated to decrease by an additional 1,96e9 units, compared to the decrease experienced by a typical non-Vietnam country.

The meaning of coefficient of determination: R-squared = 0,4042 means that 40,42% of the variation in the dependent variable is explained by the independent variable included in the model.

5.3.2. Result discussion

With $\beta5 = -1{,}96e9$, it is estimated that in the post-tariff period, Vietnam's steel export value to the U.S. would decrease by an additional 1,96e9 units, compared to the decrease experienced by a typical non-Vietnam country.

It is assumed that countries feel the effect of tariffs (-4.07e8). However, there is also a unique effect on Vietnam after the tariffs: the VNpt dummy identifies the change in Vietnam after the tariffs ended. This therefore shows: Apart from losing the common amount of $4.07 billion from the tariffs, Vietnam's exports fell an additional $1.96 billion compared to other country's exporters. This demonstrates how the regression coefficient b5 translates into a real economic impact: Vietnam was disproportionately affected by the post-2018 U.S. trade policy shift.

To illustrate, we can use the following difference-in-differences chart to visualize the effect of Trump's tariff on steel exports to the U.S from different countries:

Figure 10. The disparity in tax effects on goods exported from Vietnam and non-Vietnam countries to the U.S. post 2018.

Effect of Trump's Tariff on Steel Exports: Vietnam vs. Other Exporters
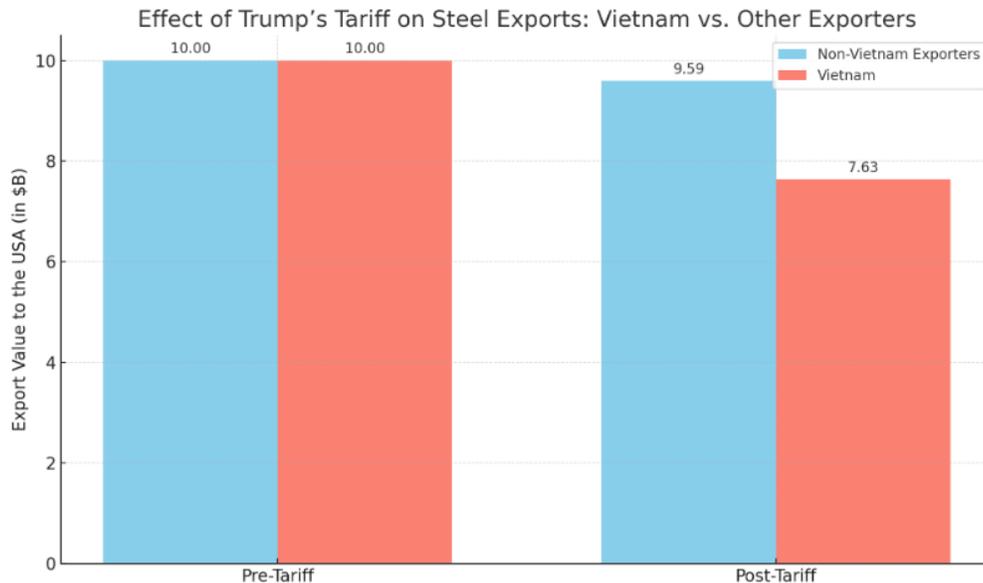
In which:

- After tariffs were introduced, Vietnam's export value dropped by less than $500 million for non-Vietnam exporters.

- Vietnam's exports decreased by as much as $2.37 billion (including the overall tariff loss and the Vietnam-specific penalty amounting to $1.96 billion).

    Such phenomenon may result from:

- The Department of Commerce is primarily acting against Vietnam by imposing anti-circumvention duties and more.

- The changes to U.S. steel policy affecting Vietnam more than other countries due to Vietnam's overdependence on exporting to the US.

6. Limitations and recommendations

6.1. Limitations

Even with the practical conclusions drawn from this research's sample regression model, its limitations must be acknowledged to improve future steel export policies.

Firstly, it is acknowledged that some data might be outdated when we consider the 46% tariff that Vietnam suddenly faced at the beginning of 2025. Using data from earlier times might fail to see changes in the trade pattern recently, thus negatively affecting the way we make decisions now.
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In addition, the model mostly explores how tariffs work, excluding NTBs such as quotas, anti-dumping studies, rules of origin rules and technical standards. NTBs may result in just as many, or even greater consequences for trade. Adopting features related to anti-circumvention rulings, licensing, and further delays would improve future models by capturing many forms of NTBs.

Lastly, the model overlooks global supply chain adjustments, namely trade diversion, substitution effects, or rerouting through third countries, which could distort the true source and scale of trade decline. Hence, it is suggested that variables reflecting indirect trade flows or global demand shocks, such as global steel prices or production shifts should be included to enhance the model's explanatory power.

6.2. Recommendations

6.2.1. For the world

Since the impact of U.S. tariffs continues and might intensify, trade diversification should be Vietnam's main priority, as it is for all affected countries. Enterprises that trade abroad must reduce their dependence on the U.S. market and search for potential markets like Southeast Asia, the Middle East, and Africa.

Moreover, global exporters should work together to push for a global system for settling trade disputes. The WTO allows nations to address disputes related to Section 232-type tariffs, which are designed for national security. While the WTO dispute mechanism appears to be weakening these days, nations experiencing adverse outcomes from U.S. policies could pressure the U.S. to make changes. Sharing views and forming groups with others in a region may give the international community more power over aggressive protectionism policies.

6.2.2. For Vietnam

With the case of Vietnam, the approach should involve reform attempts at the domestic level as well as adherence to the strategy. Initially, Vietnam has to increase the visibility and traceability of its steel supply chain. The government should make sure to validate and regulate where steel is produced so as to stop Chinese steel from being transhipped as Vietnamese. Creating customs documents using blockchain, using independent auditors, and applying stricter rules to imports could prove to other nations that Vietnam supports fair trade under any circumstances.

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Additionally, advancing industrial technology is important. Vietnam should aim to manufacture high-quality or specialized steels, instead of only sending semi-finished products abroad. The government must give incentives, facilitate investments from other countries, and promote research and development. Achieving sustainability and quality in steel exports gives Vietnam a boost in being seen as a genuine and appealing exporter.

7. Conclusion

Global steel trade patterns have been widely changed by the protectionist actions adopted by the United States in 2018 as part of Donald Trump's "America First" policy. Most noticeably, the enforcement of Section 232 tariffs led to a 25% duty on foreign steel imports, a decision explained as being for national security. As a result, fewer steel products were imported from various trade partners.

Vietnam, in particular, saw a sharper decline than other nations as the coefficient of the variable VNpt for the regression model is -1.96e9. Therefore, after the U.S. tariffs were applied, Vietnam's steel exports to the U.S. fell an additional $1.96 billion which is more than the typical -$407 million drop for all other countries recorded in the tariff dummy's coefficient of -4.07e8.

Different factors led to this outstanding vulnerability in Vietnam's exports. First, the U.S. Department of Commerce is examining the Vietnamese steel industry because it is said to be transshipping Chinese steel. Some claim that Vietnam obtains semi-finished steel from China, makes only small changes and exports the products to the U.S. to avoid duties on Chinese-made steel. Moreover, Vietnam seems to depend heavily on exports to the U.S., any new U.S. trade policies could leave the country particularly affected.

In 2025, an anti-circumvention and anti-dumping tax has just been applied to Vietnamese steel, showing how the situation is intensifying. The ban resembles the earlier action against Vietnam. Consequently, it becomes extremely difficult for many Vietnamese exporters to access the U.S. market for some types of steel. Although the regression model includes data from the 2018 tariffs, all identified trends are still relevant. The strong effect of Vietnam's coefficient indicates that if trade barriers like the 46% tax are imposed, it will further limit Vietnam's trade with other countries unless important actions are taken.

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